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Emotion dysregulation in autistic adults without intellectual disability: Characteristics and treatment with Dialectical Behaviour Therapy

La dysrégulation émotionnelle chez les adultes autistes sans déficience intellectuelle: Caractéristiques et traitement par la Thérapie Comportementale Dialectique

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Abstract

Emotion dysregulation (ED) is strongly associated with borderline personality disorder (BPD). However, recent findings suggest that ED is a transdiagnostic difficulty also prevalent among autistic adults without intellectual disability. Importantly, ED has been found to be related to non-suicidal self-injury (NSSI) and suicidal behaviours in autistic adults. However, ED has been understudied in autism spectrum condition (ASC), especially in autistic adults, and existing frameworks on the aetiology of ED in ASC have focused mainly on the role of ASC traits and co-occurring psychopathology. Given this, it is not surprising that evidence-based psychotherapies targeting ED in autistic people, especially autistic adults without intellectual disability, are lacking. To address these gaps in the literature, this thesis aimed, on the one hand, to investigate the phenomenology of ED as well as its biosocial predictors in autistic adults compared to adults with BPD. On the other hand, our work aimed to evaluate the feasibility, acceptability, and efficacy of dialectical behaviour therapy (DBT) to treat ED in autistic adults. Our findings indicated that ED is heightened in autistic adults compared to non-clinical controls, while it is milder than in BPD. Autistic women and men were found to present with similar levels of ED, even though autistic women presented with more ED risk factors, such as high rates of history of sexual violence and increased use of autistic camouflaging. In addition, our results showed that three clinical features, i.e., BPD traits, alexithymia and emotional vulnerability, strongly predicted ED scores in both ASC and BPD, whereas sensory sensitivities and autistic camouflaging were specific to ED in ASC. Regarding DBT for ED in autistic adults, our results suggested that an 18-week comprehensive DBT program was feasible, acceptable, and effective to treat ED in autistic adults with NSSI and/or suicidal behaviours. Interestingly, alexithymia emerged as a strong mediator of ED improvement following DBT, while ASC traits and marital status (single/married) emerged as strong moderators of ED outcomes. Larger-scale replication studies are needed to further investigate

ED and its biosocial correlates in ASC, as well as the efficacy of DBT to treat ED in autistic adults.

Keywords: Autism spectrum condition, adults, borderline personality disorder, emotion dysregulation, self-harm, suicidality, dialectical behaviour therapy.

Résumé

La dysrégulation émotionnelle (DE) est communément associée au trouble de la personnalité borderline (TPB). Toutefois, des études récentes montrent qu'elle consiste en une difficulté transdiagnostique, aussi prévalente parmi les adultes autistes sans déficience intellectuelle. De plus, la DE a été associée aux comportements auto-dommageables sans intention suicidaire (NSSI) et aux comportements suicidaires chez les adultes autistes. Toutefois, la DE est encore sous-étudiée dans l'autisme, en particulier chez les adultes autistes, et les modèles existants sur son étiologie dans l'autisme se sont principalement focalisés sur le rôle des traits autistiques et de la psychopathologie cooccurrence. Il n'est donc pas surprenant de constater que les interventions psychothérapiques empiriquement fondées ciblant la DE chez les personnes autistes sont manquantes, en particulier pour les adultes autistes sans déficience intellectuelle. Pour répondre à ces besoins dans la littérature, cette thèse visait, d'une part, à étudier les caractéristiques de la DE et de ses prédicteurs biosociaux chez les adultes autistes en comparaison avec les adultes avec un TPB et, d'autre part, à évaluer la faisabilité, l'acceptabilité et l'efficacité de la thérapie comportementale dialectique (TCD) pour traiter la DE chez les adultes autistes. Nos résultats ont mis en évidence un niveau de DE élevé chez les adultes autistes par rapport aux sujets témoins, toutefois moins élevé que dans le TPB. Les femmes et les hommes autistes présenteraient des niveaux de DE comparables, avec une exposition accrue des femmes autistes à certains facteurs de risque, tels que les violences sexuelles et le camouflage autistique. De plus, nos résultats ont montré que trois variables, à savoir les traits du TPB, l'alexithymie et la vulnérabilité émotionnelle, formeraient un noyau de prédicteurs forts de la DE partagés entre l'autisme et le TPB, alors que les sensibilités sensorielles et le camouflage autistique pourraient être spécifiques à la DE dans l'autisme. En ce qui concerne la TCD pour les adultes autistes sans déficience intellectuelle présentant des NSSI et/ou des comportements suicidaires, nos résultats suggèrent qu'un programme complet

de TCD de 18 semaines est faisable, acceptable et serait efficace pour traiter la DE chez cette population. L'alexithymie a émergé comme un médiateur majeur de l'amélioration de la DE suite à la TCD, alors que les traits autistiques et le statut marital (célibataire/en couple) se sont avérés être des modérateurs forts de l'évolution de l'ED. Des études de réplication à plus grande échelle sont nécessaires pour approfondir les recherches sur la DE et ses corrélats biosociaux dans l'autisme, ainsi que sur l'efficacité de la TCD pour traiter la DE chez les adultes autistes.

Mots clés : Autisme, adultes, trouble de la personnalité borderline, dysrégulation émotionnelle, comportement auto-dommageables, suicidalité, thérapie comportementale dialectique.

“ It is hard to be happy without a life worth living. This is a fundamental Tenet of DBT. Of course, all lives are worth living in reality. No life is not worth living. But what is important is that you experience your life as worth living — one that is satisfying, and one that brings happiness.”

Marsha M. Linehan, DBT Skills Training Manual

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Abbreviations

A/ASP	Adolescent/adult sensory profile
ABE	Assessment of bullying experiences
ABC-I	Aberrant behaviour checklist's irritability subscale
ACME	Causal mediation effect
ADE	Average direct effect
ADHD	Attention deficit hyperactivity disorder
ADI-R	Autism Diagnostic Interview-Revised
ADOS-2	Autism Diagnostic Observation Schedule, Second Edition revised module 4
ANOVA	Analysis of variance
APA	American psychological association
AQ	Autism spectrum quotient
AQ-Short	Autism spectrum quotient short version
ASC	Autism spectrum condition
ASD	Autism spectrum disorder
ASRS v1.1 Screener	ADHD self-report scale v1.1 screener
ATE	Average total effect
BAI	Beck anxiety inventory
BDI-II	Beck depression inventory-Second edition
BIS-15	Barratt Impulsiveness Scale-Short form
BPD	Borderline personality disorder
BSL-23	Short form of the borderline symptom list
BSS	Beck scale for suicide ideation
CAT-Q	Camouflaging autistic traits questionnaire
CBT	Cognitive behavioural therapy
CEQ	Credibility/Expectancy questionnaire
cPTSD	Complex post-traumatic stress disorder
CrI	Credibility interval
CSQ-8	Client Satisfaction questionnaire for psychotherapeutic services
CTQ-SF	Childhood trauma questionnaire-Short form
DASS-21	Depression, anxiety and stress scales
DBT	Dialectical behaviour therapy
DBT-WCCL	DBT ways of coping checklist
DERS	Difficulties in emotion regulation scale
DERS-16	Difficulties in emotion regulation scale-16 items
dIPFC	Dorsolateral prefrontal cortex activation
DSM-5	Diagnostic and statistical manual of mental disorders-Fifth edition
EAM	Experiential avoidance model
ED	Emotion dysregulation
EPM	Extended process model

ER	Emotion regulation
EV-Child	Emotional vulnerability-Child scale
FFMQ	Five Facet Mindfulness Questionnaire
fMRI	Functional magnetic resonance imaging
GREMO	Groupe de regulation émotionnelle
GAFS-8	Eight-item general alexithymia factor score
Hn	Hypothesis n
IQ	Intellectual quotient
ITS	Interpersonal theory of suicide
M	Mean
MBCT	Mindfulness-based cognitive therapy
MCMC	Markov chain Monte Carlo method
ML	Machine learning
mPFC	Medial prefrontal cortex
NC	Nonclinical controls
NEO-PI-R	The revised NEO personality inventory
NSSI	Non-suicidal self-injury
NSSI-AT	Non-suicidal self-injury assessment tool
OCD	Obsessive-compulsive disorder
OLS	Ordinary least square
Pr	Probability coefficient
PTSD	Post-traumatic stress disorder
RCT	Randomized controlled trial
RO-DBT	Radically open dialectical behaviour therapy
SA	Suicide attempt
SANRA	Assessment of narrative review articles
SASII	Suicide attempt self-injury interview
SB	Suicidal behaviours
SD	Standard deviation
SH	Self-harm
SHAP	Shapley additive explanation
SI	Suicide ideation
SPSQ SS	Sensory processing sensitivity questionnaire-Sensory sensitivity subscale
TAU	Treatment as usual condition
ToM	Theory of mind
WAIS-IV	Wechsler adult intelligence scale, Fourth edition
WHOQoL-BREF	Abbreviated World Health Organization quality of life questionnaire

General introduction

Emotion dysregulation (ED), i.e., the difficulty regulating one's emotional experience and/or expression (Beauchaine, 2015), is recognized to be a core symptom of borderline personality disorder (BPD; Chapman, 2019). However, several findings suggest that ED is a transdiagnostic difficulty, found in several psychiatric and neurodevelopmental conditions (Carmassi et al., 2022; Sloan et al., 2017). Research on ED in autism spectrum condition (ASC)¹ is in its early stages. Nevertheless, recent data suggest that ED is prevalent in autistic individuals¹ (Conner et al., 2021; Mazefsky et al., 2013). Importantly, a growing body of literature suggests that ED is associated with poor mental health, but also with NSSI and suicidal behaviours in autistic people (Moseley et al., 2019; Conner et al., 2020). Although psychosocial factors seem to play a role in the emergence of ED in ASC (Greenlee et al., 2021; McDonnell et al., 2019), existing models on the aetiology of ED in ASC have neglected it thus far, as they have focused mainly on ASC core features and co-occurring psychopathology (Mazefsky & White, 2014; Mazefsky et al., 2013). In addition, little is known about the specific phenomenology of ED in ASC, particularly in comparison with BPD (Weiner et al., 2023). Relatedly, there is a lack of evidence-based interventions targeting ED in autistic people, especially autistic adults who seem to be at the highest risk for suicidal behaviours among the autistic population (Kuroda et al., 2022; Hirvikoski et al., 2016). More specifically, the feasibility and efficacy of dialectical behaviour therapy (DBT; Linehan, 1993), the psychotherapy which has amassed the most evidence in the treatment of ED in BPD (Panos et al., 2014), had not been investigated in autistic people at the start of this thesis.

¹ Note on terminology:

Throughout the manuscript, we use the term “autistic people” (identity-first), rather than “people with autism” or “people with autism spectrum disorder”, as this was the terminology explicitly favoured by the majority of the autistic participants of a large-scale survey (Kenny et al., 2016). We also use “autism spectrum condition” instead of the DSM-5 term of “autism spectrum disorder (ASD)” to be respectful to those on the spectrum who feel that the term “disorder” is stigmatising, whereas the term “condition” acknowledges both the difficulties and the differences and strengths in autistic people (Bottema-Beutel et al., 2021).

Given this, the purpose of this thesis is, on the one hand, **(a)** to investigate the characteristics and the biosocial predictors of ED in autistic adults **(axis 1)** and, on the other hand, **(b)** to evaluate the feasibility, acceptability, and efficacy of DBT in autistic adults ED associated with NSSI and/or suicidal behaviours, including suicide ideation **(axis 2)**.

In the first part of this manuscript, we will present an overview of the current state of the literature regarding ED, ED in ASC, as well as the literature on the efficacy of DBT and its potential for treating ED in autistic adults. We will then present our empirical work that comprises five studies – two are included in axis 1 and three in axis 2. The final part of this manuscript consists of a general discussion that summarizes and examines the scientific and clinical implications of our findings.

PART I – Theoretical overview

I. Emotion dysregulation across psychopathology

In this section, we will present a general overview of emotion regulation (ER) and emotion dysregulation (ED). We will begin by addressing the literature on the major theoretical frameworks on emotion and emotion generation processes in modern research. Then we will take a closer look at ER through the lens of theoretical models that are currently the most used in the field. We will consider findings regarding the impact of ER on mental health and well-being. Following this, we will explore ED and its impact on mental health, including non-suicidal self-injury (NSSI) and suicidality across psychopathology. Finally, we will elaborate on findings regarding candidate biosocial factors involved in ED based on Linehan's (1993) biosocial theory of ED.

1. Theoretical background on emotion regulation

1.1. Emotion and emotion generation

There is no consensus in the literature on a definition of emotion (Paul et al., 2005; Cabanac, 2002). However, most contemporary researchers define emotional states as multifaceted, comprising physiological, behavioural, cognitive, and subjective components, which emerge in response to internal or external stimuli (Paul et al., 2005). Two theoretical perspectives prevail in modern research: constructionism and functionalism. Functionalism defines emotions as human reactions to stimuli that facilitate adaptive functioning by activating a variety of physical and psychological responses helping individuals to achieve their goals (Gross, 1998). According to this perspective, discrete emotions evolved to facilitate adaptive behaviour in humans (e.g., fear evolved with the purpose of signaling organisms to danger) and each emotion is linked to distinct causal mechanisms and response patterns in the organism (Panksepp, 2011, 2016). Functionalism emphasizes the adaptive function of emotions both relative to human evolution (i.e., species' survival) and to everyday life (i.e., regulating one's emotions to meet specific goals) (Bornstein et al., 2013). Constructionism, on the other hand,

suggests that emotions, which are perceived as discrete entities, are not determined by specific regions in the brain, but rather constructed in the moment through highly individualized memory and learning processes (Barrett, 2009). This perspective asserts that emotions are the product of interactions between sensory and neural networks, which are interpreted, categorized, and whose meaning is inferred based on prior experiences (Barrett, 2009, 2017; Mandler, 2013; Russell, 2009). In other words, constructivist theory posits that emotions are experienced when one appraises and categorizes experiences (e.g., physiological states, semantic knowledge, and situational cues) into discrete emotional categories. As such, constructionism distinguishes between core affective processes (i.e., general valence as pleasant/unpleasant, and activation, ranging from calm to high activation) and emotions (e.g., anger, fear, joy) (Beauchaine & Haines, 2019). This perspective rejects the theory according to which emotions evolved to maximize the species' survival and rather focuses on mechanisms through which they arise (Beauchaine & Haines, 2019). In the field of ER, functionalism is the dominant perspective and emphasizes that ER may be adaptive or maladaptive and have an impact on well-being and quality of life (Beauchaine & Haines, 2019). Thus, given the main topic of our research (i.e., maladaptive ER and its impacts), the framework of this manuscript draws from the functionalist theory of emotions and ER.

Emotion is to be distinguished from mood (Fox, 2018; Han et al., 2009; Gardner et al., 1985). Indeed, emotion is recognized to be short-lasting (seconds to minutes), activated by specific stimuli, and leading to immediate action; while mood is recognized as long lasting (from hours to days and weeks), stemming from broader internal and external environments, and tend to bias cognitions rather than actions (Fox, 2018). Although fluctuations in emotion may influence mood and vice-versa, mood disturbance is not necessarily attributable to difficulties in modulating emotions (Fox, 2018; Sheppes, et al., 2015), e.g., one may feel depressed but have no difficulty regulating their emotions (Rottenberg, 2005). Moreover,

emotions can be unlearned responses to some stimuli, leading to automatic actions critical for survival or well-being (e.g., disgust relative to rotten food), or learned responses with acquired emotional valence through classical or operant conditioning (e.g., stimulus-reward association) (Mauss et al., 2007; Steimer, 2002).

The modal model of emotion generation is the prevailing generic model to describe the emotion formation process (Gross, 1998; 2015). The model summarizes key stages of emotional response that have been established by a large body of evidence (**Figure 1**) (Gross, 1998; 2015). This model suggests that the emotion generation process occurs in a specific sequence, summarized as follows : **(1)** Situation - considered emotionally relevant to the individual, often with a particular goal in mind (can be external – e.g., interpersonal conflicts – or internal – e.g., a thought); **(2)** Attention - the situation is attended to by the individual; **(3)** Appraisal - the situation is evaluated and interpreted, both automatically and consciously by the person; and **(4)** Response - as a result of appraisal, changes in experiential, behavioural, and neurobiological responses occur. The model suggests that emotion generation is a dynamic ongoing process that occurs recursively (Gross, 2015).

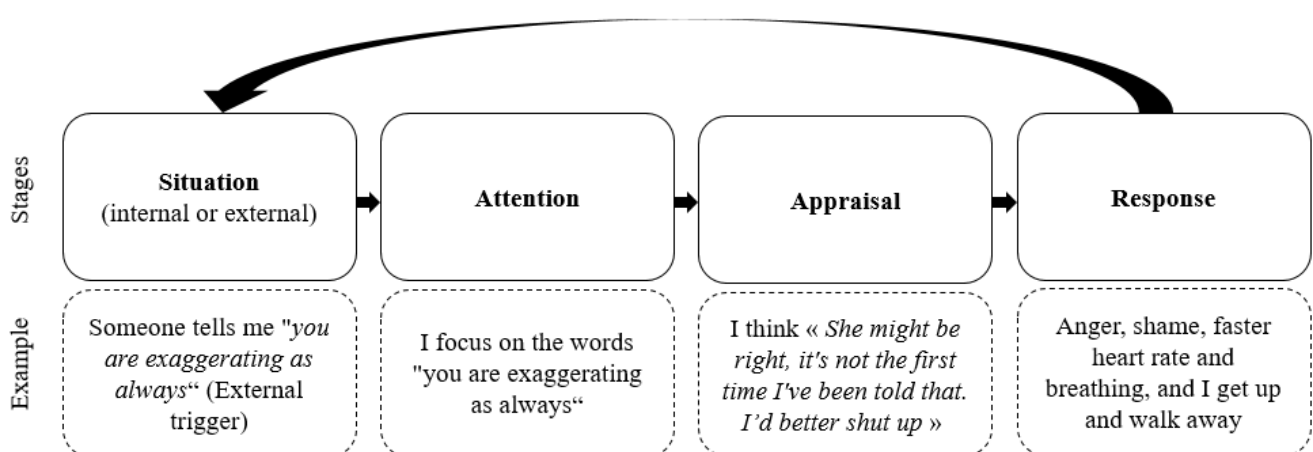


Figure 1. The modal model of emotion (Gross, 1998, 2014) illustrated with an example.

1.2. Emotion regulation

Once emotion has been generated, it is possible to regulate it. Emotion Regulation (ER) is the ability to monitor, evaluate or modify emotional reactions, especially in their intensity or temporality features, to accomplish a goal (Gross, 2015, Thompson, 1994). ER may be deliberate or automatic; self-managed and/or externally supported (e.g., parent-child co-regulation); and may occur in the context of both pleasant and unpleasant emotions (Ting & Weiss, 2017; Bargh & Williams, 2007; Carl et al., 2013). Importantly, there are many ways in which people can regulate their emotions and, depending on the behaviour adopted, these strategies are classified as adaptive or maladaptive (Dodd et al., 2019). In fact, ER strategies are thought to enhance goal-directed behaviours and are associated with greater well-being (e.g., problem-solving, cognitive reappraisal, mindfulness, and acceptance), whereas maladaptive strategies are associated with poor psychological outcomes (e.g., suppression, rumination, and avoidance) (Daros & Williams, 2019; Naragon-Gainey et al., 2017; Wolgast et al., 2011). However, maladaptive strategies can be useful in some specific contexts (e.g., avoidance of a painful situation without interfering with one's goals and quality of life). This is why effective ER relies on the ability to adopt a wide repertoire of skills with high variability across different situations –i.e., ER flexibility (Cole et al., 2019; English et al., 2017; Aldao et al., 2015). Bonanno and Burton (2013) identified three components within the ER flexibility construct: context sensitivity (i.e., ability to match an appropriate ER strategy to a given context), repertoire (i.e., ability to implement a range of strategies in a situation and over time), and feedback responsiveness (i.e., ability to monitor the effectiveness of a chosen ER strategy and to adjust if needed). From an ontological perspective and given the complex set of processes that ER encompasses (i.e., physiological, cognitive, and social), ER is widely recognized as a developmental ability that evolves across the lifespan through the maturation of the biological

structures involved, as well as learning opportunities and life experiences (Helion et al., 2019; De France & Hollenstein, 2019; Ricarte Trives et al., 2016).

According to the process model of ER (**Figure 2**), which maps onto the modal model of emotion generation, emotions can be influenced by targeting the components of the situation-attention-appraisal-response sequence (Gross, 1998, 2001, 2002, 2014; Gross & Thompson 2007). The model posits that ER involves awareness of one's emotion, goals to regulate the emotions (e.g., increase or decrease their intensity), and the effective implementation of adaptive strategies to reach the ER goal (Gross, 1998, 2014).

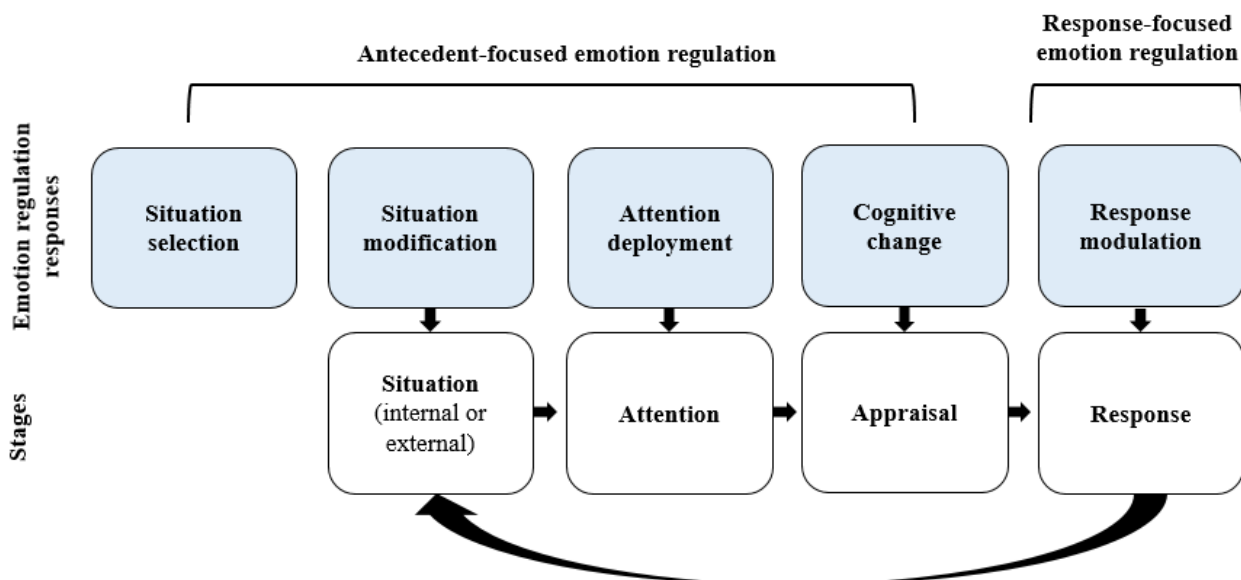


Figure 2. *The process model of ER (Gross, 1998, 2014).*

The model suggests specific emotion-regulatory processes for each stage of the emotion-generation process: **(1)** Situation selection, which includes efforts to change the course of an emotional process at the earliest stage (e.g., avoiding difficult situations); **(2)** Situation modification, which refers to efforts to change features of the situation (e.g., shortening the duration of exposure to a situation); **(3)** Attentional deployment, which refers to modifying one's early information processing (e.g., distraction from the features of the situation); **(4)** Cognitive change, which refers to late semantic-meaning processing (e.g., cognitive

reappraisal, which involves changing how one thinks about or appraises a situation); and **(5)** Response modulation, targeting the last stage, refers to the modulation of the experiential, behavioural, and/or physiological components of the emotion (e.g., inhibiting a behaviour).

Gross (2015) recently extended his model by suggesting a more dynamic conception of ER. The resulting Extended Process Model (EPM) states that emotions and subsequent ER result from a series of overlapping valuation processes through which individuals determine what is good or bad for them (Scherer, 1984). More specifically, a valuation process is articulated as follows: when people experience a situation in their internal or external world (W), they form a perception of it (P) and evaluate (V) whether that perception is good or bad (i.e., whether it is aligned or misaligned with their desired state of the world). Their evaluation may lead to action impulses (A) that serve to reduce the gap between their perceived state of the world and their desired state of the world (Gross, 2015). ER occurs when a component of the initial valuation process that generated the emotion – i.e., the world (W) being the input (first-order valuation) –, is, in turn, targeted by a new valuation process (second-order valuation) in order to modulate it (e.g., actions that seek to change the world or the perception of the world).

The EPM states that there are three valuation systems involved in ER according to the stage they are related to in the ER process (**Figure 3**). Interestingly, each of these ER valuation systems also unfolds through a perception-valuation-action sequence (Gross, 2015). The first stage, i.e., identification, involves the detection of an emotion (P), its evaluation, which is an experience that requires ER (V), and a decision about whether ER will begin (A). The second stage, i.e., selection, involves the identification of available ER strategies (P), evaluation of whether specific strategies will be successful depending on internal and external contextual factors (V), and choosing to use a particular strategy (A). The third and final stage, i.e., implementation, involves the translation of a general ER strategy into specific

behaviours/tactics that may be the most suitable for the situation (P), evaluating the potential effectiveness or ineffectiveness of specific behaviours related to the ER strategy selected (V), and choosing and implementing of specific behaviours related to the ER strategy selected (A).

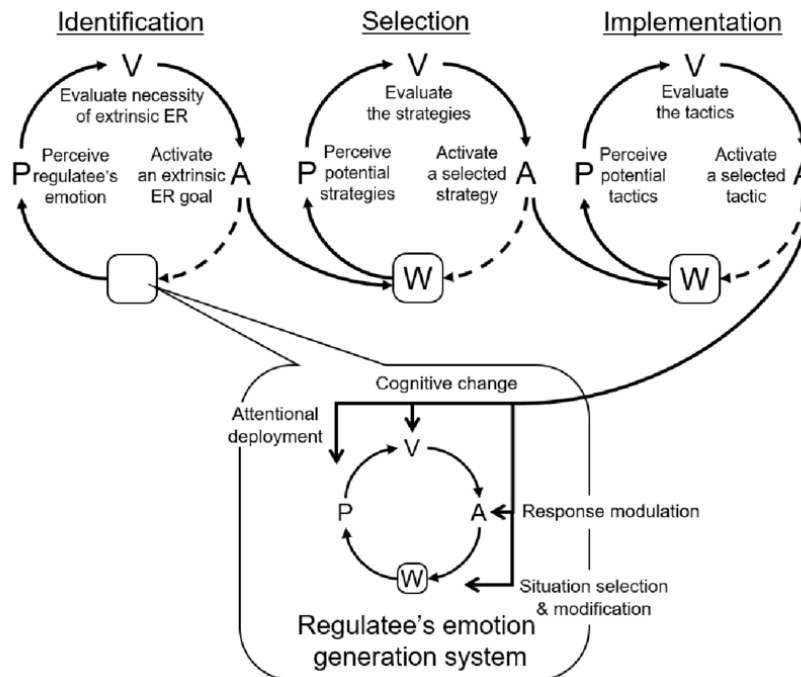


Figure 3. *The extended process model (Gross, 2015).*

Findings have associated effective ER with improved social functioning, and overall enhanced psychological and physical well-being both in case of psychopathology (Kraiss et al., 2020; Moran et al., 2018) and in the general population (Freudenthaler et al., 2017; English et al., 2012). In the context of psychopathology, studies suggest that enhancing ER abilities may decrease symptoms, but also enhance well-being (e.g., Kraiss et al., 2020). For instance, in their meta-analysis, Hu et al. (2014) reported evidence regarding the relationship between the use of two ER strategies (i.e., reappraisal and suppression) and better mental health outcomes. More specifically, a significant negative association between suppression and well-being (e.g., life satisfaction and positive affect) was found, while a positive link was found between reappraisal and well-being (Hu et al., 2014). Similar correlations were observed with symptom-related outcomes (Hu et al., 2014), suggesting that specific ER strategies (e.g., reappraisal) are more

likely to be associated with psychological well-being. Nevertheless, although reappraisal has been linked to increased well-being in several studies (e.g., Hu et al., 2014), effective ER does not rely on a set of dichotomous strategies identified as adaptive or maladaptive, but rather on the adaptation between the strategy used (e.g., reappraisal, suppression) and the cues of the ongoing situation (Bonanno & Burton, 2013). When a frequent mismatch between an ER strategy and what is required by a specific situation is observed, the emotional experience and/or expression may hinder the accomplishment of desired behaviour. This is usually known under the term emotion dysregulation (ED).

2. Emotion dysregulation as a transdiagnostic process across psychopathology

2.1. Emotion dysregulation

ED can be described as patterns of emotional experience and/or expression that interfere with appropriate goal-directed behaviour (Beauchaine, 2015). According to Gross (2015) ED may be due to: (1) a failure to engage in ER (i.e., not engaging in ER when it would be helpful to do so), (2) difficulties enacting a strategy successfully, or (3) using regulation strategies that are poorly matched to a situation –that is, poor ER flexibility due to the implementation of rigid ER and/or maladaptive ER strategies relative to the needs of the situation (e.g., avoidance, suppression, rumination) (Menefee et al., 2022; Gratz & Roemer, 2008; Linehan, 1993).

ED has been widely studied in BPD, where it has been recognized as a core feature of the disorder (Chapman, 2019; Stepp et al., 2014; Kröger et al., 2011; Linehan 1993). Linehan et al. (2007) described ED in BPD as “pervasive”, since ED occurs across a wide range of situations and contexts (i.e., behavioural, interpersonal, cognitive and identity). Pervasive ED is thought to stem from an increased emotionality in BPD (i.e., heightened emotional sensitivity and reactivity as well as slow return to baseline, with a biological underpinning) combined with an inability to regulate intense emotional responses (i.e., ER skills deficits) (Linehan et al., 2007). Importantly, numerous studies have subsequently showed that ED is involved in the

development and maintenance of several psychiatric disorders other than BPD, such as depression, anxiety, eating disorders and complex post-traumatic stress disorder (cPTSD) (Carmassi et al., 2022; Sloan et al., 2017). More recently, ED has also been found to be highly prevalent in neurodevelopmental disorders, such as autism spectrum condition (ASC) (Conner et al., 2021; Mazefsky et al., 2013; Samson et al., 2014) and attention deficit hyperactivity disorder (ADHD) (Beheshti et al., 2020; Shaw et al., 2014). Yet, comparative studies are scarce which limits our understanding of the specific mechanisms of ED in each diagnosis (Weiner et al., 2019).

ED can affect both youth (Paulus et al., 2021) and adults (Carmassi et al., 2022). Interestingly, ED in childhood and adolescence is a risk factor for the development of psychopathology in adulthood (Cole et al., 2017). Regarding gender differences, studies comparing emotional reactivity and ED between genders are scarce and results are discrepant (Yu et al., 2020; McRae et al., 2008). Indeed, some findings relying on self-report measures suggest a heightened emotional reactivity and decreased ER abilities in women relative to men (e.g., Ricarte Trives et al., 2016), while others indicate the opposite (e.g., Nolen-Hoeksema, 2011). Functional magnetic resonance imaging (fMRI) findings suggest that ER outcomes may be equivalent between men and women (McRae et al., 2008; Ando' et al., 2020), but differences in neural patterns underlying ER (e.g., cognitive reappraisal) have been reported (Stoica et al., 2021; McRae et al., 2008; Koch et al., 2007), highlighting the need to further investigate whether and how ED differs between genders.

From a psychopathological standpoint, in their review, D'Agostino et al. (2017) identified five dimensions of ED shared between several psychiatric disorders: (1) decreased emotional awareness, (2) inadequate emotional reactivity, (3) intense experience and expression of emotions, (4) emotional rigidity, and (5) cognitive reappraisal difficulties. The first, decreased emotional awareness, is related to alexithymia (i.e., difficulties identifying and

expressing one's emotions), and has been pinpointed as a key problem associated with ED, as awareness of emotions is thought to be a prerequisite for the use of ER skills (Subic-Wrana et al., 2014). The second, inadequate reactivity (i.e., emotional response that may vary between individuals in terms of intensity, the speed at which it reaches a peak, and return from this peak back to baseline), has also been found in people with ED and seems to stem from biological vulnerabilities (Shapiro et al., 2016). Regarding inadequate emotional expression, it is related to behavioural impulsivity (i.e., acting on the spur of moment) which is associated with dysregulated behaviour across psychopathology (Bakhshani, 2014). In addition, inadequate emotional expression might also result from ER abilities deficits (Jakubczyk et al., 2018). The fourth dimension, emotional rigidity (i.e., restricted emotional range and context-inappropriate emotional response), limits the experience of context-dependent emotions (“emodiversity”), akin to ER flexibility (D’Agostino et al., 2017). Finally, cognitive reappraisal is one of the most studied ER strategies, which has been found to be a key skill for effective ER (Scherer, 2023) and improved mental health (e.g., Vitolo et al., 2022).

Importantly, ED has been linked to a wide range of detrimental consequences on mental health (e.g., Ben-Dor Cohen et al., 2021), the most severe being the increased risk factor for engaging in NSSI (Wolff et al., 2019) and suicidal behaviours (Colmenero-Navarrete et al., 2021; Neacsiu et al., 2018) in both clinical and nonclinical populations.

2.2. The relationship between emotion dysregulation, NSSI and suicidality

2.2.1. Emotion dysregulation and NSSI

NSSI is defined as the direct and deliberate destruction of one’s own body tissue in the absence of lethal intent (e.g., cutting, burning, scratching, and banging or hitting) (Vega et al., 2018; Klonsky et al. 2014). NSSI is most common among adolescents and young adults, with the onset typically occurring around the age of 13-14 (Klonsky & Muehlenkamp, 2007). Lifetime NSSI rates are about 15% to 20% in adolescents and young adults, respectively (Ross

& Heath, 2002; Whitlock et al., 2006), compared to 6% in older adults (Muehlenkamp et al., 2012). Irrespective of age, rates of NSSI are higher among psychiatric populations, particularly in people presenting with ED (Klonsky & Muehlenkamp, 2007; Andover et al., 2005). Interestingly, despite the frequent assumption that NSSI is more common in women, general population studies have found equivalent rates between men and women (Klonsky, 2011; Whitlock et al., 2006). However, gender differences have been found in terms of types of NSSI. Specifically, women are more likely to skin cut, whereas men are more likely to use hitting or burning (Klonsky & Muehlenkamp, 2007). It is worth noting that NSSI is listed among disorders requiring further research in the latest version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, APA, 2013).

Several models of NSSI characterize the behaviour as a maladaptive response to strong negative affect due to ED, with theoretical and empirical work suggesting that NSSI may serve an affective regulation function (Brereton & McGlinchey, 2020; Andover & Morris, 2014; Gratz & Roemer, 2008; Linehan, 1993). Indeed, NSSI is associated with reductions in negative emotions, such as tension, fear, and sadness (e.g., Klonsky, 2009; Laye-Gindhu & Schonert-Reichl, 2005). In addition, studies using ecological momentary assessment have reported a decrease in negative affect following NSSI (e.g., Arney et al., 2011; Nock et al., 2009). To further conceptualize the role of ED in NSSI, the Experiential Avoidance Model (EAM) posits that NSSI may help to avoid intense painful emotions in people with low distress tolerance thresholds (Chapman et al., 2006). Moreover, NSSI may be used for other functions than ER, such as self-punishment or communicating one's emotional state to others by producing a physical sign of emotional distress (Klonsky et al., 2014).

Numerous studies have reported that limited access to ER skills is linked to NSSI (Wolff et al., 2019; Andover & Morris, 2014; Gratz & Roemer, 2008). Some findings also point to the role of low ER self-efficacy (i.e., beliefs in one's own ability to regulate emotions) in NSSI

(Spitzen et al., 2020). Alexithymia has also been reported to be strongly linked to NSSI (Iskric et al., 2020; Norman et al., 2020), as the behaviour may be used to regulate an emotional experience that is poorly understood (Norman et al., 2020). For instance, Gratz and Roemer (2008) found that limited access to effective ER strategies and the lack of emotional clarity (a concept closely related to that of alexithymia) were the ED dimensions most associated with NSSI in a sample of female students. In addition, people with high levels of alexithymia have been reported to exhibit low ER abilities, and are more likely to use maladaptive ER strategies, such as suppression (Swart et al., 2009). Importantly, interventions aiming to increase ER abilities in the context of ED, such as DBT, have been found to result in a decrease in ED but also in NSSI (Bahji et al., 2021), further supporting the link between the two.

2.2.2. Emotion dysregulation and suicidality

A large body of evidence indicates that suicidal behaviours is heightened among psychiatric populations relative to the general population (Bachmann, 2018; Van Orden et al., 2011). In BPD, suicide attempts are frequent; they are reported in 46%- 92% of cases at first intake, with a completion rate of 3% to 10% in longitudinal studies (Black et al., 2004). In their 10-year course study, Zanarini et al. (2008) reported a rate of 79% of suicide attempts among people with BPD compared to 49% in people with other Axis II diagnoses. More broadly, in a population-based study among American youth, 34.59% of the participants who had suicide ideation and 54.82% of those who had attempted suicide were under psychiatric care (Lawrence et al., 2021). In adolescence, an elevated rate of suicide attempts has been reported in girls compared to boys (Zygo et al., 2019; Lewinsohn et al., 2001). Some findings support that the difference between genders fades in adulthood (Lewinsohn et al., 2001), while others support that being a woman continues to be a risk factor for suicide attempts (Nock et al., 2008).

In addition to mental disorders, several risk factors for suicidality have been identified in the literature, such as psychosocial factors (e.g., social isolation, family conflict, and

unemployment), physical illness, but also previous suicide attempts and family history of suicide (Van Orden et al., 2010). Emotional distress has been reported to be a common antecedent to suicide ideation and behaviour (Dour et al., 2011; Shneidman, 1998), since individuals who experience greater difficulty in regulating high levels of emotional distress are more likely to die by suicide (Pisani et al., 2013). Therefore, ED is thought to have a considerable impact on suicide ideation and behaviour (Colmenero-Navarrete et al., 2021). However, while the association between NSSI and ER deficits has been established, findings on the relationship between ED and suicide are less straightforward (Anestis et al., 2013). Although some studies report no association between ED and suicidality (e.g., Tams et al., 2007, Hatkevich et al., 2019), a growing body of recent research rather supports a link between the two. Indeed, suicide ideation and suicide attempts have been reported to be associated with severe ED in clinical and non-clinical samples (Colmenero-Navarrete et al., 2021; Neacsiu et al., 2018). More specifically, findings link suicide ideation and behaviour to poor ER abilities (Denning et al., 2022; Brausch & Woods, 2019; Hatkevich et al., 2019) and to the increased use of maladaptive ER strategies (e.g., rumination and emotional avoidance) (Rigucci et al., 2021; Morrison & O'Connor, 2008; Najmi et al., 2007). Impaired impulse control (Hatkevich et al., 2019) and alexithymia (Hemming et al., 2019) have been found to be particularly associated with suicide ideation and behaviour. Given these findings, ED has been suggested to be a relevant treatment target in suicide prevention (Rigucci et al., 2021).

2.2.3. Link between NSSI and suicidality

Beyond the association between ED, NSSI and suicidal behaviour, a large body of literature suggests that NSSI and suicidal behaviours may be linked, with NSSI being a risk factor for suicide attempts (Klonsky et al., 2013). Although studies investigating the mechanism by which NSSI may increase suicide attempts are scarce (Willoughby et al., 2015), recent findings suggest that the relationship between suicidal behaviours and ED are mediated by

NSSI (Heffer & Willoughby, 2018; Grandclerc & Lachal, 2018; Willoughby et al., 2015). More specifically, studies referring to the Interpersonal Theory of Suicide (ITS; Joiner, 2005) suggest that ED is associated to increased suicidal desire and higher rates of NSSI, which in turn predicts a higher capability for suicide (i.e., decreased fear toward death and diminished pain tolerance) (Heffer & Willoughby, 2018). Within the ITS framework, suicidal desire is recognized as insufficient motivation to engage in suicidal behaviours as these behaviours are difficult to perform. Thus, to perform a suicidal behaviour, individuals must lose some of the fear associated with suicidal behaviours, which occurs through acquired capability for suicide (Joiner, 2005). Thus, NSSI are conceptualized as a means by which people may see their fear of suicide decrease and develop –albeit unintentionally– an increased capability to engage in suicide attempts (Heffer & Willoughby, 2018; Willoughby et al., 2015). Some findings suggest that NSSI with high tissue damage, such as skin cutting, is more strongly associated with suicidal behaviours compared to other forms of NSSI which are less severe (Baer et al., 2020; Withlock et al., 2008). Moreover, a young age of NSSI onset and a longer duration of NSSI are both significantly associated with increased frequency of subsequent episodes of NSSI and risk of a first suicide attempt (Brager-Larsen et al., 2022). These findings indicate that treating NSSI at an early age may be of preventive value, as it might prevent people from acquiring the ability to enact forms of NSSI that are more lethal (Willoughby et al., 2015).

3. Aetiology of emotion dysregulation based on Linehan’s biosocial theory

3.1. Developmental and biosocial aspects of emotion dysregulation

In contrast to emotion generation, which has a biological underpinning, ER processes develop through the interaction between biological and environmental factors since early childhood (Calkins et al., 2019; Calkins & Perry, 2016; Barzman et al., 2015). Calkins et al. (2019) suggested that there are normative developments in ER and that children acquire a set of ER skills from caregivers that enable them to cope with a wide range of challenges. Within

this framework, ED is viewed as emerging from deviations from these normative paths of ER development (Calkins et al., 2019). In the first months of life, ER is mainly automatic, relying on physiological mechanisms, and dependent on co-regulatory processes involving the parents' scaffolding (i.e., the parents' support of their child's ER) (Kopp, 1982; Sroufe, 1996). Over time, the child progressively develops independent ER abilities, relying less on parental intervention (Sameroff, 2010). In addition, ER matures over time as the child acquires the ability to identify their goals in diverse situations, including social situations with peers (Shipman et al., 2001). The development of ER abilities involves executive control processes, such as attentional and inhibitory control (Ursache et al., 2013; Rothbart & Sheese, 2007).

Temperamental factors, with a genetic and biological underpinning, may contribute to the emergence of ED and ED-related dysfunctional behaviour (e.g., NSSI, anger outbursts) (Mayo et al., 2021; Campos et al., 2020; Barzman et al., 2015). Relatedly, studies have found that genetic variants that affect the brain activity are linked to ED in youth, suggesting that ED might have a genetic basis (Barzman et al., 2015). Moreover, neuroimaging data in children have shown that enhanced amygdala and medial prefrontal cortex (mPFC) connectivity was positively associated with ER abilities and negatively associated with negative affect (Gaffrey et al., 2020). Consistently, physiological findings have suggested that differences in emotional arousal and reactivity thresholds to various stimuli might predispose to ED (Barzman et al., 2015). Nevertheless, the use of effective ER abilities is sufficient to achieve satisfying self-regulation even in the context of heightened emotional reactivity (Ursache et al., 2013). Thus, the biological component alone, i.e., emotional vulnerability, cannot account for the emergence of ED, which also stems from a lack of ER skills (Paulus et al., 2021).

Regarding environmental factors influencing the development of ER, variability in parental response to the child has been reported in numerous studies to be a key contextual source of individual differences (e.g., Ursache et al., 2013). For instance, secure attachment

relationships –developed through sensitive and supportive caregiver behaviour– have been associated with effective scaffolding, resulting in a reduction of the child’s emotional arousal (Ozeren, 2022; Brumariu, 2015). Additionally, a secure relationship increases the child’s expectations regarding their own ability to respond to environmental challenges, leading to increased self-regulatory capabilities (Brumariu, 2015). Parental support of negative emotions, through problem solving, emotion-focused responses such as comforting, and expressive encouragement, is thought to enable children to accept and manage their difficult emotions in effective ways (Waslin et al., 2023; Palmer et al., 2020). Conversely, punitive and minimizing responses are found to interfere with the development of ER abilities because these parental reactions communicate non-acceptance of negative emotional expression and focus on suppressing negative affect (Waslin et al., 2023; Jones et al., 2002). Interestingly, longitudinal data highlight that the quality of the child’s ER abilities does not depend solely on the parents’ behaviour but rather on the dyadic interaction between the child and the parents’ behaviour and characteristics (Halligan et al., 2013). Indeed, as an example, a child with heightened emotional vulnerability may be more prone to dysregulated behaviour, which might affect the parents’ willingness to provide effective scaffolding (Halligan et al., 2013). Hence, these findings suggest that interventions aiming to treat ED in children should enhance the child’s ER abilities, as well as promote the parents’ ER and scaffolding skills (De Raeymaecker & Dhal, 2022). In addition, they highlight that the development of effective ER is a transactional process involving the individual’s temperament (i.e., the biological predisposition) and the responses from the environment. Importantly, this is akin to the biosocial theory developed by Marsha Linehan (1993), which emphasizes that the transaction between temperament and environment is key to the development of ED in BPD.

3.2. Linehan's biosocial theory

Linehan's biosocial theory is the most established theory on the aetiology of BPD (Linehan, 1993; Crowell et al., 2009) (**Figure 4**). Linehan describes BPD as primarily an ED disorder that develops out of the transaction over time between two factors: **(1)** Emotional vulnerability: a biological disposition to difficulties regulating emotions and **(2)** Invalidation: childhood experiences of being raised in an invalidating environment (Crowell et al., 2009; Linehan, 1993). Emotional vulnerability refers to biological factors with a genetic basis and disturbances in the emotional system involving different brain areas (e.g., prefrontal regions and amygdala) (Kuo & Linehan, 2009). Emotional vulnerability results in dysfunctions in three dimensions: **(a)** emotional hypersensitivity (i.e., low threshold for emotional reactions), **(b)** hyperreactivity (i.e., increased change in emotional intensity and extreme reactions), and **(c)** a slow return to emotional baseline (i.e., long-lasting emotional reactions) (Kuo & Linehan, 2009; Bortolla et al., 2019). Linehan's theory has subsequently added temperamental impulsivity as an additional risk factor for BPD (Crowell et al., 2009). Invalidation, on the other hand, is described as a lack of attunement between the inner life or needs of the child and the care provided by the caregivers (Linehan, 1993). Invalidation as theorized by Linehan (1993) encompasses four main components: **(a)** parental communication of the child's emotional inaccuracy to the child (e.g., *You have no reason to be sad! You should rather feel lucky.*), **(b)** misattribution of the child's emotional experience or expressions to negative characteristics of the child (e.g., *Why are you upset? You're being too emotional.*), **(c)** discouragement or punishment of difficult emotions (e.g., *There's nothing to cry about.*), and **(d)** oversimplification of problem solving or minimizing of difficulties (e.g., *If you just did it right, you wouldn't have these problems.*). Nevertheless, given their prevalence in people with BPD; maltreatment in its different forms (e.g., physical violence, neglect) and sexual abuse are also commonly associated with this dimension (Crowell et al., 2009; Wagner & Linehan, 2006).

Invalidating environments during childhood may lead to an excessive need to control emotions, especially negative ones, because these emotions tend to be attributed to negative traits of the child and are negatively received (e.g., through minimization or punishment) (Linehan, 1993). Hence, the child does not learn how to modulate their² emotions, which results in extreme emotional states and dysregulated behaviour (Linehan, 1993). Additionally, invalidating environments fail to teach the child how to label and regulate emotional arousal, how to tolerate emotional distress, and when to trust their own emotional responses as reflections of valid interpretations of events (Linehan, 1993). Importantly, repetitive invalidation may shape extreme maladaptive coping responses, such as using self-harm with or without suicidal intent when facing painful emotions (Brereton & McGlinchey, 2020; Oumaya et al., 2008).

Linehan's model in BPD has amassed considerable evidence in its support. Consistent with Linehan's theory (1993), emotional vulnerability has been reported to be associated with BPD and ED (Reeves et al., 2010). This includes emotional sensitivity to emotional cues, emotional lability, and long-lasting emotions, but not emotional hyperreactivity (Bortolla et al., 2019; Carpenter and Trull, 2013; Kuo & Linehan, 2009). Regarding invalidation, findings are less straightforward. Indeed, while most studies support that parental invalidation in childhood is associated with BPD (Schaich et al., 2021; Hope & Chapman, 2019; Keng & Wong, 2017), others state that maternal invalidation specifically is associated with BPD (Keng & Soh, 2018), and some others suggest that invalidation does not predict BPD and is not essential to Linehan's model (Reeves et al., 2010). These discrepant results might be due to a failure to assess invalidation as theorized by Linehan, as a wide range of behaviour might be included in this component (e.g., neglect, verbal invalidation, sexual abuse) and the tools used to assess it may not align with Linehan's model (Musser et al., 2018). Overall, studies on the specific types of

² The pronoun 'they' (as well as 'them' and 'their') is used here and in other parts of the manuscript as a singular third-person pronoun (APA, 2020).

invalidation that contribute to ED in BPD are scarce and have used various tools, warranting the need to further explore invalidation and its transaction with emotional vulnerability in BPD.

Moreover, studies have highlighted that ED maintains itself and worsens over time through the consistent use of maladaptive ER strategies (Selby & Joiner, 2009; Chapman et al., 2011; Carpenter and Trull, 2013). In fact, maladaptive ER have detrimental effects on emotional responses, contributing to an increase in their intensity and duration (e.g., Sloan, 2004; Barnow et al., 2012; LeMoult et al., 2013). Furthermore, maladaptive ER has been found to mediate the link between emotional vulnerabilities in BPD and core dysfunctional behaviours, e.g., NSSI, binge eating and substance-use behaviours (e.g., Chapman et al., 2005; Selby et al., 2009).

Linehan's model has not been evaluated outside BPD. Nevertheless, some findings suggest that biological vulnerability, including impulsivity, and invalidation are involved in the emergence of ED more broadly in psychopathology (e.g., Calkins et al., 2019).

PART I – Theoretical overview

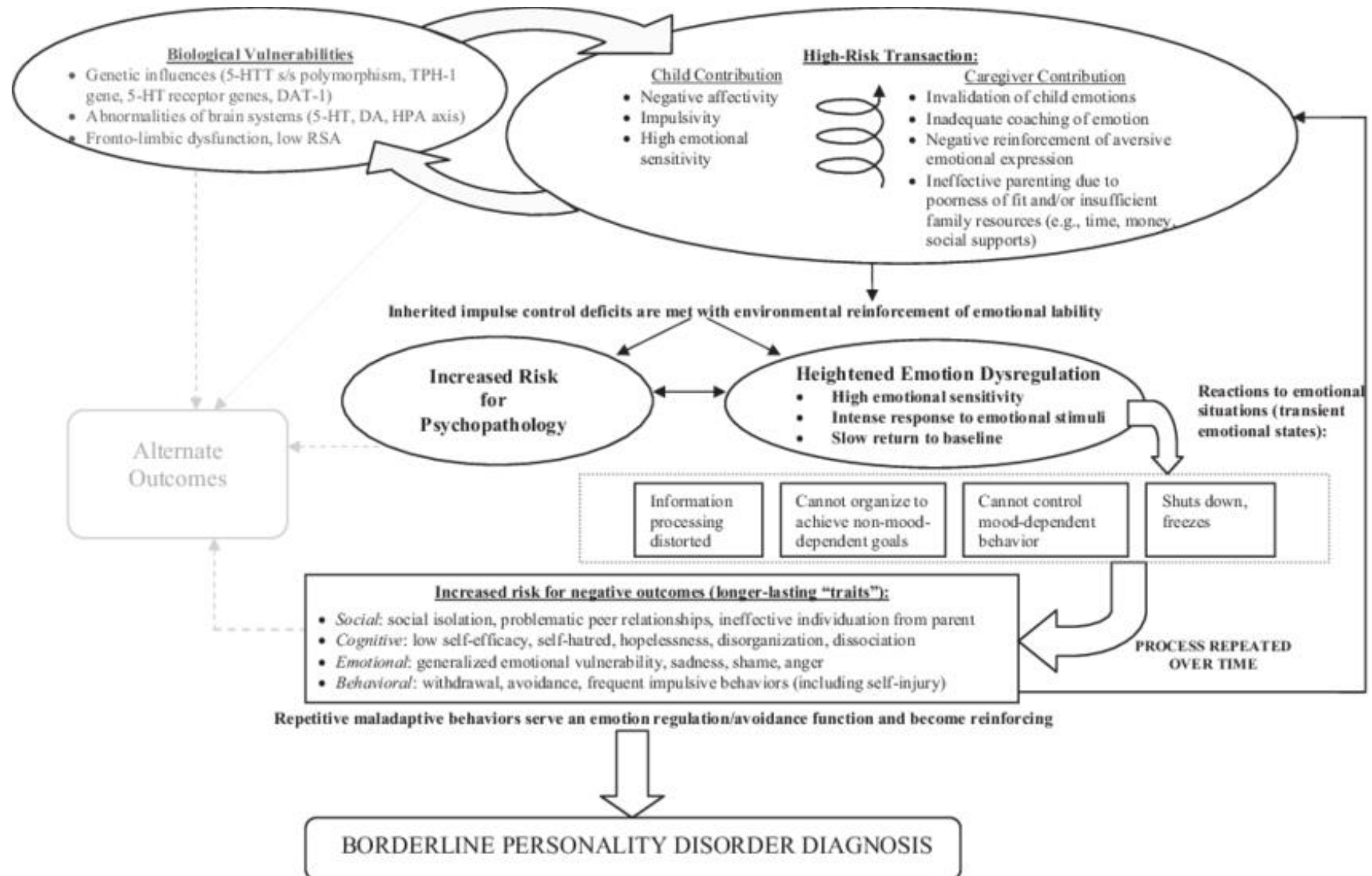


Figure 4. A biosocial developmental model of BPD (Crowell et al., 2009).

4. Section summary

ER is a dynamic process relying on a set of adaptive skills that enhances goal-directed behaviour and well-being. Effective ER has been linked to several abilities including the flexible use of ER skills and emotional awareness. By contrast, ED has been associated with mental health issues in several disorders. Indeed, although ED has been widely studied in BPD, it is rather viewed now as transdiagnostic process that negatively affects adaptive functioning and quality of life in numerous psychiatric and neurodevelopmental conditions. Importantly, findings suggest that ED might be a key risk factor for NSSI and increased suicidality across psychopathology. Given the growing awareness of the transdiagnostic nature of ED, comparative studies to characterize ED across different conditions are needed.

Studies investigating candidate etiological factors involved in ED suggest that both biological (e.g., genetic variations, patterns in brain activity, enhanced physiological responses to emotional triggers) and environmental factors (e.g., parental scaffolding, attachment style of the child, and parents' reactions to the child's emotions) might be involved. Linehan's biosocial theory (1993), underlying DBT, posits that ED in BPD arises from the transaction between temperamental emotional vulnerability and experiences of invalidation. Overall, empirical findings are supportive of the relevance of the model. Linehan's theory offers a conceptual framework with clinical usefulness allowing a comprehensive understanding of factors associated with ED. Importantly, a growing number of studies suggests that biosocial factors similar to those identified by Linehan (1993) are involved in the emergence of ED across psychopathology. Thus, it is crucial to investigate the relevance of Linehan's model in other conditions characterized by ED.

II. Emotion dysregulation in autism spectrum condition

In this section, we will focus on ED in ASC from a developmental perspective. More specifically, we will explore the prevalence of ED in the autistic population, especially in autistic adults without intellectual disability, and its impact on mental health and well-being. In this context, gender differences will be highlighted. We will also focus on the association between ED, NSSI and the risk of suicide in ASC. Finally, we will provide an overview of the biosocial factors potentially associated with ED in ASC (i.e., factors related to ASC features, co-occurring disorders, and psychosocial factors including autistic camouflaging).

1. Prevalence of emotion dysregulation in ASC

ASC is a neurodevelopmental condition characterized by particularities and difficulties in social interaction and communication, as well as the presence of restricted or repetitive interests and behaviours (APA, 2013). Emerging consensus indicates that ASC involves atypical patterns in connectivity and processing across brain regions (Mazefsky et al., 2010). Related to ED, the peculiarities and difficulties associated with ASC have an impact on multiple areas of functioning, including ER (Mazefsky et al., 2010).

ED is not part of the diagnostic criteria for ASC (APA, 2013). However, given its high prevalence in autistic people, some researchers question whether ED should be recognized as a core ASC feature (Conner et al., 2020; Mazefsky, 2015; Samson et al., 2014). Indeed, 80% of autistic people present with ER difficulties, such as irritability, aggression, anger outbursts or impulsivity (Mayes et al., 2017; Lecavalier et al., 2006). These behaviours, frequent in the autistic population, are thought to reflect significant impairments relative to the modulation of emotions to serve one's goals (i.e., ED) (Mazefsky et al., 2013; Samson et al., 2014).

Recent research suggests that autistic people are more likely to develop ED than the general population (Conner et al., 2021; Cai et al., 2018; Samson et al., 2014). In fact, autistic youth may use fewer ER adaptive strategies and more maladaptive strategies compared to their

non-autistic peers (Cai et al., 2018; Khor et al., 2014). For instance, an observational study by Jahromi et al. (2012) reported that autistic children exhibited stronger and longer-lasting emotional reactions to unpleasant events, and displayed more maladaptive strategies like avoidance, yelling, and hitting objects during a frustrating task compared to non-autistic children. In addition, autistic youth may use ER strategies less flexibly when they need to adapt to a situation (Cai et al., 2018; Khor, Melvin et al., 2014). Although ED has been mostly studied in autistic youth (Conner et al., 2021; Cai et al., 2018; Mazefsky, 2015), it also concerns autistic adults (Swain et al., 2015). Indeed, autistic adults have been found to overly rely on maladaptive ER strategies (e.g., avoidance and rumination), and to use adaptive ER skills such as cognitive reappraisal less frequently than non-autistic controls (Roy & Jahan, 2023; Samson et al., 2012). For example, Samson et al. (2012) found that autistic adults used reappraisal less frequently than non-autistic adults and reported lower levels of reappraisal self-efficacy (i.e., the belief that one can effectively apply reappraisal). Autistic adults also had greater difficulties identifying and describing their emotions in their study (Samson et al., 2012).

2. Mental health implications of emotion dysregulation in ASC

2.1. Impact of ED on adaptive functioning and well-being in ASC

Co-occurring psychiatric disorders are prevalent among the autistic population (Lai et al., 2019; Rosen et al., 2018). Specifically, anxiety and depression have been intensively studied in the context of ASC, as they are very frequent co-occurring disorders in autistic people (Nimmo-Smith et al., 2020; Hollocks et al., 2019). Indeed, in their metanalysis, Hollocks et al. (2019) reported a lifetime prevalence of anxiety disorder of 42% and 37% for depression. By contrast, in the general population, estimates of lifetime prevalence can reach 33.7% for anxiety disorder (Bandelow & Michaelis, 2015) and 21% for depression (Gutiérrez-Rojas et al., 2020). Interestingly, difficulties with ER have been pinpointed as potential contributors to problematic behaviours in ASC and to the high rates of co-occurring psychopathology (Riedelbauch et al.,

2023; Conner et al., 2021; Khor et al., 2014), including anxiety and depression (Riedelbauch et al., 2023; Conner et al., 2022). The relationship between ED and the high rates of psychopathology in ASC might be explained by the overuse of maladaptive ER strategies in autistic people (Gong et al., 2022; Cai et al., 2019; Mazefsky, 2015). Some studies specify that strategies such as reappraisal, self-blame or avoidance are associated with the development and maintenance of internalized problems such as anxiety (e.g., Cai et al., 2019). Thus, the link between ED and co-occurring disorders is increasingly acknowledged in autistic people (Conner et al., 2020; Mazefsky, 2015; Samson et al., 2014).

Relatedly, ED has been reported to be associated with an increased use of psychotropic medication, emergency services and psychiatric hospitalizations among autistic people (Conner et al., 2021). In addition, ED is thought to lead to poorer adaptive functioning (e.g., increased difficulties in interacting with others) in autistic children (Berkovits et al., 2017; Joshi et al., 2018) and adults (Conner et al., 2021).

2.2. Emotion dysregulation in relation to NSSI and suicidality in ASC

Recently, research has started to highlight the high prevalence of NSSI (Licence et al., 2020; Moseley et al., 2020; Steinfeldt-Kristensen et al., 2020) and suicidality in ASC (Hedley & Uljarević, 2018; Dell'Osso et al., 2019). For example, a meta-analysis revealed a prevalence NSSI of 42% in autistic people, irrespective of age and the presence of intellectual disability (Steenfeldt-Kristensen et al., 2020). In autistic adults without intellectual disability, Maddox et al. (2017) reported a lifetime prevalence of NSSI of 50% while Moseley et al. (2019) reported a higher prevalence of ongoing and history of NSSI of 74%. In terms of gender differences, findings are discrepant but autistic women seem to be at higher risk to engage in NSSI compared to autistic men (Moseley et al., 2019; Maddox et al., 2017). Importantly, recent studies suggest that ED might be involved in NSSI and suicide attempts in autistic people (Moseley et al., 2019; Conner et al., 2020; Licence et al., 2020; Jachyra et al., 2022).

NSSI in ASC has been mainly considered in the literature as a form of repetitive and restricted behaviour, i.e., behaviours performed in an automatic and stereotyped way that cause injuries (Goldfarb et al., 2021; Minshawi et al., 2014). However, recent findings suggest that NSSI might have similar characteristics to that found in the general population in terms of age of onset (i.e., in adolescence), methods used, and the function of the behaviour (Maddox et al., 2017). Indeed, as found in non-autistic people (Brereton & McGlinchey, 2020; Andover & Morris, 2014), autistic people might use NSSI to regulate painful emotions, particularly low-energy affective states like depression and numbness and high-energy affective states like anger and anxiety (Licence et al., 2020; Moseley et al., 2019). In fact, NSSI has been linked to alexithymia, depression, and anxiety in autistic adults (Moseley et al., 2019). Moreover, Moseley et al. (2019) suggest that NSSI in ASC may have other functions, i.e., self-punishment, deterrence from suicide, sensory stimulation and/or social communication. Scratching/pinching and skin cutting are the most used NSSI methods in autistic people (Moseley et al., 2019).

Regarding suicidality, reviews have reported prevalence rates of suicide attempts in ASC between 10–50% (Richa et al., 2014; Segers & Rawana, 2014). High rates of suicide ideation and attempts have been found in both autistic youth (Mayes et al., 2015) and adults (Jachyra et al., 2022; Cassidy et al., 2014). In a sample of autistic and non-autistic adults, Costa et al. (2020) found that the higher autistic traits, the higher suicide risk. Autistic adults without intellectual disability, especially women, have been reported to be at the highest risk of dying by suicide among the autistic population (Kölves et al., 2021; Kirby et al., 2019; Hirvikoski et al., 2016). Indeed, population-based cohort studies have reported a 3.7 to 9-fold increase in death by suicide among autistic adults without intellectual disability compared to the general population (Hirvikoski et al., 2016; Kölves et al., 2021), with this risk being heightened in those with a co-occurring ADHD (Hirvikoski et al., 2016). Importantly, ED has been associated with increased suicide ideation in autistic youth (Conner et al., 2020). However, studies investigating

the link between ED and suicidality –especially suicidal behaviour– in ASC are still lacking. Moreover, as in non-autistic populations (Heffer & Willoughby, 2018), findings support a strong link between NSSI and suicidality in ASC, suggesting that autistic adults may develop capability for suicide through NSSI (Moseley et al., 2022; Moseley et al., 2020).

Given the prevalence of ED in ASC and its association with NSSI and suicide ideation, there is a growing body of literature suggesting that ED might be a relevant treatment target in autistic individuals (Reyes et al., 2019; Conner et al., 2020), especially in case of NSSI and suicidal behaviour (Moseley et al., 2019; Conner et al., 2020).

3. Emotion dysregulation in ASC

3.1. ASC traits and emotion dysregulation

Similar to findings in non-autistic people, neuroimaging findings have associated ED to an atypical neural functioning in autistic people involving different brain areas such as the amygdala and regions of the prefrontal cortex (Mazefsky et al., 2020; Richey et al., 2015; Pitskel et al., 2014; White et al., 2014). For instance, Richey et al. (2015) found a decreased activation of the amygdala and the nucleus accumbens in autistic adults without intellectual disability when engaging in a task involving cognitive reappraisal. Moreover, physiological data suggest that autistic people may have atypical patterns of physiological response to emotions. Indeed, compared to non-autistic people, autistic individuals experience an increased physiological arousal following emotional triggers, including sensory stimuli (Conner et al., 2020; Lydon et al., 2016; White et al., 2014). In addition, following the exposure to a stressor, autistic children experience longer-lasting emotional response, reflected by higher peaks of cortisol levels and prolonged duration and recovery of cortisol elevation, compared to non-autistic children (e.g., Spratt et al., 2012).

Most research on ED in ASC has focused on exploring the relationship between ED and ASC core features (Berkovits et al., 2017; Mazefsky & White, 2014). Overall, ED has been

associated with ASC traits, with the higher the autistic traits, the higher the risk for presenting with ED (Berkovits et al., 2017; Macari et al., 2018). Considering this association, Mazefsky and White (2013) proposed a conceptualization that brings together all the ASC-related features that have been associated with ED (**Figure 5**). According to some studies (e.g., Samson et al., 2014; Mazefsky & White, 2014), specific ASC features, such as sensory sensitivities, restricted and repetitive behaviour and social cognition peculiarities, are particularly related to ED. For example, Samson et al. (2014) found that the ASC core features (i.e., social and communication difficulties, repetitive behaviour, and sensory particularities) were independently associated with ED in a sample of autistic youth. Importantly, restricted and repetitive behaviour emerged as the strongest ED predictor in their sample (Samson et al., 2014), which has also been outlined in other subsequent findings (Greenlee et al., 2021). Hence, ASC features as a whole are associated with ED, but restricted and repetitive behaviour might be particularly related to ED in autistic people. This may be explained by the motor impulsivity that drives these behaviours, which may interfere with the goal-directed behaviour required by ER (Faja & Nelson Darling, 2019; Samson et al., 2014).

Among the restricted and repetitive behaviour cluster of ASC features, sensory sensitivities might be one of the key contributors to ED in autistic people (Conner et al., 2020; Moseley et al., 2019; Mazefsky & White, 2014; Samson et al., 2014). Moseley et al. (2019) found that sensory sensitivities predicted the NSSI group categorization (current, past, or non-self-harmers), and were the only variable to predict the range of bodily areas targeted, lifetime incidence and frequency of NSSI. The authors also found that NSSI served an ER function in their sample, suggesting a link between sensory sensitivities and ED (Moseley et al., 2019). Interestingly, some studies have found that sensory sensitivities were the strongest and single predictor of NSSI in autistic youth (Duerden et al., 2012). This association may be due to the

distress reported by autistic people when experiencing intense sensory discomfort (Robertson & Simmons, 2015).

In addition, autistic people may present with low cognitive flexibility, change-related anxiety, and social cognition particularities –including perspective-taking– and this may hinder the flexible use of ER strategies and the use of ER skills that are strongly context-dependent, such as cognitive reappraisal and problem solving (Mazefsky & White, 2014; Samson et al., 2012). This may also explain why autistic people are more prone to use maladaptive strategies like rumination or avoidance rather than adaptive ones (i.e., reappraisal) (Samson et al., 2015; Mazefsky & White, 2014). Consistently, Aldao and Nolen-Hoeksema (2010) suggested that individuals might develop a ‘default’ regulatory approach that interferes with the ability to use newly learned, more adaptive strategies, such as reappraisal. This might be particularly true for autistic people, due to cognitive flexibility difficulties and change-related anxiety.

Therefore, ER might be costly for autistic people due to their atypical functioning and the challenge to constantly adapt to the “non-autistic world” (Sunagawa, 2023). This may be involved in the heightened fatigue they often report (Raymaker et al., 2020).

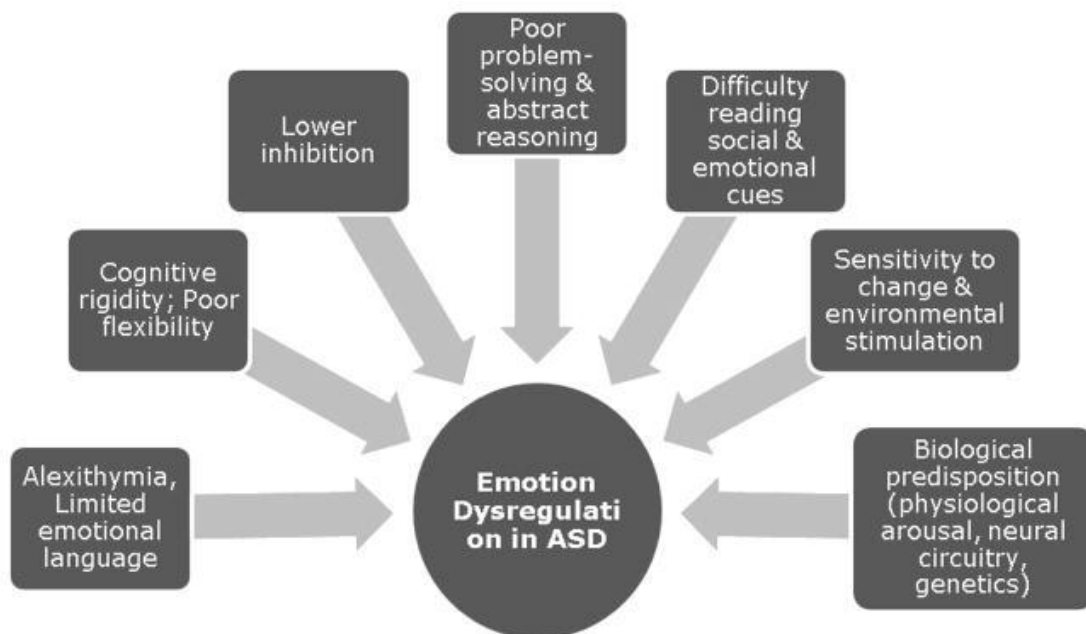


Figure 5. ASC-related features that may contribute to ED (Mazefsky & White, 2014).

3.2. Co-occurring disorders, alexithymia, and emotion dysregulation

In addition to core ASC features, some studies suggest that co-occurring disorders, especially psychiatric disorders frequently found in autistic adults, could be involved in the emergence and maintenance of ED (Mazefsky et al., 2013). Thus, ED could be seen as a by-product of co-occurring disorders characterized by ED, such as anxiety and depression (Mazefsky et al., 2013). Indeed, co-occurring psychiatric and neurodevelopmental disorders are prevalent in ASC (Lai et al., 2019), and most of these disorders present with ED, e.g., ADHD or anxiety (e.g., Shaw et al., 2014; Hofmann et al., 2012; Conner et al., 2020). For instance, Charlton and al. (2020) reported that autistic young adults with anxiety or depression showed significantly poorer ER abilities relative to those without these disorders. Conner et al. (2020) added to these results by showing an association between ER and anxiety, after controlling for ASC traits. By contrast, other studies suggest the opposite, that is, ED is seen as a risk factor for the development of psychiatric disorders in autistic people rather than a consequence of co-occurring disorders (Swain et al., 2015; Charlton et al., 2020; Conner et al., 2020). Consistent with this view, Morie et al. (2019) found that ED mediated the association between autistic features and anxiety, suggesting that anxiety may arise in autistic people through ED. Given the lack of consensus, it is worth noting that longitudinal studies are needed to determine the direction of the relationship between ED and co-occurring psychopathology in ASC.

Not a disorder *per se*, alexithymia has been associated with ED in several conditions, including ASC (Mazefsky & White, 2014; Mazefsky et al., 2013), whereby it is particularly prevalent (Morie et al., 2019; Poquérousse et al., 2018). For example, Weiner et al. (2023) found that autistic adults presented with heightened alexithymia compared to non-autistic controls, irrespective of BPD traits. Alexithymia has also been found to be involved in co-occurring disorders in ASD, as well as ED, NSSI and risk of suicide. Indeed, Morie et al. (2019) found that alexithymia mediated the association between autistic features and anxiety. In addition,

related to ED, high levels of alexithymia in autistic people have been found to contribute to the difficulty in engaging in goal-directed behaviour (Mazefsky et al., 2013). Importantly, alexithymia has been reported to predict NSSI in autistic adults, particularly when experiencing high-energy states (i.e., anger, anxiety) (Moseley et al., 2019), and it has been associated with higher risk of suicidal behaviours in those with high autistic traits (Costa et al., 2020).

3.3. Psychosocial risk factors for emotion dysregulation in ASC

Evidence supports an increased exposure of autistic people to trauma and adverse experiences both in childhood (Hellström, 2019; Fuld, 2018; Taylor & Gotham, 2016) and adulthood (Rumball et al., 2020; Brown-Lavoie et al., 2014). This includes different forms of parental maltreatment (e.g., physical and emotional neglect, physical violence) (McDonnell et al., 2019; Fisher et al., 2019), school bullying (Maïano et al., 2016), but also sexual abuse (Ohlsson Gotby et al., 2018). Autistic girls and women (Fisher et al., 2019; Bargiela et al., 2016) appear to be at the highest risk for adverse experiences (Cazalis et al., 2022; Ohlsson Gotby et al., 2018), especially sexual victimization (Cazalis et al., 2022). Adverse experiences in autistic children have been shown to contribute to co-occurring psychopathology and/or the worsening of ASC-related difficulties both in childhood (Taylor & Gotham 2016; Mehtar & Mukaddes, 2011) and in adulthood (e.g., anxiety, depression, PTSD) (Fuld, 2018).

Studies exploring the role of trauma and adverse events on the development of ED in autistic people are lacking, but some data suggest an association between the two (e.g., McDonnell et al., 2019; Mandell et al., 2005). For instance, McDonnell et al. (2019) reported that autistic children without intellectual disability were more likely to experience physical abuse than children with intellectual disability –including autistic ones– and non-autistic controls. In addition, they found that maltreated autistic children without intellectual disability experienced physical abuse and neglect more often and were victimized by more perpetrators than non-autistic controls and maltreated autistic children with intellectual disability

(McDonnell et al., 2019). Importantly, maltreatment was associated with higher likelihood of aggression, hyperactivity, and tantrums in autistic children (McDonnell et al., 2019). Furthermore, Mandell et al. (2005) found that 18.5% of their sample of autistic children had been physically abused and 16.6% had been sexually abused, with those who had been sexually abused being at higher risk of presenting with dysregulated behaviours (e.g., suicide attempts and NSSI). In addition to maltreatment, in autistic children, some studies point to the crucial role of parental scaffolding in effective ER learning, suggesting that lack of parental scaffolding is associated with increased ED (Baker et al., 2019; Fenning et al., 2018; Ting & Weiss, 2017). School bullying is another form of maltreatment to which autistic children are highly exposed (Cappadocia et al., 2014). Data are lacking on the potential link between bullying experiences in childhood and ED. However, in non-autistic people, findings suggest that school bullying might be associated with increased physiological arousal (Cappadocia et al., 2014).

To avoid bullying and other forms of aggressive behaviours, autistic people often make use of camouflaging behaviours – i.e., efforts to mask and/or compensate for autistic traits to ‘fit in’ in a non-autistic society (Cook et al., 2021; Bradley et al., 2021). Autistic camouflaging is recognized to be costly and to negatively affect the sense of identity and self-acceptance in autistic people (Perry et al., 2022; Bradley et al., 2021). Importantly, camouflaging is increasingly reported to be a key risk factor for mental health issues such as depression and anxiety (Hull et al., 2021; Lai et al., 2017), but also for lifetime suicidality among autistic adults without intellectual disability (Cassidy et al., 2020), especially autistic women (Beck et al., 2020a; Lai et al., 2017). However, mechanisms by which autistic camouflaging might contribute to mental health issues and suicidality are still to be investigated. Such is also the case for the potential link between autistic camouflaging and ED.

4. Gender discrepancies in emotion dysregulation severity

Similar to findings in the general population (Bender et al., 2012), some studies suggest that autistic women might present with higher ED levels than autistic men (Weiner et al., 2023; Sáez-Suanes et al., 2023; Wieckowski et al., 2020). For instance, in their study, Weiner et al. (2023) found that autistic women presented with heightened ED compared to autistic men, but also relative to women with BPD (Weiner et al., 2023). Additionally, other findings point to a heightened risk for suicidality in autistic women compared to autistic men (Kölves et al., 2021). For instance, Kölves et al. (2021) reported a 4.41-fold higher risk of suicide attempts in autistic women compared to autistic men. Hirvikoski et al. (2020) reported that autistic women without intellectual disability had a higher risk for suicidal behaviours than autistic men, while both had increased risk for suicidal behaviours in case of co-occurring ADHD.

The increased vulnerability of autistic women to ED and suicidality might be related to a heightened exposure to some risk factors, such as anxiety and autistic camouflaging. Indeed, autistic women seem to experience higher levels of anxiety (Sáez-Suanes et al., 2023) and use more autistic camouflaging behaviours (Beck et al., 2020a; Lai et al., 2017) compared to autistic men. Additionally, autistic women, especially those without intellectual disability, are at higher risk of late diagnosis than autistic men (Gesi et al., 2021), which is likely to increase their exposure to adverse experiences and to the use of autistic camouflaging (Bradley et al., 2021). Some other findings also point to a heightened vulnerability of autistic women to sexual abuse (Cazalis et al., 2022; Ohlsson Gotby et al., 2018). Cazalis et al. (2022) found that nine autistic women out of ten had been victims of sexual violence (compared to 30% in women from the general population). Together, these findings suggest the need to explore gender differences when studying ED and its correlates in the autistic population (Weiner et al., 2023).

It is worth noting that existing studies on ED in ASC focus on comparing autistic women and men (referring to the gender) or autistic females and males (referring to the biological sex),

while studies on ED in other genders in the autistic population are scarce (Petruzzelli et al., 2022). Thus, future studies are warranted to investigate ED in other genders as well. This is particularly important given that transgender and non-binary gender are more prevalent in ASC compared to the general population and are associated with poorer mental health (Kung, 2023).

5. Section summary

Similar to several psychiatric disorders, a growing body of literature shows that ED is prevalent in neurodevelopmental conditions, including ASC. Importantly, ED is associated with NSSI, increased suicidality and overall reduced well-being in autistic people. Some findings suggest that autistic adults without intellectual disability, especially women, might be at higher risk of severe ED and suicidality among the autistic population.

Most studies and conceptualizations of factors involved in ED in ASC focus on the impact of ASC core features on ED (e.g., sensory hypersensitivity, poor cognitive flexibility, social cognition difficulties), as well as co-occurring psychiatric disorders (e.g., anxiety and depression). Additionally, biological vulnerabilities, such as physiological hyperreactivity to emotional triggers, have also been associated with ED in ASC (Mazefsky & White, 2014; Mazefsky et al., 2014). However, fewer studies have pointed to the potential role of psychosocial factors in the development of ED in autistic individuals, such as maltreatment (e.g., physical, emotional, and sexual abuse), lack of parental emotional scaffolding, school bullying and autistic camouflaging. Hence, further research is needed to promote our understanding of the specific determinants of ED in autistic people from a comprehensive biosocial perspective.

III. Treating emotion dysregulation in autism spectrum condition

In this section, we will first summarize the literature on the efficacy of current pharmacological and psychological approaches to treat ED in autistic people, particularly autistic adults without intellectual disability. Then, we will introduce DBT, the most studied psychotherapy to treat ED in BPD. To do so, we will present the structure of DBT, and then present RCT findings regarding its efficacy in treating ED in BPD and in other psychiatric and neurodevelopmental conditions, as well as its potential mechanisms of change in the context of BPD. Finally, we will argue that DBT is relevant to treat ED in autistic adults without intellectual disability, particularly those presenting with NSSI and/or suicidal behaviour.

1. Pharmacological treatments of emotion dysregulation in ASC

Pharmacological treatments have shown limited and short-lasting efficacy in reducing ED and related behaviours in different conditions, such as BPD (Ripoll, 2013; Olabi & Hall, 2010) and ADHD (Baweja & Waxmonsky, 2022; Lenzi et al., 2017), but also ASC (Salazar de Pablo et al., 2022; Fung et al., 2016). Indeed, in their systematic review and meta-analysis, Salazar de Pablo et al. (2022) found that some pharmacological treatments, particularly risperidone and aripiprazole, were more effective than placebo to reduce ED and irritability behavioural manifestations in autistic people. Interestingly, higher severity of ED and irritability at baseline was associated with greater improvements following the medication and a better benefit–risk ratio (Salazar de Pablo et al., 2022). The latter were assessed, among other tools, by the Aberrant Behaviour Checklist’s irritability subscale (ABC-I; Aman et al., 1985) which comprises items on temper outbursts, negative mood, aggression, and NSSI. However, the authors highlighted that pharmacological treatments for ED provided a “symptomatic relief” only and were not long-lasting (Salazar de Pablo et al., 2022). In addition, these treatments present a risk of side effects such as weight gain, which might have a detrimental effect on well-being and quality of life (Salazar de Pablo et al., 2022; DeVane et al., 2019). These limits led

the authors to highlight the need for multimodal treatment plans that may include psychotherapy to treat ED in a comprehensive way (Salazar de Pablo et al., 2022). Psychological interventions may provide a more in-depth and personalized treatment of ED by enabling clients to understand their own emotional functioning and learn ER skills (Beck et al., 2020b; Conner et al., 2019). This is consistent with results reported in other conditions whereby pharmacological treatments were found to be useful as an adjunctive treatment for ED, but not as a primary and single treatment (Salazar de Pablo et al., 2022; Lenzi et al., 2017). Thus, there is a critical need to develop psychological treatments targeting ED in autistic individuals, especially given its effects on their mental health and adaptive functioning (Beck et al., 2020). Treatments based on cognitive behavioural therapy (CBT) have shown promising results with autistic adults without intellectual disability (Reyes et al., 2019), particularly DBT (Bemmouna et al., 2022; Ritschel et al., 2022), the most studied treatment for ED in BPD (May et al., 2016).

2. Cognitive behavioural therapy to treat emotion dysregulation in ASC³

The efficacy of CBT in the field of ASC has mainly been studied in autistic children and adolescents (Kuroda et al., 2022), mostly to reduce anxiety (Storch et al., 2015; Sukhodolsky et al., 2013; Sofronoff et al., 2005). Several studies have also reported that CBT interventions might be effective to improve ED in autistic youth (e.g., Nuske et al., 2023; Shaffer et al., 2023; Conner et al., 2019). In autistic adults, studies investigating the efficacy of CBT to address co-occurring disorders and difficulties are scarce, especially randomized controlled trials (RCT) (Kuroda et al., 2022; Beck et al., 2020b). Indeed, to our knowledge, only four RCTs have evaluated the efficacy CBT interventions in autistic adults without intellectual disability (Ostwald et al., 2022; Yang & Chung, 2022; Kuroda et al., 2022; Russel et al., 2013), and only one focused on ER abilities as its main outcome (i.e., Kuroda et al., 2022) (Table 1).

³ Given that studies on CBT for the treatment of ED/enhancement of ER abilities in autistic youth are numerous, and that the autistic child/adolescent population is not our population of interest, in this section we focus mainly on CBT treatments for autistic adults without intellectual disability.

Overall, in autistic adults, CBT has been shown to be effective to improve anxiety and depression (Gaigg et al., 2020; Sizoo & Kuiper, 2017), social and adaptive functioning – including social anxiety– (Ostwald et al., 2022; Bemmer et al., 2021), obsessive-compulsive disorder (OCD) (Russel et al., 2013), but also ED (Kuroda et al., 2022; Hartmann et al., 2019; Conner & White, 2018). In fact, Kuroda et al. (2022) conducted the first pilot RCT –with a waitlist control group– showing the efficacy of an 8-week CBT program provided in a group setting to enhance ER skills in a sample of autistic adults without intellectual disability. In their study, the CBT intervention resulted in significant improvements in alexithymia and in coping with stressful situations (i.e., increased ER skills) compared to controls (Kuroda et al., 2022).

Table 1. *RCTs on CBT interventions for autistic adults without intellectual disability.*

Authors	Comparison group	Sample size	Treatment target	Intervention	Main results
Ostwald et al. (2022)	Waiting list	N= 44	Social functioning, stress coping, and self-determination skills	Group-based CBT program (ACCESS program)	Significant improvement in adaptive and self-determination skills, and greater belief in the ability to access social support to cope with stressors in the intervention group compared to controls
Yang and Chung (2022)	Waiting list	N= 30	Anxiety	App-based CBT	Significant decrease in anxiety, an increase in positive affect, and a decline in stereotypic behaviour and hyperactivity compared to controls
Kuroda et al. (2022)	Waiting list	N= 60	ER abilities	Group-based CBT program	Significant improvements on the attitude regarding ASC, alexithymia and coping with stress abilities in the intervention group compared to controls
Russel et al. (2013)	Anxiety management individual sessions	N= 46	Obsessive-compulsive disorder (OCD)	Individual CBT based on exposure and response prevention	Both treatments resulted in a reduction in OCD symptoms

Moreover, preliminary data suggest that third-wave CBT, specifically mindfulness-based cognitive therapy (MBCT), might be effective to improve ED in autistic adults without intellectual disability (Pagni & Braden, 2021; Spek et al., 2013; Conner & White, 2018). The study by Conner and White (2018) is the only one so far that has investigated MBCT targeting ED in autistic adults without intellectual disability. The authors reported significant improvements in self-reported ED following the treatment (Conner & White, 2018). Moreover,

Hartmann et al. (2019) evaluated the preliminary efficacy of a CBT group-intervention that partially incorporated DBT skills, including mindfulness, to improve social and ER abilities in a sample of autistic adults without intellectual disability. Their results showed significant improvement in social abilities but not in ER (Hartmann et al., 2019), which is not surprising given that enhancing social skills was a major focus of their treatment. These preliminary findings support the pertinence of CBT, including MBCT, to treat ED in autistic adults.

3. Limits of existing CBT treatments for emotion dysregulation in autistic adults

Studies on psychological interventions to treat ED in autistic adults, particularly those without intellectual disability, are scarce (Beck et al., 2020b; Conner & White, 2018). Moreover, since the field is in its early stages, most studies provide data on the feasibility, acceptability, and preliminary efficacy of CBT interventions (Conner & White, 2018). Thus, there is a great need for studies that evaluate the efficacy of CBT interventions targeting ED in this population. In addition, very few studies had ER abilities as their main outcome (Kuroda et al., 2022; Hartmann et al., 2019; Conner & White, 2018). Indeed, to our knowledge, only three studies have targeted ER abilities in autistic adults without intellectual disability. Importantly, these studies aimed to enhance ER skills rather than treat ED and ED-related dysregulated behaviour (Kuroda et al., 2022; Hartmann et al., 2019; Conner & White, 2018). Indeed, these studies did not consider the severity of ED as an inclusion criterion (Kuroda et al., 2022; Hartmann et al., 2019; Conner & White, 2018), leading to the inclusion of autistic people who presented with mild ER difficulties. Paradoxically, the presence of suicidal behaviours (Hartmann et al., 2019) and severe co-occurring disorders (Kuroda et al., 2022; Conner and White, 2018) were considered as exclusion criteria. This means that those who were potentially more affected by ED were excluded from these studies. Therefore, although CBT interventions aiming to enhance ER abilities might be useful for a wide range of autistic adults (Kuroda et al., 2022; Hartmann et al., 2019; Conner and White, 2018), it is likely that those

who need such treatments the most (i.e., those presenting with ED and ED-related dysregulated behaviour) do not have access to them (Conner et al., 2020; Moseley et al., 2019). Taken together, these results point the lack of studies investigating the efficacy of psychological treatments for ED associated with NSSI and suicidal behaviours in autistic adults without intellectual disability.

4. Dialectical behaviour therapy to treat emotion dysregulation in ASC

4.1. Roots and overview of dialectical behaviour therapy

DBT was developed in the late 1980s by Marsha Linehan (1993), originally for chronically suicidal people and later extended to people with BPD. DBT is currently the most extensively studied and used approach to treat BPD (Stoffers et al., 2012). The dialectical philosophy in DBT is rooted in Linehan's concern to overcome the limitations of dominating approaches at the time: behaviourism and humanism. Indeed, behaviourism had the reputation to be focused on change through the enhanced use of problem-solving and behavioural change, and humanistic approaches focused on active listening and validation, with both approaches being potentially experienced as invalidating by people with high levels of ED (Linehan, 1997). Thus, Linehan (1993) proposed the “validation/acceptance-change” dialectic as one of the main components of DBT to address the needs of people with ED who were chronically suicidal. The dialectical principle is reflected in the therapist's concomitant use of acceptance and change strategies: i.e., accepting the clients as they are, validating their experiences, emotions and difficulties, and at the same time inviting them to change (Scheel, 2000; Linehan, 1993). The balance between behaviourism and humanism that Linehan introduced to DBT was also influenced by the Zen training she received, through which she discovered mindfulness and acceptance principles. It is worth noting that DBT was the first behavioural psychotherapy to formally incorporate mindfulness principles (Eeles & Walker, 2022).

DBT is an emotion-focused treatment that is usually seen as part of third-wave CBT (Hayes & Hofmann, 2021). As such, it combines acceptance-based techniques, including mindfulness practice, and strategies from traditional CBT such as problem-solving, behavioural analysis, contingency management, and skills training (Linehan, 1993). Although DBT is widely recognized as a therapy to treat ED and life-threatening behaviour, its ultimate aim is to help clients engage in building a “life worth living”, that is, a life in line with personal values where one is able to experience joy and satisfaction, despite difficult life challenges (Linehan, 1993). To do so, based on the biosocial framework, people with ED need to learn effective ER skills and be motivated to change dysfunctional behaviour that might be reinforced by environmental contingencies. Indeed, based on the biosocial theory, the environment’s responses to the individual’s needs are a key component – with emotional vulnerability – in the development of ED and the shaping of coping behaviours (Linehan, 1993). To achieve the goal of enhancing the use of adaptive ER skills in a way that is sustainable and embedded in their lives, DBT has been designed as a comprehensive therapy that serves 5 functions, including enhancing ER skills and the motivation to engage in skillful behaviour, accomplished through four complementary modes: skills group training, individual therapy, phone coaching and team consultation (Chapman, 2006; Linehan, 1993). To help chronically suicidal clients to build a life they see as worth living, DBT typically follows four stages (Linehan, 1993) (**Appendix A - DBT house of treatment**).

(a) The first stage focuses on increasing behavioural control to limit impulsive behaviour, including NSSI and suicidal attempts, by enhancing ER skills and their effective implementation;

(b) The second stage aims to get the client out of “the quiet desperation phase” through working on trauma processing –including PTSD and the sequelae of traumatic invalidation– and enhancing healthy emotional experiencing. Trauma processing may include formal

prolonged exposure to trauma ([Harned et al., 2021](#)). Enhancing emotional experiencing consists in learning to accept, manage, and process emotional responses mainly through the reduction of emotional avoidance ([Fassbinder et al., 2016](#));

(c) The third stage focuses on solving daily problems, achieving personal goals, and reaching a level of "ordinary" happiness and unhappiness (in contrast to stage 1 chronic “emotional hell”);

(d) The fourth stage – the stage the least developed or standardized of the four DBT stages – aims to help the client find deeper meaning in life and increase the ability to experience pleasant emotions on a prolonged basis.

It is worth noting that the stages are not chronological. They happen usually in a circular way (e.g., going back to stage 1 targets after starting stage 2 goals), meaning that there might be issues in each stage that the therapist and the client work through repeatedly ([Linehan, 1993](#)).

Typically, DBT is provided over 12 months ([Linehan, 1993](#)). However, findings indicate that brief formats (e.g., 6 months, 16 weeks) are also effective in treating ED (e.g. [Flynn et al., 2019](#); [Delparte et al., 2019](#); [Neacsiu et al., 2014](#); [Pasiieczny & Connor, 2011](#); [Stanley et al., 2007](#); [Koons et al., 2001](#)). For example, the RCT by [McMain et al. \(2022\)](#) found that a 6-month DBT intervention was as effective as the standard 12-month intervention in reducing NSSI and general psychopathology, as well as increasing ER skills. There were no between-group differences in dropout rates ([McMain et al., 2022](#)). Furthermore, DBT participants enrolled in the 6-month treatment showed more rapid improvements in BPD symptoms and general psychopathology ([McMain et al., 2022](#)).

While comprehensive DBT includes four modes –individual therapy, skills training group, phone coaching and consultation team meetings ([see below; Linehan, 1993](#)) –, DBT-informed treatments incorporate DBT principles and functions but do not require all the

components of the complete program (e.g., standalone skills group training) (e.g., Heath et al., 2021; Neacsiu et al., 2014). Lyng et al. (2020) compared feasibility and efficacy outcomes between comprehensive DBT and DBT standalone skills training group. They found that the two formats had overall comparable efficacy, including improvements in BPD symptoms, general psychopathology and suicide ideation. However, dropout rates were higher for standalone skills group than standard DBT (38.2% vs. 16.7%) (Lyng et al., 2020). Nevertheless, the standalone skills group has the advantage of being more feasible in clinical settings, which suggests that it might be an alternative to comprehensive DBT for at least some clients with BPD (Lyng et al., 2020; McMain et al., 2018). It is worth noting that, despite DBT's clinical usefulness, the sustainable implementation of DBT programs in routine healthcare settings may be faced with challenges, including the lack of organizational support and staff turnover (Toms et al., 2019; King et al., 2018; Swales et al., 2012).

4.2. Dialectical behaviour therapy in practice

Standard DBT addresses the following 5 functions (Chapman, 2006; Linehan, 1993) :

(a) Enhancing behavioural capabilities (including ER skills), (b) improving motivation for skillful behaviour (through contingency management and reduction of interfering emotions and cognitions), (c) assuring generalization of the skills learned in therapy sessions to the client's daily life, (d) structuring the treatment environment so that it reinforces functional rather than dysfunctional behaviour (e.g., helping the client to modify their living environment/social circles in a way that reinforces progress), and (e) enhancing therapist's capabilities and motivation to treat patients effectively. These functions are achieved through the 4 modes of comprehensive DBT (Chapman, 2006; Linehan, 1993): (a) group skills training, (b) individual psychotherapy, (c) telephone coaching, and (d) consultation team meetings (Table 2). In the next four subsections, we will present the four modes of comprehensive DBT in more detail.

Table 2. *DBT functions and corresponding modes.*

Function	Mode
Enhancing capabilities	Group skills training, between-session practice, psychoeducation
Improving motivation	Individual psychotherapy, contingency management
Assuring generalization to the natural environment	Telephone coaching, coaching from staff, between-session practice
Structuring the environment	Case management, family or marital interventions
Enhancing the therapist's capabilities and motivation	Consultation team meetings, supervision, training

4.2.1. Group skills training

The skills training is usually carried out in a group setting with approximately eight clients and two skills trainers. The group follows a manualized protocol (Linehan, 2015). In the standard format, the group meets once a week for about two and a half hours, yet there are varying adaptations (e.g., Blackford & Love, 2011). The skills training group aims to enhance functional ER through psychoeducation and training of ER skills. Homework assignments for clients are given at the end of every session and aim at generalizing the skills learnt in-session in the everyday lives of participants. Skills training is embedded in four modules; two of them teach acceptance-based skills (mindfulness and distress tolerance), while the two others teach change-related skills (emotion regulation and interpersonal effectiveness) (Linehan, 2015).

Acceptance-based skills:

Mindfulness skills, whose aim is to be fully aware of the present moment, experiencing one's emotions, thoughts, and body sensations without judging and reacting to them. There are two types of mindfulness skills in DBT: the “What skills” (observing, describing, and participating) and the “How skills” (non-judgmentally, one-mindfully and effectively). An important concept in this module is the “Wise mind” skill, which allows to base decision making and actions on a balance between emotional mind (which relies on emotions, moods,

and intuition) and rational mind (which relies on facts and personal goals). Mindfulness fosters the development of self-observation (i.e., observation of one's own emotions, cognitions, sensations, and urges) that can help to reduce impulsive reactions to emotional triggers.

Distress tolerance focusses on crisis survival skills and radical acceptance skills. Crisis survival skills aim to teach people how to go through crises without making things worse (i.e., using NSSI, suicidal behaviour, and substance abuse). There is an emphasis on adaptive cognitive distraction⁴, self-soothing and improving the moment. The radical acceptance skill fosters acceptance in situations that cannot be changed immediately and according to the desired timeframe and conditions.

Change-based skills:

Emotion regulation encompasses psychoeducation on emotions to promote an in-depth understanding of emotions and ER. ER skills include reappraisal (i.e., checking the facts skill), problem solving, engaging in opposite action to the emotion urge (e.g., instead of avoiding situations in case of fear, approaching them), and skills to reduce emotional vulnerability. The latter set of skills is of preventive value and includes behavioural activation principles and focusing on one's values.

Interpersonal effectiveness reduces crises triggered by interactions that undermine one's needs and goals. Clients learn to identify their interpersonal needs and to act accordingly.

4.2.2. Individual psychotherapy

Individual therapy consists of one-hour sessions carried out weekly. The individual therapist is the primary treatment provider and responsible for treatment planning, crisis management and decisions about individual modifications in the treatment of the client. The

⁴ Cognitive distraction is to be used in the context of crisis and consists of “functional avoidance”. Informal and formal exposure to emotions are also used throughout the therapy to help the person to develop the ability to experience rather than avoid emotions (Linehan, 1993). Importantly, by doing so, clients may increase their ER flexibility.

individual therapist supports the client in the implementation of the skills in daily life situations, helps with troubleshooting and removing obstacles to change, enhance motivation, and ensures generalization of skills use. Basic treatment strategies comprise dialectical strategies, validation, behaviour analysis, problem solving, commitment strategies, contingency management, observing-limits procedures, exposure-based procedures, cognitive modification, and stylistic strategies like reciprocal and irreverent communication⁵ (Linehan, 1993).

In order to help clients to engage in building a “life worth living”, in people who are in stage 1, that is, dysregulated behaviours are a main concern, individual therapy focuses on three intermediate targets, ranked in order of priority (Linehan, 1993): **(a)** suicidal and NSSI behaviour affecting the person's physical integrity or life; **(b)** behaviour interfering with the therapy that may emanate from the client or the therapist and may hinder the optimal course of therapy (e.g., coming late to sessions, missing sessions), and **(c)** behaviour interfering with quality of life (e.g., co-occurring psychiatric disorders, alcohol abuse, social avoidance). In individual sessions, problems are addressed according to this order of priority. For example, if the client has engaged in a NSSI during the week, the therapist and the client prioritize working around this episode through chain analysis of the target behaviour and solutions generation and rehearsal. To help identify the session's priority, the client completes a diary card with a range of emotions and target behaviours (**Appendix B - An example of a DBT diary card**).

4.2.3. Telephone coaching

Clients can call their individual therapist to receive support in applying ER skills (Chapman, 2019; Linehan, 1993). They may call, for instance, when they need help to go through a crisis, when they feel overwhelmed and need help to prevent things from getting

⁵ Irreverent communication provides the dialectical contrast to the reciprocal communication strategies of warmth, genuineness, and self-disclosure. Irreverence often involves saying unexpected things or using humor in therapy. They are change-based techniques used when the client is entrenched or stuck with the aim of increasing engagement and helping the client to open up to a new perspective (Rizvi & Roman, 2017; Linehan et al., 1993).

worse, or when they want to address an issue in the therapy session or relationship. Telephone coaching thus serve the function of skills generalization, that is, increasing one's ability to use ER skills in everyday life (Chapman, 2019). Phone coaching consists of a short call, generally lasting between 5-15 minutes. It aims to help the client identify and apply helpful skills in the moment. Thus, it does not focus on behavioural chain analysis, which is rather performed in the individual session (Linehan, 1993) (**Appendix C - Behavioural chain analysis**).

4.2.4. Consultation team meeting

DBT consultation team is a group of DBT providers (e.g., psychologists, social workers, counselors, and psychiatrists) who work together to treat clients. The members meet regularly –often weekly– to assist and support one another and prevent potential burnout. The DBT consultation team is a key resource for maintaining motivation to deliver effective treatment, enhancing the therapists' clinical skills, and promoting adherence to the DBT model (Linehan, 1993).

4.3. Empirical data on the efficacy of DBT

The efficacy of DBT is supported by numerous RCTs in BPD (Walton et al., 2020; Carter et al., 2010; McMain et al., 2009; Linehan et al., 2006; Verheul et al., 2003), and also in several other psychiatric disorders, such as depression (Lynch et al., 2003), binge-eating disorder (Carter et al., 2019; Chen et al., 2016; Masson et al., 2013), bipolar disorder (Goldstein et al., 2013; Van Dijk et al., 2013), adolescents at high risk for suicide (McCauley et al., 2018; Mehlum et al., 2014), cPTSD (Bohus et al., 2020), ADHD (Halmøy et al., 2022; Fleming et al., 2015), and substance use (Davoudi et al., 2020). DBT has also been found to be effective in transdiagnostic contexts (Neacsu et al., 2014).

In BPD, the efficacy of DBT is reflected in the evolution of several clinical outcomes:

(a) A reduction in NSSI and suicidal behaviours (Walton et al., 2020; Carter et al., 2010; McMain et al., 2009; Linehan et al., 2006). For example, the RCT by Linehan et al. (2006) reported that the DBT group had a 50% lower risk of suicide than controls following DBT;

(b) A reduction in psychiatric hospitalizations and emergency services use (Coyle et al., 2018; Carter et al., 2010; McMain et al., 2009; Linehan et al., 2006). For example, Linehan et al. (2006) reported that clients with BPD who received DBT required significantly fewer psychiatric hospitalizations and emergency visits than those who received a community treatment. Given these outcomes, DBT has been found to be cost-effective in people with BPD compared to routine care (Murphy et al., 2020; Haga et al., 2018). However, it is worth noting that results are discrepant regarding DBT cost-effectiveness (Brazier et al., 2006);

(c) An improvement of overall psychopathology, including depression symptoms (Walton et al., 2020; Carter et al., 2010; McMain et al., 2009; Linehan et al., 2006);

(d) An improvement in quality of life, including overall psychological and physical well-being following DBT (McMain et al., 2012; Carter et al., 2010).

Benefits of DBT have been reported to be maintained in follow-ups for up to two years (McMain et al., 2012; Carter et al., 2010; McMain et al., 2009; Linehan et al., 2006). Moreover, similar outcomes have been found in psychiatric and neurodevelopmental disorders other than BPD (e.g., chronic depression, bulimia, cPTSD) (Bohus et al., 2013; Harley et al., 2008; Lynch et al., 2006; Neacsiu et al., 2014; Safer et al., 2001).

Improvements in ED and quality of life observed via self-report questionnaires were also found in qualitative studies. Indeed, although few studies have focused on the subjective experience of DBT and its perceived effects, all of them report a perceived improvement in ER abilities and ER self-efficacy following the therapy (Gillespie et al., 2022; Pardo et al., 2020).

In some studies, DBT was described by participants as “life changing”, enabling to gain control of one’s life and move towards a “life worth living” (Ohlis et al., 2023; Gillespie et al., 2022). Other studies found that, from a subjective standpoint, DBT had helped building healthier and more meaningful relationships with others (Gillespie et al., 2022).

These findings support the efficacy of DBT to treat ED in several disorders characterized by ED. Yet, to our knowledge, comprehensive DBT has not been investigated in autistic people who present with NSSI and/or suicidal behaviours (Mazefsky & White, 2014).

4.4. Mechanisms of change of DBT

In contrast to the large number of studies that have investigated the efficacy of DBT, very few explored its mechanisms of change, i.e., specific processes through which improvements occur (Lynch et al., 2006). Yet, it is crucial to identify treatments’ mechanisms of change to help boost their effects by purposely activating the mechanisms identified and to prevent inadvertently eliminating or diluting essential elements if treatments are further developed, adapted, or adopted in new contexts and for new populations (Mehlum, 2021). The following mechanisms of change of DBT have been identified in BPD:

(a) Enhanced ER and behavioural control leading to reduced impulsivity and an enhanced goal-directed behaviour (Mehlum, 2021; Rudge et al., 2017);

(b) ER skills use giving access to more adaptive responses, which reduces dysregulated behaviour (Mehlum, 2021; Boritz et al., 2019; Rudge et al., 2017; Neacsiu et al., 2010);

(c) Therapeutic alliance, particularly the affirmation and protection dimensions have been reported to foster DBT outcomes (e.g., reduction in NSSI and suicidal behaviour) (Mehlum, 2021; Rudge et al., 2017; Bedics et al., 2012). It is worth noting that therapeutic alliance is recognized as a common factor involved in the efficacy of psychological therapies (Wampold, 2015);

(d) Neurobiological changes have been found to be another mechanism of change in DBT (Mehlum, 2021; Schnell & Herpertz, 2007; Goodman et al., 2014). In fact, fMRI findings have reported changes in neurocircuitry in brain regions involved in emotion reactivity and ER following DBT (e.g., reduced amygdala activation after an unpleasant emotional trigger) (Schnell & Herpertz, 2007; Goodman et al., 2014).

(e) Increased emotional awareness and acceptance of emotions have been found to be another potential mechanism of change in DBT (i.e., decreased alexithymia), enhancing access to ones' emotional experience and the ability to modulate it (Boritz et al., 2019).

More empirical studies are needed to further determine the mechanisms of change of DBT in BPD, as well as in the other psychiatric and neurodevelopmental conditions. Identifying transdiagnostic but also potentially specific mechanisms of change may allow to further increase the pertinence of DBT and to foster its efficacy (Lynch et al., 2006).

4.5. DBT in ASC

DBT has been recommended to treat ED in autistic people (i.e., Hartmann et al., 2012; Mazefsky & White, 2014). Several arguments support the potential relevance of DBT to treat ED in autistic people (Hartmann et al., 2012). Indeed, recent research points to the high prevalence of ED in autistic people and its potential contribution to the high prevalence of NSSI and suicidality among autistic adults (Jachyra et al., 2022; Conner et al., 2020; Moseley et al., 2019). These difficulties are the core target of DBT (Linehan et al., 2006; Linehan, 1993). In addition, DBT has proved to be effective in reducing ED in psychiatric disorders but also in adults with ADHD (Halmøy et al., 2022; Fleming et al., 2015), suggesting its pertinence to treat ED in neurodevelopmental conditions. Moreover, third-wave CBT approaches that include mindfulness, like DBT, have been recently found to be feasible and efficacious in treating autistic adults presenting with several mental health issues (Pagni & Braden, 2021; Spek et al., 2013), including ED (Conner & White, 2018).

When this doctoral work began (October 2020), there was no empirical data on the feasibility, acceptability, and efficacy of DBT to treat ED in autistic people. The preliminary study by Hartmann et al. (2019) was the only one at that time that had investigated the potential efficacy of a CBT intervention that partially integrated DBT skills in a sample of autistic adults without intellectual disability. However, their intervention aimed to improve social abilities, which may explain why their results showed improvement in social abilities but not in ER.

Meanwhile, Ritschel et al. (2021) published findings on the feasibility and acceptability of a DBT skills training group in a sample of autistic adults without intellectual disability. Their results suggested that standalone skills group was highly feasible and acceptable, given the high completion and attendance rates, as well as the high satisfaction levels (Ritschel et al., 2021). However, the study by Ritschel et al. (2021) did not target ED, as ED was not an inclusion criterion, and they excluded individuals with active suicide ideation. The same year, Cornwall et al. (2021) published the first results on the preliminary efficacy of radically open DBT (RO-DBT)⁶ in autistic people. However, RO-DBT has a different content than classical DBT and targets overcontrol and not ED (Lynch, 2018).

Finally, a multicentre RCT protocol was published by Huntjens et al. (2020), but, to our knowledge, their results have not yet been published. Their RCT aims to include 128 autistic adults without intellectual disability presenting with NSSI and/or suicidal behaviour. DBT treatment (skills group training + individual therapy) is compared to a treatment as usual condition (TAU) where weekly therapy sessions are provided. Their primary outcome is the level of suicide ideation and behaviour. Thus far, to our knowledge, no study has evaluated the

⁶ Radically open dialectical behaviour therapy (RO-DBT), developed by Thomas R. Lynch, is a treatment that has been developed and tested to address excessive self-control or overcontrol. RO-DBT is a transdiagnostic treatment indicated for clients with diagnoses of chronic depression, treatment-resistant anxiety disorders, anorexia nervosa, ASC, and Cluster A and C personality disorders (Lynch, 2018).

feasibility, acceptability, and efficacy of DBT to treat ED in autistic adults, especially in those with NSSI and/or suicidal behaviour.

5. Section summary

Pharmacological treatments have shown limited efficacy in treating ED in autistic people. In addition, research on the usefulness of CBT to treat ED in autistic adults is scarce and only three studies targeted ED in autistic adults without intellectual disability. However, these studies did not consider ED severity as an inclusion criterion. Given the current state of research, there is a great need for evidence-based psychotherapies targeting ED for autistic adults without intellectual disability, especially those with NSSI and suicidal behaviours.

DBT is an emotion-focused third-wave CBT supported by solid evidence in the treatment of severe ED, especially in BPD. DBT has been subsequently adapted for the treatment of ED in several psychiatric disorders, but also in adults with ADHD. DBT has yielded positive clinical outcomes such as a reduction in life-threatening behaviour and the use of psychiatric services, as well as an improvement in quality of life. Few studies have focused on the mechanisms of change associated with DBT. However, thus far, increased use of DBT skills and adaptive ER as well as increased awareness of emotions are among the main specific mechanisms that have been pinpointed.

Despite the potential pertinence of DBT to treat ED in autistic adults, studies evaluating its efficacy are lacking. This may seem surprising given the growing awareness of the heightened rates of suicidality and NSSI in autistic people. Thus, studies are needed to explore the feasibility, acceptability, and efficacy of DBT to treat ED in autistic adults without intellectual disability, especially those presenting with NSSI and/or suicidal behaviour.

PART II – Thesis' aims and overview of the empirical work conducted

The aim of the present thesis is twofold, resulting in two research axes:

The first research axis aimed to explore the characteristics and correlates of ED in autistic adults without intellectual disability, particularly in comparison with people with BPD. To this end, two studies were carried out: **(1) The first study** consisted of a narrative review that aimed to propose an application and extension of Linehan's biosocial model to ED in autistic adults without intellectual disability based on the existing literature on ED and its correlates in ASC. The study includes a case conceptualization that illustrates the model's application. **(2) The second study** is a cross-sectional online study involving 724 participants that aimed to evaluate the relevance and specificity of biosocial factors involved in our application of Linehan's model to ED in ASC. To do so, we compared these factors (as both potential correlates and predictors of ED) between autistic adults without intellectual disability, individuals with BPD and non-clinical controls.

The second research axis aimed to evaluate the feasibility, acceptability, and efficacy of DBT to treat ED associated with NSSI and/or suicidal behaviours (including suicide ideation) in autistic adults without intellectual disability. To this end, three studies were carried out: **(1) The first study** is a pilot study evaluating the feasibility, acceptability, and preliminary efficacy of an 18-week comprehensive DBT to treat ED in 7 autistic adults without intellectual disability presenting with NSSI and/or suicidal behaviours. **(2) The second study** is a RCT involving 63 additional participants that aimed to evaluate the efficacy of 18-week comprehensive DBT to treat ED in autistic adults without intellectual disability presenting with NSSI and/or suicidal behaviours. In this study, we also aimed to explore potential mediators and moderators of DBT on ED outcomes in this population. **(3) The third study** is a qualitative study involving 22 autistic participants of the RCT who benefitted from DBT. To gain an in-depth understanding of potential mechanisms of change as well as the suitability of the intervention from the perspective of autistic individuals, this study aimed at investigating the subjective experience

of autistic adults following comprehensive DBT. The latter written manuscript is in its early stages and is presented here without a discussion section. However, the results are discussed in the general discussion section. See **table 3** for an overview of the five studies and their designs.

Table 3. *Overview of the studies carried out, their designs and samples.*

Study	Study design	Groups	Sample size	Genders (%)	Mean age (SD)
Research axis 1 : ED correlates and predictors in autistic adults without intellectual disability					
Study 1.1	Narrative review with an illustrative case conceptualization	An autistic person without intellectual disability	1	Woman	37
Study 1.2	Cross-sectional online study	Autistic adults without intellectual disability + adults with BPD + nonclinical controls	724	520 women (72%) 147 men (20%) 57 non-binary (8%)	28 (± 10.32)
Research axis 2 : Feasibility, acceptability and efficacy of DBT to treat ED in autistic adults without intellectual disability					
Study 2.1	One-group pilot study	Autistic adults without intellectual disability	7	3 women (43%) 4 men (57%)	28 (± 13.34)
Study 2.2	Randomized controlled trial	Autistic adults without intellectual disability	63	29 women (46%) 28 men (44%) 5 non-binary (10%)	31 (± 9.94)
Study 2.3	Qualitative study	Autistic adults without intellectual disability	22	10 women (45%) 8 men (36%) 4 non-binary (18%)	30 (± 7.19)

PART III – Empirical contribution

AXIS 1 – Study 1

Linehan's Biosocial Model applied to Emotion Dysregulation in Autistic Adults: A Narrative Review of the Literature and an Illustrative Case Conceptualization

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Abstract

Emotion dysregulation (ED) is a transdiagnostic difficulty prevalent in autism spectrum condition (ASC). Importantly, recent research has suggested that ED is involved in self-harm and suicidality, especially in autistic adults without intellectual disability. Pre-existing models on the aetiology of ED in ASC focus mainly on biological factors to ASC features, such as sensory sensitivities, poor flexibility, and sensitivity to change. However, although psychosocial factors seem to play a role in the emergence of ED in ASC as well (e.g., childhood maltreatment and camouflaging), there is a lack of a comprehensive model conceptualizing biosocial factors involved in ED in autistic people. Linehan's biosocial model (1993) is one of the leading etiological models of ED in borderline personality disorder (BPD). It conceptualizes ED as emerging from transactions between a pre-existing emotional vulnerability in the child and an invalidating developmental environment. Beyond its clinical relevance, Linehan's model has gathered empirical evidence supporting its pertinence in BPD and in other psychiatric disorders. Although ASD and BPD are two distinct diagnoses, because they may share ED, Linehan's biosocial model might be useful for understanding the development of ED in ASD. Hence, this article aims to provide an application and extension of Linehan's model to conceptualize ED in ASC. To do so, we conducted a narrative review of the literature on ED and its underlying factors in ASC, particularly in autistic adults without intellectual disability. To investigate the pertinence of the biosocial model applied to ED in autistic people, we were interested on data on (i) ED and its behavioural correlates in ASC, in relation to the biosocial model, (ii) the potential biological and psychosocial correlates of ED in ASC and (iii) the overlapping difficulties in ASC and BPD. Finally, to assess the pertinence of the model, we applied it to the case of an autistic woman presenting with ED and suicidal behaviours. Our review and application to the case of an autistic woman suggest that ED in ASC encompasses

factors related to both biological and psychosocial risk factors as conceptualized in the BPD framework, although in both domains ASC-specific factors might be involved.

Keywords: Autism spectrum condition, Emotion dysregulation, Self-harm, Suicidality, Linehan's biosocial model, Aetiology.

Introduction

Emotion dysregulation (ED) refers to emotional experience and/or expression that interferes with appropriate goal-directed behaviour (Beauchaine, 2015). ED has been widely studied in borderline personality disorder (BPD; Daros & Williams, 2019; Carpenter & Trull, 2013). Linehan's biosocial theory (1993), one of the leading etiological models of BPD, places ED at the core of the disorder. Linehan's theory conceptualizes ED as emerging from transactions between emotional vulnerability and an invalidating developmental environment (Linehan, 1993; Crowell et al., 2009). Emotional vulnerability refers to biological factors with a genetic basis evidenced by disruptions in the emotional system involving different brain areas (e.g., prefrontal regions and amygdala) (Kuo & Linehan, 2009). Linehan's theory has subsequently added temperamental impulsivity as an additional risk factor for BPD (Crowell et al., 2009). Emotional vulnerability results in dysfunctions in three dimensions: a) emotional hypersensitivity (i.e. low threshold for emotional reactions), b) hyperreactivity (i.e. increased change in emotional intensity and extreme reactions), and c) a slow return to emotional baseline (i.e. long-lasting emotional reactions) (Kuo & Linehan, 2009; Bortolla et al., 2019). Invalidation, on the other hand, refers to the inadequate responses of the environment to the emotional needs of the child (Linehan, 1993). It may occur through the neglect, minimization or punishment of the child's emotional experience, but also through physical and sexual abuse (Crowell et al., 2009; Wagner & Linehan, 2006). According to Linehan's theory, in people presenting with emotional vulnerability, early invalidation may result in maladaptive coping (i.e., self-harm with or without suicidal intent) when they are faced with difficult emotions (Brereton & McGlinchey, 2020; Oumaya et al., 2008). An important corollary of this biosocial perspective is that, during their development, people with BPD did not learn the adaptive skills to regulate their emotions effectively. Hence, they use strategies that were involuntarily targets of operant conditioning (e.g., *“mom listens to me and is nice when I cut myself”*; *“dad says that*

it is stupid to cry”) or modelling (Linehan, 1993). Therefore, as adults, people with BPD lack the skills to regulate their emotions, as they were taught that emotional reactions are not to be trusted (i.e., they self-invalidate) and that emotions are dangerous and should be escaped or avoided (e.g., using crisis behaviours or emotional avoidance) (Linehan, 1993). Importantly, Linehan developed dialectical behaviour therapy (DBT), the treatment targeting ED with the most empirical support, based on this model (Linehan et al., 2006; Panos et al., 2014).

Some empirical studies have tested Linehan’s model in BPD (e.g. Reeves et al., 2010; Gill & Warburton, 2014). Although it is not consensual, the model has amassed considerable evidence in its support. For instance, Reeves et al. (2010) found that emotional vulnerability and ED were substantially associated with BPD symptoms, with ED mediating the relationship between emotional vulnerability and BPD symptoms. In addition, Carpenter and Trull (2013) gathered findings supporting the role of biological factors such as emotion sensitivity and lability in the emergence of BPD. Interestingly, studies have supported the role of emotional hypersensitivity and slow return to baseline but not hyperreactivity in the emotional vulnerability found in people with BPD (Kuo & Linehan, 2009; Bortolla et al., 2019). Regarding invalidation, Reeves et al. (2010) found that parental invalidation in childhood does not predict BPD, while other findings have come to opposite conclusions (Schaich et al., 2021; Hope & Chapman, 2019; Keng & Wong, 2017), particularly concerning the involvement of maternal invalidation (Keng & Soh, 2018). Beyond the association between parental invalidation and BPD, cultural and intra-individual factors seem to be involved in the emergence of BPD. For instance, Keng and Soh (2018) found that the association between self-reported maternal invalidation and BPD was moderated by two cultural factors: self-construal (i.e., the extent to which the self is defined independently of others or interdependently with others) and conformity to norms (Keng & Soh, 2018). In addition, Keng and Wong (2017) showed that low levels of self-compassion were associated with BPD independently of parental

invalidation. Finally, regarding the transaction between emotional vulnerability and invalidation, some studies support the transaction (Crowell et al., 2009; Sturrock & Mellor, 2014) while others do not (Gill & Warburton, 2014).

ED is strongly associated with BPD (Daros & Williams, 2019). However, several recent findings suggest that ED is a transdiagnostic mechanism of psychopathology (Paulus et al., 2021; Weissman et al., 2019; Sloan et al., 2017; Dvir et al., 2014; McLaughlin et al., 2011). Although Linehan's model has not been directly studied outside BPD, findings support the involvement of biological vulnerability and invalidation in the emergence of ED in various psychiatric disorders (Calkins et al., 2019), including trait impulsivity (Beauchaine, 2012) and childhood maltreatment (linked to invalidation) (Rüfenacht et al., 2021; Gruhn & Compas, 2020; Guérin-Marion et al., 2021).

In autism spectrum condition (ASC), there has been a growing interest in ED in recent years (Conner et al., 2021; Cai et al., 2018). This is probably due to the increased awareness of the high prevalence of ED in autistic youth, i.e., between 50-60%, which is significantly higher than that found in non-autistic children (Mazefsky et al., 2013; Samson et al., 2014; Mayes et al., 2019). Additionally, as in BPD, ED has been recently pinpointed as a key factor involved in the emergence of mental health issues in autistic adults, particularly self-harm and suicidality (Conner et al., 2020; Moseley et al., 2019).

Few studies have investigated the etiological factors involved in ED in ASC, and most have focused exclusively on the role of ASC-related factors (e.g. Mazefsky et al., 2013; Samson et al., 2014; Keluskar et al., 2021). Thus, to our knowledge, no studies have attempted to conceptualize ED in ASC in relation to Linehan's model. This is of special relevance given the emerging interest in DBT to treat ED in ASC (Hartmann et al., 2012; Reyes et al., 2019). Indeed, recently, DBT has been found to be feasible and acceptable in autistic adults without intellectual disability (Bemmouna et al., 2022; Ritschel et al., 2022). In those with self-harm and suicidal

behaviours, initial evidence suggests that DBT is effective in reducing ED ([Bemmouna et al., 2022](#)). Nevertheless, to improve the pertinence of DBT to autistic individuals, it is of the utmost importance to provide treatments that consider the specific features potentially involved in ED in this population ([Mazefsky & White, 2014](#)).

Case formulation is central to effectively implement behavioural treatments ([Eells, 2009](#)). Linehan's biosocial model provides a theoretical framework to inform case formulation when treating clients with BPD. However, it is still unknown whether it might also apply to autistic adults. This is crucial since DBT is in its early stages in ASC and that ED in autistic adults is still poorly understood ([Cai et al., 2018](#)).

This article aims to provide an application of Linehan's model to conceptualize ED in ASC. To do so, we conducted a narrative review of the literature on ED and its underlying factors in ASC, particularly in autistic adults without intellectual disability. Indeed, narrative reviews are well suited to address research questions with a broad scope to draw conclusions and generate areas for future research questions ([Greenhalgh et al., 2018](#); [Rozas & Klein, 2010](#)). To investigate the pertinence of the bio-social model applied to the ED found in autistic people, we were interested on data on (i) ED and its behavioural correlates in ASC, in relation to the biosocial model, (ii) the potential biological and psychosocial correlates of ED in ASC and (iii) the overlapping difficulties in ASC and BPD. Finally, to assess the pertinence of the model, we applied it to the case of an autistic woman presenting with ED and suicidal behaviours.

Our review was conducted using PubMed, Medline Ovid SP and PsycINFO search engines. Articles had to meet the following inclusion criteria: (a) articles published after 2000, (b) articles in English, (c) articles published in a peer-reviewed journal (d) articles interested in autistic individuals without intellectual disability and/or individuals with BPD. Although our primary focus was on autistic adults without intellectual disability and adults with BPD, given that our approach was developmental, we also included articles on ED in children and

adolescents with these diagnoses. However, we specify throughout our review whether the findings relate to youth or adults. Our articles research paired keywords were the following ones: “Emotion dysregulation”, “Emotion regulation”, “Emotion”, “Emotional reactivity”, “Autism”, “Adults”, “Children”, “Youth“, “Adolescents”, “Borderline personality disorder”, “Self-harm”, “Non-suicidal self-injury”, “Suicidality”, “Suicide”, “Linehan’s biosocial model”, “Linehan theory”, “Emotional vulnerability”, “Invalidation”, “Trauma”, “Adverse events”, “Bullying”, “Autistic camouflaging”, “Predictors”, “Correlates”, “Aetiology”, “Etiology”. To ensure the quality of our narrative review, we referred to the six criteria listed in the Scale for the Assessment of Narrative Review Articles (SANRA; Baethge et al., 2019).

For the illustrative case conceptualization, we used the client's quantitative and qualitative data. The client provided informed consent for the use of her data and participated in building and writing the case conceptualization. The use of personal data was approved by the University of Strasbourg research ethics board (Reference: CE-2022-138).

Emotion dysregulation in ASC

Recent research suggests that autistic people are more likely to develop ED than the general population (Conner et al., 2021; Cai et al., 2018; Samson et al., 2014). In fact, studies have shown fewer emotion regulation abilities and greater maladaptive strategies (e.g. rumination, avoidance) in autistic youth compared to their non-autistic peers (Cai et al., 2018; Khor et al., 2014). Although ED has been mostly studied in autistic youth, it also concerns adults (Swain et al., 2015). Similar to findings in the general population (Bender et al., 2012), autistic women appear to present with greater ED than autistic men (Weiner et al., 2023; Sáez-Suanes et al., 2023; Wieckowski et al., 2020).

ED is not a diagnostic criterion for ASC (APA, 2013), but given its high prevalence in autistic people, some researchers question whether it should be added to ASC core features (Samson et al., 2014; Mazefsky, 2015; Conner et al., 2020). Indeed, ED has been highly

associated with autistic core features, including sensory sensitivities, flexibility difficulties and social cognition peculiarities (Samson et al., 2014; Mazefsky & White, 2014). By contrast, others hypothesize that ED rather arises from co-occurring disorders (Mazefsky et al., 2013), as co-occurring mental health issues (e.g., anxiety and depression) are prevalent in ASC (Hossain et al., 2020; Moseley et al., 2011) and that ED is a transdiagnostic difficulty (Sloan et al., 2017). Alternatively, several studies suggest that co-occurring disorders could result from preexisting ED in ASC, suggesting that ED predisposes to the emergence of psychiatric disorders especially in adults (Swain et al., 2015; Charlton et al., 2020; Conner et al., 2020). Given that few studies with a longitudinal design have focused on ED in ASC (e.g. Greenlee et al., 2021), the sense of the relationship between ED and psychiatric disorders in ASC has not been yet been fully elucidated.

In ASC, ED has been associated with dysregulated behaviours (e.g. meltdowns, outbursts) (Mazefsky et al., 2013; Davico et al., 2022). Similar to BPD (Paris, 2019), recent studies suggest that ED is involved in self-harm with or without suicidal intent in ASC (Moseley et al., 2019; Conner et al., 2020; Licence et al., 2020; Jachyra et al., 2022). However, only recently research has started to highlight the high prevalence of self-harm (Licence et al., 2020; Moseley et al., 2020; Steinfeldt-Kristensen et al., 2020) and suicidality in ASC (Hedley & Uljarević, 2018; Dell'Oso et al., 2019). A meta-analysis revealed a prevalence of 42% of self-harm in autistic people, irrespective of age and the presence of intellectual disability (Steenfeldt-Kristensen et al., 2020). Some findings suggest that the characteristics of these behaviours are similar to those found in the general population (Maddox et al., 2017) and might be used by autistic people to regulate painful emotions, particularly low-energy affective states like sadness and high-energy affective states like anger and anxiety (Licence et al., 2020; Moseley et al., 2019). Moseley et al. (2019) suggest that self-harm in ASC may also have other

functions: i.e., self-punishment, deterrence from suicide, sensory stimulation and/or social communication.

Regarding suicidality, reviews have reported prevalence rates in ASC between 10–50% (Richa et al., 2014; Segers & Rawana, 2014). High suicidality rates have been reported in both autistic youth (Mayes et al., 2015) and adults (Jachyra et al., 2022; Cassidy et al., 2014), with adults without intellectual disability, especially women, being at the highest risk of dying by suicide among the autistic population (Cassidy et al., 2014; Hirvikoski et al., 2016; Kirby et al., 2019; Kölves et al., 2021). In relation to ED, Conner et al. (2020) found that elevated ED was associated with increased suicidal behaviours in autistic youth. Some findings support a strong association between self-harm and suicidality, suggesting that autistic adults may develop capability for suicide through self-harm (Moseley et al., 2022b; Moseley et al., 2020).

Few studies have investigated factors contributing to the heightened rates of ED and suicidality in autistic women relative to autistic men (Sáez-Suanes et al., 2023; Wieckowski et al., 2020). In addition to an increased anxiety (Sáez-Suanes et al., 2023), recent findings point to an increased use of camouflaging in autistic women contributing to elevated distress and risk of suicidality (Beck et al., 2020; Lai et al., 2017). In addition, autistic women, especially those without intellectual disability, are at higher risk of late diagnosis than men (Gesl et al., 2021), which increases their exposure to invalidation and the pressure of exhibiting socially appropriate behaviour (Hull et al., 2021). Although autistic women might be more likely to mask their social difficulties, these difficulties (e.g., identifying others' intentions) persist even though they are less visible to others, making them more vulnerable to the societal invalidation towards women, particularly sexual violence (Cazalis et al., 2022; Ohlsson Gotby et al., 2018). These findings suggest the need to pay special attention to mental health in autistic women, especially regarding ED and suicidality.

As in BPD (Shaikh et al., 2017), Conner et al. (2021) pointed to ED as a risk factor for the use of psychotropic medication, emergency services and psychiatric hospitalizations among autistic people. ED also contributes to impairments in adaptive functioning in ASC in childhood (Berkovits et al., 2017; Joshi et al., 2018) and adulthood (Mazefsky et al., 2013).

Overall, findings support the implication of both emotional vulnerability and invalidating experiences in the development of ED in ASC (e.g. Conner et al, 2020; Richey et al., 2015; McDonnell et al., 2019; Mandell et al., 2005). However, to our knowledge, no studies investigated the transactional relationship between the two components in this context.

Biological correlates of ED in ASC

Biological vulnerability to ED

Several studies have linked autistic features, including peculiarities found at the emotional level, to the atypical brain development in ASC (Andrews et al., 2022; Mazefsky et al., 2013). Indeed, neuroimaging findings show an atypical neural functioning underlying impaired emotion regulation in ASC (Mazefsky et al., 2020; Richey et al., 2015; Pitskel et al., 2014; White et al., 2014). For instance, in autistic adults without intellectual disability, Richey et al. (2015) reported a hyporegulation of key brain regions involved in effortful emotion regulation (i.e., decreased ability to enhance the nucleus accumbens' activation and to lower the amygdala's activation) while engaging in cognitive reappraisal compared to non-autistic adults (Richey et al., 2015). Autistic adults also showed decreased dorsolateral prefrontal cortex activation (dlPFC) during the task, another brain region involved in goal-directed processes (Richey et al., 2015). By contrast, some findings showed a hyperactivation in this region in ASC, suggesting a potential compensatory activation to overcome cortical inefficiency during effortful emotion regulation (Dichter, 2012). Moreover, using functional magnetic resonance imaging (fMRI), Mazefsky et al. (2020) found a longer lasting brain activity in areas involved in sustained emotional information processing (i.e., insula, pulvinar and dlPFC), akin to

rumination, in autistic youth compared to non-autistic peers. These regions have been shown to be involved in ED in conditions other than ASC (Goldin et al., 2008; Fresco et al., 2017). This suggests an atypical neural activity behind the tendency to ruminate in ASC, which is a maladaptive emotion regulation strategy prevalent in autistic people (Mazefsky et al., 2020).

Despite the paucity of studies, some findings support the involvement of the three dimensions of emotional vulnerability (i.e., hypersensitivity, hyperreactivity and slow return to emotional baseline) in ASC. For instance, Lassalle et al. (2017) found that autistic individuals were hypersensitive to fear stimuli with a significantly higher activation of the amygdala than non-autistic individuals. Sensory hypersensitivities have also been linked to increased psychophysiological arousal and increased anxiety in autistic people (Conner et al., 2020; Kuiper et al., 2019; Top, Luke et al., 2018). Regarding hyperreactivity, the majority of findings have reported an increased physiological response to emotional stimuli in autistic individuals compared to non-autistic individuals (e.g. White et al., 2014; Lydon et al., 2016). However, few other studies have rather supported equivalent physiological arousal to emotional triggers between autistic and non-autistic individuals (Samson et al., 2014; De Groot & Van Strien, 2017). It is noteworthy that discrepant results have also been reported in BPD regarding physiological hyperreactivity (Kuo & Linehan, 2009; Bortolla et al., 2019). Finally, there are findings in support of the long-lasting nature of emotional arousal in autistic children, evidenced by the prolonged duration of cortisol secretion following a stressor compared to non-autistic peers (Spratt et al., 2012).

Challenges related to ASC core features that contribute to ED

A growing body of evidence suggests a link between core ASC features and ED, with the higher the autistic traits, the higher the ED (Licence et al., 2020; Fenning et al., 2018; Samson et al., 2014; Mazefsky & White, 2014). Relatedly, Samson et al. (2014) found that interventions enhancing emotion regulation skills in autistic children improved not only ED but

also difficulties related to ASC features, which indirectly supports the link between ED and autistic traits.

Effortful emotion regulation is a deliberate process of self-regulation (Mauss et al., 2006). Thus, due to the additional daily challenges linked to ASC-related difficulties (e.g., executive dysfunction, social interaction difficulties) and subsequent anxiety and fatigue, it is crucial to acknowledge that emotion regulation may come with increased cost for autistic people (Normansell-Mossa et al., 2021; Raymaker et al., 2020; Samson et al., 2014; Mazefsky & White, 2014). Beyond this increased load, ASC-related difficulties might directly interfere with effective emotion regulation (Mazefsky & White, 2014; Samson et al., 2014). Therefore, the “emotional vulnerability” component of the biosocial model that we propose includes the contribution of ASC-features previously acknowledged in Mazefsky and White’s model (2014) and integrates recent findings (**Figure 1**).

Effortful emotion regulation requires accurate identification of key aspects of the situation to use appropriate strategies (Kobylińska & Kusev, 2019). However, difficulties with social skills in ASC (APA, 2013), particularly due to theory of mind (ToM) peculiarities, may interfere with effective emotion regulation (Senju, 2012; Mazefsky & White, 2014). However, it is important to highlight that the ToM peculiarities are neither specific to nor systematic in ASC (Gernsbacher & Yergeau, 2019). Additionally, effortful emotion regulation requires identifying one's emotional experience to be able to modulate it (Chambers et al., 2009). Yet, alexithymia, which refers to the difficulty in identifying and expressing one's emotions, is common in ASC (Poquérusse et al., 2018), limiting insight into one's own emotions and thus preventing their deliberate modulation (Mazefsky & White, 2014; Mazefsky et al., 2013). In autistic adults, alexithymia has been found to predict self-harm, particularly when experiencing high-energy states (i.e., anger, anxiety) (Moseley et al., 2019). In autistic women in particular, alexithymia has been found to be related to ED, irrespective of BPD traits (Weiner et al., 2023).

Together, these difficulties could explain why autistic people may react impulsively to emotional triggers with a lack of goal-directedness (Mazefsky et al., 2013).

Furthermore, effective emotion regulation relies on cognitive flexibility, which enables the use of context-dependent strategies (Kobylińska & Kusev, 2019). This is especially the case for skills that require increased adaptability, such as problem solving and cognitive reappraisal (Kobylińska & Kusev, 2019), and unfamiliar situations that also trigger the change-related anxiety common in ASC (APA, 2013; Mazefsky & White, 2014). Cognitive inflexibility might thus interfere with this ability (Cai et al., 2018; Mazefsky & White, 2014; Eftekhari et al., 2009), and lead to the increased use of maladaptive emotion regulation strategies (e.g., rumination, avoidance, suppression), driven by the emotional state (Mazefsky et al., 2013). Moreover, repetitive behaviours have been found to be the strongest predictor of ED in ASC (Samson et al., 2014), with one quarter of them appearing in reaction to emotional triggers (Militeri et al., 2002). This points to the difficulty in inhibiting automatic behaviours in ASC, which also interferes with flexible emotion regulation (Samson et al., 2014; Mazefsky et al., 2013). It is noteworthy that ADHD, characterized in its hyperactive dimension by impulsivity, frequently co-occurs with ASC, including in adults (e.g., Pehlivani et al., 2020 found a prevalence of 33.3%). Therefore, if present, ADHD co-occurring features are likely to contribute to emotional difficulties (Soler-Gutiérrez et al., 2023).

Sensory sensitivities, which are common in autistic people (APA, 2013), have also been reported to be significantly related to ED in ASC (Conner et al., 2020; Moseley et al., 2019; Mazefsky & White, 2014; Samson et al., 2014). In a sample of autistic adults without intellectual disability, Moseley et al. (2019) found that sensory sensitivities were a strong predictor of self-harming behaviours along with alexithymia, anxiety and depression (Moseley et al., 2019). Importantly, in autistic youth, some studies have suggested that sensory sensitivities were the strongest and single predictor of self-harm (Duerden et al., 2012). This

association may be due to the distress reported by autistic people when experiencing intense sensory discomfort (Robertson & Simmons, 2015).

Psychosocial risk factors contributing to ED in ASC

Early adverse experiences and invalidation

Autistic people are at higher risk of experiencing adverse childhood events (Hellström, 2019; Fuld, 2018; Taylor & Gotham 2016), particularly autistic girls (Fisher et al., 2019; Bargiela et al., 2016). Some studies also highlight an increased vulnerability to be detrimentally affected by adverse events in ASC, with a wider range of events acting as possible catalysts for trauma (e.g. “sensory trauma” and major changes) (Kerns et al., 2022; Rumball et al., 2020), supporting the hypothesis of a transactional relationship between biological and social factors in the emergence and maintenance of ED in autistic people. Adverse experiences in autistic children are associated with co-occurring disorders and/or the worsening of ASC-related difficulties in childhood (Taylor & Gotham 2016; Mehtar & Mukaddes, 2011) and in adulthood (e.g. mood and anxiety disorders, PTSD) (Fuld, 2018).

Autistic children may experience different forms of adverse events. First, autistic children, including those without intellectual disability, are at heightened risk of maltreatment, particularly physical neglect, and abuse (McDonnell et al., 2019; Fisher et al., 2019, Mandell, et al., 2005), including sexual abuse (Ohlsson Gotby et al., 2018). In fact, parents of autistic children are more likely to be emotionally and physically punitive at the child’s behaviour (e.g. non-responsiveness and rigid adherence to routines) as they may perceive it as oppositional (Roberts et al., 2015). Maltreatment is associated with increased dysregulated behaviours in autistic children (e.g., aggression and self-harm) (McDonnell et al., 2019), with those who have been abused being at greater risk of engaging in dysregulated behaviours, including suicide attempts (Mandell et al., 2005). For instance, Taylor and Gotham (2016) found that 90% of their sample of autistic children with high mood symptoms had experienced at least one

traumatic event. Importantly, heightened exposure to trauma may predispose autistic children to develop a co-occurring BPD given that early traumatic experiences are a key risk factor for the disorder (Ball & Links, 2009).

Additionally, autistic children have a 4-fold increased risk of being bullied at school compared to their non-autistic peers (Sterzing et al., 2012; Schroeder, Cappadocia et al., 2014) due to their atypical functioning and social difficulties (Sterzing et al., 2012), with those without intellectual disability being at higher risk (McDonnell et al., 2019). Importantly, repeated adverse experiences, including school bullying, have been shown to be associated with higher levels of distress and altered physiological arousal in adulthood (Janson & Hazler, 2004). Recent findings by Camodeca & Nava (2022) add to these results by showing that victimization strongly predicts increased physiological arousal to emotional triggers in non-autistic adults. Interestingly, this association has also been found in the case of exposure to bullying perpetrated to others (i.e. witnessing bullying without intervening) (Camodeca & Nava, 2022).

Furthermore, the heightened exposure of autistic people to adverse experiences persists in adulthood (Rumball et al., 2020; Brown-Lavoie et al., 2014). Indeed, autistic adults report more emotional bullying and greater sexual victimization compared to the general population (Weiss & Fardella, 2018; Brown-Lavoie et al., 2014), particularly women (Cazalis et al., 2022; Ohlsson Gotby et al., 2018). Additionally, autistic adults, especially those who were diagnosed in adulthood, may suffer from a lack of social support, including from relatives who reject or misunderstand their diagnosis (Crane et al., 2021; Moseley et al., 2021; Stagg & Belcher, 2019).

Given that chronic invalidation may be widespread in ASC (i.e., family members, school, society), autistic adults may present with high levels of internalized stigma related to their ASC diagnosis (e.g., Dubreucq et al., 2020; Turnock et al., 2022), which may, in turn, contribute to high levels of autistic camouflaging, i.e. efforts of masking and/or compensating for autistic traits to ‘fit in’ in society (Cage & Troxell-Whitman, 2019; Perry et al., 2022).

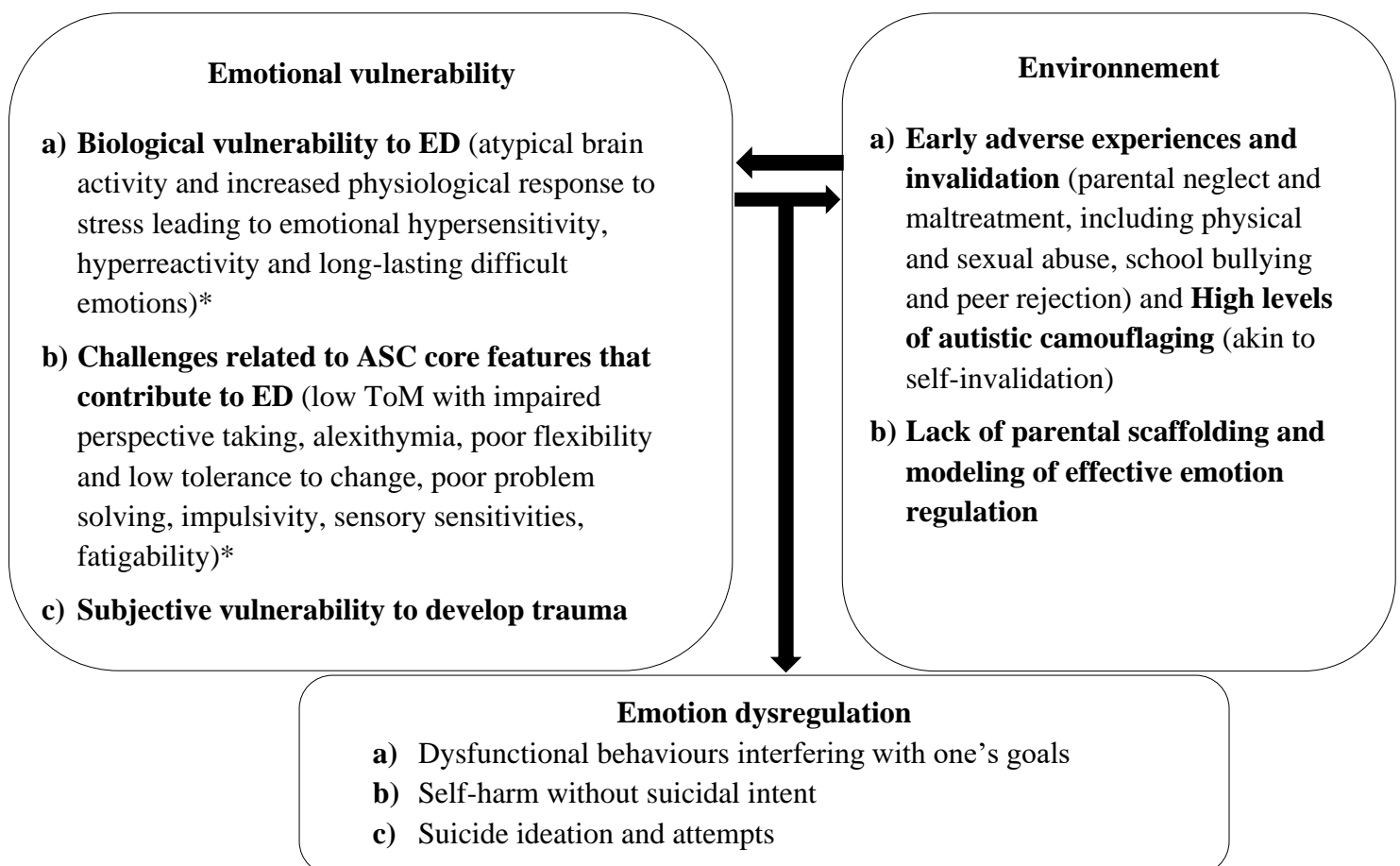
Recent findings show that autistic camouflaging negatively affects mental health (e.g., depression and anxiety) (Hull et al., 2021; Lai et al., 2017) and is associated with lifetime suicidality in autistic adults without intellectual disability (Moseley et al., 2022a; Cassidy et al., 2020), especially autistic women (Beck et al., 2020; Lai et al., 2017). Interestingly, autistic camouflaging is akin to self-invalidation in Linehan's model in many ways. First, both are the consequence of invalidation in childhood (Wood-Downie et al., 2021). Second, both teach one to mistrust one's internal states and to rely on the environment for clues on how to respond. Third, the tendency to look for external validation in both cases interferes with developing a sense of self (Perry et al., 2022). Fourth, both might be of adaptive value to avoid negative reactions such as violence and bullying (Cage & Troxell-Whitman, 2019).

Lack of parental scaffolding and modeling

Caregivers play a key role in helping the child learn effective emotion regulation, particularly through parental scaffolding, defined as a parent's support of their child's emotion regulation (Fenning et al., 2018; Gulsrud et al., 2010). This is especially the case for autistic children, given their vulnerability to develop ED and the increased influence of parental behaviour on their social and emotional development (Fenning et al., 2018; Baker et al., 2007). In autistic children, effective parental scaffolding has been associated with enhanced emotion regulation, while low parental scaffolding has been associated with ED (Baker et al., 2019; Fenning et al., 2018; Ting & Weiss, 2017; Gulsrud et al., 2010). In addition, some findings show that parents of autistic children may mainly rely on passive co-regulation strategies while providing emotional scaffolding (i.e., following the child's lead), instead of active strategies (i.e. prompting/helping, redirection of attention, physical comfort) (Ting & Weiss, 2017).

Additionally, studies point to parental ED as a potential contributor to ED in autistic youth (Berkovits et al. 2017; Ting & Weiss, 2017; Jahromi et al. 2012; Swain et al. 2015). Indeed, fewer parental externalizing problems (e.g., aggression, hyperactivity) have been linked

to adaptive emotion regulation skills in autistic children (Ting & Weiss, 2017). This may reflect that providing effective parental scaffolding and modeling for emotional regulation requires the parents to be able to use effective emotion regulation strategies to regulation their own emotions (Flujas-Contreras et al., 2022; Hendrix et al., 2022; DeLucia et al., 2021). For this reason, Flujas-Contreras et al. (2022) investigated the impact of a clinical intervention aiming at enhancing the parents' emotion regulation skills (e.g. mindfulness skills, problem solving and strategies for managing their children's behaviour and emotional problems) on their autistic children's emotion regulation abilities. Unsurprisingly, both the parents' and the children's emotion regulation abilities improved significantly following the intervention (Flujas-Contreras et al., 2022). These results bring additional support to the development of parent-mediated interventions for autistic children with ED to enhance their efficacy (Hendrix et al., 2022).



* Factors included in Mazefsky and White's model (2014)

Figure 1. Linehan's model application to ED in ASC.

Overlaps and the issue of differential diagnosis between ASC and BPD

Given the similarities between the biosocial correlates of ED in ASC and BPD, it is of great importance to consider the issue of the differential diagnosis between the two diagnoses. This may seem surprising at first since BPD is typically considered as a personality disorder, which concerns mostly women and has a strong environmental etiological component (Bornovalova et al., 2006), whereas ASC is recognized as a neurodevelopmental disorder, which concerns mostly men and has a strong biological etiological component (Sauer et al., 2021). Although the gender-based dichotomy has been challenged for both BPD and ASC in recent years, the stereotypical belief still guides many clinical decisions, leading to misdiagnosis (Weiner et al., 2019; May et al., 2021). While ASC features cannot be explained by the biosocial model (Tick et al., 2016), the fact that it may share ED with BPD may be a source of misdiagnosis (Iversen & Kildahl, 2022). In addition, there is a considerable overlap in the diagnostic criteria for ASC and BPD (e.g., difficulties in social interactions, sensory sensitivities) which makes the differential diagnosis more complex (May et al., 2021), especially in women (Rinaldi et al., 2021, Dudas et al., 2017). Indeed, among the DSM-5 criteria for ASC, only ‘focused interests’ do not have a clear overlap with BPD, but this feature is not systematically present in autistic people (May et al., 2021). In BPD, all the diagnostic criteria overlap or have research findings showing an overlap with ASC (May et al., 2021). Thus, individuals with ASC or BPD may have features that could be classified under both disorders, increasing the risk of misdiagnosis (Iversen & Kildahl, 2022), especially in women without intellectual disability (Rinaldi et al., 2021). Autistic people with ED and self-harm are at greater risk of being misdiagnosed with BPD since these difficulties are strongly associated with BPD (Iversen & Kildahl, 2022; Rinaldi et al., 2021). Similarly, individuals with BPD with a history of physical or sexual abuse are at higher risk of being misdiagnosed with ASC as they might display high levels of autistic-like traits (e.g., social withdrawal) (Dell’Osso et al., 2018).

This is not surprising given the impact of early physical and sexual abuse on the development of social-cognitive abilities and the sense of self (Trickett et al., 2011; Shaffer et al., 2009). It should also be noted that ASC and BPD can co-occur (May et al., 2021), with the co-occurrence being linked to higher suicidality than in BPD or ASC alone (Rydén et al., 2008; Chabrol & Raynal, 2018; Dell’Osso et al., 2021).

Few studies have focused on the differential diagnosis between the two diagnoses (Rinaldi et al., 2021), but some points of differentiation have been suggested, such as lower scores on tasks assessing ToM (Brewer et al., 2017) and diminished self-reported empathy (Dudas et al., 2017) in ASC relative to BPD. Differences have also been found in personality profiles (assessed by the NEO-PI-R) (e.g. higher “conscientiousness” scores in ASC and higher “neuroticism” in BPD) (Strunz et al., 2015).

Illustrative case conceptualization

Mrs. F. is a 37-year-old woman who has a full-time job and lives with her husband and young child. Mrs. F. was diagnosed with ASC without intellectual disability at the age of 35, in addition to previous diagnoses of postpartum depression and PTSD. She was subsequently diagnosed with ADHD. Mrs. F. has experienced daily suicide ideation since childhood. As a child, she frequently reflected on ways to attempt suicide and tried once to die by stopping to eat. In adulthood, she attempted suicide twice by medication overdose. Both suicide attempts required hospitalizations in an intensive care unit. Mrs. F. does not exhibit self-harm without suicidal intent. She underwent a comprehensive psychiatric evaluation as part of her ASC diagnostic assessment, including the Mini-International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998; Hergueta et al., 2015, for the French version). No co-occurring BPD was identified. No one else in Mrs. F.'s family is known to have received an ASC diagnosis. Mrs. F's case formulation using our application of the biosocial model to ASC is in **Figure 2** and her

scores on self-reported scales measuring dimensions related to the components of the model are shown in **Table 1**.

Emotional vulnerability

Regarding emotional vulnerability, Mrs. F. reports that several ordinary events can trigger distress and intense reactions (e.g., bursting into tears), resulting in a wide range of situations as potential crisis triggers (e.g., «*I don't understand why I can get so distressed over something that is not really important*»). This is akin to hypersensitivity to emotional cues relative to Linehan's model (1993). She also describes feeling intense and long-lasting emotions fueled by ruminations (e.g., «*It [the emotion] feels like a geyser*», «*It [the emotion] stays there for a long time [...] stagnant*», «*It goes round and round in my head*»). This is supportive of the two additional facets relative to emotional vulnerability in Linehan's model (1993): i.e., emotional hyperreactivity and slow return to baseline when facing difficult emotions. Mrs. F. reports dealing with these emotional difficulties since a very young age. These elements along with Mrs. F.'s self-reported problems in understanding her emotions (i.e., alexithymia) indicated that it was crucial to include these elements into the psychoeducation on the biological vulnerability component of the model. Indeed, these elements, with the ASC-related difficulties highlighted below, probably contribute to the high level of distress Mrs. F. experiences on a daily basis. This understanding is essential to increase emotional awareness and decrease self-invalidation (e.g., «*I don't understand why I can get so distressed over something that is not really important*») and shame, which are respectively a prerequisite for effective emotion regulation and a motivational factor.

Regarding ASC-related factors associated with ED included in our application of Linehan's biosocial model to ED in ASC, Mrs. F. reports that, due to her change-related anxiety, last-minute changes provoke intense anxiety. Becoming a mother at the age of 32 has been a major additional source of stress, as her child's changing needs and reactions are a source of

unrelenting unexpected events and sensory discomfort (e.g. her child's crying). Mrs. F. also explains that the difficulties in reading social cues are a major source anxiety, as they are associated with doubts over how to interpret and react to others' behaviour. In addition, Mrs. F. has auditory (noises), visual (neon lights) and olfactory (perfume) hypersensitivities that cause overwhelming sensory experiences (e.g., *«It is an invasion [...] it can cause extreme discomfort», «I struggle to put it [the sensory stimulation] aside and be available for the rest of the things»*). Mrs. F. also describes having difficulties identifying and describing her bodily experiences, as well as understanding what causes her physical pain. This is especially the case when she is in an emotional crisis (e.g., *«When I am overwhelmed, there is no access to anything [in her body and mind], I am just in survival mode»*). In extreme cases, Mrs. F.'s impulsivity can lead to verbal aggression or unplanned suicidal behaviours, which was the case in her first suicide attempt. Dealing with the ASC-related difficulties and camouflaging them result in a high level of fatigue. This interferes with her ability to regulate her emotions effectively (e.g., *«Compensating for sensory overload, camouflaging, social interactions and, also, managing my emotions... it is exhausting! »*). Camouflaging in particular is described as extremely costly and exhausting (e.g., *«I do it deliberately to modify my behaviour [...] it is there all the time and it is exhausting»*). Her responsibilities as a mother also add to the daily fatigue, as she needs to attend to the constantly changing needs of her child. Highlighting the ASC-related difficulties and adding them to the biosocial model allowed to specifically target them, especially in individual sessions. Indeed, as highlighted in a first-person account of an autistic person who benefitted from DBT ([Keenan et al., 2023](#)), DBT therapists need to consider the specific needs and motivational factors of autistic clients to increase the pertinence of DBT. Here, this means to be aware of ASC-related features that are likely to contribute to ED, integrate them in the biosocial model, as well as in the targets and goals of the therapy. In addition, therapists' destigmatizing attitudes toward ASC draw upon this conceptualization, as it aids to validate the

difficulty to cope with these challenges on a daily basis (e.g., adapt to a non-autistic world), to teach to self-validate instead of self-stigmatize and camouflage, to provide targeted psychoeducation (e.g. on autistic camouflaging and its impact on mental health), to help identify and label emotions, but also problem-solve (e.g. in relation to sensory triggers).

History of invalidation and adverse events

Mrs. F.'s parents were both alcoholics. She reports feeling abandoned in her childhood, unable to rely on her parents. She cared for her father and felt responsible for her younger sister. During her childhood and adolescence, she witnessed repeated scenes of physical violence perpetrated by her father on her mother, and, at times, by her sister on her mother. Some of these scenes were traumatic. Emotional abuse was frequent, as Mrs. F.'s mother repeatedly told her «no one will love you, you'll end up alone» or «go look in the mirror how ugly you are» while Mrs. F. was crying. She was an excellent student throughout her school years. In response to her high grades, her mother used to say «*you could have done better*». Mrs. F. reports that her mother did not care for her even when she was sick, always prioritizing work. Mrs. F. also reports that her sister was physically and verbally violent towards her, hitting and insulting her. Her mother's invalidation (e.g., punitive and minimizing behaviours) towards her continued into adulthood. As an adult, Mrs. F. and her mother did not talk for 3-years following a conflictual interaction. Although no one else in her family is known to have an ASC diagnosis, Mrs. F. thinks that her mother might be autistic. She explains that her father was the only person she felt understood by. He expressed pride and love for her and encouraged her in her studies. Her father attempted suicide after she left home to live abroad. Before her departure, he told her that he would attempt suicide if she left. Mrs. F. reports that she still feels guilty over her father's suicide attempt.

Mrs. F.'s parents exhibited dysregulated behaviours (alcoholism, physical and verbal violence, and suicide attempts) indicative of a great psychological distress and major difficulties

to regulate their emotions. Thus, Mrs. F.'s parents were not able to provide her with the necessary emotion regulation scaffolding and modelling. On the contrary, their own difficulties were a source of recurrent invalidation and trauma. In addition to the trauma related to events in her family, Mrs. F. was a victim of rape as a young adult, and subsequently developed a PTSD related to this event.

At school, Mrs. F. reported feeling isolated. Nevertheless, she reported that school was “a safe haven” because it was a structured environment, where she found intellectual fulfilment, and support from the teachers. In middle school, she was the target of bullying from peers. She had difficulty integrating groups of friends (e.g., *«I didn't have the codes of how things were done»*) and felt rejected.

In later years, Mrs. F. also experienced high levels of invalidation regarding her ASC diagnosis, both from her family and her husband, e.g., *«you're just lazy»*. The lack of understanding towards her ASC also causes her anger and sadness.

The psychosocial factors highlighted here were key to better understand Mrs. F.'s developmental environment, as well as its potential effects on ED and on her overall mental health. In particular, they helped to identify predisposing factors that seem to have contributed to self-invalidating behaviours (i.e., a secondary target in DBT involved in ED; [Linehan, 1993](#)) and, more broadly, to ED – for example, repetitive punitive invalidations and lack of scaffolding and modelling of effective emotion regulation from her parents. Given the transaction between the invalidating environment and her emotionally vulnerable temperament, including her ASC-related difficulties, it is understandable that she felt and reacted the way she did. This knowledge, inherent to the dialectical perspective of the biosocial model (Linehan, 1993), is crucial for the therapist to validate the client and to teach her to self-validate. In addition, this allowed the therapist to qualify some of the events of her life as traumatic and invalidating, to provide psychoeducation on the possible link between these events (e.g., parents' dysregulated

behaviours, lack of emotional scaffolding) and current emotional difficulties (in transaction with biological factors), including suicidal behaviour. According to the DBT framework and conceptualization (Linehan, 1993), Mrs. F. was in stage 1 of DBT, that is, she presented with behavioural dyscontrol (e.g., life-threatening behaviours). It is only in stage 2, once dysregulated behaviours are no longer present, that PTSD and the sequelae of traumatic and invalidating experiences may be directly targeted.

Table 1. *Mrs. F.'s scores on scales measuring the components of Linehan's model applied to ED in ASC.*

Scale	Assessed dimension	Mrs. F.'s score	Reference value*	Maximum score
Autism Spectrum Quotient (AQ; Baron-Cohen et al. 2001)	Autistic traits	44 ^a	32	50
Beck Anxiety Inventory (BAI; Beck et al., 1988)	Anxiety	33 ^a	30	63
Beck Depression Inventory-Second Edition (BDI-II; Beck et al., 1996)	Depression	44 ^a	29	63
Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004)	Emotion dysregulation	124 ^a	96	175
Beck Scale for Suicide Ideation (BSS; Beck et al., 1988)	Suicide ideation	27 ^a	26	38
Eight-item General Alexithymia Factor Score (GAFS-8; Williams & Gotham, 2021)	Alexithymia	51	60	40
Camouflaging of Autistic Traits Questionnaire (CAT-Q ; Hull et al., 2019)	Autistic camouflaging	108 ^a	100	175
Sensory Processing Sensitivity Questionnaire - Sensory Sensitivity Subscale (SPSQ ; De Gucht et al., 2022)	Sensory sensitivities	7.75 ^a	5.2	10
Emotional Vulnerability-Child Scale (EV-Child ; Sauer & Baer, 2010)	Emotional vulnerability in childhood	119 ^a	62	132

The Childhood Trauma Questionnaire— Short Form (CTQ-SF ; Bernstein et al., 2003)	Childhood trauma			
	Emotional abuse	20 ^a	13	25
	Physical abuse	5	10	25
	Sexual abuse	5	8	25
	Emotional neglect	17 ^a	15	25
	Physical neglect	12 ^a	10	25

Note. **AQ**: clinical cut-off (Baron-Cohen et al., 2001); **BAI**: cut-off for severe anxiety (Beck et al., 1988); **BDI**: cut-off for severe depression (Beck et al., 1996); **DERS**: cut-off for severe ED suggested by Neacsiu et al. (2014); **BSS**: cut-off used by van Spijker et al., (2014); **GAFS-8**: cut-off for high to very high alexithymia in a sample from the general population (Williams & Gotham; 2021); **CAT-Q**: cut-off used by Cook et al., (2021); **SPSQ**: mean score in a sample of women from the general population (Malinakova et al., 2021); **EV-Child**: mean score in a sample of female students (Sauer & Baer; 2010); **CTQ-SF**: cut-off scores for moderate to severe from Bernstein and Fink (1998).

^a score above the reference value.

Emotional vulnerability

a) Biological vulnerability to ED

- **Hypersensitivity:** a wide range of daily events may lead to distress (unexpected events, sensory triggers, etc.) since young age.
- **Hyperreactivity:** extreme emotions since young age.
«It [the emotion] feels like a geyser»
- **Long-lasting difficult emotions:** persistent emotional experience to which intense ruminations contribute since young age.
«It [the emotion] stays there for a long time, stagnant»
«It goes round and round in my head»

b) Challenges related to ASC core features

- **Low flexibility:** intense stress caused by change.
- **Low social abilities:** lack of understanding of social cues.
- **Alexithymia:** difficulty identifying and describing bodily experiences, as well as understanding the cause of physical pain.
- **Sensory sensitivities:** auditory (noises), visual (neon lights) and olfactory (perfume) hypersensitivities causing overwhelming experiences.
«It is an invasion [...] it can cause extreme discomfort»
- **Fatigability:** dealing with the ASC-related difficulties results in a high level of fatigue interfering with effective emotion regulation.
«Compensating for sensory overload, camouflaging, social interactions and, also, managing my emotions is exhausting! »
- **Impulsivity:** suicidal behaviours and verbal aggression when emotionally activated.

Environnement

a) Early adverse experiences and invalidation

• **Invalidation**

In childhood

- Neglectful parents (felt abandoned, responsible of herself, her sister and her father)
- Chronic invalidation by the mother (minimization of emotions, punishment of school performance, hurtful remarks about her body)
e.g., «no one will love you, you'll end up alone», «go look in the mirror how ugly you are» while Mrs. F. was crying
- Left alone by her mother when sick
- Physical and verbal abuse by the sister (beating and insults)
- Peers' rejection in elementary and middle school (not wanting to be her friend) but no bullying *per se*

In adulthood

- Invalidation from her mother and husband (including about her ASC)
e.g., «you're just lazy»
- **Camouflaging:** frequent camouflaging of autistic traits, especially at work
«I do it deliberately to modify my behaviour [...] it do it all the time. It is exhausting»
- **Traumatic events** (e.g. Scenes of her father hitting her mother, father's suicide attempt following her departure abroad, rape in adulthood)

b) Lack of parental scaffolding and modeling

- No scaffolding or modeling for effective emotion regulation by the parents
- Parents themselves in distress and exhibiting dysregulated behaviours (alcoholism, suicide attempt, physical and verbal violence)

Emotion dysregulation

- a) **Dysfunctional behaviours interfering with her goals** (outbursts, verbal aggression)
- b) **Suicide ideation and attempts**

Figure 2. Case conceptualization of Mrs. F. based on our application of Linehan's model to ASC.

Discussion

This article aimed at applying and extending Linehan’s biosocial model (Linehan, 1993) to ED in autistic adults. This is of particular interest as ED is prevalent in this population (Swain et al., 2015; Morie et al., 2019) and seems to be involved in the high rates of self-harm and suicidality (Conner et al., 2020; Moseley et al., 2019). Consequently, DBT is an emerging topic in the field of interventions targeting ED in ASC, with promising preliminary results (Bemmouna et al., 2021; Ritschel et al., 2022). However, no studies so far had focused on the utility of Linehan’s biosocial model, which underlies DBT for BPD, in ASC.

Our review and application to the case of an autistic woman suggest that ED in ASC encompasses factors related to both biological and psychosocial risk factors as conceptualized in the BPD framework, although in both domains ASC-specific factors might be involved. Indeed, in addition to the biological vulnerability similar to BPD (i.e. hypersensitivity, hyperreactivity and slow return to emotional baseline) (White et al., 2014), ToM peculiarities, sensory sensitivities, lack of cognitive flexibility, change-related anxiety and repetitive behaviours have been associated with ED in ASC (Mazefsky & White, 2014; Samson et al., 2014). Alexithymia, prevalent in ASC, has also been reported to be linked to ED in autistic adults (Moseley et al., 2019), especially in autistic women (Weiner et al., 2023). It is worth noting that ASC-related difficulties may interfere directly with the ability to self-regulate (Cai et al., 2018; Mazefsky & White, 2014; Samson et al., 2014) but also contribute to high levels of anxiety and fatigue making emotion regulation costly for autistic people (Normansell-Mossa et al., 2021; Samson et al., 2014; Mazefsky & White, 2014). Such is the case for Mrs. F., whose autistic features (e.g. sensory hypersensitivity, hypervigilance regarding social rules and how to behave in social situations) are both involved in her emotional vulnerability and in the costs of real-life use of adaptive emotion regulation skills. We note, however, that people with BPD might present with autistic-like features, including sensory hypersensitivities (Brown et al.,

2009) and ToM peculiarities (Vegni et al., 2021). Therefore, our findings support the application and extension of Linehan's model to ASC, but it also highlights under-researched topics in BPD. Indeed, it is likely, for example, that sensory particularities may also play a role in ED in people with BPD, as this has been shown to be the case in the general population (Brindle et al., 2015).

Regarding psychosocial risk factors, our review suggests that, similar to BPD and other psychological conditions (Crowell et al., 2009; Rüfenacht et al., 2021; Guérin-Marion et al., 2020), invalidating experiences seem to contribute to the emergence of ED also in autistic people. In fact, findings report that autistic children are highly exposed to different early stressful and traumatic experiences (e.g. physical and emotional maltreatment from caregivers and school bullying), especially because of their atypical functioning that cause misunderstanding and rejection from others (Warrier & Baron-Cohen, 2021; Hellström, 2019; Fuld, 2018; Kerns et al., 2015). Autistic girls seem to be particularly vulnerable to experience these adverse events (Fisher et al., 2019; Bargiela et al., 2016). Importantly, adverse experiences have been associated with co-occurring psychopathology and/or the worsening of difficulties related to ASC in childhood (Taylor & Gotham 2016; Mehtar & Mukaddes; 2011). As in BPD, these experiences have been associated with self-harming behaviours with or without suicidal intent in autistic children (McDonnell et al., 2019; Mandell et al., 2005), particularly in those who have been sexually abused (Mandell et al., 2005). In adulthood, these experiences have been associated with numerous co-occurring disorders such as mood and anxiety disorders, PTSD (Fuld, 2018), and BPD (Ball & Links, 2009; MacIntosh et al., 2015).

Beyond the impact of adverse experiences, given the potential transactional link between biological and environmental factors of ED in ASC, it is likely that the specific needs of the autistic child might differ from those of the child at risk to develop BPD. For instance, autistic children might need increased scaffolding and modeling to learn effective emotion

regulation skills than children who will develop BPD (Fenning et al., 2018; Fluja-Contreras et al., 2022). The necessary adjustments of the caregivers (e.g., teachers, parents) can be promoted by an early diagnosis of ASC (Elder et al., 2017) and enhancing the parents' emotion regulation skills (Fluja-Contreras et al., 2022).

In addition, our review and extension of the biosocial model to ASC includes excessive autistic camouflaging as a form of self-invalidation resulting from internalized invalidation from others (McQuaid et al., 2022). In addition to being costly, the self-invalidation associated with autistic camouflaging might be detrimental to the development of adaptive emotion regulation skills as well as to the sense of self and self-acceptance in autistic people (Perry et al., 2022; Bernardin et al., 2021). Importantly, recent studies found a strong negative association between autistic camouflaging and lifetime suicidality in autistic adults, especially autistic women (Cassidy et al., 2020; Beck et al., 2020; Lai et al., 2017). The latter finding can be explained by several factors. Indeed, autistic women, especially those without intellectual disability, are diagnosed later than men (Gesi et al., 2021). Relatedly, greater expectations for adolescent and adult autistic women to engage in adaptive social behaviour are more prominent (Hull et al., 2020). This may, in turn, be involved in the enhanced use of compensatory behaviour to mitigate social challenges and mask autistic traits in autistic females, i.e., camouflaging (Lai et al., 2017; McQuaid et al., 2022). Therefore, if autistic women, especially those who are undiagnosed, are more likely to mask their mindreading and overall social difficulties, this may promote their social inclusion (Halsall et al., 2021). However, they probably lack the social skills that might make them less vulnerable to societal invalidation towards women in general, including sexual violence (Pecora et al., 2019; Cazalis et al., 2022; Ohlsson Gotby et al., 2018). Mrs. F.'s case illustrates the impact of late diagnosis (at the age of 35) and the resulting autistic camouflaging to "try to fit in" since childhood. We speculate that an early diagnosis could be beneficial in several ways. For example, it could foster the

understanding of one's own functioning, prevent self-invalidation and enhance self-acceptance in autistic people. In autistic women, earlier diagnosis could also be of preventive value in relation to sexual violence, enabling access to targeted sexual education and assertiveness programs (Pecora et al., 2020).

Moreover, regarding the overlap in biosocial correlates of ED between ASC and BPD, it appears crucial to expand our knowledge of ED and its mechanisms in both diagnoses. Thus, we suggest considering the following points of potential differentiation in future studies. First, people with BPD might present with autistic-like features, such as sensory hypersensitivities (Brown et al., 2009) and ToM peculiarities (Vegni et al., 2021). Thus, comparative studies are needed to investigate the extent to which the ASC-related factors specifically contribute to ED in ASC relative to disorders with ASC-like features such as BPD. We also suggest to further investigate how these factors may interact with each other and contribute to ED. For instance, recent findings suggest an association between high sensory sensitivity (i.e., low sensory threshold and ease of excitation) and alexithymia in non-autistic young adults, with this interaction affecting emotion processing and regulation (Jakobson & Rigby, 2021). Second, ED in BPD is significantly involved in interpersonal problems (e.g. conflicts, physical/verbal violence) due to mood swings and chronic fear of abandonment (Biskin, 2015; APA, 2013). In ASC, relationships are not likely to be affected in the “stormy” way found in BPD, as social difficulties are rather related to poor social abilities that makes it difficult to bond with others (Kwan et al., 2020). It seems therefore relevant to investigate the impact of ED on relationships in both BPD and ASC to potentially highlight distinctions in ED between the two diagnoses. Third, in BPD, ED is strongly linked to affective instability in interpersonal contexts (Schmidt, 2022). In ASC, by contrast, ED seems to arise from the interaction between ASC traits and contextual factors (e.g., invasive sensory stimuli, changes in the environment/planning) (Mazefsky et al. 2013; Samson et al., 2014). Thus, it seems relevant to further investigate

whether and how ED might be more related to widespread context cues in ASC compared to BPD. Fourth, to date, evidence supports the role of emotional vulnerability and invalidation separately in the development of ED in ASC. Thus, the transaction between the two is yet to be empirically tested in ASC. Fifth, previous findings have reported differences in the development of personality styles between ASC and BPD ([Strunz et al., 2015](#)). Hence, it seems relevant to explore whether and how the factors inherent to the development of personality in BPD contribute to ED relative to ASC ([van Dijke & Ford, 2015](#)).

Finally, we acknowledge that the paucity of data on ED and its mechanisms in ASC might have limited the potential determinants of our application of Linehan's model. Nevertheless, given the increasing awareness of the impact of ED on autistic adults' mental health, our application has the advantage of providing a pragmatic model that can inform the delivery of psychological treatments for this population. Additionally, our application of the model to ASC may foster new and much needed research on the biosocial mechanisms of ED in ASC. For instance, as a growing body of research has shown that autistic women are at greater risk for severe ED ([Wieckowski et al., 2020](#)) and suicidality than men ([Hirvikoski et al., 2016](#)). Hence, it seems crucial to consider this discrepancy in future studies by systematically exploring cross-gender (including non-binary, transgender and gender non-conforming) differences in the implication of the determinants of ED in ASC. Moreover, our application might provide clinicians with a comprehensive framework of ED in ASC, enhancing the systematic assessment of traumatic and invalidating experiences in autistic clients. The latter include different layers of invalidation, which might be related to intersectional factors (e.g., gender) involved in family invalidation, peer invalidation but also societal discrimination leading to self-stigma and self-invalidation ([Cazalis et al., 2022](#)). Finally, our application of the model may inform psychological treatments targeting ED, especially DBT-based interventions ([Linehan, 1993](#)), with specific adaptations that might increase their effectiveness ([Keenan et](#)

[al., 2023](#)). For example, increased scaffolding and modelling from the therapist and the use of a psychoeducational biosocial model that integrates the ASC specificities might be particularly valuable to this aim.

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AXIS 1 – Study 2

The biosocial correlates and predictors of emotion dysregulation in autistic adults compared to borderline personality disorder and nonclinical controls

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Abstract

Background: Emotion dysregulation (ED) is a core symptom of borderline personality disorder (BPD), whose aetiology has been attributed to biosocial factors. In autism spectrum disorder (ASD), although ED is prevalent and is associated with decreased well-being (e.g., self-harm, suicidality), it has been understudied, especially in adults. It is therefore crucial to further understand ED in autistic adults to improve its treatment. Our study investigates ED, its behavioural correlates (e.g., self-harm, suicidality) and biosocial predictors in autistic adults relative to BPD and nonclinical controls (NC).

Methods: 724 participants (ASD = 154; BPD = 111; NC = 459) completed 11 self-reported questionnaires assessing ED, ASD and BPD traits, co-occurring disorders, alexithymia, emotional vulnerability and invalidating experiences (e.g., bullying, autistic camouflaging). The occurrence of ED behavioural correlates (i.e., self-harm, history of suicide attempts, and psychiatric hospitalizations) was collected. In addition, between-groups analyses, linear regressions and machine learning models (ML) were used to identify ED predictors in each group.

Results: ED and its behavioural correlates were higher in ASD compared to NC, but milder than in BPD. While gender did not predict ED scores, autistic women had increased risk factors to ED, including sexual abuse and camouflaging. Interestingly, BPD traits, emotional vulnerability, and alexithymia strongly predicted ED scores across the groups. Using ML models, sensory sensitivity and autistic camouflaging were associated with ED in ASD, and ADHD symptoms with ED in BPD.

Limitations: ASD and BPD diagnoses were self-reported, which did not allow us to check their accuracy. Additionally, we did not explore the transactional and the moderating/mediating relationships between the different variables. Moreover, our research is

cross-sectional and cannot draw conclusions regarding the direction and causality of relationships between ED and other clinical dimensions.

Conclusions: ED and its behavioural correlates are heightened in BPD compared to ASD and nonclinical controls. In the ASD group, there were no gender differences in ED, despite the heightened exposure of autistic women to ED risk factors. BPD traits, emotional vulnerability, and alexithymia are core to ED regardless of diagnosis. Although less central, sensory sensitivity and autistic camouflaging seem to be specific predictors of ED in autistic adults.

Keywords: Autism spectrum disorder, Borderline personality disorder, Emotion dysregulation, Non-suicidal self-injury, Suicidality, biosocial, Aetiology.

Background

Emotion dysregulation (ED) is defined as patterns of emotional experience or expression that interfere with goal-directed behaviour [1]. ED is recognized as a core etiological and maintenance mechanism of borderline personality disorder (BPD) [2,3]. Recently, ED has been found to be a key transdiagnostic mechanism of psychopathology involved in the development and maintenance of several psychiatric disorders, such as depression, eating disorders and complex post-traumatic stress disorder (cPTSD) [4,5,6,7,8]. Interestingly, in recent years, ED has also become a central area of research in autism spectrum disorder (ASD) [9,10]. Indeed, findings support that ED is more prevalent in autistic people compared to the general population [9,10,11,12]. Of particular importance, recent findings have reported a high prevalence of self-harm [13,14,15] and suicidality in ASD [16,17,18], particularly in autistic adults without intellectual disability presenting with high levels of ED [19,20,21]. Indeed, similar to findings in BPD and in the general population [14, 22], ED has been associated with self-harm with or without suicidal intent in ASD [19,21]. Interestingly, akin to BPD [22], self-harm and suicidal behaviours have also been found to be strongly linked in ASD [14,23]. This suggests that ED is a risk factor for suicidality and self-harm in ASD, and that autistic people may develop capability for suicide through self-harm [14,23]. Autistic women in particular have been reported to be at greater risk of developing severe ED compared to autistic men [24,25,26], which suggests that gender-related factors might be involved in ED in ASD [27].

Few studies have focused on interventions targeting ED in autistic adults. Pharmacological treatments have shown limited effectiveness in this context [28]. Therefore, there is a critical need to develop psychological interventions targeting ED in autistic people given the multitude of downstream effects on adaptive functioning and quality of life [29]. Interventions based on cognitive behavioural therapy (CBT) have shown encouraging outcomes [30]. This is particularly the case for dialectical behaviour therapy (DBT) [31,32],

the most studied treatment targeting ED in BPD [33,22]. Recently, DBT has proved to be feasible and acceptable in autistic adults without intellectual disability, as well as potentially effective to reduce ED in the presence of self-harm and suicidal behaviours [31,32].

Linehan's biosocial theory, which underlies DBT, conceptualizes that biological and environmental factors in childhood are involved in the emergence of ED in BPD [33]. According to this theory, ED emerges from an interaction between: (a) emotional vulnerability that stems from biological factors impacting the functioning of brain areas (e.g., prefrontal regions and amygdala) involved in emotional processing, and (b) an invalidating environment that refers to chronic and inadequate responses of the environment to the emotional needs of the child (i.e., neglect, minimization or punishment, including physical and sexual abuse) [22,33]. Temperamental impulsivity has been subsequently added to the model as an additional risk factor for BPD [22,34]. According to Linehan, invalidation early in life maintains and may exacerbate the pre-existing biological vulnerability in the child [33]. It also shapes maladaptive coping responses, such as using self-harm with or without suicidal intent when experiencing emotional pain [22,35]. Most empirical findings support the relevance of Linehan's model to conceptualize ED in BPD [e.g., 36,37,38,39,40].

Although DBT has been adapted to and studied in clinical conditions other than BPD [e.g., 41,42,43], few studies have focused on the pertinence of Linehan's biosocial model to conceptualize ED beyond BPD. Nevertheless, there are findings that support the implication of emotional vulnerability [44], including temperamental impulsivity [45], and invalidation (e.g., childhood maltreatment) [46,47,48] in the development of ED across psychopathology.

In ASD, studies investigating the factors involved in the emergence of ED have mainly focused on ASD-related particularities (e.g., social cognition peculiarities, sensory sensitivity, cognitive inflexibility) [9,49] and the role played by co-occurring disorders (e.g., anxiety, depression) [11,20,50,51,52]. Thus, to our knowledge, there is a lack of comprehensive models

which integrate biological and psychosocial factors potentially involved in the emergence of ED in ASD [e.g., 21,53,54,55].

Based on the existing literature, including Mazefsky and White’s model for ED in autistic youth [49], we recently proposed an application of Linehan’s biosocial model to ED in ASD [56] to provide a comprehensive conceptualization of the biosocial factors (i.e., emotional vulnerability and invalidating environment) involved in the emergence of ED in ASD. More specifically, we considered the interplay between ASD traits and both emotional vulnerability and the experience of invalidation. Indeed, in addition to the biological vulnerability similar to that found in BPD (i.e., hypersensitivity, hyperreactivity and slow return to emotional baseline) [57], ToM peculiarities, sensory sensitivity, lack of cognitive flexibility, change-related anxiety and repetitive behaviours have been associated with ED in ASD [49,11]. Alexithymia, prevalent in ASD, has also been reported to be linked to ED in autistic adults [20], especially in autistic women [27]. Moreover, ASD-related difficulties seem to interfere directly with the ability to self-regulate [10,11,49], but also contribute to high levels of anxiety and fatigue making emotion regulation costly for autistic people [11,49,58]. In terms of invalidating experiences, autistic children are highly exposed to different early stressful and traumatic experiences (e.g., physical and emotional maltreatment from caregivers and school bullying), because of their atypical functioning that cause misunderstanding and rejection from others [59,60,61]. Autistic girls seem to be particularly vulnerable to the experience of adverse events [62,63]. Among other environmental factors potentially involved in the emergence of ED, lack of parental scaffolding and modeling (i.e., support provided by the parent to help the child regulate their emotions) have been pinpointed as risk factors for dysregulated behaviours in autistic youth [64,65]. Additionally, recent studies have reported that autistic camouflaging, i.e., behaviours and/or strategies used to appear “less autistic”, is associated with lifetime suicidality, especially in autistic women [66,67,68]. Given this, our extension of the biosocial model to ASD includes

excessive autistic camouflaging as a form of self-invalidation resulting from internalized invalidation from others [69].

The application of Linehan’s model to ASD requires an empirical test of its validity as well as an assessment of its specificity to ED in ASD, particularly in comparison with BPD. The latter point is crucial given that ED is highly associated with BPD [70] and that individuals with BPD may exhibit ASD-like traits that may lead to misdiagnosis with ASD [71]. For instance, some studies found that individuals with BPD might also have sensory sensitivity and social cognition peculiarities [72,73]. Despite the overlap between ASD and BPD, studies comparing ED and its etiological factors in ASD and BPD are lacking.

The aim of the current study is to evaluate the relevance and the specificity of factors involved in Linehan’s model applied to ED in ASD [56]. To do so, autistic adults without intellectual disability (ASD group), adults with BPD (BPD group), and adults without any known diagnoses (nonclinical controls group; NC group) completed a battery of self-report scales measuring the model’s components and indicated the occurrences of the ED behavioural correlates (i.e., hospitalizations, self-harm and suicidal behaviours). We did not assess parental scaffolding as relevant measures are observational in the context of child-parent interaction [64,74]. Specifically, we were interested in the characteristics of ED and its behavioural correlates in each clinical group. Given that ED is a core feature of BPD and that self-harm and suicidal behaviours are strongly associated with BPD [2,3,22], we hypothesized that ED and its behavioural correlates would be higher in the BPD group compared to the ASD group, whereas both clinical groups would have heightened ED scores compared to the NC group (**H1**). In addition, since self-harm has been associated with ED in BPD [22] and ASD [14,20], we expected to find an association between self-harm and suicidal behaviours in both groups (**H2**). We also expected ED to be a predictor of the presence of self-harm and/or suicidal behaviours in both clinical groups (**H3**). Moreover, we hypothesized that ED would be heightened in the

BPD group compared to the ASD group, whereas both clinical groups would have higher ED scores compared to the NC group (**H4**). Additionally, in the autistic group only, we expected to observe gender differences, with autistic women presenting with higher ED than autistic men (**H5**) [27]. Regarding ED predictors, we hypothesized that emotional vulnerability, impulsivity and invalidation – which are direct measures of the biosocial model – would predict ED in both clinical groups, but ASD-related factors would be specific predictors of ED in the ASD group compared to the BPD group (**H6**). To assess the specific load of ED predictors, machine learning (ML) models were used, and we expected emotional vulnerability and invalidation to emerge among the largest contributors of ED in both clinical groups, while ASD-related factors were expected to rank among the largest ED predictors for the ASD group only (**H7**).

Methods

Participants' recruitment and study sample

This cross-sectional study was conducted online from January 2, 2023, to April 26, 2023. Data were collected anonymously through LimeSurvey using a 45-minute battery of standardized scales. The call for participants was advertised by different means: emails, leaflets distribution, poster display in mental health institutions, posts on social networks (Facebook, LinkedIn and Discord), targeting various communities: mental health professionals (psychologists and psychiatrists) in institutions or in private practice, researchers in the field of adult ASD and/or BPD, associations in the field of adult ASD or BPD, student communities, and people from the general population more broadly. The call for participants was advertised mainly in France.

The inclusion criteria were : being aged ≥ 18 years old and being fluent in French. For the ASD and BPD groups, having received a formal diagnosis by a physician was required. The co-occurrence of ASD and BPD was an exclusion criterion. For the no-diagnosis group (NC),

participants were required to have no self-reported psychiatric or neurodevelopmental diagnosis.

The sample size has been estimated using G*Power 3.1.9.7 [75] for the three groups comparison on an effect size of $f = 0.25$, a power of 80%, assuming $\alpha = 0.05$. Consequently, a minimum target sample was set at $N = 125$.

Measures

Emotion dysregulation

Difficulties in Emotion Regulation Scale-16 (DERS-16) [76]. The DERS-16 is a brief form of the 36-item DERS [77]. The DERS-16 is a self-report scale measuring emotion regulation difficulties. It consists of 16 items grouped into 5 dimensions: (a) lack of emotional clarity (Clarity), (b) difficulty engaging in goal-directed behaviour when distressed (Goals), (c) impulse control difficulties when distressed (Impulse), (d) limited access to strategies for regulation (Strategies), and (e) non-acceptance of emotional responses (Non-acceptance). Items are rated on a 5-point Likert scale (1= “almost never” to 5= “almost always”). Higher scores reflect greater emotion regulation difficulties. There is no validated French version of the DERS-16. However, we took the corresponding 16 items from the French-validated 36-item version by Dan-Glauser & Scherer [78]. The scale showed adequate internal consistency (Cronbach's $\alpha = .92$) among a college sample [76]. In the present study, the internal consistency for the total DERS-16 was overall excellent for the total scale (Cronbach's $\alpha = .95$) and for the subscales (Cronbach's α between .82 and .95).

ASD and BPD traits importance

Autism Spectrum Quotient Short Version (AQ-Short) [79]. The AQ-Short is a brief version of the AQ-50 [80]. The AQ-Short is a self-report scale composed of 28 items that assess core autistic traits in adults. The scale comprises 4 subscales: (a) social skills, (b) routine, (c) attention switching, and (d) imagination. Items are rated on a 4-point Likert scale (1= “definitely

agree” to 4= “definitely disagree”). Higher scores indicate higher level of autistic traits. There is no validated French version of the AQ-Short. However, we took the 28 corresponding items from the complete French version validated by Lepage et al. [81]. The AQ-Short total score internal consistency has been reported to be good (Cronbach’s α between .77 and .86) [79]. In the present study, the AQ-Short internal consistency was very good (Cronbach’s α = .87).

Short form of the Borderline Symptom List (BSL-23) [82], French validation by Nicastro et al. [83]. BSL-23 is a short version of the BSL-95 [84]. BSL-23 is a self-report scale constituted of 23 items assesses the severity of BPD symptoms and behaviour. Each item is answered on a 5-point Likert scale (0= “not at all” to 4= 1 “very strong”): 0-1 point refers to no BPD symptoms, 2-23 points to mild, 24-69 points to moderate, and 70-92 points to severe BPD symptoms. The BSL-23 internal consistency is excellent (Cronbach’s α = .94) [82]. In the present study, the internal consistency of the BSL-23 was excellent (Cronbach’s α = .97).

Co-occurring disorders

ADHD Self-Report Scale v1.1 screener (ASRS v1.1 Screener) [85], French validation by Caci et al. [86], is a 6-item self-report measure of attention deficit hyperactivity disorder (ADHD) symptoms in adults. In this study, the ASRS v1.1 was used as a measure of inattention and impulsivity, potentially involved in the biological component of the biosocial model. Items are rated on a 5-point Likert scale (0= “never” to 4= “very often”). Respondents who endorsed at least four out of six items are considered at “elevated” risk for ADHD. The ASRS v1.1 Screener has demonstrated good psychometric properties in studies with adults (Cronbach’s α between .63 and .72) [85,87]. In the present study, the ASRS v1.1 Screener’s internal consistency was good (Cronbach’s α = .79).

Depression, Anxiety and Stress Scales (DASS-21) [88], French validation by Nahaboo [89] is a shortened version of the DASS-42 [90]. The DASS-21 is a self-report scale that assesses through 21 items the full range of core symptoms of three affective states: depression,

anxiety and stress. Items are rated on a 4-point Likert scale (0= “did not apply to me at all” to 3= “applied to me very much”). Scores are summed and multiplied by 2 to create separate seven-item subscales for each dimension. The subscales’ internal consistency ranged between excellent and good in the validation study (Depression $\alpha = .91$; Anxiety $\alpha = .84$; Stress $\alpha = .90$) [88]. In the present study, the DASS-21’s internal consistency was excellent (Depression $\alpha = .95$) and ranged from very good to excellent for the subscales (Depression $\alpha = .93$, Anxiety $\alpha = .86$, Stress $\alpha = .93$).

Emotional vulnerability

Emotional Vulnerability-Child Scale self-report (EV-Child) [91] is a self-report scale that retrospectively assesses emotional vulnerability during childhood. The scale includes items addressing Linehan’s [33] concept of slow return to emotional baseline. The scale encompasses 22 items rated on a 6-point Likert scale (1= “never” to 6= “always”). Higher scores indicate higher level of emotional vulnerability during childhood. The scale demonstrated excellent internal consistency in the validation study (Cronbach’s $\alpha = .92$). In the present study, internal consistency was excellent (Cronbach’s $\alpha = .94$).

ASD-related factors contributing to ED

Camouflaging Autistic Traits Questionnaire (CAT-Q) [92] is a 25-item, self-report questionnaire that assesses social camouflaging behaviour. Items are rated on a 7-point Likert scale (1= “Strongly disagree” to 7= “Strongly agree”). The scale contains 3 subscales: (a) Assimilation, i.e., strategies used to blend in during social situations, (b) Compensation, i.e., strategies to compensate for ASD-related communication and social difficulties, and (c) Masking, i.e., strategies to appear ‘non-autistic’ in social contexts. Higher scores indicated greater camouflaging. There is no French validation of the scale. However, we have used the scale translated and back translated by our team in an ongoing French validation study (Bureau et al., submitted). The CAT-Q has shown excellent internal consistency (Cronbach’s $\alpha = .94$).

[92]. In the current sample the internal consistency for the total scale was very good (Cronbach's $\alpha = .86$), good for the Compensation subscale (Cronbach's $\alpha = .76$), acceptable for Masking subscale (Cronbach's $\alpha = .58$) and poor for Assimilation subscale (Cronbach's $\alpha = .45$).

Sensory Processing Sensitivity Questionnaire - Sensory Sensitivity subscale (SPSQ SS) [93] is 16-item, self-report scale that measures high sensitivity to various stimuli. The tool encompasses two subscales: (a) Sensory sensitivity (SS) which assesses sensory processing sensitivity) and (b) Other sensitivity (OS) which assesses sensitivity to emotions and various life experiences. Items are rated on an 11-point Likert scale (0= “compared to others” to 10= “much more sensitive than the people around me”). Higher scores indicated greater is the sensitivity. In the current study, we only used the SS subscale. The subscale has excellent internal consistency (Cronbach's $\alpha = .89$) [93]. In the current sample the internal consistency of the SS was acceptable (Cronbach's $\alpha = .67$).

Eight-item General Alexithymia Factor Score (GAFS-8) [94] is a self-report unidimensional scale that measures alexithymia using 8 items derived from the Toronto Alexithymia Scale (TAS-20) [95]. The selection of items (TAS-20 items: 1, 2, 6, 9, 11, 12, 13, and 14) has been found to be a more robust measure of alexithymia in both autistic and non-autistic samples [94]. Items are rated on a 5-point Likert scale (1= “Strongly Disagree” to 5= “Strongly Agree”). Higher scores indicate higher level of alexithymia. As the measure is recent and has not yet been validated in French, we referred to the corresponding items in the French version of the TAS-20 [96]. In the present sample, the internal consistency of the GAFS-8 was excellent (Cronbach's $\alpha = .92$).

Invalidation and adverse experiences

Childhood Trauma Questionnaire-Short Form (CTQ-SF) [97], French validation by Paquette et al. [98], is a 28-item, self-report questionnaire designed to assess five types of maltreatment during childhood: (a) physical abuse, (b) sexual abuse, (c) emotional abuse, (d)

physical neglect, and (e) emotional neglect; with 5 items per scale (and 3 additional “minimization” items, which were not used in the present study). Each item is scored on a 5-point Likert (1= “never true” to 5= “very often true”). The total score is calculated as the sum of all items, with higher scores reflecting higher rates of childhood traumatic events. The internal reliability of the CTQ-SF is excellent for the total score (Cronbach’s $\alpha = .95$), good to excellent for four dimensions (Cronbach’s α respectively .81– .86, .84– .89, .92– .95, and .88– .91) and acceptable for physical neglect (Cronbach’s α ranging from .61– .78) [97]. In the present sample, internal consistency for the CTQ-SF total scale was very good (Cronbach’s $\alpha = .92$), very good to excellent for 4 of the subscales (Cronbach’s α r between .85 and .92) and moderate for Physical neglect (Cronbach’s $\alpha = .68$).

Assessment of Bullying Experiences (ABE) [99] is a questionnaire assessing bullying experiences including those unique of autistic and neurodivergent youth (e.g., verbal teasing about social differences) grouped in 4 subscales: (a) Verbal, (b) Physical, (c) Relational, and (d) Cyber bullying. The ABE comprises 22 items that ask parents to rate the frequency with which their child has experienced specific bullying behaviour on a 6-point Likert scale (0= “has never happened” to 5= “weekly or more”). In the current study, we used the ABE as a self-report questionnaire and were interested only in the total score. In our sample, the internal consistency of the ABE was excellent (Cronbach’s $\alpha = .94$).

Socio-demographic and clinical data

The demographic characteristics of participants collected in this study were gender (Woman/man/other), age (years), country of residency, marital status, professional status, educational status, and living situation. The clinical data collected were the neurodevelopmental and/or psychiatric diagnoses received, whether the person had current psychotropic medication or not, as well as ED severity indicators: the presence or not of self-harming behaviours in the

previous year, the presence or not of suicide ideation, history of at least a suicide attempt, and history of hospitalization in psychiatry services.

Statistical analysis

Descriptive and comparative analyses

Descriptive and comparative statistical analyses were conducted using Jamovi 2.6.23 [100]. Descriptive results were expressed in means (*M*) and standard deviations (*SD*) for continuous variables and in numbers (*n*) and percentages for ordinal variables.

To investigate whether a significant interaction exists between the groups (ASD/BPD/NC) and each severity indicator of ED, we used the chi-square test of association [101]. The same test was used to investigate the association between self-harm and suicidal behaviours.

To analyse the predictive value of the DERS-16 total score for self-harm and suicidal behaviours in the ASD and BPD groups, we performed a binomial logistic regression [102] with two categories (individuals with self-harming and/or suicidal behaviours and those without self-harming and/or suicidal behaviours).

As our data were not normally distributed, we used the Kruskal-Wallis one-way test [103], a non-parametric alternative to the one-way ANOVA, followed by the Steel-Dwass-Chritchlow-Fligner [104] post-hoc test, for pairwise comparisons to assess whether there were significant differences between groups on the scales. Epsilon squared (ϵ^2) was used to calculate the effect size [105]. $\epsilon^2 \leq 0.05$ being considered as small effect size, between 0.06-0.13 as moderate effect size, and ≥ 0.14 as large effect size [106].

Linear regression analyses

To identify ED predictors in each group (ASD/BPD/NC), we conducted linear regression analyses. The following variables were included in the model: ASD, BPD and ADHD traits (assessing impulsivity), emotional vulnerability in childhood, autistic

camouflaging, sensory processing particularities, alexithymia, childhood trauma, school bullying and gender for the autistic group (Woman/man). Only women and men were considered due to the small number of participants of other genders. The ordinary least squares (OLS) method was used to estimate the regression coefficients and determine the best-fit line that minimized the sum of squared residuals. We then extracted the model fits statistics, the estimated coefficients for each predictor, and information about the residuals that help interpret the regression analysis.

Machine learning models

To study the importance of the ED predictors, we trained a powerful ML model XGBoost [107] using each one of the three groups. We first separated the data into subsets of 80% for training, 10% for validation, and 20% for testing to prepare it for training. We then normalized the numerical attributes using standard scaling to ensure that all features contribute equally to the model's learning process.

We also encoded the categorical attributes using one-hot encoding to effectively represent them in a numerical format. To optimize the performance of the XGBoost model, we conducted hyperparameter tuning using a GridSearch [108]. This involved systematically exploring various combinations of hyperparameters and evaluating the model's performance using a suitable evaluation metric to find the optimal ones.

To assess the generalizability of the trained model, we employed cross-validation [109]. Cross-validation involves dividing the dataset into multiple subsets, or folds, and training the model on a subset while evaluating it on the remaining folds. By averaging the performance across all folds, we obtained a more robust estimate of the model's performance. Furthermore, we used SHapley Additive exPlanations (SHAP) [110] values to assess the significance of each feature in the XGBoost model. By calculating the relative contributions of each feature to the expected result, SHAP values offer a consistent measure of feature relevance. This study gives

us insights into the underlying relationships and influences within the dataset and helps understand the relative impact of features on the model's predictions.

Statistical significance was set at p -values ≤ 0.05 and the trend towards significance threshold was set at 0.08.

Results

Sample description

A total of 2151 individuals began the study and 1049 (49%) provided complete data. 724 (69%) met the inclusion criteria for one of the three groups (**Figure 1**). 154 (21%) constituted the ASD group (mean age= 32.62 ± 12.05 , range from 18 to 61, 58% women), 111 (15%) constituted the BPD group (mean age= 28.64 ± 8.97 , range from 18 to 62, 78% women) and 459 (63%) constituted the NC group (mean age= 25.92 ± 9.43 , range from 18 to 65, 75% women) (**Table 1**). Seventy-nine (11%) participants declared also having a formal diagnosis of ADHD (52 (34%) in the ASD group and 27 (24%) in the BPD group. Ninety-nine % of participants were from France. The remaining were from other French-speaking countries (2 from Belgium, 4 from Canada and 3 from Switzerland).

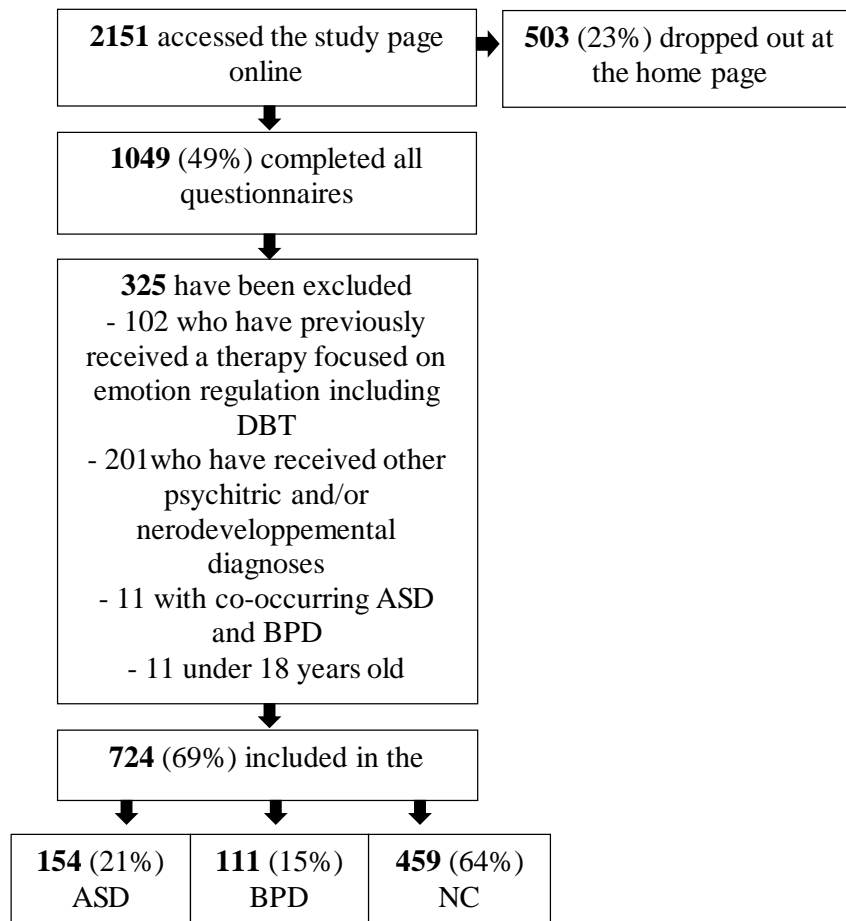


Figure 1. Study flow chart. Note: ASD=Autism spectrum disorder; BPD=Borderline personality disorder, NC= Nonclinical controls.

Table 1. *Sample description.*

		Global	ASD	BPD	NC
n (%)		724 (100%)	154 (21%)	111 (15%)	459 (63%)
Mean age (SD)		27.77 (10.32)	32.62 (12.05)	28.64 (8.97)	25.92 (9.43)
Age range		18-65	18-61	18-62	18-65
Gender n (%)					
	Woman	520 (72%)	89 (58%)	87 (78%)	344 (75%)
	Man	147 (20%)	46 (30%)	15 (14%)	86 (19%)
	Non-binary	57 (8%)	19 (12%)	9 (8%)	29 (6%)
Marital status, n (%)					
	Single	365 (50%)	83 (54%)	54 (49%)	228 (50%)
	Married / in relationship	340 (47%)	62 (40%)	53 (48%)	225 (49%)
	Divorced /widow	19 (3%)	9 (6%)	4 (4%)	6 (1%)
Professional status, n (%)					
	Professionnally active	184 (25%)	45 (29%)	39 (35%)	100 (22%)
	Student	475 (66%)	76 (49%)	50 (45%)	349 (76%)
	Unemployed	61 (8%)	33 (21%)	21 (19%)	7 (2%)
	Retired	4 (1%)	0 (0%)	1 (1%)	3 (1%)
Educational status, n (%)					
	High School degree or less	160 (22%)	37 (24%)	37 (33%)	86 (19%)
	College graduate	564 (78%)	117 (76%)	74 (67%)	373 (81%)
Living situation, n (%)					
	Alone	252 (35%)	56 (36%)	45 (41%)	151 (39%)
	Alone with children	20 (3%)	6 (4%)	6 (5%)	8 (2%)
	With parents	169 (23%)	33 (21%)	23 (21%)	113 (29%)
	Flatsharing	89 (12%)	15 (10%)	7 (6%)	67 (17%)
	With partner with or without children	194 (27%)	44 (29%)	30 (27%)	49 (13%)
With other psychiatric and/or developmental diagnoses, n (%)		205 (28%)	109 (71%)	96 (86%)	0 (0%)
	ADHD	79 (11%)	52 (34%)	27 (24%)	0 (0%)
Current psychotropic medication, n (%)		172 (24%)	63 (41%)	79 (71%)	30 (7%)

ED severity indicators

The BPD group had the highest occurrence of all ED severity indicators (**Table 2**). Indeed, the prevalence of self-harming behaviours (over the year prior to their participation in the study) in the BPD group was 82% compared to 51% in the ASD group and 35% in the NC group, with these differences being significant ($X^2 p_{\text{BPD-ASD}} < 0.001$, $X^2 p_{\text{BPD-NC}} < 0.001$); the lifetime occurrence of suicide attempts in the BPD group (77%) was significantly higher than in the ASD group (39%) and the NC group (12%) ($X^2 p_{\text{BPD-ASD}} < 0.001$, $X^2 p_{\text{BPD-NC}} < 0.001$); the suicide ideation occurrence was also higher in the BPD group (91%) compared to the ASD

group (55%) and the NC group (36%) ($X^2 p_{\text{BPD-ASD}} < 0.001$, $X^2 p_{\text{BPD-NC}} < 0.001$); and the history of hospitalization in psychiatric services was more frequent in the BPD group (64%) than in the ASD group (22%) and the NC group (3%) ($X^2 p_{\text{BPD-ASD}} < 0.001$, $X^2 p_{\text{BPD-NC}} < 0.001$). The ASD group had a higher occurrence of all the ED severity indicators compared to the NC group ($p_{\text{ASD-NC}} < 0.001$ for all indicators).

Table 2. ED severity indicators occurrence in each group and chi-square comparison of participant's distribution between each pair of groups.

	ASD n=154	BPD n=111	NC n=459	ASD vs. BPD		ASD vs. NC		BPD vs. NC	
				χ^2	p-value	χ^2	p-value	χ^2	p-value
Self-harm, n (%)	79 (51%)	91 (82%)	160 (35%)	26.4	<0.001***	13.1	<0.001***	80.5	<0.001***
History of suicide attempts, n (%)	60 (39%)	86 (77%)	54 (12%)	38.7	<0.001***	56.3	<0.001***	208	<0.001***
Self-harm + suicide attempts, n (%)	39 (25%)	75 (68%)	33 (7%)	47	<0.001***	36.6	<0.001***	212	<0.001***
Suicidal ideation, n (%)	85 (55%)	101 (91%)	163 (36%)	39.5	<0.001***	18.5	<0.001***	111	<0.001***
History of hospitalization in psychiatry services, n (%)	34 (22%)	71 (64%)	14 (3%)	47.3	<0.001***	57.8	<0.001***	261	<0.001***

*** $p < 0.001$

In addition, a significant association between self-harming behaviours and suicidal behaviours was found in the three groups ($X^2 p_{\text{BPD}} = 0.008$; $X^2 p_{\text{ASD}} = 0.007$; $X^2 p_{\text{NC}} < 0.001$) (Table 3).

Table 3. Chi-square test of association between self-harm and suicidal behaviours in the sample and in each group.

	Global n=724		ASD n=154		BPD n=111		NC n=459	
	Suicide attempts	No suicide attempts	Suicide attempts	No suicide attempts	Suicide attempts	No suicide attempts	Suicide attempts	No suicide attempts
Self-harm	147 (20%)	183 (25%)	39 (25%)	40 (26%)	75 (68%)	16 (14%)	33 (7%)	127 (28%)
No self-harm	53 (7%)	341 (47%)	21 (14%)	54 (35%)	11 (10%)	9 (8%)	21 (5%)	278 (61%)
χ^2	86.8		7.39		7.06		18.6	
p-value	<0.001***		0.007**		0.008**		<0.001***	

** $p < 0.01$, *** $p < 0.001$

Link between ED and self-harm and/or suicidal behaviours

The bimodal logistic regression analysis showed that the DERS-16 mean score significantly predicted the presence of self-harm and/or suicidal behaviours in both the ASD group ($z = 3.700, p < 0.011$) and the BPD group ($z = 2.208, p = 0.027$).

The DERS-16 prediction accuracy rates were 71% for the ASD group and 92% in the BPD group. The prediction accuracy rate of the DERS-16 is especially high for the presence of self-harm and or suicidal behaviours (90% for ASD and 100% for BPD) (**Table 4**).

Table 4. Association between DERS-16 total and self-harm and suicidal behaviours using bimodal logistic regression.

Predictor	ASD n=154		BPD n=111	
	z	p-value	z	p-value
DERS	3.7	<0.001***	2.208	0.027*
Prediction accuracy rate	71%		92%	
with SH and /or SA	90%		100%	
without SH and /or SA	37%		0%	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

SH = self-harm

SA = Suicide attempts

Questionnaire scores' comparisons between groups

Emotion dysregulation

The BPD group had significantly higher scores on the DERS-16 total scale and on its subscales than the ASD group, with large effect sizes, except for Clarity and Goals subscales ($W = 11.75, p < 0.001$ for the total; $W = 5.56, p = 0.005$ for Clarity; $W = 12.84, p < 0.001$ for Impulse; $W = 9.72, p < 0.001$ for Non-acceptance; $W = 5.23, p = 0.011$ for Goals; $W = 11.00, p < 0.001$ for Strategies) and the NC group ($W = 17.03, p < 0.001$ for the total; $W = 13.29, p < 0.001$ for Clarity; $W = 17.25, p < 0.001$ for Impulse; $W = 13.69, p < 0.001$ for Non-acceptance; $W = 11.70, p < 0.001$ for Goals; $W = 16.75, p < 0.001$ for Strategies). The DERS-16 total score was significantly higher in the ASD group compared to the NC group ($W = 7.35, p < 0.001$). This

was also the case for the DERS-16 subscales ($W= 9.10, p <0.001$ for Clarity; $W= 5.70, p <0.001$ for Impulse; $W= 3.48, p = 0.037$ for Non-acceptance; $W= 7.10, p <0.001$ for Goals; $W= 6.86, p = 0.002$ for Strategies) (**Table 5**). See additional material for the correlation analyses between the scales for each group [**Additional file 1**].

ASD and BPD traits

As expected, on the AQ-Short, the score of the ASD group was significantly higher than the BPD group, with large effect sizes ($W= -12.68, p <0.001$) and the NC group ($W= 20.26, p <0.001$), while the BPD group scored higher than the NC group ($W= 6.20, p <0.001$). On the BSL-23, the BPD group score was significantly higher than the ASD group ($W= 13.48, p <0.001$) and the N.C group ($W= 17.72, p <0.001$) with large effect sizes, while the ASD group scored significantly higher than the NC group ($W= 5.48, p <0.001$).

Co-occurring disorders

On the ASRS v1.1, there was no significant difference between the ASD and BPD groups ($W= 1.43, p = 0.568$), both scoring significantly higher than the NC group ($W_{ASD-NC}= 7.14, p <0.001$; $W_{BPD-NC}= 8.70, p <0.001$).

On the DASS-21, the score of the BPD group was significantly higher than that of the ASD group ($W= 10.36, p <0.001$) and the NC group ($W= 15.99, p <0.001$) with large effect sizes except. Specifically, the BPD group scored significantly higher on the Stress and Depression subscales ($W= 9.96, p <0.001$ and $W= 9.45, p <0.001$, respectively) compared to the ASD group, and significantly higher on all subscales compared to the NC group. The ASD group scored significantly higher than the NC group ($W= 6.87, p <0.001$).

Emotional vulnerability

On the EV-Child, the score of the BPD group was significantly higher than the ASD group ($W= 5.41, p <0.001$) and the NC group ($W= 14.11, p <0.001$), respectively, with small

and large effect sizes. The ASD group scored significantly higher than the NC group ($W = 11.29$, $p < 0.001$), with a moderate effect size.

ASD-related factors contributing to ED

On the CAT-Q (camouflaging), the ASD group had significantly higher scores than the BPD group ($W = -5.35$, $p < 0.001$) and the NC group ($W = 13.44$, $p < 0.001$), while the BPD group had a significantly higher score than the NC group ($W = 5.86$, $p < 0.001$). This was also the case for the Compensation subscale ($W_{ASD-BPD} = -5.94$, $p < 0.001$; $W_{ASD-NC} = 14.41$, $p < 0.001$; $W_{BPD-NC} = 6.51$, $p < 0.001$). On the Masking subscale, the ASD group had significantly higher scores than the BPD group ($W = -5.25$, $p < 0.001$) and the NC group ($W = 9.15$, $p < 0.001$), but no significant difference was found between the BPD and NC groups ($W = 1.51$, $p = 0.536$). There was no significant difference between the three groups on the Assimilation subscale.

On the SPSQ SS (sensory sensitivity) subscale score there was no significant difference between the ASD and BPD groups ($W = -1.69$, $p = 0.456$), both scoring significantly higher than the NC group ($W_{ASD-NC} = -6.87$, $p < 0.001$; $W_{BPD-NC} = 4.25$, $p = 0.007$).

Similarly, on the GAFS-8 (alexithymia), there was no significant difference between the ASD and BPD groups ($W = -2.38$, $p = 0.211$), both scoring significantly higher than the NC group ($W_{ASD-NC} = 11.34$, $p < 0.001$; $W_{BPD-NC} = 7.31$, $p < 0.001$).

Invalidation and adverse experiences

On the CTQ-SF, the score was significantly higher in the BPD group compared to the ASD group ($W = 5.99$, $p < 0.001$) and the NC group ($W = 13.78$, $p < 0.001$). This was also the case for all the CTQ-SF subscales except for Emotional neglect, although a trend towards significance was observed ($W = 3.14$, $p = 0.068$). The ASD group scored significantly higher than the NC group on the CTQ-SF total ($W = 8.41$, $p < 0.001$) and subscales.

On the ABE, there was no significant difference between the ASD and BPD groups ($W = -0.21, p = 0.988$), both scoring significantly higher than the NC group ($W_{ASD-NC} = 12.93, p < 0.001$; $W_{BPD-NC} = 10.47, p < 0.001$).

Table 5. Scales mean scores pairwise comparisons between the groups using the Kruskal-Wallis one-way test.

	ASD n=154		BPD n=111		NC n=459		ASD vs. BPD			ASD vs. NC			BPD vs. NC		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>W</i>	<i>p-value</i>	ε^2	<i>W</i>	<i>p-value</i>	ε^2	<i>W</i>	<i>p-value</i>	ε^2
DERS-16	49.86	15.05	65.87	11.7	42.15	16.45	11.75	<0.001***	0.2617 ^a	7.35	<0.001***	0.0442	17.03	<0.001***	0.2549 ^a
Clarity	6.31	2.24	7.41	2.01	4.94	2.31	5.56	0.005**	0.0586	9.10	<0.001***	0.0676	13.29	<0.001***	0.1551 ^a
Impulse	7.24	3.51	11.84	3.23	6.17	3.58	12.84	<0.001***	0.3120 ^a	5.70	<0.001***	0.0265	17.25	<0.001***	0.2616 ^a
Non-acceptance	8.36	3.86	11.76	3.33	7.51	3.82	9.72	<0.001***	0.1789 ^a	3.48	0.037*	0.0099	13.69	<0.001***	0.1647 ^a
Goals	11.82	3.08	13.21	2.16	10.15	3.64	5.23	<0.001***	0.0519	7.10	<0.001***	0.0412	11.70	<0.001***	0.1203
Strategies	16.14	5.91	21.66	3.84	13.38	6.05	11.00	<0.001***	0.2290 ^a	6.86	0.002**	0.0384	16.75	<0.001***	0.2466 ^a
AQ-Short	21.1	3.6	15.41	4.84	12.79	5.66	-12.68	<0.001***	0.3044 ^a	20.26	<0.001***	0.3355 ^a	6.20	<0.001***	0.0338
BSL-23	30.91	21.1	60.55	19.09	24.21	21.51	13.48	<0.001***	0.3443 ^a	5.48	<0.001***	0.0279	17.72	<0.001***	0.2761 ^a
ASRS v1.1 Screener	15.1	5.59	15.95	4.69	12.66	4.96	1.43	0.568	0.0039	7.14	<0.001***	0.0416	8.70	<0.001***	0.0666
DASS-21	56.16	28.56	82.77	23.54	43.16	29.04	10.36	<0.001***	0.2034 ^a	6.87	<0.001***	0.0386	15.99	<0.001***	0.2246 ^a
Stress	21.99	10.13	30.83	7.63	17.38	10.63	9.96	<0.001***	0.1878 ^a	6.64	<0.001***	0.0361	15.61	<0.001***	0.2140 ^a
Anxiety	14.73	10.18	23.62	9.99	11.58	9.93	9.45	<0.001***	0.1690 ^a	5.21	<0.001***	0.0222	13.99	<0.001***	0.1719 ^a
Depression	19.44	12.8	28.32	10.13	14.2	11.69	7.86	<0.001***	0.1169	6.37	<0.001***	0.0332	14.41	<0.001***	0.1824 ^a
EV-Child self-report	92.28	20.09	101.42	19.45	74.62	24.1	5.41	<0.001***	0.0555	11.29	<0.001***	0.1042	14.11	<0.001***	0.1749 ^a
CAT-Q	100.75	11.86	94.59	13.99	87.87	14.59	-5.35	<0.001***	0.0542	13.44	<0.001***	0.1476 ^a	5.86	<0.001***	0.0302
Compensation	44.08	7.72	39.61	9.67	34.24	10.54	-5.49	<0.001***	0.0571	14.41	<0.001***	0.1696 ^a	6.51	<0.001***	0.0373
Masking	23.09	3.75	21.27	4.46	20.79	3.84	-5.25	<0.001***	0.0522	9.15	<0.001***	0.0684	1.51	0.536	0.0020
Assimilation	33.58	4.55	33.7	4.34	32.84	4.47	-2.48	0.983	0.0001	2.91	0.098	0.0069	2.51	0.177	0.0056
SPSQ SS subscale	56.36	10.13	54.65	9.71	49.24	9.17	-2.38	0.211	0.0108	11.43	<0.001***	0.1051	7.31	<0.001***	0.0470
GAFS-8	29.38	7.99	29.5	7.29	23.24	9.21	-0.45	0.946	0.0004	10.18	<0.001***	0.0846	9.05	<0.001***	0.0720
CTQ-SF	48.49	16.01	57.77	17.88	40.12	12.87	5.99	<0.001***	0.0679	8.41	<0.001***	0.0577	13.78	<0.001***	0.1669 ^a
Emotional abuse	12.57	5.46	15.35	5.5	9.59	4.75	5.59	<0.001***	0.0593	8.93	<0.001***	0.0651	13.49	<0.001***	0.1600 ^a
Physical abuse	6.72	3.34	8.35	5.08	6.04	2.54	4.00	0.013*	0.0303	3.41	0.042*	0.0095	7.91	<0.001***	0.0550
Sexual abuse	7.37	4.35	9.61	6.23	6.29	3.5	3.78	0.021*	0.0270	6.21	<0.001***	0.0315	9.73	<0.001***	0.0833
Emotional neglect	13.73	4.99	15.27	4.79	11.27	4.69	3.14	0.068	0.0187	7.58	<0.001***	0.0469	10.4	<0.001***	0.0951
Physical neglect	8.09	3.21	9.19	3.62	6.94	2.49	3.73	0.023*	0.0264	5.94	<0.001***	0.0288	9.57	<0.001***	0.0804
ABE	43.75	22.4	43.87	25.05	24.81	18.1	-0.21	0.988	0.0000	12.93	<0.001***	0.1365	10.47	<0.001***	0.0964

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ^a Large effect size

Gender differences

When considering gender differences (**Table 6**), we did not include the non-binary (i.e., “other”) sub-group because of the small number of participants ($n = 19$).

Autistic women had a significantly higher DASS-21 score than the autistic men ($W = -3.90, p = 0.016$) and the BPD group ($W = 8.32, p < 0.001$), especially regarding the Stress ($W_{ASD-BPD} = -5.22, p < 0.001$ and $W_{ASD-NC} = 7.01, p < 0.001$) and Anxiety subscales ($W_{ASD-BPD} = -4.42, p = 0.005$ and $W_{ASD-NC} = 7.02, p < 0.001$).

On the EV-Child (emotional vulnerability), the score tended to be higher in autistic women compared to men ($W = -3.27, p = 0.054$). No significant difference was found relative to the BPD group, but there was a trend for a higher score in the BPD group compared to autistic women ($W = 3.29, p = 0.053$).

On the CAT-Q (measuring total camouflaging and Compensation subscale), autistic women scored significantly higher than ASD men ($W = -4.01, p = 0.013$) and the BPD group ($W = -5.83, p < 0.001$), while no differences were found between ASD men and the BPD group ($W = 1.63, p = 0.482$). On the Assimilation subscale, ASD women scored significantly higher than ASD men ($W = -3.97, p = 0.014$) but similar to the BPD group ($W = -1.49, p = 0.544$).

Autistic women had a significantly higher SPSQ SS (sensory processing) scores than ASD men ($W = -4.31, p = 0.006$) and the BPD group ($W = -3.91, p = 0.016$). There was no significant difference between autistic men and the BPD group on this scale ($W = -1.22, p = 0.663$).

On the CTQ-SF (childhood maltreatment), the Sexual abuse subscale score was significantly higher in autistic women than autistic men ($W = -5.00, p = 0.001$) and comparable to the BPD group, although they tended to be lower than the latter group ($W = 1.46, p = 0.056$).

Table 6. Scales mean scores pairwise comparisons between ASD women, ASD men and BPD using the Kruskal-Wallis one-way test.

	ASD Women n=89		ASD Men n=46		BPD n=111		ASD Women vs. ASD Men			ASD Women vs. BPD			ASD Men vs. BPD		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>W</i>	<i>p-value</i>	ϵ^2	<i>W</i>	<i>p-value</i>	ϵ^2	<i>W</i>	<i>p-value</i>	ϵ^2
DERS-16	50.98	14.5	46.26	16.39	65.87	11.7	-2.26	0.248	0.0189	9.93	<0.001***	0.2477 ^a	-9.24	<0.001***	0.2735 ^a
Clarity	6.43	2.1	6.04	2.37	7.41	2.01	-1.41	0.581	0.0074	4.63	0.003**	0.0539	-4.66	0.003**	0.0695
Impulse	7.4	3.37	7.09	3.88	11.84	3.23	-1.26	0.646	0.0059	11.19	<0.001***	0.3149 ^a	-9.05	<0.001***	0.2623 ^a
Non-acceptance	8.67	3.67	7.26	3.9	11.76	3.33	-3.14	0.068a	0.0368	8.14	<0.001***	0.1663 ^a	-8.52	<0.001***	0.2328 ^a
Goals	12.07	2.91	10.93	3.5	13.21	2.16	-2.68	0.14	0.0268	3.84	0.018*	0.0370	-5.91	<0.001***	0.1120
Strategies	16.4	5.85	14.93	6.08	21.66	3.84	-1.76	0.428	0.0115	9.25	<0.001***	0.2151 ^a	-9.07	<0.001***	0.2638 ^a
AQ-Short	21.17	3.56	21	3.79	15.41	4.84	-0.509	0.931	0.0005	-11.28	<0.001***	0.3165 ^a	8.73	<0.001***	0.2447 ^a
BSL-23	31.07	19.68	27.3	20.68	60.55	19.09	-1.87	0.382	0.0131	12.05	<0.001***	0.3647 ^a	-10.29	<0.001***	0.3391 ^a
ASRS v1.1 Screener	15.17	5.76	14.52	4.9	15.95	4.69	-1.36	0.6	0.0069	0.942	0.78	0.0022	-2.53	0.173	0.0205
DASS-21	59.82	27.51	46.3	27.55	82.77	23.54	-3.9	0.016*	0.0567	8.32	<0.001***	0.1740 ^a	-9.26	<0.001***	0.2748 ^a
Stress	24.11	9.65	17.61	9.87	30.83	7.63	-5.22	<0.001***	0.1018	7.01	<0.001***	0.1234	-9.88	<0.001***	0.3128 ^a
Anxiety	16.38	10.11	10.96	8.14	23.62	9.99	-4.42	0.005**	0.0730	7.02	<0.001***	0.1238	-9.34	<0.001***	0.2796 ^a
Depression	19.33	12.11	17.74	13.88	28.32	10.13	-1.31	0.625	0.0064	7.36	<0.001***	0.1360	-6.08	0.005**	0.1184
EV-Child self-report	95.58	19.22	86.93	22.58	101.42	19.45	-3.27	0.054a	0.0399	3.29	0.053a	0.0271	-5.31	<0.001***	0.0904
CAT-Q	102.55	11.98	96.65	11.59	94.59	13.99	-4.01	0.013*	0.0600	-5.83	<0.001***	0.0855	1.63	0.482	0.0085
Compensation	45.21	7.61	41.48	7.78	39.61	9.67	-3.75	0.022*	0.0524	-5.94	<0.001***	0.0886	1.8	0.409	0.0104
Masking	23.13	3.91	23.04	3.61	21.27	4.46	-0.478	0.939	0.0009	-4.799	0.002**	0.0579	3.467	0.038*	0.0385
Assimilation	34.2	4.42	32.13	4.75	33.7	4.34	-3.97	0.014*	0.0589	-1.49	0.544	0.0056	-2.18	0.273	0.0152
SPSQ SS subscale	58.01	9.47	53.13	11.34	54.65	9.71	-4.31	0.006**	0.0695	-3.91	0.016*	0.0384	-1.22	0.663	0.0048
GAFS-8	29.61	7.58	28.63	8.68	29.5	7.29	-0.703	0.873	0.0018	-0.432	0.95	0.0005	-0.227	0.9086	0.0002
CTQ-SF	49.62	16.2	45.39	14.08	57.77	17.88	-1.99	0.337	0.0148	4.54	0.004**	0.0518	-5.81	<0.001***	0.1082
Emotional abuse	13.13	5.37	11.15	5.18	15.35	5.5	-3.03	0.082	0.0342	3.9	0.016*	0.0382	-6.04	<0.001***	0.1168
Physical abuse	6.69	3.73	6.61	2.39	8.35	5.08	1.87	0.381	0.0131	4.45	0.005**	0.0499	-2.04	0.32	0.0133
Sexual abuse	8.11	4.9	5.78	2.5	9.61	6.23	-5	0.001**	0.0933	1.46	0.0557a	0.0053	-5.63	<0.001***	0.1016
Emotional neglect	13.7	4.84	13.85	5.06	15.27	4.79	0.365	0.964	0.0005	3.006	0.085	0.0227	-1.866	0.384	0.0112
Physical neglect	7.99	2.81	8	3.39	9.19	3.62	-0.635	0.895	0.0015	3.195	0.062a	0.0257	-3.026	0.082	0.0294
ABE	44.09	22.12	40.5	22.14	43.87	25.05	-1.356	0.603	0.0069	-0.407	0.955	0.0004	-1.001	0.759	0.0032

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ^a Large effect size

Predictors of ED

Linear regression models

Linear regression analyses showed three significant predictors of ED in the ASD group, with the regression model accounting for 54.6% of the variance (**Table 7**): BPD traits measured by the BSL-23 ($t= 7.348, p <0.001$), emotional vulnerability measured by the EV-Child ($t= 3.682, p <0.001$), and alexithymia measured by the GAFS-8 ($t= 3.805, p <0.001$). A trend towards significance was found on the SPSQ SS subscale measuring sensory sensitivity ($t= 1.916, p= 0.057$).

In the BPD group, the same three variables were found to be strong predictors of ED, with the regression model accounting for 39.6% of the variance: BPD traits ($t= 3.900, p <0.001$), emotional vulnerability ($t= 2.386, p= 0.019$), and alexithymia ($t= 2.256, p= 0.026$). A trend towards significance was found on the ASRS v1.1 Screener measuring ADHD symptoms ($t= 1.851, p= 0.067$).

In the NC group, six significant predictors of ED were found, with the regression model accounting for 66.8% of the variance: BPD traits ($t= 13.383, p <0.001$), ADHD symptoms ($t= 3.054, p= 0.002$), emotional vulnerability ($t= 6.091, p <0.001$), autistic camouflaging measured by the CAT-Q ($t= -2.297, p= 0.022$), sensory hypersensitivity ($t= 2.603, p= 0.010$), and alexithymia ($t= 8.017, p <0.001$).

Table 7. *Linear regression models for ED predictors.*

Predictors	ASD n=154		BPD n=111		NC n=459	
	<i>t</i>	<i>p-value</i>	<i>t</i>	<i>p-value</i>	<i>t</i>	<i>p-value</i>
Woman	-0.409	0.683	-0.737	0.463	-0.776	0.438
Man	-0.583	0.561	-0.895	0.373	-0.736	0.462
AQ-Short	1.632	0.105	-0.432	0.666	0.930	0.353
BSL-23	7.348	<0.001 ^{***}	3.900	<0.001 ^{***}	13.383	<0.001 ^{***}
ASRS v1.1 Screener	1.501	0.136	1.851	0.067 ^a	3.054	0.002 ^{**}
EV-Child self-report	3.682	<0.001 ^{***}	2.386	0.019 [*]	6.091	<0.001 ^{***}
CAT-Q	0.796	0.428	-0.469	0.640	-2.297	0.022 [*]
SPSQ SS subscale	1.916	0.057 ^a	0.580	0.563	2.603	0.010 [*]
GAFS-8	3.805	<0.001 ^{***}	2.256	0.026 [*]	8.017	<0.001 ^{***}
CTQ-SF	-1.631	0.105	-0.205	0.838	-1.051	0.294
ABE	-1.002	0.318	0.963	0.338	-0.027	0.979
R²	0.579		0.457		0.676	
Adjusted R²	0.546		0.396		0.668	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

^a Trend towards significance

ED Predictors rankings

Figure 2 presents the SHAP summary plots that display the importance of the 11 variables selected, the magnitude of their impact (i.e., the effect size) in each group, and the direction of a specific feature's association with ED.

For the ASD group, BPD traits (BSL-23), alexithymia (GAFS-8), emotional vulnerability (EV-Child), sensory sensitivity (SPSQ SS), and autistic camouflaging (CAT-Q), respectively carried most of the general model's predictive power with an absolute mean SHAP value of 0.37, 0.14, 0.13, 0.11 and 0.09 respectively.

For the BPD group, BPD traits, emotional vulnerability, alexithymia and ADHD traits (ASRS v1.1 Screener) respectively carried most of the general model's predictive power with an absolute mean SHAP value of 0.28, 0.15, 0.13 and 0.10 respectively.

For the NC group, BPD traits, alexithymia, emotional vulnerability, ADHD traits, and sensory sensitivity respectively carried most of the general model's predictive power with an absolute mean SHAP value of 0.40, 0.21, 0.15, 0.10, and 0.08 respectively.

For all groups, gender (Woman/Man) ranked at the bottom of the model, indicating a very low predictive value on ED scores.

Furthermore, the SHAP value range for the BSL-23 was wider in the ASD group compared to the BPD group, which means that the BPD traits predicted more strongly ED in the ASD group than in the BPD group.

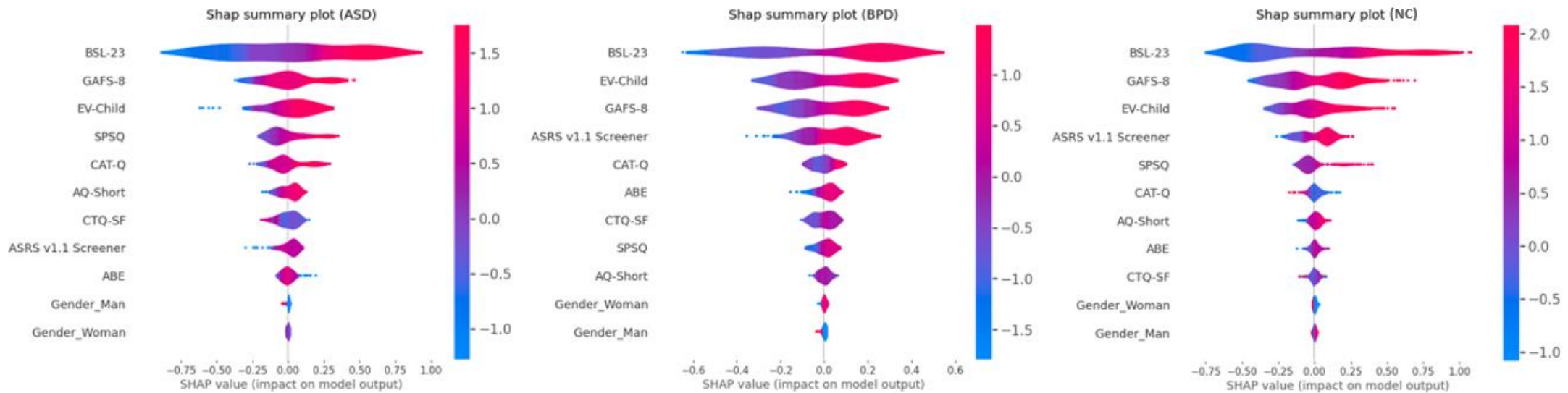


Figure 2. Shapley values plots illustrate how explanatory variables contribute to ED in each group (ASD/BPD/NC). The feature list down the y-axis is in order of contribution to the model (most to least). On the x-axis the SHAP values for each observation are presented —negative SHAP values are interpreted as reduced ED, while positive SHAP values are interpreted as increased ED. Each dot represents an individual respondent; hence, the number of dots against each feature reflects the sample size of the training set. The dot's position along the x-axis is the feature's impact on the model's prediction for that respondent. The colour indicates whether the value of the characteristic considered is high or low in relation to the range of values (red refers to high values and blue to low values). When multiple dots arrive at the same coordinate in the plot, they pile up to show the density of effect sizes. The graph has a median line and the farther the point is from the median line, the stronger is the influence on the output, with the points on the right correlating positively with ED and the points on the left negatively).

Discussion

Our study is the first to provide an investigation of ED in autistic adults compared to BPD and nonclinical controls. Our results suggest that ED scores and its behavioural correlates (i.e., suicidality, self-harming behaviour, and hospitalizations) are increased in ASD compared to ND. Nevertheless, people with BPD had the highest scores of ED and the greatest occurrences of its behavioural correlates in our sample. Interestingly, and contrary to our hypotheses, the same three dimensions, i.e., BPD traits, emotional vulnerability, and alexithymia, significantly predicted ED scores in both the ASD and BPD groups. Consistently, these three dimensions ranked as the greatest ED predictors in the ML models for both the ASD and BPD groups, whereas sensory sensitivity and autistic camouflaging were associated with ED in ASD, and ADHD symptoms with ED in BPD.

First of all, in line with our hypothesis (H4), we found that ED was higher in the BPD group than the ASD group, with both clinical groups scoring higher than the nonclinical controls. This result is not surprising given that ED is a core feature of BPD [2,3], and that ED is typically considered as a co-occurring difficulty in autistic people [49]. Yet, unlike our results, recent findings by Weiner et al. [27] suggested that ED was heightened in autistic adults, particularly autistic women, compared to women with BPD. However, their sample of autistic people was recruited from a DBT waiting list, hence their results could not be generalized to autistic adults in other contexts. This is not the case for our results, as both the BPD and the ASD groups were recruited from the general population.

Relatedly, consistent with our hypothesis (H1), the prevalence of suicidal behaviour, use of psychiatry services and self-harm was higher in the BPD group compared to the ASD group, while these behaviours were more frequent in both clinical groups compared to the NC group. Interestingly, the rates of suicidal and self-harming behaviours found in the BPD and ASD groups are consistent with previous findings. Indeed, in their review, Oumaya et al. [22]

reported that self-harm rates ranged between 50-80% and suicidality rates ranged between 40-85% in BPD, which match the 82% prevalence of self-harm and 77% of suicidal behaviours in our BPD group. In our ASD group, the rate of 41% of self-harm matches the 50% reported by Maddox et al. [19], and the rate of 39% of suicide attempts is congruent with the 35% rate found by Cassidy et al. [111]. These results add to previous research showing that the rates of self-harm and suicidal behaviours in autistic adults are higher than that of non-autistic people [13,14]. Nevertheless, our study is the first to show that the prevalence of these behavioural ED correlates is decreased in ASD compared to BPD. These results are congruent with the ED levels found in our groups. Indeed, while ED scores are higher in the ASD group compared to the NC group, the BPD group displayed the highest ED scores in our sample. Moreover, consistent with our hypotheses (H2), self-harm and suicidal behaviours were strongly associated in each group and ED strongly predicted these behaviours in both clinical groups (H3). This is in line with numerous studies suggesting that there is a strong link between self-harm and suicidality [14,23,112], and that ED predicts these behaviours in both ASD and BPD [113,114].

In terms of gender differences, contrary to our hypothesis (H5), autistic women did not show a heightened ED compared to autistic men and to the BPD group. Indeed, the BPD group scored the highest compared to both autistic women and men. This result is inconsistent with findings supporting a heightened ED in autistic women compared to both autistic men [24,25,27] and women with BPD [27]. However, studies comparing ED in autistic women and people with BPD are scarce [27] and those comparing ED across genders in autistic adults have focused on individuals attending psychiatric facilities, unlike our study [25,27,52]. Thus, compared to these findings, our results are probably more representative of ED levels across genders in the adult autistic population irrespective of their co-occurring disorders. It is noteworthy, however, that autistic women had higher levels of anxiety and stress compared to

autistic men, but lower scores than the BPD group. This is in line with findings supporting an increased vulnerability to anxiety in autistic women compared to autistic men, that may be attributed to psychosocial (e.g., increased use of camouflaging) and biological (e.g., heightened sensory sensitivity) factors [24,115,116].

As expected, the analyses between groups showed that the ASD group had the highest ASD traits (measured by the AQ-Short), while the BPD group showed the highest BPD traits (measured by the BSL-23). However, the ASD group scored higher than the NC group on the BSL-23 and the BPD group scored higher than the NC group on the AQ-Short, which might reflect the overlapping features between ASD and BPD [117,118]. ADHD traits were equivalent between the ASD and BPD groups, but the ADHD co-occurrence was higher in ASD compared to BPD (34% in the ASD group and 24% in the BPD group). This could be due to an increased awareness among clinicians of the high co-occurrence between ADHD and ASD and their shared neurodevelopmental nature, which might increase the likelihood of screening for ADHD in autistic people [119,120]. Moreover, alexithymia scores were found to be similar in our clinical groups, but also across genders in the ASD group. Hence, although alexithymia has been strongly linked to ASD traits [121], it can be rather seen as a transdiagnostic feature also found in BPD [122].

Regarding factors specifically related to Linehan's biosocial model, the BPD group showed higher scores on the scales assessing emotional vulnerability and invalidating experiences compared to the ASD group. This is in line with the fact that ED is central in BPD, and the transaction between these components is recognized as predictive of ED in this disorder [33,22]. Nevertheless, autistic women showed similar emotional vulnerability scores compared to the BPD group and tended to present with higher levels of emotional vulnerability relative to autistic men. The rates of sexual abuse in autistic women were also found to be equivalent to the BPD group in our study, and both were higher than those reported by autistic men and the

NC group. These results add to findings pointing to an increased prevalence of sexual abuse among autistic women [123,124,125]. In fact, Cazalis et al. [123] reported a 2 to 3-fold increase of victimization in autistic women compared to non-autistic women, as well as high rates of revictimization. This, in turn, is associated with a higher risk to develop mental health issues, including anxiety disorders and PTSD [123,126]. Additionally, autistic women showed higher scores on both the camouflaging and the sensory processing scales compared to both autistic men and the BPD group. However, no significant difference was found in sensory processing between autistic men and the BPD group. Given that sensory sensitivity has been linked to daily psychophysiological arousal and increased anxiety, this might partially explain why autistic women tended to present with higher emotional vulnerability and anxiety scores relative to autistic men in our study [23,127].

Interestingly, while autistic women presented with increased emotional vulnerability and sensory sensitivity (biological components), and higher rates of sexual abuse and camouflaging (psychosocial components) than autistic men, it is worth noting that ED scores were equivalent between the two genders. This can be explained by the fact that autistic women may have increased emotion regulation abilities relative to autistic men, which might compensate for their heightened exposure to ED risk factors and to anxiety. Consistent with this hypothesis, autistic women have been reported to have increased social skills [128] and greater use of autistic camouflaging [67,68] than autistic men, which could underlie a greater ability to engage in goal-directed behaviour that may be useful for emotion regulation although the selected goals, e.g., camouflaging, might be detrimental to their well-being on the long run [67,68]. Previous data has reported an increased use of emotion regulation strategies in NC women compared to men, while ED is equally associated with psychopathology in both genders [129].

Considering the predictors of ED, we found that BPD traits, emotional vulnerability, and alexithymia predicted ED in both clinical groups. Consistently, the SHAP value plots showed that the BPD traits were the main ED predictor across groups (ASD/BPD/NC), followed by emotional vulnerability and alexithymia. These results suggest that ED is central to BPD as conceptualized by Linehan's theory [33]. Additionally, they indicate that BPD traits, emotional vulnerability and alexithymia might be central to ED, irrespective of the diagnosis. Interestingly, BPD traits were a stronger predictor of ED in the ASD group compared to the BPD group with a wider range of SHAP value. This can be explained by the fact that the BSL-23 (measuring BPD traits) might lack discriminative and predictive power in the BPD group, as BPD traits are intrinsic to BPD. Conversely, in ASD, it is likely that BPD traits may refer to the overlapping difficulties between ASD and BPD (e.g., social communication peculiarities, disturbed sense of self) [117,118]. Moreover, emotional vulnerability was identified as one of the three strongest ED predictor in both groups, suggesting a strong biological basis underlying ED regardless of diagnosis. Alexithymia ranked second in the SHAP value plots for ASD, while emotional vulnerability ranked second for BPD. Thus, although alexithymia has been pinpointed by several studies as a transdiagnostic process involved in ED [e.g., 27,130], this suggests that alexithymia might be particularly central to ED in ASD. ASD-related factors, on the other hand, did not predict ED in the ASD group compared to the BPD group, contrary to our hypotheses (H6 and H7). However, sensory sensitivity showed a trend towards significance in the linear regression model in the ASD group and ranked fourth in the SHAP value plot. This suggest that sensory processing particularities may be the ASD-related factor that contributes the most to ED in ASD, which is congruent with previous findings in autistic youth [20,131]. It is noteworthy that autistic camouflaging ranked as the fifth strongest ED predictor in the ASD group. In the BPD group, ADHD symptoms ranked as the fourth predictor in the SHAP value plot, which is consistent with the fact that impulsivity is a core feature of BPD [132].

Furthermore, contrary to our hypotheses (H6 and H7), the childhood invalidation measures, including early trauma (CTQ-SF) and bullying (ABE), did not emerge as significant ED predictors in the clinical groups, which is inconsistent with Linehan's model [33]. Another study also failed to identify parental invalidation as BPD predictors and suggested that it was irrelevant for the model [36], while Keng & Soh [40] suggested that maternal invalidation contributed to BPD. It is noteworthy that Linehan [33] considered that invalidation included several forms of emotional invalidation (i.e., minimization, punishment, ignoring the emotional experience) with a focus on parental invalidation that was not tackled by the measures we used (i.e., CTQ-SF and the ABE). Moreover, in Linehan's theory it is rather the transaction between the two components that is key to ED, and this was not assessed in our study [33].

Limitations

Our study has a number of limitations. First, the sample size (N= 724) was limited, especially since the participants were divided into three groups. Using a larger sample would have also allowed to optimize our predictive models for ED, especially those based on ML as large data sets are supported to improve the accuracy of such models [133,134]. Second, as the study was conducted online, the ASD and BPD diagnoses were self-reported, which did not allow us to check their accuracy. However, it was stated in the online form that a formal diagnosis provided by a psychiatrist was required. Third, we assessed self-harming and did not distinguish skin-cutting from other forms of self-harm. Given that skin-cutting in particular has been associated with severe ED [20] and with suicidal behaviours [135], it would be relevant to distinguish between different types of self-harming behaviours in future studies. Fourth, all the study measures were self-reported. Indeed, self-report scales have numerous limitations, including relying on the participant's ability to accurately self-assess their functioning [136]. This might be particularly challenging in studies on ED since it might be accompanied by high levels of alexithymia, which was the case in our study. Fifth, although we

have opted for a short version for each scale, we had many questionnaires, which probably explains the high dropout rate in our study (51%). Reducing the number of measures could lighten the burden on participants, reduce the dropout rate and potentially improve the quality of the data collected [137]. Sixth, in our study we did not explore the transactional and the potential moderating/mediating relationships between the model's components and factors. Indeed, this study aimed to provide initial results of ED comparing ED correlates between BPD, ASD and a nonclinical group. These results may pave the way to further investigate how the different ED correlates identified for ASD interact. Seventh, our cross-sectional findings prevent any conclusions regarding the direction and causality of relationships between ED and its correlates; longitudinal research is warranted to address the latter. Finally, we measured the psychosocial factors of the model through the CTQ-SF (childhood trauma) and the ABE (school bullying), whereas there are tools that may be more appropriate to measure invalidation as conceptualized by Linehan [33], such as the Socialization of Emotion Scale [91].

Conclusions

To conclude, ED scores are higher in ASD compared to nonclinical controls, but milder than in BPD. While gender did not predict ED scores in our sample, autistic women had increased risk factors to ED relative to autistic men (i.e., emotional vulnerability, sexual abuse, sensory particularities, autistic camouflaging and anxiety). This suggests that it is crucial to consider gender-related factors potentially involved in ED in ASD in future studies. Importantly, the same three dimensions, i.e., BPD traits, alexithymia and emotional vulnerability, seem to be involved in ED across the clinical groups, suggesting that they might be key to ED irrespective of diagnosis. However, sensory processing and autistic camouflaging may be more specific to ED in ASD, while ADHD symptoms may play a specific role in ED in BPD. Given that the same three main contributors to ED were found in ASD and BPD, our

results outline that DBT, built upon Linehan's biosocial model, is likely to be as relevant to treat ED in autistic adults as it is in BPD.

List of abbreviations

ABE	Assessment of bullying experiences
ADHD	Attention deficit hyperactivity disorder
AQ-Short	Autism spectrum quotient short version
ASD	Autism spectrum disorder
ASRS v1.1 Screener	ADHD self-report scale v1.1 screener
BPD	Borderline personality disorder
BSL-23	Short form of the borderline symptom list
CAT-Q	Camouflaging autistic traits questionnaire
CBT	Cognitive behavioural therapy
cPTSD	Complex post-traumatic stress disorder
CTQ-SF	Childhood trauma questionnaire-Short form
DASS-21	Depression, anxiety and stress scales
DBT	Dialectical behaviour therapy
DERS-16	Difficulties in emotion regulation scale-16
EV-Child	Emotional vulnerability-Child scale
GAFS-8	Eight-item general alexithymia factor score
M	Mean
ML	Machine learning
NC	Nonclinical controls
OLS	Ordinary least square
SD	Standard deviation
SHAP	Shapley additive explanation
SPSQ SS	Sensory processing sensitivity questionnaire - Sensory sensitivity subscale

Declarations

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the University of Strasbourg (Ethical approval number: Unistra/CER/2022-35). The participants provided informed consent to participate by checking the box intended for this purpose prior to accessing the questionnaires. All study procedures complied with the ethics code outlined in the Declaration of Helsinki.

The study has been preregistered prior to data analysis in the Open Science Framework (OSF; registration DOI: <https://doi.org/10.17605/OSF.IO/U8WY6>).

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Author contributions

DB performed conceptualization of the project, data collection and analysis, and writing of manuscript. AL performed and analysed linear regression and machine learning predictions, and wrote the corresponding methods and results. LW performed conceptualization of the

project, provided supervision, reviewed and edited the drafts and the final manuscript. All authors read and approved the final manuscript.

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Additional file 1

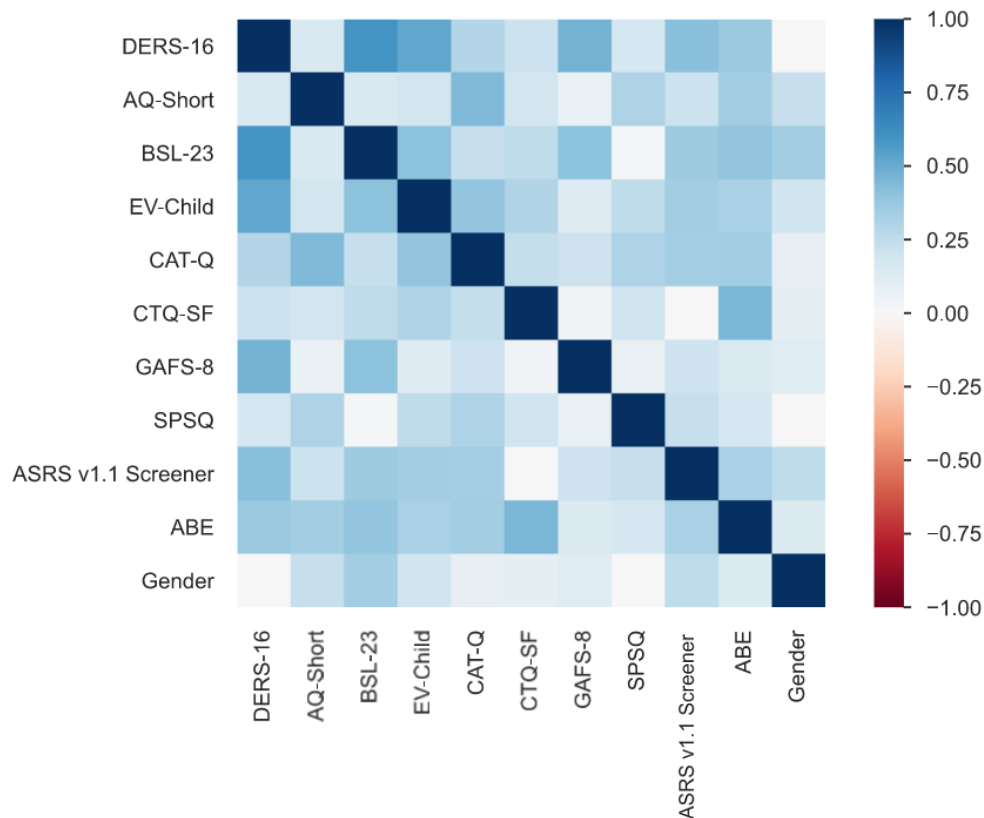
The biosocial correlates and predictors of emotion dysregulation in autistic adults

compared to borderline personality disorder and nonclinical controls

Correlation matrixes for each group

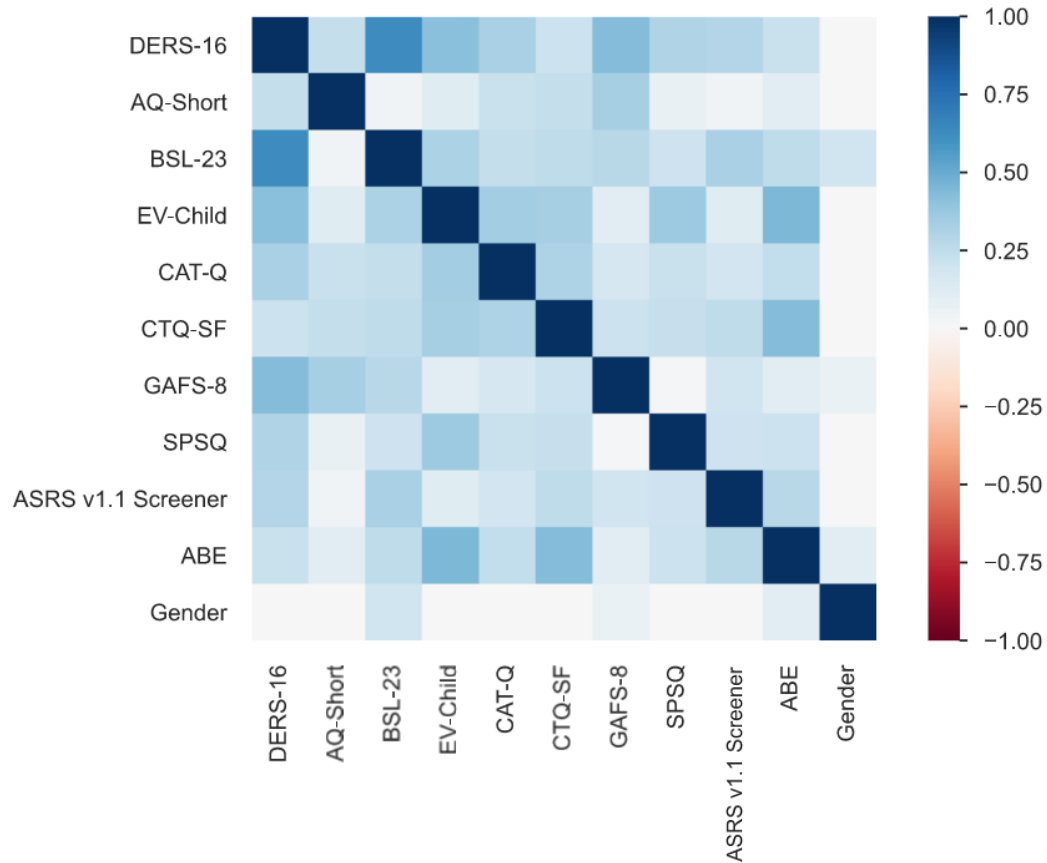
BPD group

	DERS-16	AQ-Short	BSL-23	EV-Child	CAT-Q	CTQ-SF	GAFS-8	SPSQ	ASRS v1.1 Screener	ABE	Gender
DERS-16	1.000	0.151	0.601	0.518	0.290	0.213	0.473	0.179	0.417	0.369	0.000
AQ-Short	0.151	1.000	0.152	0.187	0.440	0.180	0.065	0.311	0.214	0.347	0.227
BSL-23	0.601	0.152	1.000	0.407	0.229	0.255	0.407	0.009	0.354	0.394	0.345
EV-Child	0.518	0.187	0.407	1.000	0.397	0.302	0.130	0.255	0.348	0.327	0.198
CAT-Q	0.290	0.440	0.229	0.397	1.000	0.238	0.203	0.308	0.339	0.348	0.079
CTQ-SF	0.213	0.180	0.255	0.302	0.238	1.000	0.032	0.199	-0.000	0.453	0.101
GAFS-8	0.473	0.065	0.407	0.130	0.203	0.032	1.000	0.078	0.206	0.148	0.123
SPSQ	0.179	0.311	0.009	0.255	0.308	0.199	0.078	1.000	0.228	0.166	0.000
ASRS v1.1 Screener	0.417	0.214	0.354	0.348	0.339	-0.000	0.206	0.228	1.000	0.326	0.256
ABE	0.369	0.347	0.394	0.327	0.348	0.453	0.148	0.166	0.326	1.000	0.138
Gender	0.000	0.227	0.345	0.198	0.079	0.101	0.123	0.000	0.256	0.138	1.000



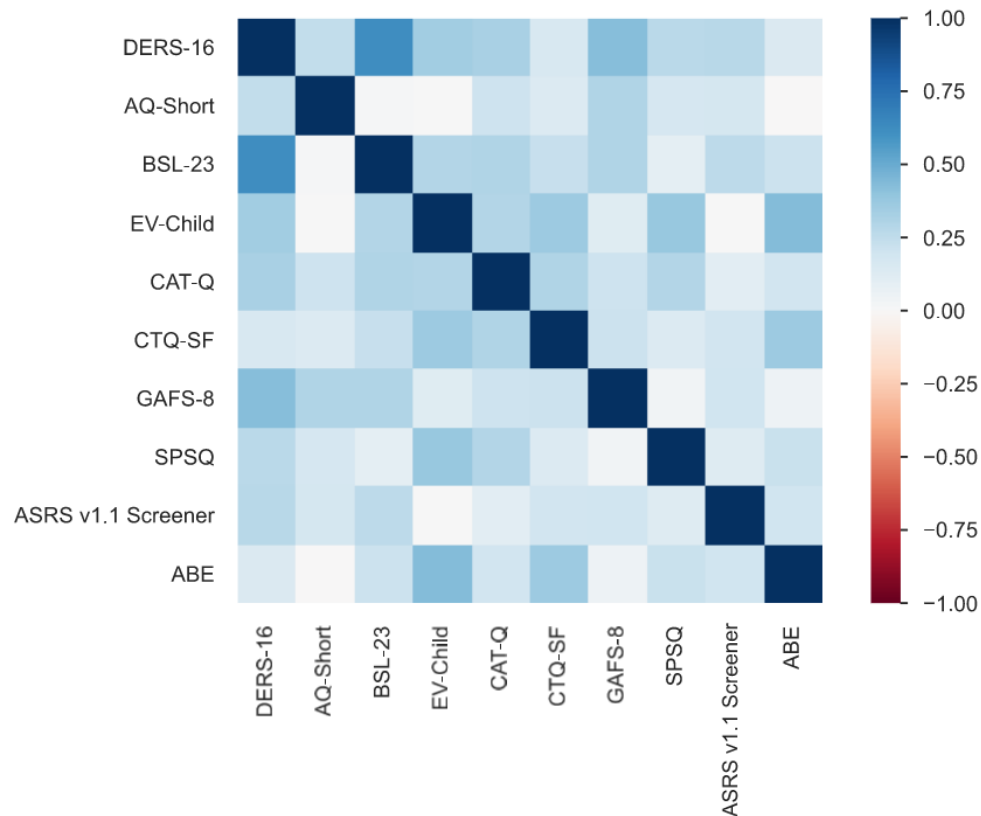
ASD group

	DERS-16	AQ-Short	BSL-23	EV-Child	CAT-Q	CTQ-SF	GAFS-8	SPSQ	ASRS v1.1 Screener	ABE	Gender
DERS-16	1.000	0.237	0.632	0.421	0.324	0.218	0.437	0.302	0.295	0.219	0.000
AQ-Short	0.237	1.000	0.034	0.123	0.225	0.241	0.335	0.075	0.038	0.111	0.000
BSL-23	0.632	0.034	1.000	0.319	0.236	0.253	0.278	0.204	0.326	0.256	0.197
EV-Child	0.421	0.123	0.319	1.000	0.351	0.334	0.113	0.363	0.118	0.450	0.000
CAT-Q	0.324	0.225	0.236	0.351	1.000	0.312	0.170	0.225	0.192	0.243	0.000
CTQ-SF	0.218	0.241	0.253	0.334	0.312	1.000	0.214	0.228	0.256	0.436	0.000
GAFS-8	0.437	0.335	0.278	0.113	0.170	0.214	1.000	0.017	0.197	0.103	0.068
SPSQ	0.302	0.075	0.204	0.363	0.225	0.228	0.017	1.000	0.208	0.214	0.000
ASRS v1.1 Screener	0.295	0.038	0.326	0.118	0.192	0.256	0.197	0.208	1.000	0.275	0.000
ABE	0.219	0.111	0.256	0.450	0.243	0.436	0.103	0.214	0.275	1.000	0.104
Gender	0.000	0.000	0.197	0.000	0.000	0.000	0.068	0.000	0.000	0.104	1.000



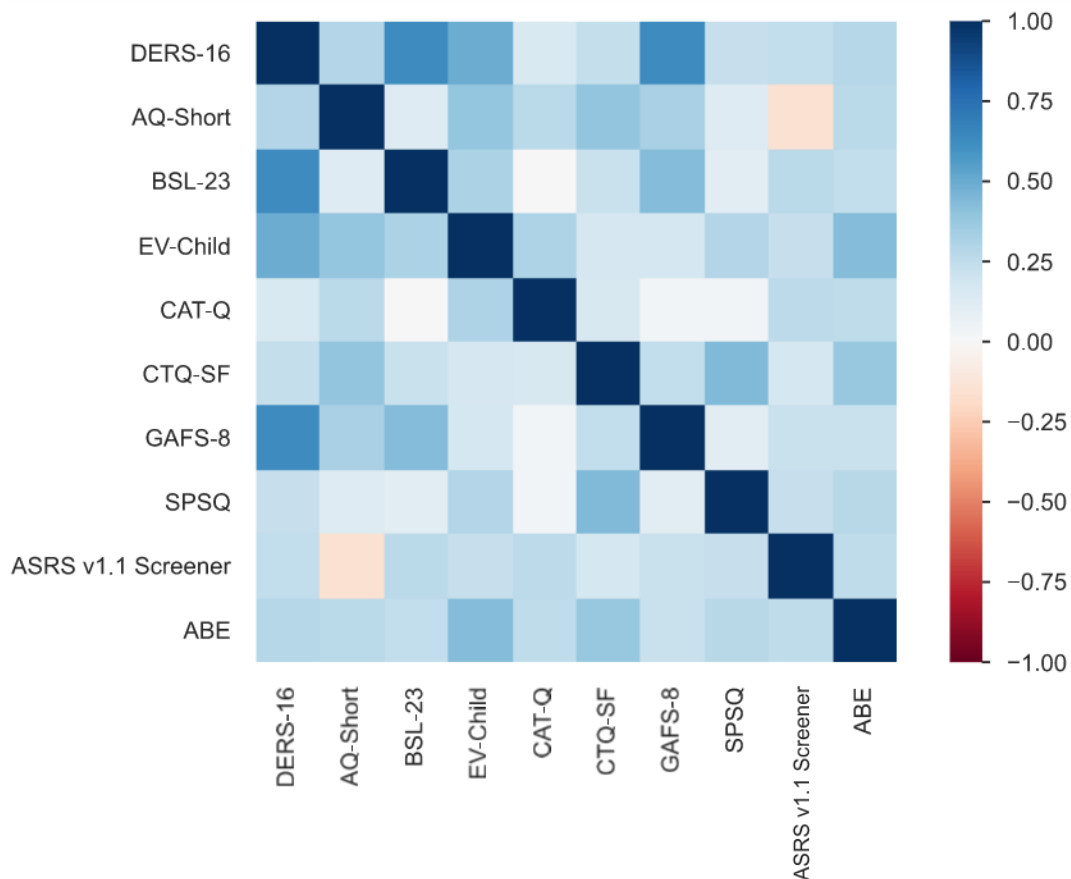
ASD women group

	DERS-16	AQ-Short	BSL-23	EV-Child	CAT-Q	CTQ-SF	GAFS-8	SPSQ	ASRS v1.1 Screener	ABE
DERS-16	1.000	0.246	0.618	0.349	0.322	0.158	0.429	0.273	0.281	0.146
AQ-Short	0.246	1.000	0.013	0.003	0.209	0.138	0.298	0.166	0.177	-0.000
BSL-23	0.618	0.013	1.000	0.290	0.300	0.228	0.298	0.097	0.266	0.215
EV-Child	0.349	0.003	0.290	1.000	0.293	0.366	0.124	0.380	0.004	0.434
CAT-Q	0.322	0.209	0.300	0.293	1.000	0.302	0.207	0.290	0.108	0.189
CTQ-SF	0.158	0.138	0.228	0.366	0.302	1.000	0.217	0.136	0.193	0.360
GAFS-8	0.429	0.298	0.298	0.124	0.207	0.217	1.000	0.034	0.203	0.052
SPSQ	0.273	0.166	0.097	0.380	0.290	0.136	0.034	1.000	0.131	0.226
ASRS v1.1 Screener	0.281	0.177	0.266	0.004	0.108	0.193	0.203	0.131	1.000	0.199
ABE	0.146	-0.000	0.215	0.434	0.189	0.360	0.052	0.226	0.199	1.000



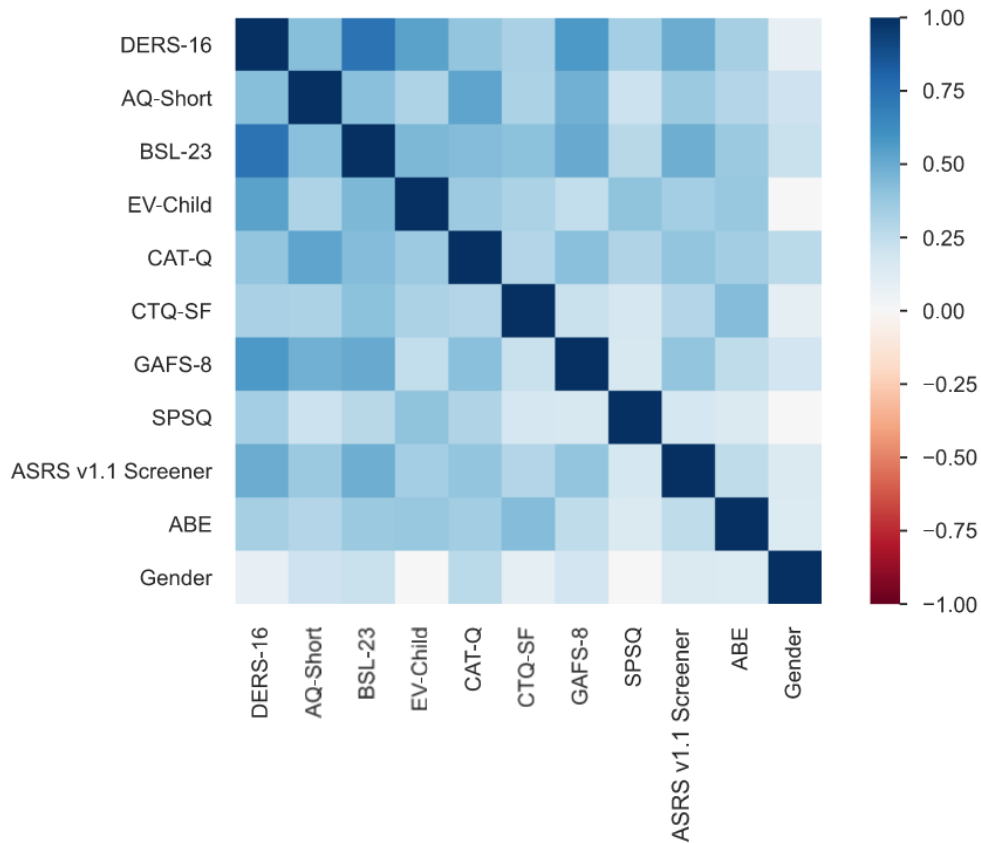
ASD men group

	DER S-16	AQ- Short	BSL-23	EV- Child	CAT- Q	CTQ- SF	GAFS -8	SPSQ	ASRS v1.1 Screener	ABE
DER-S-16	1.000	0.295	0.630	0.499	0.152	0.238	0.626	0.228	0.249	0.282
AQ-Short	0.295	1.000	0.128	0.386	0.268	0.394	0.327	0.129	-0.150	0.273
BSL-23	0.630	0.128	1.000	0.319	-0.004	0.223	0.434	0.104	0.269	0.250
EV-Child	0.499	0.386	0.319	1.000	0.305	0.165	0.176	0.296	0.229	0.432
CAT-Q	0.152	0.268	-0.004	0.305	1.000	0.163	0.027	0.028	0.259	0.256
CTQ-SF	0.238	0.394	0.223	0.165	0.163	1.000	0.243	0.440	0.177	0.380
GAFS-8	0.626	0.327	0.434	0.176	0.027	0.243	1.000	0.107	0.221	0.220
SPSQ	0.228	0.129	0.104	0.296	0.028	0.440	0.107	1.000	0.228	0.280
ASRS v1.1 Screener	0.249	-0.150	0.269	0.229	0.259	0.177	0.221	0.228	1.000	0.255
ABE	0.282	0.273	0.250	0.432	0.256	0.380	0.220	0.280	0.255	1.000



NC group

	DERS-16	AQ-Short	BSL-23	EV-Child	CAT-Q	CTQ-SF	GAFS-8	SPSQ	ASRS v1.1 Screener	ABE	Gender
DERS-16	1.000	0.429	0.742	0.532	0.393	0.323	0.576	0.343	0.500	0.335	0.079
AQ-Short	0.429	1.000	0.421	0.311	0.529	0.317	0.479	0.219	0.375	0.295	0.209
BSL-23	0.742	0.421	1.000	0.451	0.431	0.409	0.502	0.275	0.487	0.373	0.222
EV-Child	0.532	0.311	0.451	1.000	0.363	0.317	0.246	0.401	0.339	0.375	0.000
CAT-Q	0.393	0.529	0.431	0.363	1.000	0.291	0.419	0.303	0.396	0.349	0.272
CTQ-SF	0.323	0.317	0.409	0.317	0.291	1.000	0.225	0.167	0.292	0.437	0.087
GAFS-8	0.576	0.479	0.502	0.246	0.419	0.225	1.000	0.159	0.396	0.250	0.192
SPSQ	0.343	0.219	0.275	0.401	0.303	0.167	0.159	1.000	0.179	0.143	0.000
ASRS v1.1 Screener	0.500	0.375	0.487	0.339	0.396	0.292	0.396	0.179	1.000	0.256	0.143
ABE	0.335	0.295	0.373	0.375	0.349	0.437	0.250	0.143	0.256	1.000	0.133
Gender	0.079	0.209	0.222	0.000	0.272	0.087	0.192	0.000	0.143	0.133	1.000



AXIS 2 – Study 1

Feasibility, Acceptability and Preliminary Efficacy of Dialectical Behavior Therapy for Autistic Adults without Intellectual Disability: A Mixed Methods Study

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Feasibility, Acceptability and Preliminary Efficacy of Dialectical Behavior Therapy for Autistic Adults without Intellectual Disability: A Mixed Methods Study

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Abstract

Self-harm and suicidal behaviors are prevalent among autistic adults without intellectual disability (ID). Emotion dysregulation (ED), the difficulty in modulating emotions, has been identified as an important risk factor. Dialectical behavior therapy (DBT) has been proved effective to treat ED in disorders other than autism spectrum disorder. Our study aimed at assessing the feasibility, acceptability and preliminary efficacy of DBT in seven autistic adults without ID exhibiting self-harm and/or suicidal behaviors linked to severe ED. Our results suggest that DBT is feasible and highly acceptable to autistic adults without ID. Additionally, mean scores on the Difficulties in Emotion Regulation Scale decreased significantly post-treatment and at 4-month follow-up, suggesting that DBT might be efficacious in reducing ED in this population.

Keywords Autism spectrum disorder · Adults · Emotion dysregulation · Self-harm · Suicidality · Dialectical behavior therapy

Autistic adults are at greater risk of co-occurring psychiatric disorders, self-harm and suicidal behaviors compared to the general population (Hollocks et al., 2019; Licence et al., 2019; Cassidy et al., 2020; Moseley et al., 2020). A meta-analysis including 37 studies revealed a prevalence of self-harm of 42% in autistic individuals, irrespective of age and the presence or the absence of intellectual disability (ID) (Steenfeldt-Kristensen et al., 2020). In the first study investigating self-harming behaviors in autistic individuals without ID, Maddox et al. (2017) reported that 50% of their sample had a history of self-harm, and that these behaviors were qualitatively similar to those seen in the general

population. Consistent with these findings, more recently, Licence et al. (2019) reported a prevalence of self-harm of 24% in their autistic sample. In addition to self-harm, suicidal ideation and suicidal attempts have also been reported at high rates in autistic individuals (Hedley & Uljarević, 2018; Dell'Osso et al., 2019), with the prevalence of suicidal attempts ranging between 7 and 47% (Zahid & Upthegrove, 2017). Autistic adults without ID in particular appear to be at a greater risk for suicidal behaviors. Indeed, in a sample of recently diagnosed autistic adults without ID, 66% self-reported suicidal ideation and 35% self-reported plans or attempts of suicide (Cassidy et al., 2014). More generally, two population-based cohort studies led in Denmark and Sweden highlighted the importance of this problem in autistic individuals, as they reported respectively a 3.7 and a 9-fold increase in death by suicide among autistic adults without ID compared to the general population (Hirvikoski et al., 2016; Kølves et al., 2021).

Yet the increased risk of suicide in autism spectrum disorder (ASD) remains understudied. Recent research has highlighted several risk factors, including self-harming behaviors (Cassidy et al., 2018; Moseley et al., 2020), the severity of ASD symptoms (Cassidy et al., 2018; Costa et al., 2020), psychiatric comorbidities (Richa et al., 2014; Cassidy et al., 2018), loneliness and lack of social support

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(Hedley et al., 2017), camouflage of ASD characteristics (Cassidy et al., 2018) and, particularly, emotion dysregulation (ED) (Mazefsky et al., 2013; Moseley et al., 2019; Conner et al., 2020). ED is defined as the deficit in adaptive and efficient emotion regulation that interferes with appropriate goal-directed behavior (Gross, 1998). Several studies on clinical and non-clinical samples revealed a significant positive association between ED and self-harm (Wolff, 2019), as well as a significant positive association between ED and suicidal ideation and attempts (Turton et al., 2021). In ASD, ED has also been identified as a risk factor in the emergence of self-harm, as autistic individuals may use self-harming behaviors as a way to regulate painful emotions, i.e., low-energy affective states such as depression or high-energy affective states such as anger and anxiety (Moseley et al., 2019). Alexithymia, in particular, a prevalent trait in ASD (Kinnaird et al., 2019; Ziermans et al., 2019), has been identified as predictive of using self-harm to regulate emotions, especially those related to high-energy affective states (Moseley et al., 2019). In the context of alexithymia, self-harming behaviors are conceptualized as a way to communicate one's emotions when sharing them through words is not possible (Moseley et al., 2019). It has also been suggested that alexithymia interferes with emotion regulation, as it is difficult to regulate emotions that were not previously identified (Morie et al., 2019). In addition to self-harm, recent research has suggested an association between suicidal ideation and suicidal behaviors with ED in ASD. Indeed, in a sample of autistic children and adolescents, Conner et al. (2020) reported that greater ED was associated with an increased likelihood of suicidal ideation and attempts. More specifically, increased suicidality was found to be related to enhanced emotional reactivity and elevated dysphoria—i.e., low positive affect and motivation—in autistic individuals (Conner et al., 2020).

There is a growing body of literature suggesting that ED might be a relevant treatment target in autistic individuals (Reyes et al., 2019; Conner et al., 2020), especially those with self-harming behaviors and increased suicidality (Moseley et al., 2019; Conner et al., 2020). In autistic youth, preliminary evidence suggests that cognitive behavioral therapy (CBT) and mindfulness-based interventions might be effective for decreasing ED (e.g. Thomson et al., 2015; Weiss et al., 2018; Conner et al., 2019; Factor et al., 2019; Shaffer et al., 2019). However, to our knowledge, only two studies have focused on the treatment of ED in autistic adults. The first study (Conner & White, 2018) evaluated the feasibility and the preliminary efficacy of a 6-week individual mindfulness intervention aiming to enhance emotion regulation abilities. The second study (Hartmann et al., 2019) assessed the effectiveness of a 12-week CBT- and DBT-informed group intervention aiming to enhance emotion regulation and social communication abilities. These

studies have some limitations, however. First, the severity of the ED was not considered; second, individuals with severe comorbidities were excluded in the study by Conner and White (2018) and those with suicidal ideation were excluded in the study by Hartmann et al. (2019). Importantly, the intervention used in the study by Hartmann et al. (2019) mainly targeted social communication difficulties, hence the in-session practices focused exclusively on social situations. Findings on psychological treatments for ED associated with self-harm and suicidal behaviors in autistic adults without ID are therefore lacking.

Dialectical behavior therapy (DBT) (Linehan, 1993) has assembled a large body of evidence in the treatment of ED associated with self-harm and suicidal behaviors in borderline personality disorder (BPD) (Linehan et al., 2006; Panos et al., 2014). DBT is a third-wave CBT that combines acceptance-based techniques, including mindfulness training, and strategies from traditional CBT, including problem-solving, behavioral analysis, contingency management, and skills training techniques (Linehan, 1993). Comprehensive DBT relies on 4 primary modes: (a) weekly group skills training which covers 4 modules balancing acceptance-based skills (Mindfulness and distress tolerance) and change-oriented skills (Emotion regulation and interpersonal effectiveness); (b) weekly individual therapy; (c) as-needed intersession telephone contact between therapist and patient and (d) weekly consultation team meetings for DBT providers. Typically, DBT is provided over 12 months (Linehan, 1993). The optimal duration of DBT has been understudied, but some findings indicate that brief formats (e.g. 6-month, 16-week) are effective in treating ED (e.g. Koons et al., 2001; Stanley et al., 2007; Pasieczny & Connor, 2011; Neacsu et al., 2014; Delparte et al., 2019). Moreover, briefer formats have the advantage of being more feasible, cost-effective, and easily implementable in clinical settings (McMain et al., 2018).

In addition to BPD, DBT has been found to be effective in several psychiatric disorders characterized by ED, e.g., complex post-traumatic stress disorder (c-PTSD), depression, anxiety and eating disorders (Safer et al., 2001; Lynch et al., 2003; Chen et al., 2008; Harley et al., 2008; Bohus et al., 2013; Neacsu et al., 2014). In addition, the efficacy of DBT has also been studied in adults with attention-deficit/hyperactivity disorder (ADHD) (Hirvikoski et al., 2011; Philipson et al., 2014; Fleming et al., 2015), suggesting its clinical pertinence in neurodevelopmental disorders.

In autistic individuals, DBT has been recommended to treat ED but its feasibility and preliminary efficacy have not been investigated (Hartmann et al., 2012; Mazefsky and White, 2014). Indeed, the preliminary study by Hartmann et al. (2019) is the only one that partially incorporated DBT skills and principles. Their results showed no significant improvement in emotion regulation among autistic participants, but they found a significant improvement in social

communication, which was a major focus of their treatment. Thus, to date, there are no findings on the feasibility and/or the preliminary efficacy of an intervention based entirely on DBT in autistic adults without ID.

Given the high prevalence of ED, self-harm and suicidal behaviors in autistic adults without ID (Hirvikoski et al., 2016; Steinfeldt-Kristensen et al., 2020), the lack of evidence-based psychological treatments targeting severe ED in these adults (Bishop-Fitzpatrick et al., 2013; Shattuck et al., 2020), and the potential usefulness of DBT in ASD (Hartmann et al., 2012, 2019), it seems crucial to investigate the feasibility and utility of DBT in this population. This could foster research on the treatment of severe ED in autistic adults without ID and, more importantly, address their clinical needs (Murphy et al., 2016).

Our study aims to evaluate the feasibility, acceptability and preliminary efficacy of a brief 18-week DBT (Neacsiu et al., 2014; Weiner, 2019) for autistic adults without ID presenting with ED and self-harming and/or suicidal behaviors. In addition to being feasible and acceptable, we hypothesize that DBT will lead to a significant decrease in self-reported ED measured by the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), as well as a significant improvement in self-reported depression, hopelessness, alexithymia, perceived quality of life and the frequency and intensity of self-harm and suicidal ideation.

Methods

Participants

Participants were recruited in the adult outpatient clinic of the Psychiatry Department of the University Hospital of Strasbourg. Among the ten participants initially approached, seven (three women and four men) were included and received at least half of the therapy, two were excluded and one declined to participate. The seven participants were aged between 19 and 56 years ($M = 27.71$; $SD = 13.34$). They had previous diagnoses of ASD supported by the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003) and the Autism Diagnostic Observation Schedule, Second Edition revised module 4 (ADOS-2; Hus & Lord, 2014; Lord et al., 2012), as well as previous IQ assessments based on the Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV; Wechsler, 2011) indicating the absence of ID (Total IQ above 80). Total IQ scores ranged from 81 to 156 ($M = 108.8$; $SD = 25.69$) (Table 1).

In addition to a diagnosis of ASD without ID, adult participants had to meet the following two criteria to ensure that they fit the targeted severity: (a) having a DERS total score above the cut-off of 96 at baseline reflecting severe ED (Neacsiu et al., 2014) and (b) exhibiting self-harming

Table 1 Sample description at baseline

<i>Demographics</i>	
Age, Mean (SD)	27.71 (13.34)
Age range	19–56
Gender, n (%)	
Woman	3 (43%)
Man	4 (57%)
Ethnicity	
European white	7 (100%)
Marital status, n (%)	
Single	6 (86%)
In relationship	1 (14%)
Professional status, n (%)	
University student	4 (57%)
Employed	1 (14%)
Unemployed	2 (29%)
<i>Clinical variables</i>	
Total IQ mean (SD)	108.8 (25.69)
IQ range	81–156
Other diagnoses, n (%)	
ADHD	2 (29%)
BPD	1 (14%)
Current psychotropic medication, n (%)	5 (71%)
Psychological and psychiatric care prior to the study	
CBT + psychiatric follow-up	4 (57%)
Psychiatric follow-up only	2 (29%)
No psychological or psychiatric care	1 (14%)
Self-harming behaviors, n (%)	4 (57%)
Suicidal ideation, n (%)	5 (71%)
History of suicide attempts, n (%)	5 (71%)

and/or suicidal behaviors, including suicidal ideation, in the last year prior to the study (Table 2). DERS total scores at inclusion ranged from 107 to 144 ($M = 123.57$; $SD = 13.56$).

Two participants were excluded respectively due to frequent hospitalizations related to a comorbid bipolar disorder and failing to complete post-treatment measures. One participant joined the group in the second half of therapy and followed the first part later in an individual setting.

Medication was unchanged during the study.

Participants received no financial incentives. Their participation was motivated by the potential benefits of the therapy on their mental health.

DBT Intervention

The intervention was based on the 4 components of comprehensive DBT (Linehan, 1993), i.e., (a) a 2h15 weekly skills training group session (Neacsiu et al., 2014; Weiner, 2019) (Table 3), (b) a weekly 1-h individual therapy session, (c)

Table 2 Self-harming behaviors, suicidal ideation and suicide attempts in participants

Participants	Self-harm	Nature of self-harm	Occurrence of self-harming behaviors before therapy	Suicidal ideation	Occurrence of suicidal ideation before therapy	Number of previous suicide attempts	Baseline DERS total score
1	–	–	–	Yes	Very frequent*	1	107
2	Yes	Self-punching	On average 1 occurrence/month	–	–	–	123
3	Yes	Scratching, punching things	On average 1 occurrence/month	Yes	Frequent**	2	126
4	Yes	Inserting needles into the body, genital mutilation	On average 2 occurrences/month	Yes	Frequent**	–	107
5	–	–	–	Yes	Occasional	3	106
6	–	–	–	Yes	Very frequent*	1	144
7	Yes	Skin cutting	At least 3 occurrences/week	Yes	Very frequent*	4	135

*Several times a week

**Several times a month

Table 3 DBT skills training program

Modules	Skills
Mindfulness	1 Wise Mind and the «What» skills of mindfulness
	2 The «How» skills of mindfulness
Distress tolerance	3 STOP and TIPP skills
	4 ACCEPTS skills
	5 IMPROVE and self-soothing skills
	6 Radical acceptance and willingness
Interpersonal effectiveness	7 DEAR MAN skills
	8 GIVE and FAST skills
	9 Validating others and self-validation
Debriefing session	
Mindfulness	10 Mindfulness skills review
Emotion regulation	11 Identifying and labeling emotions
	12 Checking the facts
	13 Opposite action
	14 Problem solving
	15 ABC skills
	16 PLEASE skills
Debriefing session	

access to telephone coaching and, (d) a weekly 2-h therapist consultation.

The 18-week brief DBT protocol applied is based on Neacsiu et al. (2014) and Weiner (2019). The program included 16 skills training sessions and 2 debriefing sessions at mid- and end-of-therapy. The four modules of DBT skills (mindfulness, emotion regulation, distress tolerance and interpersonal effectiveness) were covered during the 16 skills training sessions. The 16-week program developed

by Neacsiu et al. (2014) does not include the debriefing sessions. These debriefing sessions were an opportunity to review the skills learned in the previous sessions, to role-play or model skills, to answer questions and provide additional explanations of the skills if needed, and to collect feedback from participants on their experience in the group sessions, as well as their recommendations (Weiner, 2019). The duration of the intervention is consistent with the length of CBT programs targeting affective disorders in autistic individuals (number of sessions ranging from 4 to 50 and the duration of sessions ranging from 40 to 180 min) (Weston et al., 2016). Moreover, based on previous studies recommending to extend CBT treatments when provided to autistic individuals (e.g. Maddox et al., 2019), the two debriefing sessions added to the 16-week DBT program (Neacsiu et al., 2014) allowed us to meet this recommendation in order to enhance skills learning. In addition, our program consisted of the four modes of DBT – i.e., weekly skills training, weekly individual therapy, telephone coaching and consultation team (Linehan, 1993) – whereas Neacsiu et al.'s (2014) consisted of group skills learning only.

DBT was initially scheduled for January 2020 to late May 2020. However, due to the COVID-19 pandemic, group sessions were interrupted mid-therapy (between March 2020 and June 2020), and the intervention ended in early August 2020. During the two-month interruption, individual sessions continued via phone, video calls or email for those who were not comfortable with phone or video-calls. In addition, every week, participants received a 10 to a 20-min video made by our DBT team reviewing skills previously seen in group sessions.

Adaptations were introduced to DBT to adjust the therapy to the needs of autistic adults without ID (Attwood, 2003;

Anderson & Morris, 2006). Firstly, because of the cognitive inflexibility found in autistic individuals (Nyrenius & Billstedt, 2020), the therapy environment was kept as stable as possible (room, room layout, schedule, facilitators, etc.) and individual sessions were ritualized on a regular schedule for the majority of the participants. Secondly, given the sensory particularities of the participants, we administered the *Adolescent/Adult Sensory Profile* pre-treatment (A/ASP; Brown & Dunn, 2002). Because the majority of participants had auditory hypersensitivity, the skills training took place in the quietest room of the clinic to avoid noise disturbance. The room was also equipped with two air conditioners to adjust the temperature if necessary. Thirdly, as social anxiety is common in autistic individuals (Maddox & White, 2015), we addressed this issue in three ways: (a) the individual barriers to participating in the skills-training group (e.g. the anxiety of being in the presence of other people, the fear of dealing with social interactions in the group, the fear of speaking up in the group) were identified and addressed through psychoeducation and/or problem-solving during the pre-treatment phase, (b) participants were given the possibility to be accompanied to join the group therapy room from the waiting room if needed, and (c) an activity was proposed in the first session to normalize emotions related to anxiety. The activity consisted of anonymously revealing one's anxiety level on a scale of 1 to 4 on a piece of paper and putting it in a ballot box. Then a facilitator counted out loud the papers allowing the participants to realize that anxiety was a shared experience in the group. Fourthly, due to information processing abnormalities found in autistic individuals (e.g. slower information processing, difficulty in selecting relevant information due to weak central coherence, deficits in conceptual reasoning) (Williams et al., 2015; Haigh et al., 2018), DBT patient manuals were modified through a significant reduction in text and the addition of models and images illustrating the skills. We also incorporated the “emotional thermometer”, i.e., a visual tool widely used in ASD to help identify the intensity of emotions (Attwood, 2003). In addition, the facilitators gave concise instructions and explanations based on the use of concrete examples, role-playing and modeling. The mindfulness practices proposed at the beginning of skills training sessions were also based on precise and clear instructions, inviting participants to focus their attention on concrete elements of the present moment (e.g. breath, body sensations, environment sounds, objects) (Spek et al., 2013; Kiep et al., 2015). Fifthly, due to planning difficulties related to executive dysfunction (Wallace et al., 2016), support for planning between-sessions practices was provided when needed. Finally, given that autistic individuals are highly motivated to engage in their focused interests and are more motivated than non-autistic individuals by intrinsic motivational factors (Grove et al., 2016), participants' focused interests were used in examples

during group sessions and incorporated when possible to in between-session practices to enhance their motivation.

Therapists

The skills training group and individual therapy were provided by a senior clinical psychologist (LW, professor of clinical psychology) and a graduate-level clinical psychology intern (DB). LW is a CBT and DBT specialist (trainings attended include DBT foundational training, DBT advanced training, DBT for leaders, DBT for PTSD provided by certified trainers and clinicians—e.g., Shelley McMain, Michaela Swales). DB was trained in DBT during her master's program, which includes a full module on DBT provided by LW, as well as a one-year clinical experience in the DBT clinic of the University Hospital of Strasbourg. The senior psychologist provided weekly supervision to the intern. The therapists relied on the French version of the DBT Skills Training Manual (Linehan, 2017) and participated in weekly team consultations to discuss complex cases and increase adherence to the DBT model.

Measures

Feasibility and Acceptability

Feasibility and acceptability were assessed via (a) the attrition rate, i.e., the percentage of dropouts from therapy, (b) the attendance rate, i.e., the overall percentage of attendance at group sessions, and (c) satisfaction measured quantitatively post-treatment using the Client Satisfaction Questionnaire for psychotherapeutic services (CSQ-8; Sabourin et al., 1989), an 8-item questionnaire using a 4-point Likert scale (1 = not at all satisfied, 4 = completely satisfied) that assesses overall satisfaction with psychotherapeutic care received in inpatient or outpatient services. The measure has excellent psychometric properties when assessing psychotherapy outcomes (Attkisson & Zwick, 1982; Sabourin et al., 1989). Satisfaction was also measured qualitatively through the investigation of participants' subjective experiences of DBT using a semi-structured interview conducted post-treatment by one of the therapists (DB). Despite the potential biases associated with this procedure (e.g., social desirability, lack of neutrality of the interviewer; Collins et al., 2005), this method was preferred for three reasons. First, we aimed at fostering feasibility by reducing the social anxiety and the change anxiety of the participants. Indeed, minimizing potential distress levels is a concern while conducting qualitative research in autistic individuals (e.g. recruiting through a person close to the individual, giving as much detail as possible about the process in advance) (Robertson and Simmons, 2015; Camm-Crosbie et al., 2019). Second, there were no personal relationships between any of the therapists and

any of the participants, maximizing both the therapist and participants' neutrality in the context of the study. Third, the two therapists analyzed the data. Given the absence of qualitative findings on the effects of DBT on autistic individuals, the data were analyzed from an exploratory perspective. Therefore, it was useful to have a background on the subjective experiences to minimize the risk of fragmenting and decontextualizing them in the coding process. The interview template utilized open-ended questions designed to explore participants' experiences in 3 broad areas: (i) experience of the group therapy (e.g. how did you feel in the group during the group sessions?), (ii) experience of the individual therapy (e.g. What did you think of the individual sessions? How useful were they for you?) and (iii) overall impact of the therapy on their lives (e.g. To what extent, if any, has the therapy impacted your daily life?). At the beginning of each interview, the interviewer made it clear to participants that she was interested in learning about their subjective experience, and that there were no right or wrong answers and no obligation to answer any question.

Preliminary Efficacy

To evaluate preliminary efficacy, we administered the following self-report scales pre-treatment (January 2019), post-treatment (June 2019 for the two who participated in half of the therapy and August 2019 for the ones who completed the therapy) and at a 4-month follow-up.

Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), in its French version (Dan-Glauser & Scherer, 2013), is our primary efficacy outcome. DERS measures difficulties in regulating emotions. It consists of 36 items grouped into 6 dimensions: (a) non-acceptance of emotional responses ("Non-acceptance"), (b) difficulty engaging in goal-directed behavior when distressed ("Goals"), (c) impulse control difficulties when distressed ("Impulse"), (d) lack of awareness of emotions ("Awareness"), (e) limited access to strategies for regulation ("Strategies") and (f) lack of emotional clarity ("Clarity"). Items are rated on a 5-point Likert scale (1 = almost never, 5 = almost always). Higher scores correspond to greater difficulties. The DERS has adequate internal consistency (Cronbach's $\alpha=0.93$), test-retest reliability ($r=0.88$), and construct and predictive validity among a college sample (Gratz & Roemer, 2004). McVey et al. (2021) provided preliminary evidence for the utility of the DERS in autistic adolescents and adults. Their results supported a 6-factor structure, similar to that found in the general population (Gratz & Roemer, 2004). However, minor differences were identified: items 1 and 7 loaded onto Awareness instead of Clarity, items 22 and 24 loaded onto Awareness instead of, respectively, Strategies and Impulse and item 34 did not load onto any factor. In

the autistic sample, the DERS subscales showed good internal consistency (Cronbach's α values ranging from 0.80 to 0.90). The tool also showed good construct validity as 5 of the DERS subscales were positively correlated to the Beck Anxiety Inventory (BAI; Beck et al., 1988) and the Beck Depression Inventory-Second Edition (BDI-II; Beck et al., 1996). In the current study, the DERS total and subscale scores were calculated considering the minor modifications supported by these findings. In the absence of an official cut-off, we used the one by Neacsiu et al. (2014) to set the score of 97 as the threshold for severe ED. The internal consistency of the DERS for baseline total scores in the current sample was good ($\alpha=0.78$).

Beck Depression Inventory—Second Edition (BDI-II; Beck et al., 1996), French validation by Bourque and Beaudette (1982), is a 21-item questionnaire that assesses the severity of depression. Items are rated on a scale from 0 to 3 (0 = least, 3 = most). Meta-analysis on 144 studies showed that the BDI-II has strong psychometric properties (Erford et al., 2016). In autistic adults, the BDI-II has strong reliability and validity, as well as a moderate ability to discriminate between depressed and non-depressed individuals (Williams et al., 2021). We calculated BDI-II autism-specific T-scores as suggested by Williams et al. (2021). A person with a T-score ≤ 49.1 is considered as unlikely depressed, with a T-score > 49.1 as possibly depressed, with a T-score > 50.4 as likely depressed, with T-score > 56.7 as very likely depressed, and with a T-score > 60 as almost certainly depressed. The internal consistency of the BDI-II for baseline scores in the current sample was excellent ($\alpha=0.96$).

Beck Hopelessness Scale (BHS; Beck et al., 1974), French validation by Bouvard et al. (1992), is a 20-item true/false scale that assesses key aspects of hopelessness: (a) negative feelings about the future, (b) loss of motivation and (c) lack of hope. Higher scores indicate a greater pessimism and an increased risk of suicide. The BHS has rarely been used to assess hopelessness in autistic individuals (Cashin et al., 2013; Koegel et al., 2016). However, it is the most frequently used instrument for the measurement of hopelessness in clinical and non-clinical populations. In both clinical and non-clinical samples, the measure has good psychometric properties (e.g. Beck et al., 1974; Bouvard et al., 1992; Steed, 2001; Kliem et al., 2018). In clinical populations, the BHS proved to discriminate between individuals with a high and moderate risk of suicide, as well as individuals with and without a history of suicide attempts (Granö et al., 2017; Balsamo et al., 2020). The internal consistency of the BHS for baseline scores in the current sample was good ($\alpha=0.82$).

Eight-item General Alexithymia Factor Score (GAFS-8; Williams & Gotham, 2021) is an 8-item unidimensional scale that measures alexithymia using eight items derived from the Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994). The selection of items (TAS-20 items: 1, 2, 6, 9, 11, 12, 13, and 14) has been found to be a reliable measure of alexithymia in autistic adults (Williams & Gotham, 2021). The GAFS-8 is the only alexithymia score to be thoroughly validated in the autistic population to date (Williams & Gotham, 2021). As the measure is recent and has not yet been validated in French, we referred to the corresponding items in the French version of the TAS-20 (Loas et al., 1996). The internal consistency of the GAFS-8 for baseline scores in the current sample was excellent ($\alpha=0.93$).

Abbreviated World Health Organization Quality of Life Questionnaire (WHOQoL-BREF; The WHOQoL Group, 1998), French validation by Baumann et al. (2010), is a 26-item scale assessing 4 domains of perceived quality of life: (a) physical health, (b) psychological health, (c) social relationships and (d) environment. Items are scored on a 5-point Likert scale. The scores are transformed on a scale from 0 to 100 to enable comparisons to be made between domains composed of unequal numbers of items. The WHOQoL-BREF has good psychometric properties (Skevington et al., 2004). Silva et al. (2014) suggested a cut-off of 60 as being reflective of a satisfactory quality of life. In autistic individuals, the WHOQoL-BREF has good psychometric properties (McConachie et al., 2018). The internal consistency of the WHOQoL-BREF domains for baseline scores in the current sample was good ($\alpha=0.83$ for the “Physical health” domain, $\alpha=0.94$ for the “Psychological health” domain, $\alpha=0.74$ for the “Social relationships” domain and $\alpha=0.85$ for the “Environment” domain).

The frequency of self-harm and suicidal behaviors, as well as the intensity of suicidal ideation, were tracked on the DBT diary card in which participants recorded their emotions, urges and target behaviors daily (Linehan, 1993). At follow-up, we sent participants 6 questions investigating whether the improvements achieved during therapy in terms of self-harming behaviors and suicidal ideation were maintained (e.g. Q1. Since the end of psychotherapy and up to now, have you had self-harming behaviors? Q2. If so, how many times approximately have these behaviors occurred during this period?).

Data Analysis

Descriptive feasibility results were expressed in means (M), standard deviations (SD), numbers and percentages. Thematic analysis was applied to the transcripts of

semi-structured interviews following the guidelines suggested by Braun and Clarke (2006). This required reading and re-reading transcripts to become familiar with the data, coding the content manually and generating main themes. DB carried out the process under the supervision of LW.

Given that the small sample size ($n=7$) does not allow us to assume the normality of the data distribution, we used the Wilcoxon signed-rank test (Wilcoxon, 1945), a non-parametric alternative to the one-sample t test, to analyze the preliminary efficacy outcomes. We performed Wilcoxon signed-rank for pairwise comparisons to assess whether significant differences occurred between pre- and post-treatment, and between pre-treatment and follow-up mean scores for each scale. The significant level was set at $p<0.05$. Pairs Rank-Biserial correlation coefficients (r) were calculated to assess the effect size, r around 0.1 being considered as small effect size, around 0.2 as medium effect size and over 0.5 as large effect size.

We also calculated Reliable Change Indices (RCI; Jacobson & Truax, 1991) for the DERS total score and subscales scores. RCI indicates whether a change that occurred over time in an individual score (e.g., between a patient's pre-intervention and post-intervention assessment) is significantly greater than a difference that could have occurred due to random measurement error alone. The calculation formula is:

$$RCI = (X_{\text{post}} - X_{\text{pre}}) / \sqrt{2 \times SD \sqrt{(1 - r)^2}}$$

where: X_{post} = post-treatment individual score, X_{pre} = pre-treatment individual score, SD = Standard deviation of the clinical sample, and r = test-retest reliability of the measure.

The stability of the DERS has not yet been tested in autistic samples, therefore we referred to the test–retest reliability of the French version (Dan-Glauser & Scherer, 2013). We note that this test–retest value does not consider the minor modifications introduced in the calculation of DERS total score and subscale scores with autistic adults. The calculation of the RCIs is therefore approximate, nevertheless informative. A RCI below -1.96 is considered as a negative reliable change reflecting a significant improvement on the DERS individual total and subscale scores and a RCI above 1.96 is considered as a positive reliable change reflecting a worsening on the DERS individual total and subscale scores (Jacobson & Truax, 1991).

In case of missing data, we considered the overall mean of the scale or the subscale (Kaushal, 2014).

Finally, regarding self-harming behaviors and suicidal ideation, the changes observed in DBT diary cards and self-reported changes at follow-up were reported descriptively.

Results

Feasibility and Acceptability

Attrition Rate

2 (29%) participants out of seven dropped out from therapy. One dropout was due to concerns related to the risk of contracting COVID-19 when the group sessions were resumed in June 2020 after 2 months of lockdown and the other was due to professional reasons. The seven participants completed all assessments and missing data were rare (less than 5%). The participant without a follow-up measure is the one who joined the group mid-therapy and completed the therapy with a time lag.

Attendance Rate

The mean attendance rate of the seven participants was 98% (Range = 90–100%; SD = 4%). Specifically, for the five participants who completed the therapy, the rate was 96% and for the two participants who only participated in the first half of the therapy, the rate was 100% before dropout. These rates reflect high adherence to the therapy. The majority of patients (five out of seven) wished to resume the group

sessions after the lockdown, in compliance with the hospital's health protocol.

Satisfaction Level

Participants, including the two who completed only half the therapy, reported high satisfaction with the therapy as the CSQ-8 mean score was 3.59 out of 4 (Range = 3.13–4; SD = 0.31) (Fig. 1). They were most satisfied with the quality of the skills training sessions, which they all rated at a maximum score of 4. Their intention to return to the care unit if needed and their likelihood to recommend the therapy to a friend also scored high, respectively 3.43 and 3.57 out of 4.

Participants' Subjective Experiences

Five main themes emerged from the thematic analysis (Braun & Clarke, 2006) of the transcripts (Table 4): (a) The environment of the group, described as “caring” and “reassuring”, allowed them to “feel confident”. Some mentioned that the activity to normalize anxiety in the first session helped them to feel more relaxed; (b) the group setting of the skills training was considered rewarding due to the diversity of profiles; this led them to “feel less alone with personal difficulties” and to “meet people like me”. Some

Fig. 1 Mean scores of the CSQ-8 items

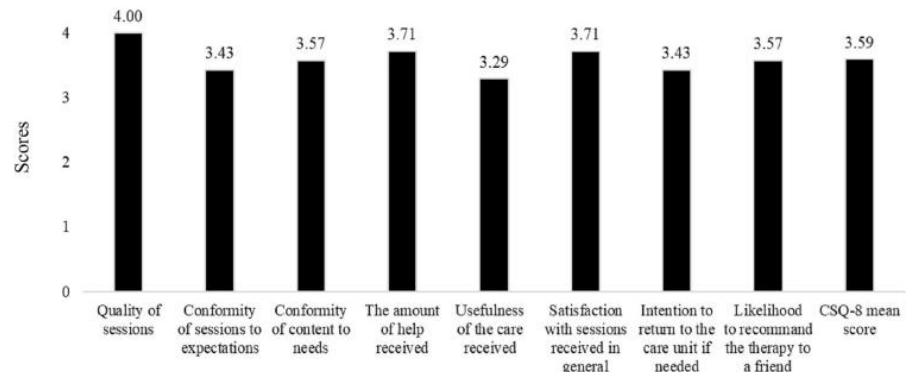


Table 4 Identified themes and example quotes

Theme	Example quote
1 The environment of the group skills training	It's a safe environment. I didn't identify any danger. I felt confident
2 The group setting of the skills training	Being confronted with the group is difficult but necessary. We meet people like us and it has an interesting resonance. You feel you belong to a group
3 The content of the skills training group	There are useful skills that I didn't have and that I discovered, especially understanding and naming emotions, because it was difficult for me to identify what I was feeling
4 The individual therapy sessions	The individual therapy sessions were very helpful. It allows you to dissect and better understand situations and then put the skills together
5 The building of a <i>life worth living</i>	I see other possibilities for the future than dying. I've screwed up many years, I've screwed up my body, now I can do something else with my life

participants suggested that interactions between participants during group sessions could be further encouraged by the facilitators. Only one participant reported that he would have preferred to benefit from the skills training in an individual setting; (c) the skills learned were considered “useful”, “diverse”, “applicable” and “effective”. Some participants suggested adding short and regular skills reviews during the group sessions; (d) the individual weekly therapy sessions were considered essential as they allowed participants to “dissect specific real-life situations”, “put skills together”, and “step back from emotional episodes”; and (e) DBT helped participants to start building a *life worth living* as they felt that they could “accept themselves and their ASD more”, “survive crisis episodes”, “allow themselves to have more fun activities”, “identify one’s values” and to take steps in valued directions. One participant reported having “a new and healthier life”, which led her to grieve the life before therapy where suicide attempts and hospitalizations were frequent.

Preliminary Efficacy

Wilcoxon signed-rank test comparisons of the mean pre- and post-treatment scores revealed significant improvements with large effect sizes (Table 5). The mean DERS total score, assessing self-reported ED, decreased significantly post-treatment ($p=0.036$, $r=-1.00$). This improvement was maintained at follow-up ($p=0.031$, $r=-1.00$). In addition, 4 (57%) of the seven participants had a follow-up score below the cut-off of 96 (Fig. 2).

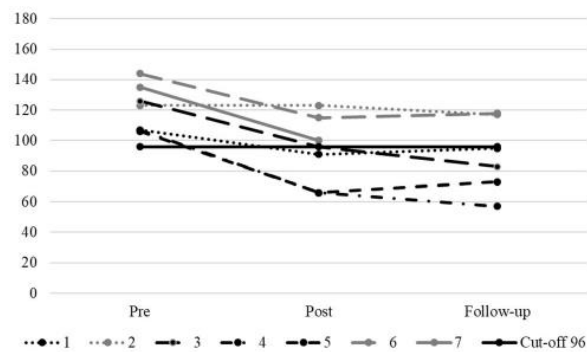


Fig. 2 Individual DERS total scores across the study

On the level of the DERS subscales, the mean scores of three subscales decreased significantly post-treatment with this decrease being maintained at follow-up: “Awareness” (post-treatment: $p=0.036$, $r=-1.00$; follow-up: $p=0.031$, $r=-1.00$), “Impulse” (post-treatment: $p=0.036$, $r=-1.00$; follow-up: $p=0.034$, $r=-1.00$) and “Strategies” (post-treatment: $p=0.035$, $r=-1.00$; follow-up: $p=0.036$, $r=-1.00$).

At the intra-individual level, the DERS total scores showed a negative reliable change ($RCI < -1.96$), i.e., diminished self-reported ED, for 6 (86%) participants out of seven post-treatment. Among the five participants that improved and had a follow-up assessment, the decrease in the DERS total score was maintained for 4 (80%) of them (Table 6). On the subscale level, 5 (71%) participants out of seven demonstrated reliable improvement at the “Strategies”

Table 5 Comparison of the preliminary efficacy outcomes by Wilcoxon signed-rank test

	Pre		Post		Follow-up		Pre-post		Pre-followup	
	Mean	SD	Mean	SD	Mean	SD	<i>p</i>	Effect size	<i>p</i>	Effect size
DERS total	121.14	15.12	93.86	21.98	90.50	24.35	0.036*	-1.000	0.031*	-1.000
Non-acceptance	18.57	6.60	14.57	7.59	15.33	5.39	0.219	-0.571	0.462	-0.381
Awareness	28.43	6.88	20.14	6.49	18.50	4.93	0.036*	-1.000	0.031*	-1.000
Goals	21.14	2.12	20.00	2.52	19.33	4.84	0.134	-0.800	0.293	-0.524
Impulse	21.71	6.42	15.71	7.27	13.33	5.39	0.036*	-1.000	0.034*	-1.000
Strategies	23.00	5.51	17.57	3.55	16.50	5.24	0.035*	-1.000	0.036*	-1.000
Clarity	8.29	2.29	5.86	3.24	7.50	3.83	0.062	-0.821	1.000	-0.048
BDI-II autism-specific ^{T-score}	54.97	11.15	49.39	10.20	50.18	10.10	0.031*	-0.929	0.313	-0.524
BHS	13.57	4.58	8.29	4.42	9.17	3.76	0.022**	-1.000	0.063	-0.905
GAFS-8	26.00	10.31	23.29	7.78	20.29	6.45	0.293	-0.524	0.293	-0.524
WHOQoL-BREF										
Physical health	57.29	16.14	64.57	13.61	56.5	11.18	0.141	0.714	0.581	-0.400
Psychological health	32.14	24.94	42.86	22.66	38.67	20.86	0.181	1.000	0.684	0.267
Social relationships	21.57	26.34	31.14	23.34	29.17	26.05	0.410	0.467	0.789	0.333
Environment	72.43	13.23	80.71	15.38	73.00	14.04	0.035*	1.000	1.000	0.067

* $p < 0.05$

** $p < 0.03$

Table 6 RCIs on DERS individual scores

Participants	DERS total			Non-acceptance			Awareness			Goals			Impulse			Strategies			Clarity		
	Pre-post	Pre-fol-lowup	lowup	Pre-post	Pre-fol-lowup	lowup	Pre-post	Pre-fol-lowup	lowup	Pre-post	Pre-fol-lowup	lowup	Pre-post	Pre-fol-lowup	lowup	Pre-post	Pre-fol-lowup	lowup	Pre-post	Pre-fol-lowup	lowup
1	-2.16 ^a	-1.62	-0.63	-0.42	-0.63	-1.61	-1.61	-1.61	0.68	2.05 ^b	-0.27	-0.00	-0.81	0.41	-2.02 ^a	-2.70 ^a					
2	-0.00	-0.81	0.84	2.52 ^b	0.84	-0.00	0.54	-0.00	-0.00	-0.00	-0.00	-2.94 ^a	-3.25 ^a	-2.84 ^a	-2.70 ^a	3.37 ^b					
3	-4.05 ^a	-5.81 ^a	-1.68	-1.47	-1.68	-1.79	-2.15 ^a	-0.00	-0.00	-4.09 ^a	-1.60	-2.67 ^a	-2.44 ^a	-1.62	-0.67	-2.02 ^a					
4	-5.54 ^a	-6.75 ^a	-3.15 ^a	-2.73 ^a	-3.15 ^a	-1.61	-1.43	-0.68	-0.68	-3.40 ^a	-2.40 ^a	-2.40 ^a	-2.84 ^a	-4.47 ^a	-1.35	-1.35					
5	-5.40 ^a	-4.46 ^a	-0.42	-0.63	-0.42	-3.58 ^a	-3.22 ^a	-2.05 ^a	-2.05 ^a	-1.36	-2.40 ^a	-2.40 ^a	-0.00	0.81	-3.37 ^a	-2.70 ^a					
6	-3.92 ^a	-3.51 ^a	0.63	-0.84	0.63	-0.72	-0.90	-2.05 ^a	-2.05 ^a	-4.09 ^a	-3.20 ^a	-2.40 ^a	-3.25 ^a	-4.87 ^a	1.35	2.02 ^b					
7	-4.73 ^a	-	-	-2.31 ^a	-	-1.07	-	-1.36	-1.36	-	-1.34	-	-2.84 ^a	-	-2.70 ^a	-					

^aNegative reliable change reflecting a significant improvement (RCI < -1.96)^bPositive reliable change reflecting a significant worsening (RCI > 1.96)

subscale post-treatment and 3 (50%) out of 6 at follow-up. Reliable improvement was reported on the “Impulse” subscale by 3 (43%) participants out of 7 post-treatment and by 5 (83%) out of 6 at follow-up. On the “Awareness” subscale, one (14%) participant out of 7 showed reliable improvement post-treatment and 2 (33%) out of 6 at follow-up. On the “Clarity” subscale, reliable improvement was reported by 4 (57%) participants out of seven post-treatment and by 3 (50%) out of 6 at follow-up. 2 (30%) participants showed a reliable worsening at follow-up on this scale, one of them after reliably improving post-treatment. On the “Goals” subscale, reliable improvement was reported by 2 (28%) participants out of seven post-treatment and by 3 (50%) out of 6 at follow-up. A reliable worsening was reported by one participant at follow-up at this subscale. Finally, on the “Non-acceptance” subscale, reliable improvement was reported by 2 (28%) participants out of seven and reliable worsening by one participant (14%) post-treatment. At follow-up, 1 (17%) out of 6 showed a reliable improvement at this subscale.

Mean scores on the BDI-II and BHS also decreased significantly post-treatment (respectively, $p = 0.031$ and $r = -0.93$; $p = 0.022$ and $r = -1.00$) showing a decrease in self-reported levels of depression and hopelessness. Three participants had initial BDI-II autism-specific T -score on the severe range (1 almost certainly depressed and 2 very likely depressed), and they were on the moderate range post-treatment (Likely and possibly depressed); one participant’s BDI-II autism-specific T -score changed from “possibly depressed” to “unlikely depressed” post-treatment. However, the significant improvements on the BDI-II and BHS mean scores were not maintained at follow-up (respectively, $p = 0.313$ and $r = -0.52$; $p = 0.063$ and $r = -0.90$). The self-reported level of depression returned to baseline for 1 participant after improving post-treatment and worsened for another one at follow-up.

Regarding alexithymia, the decrease in the mean GAFS-8 score was neither significant post-treatment ($p = 0.293$, $r = -0.52$) nor at follow-up ($p = 0.293$, $r = -0.52$).

Concerning the perceived quality of life measured by the WHOQoL-BREF, only the mean score in the “Environment” domain increased significantly post-treatment ($p = 0.035$, $r = 1.00$), reflecting greater satisfaction with the living environment, leisure activities and access to care services. However, this significant improvement was not maintained at follow-up ($p = 1.00$, $r = -0.07$).

All participants reported that DBT had a beneficial effect on their self-harm and/or suicidal behaviors, including suicidal ideation.

Of the four participants presenting with self-harm, 3 (80%) reported on the DBT diary cards a complete cessation of self-harming behaviors for at least three months during therapy. At follow-up, 2 (50%) participants reported that they had not engaged in self-harming behaviors during the

4 months following the end of the therapy; and the other 2 (50%) reported having had few self-harming behaviors (ranging from 2 to 4) during the 4-month follow-up period.

There were no suicide attempts during therapy and over the follow-up period. Participant seven (Table 2) who had been hospitalized several times the year prior to engaging in DBT was hospitalized neither during therapy nor during the 4-month follow-up period.

Of the 5 participants with suicidal ideation, 3 (60%) reported that the decline in the frequency of suicidal thoughts observed during therapy continued over the 4-month follow-up period. One participant also reported a decrease in the intensity of suicidal ideation and a higher “tolerance threshold” towards situations that usually triggered suicidal thoughts post-treatment and at follow-up.

Discussion

Our study aimed to evaluate the feasibility, acceptability and preliminary efficacy of DBT in autistic adults without ID presenting with self-harm and/or suicidal behaviors. Our results suggest that DBT is feasible and might be efficacious in reducing ED in this context. These results are consistent with previous findings supporting the relevance of third-wave CBT approaches as a treatment of ED in autistic adults without ID (Conner & White, 2018; Hartmann et al., 2019). Importantly, our results are the first to suggest that DBT might be feasible and clinically pertinent for autistic adults without ID presenting with self-harm and/or suicidal behaviors.

Firstly, our results reveal that DBT was feasible and highly acceptable to participants. Indeed, adherence to DBT was high and participants were highly satisfied with both group and individual sessions. Their subjective experience of DBT was overall positive, including group skills training, individual sessions, and the impact of DBT on *building a life worth living*. They also judged the adaptations introduced to DBT as relevant, consistent with findings suggesting that adaptations are required to foster the feasibility of psychotherapies in autistic individuals (Weston et al., 2016; Cooper et al., 2018). Moreover, it should be noted that in France, as in other European countries, psychological care for autistic adults is still underdeveloped, despite government efforts in recent years (Micai et al., 2021). This may have had an impact on the subjective feedback of the participants, as most of them were glad to have access to a psychological treatment conceived to address their specific needs.

Secondly, our results suggest that DBT might effectively reduce ED in autistic adults exhibiting self-harm and/or suicidal behaviors, as reflected by the significant decrease in the DERS total scores post-treatment and at follow-up. Specifically, the mean scores of the “Awareness”, “Impulse”

and “Strategies” subscales decreased significantly, with improvements being maintained at follow-up. In other clinical samples than autistic adults, previous findings suggest that DBT may have a significant positive effect on some (i.e., “Strategies” and “Goals”) or all of the DERS subscales (e.g. Gibson et al., 2014; Neacsiu et al., 2014; Alavi et al., 2021). In our study, on the “Clarity” subscale, the mean score did not improve significantly, but on the intra-individual level, the RCIs of four participants showed a reliable improvement. These discrepant outcomes are due to the “Clarity” mean score which was impacted by the worsening of scores in two participants at follow-up; one of them was grieving the loss of a loved one at the time of the assessment. Regarding the “Goals” and “Non-acceptance” subscales, we hypothesize that skills related to these domains were less intensely addressed by the program than the skills related to “Awareness”, “Impulse” and “Strategies”. Indeed, “Non-acceptance” was mainly addressed in the session on “Radical acceptance” (one session of the distress tolerance module) and those related to “Goals” were targeted mainly in the session on “opposite action” (one session of the emotion regulation module). By contrast, “Awareness” was addressed during the three sessions of the mindfulness module and practiced at the beginning of each session; “Impulse”, which refers to impulsivity during an emotional crisis, was taught during three sessions of the distress tolerance module; and “Strategies” encompasses the full range of DBT skills.

Regarding individual DERS total scores, the RCIs revealed a reliable improvement for six participants out of seven post-treatment, with four of them maintaining this improvement at follow-up. Individual scores improved the most on the “Impulse” and “Strategies” subscales. These improvements are consistent with those observed in the mean score level. However, the significant improvement in the mean score of the “Awareness” subscale was not reflected in the individual results, as only one participant out of seven showed a reliable improvement post-treatment and two out of six at follow-up. The test–retest reliability of this subscale is the lowest of the DERS subscales with $\rho = 0.67$ (Dan-Glauser & Scherer, 2013), which probably had an impact on the calculation of the RCIs of this subscale.

Overall, the significant improvement in self-reported ED is consistent with our clinical observations and with findings relative to DBT in several disorders (Panos et al., 2014; DeCou et al., 2019). It is also in line with the results of other studies targeting ED in autistic adults without co-occurring ID using third-wave CBT approaches, including interventions partially based on DBT (Conner & White, 2018; Hartmann et al., 2019). However, our study is different from previous research due to: (a) the approach adopted, based entirely on DBT, and (b) the population of interest, i.e., autistic adults without ID exhibiting self-harm and/or suicidal behaviors associated with severe ED. The latter

point is particularly important given that recent research has highlighted the high prevalence of self-harm and suicidal behaviors in this population and the lack of psychological interventions aiming to address them (Licence et al., 2019; Cassidy et al., 2020; Moseley et al., 2020).

The data collected on DBT diary cards showed that the majority of the participants with self-harm ceased these behaviors for at least 3 months up to the post-treatment measure, and this was maintained in half of them at follow-up. In only one participant, DERS total score did not improve, although self-harming behaviors did, with a complete cessation post-treatment and at follow-up. This discrepancy might be explained by contextual factors: The post-treatment and the follow-up assessments were conducted while this participant was experiencing work-related problems and grieving the loss of a family member. The frequency and severity of self-harm decreased in most of the participants. In addition, most of the participants reported a decline in the frequency of suicidal thoughts and no suicide attempt occurred during the study. These improvements are in line with previous studies that support the effectiveness of DBT in reducing suicidal behaviors (Panos et al., 2014; DeCou et al., 2019). Given the significant improvement in DERS mean scores, we hypothesize that the acquisition of emotion regulation skills enabled participants to cope more effectively with stressful situations. This is consistent with several findings suggesting that emotion regulation skills use is a key change mechanism of DBT (Lynch et al., 2006; Neacsu et al., 2010; Mehlum, 2021).

Regarding self-reported depression, hopelessness and quality of life, significant improvements were achieved post-treatment but they were not sustained at follow-up. Post-treatment outcomes are consistent with previous studies showing that brief DBT formats result in a significant decrease in these clinical dimensions at the end of the treatment (Stanley et al., 2007; Mehlum et al., 2014; Swales et al., 2016; Sahranavard & Miri, 2018). Other studies have found that changes in depression (e.g. Lynch et al., 2003; Neacsu et al., 2014; Mehlum et al., 2019), hopelessness (e.g. Mehlum et al., 2019) and quality of life (Carter et al., 2010) measures were sustained at follow-up. In our sample, we hypothesize that the improvement observed on these dimensions was not sustained at follow-up due to the effects of the COVID-19 pandemic on the participants' mental health. Indeed, all of them reported increased depression and anxiety related to the pandemic, and one of them lost a family member due to COVID-19. Their reports are in line with findings showing that the COVID-19 pandemic increased the level of distress and depression in autistic individuals and decreased their quality of life (Mutluer et al., 2020; Patel et al., 2021). However, it is noteworthy that our main outcome, ED, proved resistant to the unfavorable context as

the significant improvement in the DERS mean scores was maintained at follow-up.

Alexithymia is the only dimension that did not show statistically significant improvement following DBT neither post-treatment nor at follow-up. This result is inconsistent with the significant improvement in the mean score of the "Awareness" DERS subscale—referring to difficulties in recognizing one's emotions—observed in our sample. However, we note that alexithymia cannot be reduced to "Awareness", i.e., being aware of one's emotions. Indeed, it also encompasses difficulties in describing one's feelings, externally orientated thinking and constricted imaginal processes (Goerlich, 2018). Hence, it is possible that the participants became more aware of their emotions following DBT, but they still had difficulties in labeling them, as well as flexibly orienting their attention and their imagination processes. Attention and imagination peculiarities are core difficulties found in autistic individuals, which were only marginally targeted by our DBT intervention. Hence the lack of significant improvement on the GAFS-8 in our study might be explained by the fact that alexithymia was not the main target of our intervention (Cameron et al., 2014). Alexithymia has rarely been measured in DBT protocols (Bianchini et al., 2019; Holmqvist Larsson et al., 2020), and it is still unknown whether and how it changes in other clinical populations during the course of DBT.

Given that our study is the first to assess the feasibility, acceptability and clinical pertinence of DBT in autistic adults without ID, several limitations are to be noted. First, the sample size ($n = 7$) was small, which does not allow generalizing the results to the target population. Second, there was no control group, which does not allow providing definitive evidence that the improvements found here are due to DBT. Regarding these two limitations, larger sample sizes and the use of control groups are needed in future studies to investigate the efficacy of DBT in controlled trials with autistic adults without ID presenting with self-harm and/or suicidal behaviors. Third, the duration of participation was heterogeneous (two patients completed half of the therapy) due to the dropouts caused by the pandemic, which may have influenced outcomes. Fourth, the study sample was heterogeneous in terms of age, IQ, and severity of self-harm and suicidal behaviors, making it difficult to determine the clinical characteristics of the autistic adults that can benefit the most from the treatment. However, this heterogeneity might be considered as representative of the variability present among the autistic population (Masi et al., 2017). Our sample was homogeneous in terms of ethnicity, however, as all participants were white Europeans. To determine whether DBT is pertinent to the autistic population irrespective of ethnicity, future studies should consider including diverse samples with various ethnic and cultural backgrounds.

Fifth, all the measures were self-reported. This can be particularly problematic since autistic individuals might present with high levels of alexithymia, which can interfere with their ability to recognize their emotional states (Kinnaird et al., 2019; Ziermans et al., 2019). However, all measures used here, except the BHS, have been proven to be reliable and valid in autistic adults (DERS: McVey et al., 2021; BDI-II: Williams et al., 2021; GAFS-8: Williams & Gotham, 2021; and WHOQoL-BREF: McConachie et al., 2018); the DERS, in particular, has recently been shown to be valid and reliable in autistic individuals in clinical settings, and has been suggested as potentially useful in trials evaluating the effectiveness of psychological interventions, such as DBT, on ED (McVey et al., 2021). Nevertheless, to gain further insight on how DBT might reduce ED in autistic individuals, future studies may consider including objective assessments such as physiological measures to quantify changes in ED (e.g. Vasilev et al., 2009; Davies et al., 2015). Sixth, the interviews and the qualitative analysis were conducted by the therapists involved in the study, which might have interfered with the neutrality required in the process. Indeed, since this was a feasibility trial, we favored feasibility—e.g., reduction of participants' social anxiety—over the maximization of neutrality. In future mixed methods studies investigating the efficacy of DBT on autistic individuals, the interviews and data analysis should be conducted by researchers who are not directly involved in the therapy (Sutton & Austin, 2015). Moreover, the use of double-code transcripts (Raskind et al., 2019) and specific computer softwares (Cope, 2014) are warranted. Finally, our study was disrupted by the COVID-19 pandemic, which was the case for clinical research in general (Padala et al., 2020; Sathian et al., 2020). Despite this, we found that self-reported ED improved significantly post-treatment and at follow-up, whereas other mental health measures (e.g., depression) improved post-treatment and this was lost at follow-up. These results highlight the specific and robust impact of DBT on self-reported ED, which proved resilient despite the highly stressful conditions related to the pandemic.

Overall, our results are the first to suggest that DBT is feasible and they provide preliminary evidence for its efficacy for the treatment of severe ED in autistic adults without ID exhibiting self-harm and suicidal behaviors. These results bear important clinical relevance, given the lack of evidence-based psychological treatments targeting the specific needs of a large number of autistic adults presenting with ED associated with self-harm and/or suicidal behaviors. Importantly, they support the need to further study the efficacy of DBT in autistic adults without ID through randomized controlled trials (Huntjens et al., 2020).

Author Contributions DB and LW developed the study aim and protocol. They set up the protocol and provided the DBT treatment. LW also provided DBT supervision to DB. RC and SW were actively involved in recruiting participants. DB conducted the statistical and qualitative analyses with the help of SW and LW. DB wrote the first draft with LW, RC and SW provided feedback. All authors read and approved the final manuscript.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors. The current study is the preliminary step for a randomized controlled trial (RCT) being conducted as part of DB's PhD project that was approved by the regional ethics committee of the East of France (No. SI 21.01.21.41923).

Informed Consent Informed consent was obtained from all individual participants included in the study.

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AXIS 2 – Study 2

Dialectical Behaviour Therapy to Treat Emotion Dysregulation in Autistic adults without Intellectual Disability: a Randomized Controlled Trial

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Abstract

Background: Emotion dysregulation (ED) is prevalent in autistic adults without intellectual disability (ID). Importantly, ED has been associated with non-suicidal self-injury (NSSI) and suicidal behaviours in autistic adults. Dialectical behaviour therapy (DBT) has shown to be feasible and acceptable among autistic adults without intellectual disability. Preliminary findings also suggest that DBT might reduce ED associated with NSSI and/or suicidal behaviours in this population. However, studies evaluating the efficacy of DBT to treat ED in autistic adults are lacking.

Methods: 63 autistic adults presenting with ED with NSSI and/or suicidal behaviours were randomized either to the DBT condition (18-week comprehensive DBT treatment) or to the treatment as usual (TAU) condition. Participants completed self-reported questionnaires – including ED, alexithymia, DBT skills use and quality of life– at pre-, mid-, post-DBT, and at 6-month follow-up. Mediation and moderation effects were explored.

Results: Self-reported ED, alexithymia and DBT skills use improved significantly more in the DBT condition relative to TAU at mid- and post-DBT; the improvement was sustained at follow-up in the DBT condition. Additionally, alexithymia and mindfulness mediated the treatment effects on ED mid- and post-DBT. Moreover, self-reported depression, mindfulness and quality of life improved significantly more in the DBT condition than TAU post-DBT, with improvements lasting at follow-up in the DBT condition. However, there was no significant difference between conditions on impulsivity, anxiety, and suicide ideation. Finally, autistic traits and marital status (single/in relationship) moderated the DBT effect on ED at follow-up.

Conclusions: DBT seems to be effective to reduce ED in autistic adults with NSSI and/or suicidal behaviours. Interestingly, the improvements on ED were mediated by a decrease in alexithymia and an increase in mindfulness scores.

Keywords: Autism spectrum condition, Adults, Emotion dysregulation, Non-suicidal self-injury, Suicidality, Dialectical behaviour therapy, Randomized controlled trial.

Background

A growing body of research indicates high rates of non-suicidal self-injury (NSSI; Moseley et al., 2019; Maddox et al., 2017) and suicidality (Cassidy et al., 2014; Hirvikoski et al., 2016; Kirby et al., 2019; Kølves et al., 2021) in autistic people, including autistic adults without intellectual disability. Indeed, population-based cohort studies have reported a 3.7 to 9-fold increase in death by suicide among autistic adults without intellectual disability compared to the general population (Hirvikoski et al., 2016; Kølves et al., 2021), with this risk being heightened in those with a co-occurring ADHD (Hirvikoski et al., 2016). Autistic women, in particular, appear to be at the highest risk of dying by suicide among the autistic population (Hirvikoski et al., 2016). Recent studies show that emotion dysregulation (ED) is prevalent in autistic people (Conner et al., 2021; Cai et al., 2018; Samson et al., 2014), including autistic adults (Swain et al., 2015). Difficulties with emotion regulation (ER) in autistic people have been pinpointed as potential contributors to the high rates of co-occurring psychopathology, such as anxiety and depression (Conner et al., 2023; Riedelbauch et al., 2023; Conner et al., 2021). Importantly, ED has also been shown to be involved in NSSI and suicidal behaviours in autistic people (Moseley et al., 2019; Conner et al., 2020; Licence et al., 2020; Jachyra et al., 2022). Indeed, recent findings show that NSSI might be used by autistic people to regulate painful emotions, particularly low-energy affective states like depression and numbness and high-energy affective states like anger and anxiety (Licence et al., 2020; Moseley et al., 2019). NSSI has been strongly linked to alexithymia in autistic people –i.e., difficulties identifying and expressing one's emotions– (Moseley et al., 2019), as awareness of emotions is considered to be a prerequisite to effective ER (Subic-Wrana et al., 2014). Moreover, ED is strongly associated with increased suicide ideation in autistic youth, suggesting its involvement in the high rates of suicidality in autistic people (Conner et al., 2020).

There is no consensus on whether ED found in autistic adults is due to co-occurring disorders or rather predispose to co-occurring disorders (Mazefsky et al., 2013; Charlton et al., 2020; Conner et al., 2020). Consistent with the latter view, Morie et al. (2019) found that ED mediated the association between autistic features and anxiety, suggesting that anxiety may arise in autistic people through ED. Additionally, high autistic traits (e.g., sensory sensitivities, reduced flexibility, social interaction difficulties) have been associated with a heightened ED, indicating that ED might be intrinsic to autism (Berkovits et al., 2017; Mazefsky & White, 2014). Relatedly, autistic camouflaging—i.e., efforts to mask and/or compensate for autistic traits to ‘fit in’ in a non-autistic society—has also been associated with lifetime suicidality in autistic adults without intellectual disability (Cassidy et al., 2020; Beck et al., 2020), particularly autistic women (Beck et al., 2020; Lai et al., 2017). However, the relationship between autistic camouflaging and ED has not been investigated.

Research on ED in autistic people is recent, and few studies have focused on treatments targeting ED in this population. Psychotropic treatments have shown limited efficacy in treating ED in autistic people (Salazar de Pablo et al., 2022) and evidence-based psychotherapies are lacking, especially for autistic adults (Kuroda et al., 2022; Beck et al., 2020; Conner & White 2018). Thus, it is crucial to develop psychological interventions targeting ED in autistic adults, especially when ED is associated with life-threatening behaviours (Conner et al., 2020; Moseley et al., 2019).

Dialectical behaviour therapy (DBT) (Linehan, 1993) is a third-wave cognitive behavioural therapy (CBT) that assembled a large body of evidence in treating ED associated with NSSI and suicidal behaviours in borderline personality disorder (BPD) (Linehan et al., 2006; Panos et al., 2014). DBT has subsequently proved its efficacy to treat ED in several psychiatric disorders, such as depression, anxiety and eating disorders, as well as in transdiagnostic contexts (Chen et al., 2008; Harley et al., 2008; Lynch et al., 2003; Neacsiu et

al., 2014; Safer et al., 2001). Interestingly, DBT has also been shown effective in adults with attention-deficit/hyperactivity disorder (ADHD) (Fleming et al., 2015; Hirvikoski et al., 2011), which suggests its clinical relevance in neurodevelopmental conditions.

Different mechanisms seem to lead to improvements in ED following DBT (Mehlum, 2021; Lynch et al., 2006). Main identified mechanisms in DBT for BPD include an increased use of ER skills (Mehlum, 2021; Boritz et al., 2019), reduced alexithymia (Boritz et al., 2019), reduced behavioural impulsivity (Mehlum, 2021; Rudge et al., 2017), and the quality of the therapeutic alliance (Mehlum, 2021; Rudge et al., 2017).

DBT has been recommended to treat ED in autistic individuals (Hartmann et al., 2012; Mazefsky & White, 2014). In a recent first-person account of an autistic adult without intellectual disability, DBT with some adaptations (e.g., using visuals, graphics and incorporating the client's interests to the therapy) was seen as beneficial to treat ED (Keenan et al., 2023). Moreover, preliminary findings support the feasibility and high acceptability of comprehensive DBT (Bemmouna et al., 2022), as well as standalone group skills training (Ritschel et al., 2022) among autistic adults without intellectual disability. Importantly, Bemmouna et al.'s (2022) feasibility study involving autistic adults with ED associated with NSSI and/or suicidal behaviours found that DBT resulted in a significant decrease in ED and its behavioural correlates (i.e., NSSI and suicidality). However, to our knowledge, no study to date has provided evidence of the efficacy of DBT in treating ED in autistic adults without intellectual disability. Moreover, no study has investigated the mechanisms of change of DBT in this population.

This study aims to evaluate the efficacy of a brief 18-week comprehensive DBT (Bemmouna et al., 2022; Neacsiu et al., 2014; Weiner, 2019) for autistic adults without intellectual disability presenting with ED and NSSI and/or suicidal behaviours. To do so, in this randomized controlled trial (RCT), autistic adults will be allocated to the DBT condition

(directly receiving the treatment) or the treatment as usual (TAU) condition (5-month waitlist before receiving the DBT treatment). Assessments included a 6-month follow-up measure to check the sustainability of outcomes. In addition, mediation and moderation effects were explored. Our hypotheses are the following: **(H1)** self-reported ED measured by the *Difficulties in Emotion Regulation Scale* (DERS; Gratz & Roemer, 2004) –our main efficacy outcome– will decrease significantly more in the DBT condition compared to the TAU condition mid and post-treatment. The improvements observed in the DBT condition will be maintained at the 6-month follow-up; **(H2)** secondary outcomes, i.e., depression, anxiety, impulsivity, alexithymia, and suicide ideation, DBT skills use, mindfulness and quality of life will improve significantly more in the DBT condition relative to the TAU condition both mid- and post-DBT. Improvements will also be maintained at the 6-month follow-up in the DBT condition; **(H3)** a decrease in alexithymia, impulsivity, and an increase of skills use and mindfulness will mediate the effect of DBT on ED; **(H4)** autistic traits, autistic camouflaging, BPD traits, time since diagnosis, treatment credibility and the marital status (single/in a relationship) will moderate the effect of DBT on ED. Regarding the moderation analyses, given the positive correlation between ED and the variables of interest (with the exception of time since diagnosis and treatment credibility), we expect that the higher the corresponding scores for these dimensions, the lower the improvement on ED.

Methods

Participants' recruitment and study sample

The study was advertised by e-mail, telephone, and face-to-face meetings among a wide network of psychiatrists and psychologists in institutions and private practice, associations for autistic adults, and the local university's special needs unit. Participants were referred by mental health professionals or contacted us on their own initiative after having read the study brochure.

Participants had to meet the following criteria: **(a)** being ≥ 18 years old, **(b)** having a formal diagnosis of autism spectrum condition (ASC) supported by the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003) and the Autism Diagnostic Observation Schedule, Second Edition revised module 4 (ADOS-2; Hus & Lord 2014; Lord et al., 2012), as well as a previous IQ assessment based on the Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV; Wechsler, 2011) indicating the absence of intellectual disability (Total IQ above 80), **(c)** having a DERS total score above the cut-off of 96 at baseline reflecting high ED (Neacsiu et al., 2014), **(d)** presenting NSSI and/or suicidal behaviours and/or suicide ideation in the 6 months prior to inclusion, and **(e)** being able to understand and consent to the research aims.

Twenty-six individuals had suspected ASC, but no formal diagnosis. With their consent, they underwent ASC assessments performed in collaboration with the adult ASC Expert Center of Strasbourg. Following the evaluations, 18 were diagnosed with ASC and were included in the study.

Exclusion criteria were: **(a)** having already received DBT, and **(b)** having a lifetime diagnosis of schizophrenia, schizoaffective disorder, or any unspecified psychotic disorder.

Participants received no financial incentives. Their participation was motivated by the potential benefits of the therapy on their mental health.

The minimal sample size was estimated based on assumptions on the DERS scores distributions from the pilot study. The margin of error was set at 0.05 and the minimal statistical power at 90%. A sample of at least 48 participants was required to demonstrate a reduction of at least 10 points in the DERS mean score mid-therapy (T1) compared to baseline (T0), with a power of 95%, and a reduction of at least 15 points post-therapy (T2) and at 6-month follow-up (T3) compared to T0, with a power of 91%. To cover potential dropouts, 64 participants were included.

Procedure

Individuals eligible for inclusion were randomized with a 1:1 allocation ratio into one of these two conditions: **(a)** DBT condition (experimental condition) where participants directly received the DBT treatment, or **(b)** TAU condition (control condition) where participants were on a 5-month waiting list before receiving the same DBT treatment in their turn. Participants in the TAU condition continued their usual care, consisting of a psychiatric follow-up and psychological counselling, while on the waiting list. Participants did not receive CBT nor DBT during the study.

Randomization was carried out on Cleanweb platform, in blocks of 16 participants (4 blocks in total), resulting in 8 groups in total. Randomization occurred as participants' recruitment progressed, therefore preventing stratification using baseline variables.

After the therapy, participants were contacted for a 6-month follow-up assessment, which marked the end of their participation in the study.

Participants were encouraged to maintain their psychotropic medication stable during their participation in the study. However, they were not excluded if a minor treatment change occurred during the study (e.g., dose change), given the difficulty to ensure such stability due to the long duration of their participation (11 months for the DBT condition and 16 months for the TAU condition, including the follow-up period).

DBT treatment

The intervention consisted of an 18-week comprehensive DBT, similar to that provided in our pilot study ([Bemmouna et al., 2022](#); [Neacsiu et al., 2014](#); [Linehan, 1993](#)). The treatment encompassed **(a)** a 2h15 weekly skills training group session, **(b)** a weekly 1-hour individual therapy session, **(c)** access to telephone coaching, and **(d)** a weekly 2-hour therapist consultation. The ER skills training sessions covered the four DBT modules, i.e., mindfulness

(3 sessions), emotion regulation (6 sessions), distress tolerance (4 sessions) and interpersonal effectiveness (3 sessions). Two debriefing sessions took place at mid- and end-of-therapy.

Key adaptations of DBT to autistic adults without intellectual disability are similar to those introduced for the pilot study (Bemmouna et al., 2022), i.e., **(a)** maintaining the stability of the therapy environment (room, schedule, facilitators, etc.); **(b)** adapting the participant's manuals through a significant reduction in text and the addition of schematics and images illustrating the skills; **(c)** addressing the individual barriers to participating in the skills group (e.g. the anxiety of being in the presence of other people, the fear of dealing with social interactions, the fear of speaking up in the group) during the pre-treatment sessions; **(d)** giving concise instructions and explanations based on the use of concrete examples, role-playing and modeling; **(e)** facilitating mindfulness practices based on precise and clear instructions, inviting participants to focus their attention on concrete elements of the present moment (e.g. breath, body sensations, environment sounds, objects) (Spek et al., 2013; Kiep et al., 2015); **(f)** providing support for inter-session practice if needed; and **(g)** for those with intense interests, therapists tried to introduce these interests into the examples/practices. Moreover, all participants filled in the *Adolescent/Adult Sensory Profile* (A/ASP; Brown & Dunn, 2002) pre-treatment to identify their sensory particularities and to take them into account during therapy. The group sessions were scheduled in the quietest rooms of the clinic.

Therapists

The skills training group and individual therapy were provided by four clinical psychologists, including a senior psychologist (LW, professor of clinical psychology, extensively trained in DBT). All psychologists were trained both in CBT and in DBT through their university training, but also through specialized DBT training programs and clinical experience within the DBT team of the University Hospitals of Strasbourg.

The senior psychologist provided weekly supervision to the team. The therapists relied on the French version of the *DBT Skills Training Manual* (Linehan, 2017) and participated in weekly consultation team to discuss complex cases and increase adherence to the DBT model.

Measures

Feasibility and acceptability

Feasibility and acceptability were assessed via : **(a)** the attrition rate, i.e., the percentage of dropouts from therapy, **(b)** the attendance rate, i.e., the overall percentage of attendance at group sessions, and **(c)** satisfaction measured quantitatively post-treatment using the *Client Satisfaction Questionnaire for psychotherapeutic services* (CSQ-8; Sabourin et al., 1989), an 8-item questionnaire using a 4-point Likert scale (1 = not at all satisfied to 4 = completely satisfied) that assesses overall satisfaction with psychotherapeutic care received in inpatient or outpatient services. The measure shows excellent psychometric properties when assessing psychotherapy outcomes (Attkisson & Zwick, 1982; Sabourin et al., 1989).

Efficacy

To evaluate the intervention's efficacy, we administered the following self-report scales pre-treatment (T0), mid-treatment (T1), post-treatment (T2), and at a 6-month follow-up (T3). Participants in the TAU condition completed the T1 and T2 questionnaires at the same time as those in therapy. They completed the questionnaires again at equivalent time points, including at 6-month follow-up, once they switched to the DBT condition (**Figure 1**). Between-condition comparison is made at T0, T1 and T2, but not at T3. Indeed, the TAU condition does not have a T3 measure, because at that point they had switched to the DBT condition.

	T0	T1	T2	T3	T1'	T2'	T3'
DBT condition	x	x	x	x			
TAU condition	x	x	x				
DBT after TAU condition					x	x	x

Figure 1. *Assessment points for each condition.*

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004), French version by Dan-Glauser and Scherer (2013), is our primary efficacy outcome. DERS measures ER difficulties. It consists of 36 items grouped into 6 dimensions: (a) non-acceptance of emotional responses (“Non-acceptance”), (b) difficulty engaging in goal-directed behaviours when distressed (“Goals”), (c) impulse control difficulties when distressed (“Impulse”), (d) lack of awareness of emotions (“Awareness”), (e) limited access to strategies for regulation (“Strategies”) and (f) lack of emotional clarity (“Clarity”). Items are rated on a 5-point Likert scale (1= almost never to 5= almost always). Higher scores indicate greater difficulties. The DERS has adequate internal consistency (Cronbach's $\alpha = .93$), test–retest reliability ($r = .88$), and construct and predictive validity among a college sample (Gratz & Roemer, 2004). In the current study, the DERS total and subscale scores were calculated considering the minor modifications supported by McVey et al. (2021) findings on the utility of the DERS in autistic adolescents and adults. In the absence of an official cut-off, we used the one by Neacsiu et al. (2014) to set the score of 97 as the threshold for high ED. The internal consistency of the DERS for baseline total scores in the current sample was very good (Cronbach's $\alpha = .84$).

The Barratt Impulsiveness Scale-short form (BIS-15; Spinella, 2007), French version by Rousselle and Vigneau (2016), is an abbreviated version of the 30-item BIS-11 (Patton et al., 1995; Stanford et al., 2009). The BIS-15 is a self-report questionnaire constituted of 15 items that assesses three facets of impulsivity: (a) non-planning, (b) motor impulsivity, and (c) attentional impulsivity. Each item is scored on a 4-point Likert scale (1= rarely to 4= almost always). Higher scores represent higher impulsivity. The BIS-15 has proven to be a reliable measure of impulsiveness, showing a good internal consistency (Cronbach's $\alpha = .79$) (Spinella, 2007). The internal consistency of the DERS for baseline total scores in the current sample was very good (Cronbach's $\alpha = .86$).

The Eight-item General Alexithymia Factor Score (GAFS-8; Williams & Gotham, 2021) is a self-report measure for alexithymia using 8 items from the Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994). The selection of items (TAS-20 items: 1, 2, 6, 9, 11, 12, 13, and 14) has been found to be a reliable measure of alexithymia in autistic adults (Williams & Gotham, 2021). Items are rates on a 5-point Likert scale (1= strongly disagree to 5= strongly agree). Higher scores represent higher alexithymia. The GAFS-8 is the only alexithymia score to be thoroughly validated in the autistic population to date (Williams & Gotham, 2021). As the measure is recent and has not yet been validated in French, we referred to the corresponding items in the French version of the TAS-20 (Loas et al., 1996). The internal consistency of the GAFS-8 for baseline scores in the current sample was very good (Cronbach's $\alpha = .81$).

The Beck Anxiety Inventory (BAI; Beck et al., 1988), French version by Freeston et al. (1994), is a 21-item self-report measure of anxiety symptoms. It uses a 4-point Likert scale (0= not at all to 3= severely, I could barely stand it). Beck and Steer (1993) suggested 16 as cut-off for clinically significant anxiety on the BAI. Higher scores represent higher anxiety. The scale has a high internal consistency (Cronbach's $\alpha = .92$) and a test-retest reliability (Beck et al., 1988). The internal consistency of the BAI for baseline scores in the current sample was very good (Cronbach's $\alpha = .89$).

The Beck Depression Inventory—Second Edition (BDI-II; Becket al., 1996), French validation by Bourque and Beaudette (1982), is a self-report questionnaire that assesses the severity of depression. The 21 items are rated on a scale (0= least to 3= most). Higher scores represent higher depression. Dole et al. (2012) suggested ≥ 23 as cut-off for clinically significant depression on the BDI-II. A meta-analysis on 144 studies showed that the BDI-II has strong psychometric properties, including a very good internal consistency (Cronbach's $\alpha = .89$) (Erford et al., 2016). In autistic adults, the BDI-II has strong reliability and validity, as well as a moderate ability to discriminate between depressed and non-depressed individuals (Williams

et al., 2021). The internal consistency of the BDI-II for baseline scores in the current sample was very good (Cronbach's $\alpha = .87$).

The Beck Scale for Suicide Ideation (BSS; Beck & Steer, 1991), French version by De Man et al. (1987). The BSS is a self-report scale that includes 21-items assessing the intensity of suicide ideation over the past week. The total score comprises the first 19 items (scored 0 to 2). Higher values indicate a greater risk of suicide. The BSS has proven to be a reliable measure across many different settings and samples, showing good internal consistencies (e.g., Cronbach's $\alpha = .87$ in an outpatient sample (Barnhofer et al., 2009), and $\alpha = .89$ in a risk sample (Crane et al., 2014)). The internal consistency of the BSS for baseline scores in the current sample was excellent (Cronbach's $\alpha = .90$).

The DBT Ways of Coping Checklist (DBT-WCCL; Neacsiu et al., 2010), French version by (Janelle et al., 2011), is a 59-item self-report scale on the frequency of adaptive and maladaptive skills used to regulate emotions over the past month. Thirty-eight items measure the frequency of DBT skills use and 21 items measure dysfunctional coping strategies. Items are rated on a 4-point Likert scale (0= "never use" to 3= "always use"). Higher values indicate a higher use of DBT skills for the "Skills use" subscale, and a higher use of dysfunctional coping strategies for the "General dysfunctional coping" and "Blaming others" subscales. DBT skills use independent of the DBT language and therefore, the measure is applicable to those who have no prior exposure to DBT. Outside BPD, the DBT-WCCL showed excellent internal consistency (Cronbach $\alpha = .94$) (Stein et al., 2016). The internal consistency of the DBT-WCCL for baseline scores in the current sample was very good (Cronbach's $\alpha = .87$).

The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006), French version by Heeren et al. (2011), is a 39-item self-report questionnaire that assesses five facets of mindfulness: (a) observing, i.e., attention to emotions and sensations, (b) describing, i.e., perceived ability to apply words to internal experiences, (c) acting with awareness, i.e., the

extent to which individuals are aware of their internal and external experiences, (d) non-judging of inner experience, i.e., the extent to which individuals can welcome thoughts and emotions without judging them, and (e) non-reactivity to inner experience, i.e., the extent to which individuals welcome thoughts and feelings without reacting to them. Items are rated on a 5-point Likert scale (1 = never or very rarely true to 5 = very often or always true). Higher scores indicate higher levels of mindfulness. The scale has shown good internal consistency (Cronbach's α from .78–.88) (e.g., Gu et al., 2016). The internal consistency of the FFMQ for baseline scores in the current sample was very good (Cronbach's α = .85).

The Abbreviated World Health Organization Quality of Life Questionnaire (WHOQoL-BREF; The WHOQoL Group, 1998), French validation by Baumann et al. (2010), is a self-report scale constituted of 26 items assessing 4 domains of perceived quality of life: (a) physical health, (b) psychological health, (c) social relationships, and (d) environment. Items are scored on a 5-point Likert scale. The WHOQoL-BREF has good psychometric properties (Skevington et al., 2004), including in autistic individuals (McConachie et al., 2018). The internal consistency of the WHOQoL-BREF domains for baseline scores in the current sample was between moderate and good (Cronbach's α = .58 for the “Physical health” domain, Cronbach's α = .71 for the “Psychological health” domain, Cronbach's α = .51 for the “Social relationships” domain and Cronbach's α = .75 for the “Environment” domain).

The BIS-15, GAFS-8, DBT-WCCL, and FFMQ were also used to explore potential mediation effects on the DERS outcomes.

Scales used for moderation analyses

The following scales were administered at T0 to explore potential moderation effects.

The Autism Spectrum Quotient (AQ) (Baron-Cohen et al., 2001), French version validated by Lepage et al. (2009). The AQ is a self-report scale composed of 50 items that assess core autistic traits in adults. The scale comprises five subscales: (a) communication, (b)

imagination, (c) social skills, (d) attention switching, and (e) attention-to-detail. Items are rated on a 4-point Likert scale (1= definitely agree to 4= definitely disagree). Higher scores indicate higher level of autistic traits. In adults referred for an ASC assessment, a cut-off of 26 was suggested by Woodbury-Smith et al. (2005). The AQ total score internal consistency has been reported to be from acceptable to good (Cronbach's α ranging between .63 and .78) (Baron-Cohen et al., 2001). In the present study, the AQ-Short internal consistency was excellent (Cronbach's $\alpha = .92$).

The Short form of the Borderline Symptom List (BSL-23) (Bohus et al., 2009), French validation by Nicastro et al. (2016). BSL-23 is a short version of the BSL-95 (Bohus et al., 2007). BSL-23 is a self-report scale constituted of 23 items assesses the severity of BPD symptoms and behaviour. Each item is answered on a 5-point Likert scale (0= not at all to 4= very strong). Higher scores indicate higher level of BPD traits, with scores between 70 and 92 reflecting severe BPD symptoms. The BSL-23 internal consistency is excellent (Cronbach's $\alpha = .94$) (Bohus et al., 2009). In the present study, the internal consistency of the BSL-23 was excellent (Cronbach's $\alpha = .94$).

The Camouflaging Autistic Traits Questionnaire (CAT-Q) (Hull et al., 2019) French version by Bureau et al. (2023), is a 25-item self-report questionnaire that assesses social camouflaging behaviour. Items are rated on a 7-point Likert scale (1= Strongly disagree to 7= Strongly agree). The scale contains 3 subscales: (a) Assimilation, i.e., strategies used to blend in during social situations, (b) Compensation, i.e., strategies to compensate for ASC-related communication and social difficulties, and (c) Masking, i.e., strategies to appear 'non-autistic' in social contexts. Higher scores indicated greater camouflaging. The CAT-Q has shown excellent internal consistency (Cronbach's $\alpha = .94$) (Hull et al., 2019). In the current sample the internal consistency for the total scale was very good (Cronbach's $\alpha = .80$).

The Credibility/Expectancy Questionnaire (CEQ; Devilly & Borkovec, 2000), French version by Coste et al. (2019), is a self-report instrument measuring treatment credibility and client expectancy for improvement. The scale contains 6 items rated on a 1-9 or a 0%-100% scale, depending upon the item. Higher the scores higher the credibility and expectancy for improvement. The CEQ demonstrates high internal consistency, (Cronbach's $\alpha = .79-.90$). Retest reliability is $r = 0.82$ for the expectancy factor and $r = 0.75$ for the credibility factor (Deville & Borkovec, 2000). In the present study, the internal consistency of CEQ was moderate (Cronbach's $\alpha = .65$).

Suicidal behaviours

Suicidal behaviours were tracked throughout the treatment. Participants in the TAU condition were asked to report whether suicidal behaviours occurred during the waiting period before starting the treatment.

Subjective impacts of DBT on NSSI and suicide ideation

At 6-month follow-up, participants were asked to report whether any suicide attempts had occurred, as well as their subjective evaluation of potential impacts of DBT on NSSI and suicide ideation. We collected these clinical outcomes only at follow-up so that the participants have time to observe potential progress and at a distance from the context of intensive therapy.

The questionnaire included the following 7 questions: Q1. Since the end of therapy and up to now, have you had self-harming behaviour?; Q2. If so, how many times approximately have these behaviours occurred during this period? Q3. Have you observed any improvement in your self-harming behaviours compared with the period before therapy?; Q4. Have you had any suicide ideation since the end of therapy?; Q5. If so, how often did approximately these thoughts appear during this period?; Q6. Have you observed any improvement in your suicide ideation compared with the period before therapy?; and Q7. Since the end of therapy, have you attempted suicide?

Socio-demographic and clinical data

Participants also filled in a form aiming to collect demographic and clinical data. The demographic data collected included: gender (female/male/other), age (years), marital status, professional status, educational status, and living situation. The clinical data collected included: date of ASC diagnosis, co-occurring diagnosis of BPD and/or ADHD, whether the person had a current psychotropic medication, whether the person had current psychiatric and/or psychological follow-up, the presence or not of NSSI in the previous year, the nature of NSSI (e.g., skin cutting, burning), the presence or not of suicide ideation in the previous year, history of suicide attempts, date of the last suicide attempt, history of hospitalization in psychiatry services, and date and reason for the last psychiatric hospitalization.

Statistical analyses⁷

Descriptive statistics are presented as means and standard deviations (*SD*) for the continuous variables and as frequencies and percentages (%) for categorical data.

The data were analysed according to a Bayesian paradigm using R software, Version 4.3.1 (The R Foundation for Statistical Computing, Vienna, Austria; <https://www.r-project.org>) and JAGS software, Version 4.3.1 (Lunn et al., 2000).

To meet the primary objective, inferential analysis was conducted to study the evolution of the DERS mean score over time, using Bayesian mixed linear regression including time (effect of treatment) as fixed effect and participants as random effect.

To meet the secondary objectives, Bayesian mixed linear regressions were used to study the evolution of the different variables.

⁷ Additional analyses in preparation:

- Subjective impact of DBT at follow-up (ad-hoc questionnaire), particularly on NSSI and suicidal behaviours/ideation.
- Relationship between sensory sensitivities, alexithymia and ED at baseline.

The priors were, on the one hand, very uninformative and, on the other hand, informative in the context of a sensitivity analysis.

For each analysis, the posteriors of the parameter of interest (proportion, mean, regression coefficient, etc.) were estimated using the Markov Chain Monte Carlo method (MCMC; including Monte Carlo with Gibbs sampling). The default number of iterations was 100,000, after deleting the first 10,000 and retaining one value out of two (210,000 iterations were therefore performed). Convergence was estimated graphically. Autocorrelation was estimated graphically and, if necessary, the number of iterations was increased to raise the step size of the values retained, with the aim of reducing autocorrelation as much as possible.

Results are presented as coefficients, together with 95% credibility intervals (CrI), and the probability that the coefficient would be higher than 0 was calculated based on the posterior distribution (probability coefficient > 0 , hereinafter abbreviated “Pr > 0 ”). It should be noted that these probabilities must not be confused with the p value of classical (frequentist) statistical analyses. The reported Pr > 0 value indicates an effect for values close to 1 (with a high probability if greater than 97.5%) (Kruschke & Liddell, 2018). The Bayesian framework does not imply a strict cut-off for this probability but rather a contextualized probability interpretation.

T3 data for the penultimate group are not included in the current results, as well as the therapy outcomes (T1, T2 and T3 while being in the DBT condition) for the last group.

Ethics approval and consent to participate

The study was approved by the regional ethics committee of the East of France (Ethical approval number: SI 21.01.21.41923). Informed consent was obtained from all individual participants included in the study. All procedures performed in the study complied with the ethics code outlined in the Declaration of Helsinki.

The study has been preregistered at clinicaltrials.gov (Identifier: NCT04737707).

Results

Sample description

A total of 119 individuals were assessed for eligibility to be included in the study. 55 (46%) were excluded (**Figure 1**). The majority of those excluded, 52 (95%), did not meet the inclusion criteria related to ED (i.e., DERS score above 96 and presenting NSSI and/or suicidal behaviours/ideation over the last 6 months prior to inclusion). It should be noted that participants had different ED-related behaviours (e.g., some presented with suicide ideation only, while others presented with NSSI, suicidal behaviours and ideation), but all met the criteria that set the threshold at which they were eligible for inclusion. Sixty-four (54%) were randomized. One person withdrew consent to participate, resulting in the destruction of all personal data.

Participants' demographic and clinical variables are in **Table 1**. The sample was constituted of 29 (46%) women, 28 (44%) men, and 5 (8%) non-binary individuals. Mean age was 30 years old (± 9.94 , range from 18 to 67 years old). Thirty-eight (60%) were diagnosed with ASC in the year prior to inclusion; 6 (10%) had a co-occurring diagnosis of BPD, while 27 (43%) had a co-occurring ADHD. A third of our sample, 21(33%), presented with NSSI, suicidal behaviours and ideation.

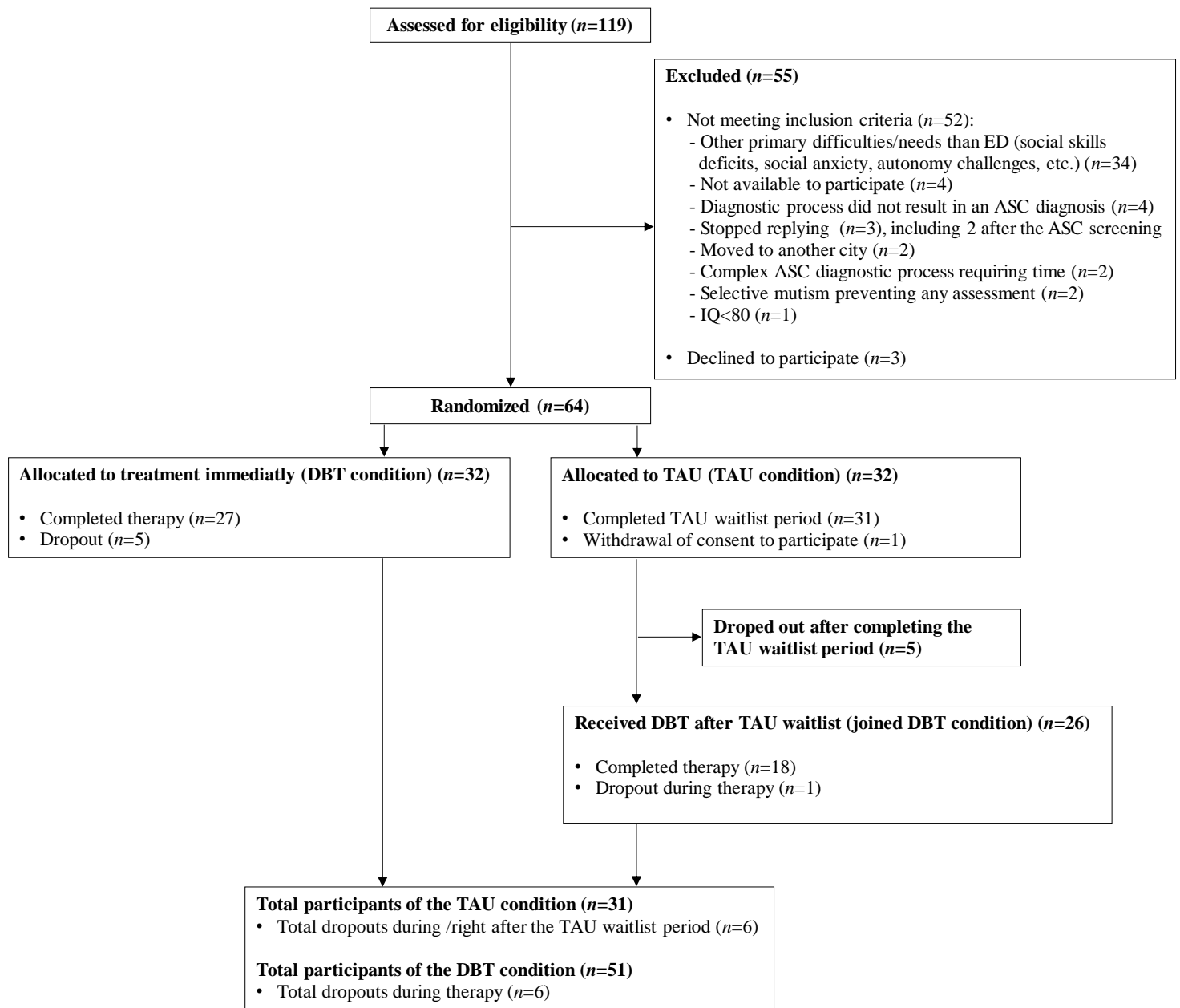


Figure 1. *Study participants' inclusion flow chart.*

Table 1. *Sample description.*

		Global	DBT*	TAU
<i>Demographics</i>				
n (%)		63 (100%)	51 (81%)	31 (49%)
Mean age (SD)		30 (9.94)	29 (9.87)	31 (10.10)
Age range (Min-max)		18-67	18-67	19-67
Gender, n (%)				
	Women	29 (46%)	23 (45%)	11 (35%)
	Men	28 (44%)	22 (43%)	19 (61%)
	Non-binary	5 (8%)	5 (10%)	1 (3%)
Marital status, n (%)				
	Single	33 (52%)	29 (57%)	16 (52%)
	Married / in relationship	27 (43%)	19 (37%)	8 (26%)
	Divorced	3 (5%)	3 (6%)	2 (6%)
Having children, n (%)		8 (13%)	6 (12%)	6 (19%)
Professional status, n (%)				
	Professionnaly active	21 (33%)	16 (31%)	11 (35%)
	Student	21 (33%)	17 (33%)	11 (35%)
	Unemployed	20 (32%)	17 (33%)	8 (26%)
	Retired	1 (2%)	1 (2%)	1 (3%)
Educational status, n (%)				
	College graduate	44 (70%)	36 (71%)	23 (74%)
	High School degree or less	19 (30%)	15 (29%)	8 (26%)
Living situation, n (%)				
	Alone	28 (44%)	24 (47%)	13 (42%)
	With parents	17 (27%)	14 (27%)	8 (26%)
	With partner with or without children	13 (21%)	11 (22%)	6 (19%)
	Flatsharing	3 (5%)	1 (2%)	3 (10%)
	Alone with children	2 (3%)	1 (2%)	1 (3%)
<i>Clinical variables</i>				
Recent ASC diagnosis (<1 year), n (%)		38 (60%)	34 (67%)	15 (48%)
Co-occurring BPD, n (%)		6 (10%)	5 (10%)	2 (6%)
Co-occurring ADHD, n (%)		27 (43%)	22 (43%)	17 (55%)
Current psychotropic medication, n (%)		51 (81%)	41 (80%)	26 (84%)
Current psychological and psychiatric care, n (%)				
	Psychological + psychiatric follow-up	25 (40%)	20 (39%)	12 (39%)
	Psychiatric follow-up only	26 (41%)	21 (41%)	15 (48%)
	Psychological follow-up only	2 (3%)	1 (2%)	2 (6%)
	No follow-up	10 (16%)	9 (18%)	2 (6%)
Current NSSI, n (%)		37 (59%)	32 (63%)	17 (55%)
	Current skin cutting	18 (29%)	15 (29%)	6 (19%)
	Frequent skin cutting ¹	6 (10%)	4 (8%)	3 (10%)
Current suicide ideation (SI), n (%)		56 (89%)	44 (86%)	29 (94%)
History of suicidal behaviours (SB), n (%)		32 (51%)	24 (47%)	14 (45%)
	SB in the year prior to inclusion	11 (17%)	10 (20%)	5 (16%)
History of hospitalization in psychiatry, n (%)		28 (44%)	23 (45%)	13 (42%)
	Last hospitalization for NSSI and/or SI and/or SB	24 (38%)	20 (39%)	11 (35%)
	Hospitalization in the last year prior to inclusion	14 (22%)	12 (24%)	5 (16%)
Participants with NSSI only, n (%)		4 (6%)	4 (8%)	1 (3%)
Participants with SI only, n (%)		15 (24%)	11 (22%)	9 (29%)
Participants with SI and SB, n (%)		11 (17%)	8 (16%)	5 (16%)
Participants with NSSI and SI, n (%)		12 (19%)	12 (24%)	7 (23%)
Participants with NSSI, SI and SB, n (%)		21 (33%)	16 (31%)	9 (29%)

* Includes both participants who received DBT directly and those who received it after the TAU waitlist period

¹Daily/many times a week

Feasibility and acceptability outcomes

Attrition rate

Six (10.34%) participants out of the 58 who started DBT dropped out from the therapy. Only one dropout was related to acceptability challenges, specifically due to extreme anxiety in the group context. Another dropout was related to cumulated absences. The other 4 dropouts were related to reasons external to therapy (i.e., 1 moved to another town, 1 due to a physical issue, 1 due to family problems, and 1 with no reason given).

Attendance rate

The mean attendance rate of the 58 participants who started DBT was 87.82% ($\pm 13\%$, range from 29 to 100%). For the 52 participants who completed the treatment, the mean attendance rate was 89.38% ($\pm 9\%$, range from 67 to 100%). Only one participant needed accommodation to attend only half of the 3 last group sessions (skipping the collective feedback of between-session practices) due to anxiety and fatigue. This was necessary to enable her to continue her participation and prevent her from dropping out.

Satisfaction

The CSQ-8 mean score, assessing the participants' satisfaction with the treatment, was 3.58 out of 4 (± 0.37 , range from 2.63 to 4) (**Figure 2**). Participants were most satisfied with the quality of the sessions, which they rated 3.73 (± 0.45 , range from 3.00 to 4.00) on average. Their likelihood to return to the care unit if needed and their likelihood to recommend the therapy to a friend also scored high, respectively 3.63 (± 0.55 , range from 2.00 to 4.00) and 3.73 (± 0.58 , range from 2.00 to 4.00).

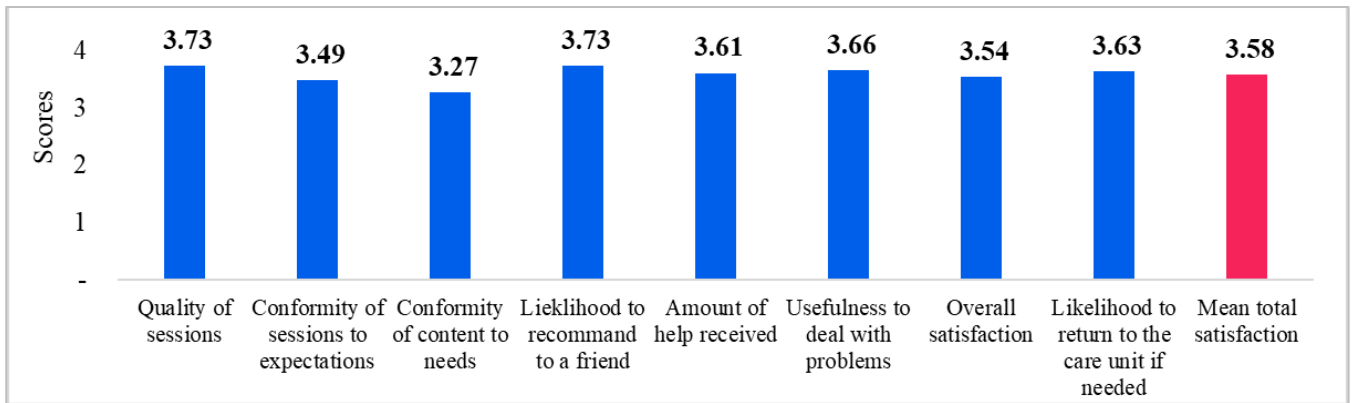


Figure 2. Mean scores of the CSQ-8 items (out of 4).

Efficacy outcomes

Condition X Time interaction effects on the efficacy measures

Comparative results between the two conditions at T1 and T2 are in **Table 2**. The evolution of the scales over time, including at T3 for the DBT condition is in **Table 3**.

The **DERS total mean score**, assessing self-reported ED, decreased significantly more (with large effect sizes) in the DBT condition than TAU at both T1 ($\beta_{01} = -18.52$ [-27.40 to -9.60], with $\Pr(\beta_{01} < 0) = 1.000$) and T2 ($\beta_{02} = -31.456$ [-40.82 to -21.96], with $\Pr(\beta_{02} < 0) = 1.000$) compared to T0 (**Figure 3**). In the DBT condition, the DERS total mean score decreased significantly compared to T0 at all measurement time points.

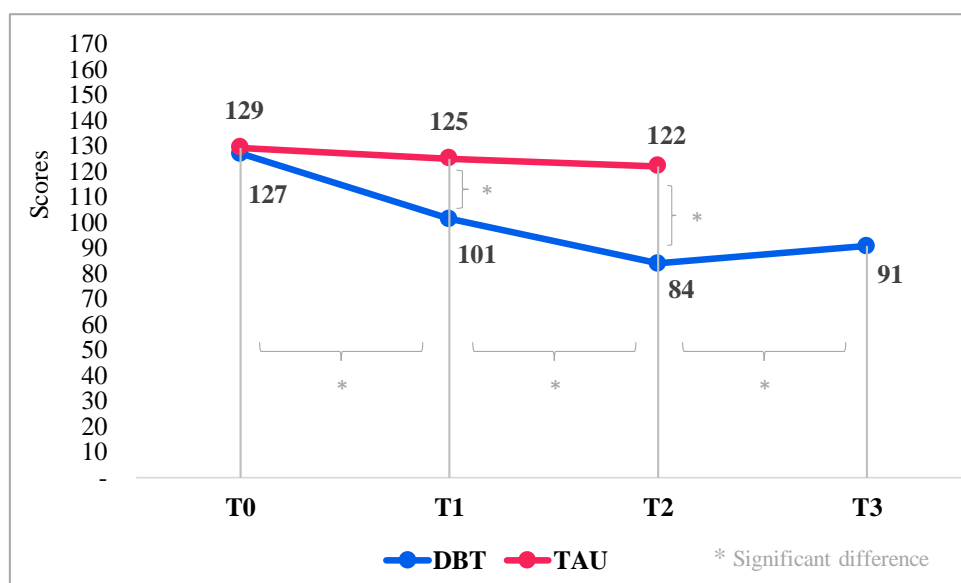


Figure 3. Condition X Time interaction effects on the DERS total mean score.

Regarding the **DERS subscales**, the “Awareness”, “Impulse”, “Goals” and “Strategies” mean scores also decreased significantly more in the DBT condition compared to TAU at both T1 (for “Awareness” : $\beta_{01} = -5.66$ [-8.56 to -2.76], with $\Pr(\beta_{01} < 0) = 1.000$; for “Impulse” : $\beta_{01} = -3.96$ [-6.44 to -1.48], with $\Pr(\beta_{01} < 0) = 0.999$; for “Goals” : $\beta_{01} = -2.38$ [-4.22 to -0.52], with $\Pr(\beta_{01} < 0) = 0.994$; for “Strategies” : $\beta_{01} = -4.49$ [-6.84 to -2.14], with $\Pr(\beta_{01} < 0) = 1.000$), and T2 (for “Awareness” : $\beta_{02} = -9.15$ [-12.22 to -6.07], with $\Pr(\beta_{02} < 0) = 1.000$; for “Impulse” : $\beta_{02} = -5.66$ [-8.28 to -3.05], with $\Pr(\beta_{02} < 0) = 1.000$; for “Goals” : $\beta_{02} = -5.22$ [-7.18 to -3.25], with $\Pr(\beta_{02} < 0) = 1.000$; for “Strategies” : $\beta_{02} = -7.16$ [-9.70 to -4.66], with $\Pr(\beta_{02} < 0) = 1.000$). The “Clarity” and “Non-acceptance” subscales decreased significantly more in the DBT condition than TAU only at T2 (for “Clarity” : $\beta_{02} = -1.42$ [-2.79 to -0.05], with $\Pr(\beta_{02} < 0) = 0.979$; for “Non-acceptance” : $\beta_{02\text{ NA}} = -4.28$ [-7.28 to -1.27], with $\Pr(\beta_{02} < 0) = 0.997$). In the DBT condition, all DERS subscales decreased significantly compared to T0 at all measurement time points.

The **BIS-15 total mean score**, measuring impulsivity, did not differ significantly between the DBT and TAU conditions at either T1 ($\beta_{01} = -0.28$ [-2.65 to 2.06], with $\Pr(\beta_{01} < 0) = 0.589$) or T2 ($\beta_{02} = -0.18$ [-2.67 to 2.32], with $\Pr(\beta_{02} < 0) = 0.56$). No significant difference was found on the BIS subscales at T1 and T2. In the DBT condition, no significant change was observed on the BIS-15 total mean score at the different measurement time points. This was also the case for the subscales.

The **GAFS-8 mean score**, measuring alexithymia, decreased significantly (with a large effect size) more in the DBT condition compared to TAU at both T1 ($\beta_{01} = -3.85$ [-6.85 to -0.84], with $\Pr(\beta_{01} < 0) = 0.994$) and T2 ($\beta_{02} = -5.88$ [-9.06 to -2.69], with $\Pr(\beta_{02} < 0) = 1.000$) (**Figure 4**). In the DBT condition, the GAFS-8 mean score decreased significantly at all measurement time points.

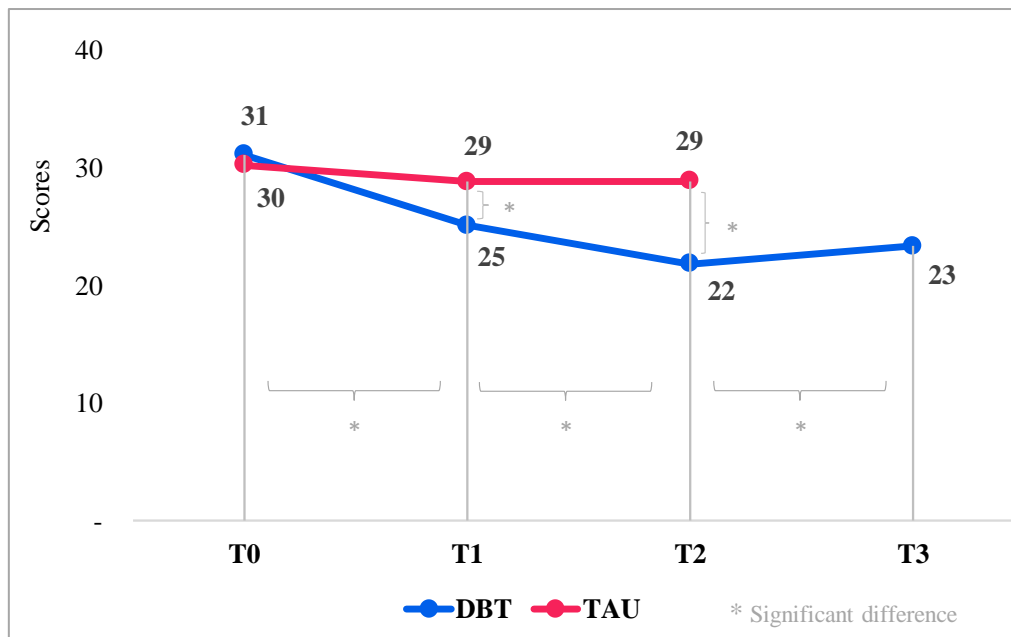


Figure 4. Condition X Time interaction effects on the GAFS-8 total mean score.

The **BAI mean score**, measuring anxiety, did not differ significantly between the DBT and TAU conditions at T1 ($\beta_{01} = -4.88$ [-10.13 to 0.33], with $\Pr(\beta_{01} < 0) = 0.966$) and T2 ($\beta_{02} = -4.17$ [-9.79 to 1.34], with $\Pr(\beta_{02} < 0) = 0.931$). Similarly, the **BSS mean score**, measuring suicide ideation, did not differ significantly between the DBT and TAU conditions at T1 ($\beta_{01} = 1.02$ [-2.60 to 4.72], with $\Pr(\beta_{01} < 0) = 0.709$) and T2 ($\beta_{02} = 0.16$ [-3.53 to 3.88], with $\Pr(\beta_{02} < 0) = 0.534$). However, the **BDI-II mean score**, measuring depression, decreased significantly more in the DBT condition compared to TAU only at T2 ($\beta_{02} = -5.74$ [-10.80 to -0.67], with $\Pr(\beta_{02} < 0) = 0.986$). In the DBT condition, the BAI and BSS mean scores decreased significantly at all measurement times, while the BDI-II mean score decreased significantly post-treatment and at follow-up only.

Regarding the **DBT-WCCL**, measuring the use of DBT skills and maladaptive coping strategies, only the “Skills use” subscale mean score decreased significantly (with a large effect size) more in the DBT condition compared to TAU at both T1 ($\beta_{01} = 14.95$ [5.66 to 24.19], with $\Pr(\beta_{01} > 0) = 0.999$) and T2 ($\beta_{02} = 16.27$ [6.55 to 26.01], with $\Pr(\beta_{02} > 0) = 0.999$) (**Figure 6**). The “General dysfunctional coping” and “Blaming others” subscales did not differ between the

two conditions. In the DBT condition, the “Skills use” subscale mean score decreased significantly at all measurement time points, the “General dysfunctional coping” mean score decreased significantly post-DBT and at follow-up, and no significant difference was observed on the “Blaming others” subscale over time.

The **FFMQ total mean score**, measuring mindfulness skills, decreased significantly more in the DBT condition compared to TAU only at T2 ($\beta_{02} = 17.04$ [8.84 to 25.25], with $\Pr(\beta_{02} > 0) = 1.000$) (**Figure 6**). Specifically, the “Description” and “Non-judgmental inner critic” subscales decreased significantly more in the DBT condition compared to TAU only at T2 (for “Description”: $\beta_{02} = 3.38$ [0.90 to 5.85], with $\Pr(\beta_{02} > 0) = 0.995$; for “Non-judgmental inner critic”: $\beta_{02} = 5.82$ [2.06 to 9.53], with $\Pr(\beta_{02} > 0) = 0.999$). The “Non-reactivity” subscale is the only one that decreased significantly more in the DBT condition than TAU at T1 ($\beta_{01} = 2.64$ [0.18 to 5.11], with $\Pr(\beta_{01} > 0) = 0.984$) and T2 ($\beta_{02} = 4.82$ [2.20 to 7.39], with $\Pr(\beta_{02} > 0) = 1.000$). In the DBT condition, the FFMQ mean score decreased significantly at all measurement time points. This was also the case for the subscales, except for the “Observation” subscale, which showed no significant change at the measurement time points.

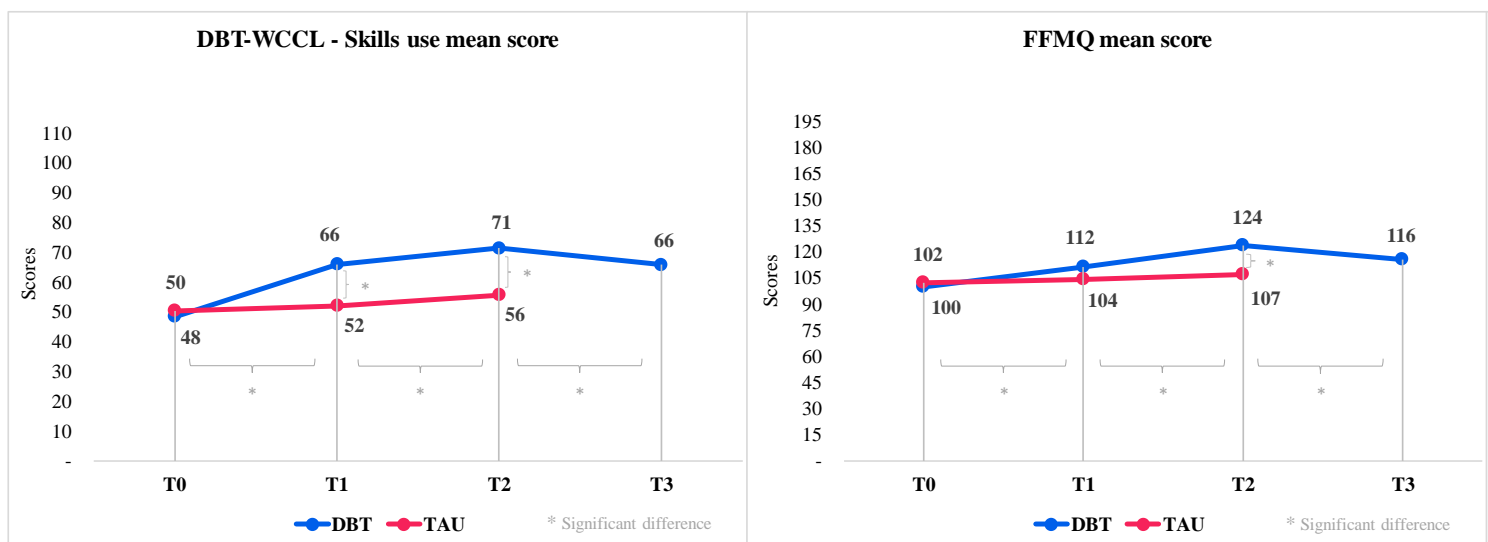


Figure 6. Condition X Time interaction effects on the DBT-WCCL – Skills use subscale and the FFMQ total mean scores.

Regarding the **WHOQoL-BREF**, measuring quality of life, the “Physical health” and “Psychological health” subscales decreased significantly more in the DBT condition compared to TAU only at T2 (for “Physical health”: $\beta_{02} = 2.88$ [0.87 to 4.88], with $\Pr(\beta_{02} > 0) = 0.997$; for “Psychological health”: $\beta_{02} = 3.09$ [0.91 to 5.28], with $\Pr(\beta_{02} > 0) = 0.997$). No significant differences were found on the “Social relationships” and “Environment” subscales at T1 and at T2. In the DBT condition, a significant increase occurred at all measurement time points in the “Physical health” subscale, the “Psychological health” subscale, and the “Social relationships” subscale. No significant change was observed on the “Environment” subscale over time.

Suicidal behaviours

One suicide attempt in each condition (DBT and TAU) was reported. There were no suicides during the study.

Table 2. Comparison of the efficacy measures' evolution between conditions at T1 and T2.

		DBT						TAU						DBT vs. TAU								Time points with significant difference between DBT and TAU	
		T0		T1		T2		T0		T1		T2		T1-T0				T2-T0					
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	Pr ($\beta_{01} < 0$) ²	Cohen's d	β_{02}^1	95% CrI	Pr ($\beta_{02} < 0$) ²	Cohen's d		
DERS		127.15	16.33	101.48	23.26	83.93	18.65	129.45	14.85	125.18	20.19	122.09	15.71	-18.52	[-27.40 to -9.60]	1.000 [*]	-1.069 ^a	-31.46	[-40.82 to -21.96]	1.000 [*]	-2.154 ^a	T1 & T2	
	Clarity	9.71	2.47	7.85	3.11	6.43	2.57	9.68	2.60	9.25	3.19	8.44	2.00	-1.17	[-2.47 to 0.12]	0.962	-0.446	-1.42	[-2.79 to -0.05]	0.979 [*]	0.837 ^a	T2	
	Awareness	31.98	6.37	26.15	7.83	22.43	7.33	30.19	7.09	30.29	6.78	30.13	6.78	-5.66	[-8.56 to -2.76]	1.000 [*]	-0.554	-9.15	[-12.22 to -6.07]	1.000 [*]	-1.077 ^a	T1 & T2	
	Impulse	20.23	5.35	14.91	5.03	12.02	4.56	21.74	4.32	20.61	4.61	19.22	4.45	-3.96	[-6.44 to -1.48]	0.999 [*]	-1.167 ^a	-5.66	[-8.28 to -3.05]	1.000 [*]	-1.591 ^a	T1 & T2	
	Non-acceptance	20.29	6.92	16.76	6.63	13.36	5.61	22.26	5.98	21.18	6.72	20.52	6.22	-2.01	[-4.87 to 0.85]	0.916	-0.663	-4.28	[-7.28 to -1.27]	0.997 [*]	-1.229 ^a	T2	
	Goals	22.02	2.98	18.80	4.79	16.07	4.42	22.13	3.90	21.39	4.35	21.78	3.42	-2.38	[-4.22 to -0.52]	0.994 [*]	-0.559	-5.22	[-7.18 to -3.25]	1.000 [*]	-1.390 ^a	T1 & T2	
	Strategies	22.92	4.28	17.00	5.75	13.61	4.74	23.45	2.82	22.46	4.66	22.00	4.22	-4.49	[-6.84 to -2.14]	1.000 [*]	-1.018 ^a	-7.16	[-9.70 to -4.66]	1.000 [*]	-1.834 ^a	T1 & T2	
BIS-15		35.21	7.57	34.91	7.62	33.71	7.63	37.26	8.40	38.18	8.31	36.35	7.81	-0.28	[-2.65 to 2.06]	0.589	-0.414	-0.18	[-2.67 to 2.32]	0.559	-0.344	-	
	Non-planning	11.60	3.73	11.53	3.89	11.18	4.32	12.52	3.81	13.29	3.43	12.57	3.68	-0.59	[-2.01 to 0.84]	0.793	-0.470	-0.34	[-1.86 to 1.18]	0.674	-0.336	-	
	Motor impulsivity	10.29	3.22	10.31	3.89	9.84	3.34	11.45	3.58	11.50	3.50	11.00	2.78	0.42	[-0.78 to 1.63]	0.255	-0.317	0.01	[-1.28 to 1.31]	0.493	-0.366	-	
	Attentional impulsivity	13.31	2.86	13.07	2.98	12.68	3.12	13.29	3.18	13.39	3.13	12.78	3.29	-0.16	[-1.25 to 0.91]	0.617	-0.107	0.10	[-1.03 to 1.22]	0.436	-0.032	-	
GAFS-8		31.13	6.46	25.11	9.45	21.84	7.75	30.27	5.66	28.82	7.87	28.87	6.88	-3.84	[-6.85 to -0.84]	0.994 [*]	-0.417	-5.88	[-9.06 to -2.69]	1.000 [*]	-0.941 ^a	T1 & T2	
BAI		29.25	12.20	25.46	12.98	20.71	11.27	27.17	12.47	27.82	14.64	23.50	12.17	-4.88	[-10.13 to 0.33]	0.966	-0.173	-4.17	[-9.79 to 1.34]	0.931	-0.241	-	
BDI-II		25.46	11.64	20.54	12.91	13.73	9.74	26.97	7.67	23.14	13.92	22.24	10.29	-1.12	[-5.78 to 3.51]	0.682	-0.195	-5.74	[-10.80 to -0.67]	0.986 [*]	-0.858 ^a	T2	
BSS		9.85	8.61	7.61	9.45	3.89	6.20	11.55	8.03	8.33	8.92	6.95	8.11	1.02	[-2.60 to 4.72]	0.709	-0.078	0.16	[-3.53 to 3.88]	0.534	-0.447	-	
DBT-WCCL																							
	General dysfunctional coping	27.71	8.46	25.02	9.19	21.64	9.13	29.13	6.98	27.85	6.46	24.62	7.69	-0.98	[-5.20 to 3.23]	0.678	-0.341	-0.04	[-4.58 to 4.39]	0.507	-0.343	-	
	Blaming others	5.50	4.11	5.61	4.11	5.16	4.24	6.97	4.34	5.70	4.84	5.19	4.56	1.51	[-0.32 to 3.36]	0.053	-0.022	1.62	[-0.32 to 3.57]	0.051	-0.007	-	
DBT-WCCL														β_{01}^1	95% CrI	Pr ($\beta_{01} > 0$) ²	Cohen's d	β_{02}^1	95% CrI	Pr ($\beta_{02} > 0$) ²	Cohen's d		
	Skills use	48.40	18.10	66.00	21.64	71.41	19.87	50.47	16.98	52.07	19.29	55.71	20.64	14.95	[5.66 to 24.19]	0.999 [*]	0.669	16.27	[6.55 to 26.01]	0.999 [*]	0.780	T1 & T2	
FFMQ		100.08	17.52	111.57	24.07	123.82	20.32	102.39	15.74	104.22	17.78	107.17	15.96	7.57	[-0.28 to 15.41]	0.970	0.334	17.04	[8.84 to 25.25]	1.000 [*]	0.878 ^a	T2	
	Observation	27.63	6.71	27.00	8.53	28.11	7.22	28.39	7.57	28.52	7.78	28.09	7.10	-0.01	[-3.06 to 3.06]	0.499	-0.184	1.46	[-1.79 to 4.65]	0.810	0.004	-	
	Description	17.75	6.77	20.80	6.91	23.86	7.15	19.13	6.27	20.33	7.49	21.09	6.47	1.50	[-0.82 to 3.82]	0.898	0.066	3.38	[0.90 to 5.85]	0.995 [*]	0.401	T2	
	Aware actions	20.23	5.44	22.94	8.02	24.05	8.09	21.48	6.58	21.59	7.01	22.04	5.32	1.56	[-1.00 to 4.14]	0.885	0.175	1.77	[-0.97 to 4.49]	0.897	0.275	-	
	Non-judgemental inner critic	20.33	7.82	23.22	8.99	28.07	7.60	19.10	6.58	19.19	6.96	20.35	7.19	2.26	[-1.30 to 5.78]	0.892	0.485	5.82	[2.06 to 9.53]	0.999 [*]	1.035 ^a	T2	
	Non-reactivity	14.15	4.54	17.61	5.87	19.73	5.28	14.29	3.82	14.59	5.10	15.61	4.04	2.64	[0.18 to 5.11]	0.984 [*]	0.538	4.82	[2.20 to 7.39]	1.000 [*]	0.841 ^a	T1 & T2	
WHOQoL-BREF																							
	Physical health	17.73	4.29	19.38	4.72	21.07	4.89	18.29	3.88	18.33	4.34	18.30	3.61	1.42	[-0.46 to 3.30]	0.930	0.228	2.88	[0.87 to 4.88]	0.997 [*]	0.615	T2	
	Psychological health	13.04	3.95	15.11	4.70	17.18	4.92	13.16	3.51	13.67	4.27	13.70	4.38	1.28	[-0.80 to 3.38]	0.885	0.318	3.09	[0.91 to 5.28]	0.997 [*]	0.735	T2	
	Social relationships	7.54	2.67	8.64	2.67	9.14	3.23	7.61	2.43	7.52	2.23	8.00	2.37	1.03	[-0.33 to 2.37]	0.930	0.447	1.07	[-0.34 to 2.47]	0.933	0.383	-	
	Environment	24.40	6.70	25.42	6.80	26.50	7.74	25.65	5.45	26.74	5.86	26.17	5.88	0.10	[-2.59 to 2.82]	0.528	-0.204	0.95	[-1.88 to 3.74]	0.744	0.045	-	

* Pr > 0.975

^a Large effect size¹ Number of points of difference between DBT and TAU (For instance, at T1 the DEERS mean score decreased by 18.52 points more at the DBT condition than TAU)² Pr ($\beta < 0$) fo scales expected to decrease and Pr ($\beta > 0$) expected to increase following treatment

PART III – Axis 2 – Study 2

Table 3. *Efficacy measures' evolution over time compared to T0 in the DBT condition.*

	T0		T1		T2		T3		T1-T0			T2-T0			T3-T0			Time points with significant difference between DBT and TAU
	M	SD	M	SD	M	SD	M	SD	β_{01}^1	95% CrI	Pr ($\beta_{01} < 0$) ²	β_{02}^1	95% CrI	Pr ($\beta_{02} < 0$) ²	β_{03}^1	95% CrI	Pr ($\beta_{03} < 0$) ²	
DERs	127.15	16.33	101.48	23.26	83.93	18.65	90.81	21.97	-23.96	[-29.57 to -18.30]	1.000 [*]	-40.88	[-46.52 to -35.12]	1.000 [*]	-36.83	[-43.52 to -30.17]	1.000 [*]	T1, T2 & T3
Clarity	9.71	2.47	7.85	3.11	6.43	2.57	6.78	2.44	-1.62	[-2.45 to -0.81]	1.000 [*]	-2.91	[-3.73 to -2.08]	1.000 [*]	-2.95	[-3.90 to -2.00]	1.000 [*]	T1, T2 & T3
Awareness	31.98	6.37	26.15	7.83	22.43	7.33	23.11	5.60	-5.82	[-7.64 to -4.01]	1.000 [*]	-9.46	[-11.31 to -7.60]	1.000 [*]	-9.99	[-12.13 to -7.82]	1.000 [*]	T1, T2 & T3
Impulse	20.23	5.35	14.91	5.03	12.02	4.56	14.04	6.24	-5.15	[-6.68 to -3.62]	1.000 [*]	-8.08	[-9.66 to -6.50]	1.000 [*]	-6.14	[-7.95 to -4.35]	1.000 [*]	T1, T2 & T3
Non-acceptance	20.29	6.92	16.76	6.63	13.36	5.61	13.48	5.29	-3.41	[-5.20 to -1.60]	1.000 [*]	-6.65	[-8.48 to -4.85]	1.000 [*]	-6.68	[-8.81 to -4.55]	1.000 [*]	T1, T2 & T3
Goals	22.02	2.98	18.80	4.79	16.07	4.42	17.56	4.77	-3.20	[-4.37 to -2.03]	1.000 [*]	-5.87	[-7.08 to -4.65]	1.000 [*]	-4.89	[-6.27 to -3.50]	1.000 [*]	T1, T2 & T3
Strategies	22.92	4.28	17.00	5.75	13.61	4.74	15.85	4.75	-5.57	[-7.05 to -4.09]	1.000 [*]	-8.83	[-10.35 to -7.31]	1.000 [*]	-7.13	[-8.88 to -5.37]	1.000 [*]	T1, T2 & T3
BIS-15	35.21	7.57	34.91	7.62	33.71	7.63	34.81	7.58	0.30	[-1.19 to 1.79]	0.352	-1.35	[-2.85 to 0.15]	1.000 [*]	-1.49	[-3.25 to 0.26]	0.952	-
Non-planning	11.60	3.73	11.53	3.89	11.18	4.32	11.93	3.28	0.05	[-0.86 to 0.96]	0.452	-0.42	[-1.34 to 0.50]	1.000 [*]	-0.54	[-1.61 to 0.52]	0.843	-
Motor impulsivity	10.29	3.22	10.31	3.89	9.84	3.34	9.74	3.54	0.31	[-0.44 to 1.08]	0.208	-0.42	[-1.20 to 0.36]	1.000 [*]	-0.57	[-1.48 to 0.34]	0.887	-
Attentional impulsivity	13.31	2.86	13.07	2.98	12.68	3.12	13.15	2.54	-0.11	[-0.78 to 0.58]	0.628	-0.53	[-1.23 to 0.16]	1.000 [*]	-0.35	[-1.15 to 0.45]	0.803	-
GAFS-8	31.13	6.46	25.11	9.45	21.84	7.75	23.37	7.16	-5.33	[-7.22 to -3.45]	1.000 [*]	-8.33	[-10.23 to -6.40]	1.000 [*]	-7.90	[10.12 to -5.65]	1.000 [*]	T1, T2 & T3
BAI	29.25	12.20	25.46	12.98	20.71	11.27	24.70	11.11	-3.87	[-7.15 to -0.59]	0.989 [*]	-7.68	[-10.99 to -4.37]	1.000 [*]	-4.00	[-7.79 to -0.13]	0.979 [*]	T1, T2 & T3
BDI-II	25.46	11.64	20.54	12.91	13.73	9.74	17.19	11.22	-4.28	[-7.22 to -1.37]	0.998 [*]	-10.26	[-13.29 to -7.31]	1.000 [*]	-8.45	[-11.95 to -5.00]	1.000 [*]	T1, T2 & T3
BSS	9.85	8.61	7.61	9.45	3.89	6.20	4.96	8.04	-2.20	[-4.54 to 0.10]	0.971	-4.66	[-6.89 to -2.45]	1.000 [*]	-4.29	[-6.86 to -1.66]	0.999 [*]	T2 & T3
DBT-WCCL																		
General dysfunctional coping	27.71	8.46	25.02	9.19	21.64	9.13	24.00	8.80	-2.13	[-4.73 to 0.46]	0.945	-5.19	[-7.87 to -2.55]	1.000 [*]	-3.41	[-6.49 to -0.37]	0.986 [*]	T2 & T3
Blaming others	5.50	4.11	5.61	4.11	5.16	4.24	5.67	4.21	0.38	[-0.76 to 1.51]	0.253	-0.05	[-1.21 to 1.12]	0.535	0.29	[-1.06 to 1.64]	0.334	-
DBT-WCCL									β_{01}^1	95% CrI	Pr ($\beta_{01} > 0$) ²	β_{02}^1	95% CrI	Pr ($\beta_{02} > 0$) ²	β_{03}^1	95% CrI	Pr ($\beta_{03} > 0$) ²	
Skills use	48.40	18.10	66.00	21.64	71.41	19.87	65.93	16.15	16.64	[11.05 to 22.36]	1.000 [*]	22.24	[16.44 to 27.98]	1.000 [*]	18.67	[12.00 to 25.36]	1.000 [*]	T1, T2 & T3
FFMQ	100.08	17.52	111.57	24.07	123.82	20.32	115.74	18.66	10.37	[5.46 to 15.25]	1.000 [*]	23.09	[18.09 to 28.04]	1.000 [*]	19.60	[13.75 to 25.27]	1.000 [*]	T1, T2 & T3
Observation	27.63	6.71	27.00	8.53	28.11	7.22	28.07	5.86	-0.34	[-2.23 to 1.54]	0.366	0.91	[-1.04 to 2.84]	0.823	1.62	[-0.66 to 3.88]	0.918	-
Description	17.75	6.77	20.80	6.91	23.86	7.15	22.04	6.40	2.82	[1.36 to 4.29]	1.000 [*]	5.61	[4.10 to 7.10]	1.000 [*]	5.18	[3.41 to 6.92]	1.000 [*]	T1, T2 & T2
Aware actions	20.23	5.44	22.94	8.02	24.05	8.09	22.15	6.16	1.91	[0.30 to 3.53]	0.990 [*]	3.20	[1.58 to 4.80]	1.000 [*]	2.72	[0.82 to 4.65]	0.997 [*]	T1, T2 & T3
Non-judgemental inner critic	20.33	7.82	23.22	8.99	28.07	7.60	25.37	8.06	2.71	[0.49 to 4.89]	0.991 [*]	7.66	[5.40 to 9.93]	1.000 [*]	5.52	[2.93 to 8.10]	1.000 [*]	T1, T2 & T3
Non-reactivity	14.15	4.54	17.61	5.87	19.73	5.28	18.11	6.39	3.45	[1.93 to 5.00]	1.000 [*]	5.86	[4.29 to 7.39]	1.000 [*]	4.76	[2.93 to 6.57]	1.000 [*]	T1, T2 & T3
WHOQoL-BREF																		
Physical health	17.73	4.29	19.38	4.72	21.07	4.89	19.85	5.45	1.31	[0.12 to 2.49]	0.984 [*]	2.89	[1.67 to 4.09]	1.000 [*]	1.87	[0.46 to 3.27]	0.995 [*]	T1, T2 & T3
Psychological health	13.04	3.95	15.11	4.70	17.18	4.92	16.15	4.61	1.71	[0.41 to 3.02]	0.994 [*]	3.82	[2.49 to 5.12]	1.000 [*]	3.33	[1.79 to 4.84]	1.000 [*]	T1, T2 & T3
Social relationships	7.54	2.67	8.64	2.67	9.14	3.23	8.59	2.96	0.93	[0.08 to 1.78]	0.984 [*]	1.52	[0.66 to 2.36]	1.000 [*]	1.18	[0.19 to 2.17]	0.990 [*]	T1, T2 & T3
Environment	24.40	6.70	25.42	6.80	26.50	7.74	26.85	6.24	0.78	[-0.90 to 2.48]	0.817	1.75	[0.03 to 3.47]	0.977 [*]	2.49	[0.50 to 4.44]	0.994 [*]	T2 & T3

* Pr > 0.975

¹ Number of points of difference between time points (For instance, at T1 the DERs mean score decreased by 23.96 points compared to T0)

² Pr ($\beta < 0$) fo scales expected to decrease and Pr ($\beta > 0$) expected to increase following treatment

Mediation and moderation effects on the treatment response

Mediation analyses showed that, among the four variables explored (i.e., alexithymia, skills use, mindfulness skills, impulsivity), only two mediated the DBT effects on the DERS (assessing ED): the GAFS-8 (assessing alexithymia) and the FFMQ (assessing mindfulness) (**Table 4**).

The GAFS-8 scores significantly mediated the effect of DBT on the DERS score at both T1 (ACME = -5.44 [-11.34 to 0.12], with $p=0.04$) and T2 (ACME = -11.44 [-20.41 to -4.26], with $p<0.0001$). The proportion of the total effect of the DBT on the DERS score mediated by alexithymia (GAFS-8) was 22% at T1 and 28% at T2.

The FFMQ scores significantly mediated the effect of DBT on the DERS score at T2 only (ACME = -10.21 [-17.40 to -3.14], with $p<0.0001$). The proportion of the total effect of the DBT on the DERS score mediated by mindfulness (FFMQ) at T2 was 26%.

Since there were no effects of DBT on anxiety symptoms, the mediating effect of ED was considered only regarding depression symptoms ([Fairchild & McDaniel, 2017](#)). The post-hoc analysis showed a mediating effect of the DERS score on the BDI-II score (assessing depression symptoms) at T1 (ACME = -3.95 [-8.39 to -0.29], with $p=0.04$) and at T2 (ACME = -7.11 [-11.53 to -2.95], with $p<0.0001$). The proportion of the total effect of DBT on the BDI-II score mediated by emotion dysregulation (DERS) was 71% at T1 and 76% at T2.

Table 4. *Effect decomposition for four variables as hypothesized mediators.*

Mediator	T1			T2		
	β	95% CI	<i>p</i> -value	β	95% CI	<i>p</i> -value
GAFS-8						
ACME	-5.44	[-11.34 to 0.12]	0.04*	-11.44	[-20.41 to -4.26]	<0.0001***
ADE	-18.56	[-30.12 to -8.86]	<0.0001***	-26.54	[-32.83 to -20.05]	<0.0001***
ATE	-24.00	[-35.48 to -11.36]	<0.0001***	-37.98	[-46.30 to -29.84]	<0.0001***
Prop. mediated (%)	0.22	[0.01 to 0.39]	0.04*	0.28	[0.13 to 0.48]	<0.0001***
BIS-15						
ACME	-4.33	[-8.72 to 0.73]	0.08	-1.17	[-3.67 to 0.59]	0.24
ADE	19.87	[-30.72 to -11.33]	<0.0001***	-37.74	[-47.66 to -29.83]	<0.0001***
ATE	-24.2	[-33.45 to -14.32]	<0.0001***	-38.91	[-48.67 to -30.60]	<0.0001***
Prop. mediated (%)	0.18	[-0.04 to 0.34]	0.08	0.03	[-0.01 to 0.09]	0.24
DBT WCCL - Skills use						
ACME	-2.65	[-7.53 to 0.36]	0.08	-2.63	[-6.05 to 0.72]	0.16
ADE	-22.96	[-33.63 to -13.60]	<0.0001***	36.27	[-43.72 to -28.85]	<0.0001***
ATE	-25.61	[-37.69 to -16.83]	<0.0001***	-38.90	[-45.40 to -31.70]	<0.0001***
Prop. mediated (%)	0.09	[0.01 to 0.29]	0.08	0.08	[-0.02 to 0.18]	0.16
FFMQ						
ACME	-5.12	[-12.36 to 1.52]	0.20	-10.21	[-17.40 to -3.14]	<0.0001***
ADE	-19.19	[-26.96 to -10.93]	<0.0001***	-27.65	[-33.81 to -22.17]	<0.0001***
ATE	-24.32	[-36.30 to -14.16]	<0.0001***	-37.86	[-43.92 to -28.11]	<0.0001***
Prop. mediated (%)	0.20	[-0.09 to 0.41]	0.20	0.26	[0.11 to 0.43]	<0.0001***

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

ACME = causal mediation effect

ADE = average direct effect

ATE = average total effect

Prop. Mediated = proportion mediated (%)

Moderation analyses showed that, among the five variables explored (i.e., autistic traits, BPD traits, camouflaging, treatment credibility, time since diagnosis, and marital status), only two moderated the effect of the DBT intervention: the AQ (assessing autistic traits) and marital status (in a relationship or single).

A higher AQ score was significantly associated with better ED outcomes at T3. Specifically, a one-unit increase in the AQ score at T0 was associated with a decrease in the DERS score by 1.131 [0.017 to 2.233] points at T3 ($\text{Pr}(\beta_{03} > 0) = 0.023$). In addition, being single was associated with worse ED outcomes at T3. Specifically, being single was associated with a DERS score increase of 15.61 [1.166 to 30.002] points at time T3 ($\text{Pr}(\beta_{03} > 0) = 0.983$) compared to those who were in a relationship.

Discussion

To the best of our knowledge, this study is the first to evaluate the efficacy of a 18-week comprehensive DBT to treat ED in autistic adults presenting with ED associated with NSSI and/or suicidal behaviours/ideation. Our results support previous findings showing the high feasibility and acceptability of DBT among autistic adults (Bemmouna et al., 2022; Ritschel et al., 2022). Furthermore, they are the first to show that DBT is effective to reduce ED in this population. Indeed, consistent with our hypothesis, self-reported ED (measured by the DERS) decreased significantly in the DBT condition compared to TAU mid- and post-therapy, with improvements being maintained at follow-up. Importantly, both post-therapy ($M = 83.93$) and follow-up ($M = 90.81$) DERS mean scores were below the severity cut-off of 96. These results add to our preliminary observational results (Bemmouna et al., 2022) and suggest that DBT is effective to treat ED in autistic adults with NSSI and/or suicidal behaviours/ideation. Importantly, there was a significant decrease in depression post-therapy in the DBT condition compared to TAU, but suicide ideation and anxiety did not differ between DBT and TAU.

In addition to ED improvements, participants' scores on several scales also improved. Indeed, self-reported ER skills use (measured by the DBT-WCCL) increased significantly more in the DBT condition compared to TAU mid- and post-therapy, with this increase being maintained at follow-up. However, contrary to our hypothesis and to existing findings in BPD (Boritz et al., 2019; Rudge et al., 2017; Neacsiu et al., 2010), skills use did not mediate improvements in the DERS. Furthermore, unlike the general skills use, self-reported mindfulness (measured by the FFMQ) not only increased significantly more in the DBT condition than in TAU post-therapy but was also found to mediate the DERS improvements. This suggests that mindfulness skills, specifically, had a key impact on DBT outcomes in autistic adults, consistent with previous studies suggesting that mindfulness-based treatments may be useful for ED in autistic adults (Conner & White, 2018). This seems to be due to the

fact that mindfulness is crucial to enhance the awareness of one's emotional experience, which allows access to effortful ER (Liu et al., 2022; Subic-Wrana et al., 2014).

Moreover, the lack of awareness of one's emotional experience is a core feature of alexithymia (Poquérousse et al., 2018). Hence, it is not surprising that enhanced emotional awareness, probably due to increased use of mindfulness skills, are also reflected in reduced alexithymia (measured by the GAF-8) following DBT. Indeed, self-reported alexithymia decreased significantly more in the DBT condition compared to TAU both mid- and post-therapy, with this improvement being maintained at follow-up. This is consistent with findings in different disorders (e.g., BPD and PTSD) reporting improvements in ED and alexithymia following DBT (Salles et al., 2022). Interestingly, we found that alexithymia partially mediated the effect of DBT on ED. This is in line with previous findings pointing to alexithymia as a mechanism of change in DBT (Boritz et al., 2019), as well as studies supporting the strong link between alexithymia and ED in autistic adults (Morie et al., 2019), including associated NSSI (Moseley et al., 2019) and suicidal behaviours (Costa et al., 2020). This result supports the importance of targeting alexithymia through increased emotional awareness while treating ED in autistic adults.

Notwithstanding these improvements in ED and alexithymia, self-reported suicide ideation (measured by the BSS) and anxiety (measured by the BAI) levels did not decrease significantly in the DBT condition compared to TAU, despite a significant improvement of both clinical dimensions over time in the DBT condition. The absence of a significant difference between the two conditions is because TAU participants also improved significantly over time, thereby reducing the gap between the two conditions. We hypothesize that TAU participants might have improved due to the positive impact of anticipating the start of DBT at the end of the waitlist period. Indeed, similar improvements have been previously observed in waiting list controls in equivalent research protocols (Munder et al., 2019; Posternack & Miller, 2001),

suggesting that waiting list controls may underestimate the effects of psychotherapy (Munder et al., 2019). Therefore, it is possible that differences would have emerged in anxiety and suicide ideation in the DBT group compared to TAU no therapy had been planned for the latter at the end of the waiting period (Munder et al., 2019). Moreover, it is worth noting that the meta-analysis by Chen et al. (2020) showed that DBT had a negligible effect on suicide ideation in BPD, in contrast to suicide attempts. The authors hypothesize that this was probably attributable to the fact that DBT focuses more on reducing life-threatening behaviours (e.g., NSSI, suicide attempts) than suicide ideation (Chen et al., 2020). Additionally, regarding anxiety, it is worth highlighting that anxiety in autistic people is intrinsic to some ASC core features that are not influenced by DBT (e.g., sensory sensitivities, sensitivity to change) (e.g., Normansell-Mossa et al., 2021; South et al., 2021; Syu et al., 2020). However, further studies are needed to investigate to what extent DBT might reduce suicide ideation and anxiety in autistic adults without intellectual disability.

In contrast to suicide ideation and anxiety, self-reported depression (measured by the BDI-II) improved significantly more in the DBT condition compared to TAU post-therapy, although there were improvements in both conditions. In addition, the improvement in the DBT condition was maintained at follow-up. This is in line with several findings in BPD reporting decreased depression following DBT, with this improvement being sustained long-term (e.g., Fleischhaker et al., 2011; Linehan et al., 2006). Importantly, the reduction in depressive symptoms post-treatment was mediated by improvements in ED, suggesting that ED is highly associated with depression in autistic adults (Conner et al., 2023; Charlton et al., 2002; Cai et al., 2018). This is of particular interest given the high rates of depression in autistic adults, with a lifetime prevalence of 37% (Hollocks et al., 2018) compared to that of 15-21% in the general population (Gutiérrez-Rojas et al., 2020). Although depression symptoms are not the primary target of DBT, their improvements might reflect an enhanced orientation towards goals related

to participants’ “life worth living”, which is the ultimate aim of DBT (Linehan, 1993). This is consistent with the significant increase in the “psychological health” dimension of quality of life (measured by the WHOQoL-BREF) in the DBT condition compared to TAU post-treatment, which encompasses items on satisfaction with one’s life, finding a meaning to one’s life, being satisfied with oneself. Together, these results suggest that DBT in autistic adults may also result in a reduction in depression, indicating that ED might be a relevant target when treating autistic adults with depression. In fact, in clinical contexts other than ASC, DBT has been found to be effective in the treatment of depression (Saito et al., 2020; Lynch et al., 2003).

Moreover, it is noteworthy that the “physical health” dimension (e.g., physical pain, energy level at a daily basis, sleep quality) of the quality-of-life scale also improved significantly more in the DBT condition than TAU post-DBT, although physical problems are not targeted by DBT. Consistently, ED has been associated with poor physical health (Calkins et al., 2019) and enhanced ER abilities with improved physical health (Song et al., 2015). More broadly, findings support an interaction between mental and physical health, with reciprocal interactions between the two (Ohrnberger et al., 2017; Doherty & Gaughran, 2014), suggesting that improvement in one dimension may result in improvement in the other. In addition, some ER skills taught in the skills group, such as radical acceptance and awareness of one's bodily sensations, might have improved the way the participants cope with their physical problems.

Surprisingly, improvements in ED were not accompanied by a decrease in self-reported impulsivity (measured by the BIS-15) in the DBT condition compared to TAU. In addition, impulsivity did not mediate the effect of DBT on ED. These results are discrepant with previous findings suggesting that DBT may result in a reduction in impulsivity (e.g., Bianchini et al., 2019; Jamilian et al., 2014), and that increased self-control might be among DBT’s mechanisms of change (Mehlum, 2021; Rudge et al., 2017). In addition, they are incongruent with the results on the “impulse” DERS subscale and the “non-reactivity” FFMQ subscale – both are measures

of impulsivity -- which significantly improved in the DBT condition compared to TAU both mid- and post-therapy. This might be due to the tool used in our study to capture impulsivity changes following DBT. Indeed, the BIS-15 has not been validated in autistic adults and it measures impulsivity as a personality trait, i.e., as a stable characteristic of the individual (Spinella, 2007). Thus, scales measuring state impulsivity, i.e., in response to specific contexts, such as the *State Impulsivity Scale* (SIS; Iribarren et al., 2011), might be more appropriate to assess impulsivity in a more context-dependent perspective.

Regarding the moderation effects, the DERS outcome was found to be moderated by autistic traits (measured by the AQ) at follow-up. Specifically, a higher AQ score at baseline was associated with a higher likelihood of improvement at follow-up. This might seem surprising, as previous findings have supported a positive correlation between autistic traits and ED (Mazefsky & White, 2014; Samson et al., 2014), suggesting that higher autistic traits might be associated with increased ED severity. Yet, similar results have been found in BPD, whereby higher levels of BPD symptoms were associated with higher improvements following DBT (e.g., Seow et al., 2020). This might be explained by the fact that the higher ED at baseline, the wider the potential for improvement following DBT (i.e., regression toward the mean). In addition to autistic traits, marital status also moderated the DERS improvement at follow-up, with those being in a relationship showing increased improvements. This is not surprising as loneliness is reported to be associated with overall decreased mental health and quality of life in autistic adults (Umagami et al., 2022). This may suggest that single autistic adults have the additional burden of loneliness, which negatively affects their mental health and the improvement of ED in the context of DBT.

Limitations

Our study has limitations to be noted. First, our sample ($N=63$) is limited. Although the present study is larger than our preliminary feasibility trial (Bemmouna et al., 2022), larger-

scale studies are needed for the results to be more generalizable. Second, our control condition is a TAU waiting list, which does not allow concluding if the improvements found in the DBT condition are specific to DBT. Indeed, in future studies, we highly recommend to compare DBT to an active control condition in which participants undergo an intervention that encompasses common factors in psychotherapy (e.g., listening, support, presence), such as a discussion group (e.g., Wuthrich et al., 2016; Hirvikoski et al., 2011). Comparing DBT with other interventions targeting ED in autistic adults, such as the mindfulness program by Conner and White (2018) might allow to evaluate whether DBT is potentially superior in treating ED than other CBT interventions. Third, all the measures were self-reported, and this kind of assessments is known to be subject to multiple biases and limitations, such as the difficulty of self-assessment (Althubaiti, 2016). This might be especially the case in people with high levels of alexithymia, such as autistic individuals (Kinnaird et al., 2019). Nevertheless, there are findings supporting that autistic adults are able to report accurately their own difficulties and experiences (Sandercock et al., 2020), including their ER abilities and alexithymia (Berthoz & Hill, 2005). Fourth, we collected data on the perceived potential effects of DBT on NSSI only at follow-up. However, we did not analyze NSSI objective frequency (i.e., tracking number of behaviours through therapy) as a therapy outcome. This is because NSSI was of different natures and frequencies within and between participants (e.g., banging oneself, banging a wall, skin cutting, scratching the skin with nails/tools, etc.), which made it complex to track and analyze them over time as a homogeneous category. Moreover, unlike trials aimed primarily at reducing NSSI (Turner et al., 2014), NSSI was considered as an indicator of high ED in our study, with ED – and related lack of ER skills – remaining the primary target of the intervention. Additionally, while the use of daily NSSI tracking data in research might be complex, especially on trials lasting several months and with a number of participants exhibiting various types of behaviour, the standardized assessment tools developed (e.g., *The Non-Suicidal Self-Injury Assessment*

Tool (NSSI-AT) by Whitlock et al. (2014), the *Suicide Attempt Self-injury Interview* (SASII) by Linehan et al. (2006)) are retrospective, assessing NSSI at a specific time, which makes them subject to several biases, particularly recall difficulties and selective memory (Althubaiti, 2016). In fact, retrospective self-reported measures appear to be less useful for quantifying the frequency of a behaviour than measuring internal experiences, which are subjective by nature, although in both cases the limitations of such measures persist. We believe this is especially problematic when considering NSSI as a behavioural and objective outcome to evaluate an intervention's efficacy. Incidentally, this also implies taking our subjective outcome on NSSI at follow-up with a degree of caution. Sixth, six (10%) of our autistic participants had a co-occurring BPD. ED in these participants could stem mainly from the co-occurring BPD and to a lesser extent from ASC-related factors. Thus, a co-occurring BPD could be considered as an exclusion criterion in future trials targeting ED in autistic adults. However, as these participants are also autistic, they could also be considered as part of possible candidate profiles for DBT among the autistic population (Dell'Oso et al., 2023; Cheney et al., 2023). It should be added that the issue of differential diagnosis between BPD and ASC is complex, sometimes requiring long-term assessment to determine whether there is a co-occurrence (Iversen & Kildahl, 2022; May et al., 2021). Seventh, participants were encouraged to keep their psychotropic medication stable throughout their participation in the study. However, due to the length of participation (11 months for the DBT condition and 16 months for the TAU condition, including the follow-up period), some participants in both conditions made modifications to their psychotropic medication. However, it should be noted that the changes concerned both conditions and were minor. In addition, previous RCT findings have shown that pre-to-post changes in psychotropic medication were uncorrelated with pre-to-post DBT changes in the psychotherapy outcomes, and not significantly associated with either symptomatic remission or dropout rates (Bohus et al., 2020). Eighth, 60% of the participants received their ASC diagnosis in the year prior to

inclusion, for some shortly prior to inclusion. Given the emotional impact of the diagnosis of ASC (Bureau & Clément, 2023), future studies should consider investigating the moderating effect of the date of diagnosis on DBT outcomes on ED. Finally, the DBT intervention we provided included some adaptations for autistic adults without intellectual disability. These adaptations appear to meet the needs of the target population (Keenan et al., 2023). However, there are no findings on whether and how these adaptations are sufficient or necessary. Thus, it would be relevant to investigate in future studies the optimal adaptations of DBT to enhance its efficacy in autistic adults.

Conclusions

Our RCT results are the first to suggest that DBT is effective to treat ED in autistic adults without intellectual disability exhibiting NSSI and/or suicidal behaviours/ideation. Indeed, the DBT condition improved significantly more than TAU in self-reported ED, alexithymia, depression, as well as ER skills, mindfulness and overall psychological and physical health. The improvements in the DBT condition were maintained at the 6-month follow-up. However, DBT did not show efficacy to reduce self-reported impulsivity, anxiety and suicide ideation. Moreover, ED improvements were found to be mediated by alexithymia mid- and post-therapy, and by mindfulness post-therapy. The effect of DBT on depression post-therapy was mediated by ED. Additionally, autistic traits and marital status (single/in relationship) moderated the ED outcomes. These results are of clinical and scientific interest, paving the way for further investigations of DBT to treat ED in autistic adults, especially through larger-scale RCTs.

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AXIS 2 – Study 3

Autistic Adults’ Subjective Experience of Dialectical Behaviour Therapy: A Qualitative Study

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Abstract

Background: Emotion dysregulation (ED) is prevalent in autistic adults without intellectual disability (ID). Importantly, ED has been associated with non-suicidal self-injury (NSSI) and suicidal behaviours in autistic adults. Dialectical behaviour therapy (DBT) has shown to be feasible and acceptable, and potentially effective to treat ED among autistic adults without intellectual disability (ID). However, DBT is in its early stages in the field of autism, so its efficacy and how autistic adults may experience it are crucial to optimize its adaptation and development for this population.

Methods: 22 autistic adults (10 women, 8 men and 4 non-binary individuals) presenting with ED with NSSI and/or suicidal behaviours –including suicide ideation– who received a compressive DBT, as part of a RCT, were interviewed using a semi-structured approach. An inductive thematic analysis was conducted.

Results: Eight themes emerged: (1) therapy usefulness and costs, (2) group benefits and constraints, (3) importance of the individual therapy, (4) skills use and teaching, (5) emotion regulation, (6) interpersonal relationships, (7) building a “life worth living”, and (8) ideas to improve the therapy.

Conclusions: Our findings indicate that DBT was experienced as highly helpful despite the level of effort it requires. Participants found that individual therapy was a key component to enhance motivation and skills use. Perceived benefits concern emotion regulation, relationships and building a *life worth living*. Participants suggested some areas of improvement to enhance DBT’s pertinence when applied to autistic adults.

Keywords: Autism spectrum condition, Adults, Emotion dysregulation, Non-suicidal self-injury, Suicidality, Dialectical behaviour therapy, Subjective experience, Qualitative study.

Background

Emotion dysregulation (ED) is defined as patterns of emotional experience and/or expression that interfere with appropriate goal-directed behaviours (Beauchaine et al., 2015). Recent studies show that ED is prevalent in autistic people (Conner et al., 2021; Cai et al., 2018; Samson et al., 2014), including adults (Swain et al., 2015). ED in autistic people has been pinpointed as a potential contributor to the high rates of co-occurring psychopathology, such as anxiety and depression (Riedelbauch et al., 2023; Conner et al., 2021; Khor et al., 2014). Importantly, ED has also been shown to be associated with non-suicidal self-injury (NSSI) and suicidal behaviours in autistic people (Moseley et al., 2019; Conner et al., 2020; Licence et al., 2020; Jachyra et al., 2022).

Dialectical behaviour therapy (DBT) (Linehan, 1993) is a third-wave cognitive behavioural therapy (CBT) that has amassed a large body of evidence in treating ED associated with NSSI and suicidal behaviours in borderline personality disorder (BPD) (Linehan et al., 2006; Panos et al., 2014). DBT has subsequently found effective to treat ED in several psychiatric and neurodevelopmental disorders, such as ADHD, depression, anxiety and eating disorders (Chen et al., 2008; Harley et al., 2008; Lynch et al., 2003; Neacsiu et al., 2014; Safer et al., 2001). In autism spectrum condition (ASC), however, studies investigating DBT's efficacy in treating ED associated with life-threatening behaviours are lacking (Bemmouna et al., 2022).

Although DBT is widely recognized as an effective treatment for ED and life-threatening behaviours, its ultimate aim is to help individuals engage in building a *life worth living*, that is, a life in line with personal values and goals (Linehan, 1993). To do so, DBT has been designed as a comprehensive therapy that serves 5 functions, including enhancing adaptive emotion regulation skills and the motivation to engage in skilful behaviour, that are accomplished through four modes: skills training group, individual therapy, phone coaching

and team consultation (Chapman, 2006; Linehan, 1993). Comprehensive DBT usually refers to these four complementary modes, but other formats, which include mainly standalone skills training group, have also been evaluated in the literature (Valentine et al., 2015; Linehan, 1993).

Several arguments have been raised to support the use of DBT to treat ED in autistic people (Hartmann et al., 2012). First, ED is highly prevalent in autistic people, and it seems linked to the high prevalence of NSSI and suicidal behaviours among autistic adults (Jachyra et al., 2022; Conner et al., 2020; Moseley et al., 2019). Second, DBT has proved to be effective in reducing ED in psychiatric disorders but also in adults with ADHD (Halmøy et al., 2022; Fleming et al., 2015), suggesting its pertinence to treat ED in neurodevelopmental conditions. Third, third-wave CBT approaches that include mindfulness, like DBT, have been recently found to be feasible and effective in treating autistic adults presenting with several mental health issues (Pagni & Braden, 2021; Beck et al., 2020), including ED (Conner & White, 2018). Finally, recent research has reported findings regarding the feasibility and preliminary efficacy of comprehensive DBT (Bemmouna et al., 2022) and standalone DBT skills training groups (Ritschel et al., 2022) in the treatment of ED in autistic adults without intellectual disability.

Yet, as highlighted in a recent first-person account of an autistic person who benefitted from comprehensive DBT, reasonable accommodations based on lived experiences of autistic individuals may help to promote one's engagement, retention, and use of core skills (Keenan et al., 2023). In other words, it is crucial to consider the subjective experience of autistic people who benefitted from DBT to foster its pertinence and efficacy in this population. To our knowledge, in addition to the aforementioned first-person account, only one study by Bemmouna et al. (2022) has focused on the subjective experience of autistic adults who underwent DBT. In their pilot mixed methods study with seven autistic adults, the authors reported that thematic analysis yielded five themes, i.e., (1) the therapeutic alliance in the skills training group, (2) the group setting of the skills training, (3) the usefulness of the skills learned,

(4) the usefulness of the individual therapy sessions, and (5) the overall positive impact of DBT, which generated hope, and helped build a *life worth living* (Bemmouna et al., 2022). Interestingly, these results are similar to those from a systematic review focusing on the processes and impact of DBT from the perspective of individuals with BPD, which found four themes common to the seven studies included: i.e., (1) life before DBT, (2) the relationships that support change (including the therapeutic relationship), (3) developing self-efficacy, and (4) a shift in perspective –the latter being characterized by an increased insight, self-acceptance and hope for the future following DBT (Little et al., 2018). In the same study, participants emphasized the importance of learning and using new skills, taking responsibility for change and the therapeutic relationship in effective change following DBT (Little et al., 2018). Nevertheless, most studies on DBT’s efficacy, impact and process have relied thus far on quantitative methodology, and only few studies used qualitative methods to understand how individuals with BPD experience DBT (Gillespie et al., 2022; Little et al., 2018).

In ASC, to our knowledge, only the mixed-methods study by Bemmouna et al. (2022) and the first-person account by Keenan et al. (2023) have focused on autistic adults’ subjective experience of DBT. However, in the only study that used a qualitative methodology (i.e., Bemmouna et al., 2022) the number of participants was small, and the qualitative methodology was secondary, hence suffering from several biases. Therefore, larger-scale qualitative studies on autistic adults’ subjective experience of DBT are lacking.

The aim of this study is to explore the subjective experiences of autistic adults following comprehensive DBT using thematic analysis (Braun & Clarke, 2006). This is crucial given that DBT is increasingly seen as a useful treatment for ED and ED-related dysfunctional behaviours in autistic people (e.g., Keenan et al., 2023; Bemmouna et al., 2022; Ritschel et al., 2022), and that subjective accounts of DBT may potentially increase treatment retention, as well as DBT’s efficacy. Indeed, as qualitative research is concerned more with meaning and experience than

measuring the effect of certain variables, it arguably allows for a more in-depth understanding of a particular experience (Willig, 2019). A better understanding of the subjective impacts and processes of change of DBT applied to autistic adults is therefore likely to improve its pertinence in this population.

Methods

Participants

The study included 22 participants who took part in a randomized controlled trial (RCT) evaluating the efficacy of DBT in autistic adults without intellectual disability with ED associated with NSSI and/or suicidal behaviours (including suicide ideation) (Bemmouna et al., in preparation). In the RCT, the participants were randomized either to the DBT condition (18-week comprehensive DBT treatment) or to the treatment as usual (TAU) condition and they were invited to participate in the qualitative study post-intervention. The 22 participants completed the therapy and volunteered to participate. They belonged to the first five groups conducted in the RCT (4 from group 1, 3 from group 2, 7 from group 3, 4 from group 4, and 4 from group 5).

To be included in the RCT, participants had to meet the following criteria: **(a)** being \geq 18 years old, **(b)** having a formal diagnosis of ASC supported by the *d* (ADI-R; Rutter et al., 2003) and the *Autism Diagnostic Observation Schedule, Second Edition revised module 4* (ADOS-2; Hus & Lord 2014; Lord et al., 2012), as well as a previous IQ assessment based on the *Wechsler Adult Intelligence Scale, Fourth Edition* (WAIS-IV; Wechsler, 2011) indicating the absence of intellectual disability (Total IQ above 80), **(c)** having a DERS total score above the cut-off of 96 at baseline reflecting high ED (Neacsiu et al., 2014), **(d)** presenting NSSI and/or suicidal behaviours and/or suicide ideation in the 6 months prior to inclusion, and **(e)** being able to understand and consent to the research aims. Exclusion criteria were: **(a)** having

received a DBT, and **(b)** having a lifetime diagnosis of schizophrenia, schizoaffective disorder, or any unspecified psychotic disorder.

Participants' demographic and clinical variables are presented in **Table 1**. The sample included 10 (45%) women, 8 (36%) men, and 4 (18%) non-binary individuals. Mean age was 30 years old (± 7.19 , range from 19 to 43 years old). Seventeen of them (77%) were diagnosed with ASC in the year prior to inclusion; 3 (14%) had a co-occurring BPD, while 13 (59%) had a co-occurring ADHD. Five of them (23%) presented with NSSI, suicidal behaviours and ideation. Seven participants (32%) were randomized to the TAU waiting list condition in the RCT before receiving the DBT treatment.

DBT intervention

The intervention consisted of a 18-week comprehensive DBT, similar to that provided in our pilot study ([Bemmouna et al., 2022](#); [Neacsu et al., 2014](#); [Linehan, 1993](#)). The treatment encompassed **(a)** a 2h15 weekly skills training group session, **(b)** a weekly 1-hour individual therapy session, **(c)** access to telephone coaching, and **(d)** a weekly 2-hour therapist consultation. The skills training group sessions covered the four DBT modules, i.e., mindfulness (3 sessions), emotion regulation (6 sessions), distress tolerance (4 sessions) and interpersonal effectiveness (3 sessions). Two debriefing sessions took place at mid- and end-of-therapy.

Key adaptations of DBT to autistic adults without intellectual disability are like those described in the pilot study ([Bemmouna et al., 2022](#)). They include : **(a)** maintaining the stability of the therapy environment (room, schedule, facilitators, etc.); **(b)** adapting the participant's manuals through a significant reduction in text and the addition of schematics and images illustrating the skills; **(c)** addressing the individual barriers to participating in the skills group (e.g. the anxiety of being in the presence of other people, the fear of dealing with social interactions, the fear of speaking up in the group) during the pre-treatment sessions; **(d)** giving

concise instructions and explanations based on the use of concrete examples, role-playing and modeling; (e) facilitating mindfulness practices based on precise and clear instructions, inviting participants to focus their attention on concrete elements of the present moment (e.g. breath, body sensations, environment sounds, objects) (Spek et al., 2013; Kiep et al., 2015); (f) providing support for inter-session practice if needed; and (g) for those with intense interests, therapists tried to introduce these interests into the examples/practices. Moreover, all participants filled in the *Adolescent/Adult Sensory Profile* (A/ASP; Brown & Dunn, 2002) pre-treatment to identify their sensory particularities and to take them into account during therapy. The group sessions were scheduled in the quietest rooms of the clinic.

The treatment was provided by four clinical psychologists, including a senior psychologist (LW, professor of clinical psychology, extensively trained in DBT). All psychologists were trained both in CBT and in DBT through their university training, but also through specialized DBT training programs, and clinical experience within the DBT team of the University Hospitals of Strasbourg.

The senior psychologist provided weekly supervision to the team. The therapists relied on the French version of the *DBT Skills Training Manual* (Linehan, 2017) and participated in weekly consultation team to discuss complex cases and increase adherence to the DBT model.

Table 1. *Sample description.*

Demographics		
n (%)		22 (100%)
Mean age (SD)		30 (7.19)
Age range (Min-max)		19-43
Gender, n (%)		
	Women	10 (45%)
	Men	8 (36%)
	Non-binary	4 (18%)
Marital status, n (%)		
	Single	11 (50%)
	Married / in relationship	10 (45%)
	Divorced	1 (5%)
Having children, n (%)		4 (18%)
Professional status, n (%)		
	Employed/self-employed	6 (27%)
	Student	7 (32%)
	Unemployed	9 (41%)
Educational status, n (%)		
	College graduate	19 (86%)
	High School degree or less	3 (14%)
Living situation, n (%)		
	Alone	11 (50%)
	With parents	4 (18%)
	With partner with or without children	6 (27%)
	Alone with children	1 (5%)
Clinical variables		
Recent ASC diagnosis (<1 year), n (%)		17 (77%)
Co-occurring BPD, n (%)		3 (14%)
Co-occurring ADHD, n (%)		13 (59%)
Current psychotropic medication, n (%)		18 (82%)
Current psychological and psychiatric care, n (%)		
	Psychological + psychiatric follow-up	9 (41%)
	Psychiatric follow-up only	10 (45%)
	No follow-up	3 (14%)
Current NSSI, n (%)		14 (64%)
	Current skin cutting	3 (14%)
	Frequent skin cutting ¹	1 (5%)
Current suicide ideation (SI), n (%)		20 (91%)
History of suicidal behaviours (SB), n (%)		8 (36%)
	SB in the year prior to inclusion	3 (14%)
History of hospitalization in psychiatry, n (%)		11 (50%)
	Last hospitalization for NSSI and/or SI and/or SB	9 (41%)
	Hospitalization in the last year prior to inclusion	5 (23%)
Participants with NSSI only, n (%)		2 (9%)
Participants with SI only, n (%)		5 (23%)
Participants with SI and SB, n (%)		3 (14%)
Participants with NSSI and SI, n (%)		7 (32%)
Participants with NSSI, SI and SB, n (%)		5 (23%)
Received DBT after TAU waiting list, n (%)		7 (32%)

¹Daily/many times a week

Interviews

The semi-structured interviews were conducted by graduate level psychology students who were not involved in the study (Peters & Halcomb, 2015). They were audio-recorded with the participants' consent. Their duration ranged between 20 and 60 minutes.

An interview template was prepared to guide the interviewers and to ensure that all questions of interest were covered (Appendix 1). The template included prompt questions in case the initial formulation was not clear to the participant. Open-ended questions were used to favour the patient's free expression, without guiding the answers but recontextualizing if needed (Appendix 2). The questions were designed to explore the participants' experience in 3 broad areas: (a) the overall experience of the therapy (e.g., What is your general appreciation of the therapy?); (b) their experience of therapy components (i.e., group sessions and individual therapy) (e.g., how did you experience the group/individual sessions?), and (c) the overall perceived effects of the therapy (e.g. what effects, if any, has the therapy had on your ability to regulate your emotions?). At the beginning of each interview, the interviewers made it clear to participants that they were interested in learning about their subjective experience, and that there were no right or wrong answers and no obligation to answer any question.

Data analysis

Thirty interviews were conducted, but only 22 were analysed because of saturation of data, i.e., no new codes or themes were identified (Saunders et al., 2018). We were careful to include interviews of participants from different groups.

Audio recordings of the interviews were transcribed verbatim and an inductive thematic analysis (i.e., « bottom up ») was carried out by four graduate psychology students trained by the first author, following the six-step process by Braun and Clarke (2006). Thematic analysis was chosen because it is suitable for evaluating patient experiences following psychotherapy (Braun & Clarke, 2014), and because it is flexible and appropriate for managing rich data

material (Braun & Clarke, 2006). The psychology students did not analyse their own interviews in order to maximise the coders' neutrality regarding the text being analysed. Thematic analysis required getting familiar with the text, coding the content using Taguette (Rampin et al., 2020), generating themes, reviewing themes, defining, and naming themes, and writing and choosing prominent examples of themes. This process was conducted for each individual interview. Following this, a consensus was met between the four psychology graduate students regarding the whole sample, leading to agreement on eight main higher-order themes. Quite expectedly, emerging trends in the data and the main coding categories reflected to some extent the questions asked during the interviews; to ensure reliability, consensus on the final themes was sought between the four students. The consensus process was carried out under the supervision of the first author.

As interviews were conducted in French, the final themes and the illustrative quotes have been translated from French into English by the first author.

Ethics approval and consent to participate

The study was approved by the regional ethics committee of the East of France (Ethical approval number: SI 21.01.21.41923). All procedures performed in the study complied with the ethics code outlined in the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the RCT. In addition, for the qualitative study, participants provided informed consent for the audio recording of the interviews and the use of the collected qualitative data. The audios and transcriptions ensured the participants' anonymity. The audios were destroyed once the thematic analysis had been completed.

Results

Eight main themes emerged from the thematic analysis (**Table 2**).

Therapy usefulness and costs

The participants highlighted that they were highly satisfied with the treatment, which they qualified as comprehensive, well structured, and helpful to improve their emotion regulation and daily life. Some participants indicated that the therapy was an opportunity they wished all autistic adults could benefit from. For instance, one participant said: *“I really appreciated the therapy and I'm glad I did it. It really helped me improve my daily life and my self-confidence. I have no regrets having done it, and I hope that many other autistic people will be able to benefit from it.”*

In contrast, the participants also indicated that the therapy was intensive, as it encompassed both weekly group sessions and individual sessions. They shared that the therapy required a great deal of personal work, not only in terms of time but also in terms of energy, which was related for some to increased fatigue. For instance, a participant testified: *“It was intensive. It requires a lot of personal effort [...] maybe I didn't expect it to be so much work.”*

Group benefits and constraints

Participants described the group environment as secure and judgment-free, allowing them to feel comfortable and to express themselves. For instance, a participant said: *“There was no judgment, there was a friendly atmosphere, so it allowed people to express themselves freely, and the fear that I had at the beginning decreased afterwards.”*

Participants also shared that the group allowed them to meet other autistic adults who dealt with similar problems; this made them feel less alone regarding their difficulties. For example, a participant said: *“It also allowed me to see that there are other people who face the same difficulties as me and that I'm not alone in experiencing difficulties like this.”*

Moreover, participants mentioned that the group, particularly feedback on between-session practices, allowed them to learn how others applied the skills in different situations than theirs. This broadened the range of contexts in which skills may be used. For instance, a participant shared: *“Being in a group was also useful to see other people dealing with problems that you hadn't necessarily thought of [...] and to see other applications of the same skills”*.

In contrast, the group was also found to be energy consuming and tiring. For instance, a participant indicated: *“It's very consuming, especially the group therapy. It's very intense.”* Others found the group context intimidating and anxiety provoking due to several factors, including the social context, having to share homework to the group, and the fear of being judged by others (especially in the first sessions). For some, the skills were explained too slowly or with too many details, and they would have preferred sessions with a faster pace and fewer explanations.

Importance of individual therapy

Participants found the individual therapy to be a key component of the treatment, with some highlighting that it was the most helpful. They found the sessions to be active and of optimal duration. They mentioned that the individual sessions were crucial to maintain motivation to continue the therapy. Moreover, they experienced the therapeutic alliance with their individual therapist as very positive, i.e., supportive and encouraging. For example, a participant shared: *“She [the therapist] is really caring, a good listener, very encouraging, that's a big motivation as well, it's really very helpful, essential, I think.”*

They also shared that the individual therapy helped them to deepen their understanding of the skills learned in the group and to analyse emotionally challenging situations they had to deal with. For instance, a participant testified: *“It's good to learn the skills in group, but without the individual sessions with [name of therapist] it wouldn't have been as effective, so it's great to be able to pick them up again afterwards in individual therapy.”*

They also indicated that individual sessions were an opportunity to “zoom in” on their emotional experience and better understand their emotions. For example, a participant said: *"I had to look at what I felt through a microscope."*

Skills use and their teaching

The skills learnt in the group were found useful, concrete, helpful and effective. For instance, a participant shared: *"I try out different skills and they often work."* Participants reported that the skills were applicable in the challenging situations found in their daily lives. They reported using them frequently (ranging from daily to a few times a week). For instance, a participant shared: *"Mindfulness skills, and Wise Mind⁸, I use them every day. But other skills like DEAR MAN⁹ or STOP¹⁰, I don't use them every day, it depends."*

Participants shared that some skills enabled them to label strategies they were already using prior to the therapy, making their implementation more intentional and structured. For example, a participant said: *"There are things I used to do but I didn't know they were skills, so identifying them and saying to myself at that moment I'm doing this as a skill helps me to be fully aware of what I'm doing."*

In addition, some reported having shared some skills with family members (partner, children, and parents) and friends to help them better deal with their difficult emotions.

Perceived benefits of the therapy on emotion regulation

Participants expressed that the treatment helped them better identify their emotions and what triggers them, as well as welcome and accept their emotional experience even when it is painful. For instance, a participant said: *"I can feel the emotion popping up and I can spot it better and I can identify more clearly what has triggering it."*

⁸ A mindfulness skill that combines emotional and rational mind in order to act wisely.

⁹ An interpersonal effectiveness skill used to communicate one's objective effectively.

¹⁰ A distress tolerance skill used to prevent impulsive actions.

Additionally, they said that the therapy helped them to better handle difficult emotions, especially emotional crises. More precisely, they reported that they felt less impulsive, as they felt now more able to go through emotional crises and have no impulsive behaviours (e.g., self-harm). Moreover, participants reported that the therapy allowed them to learn new emotion regulation skills that felt automatic now. For example, a participant said: *"I take a step back, I don't react as fast as I used to, I pause for a while, I think, even if it's only for a few seconds, even if it's just for a few seconds, I breathe, I do paced breathing"*, and another participant said: *"At first it's an effort, but as time goes by it becomes automatic. The more you use the skill, the more automatic it becomes. It's great!"*

They also felt that they were better able to anticipate upcoming difficult situations (i.e., the Cope ahead skill), which enables them to deal with them more effectively. In addition, although they continue to experience intense emotions, participants felt that they were now more able to cope with them. For instance, a participant shared: *"There are always difficult emotions, very strong, intense, but I manage them, and it doesn't stop me from doing things. I'm still afraid but I try and often it works. So, I live with it [emotions] much better and now I want to try other things. It really changed my life."*

Perceived benefits of the therapy regarding interpersonal relationships

Participants reported that the therapy helped them to be to initiate social interactions and to better communicate with others. Some shared that, following DBT, they were now able to experience what it feels like to have a social life: *"I started GREMO¹¹ and I started seeing more people and creating a social life for myself"*. They explained that these changes were due to “enhanced self-confidence” and “decreased social anxiety”.

In addition to an increase in the number of meaningful interactions, participants reported that the skills helped to improve the quality of their interactions, as they felt they could act less

¹¹ GREMO for *Groupe de Régulation EMotionnelle* (Emotion Regulation Group) referring to the name of our DBT skills training group

impulsively and communicate with more assertiveness. As a result, they expressed greater overall satisfaction with their relationships. For instance, a participant said: *"I'm much less impulsive in my answers, and I also feel that I can better communicate my limits, and people respect that."*, while another reported: *"With my parents, we realized that our communication was disastrous [...] but I noticed as the therapy progressed everything that was wrong with our communication and now that will likely change."*

Finally, some participants felt more able to ask for help when they needed it.

Perceived benefits of the therapy for building a life worth living

Some participants reported that the therapy helped them identify their “true values” and to engage actions in their direction. For instance, a participant said: *"It allowed me to move towards my true values. Until then, I had been wearing a kind of mask"*. Others mentioned having already identified their values prior to the therapy, and that the latter encouraged them to move in their direction.

Moreover, participants shared being overall more optimistic about the future, as well as feeling more confident to face future challenges. Some explained experiencing an enhanced sense of self-efficacy to deal with difficulties. For example, a participant reported: *"I'm more confident about the future, I don't know what's going to happen tomorrow, but I know that I'm going to handle it, that I'm going to manage it, whereas before I was really overwhelmed, I would have preferred to die. Now I'm happy in my little life."* However, for some participants, it was too early for them to see all the potential effects of the therapy, especially in relation to life goals.

Ideas to improve the therapy

Most participants agreed that the end of the therapy was abrupt, which led to an increased anxiety for some participants. Thus, participants suggested ensuring a more gradual end for those who need it. This can be achieved by individual sessions continuing, at increasingly longer intervals, after the end of the group. For instance, a participant said:

"Sometimes, I was a bit afraid of the aftermath, that it would stop [...]. I have a psychiatrist, but the sessions last 20 minutes, so it's not the same. I'm afraid of losing my skills and regressing [...]. The end is a bit abrupt."

Other main improvement areas consisted of a room for group sessions that was more adapted to sensory needs (e.g., noise, light and heat), group sessions on weekdays other than Fridays because of fatigue, more role-play during sessions in order to model the skills, clarifying some of the text in the manual and adding more colours, illustrations, and summaries. Some participants felt the group sessions' content could be reduced using explanations that were less detailed.

Discussion

This section is in preparation.

Table 2. *Summary of identified items, their content and example quotes.*

Themes	Theme content	Example quotes
1. Therapy usefulness and costs	High level of satisfaction with therapy (helpful therapy, high quality therapy, an opportunity for autistic adults). However, the program requires significant effort in terms of time and energy.	<p><i>"I really appreciated the therapy and I'm glad I did it. It really helped improve my daily life and my self-confidence. I have no regrets having done it, and I hope that many other people will be able to benefit from it."</i> (satisfaction)</p> <p><i>"It was intensive. It requires a lot of personal effort [...] maybe I didn't expect it to be so much work."</i> (effort)</p>
2. Group benefits and constraints	Group environment perceived as secure, the group setting allows to normalize one's difficulties and to see how others apply skills. However, the group sessions can be tiring, anxiety provoking, and too slow for some.	<p><i>"There was no judgment, there was a friendly atmosphere, so it allowed people to express themselves freely, and the fear that I had at the beginning decreased afterwards."</i> (secure environment)</p> <p><i>"It also allowed me to see that there are other people who face the same difficulties as me and that I'm not alone in experiencing difficulties like this."</i> (normalization of difficulties)</p> <p><i>"Being in a group was also useful to see other people dealing with problems that you hadn't necessarily thought of [...] and to see other applications of the same skills."</i> (learning from others)</p> <p><i>"It's very consuming, especially the group therapy. It's very intense."</i> (tiring)</p> <p><i>"Group sessions are very intimidating."</i> (intimidating)</p>

3. Importance of the individual therapy	<p>Individual therapy considered as crucial, the most helpful according to some.</p> <p>Therapeutic alliance perceived as very positive and supportive.</p> <p>Sessions experienced as active, with optimal duration, enabling to zoom in on individualized difficult situations, emotions and the skills.</p>	<p><i>"It's good to learn the skills in group, but without the individual sessions with [name of therapist] it wouldn't have been as effective, so it's great to be able to pick them up again afterwards in individual therapy."</i> (individual therapy as crucial)</p> <p><i>"She [the therapist] is really caring, a good listener, very encouraging, that's a big motivation as well, it's really very helpful, essential, I think."</i> (quality of the therapeutic alliance)</p> <p><i>"I had to look at what I felt through a microscope."</i> (zooming in on emotions)</p>
4. Skills use and their teaching	<p>Skills judged as useful, concrete and helpful.</p> <p>They were used frequently.</p> <p>Some tools already in use were identified as skills.</p> <p>Some skills were harder to learn and apply than others.</p> <p>Some participants shared skills to relatives.</p>	<p><i>"I try out different skills and they often work."</i> (useful skills that work)</p> <p><i>"Mindfulness skills, and wise mind, I use them every day. But other skills like DEAR MAN or STOP, I don't use them every day, it depends."</i> (skills used frequently)</p> <p><i>"There are things I used to do but I didn't know they were skills, so identifying them and saying to myself at that moment I'm doing this as a skill helps me to be fully aware of what I'm doing."</i> (identifying tools already in use as skills)</p>
5. Perceived benefits of the therapy on emotion regulation	<p>Improved ability to identify emotions and welcome/accept them.</p> <p>Better handling of difficult emotions (crises) and reduced impulsivity.</p> <p>Better anticipation of difficult situations.</p>	<p><i>"I can feel the emotion coming popping up and I can spot it better and I can identify more clearly what is has triggering it."</i> (emotional awareness)</p> <p><i>"There are always difficult emotions, very strong, intense, but I manage them, and it doesn't stop me from doing things. I'm still afraid but I try and often it works. So,</i></p>

	Development of new emotional regulation automatisms.	<p><i>I live with it [emotions] much better and now I want to try other things. It really changed my life."</i> (enhanced emotion regulation)</p> <p><i>"I take a step back, I don't react as fast as I used to, I pause for a while, I think, even if it's only for a few seconds. I breathe, I do paced breathing."</i> (decreased impulsivity)</p> <p><i>"At first it's an effort, but as time goes by it becomes automatic. The more you use the skill, the more automatic it becomes. It's great."</i> (new emotion regulation automatisms)</p>
6. Perceived benefits of the therapy regarding interpersonal relationships	<p>Communicating more and better.</p> <p>More interactions and the start of a social life for some.</p> <p>More satisfaction in relationships due to better communication.</p> <p>More self-confidence in relationships (daring to assert oneself) - less social anxiety for some.</p> <p>Asking for help more easily.</p>	<p><i>"I started GREMO and I started seeing more people and creating a social life for myself."</i> (more social interactions)</p> <p><i>"I'm much less impulsive in my answers, and I also feel that I can better communicate my limits, and people respect that."</i> (daring communicating and communicating better)</p> <p><i>"With my parents, we realized that our communication was disastrous [...] but I noticed as the therapy progressed everything that was wrong with our communication and now that will likely change."</i> (amelioration of communication et relations)</p>

<p>7. Perceived benefits of the therapy for building a life worth living</p>	<p>Identification of values and, for some, continuing to move towards values identified prior to therapy.</p> <p>Engaging in new actions/activities</p> <p>More optimism, more confidence about future challenges and an increased sense of self-efficacy to cope with challenges.</p> <p>For some, it was too early to know if effect on values.</p>	<p><i>"It allowed me to move towards my true values. Until then, I had been wearing a kind of mask."</i> (identifying values)</p> <p><i>"I'm more confident about the future, I don't know what's going to happen tomorrow but I know that I'm going to handle it, that I'm going to manage it, whereas before I was really overwhelmed, I would have preferred to die. Now I'm happy in my little life."</i> (optimism and enhanced self-efficacy)</p>
<p>8. Ideas to improve the therapy</p>	<p>Gradual end of therapy (vs. abrupt end).</p> <p>Shorter/longer group sessions.</p> <p>More adapted room for group sessions (noise, light and heat).</p> <p>Avoiding group sessions on Fridays because of fatigue.</p> <p>Improving manuals (make some texts clearer, more colours and illustrations, and adding summaries).</p> <p>Lighten the sessions' content for some.</p>	<p><i>"Sometimes, I was a bit afraid of the aftermath, that it would stop [...]. I have a psychiatrist, but the sessions last 20 minutes, so it's not the same. I'm afraid of losing my skills and regressing [...]. The end is a bit abrupt."</i> (abrupt end)</p> <p><i>"Some texts [in the manual] are too vague or not precise enough."</i> (manual)</p>

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Appendix 1 - Interview template

The aim of this interview is to learn about your subjective experience of the therapy (group and individual therapy) and its potential effects on you. I am going to ask you a few questions. There are no right or wrong answers. I am interested in your personal feedback, whatever it may be.

For research purposes, I will need your consent to record the interview so that it can be analysed later. The audio recording will be anonymous, accessible only to the research team involved in the study and will be stored temporarily for the time it takes to analyse it, before being permanently destroyed. Do you authorize me to record the interview? (If yes, please provide the consent form for signature).

Do not hesitate to ask me for clarification if any questions are unclear to you.

OVERALL EXPERIENCE OF THE THERAPY

1. What is your overall assessment of the therapy?

Prompts: How would you rate the therapy overall? Why? What is your overall impression of the therapy?

2. What, if anything, did you find most helpful about the therapy?

Prompt: What, if anything, has been most helpful to you in the therapy?

3. Were there any aspects of the therapy that left you dissatisfied?

Prompts: Were there any aspects of the therapy that displeased you? What do you think could be improved in the therapy?

EXPERIENCE OF THERAPY COMPONENTS

4. How did you experience the group?

Prompts: How did you feel in the group? What did you like and dislike about the group experience?

5. What is your appreciation of the individual therapy?

Prompts: How would you evaluate the individual therapy? How did the individual therapy go for you?

OVERALL PERCEIVED EFFECTS OF THERAPY

6. What effects, if any, has therapy had on your ability to regulate difficult emotions?

Prompt: Has the therapy had any impact on your ability to regulate difficult emotions (fear, anger, sadness, etc.)? Please elaborate.

7. Which place do the skills you have learned currently occupy in your life?

Prompts: How often do you use them? How useful are the skills to you?

8. Could you give me an example of a specific situation in which you used GREMO skills (specify the skills used)?

9. To what extent, if any, has therapy helped you to take action in line with your values/what is important to you?

Prompt: Has therapy helped you to make any decisions, do certain activities, start certain actions, etc. that are important to you?

10. Has therapy had any effect on the way you interact with people around you?

Prompt: Have you noticed any change in the way you communicate and react to those around you following therapy? Please elaborate.

11. How do you now feel about current and future challenges in your life (difficulties, problems, undesirable events)?

Prompts: What impact, if any, has therapy had on the way you deal with difficulties in your life? Has your ability to deal with difficulties in your life changed following therapy?

Appendix 2 - Instructions to the interviewer

- Introduce yourself briefly at the beginning;
- Be careful **not to suggest hypotheses for answers, or direct answers**. Simply invite participants to elaborate and reformulate if necessary;
- If the participant does not understand the question, do not hesitate to rephrase and give examples;
- Do not hesitate to ask the participant to develop if the answer is too short;
- Do not hesitate to clarify what the person means by certain terms/sentences that seem vague to you;
- You do not have to follow this framework strictly, so do not hesitate to pick up on relevant points as the interview progresses;
- Leave the recording running until the participant has left.

PART IV – General discussion

General discussion

The aim of this thesis was twofold: **(a)** to investigate the characteristics and correlates of ED in autistic adults without intellectual disability relative to people with BPD (Axis 1), and **(b)** to evaluate the feasibility, acceptability, and efficacy of DBT to treat ED associated with NSSI and/or suicidal behaviours in this population (Axis 2).

The literature on ED in ASC is still in its early stages (Cai et al., 2018). Nevertheless, a growing number of recent studies has found that ED is prevalent in autistic people (Conner et al., 2021; Cai et al., 2018; Samson et al., 2014), including autistic adults (Swain et al., 2015). Importantly, ED has been recently suggested to be an important risk factor for suicidality and NSSI in autistic individuals (Jachyra et al. 2022; Conner et al., 2020; Moseley et al., 2019). Since the interest in ED in ASC is recent, there is a great need to improve its understanding, especially in adults, whereby mental-health problems are frequent and may overshadow ED. Relatedly, this has led some authors to hypothesize that ED in autistic adults might be attributable to co-occurring mental-health problems (Charlton and al., 2020; Mazefsky et al., 2013). Because ED is a core symptom in BPD (Linehan, 1993), we considered that the question of the specificity of its characteristics and aetiology in ASC should be addressed in comparison to this disorder. This seems particularly relevant given the increasing awareness of gender-related biases in ASC diagnosis in adults that may lead to misdiagnosis of BPD in autistic women in particular (Darling Rasmussen, 2023; Pires et al., 2023), but also, irrespective of gender, in autistic adults presenting with severe ED associated with NSSI (Watts et al., 2023; Iversen & Kildahl, 2022).

The two studies presented in Axis 1 of this thesis sought to contribute to our understanding of ED in ASD, particularly compared to BPD (Glenn & Klonsky, 2009; Linehan, 1993). Indeed, given that ED is a core symptom in BPD, and that the differential diagnosis may be tricky especially in women, our research aimed to determine whether ED presentation and

aetiology differed in each condition. This seemed to be a crucial first step to address the question of the treatment of ED in autistic individuals, especially when ED is associated with NSSI and/or suicidal behaviours (Conner et al., 2020; Reyes et al., 2019; Mazefsky & White, 2014). DBT has amassed a large body of findings in the treatment of ED in BPD, as well as in other psychiatric and neurodevelopmental conditions (Delaquis et al., 2022; Panos et al. 2014; Linehan, 1993). Yet findings on its feasibility and usefulness to treat ED in the context of ASC were lacking (Mazefsky & White, 2014; Hartmann et al., 2012). Therefore, the three empirical studies in Axis 2 of this thesis sought to provide data on the feasibility, the efficacy, and the mechanisms of change of DBT for autistic adults with ED and NSSI and/or suicidal behaviours.

I. Similarities and differences between ED in ASC and BPD

ASC and BPD might share ED among its features (Conner et al., 2021; Glenn & Klonsky, 2009), as well as high rates of life-threatening behaviours, i.e., NSSI and suicidal behaviours (Moseley et al., 2020; Oumaya et al., 2008). However, apart from Weiner et al. (2023), so far, no studies had been conducted to investigate ED and life-threatening behaviours in ASC in comparison to BPD. Our study 2 of axis 1 is therefore the first large-scale study on ED in autistic adults compared to people with BPD and non-clinical controls. Interestingly, our results suggested that both autistic adults and people with BPD showed heightened levels of ED and its behavioural correlates (i.e., NSSI, suicidal behaviours and psychiatric hospitalizations) compared to nonclinical controls. Moreover, in line with previous findings (Klonsky et al., 2013; Moseley et al., 2022; Moseley et al., 2020; Conner et al., 2020), we found that NSSI and suicidal behaviours were strongly associated in both the ASC and the BPD groups, with ED predicting the presence of NSSI and/or suicidal behaviours in both groups. Hence, regardless of the diagnosis, NSSI and suicidal behaviours are related, on the one hand, and they are strongly linked to ED, on the other. In terms of treatment of suicidal behaviours and NSSI in ASC, this result supports the use of Linehan's (1993) conceptualization of ED as

a key problem associated with life-threatening behaviours in ASC as well. Moreover, given the relationship between NSSI and suicidal behaviours in autistic adults as findings suggest that suicidal behaviours may develop through acquired capability achieved by means of NSSI (Heffer & Willoughby, 2018; Willoughby et al., 2015), it seems relevant to prioritize targeting NSSI in DBT when working with autistic people who do not present with suicidal behaviours. This is consistent with DBT's primary targets of treatment¹², which may be used as such in the treatment of autistic adults presenting with ED and life-threatening behaviours.

Nevertheless, ED and its behavioural correlates were the highest in the BPD group, even after controlling for gender (women/men) in the autistic group. This is inconsistent with previous findings by Weiner et al. (2023) suggesting that autistic women had heightened ED compared to autistic men and, surprisingly, to individuals with BPD as well. However, their sample of autistic people was recruited from a DBT waiting list; hence, their findings cannot be generalized to autistic adults in other contexts (Weiner et al., 2023). This is not the case for our results, as both the BPD and the ASC groups were recruited from the general population.

Overall, our results suggest that, akin to BPD, in autistic adults, ED is heightened and strongly related to life-threatening behaviours. However, ED appears to be less central in ASC, affecting a subgroup of autistic people (Conner et al., 2021; Mazefsky & White, 2014), whereas it is a core symptom in BPD (Glenn & Klonsky, 2009; Linehan, 1993). Thus, although ED is prevalent in autistic people (Conner et al., 2021), our findings suggest that ED should be viewed as a co-occurring problem, rather than considering its inclusion among ASC core features, as some researchers have suggested (Samson et al., 2014; Mazefsky, 2015; Conner et al., 2020). However, given the scarcity of data comparing ED in ASC and BPD, further comparative studies are needed to advance our understanding of ED in ASC. This is key to improve

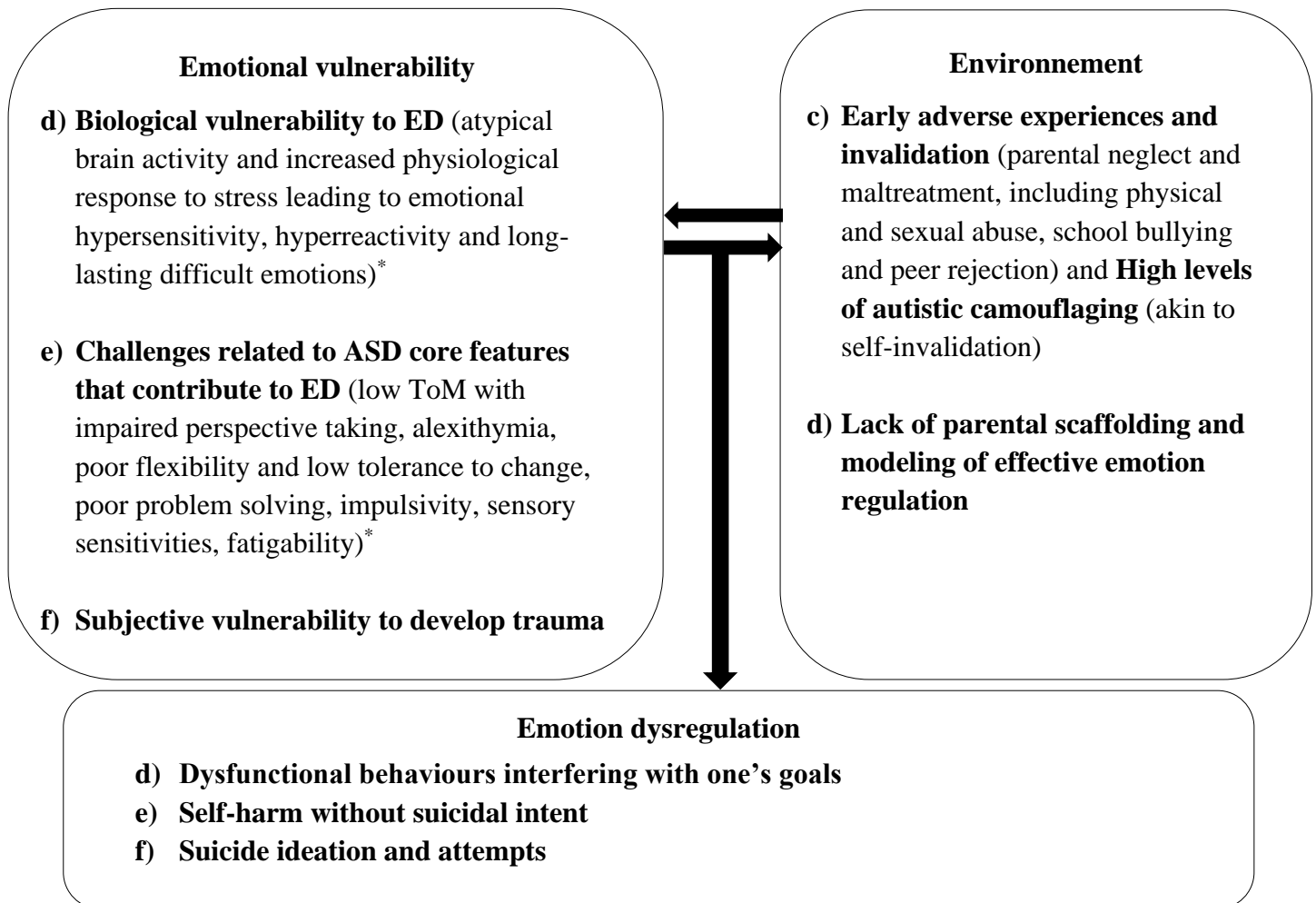
¹² Life threatening behaviours, therapy interfering behaviours, and quality of life interfering behaviours.

treatments for autistic people with ED, but also to identify clues for differential diagnosis, particularly when ED is present (Iversen & Kildahl, 2022).

II. Our application of Linehan's model to ED in ASC in light of our empirical findings

Several studies have suggested that ED in ASC encompasses multiple factors (Mazefsky & White, 2014; Mazefsky et al., 2013). Indeed, while ED in BPD is recognized as a core difficulty stemming from the transaction between emotional vulnerability (biological component) and childhood invalidation (social component) (Carpenter & Trull, 2013; Crowell et al., 2009; Kuo & Linehan, 2009; Putnam & Silk, 2005; Linehan, 1993), in ASC, ED is a co-occurring problem which has to be considered within the transaction between the aforementioned biosocial factors and ASC core features and coping mechanisms (e.g., autistic camouflaging) (Conner et al., 2020; Mazefsky, 2015; Samson et al., 2014). As a matter of fact, ASC core features have been found to be associated with high levels of anxiety (e.g., social anxiety and change-related anxiety), as well as various mental health issues such as a heightened risk for depression (Kurtz et al., 2023; Liew et al., 2015). This is why most research has focused on the contribution of ASC features to ED, including sensory sensitivities, repetitive behaviours and sensitivity to change (Mazefsky & White, 2014; Mazefsky et al., 2013; Samson et al., 2014). Some other findings have highlighted the role of co-occurring psychiatric disorders in ED in autistic people, suggesting that ED in ASC might arise from co-occurring disorders (Mazefsky et al., 2013). This is supported by the fact that co-occurring psychopathology is prevalent in autistic people (Hossain et al., 2020; Lai et al., 2019) and that ED is a transdiagnostic difficulty (Carmassi et al., 2022; Sloan et al., 2017). Alternatively, other researchers have suggested that co-occurring psychiatric disorders in ASC may arise from pre-existing ED (Swain et al., 2015; Charlton et al., 2020; Conner et al., 2020). In this vein, based on the literature on ER in autistic children, Mazefsky et al. (2014; 2013) proposed two models

that posit that autistic features may predispose to ED in autistic people, while acknowledging the contribution of co-occurring psychiatric disorders to the emergence of ED. Although the two models have the clear merit of highlighting the importance of ED in ASC and its link to ASC features, they probably overstate the contribution of ASC features and co-occurring psychopathology to ED in ASC as they do not include potential psychosocial factors (Greenlee et al., 2021; McDonnell et al., 2019; Fenning et al., 2018; Mandell et al., 2005). More broadly, the focus of existing literature on the contribution of ASC traits to ED may explain why the involvement of other factors, such as psychosocial ones, has been overlooked (Greenlee et al., 2021; McDonnell et al., 2019; Fenning et al., 2018; Mandell et al., 2005).



* Factors included in Mazefsky and White's model (2014)

Figure 6. Our suggested application of Linehan's biosocial model to ED in ASC.

To our knowledge, our application of Linehan's biosocial model to ASC, developed in study 1 of axis 1, is the first comprehensive conceptualization of factors associated with ED in ASC. Based on a review of the literature, the model aimed to expand its focus beyond ASC features and co-occurring psychopathology to include other potential contributors to ED in ASC. Although no studies so far have investigated the transaction between biological and social components, some research findings pointed to the involvement of biosocial factors in the aetiology of ED in ASC. Indeed, autistic people seem to experience emotional vulnerability like people with BPD –i.e., emotional sensitivity, emotional reactivity, and long-lasting emotions (Richey et al., 2015; Pitskel et al., 2014; Spratt et al., 2012). In addition, adverse experiences in childhood are common in autistic individuals (e.g., maltreatment and abuse in multiple forms, school bullying) (Hellström, 2019; Taylor & Gotham 2016). These contextual factors have been suggested to be associated with ED and its behavioural expressions (e.g., NSSI and suicidal attempts) (Greenlee et al., 2021; McDonnell et al., 2019; Mandell et al., 2005). Furthermore, the lack of parental scaffolding for effective ER has also been suggested to potentiate ED in ASC, as the autistic child does not get the opportunity to learn ER abilities through helpful parental guidance (Greenlee et al., 2021; Baker et al., 2019; Fenning et al., 2018). Hence, our review of the literature provides a broader scope to ED in ASC, beyond ASC-related factors and co-occurring psychopathology. Through its biosocial focus based on Linehan's model (1993), it provides an up-to-date conceptualisation of ED in autistic people, including the potential role played by ASC-related coping behaviours, particularly autistic camouflaging (Cook et al., 2021; Bradley et al., 2021). Indeed, the latter is conceptualized in our model as a form of self-invalidation stemming from internalized ASC-related stigma (**figure 6**). Autistic camouflaging has been previously suggested to be a risk factor for suicidality in autistic adults (Cassidy et al., 2020), especially in autistic women (Beck et al., 2020a; Lai et al., 2017). Recent research has pointed to the possible under-diagnosis or misdiagnosis of ASC in females,

partially because of their increased use of autistic camouflaging (McQuaid et al., 2022; Bradley et al., 2021). Thus, when conceptualizing ED in autistic adults, it seems relevant to include camouflaging within the transaction between ASC-features, emotion vulnerability and invalidation (**figure 6**).

Beyond the potential gender gap in camouflaging and its consequences on mental health, study 1 of axis 1 highlighted other potential gender discrepancies in ED and ED-related risk factors among autistic people. Particularly, ED and suicidality have been found to be heightened in autistic women compared to autistic men (Weiner et al., 2023; Sáez-Suanes et al., 2023; Wieckowski et al., 2020; Hirvikoski et al., 2020). Further, there is a greater likelihood of ASC late diagnosis – due in part to increased use of autistic camouflaging– (McQuaid et al., 2022), and sexual violence in autistic women (Cazalis et al., 2022; Ohlsson Gotby et al., 2018). Hence, in our application of Linehan’s biosocial model (1993), we argued that ED in ASC should be considered according to a multi-faceted perspective, and that gender differences may play a role in the individual components of the model, as well as in their interaction. In addition to cis-gender women, gender non-conforming and transgender individuals present with higher risks of poor mental health (Newell et al., 2023; Kung, 2023), whose aetiology should be viewed through an intersectional lens, that is, through the consideration of multiple sources of minority stress related-stigma (e.g., gender, neurodiversity) (Kung, 2023). Moreover, from a clinical standpoint, this framework encourages clinicians, especially those providing DBT, to explore potential psychosocial factors contributing to ED in their autistic clients, as this is crucial for case formulation and for the provision of therapy (Kramer et al., 2023).

Based on this first conceptual study, our second study in axis 1 investigated the pertinence and specificity of the biosocial model in ASC. Our empirical findings are supportive of emotional vulnerability (the biological component of the biosocial model) as a contributor to ED in ASC. Indeed, using regression analyses, we found that emotional vulnerability was

part of the three ED predictors shared by ASC and BPD, along with alexithymia and BPD traits. However, it is worth noting that emotional vulnerability ranked second in the ED predictors hierarchy (after BPD traits) in our BPD group, while it ranked third in our autistic group (after BPD traits and alexithymia). This may suggest that, although emotional vulnerability is a shared feature, it might be less central in ASC than BPD. Conversely, alexithymia seems to be more central in ASC than in BPD. This latter result is in line with previous findings suggesting that alexithymia is heightened in autistic women compared to women with BPD (Weiner et al., 2023). Indeed, although it does not belong among ASC core features (APA, 2013), alexithymia has been closely associated with ASC in the literature (Kinnaird et al., 2019; Poquérousse et al., 2018). Interestingly, recent research indicates that alexithymia might primarily arise from interoception awareness deficits, i.e., low ability to perceive the internal state of one's body (e.g., fatigue, hunger, pain, temperature, and heart rate) in both clinical and nonclinical populations (Scarpazza et al., 2022; Brewer et al., 2016). In ASC, impaired interoception has been reported in both autistic youth and adults (Mul et al., 2018; DuBois et al., 2016), and it has been associated with alexithymia (Mul et al., 2018). Interestingly, some findings suggest that autistic adults might show reduced ability to accurately identify their body sensations, despite reporting an increased subjective sensitivity to internal signals, a discrepancy possibly explained by alexithymia (Garfinkel et al., 2016). This discrepancy between increased interoceptive sensitivity and low accuracy in identifying body signals has been found to be anxiety-provoking (Garfinkel et al., 2016). Hence, from this standpoint, low interoception abilities are thought to interfere with effective ER through the misperception of body signals and their subsequent integration into the ER process, but also through their contribution to anxiety (Zamariola et al., 2019). Given these findings, it is not surprising that interoception-based interventions, including mindfulness, have been found to improve interoceptive awareness, ER abilities (Mahler et al., 2022; Quadt et al., 2021), and reduce anxiety in autistic

people (Quadt et al., 2021). In BPD, fewer studies have investigated interoception abilities, but similar impairments have been reported (Flasbeck et al., 2020). It is therefore possible that interoception deficits and alexithymia are more prominent in ASC. Another possibility is related to the influence of stereotypical understandings of ASC and BPD in driving some research topics, that is, the stereotypical view according to which autistic people present with alexithymia and emotional numbness whereas people with BPD present with emotional hypersensitivity and hyperreactivity (Kulacaoglu & Kose, 2018; Mazefsky et al., 2014). Further research is needed on alexithymia in ASC, particularly the association between interoception and ER, as well as its link to suicidal behaviours (Davey et al., 2018). Moreover, while there is a large body of literature on alexithymia in ASC, studies on emotional vulnerability in ASC are far scarcer. Hence, studies are needed to expand our knowledge about emotional vulnerability in ASC, specifically in relation to the components identified in BPD (Linehan, 1993), i.e., emotional sensitivity, emotional reactivity, and long-lasting emotional responses. This may provide insight into the aspects of emotional vulnerability shared with BPD, thereby either supporting or suggesting adjustments to the emotional vulnerability component in our application of Linehan's model to ED in ASC.

Moreover, our findings from study 2 of axis 1 showed that BPD traits were the main predictor of ED in both ASC and BPD. While this is not surprising in the BPD group, in the ASC group, it may either reflect that ED is intrinsically associated with BPD symptoms or suggest the existence of overlapping traits between ASC and BPD (May et al., 2021; Rinaldi et al., 2021; Dudas et al., 2017). Indeed, there is a considerable overlap in the diagnostic criteria for ASC and BPD (e.g., difficulties in social interactions) which makes the differential diagnosis challenging (May et al., 2021), especially in women (Rinaldi et al., 2021, Dudas et al., 2017). This points inevitably to the issue of the differential diagnosis between ASC and BPD, particularly in the presence of severe ED and ED-related behaviours (i.e., NSSI, suicide

attempts and psychiatric hospitalizations) (Darling Rasmussen, 2023; Dell'Osso et al., 2023; Iversen & Kildahl, 2022).

More surprisingly, our empirical findings did not support the contribution of ASC features as a whole, measured by the AQ-Short (Hoekstra et al., 2011), to ED in autistic adults. However, using SHAP values, sensory sensitivities were among the main ED predictors in the autistic group¹³, suggesting that sensory sensitivities might be uniquely linked to ED in ASC. These results might be due to the way autistic features were measured in our study. In the study by Samson et al. (2014) with autistic youth, ASC cluster traits were measured individually, and not with a single questionnaire. Inconsistent with our findings, the authors found that ASC traits were associated with ED, especially repetitive behaviours. In addition, in a study by Vaiouli and Panayiotou (2021) in a sample of adults from the general population, a significant association between ASC traits measured by the AQ-Short and ER difficulties was found, and this association was partially mediated by alexithymia. Regardless of the debate whether or not ASC features as a whole are linked to ED, sensory sensitivities seem to be the strongest predictor of NSSI in autistic youth (Duerden et al., 2012), which may be seen as a proxy of ED. Indeed, in autistic adults without intellectual disability, Moseley et al. (2019) found that sensory sensitivities predicted the NSSI group categorization (current, past, or non-self-harmers), and were the only variable to predict the range of bodily areas targeted, lifetime incidence and frequency of NSSI. Interestingly, the authors also found that NSSI served an ER function in their sample, suggesting a link between sensory sensitivities and ED (Moseley et al., 2019). This is unsurprising given prior findings pointing to sensory peculiarities as a key contributor to anxiety across psychopathology (DeSerisy et al., 2019; McMahon et al., 2019), but also in autistic people (South & Rodgers, 2017). Indeed, sensory processing peculiarities may lead to overwhelming and painful sensory experiences (Jakobson & Rigby, 2021; Moseley et al.,

¹³ After BPD symptoms, alexithymia, and emotional vulnerability

2019). Interestingly, sensory processing peculiarities may be related to alexithymia (Jakobson & Rigby, 2021; South & Rodgers, 2017), which is central to ED (Preece et al., 2023), including in ASC (Morie et al., 2019; Kinnaird et al., 2019). More specifically, sensory sensitivities may be involved in an intense information input originating from internal experiences, which may be overwhelming and difficult to understand when one presents with alexithymia (Liss et al., 2008). This is exactly what has been shown in autistic people whereby increased interoceptive sensitivity and low accuracy in identifying body signals have been found to be anxiety-provoking (Garfinkel et al., 2016). Thus, it is likely that sensory sensitivities and alexithymia are related in ASC and both seem to play a role in ED, which highlights the importance of targeting them in ED-focused interventions for autistic people (Kinnaird et al., 2019). As we will see in the next section, this is consistent with the results of our RCT on DBT in autistic adults, as decreased alexithymia scores partially mediated the effect of the intervention on ED.

Nevertheless, given the discrepant findings in the literature regarding the role of ASC traits in ED in autistic people, future studies should consider assessing the core autistic trait domains separately in order to tackle their specific relationship with ED. Specifically, since flexibility is considered to be a key ability for effective ER (Cai et al., 2018), it seems relevant to explore the relationship between poor flexibility abilities in ASC and ED. Additionally, emotional vulnerability, alexithymia, and sensory sensitivities may be seen as part of the biological component of the biosocial model. Hence, it seems important to assess the three processes of emotional vulnerability, i.e., emotional hypersensitivity, hyperreactivity, and long-lasting emotions (Linehan, 1993), and their specific relationship with alexithymia and sensory sensitivities.

Similar to ASC core features, our empirical findings did not support the involvement of the invalidation component of the biosocial model in ED in ASC. However, this was also the case in the BPD group. This may suggest that this component might not be central to ED

irrespective of the diagnosis (e.g., Reeves et al., 2010). However, given that most studies (Schaich et al., 2021; Hope & Chapman, 2019; Keng & Wong, 2017) have reported the contribution of early invalidating experiences to ED in BPD, we argue that these results rather reflect the difficulty of measuring this construct in cross-sectional studies (Musser et al., 2018). Indeed, a large range of adverse experiences can be considered as part of this component (e.g., parental neglect, physical maltreatment, emotional abuse, sexual abuse, school bullying) (Musser et al., 2018). For this reason, according to the systematic review by Musser et al. (2018), only a minority of studies investigating the invalidation component of Linehan's biosocial model used tools that assess its four key components, i.e., parental communication of the child's emotional inaccuracy to the child, misattribution of the child's emotional experience to negative characteristics of the child, punishment of difficult emotions, and minimizing of difficulties. However, this does not mean that other forms of maltreatment and adverse experiences are not risk factors for ED. Indeed, several findings support high rates of maltreatment and abuse, including sexual abuse, among individuals with BPD (Euler et al., 2021; Zanarini et al., 2002). Nevertheless, over 90% of those with a history of such abuse do not ultimately develop BPD (Fruzzetti et al., 2005). Instead, the disruption of ER developmental processes and subsequent manifestation of BPD is theoretically linked to an invalidating family environment, i.e., the four invalidation components in Linehan's theory (Musser et al., 2018; Linehan, 1993). Hence, there is a need for greater scientific rigor in the measurement of invalidation in future studies, using tools that align with Linehan's model (Musser et al., 2018), such as the *Socialization of Emotion Scale* (SES; Sauer & Baer, 2010).

Regarding autistic camouflaging, considered in our model as a form of self-invalidation akin to ASC-related self-stigma (Perry et al., 2022; Dubreucq et al., 2020), our findings from study 2 of axis 1 suggest that it might predict ED in ASC as it ranked among top ED predictors in our autistic group. We note, however, that autistic camouflaging did not emerge as a

significant ED predictor in the linear regression analysis. Our findings are among the first to explore the link between ED and autistic camouflaging as existing studies have focused on the association between autistic camouflaging and suicidality in ASC, but not its association with ED (Cassidy et al., 2020). Hence, it appears crucial to further explore the relationship between ED and autistic camouflaging, since both have been pointed out as important risk factors for suicidality in autistic people (Jachyra et al., 2022; Conner et al., 2020). In addition, beyond suicidality, autistic camouflaging has been associated with anxiety and depression in autistic adults (Hull et al., 2021), with ER significantly mediating the associations between camouflaging and both depression and anxiety (McQuaid et al., 2022). Hence, our findings underscore the idea that it is important to investigate whether and how ED mediates the effect of camouflaging on mental health and increased suicidality in autistic people (Moseley et al., 2022a; Cassidy et al., 2020). In addition, it is crucial to explore in which ways autistic camouflaging contributes to ED in ASC. For instance, there might be a threshold level at which camouflaging becomes detrimental to the mental health of autistic people. The latter suggestion is underpinned by the idea that autistic camouflaging may act as “double-edged sword” as it may promote the social integration of autistic individuals (Alaghband-rad et al., 2023), but it may also be costly and have detrimental effects to the mental health and the sense of self of autistic adults (Sunagawa, 2023; Moseley et al., 2022; Cassidy et al., 2020).

III. DBT as a promising treatment for ED in autistic adults

Studies evaluating CBT interventions targeting ED in autistic adults are scarce (Kuroda et al., 2022; Beck et al., 2020b). Yet, as highlighted in study 2 of axis 1, ED and life-threatening behaviours are heightened in autistic adults. Even more alarmingly, a recent study by our team showed that ED is particularly heightened in autistic women compared to people with BPD (Weiner et al., 2023).

DBT is recognized to be an effective treatment for ED in people with BPD (Panos et al., 2014). Indeed, several RCT findings support the efficacy of DBT in reducing ED and associated life-threatening behaviours in this population (Panos et al., 2014). Beyond BPD, RCT findings indicate the clinical relevance of DBT in other psychiatric and neurodevelopmental conditions, including ADHD (Halmøy et al., 2022; Fleming et al., 2014). Despite these findings, at the start of this thesis, no data were available on the feasibility and efficacy of DBT to treat ED in autistic people, apart from the study by Hartmann et al. (2019), which assessed an intervention partially based on DBT among autistic adults without intellectual disability. Their results showed that the intervention was ineffective on enhancing ER skills; this was not surprising given that their participants did not necessarily present with ED and that the intervention focused heavily on improving social skills (Hartmann et al., 2019). Apart from these results, studies evaluating DBT-based interventions in autistic individuals were lacking. During this thesis, two studies of interest were published: the study by Ritschel et al. (2022) on the feasibility and acceptability of standalone DBT skills group for autistic adults without intellectual disability, and the RCT by Kuroda et al. (2022) evaluating an 8-week CBT program provided in a group setting to enhance ER skills.

Therefore, to date, our axis 2 studies are the first to show the feasibility (study 1) and the efficacy (study 2) of comprehensive DBT to treat ED in autistic adults without intellectual disability. Our findings are also unique since they provide data on DBT in autistic people with ED associated with NSSI and/or suicidal behaviour. Considering the latter category (i.e., those with suicidal behaviour), our samples included people with suicide ideation and past suicide attempts, but also people with suicide ideation and no history of suicide attempts. In this case, within the ideation-to-action framework (Bayliss et al., 2022; Klonsky et al., 2017), DBT was hypothesized to be likely to reduce suicide ideation, non-suicidal ED-related dysfunctional

behaviour (e.g., anger outbursts, hetero-aggression) and prevent the development of other types of suicidal behaviours (e.g., suicide attempts).

Our pilot study ([Bemmouna et al., 2022](#)) with 7 autistic adults showed that comprehensive DBT was feasible and highly acceptable in autistic adults without intellectual disability. Indeed, participants reported a high level of satisfaction with the therapy and 5 out of 7 completed the therapy; the 2 dropouts were not due to acceptability concerns (i.e., fear of contracting COVID-19 and professional reasons). This is consistent with the results by Ritschel et al. ([2022](#)), as their DBT skills training group was found to be feasible and was perceived as helpful by autistic participants. Our subsequent results (study 2 of axis 2) added to those by showing a high level of satisfaction, high rates of participation in the group sessions (89.38%) and high rates of therapy completion (10.34% dropped-out). Similar to Ritschel et al. ([2022](#)), the subjective feedback of our autistic participants on their experience of comprehensive DBT was also overall positive. More specifically, the thematic analysis of study 3 of axis 2 revealed that participants perceived DBT as highly helpful despite the efforts that it required. From a quantitative standpoint, the drop-out rates from both the feasibility and the efficacy trials are less than half of the weighted average dropout rate of 28% in RCTs on DBT ([Dixon & Linardon, 2020](#)) and of 26.2% in studies on CBT ([Fernandez et al., 2015](#)) across various psychiatric disorders. In behavioural therapies designed for autistic adults (e.g., CBT for co-occurring OCD), the dropout rates have been found to be similar to that of our RCT ([Elliott et al., 2021](#)).

In terms of the efficacy of comprehensive DBT, self-reported ED improved significantly more in the DBT group compared to TAU at all measurement time points, and ED improvement was maintained at 6-month follow-up. This is consistent with previous studies suggesting that DBT results in significantly improved ER abilities in several psychiatric and neurodevelopmental conditions ([Halmøy et al., 2022](#); [Fleming et al., 2014](#)). Given the lack of evidence-based interventions targeting ED associated with NSSI and/or suicidal behaviours in

autistic adults (Kuroda et al., 2022; Beck et al., 2020b), our results are of the utmost clinical importance. Indeed, there is a growing awareness of the high prevalence of ED and suicidality in autistic adults (Kirby et al., 2019; Hirvikoski et al., 2016). In addition, ED has been found to be associated with suicidality in autistic people (Conner et al., 2020; Moseley et al., 2020). Therefore, an intervention that effectively improves ED might not only have an effect on life-threatening behaviours, but also on co-occurring psychopathology. Ultimately, consistent with DBT's main aim, such an intervention may also improve the quality of life of autistic adults. Our results provide evidence that DBT is effective in reducing ED, depression symptoms and that it also leads to better quality of life. However, as we will discuss later in this chapter, DBT did not lead to a reduction in suicide ideation or anxiety symptoms.

In terms of co-occurring psychopathology, self-reported depression symptoms decreased significantly more in the DBT condition than the TAU condition post-treatment, with this decrease being sustained at follow-up. This is in line with findings in BPD reporting decreased depression symptoms following DBT (e.g., Fleischhaker et al. 2011; Linehan et al., 2006). In addition, in clinical contexts other than ASC, DBT has been found effective in the treatment of depression (Saito et al., 2020; Lynch et al., 2003). Importantly, the reduction in depressive symptoms post-treatment was mediated by improvements in ED, suggesting that ED is highly associated with depression in autistic adults (Conner et al., 2023; Cai et al., 2018). This is in line with Conner et al.'s (2023) recent findings suggesting that ER impairments are significant contributors to anxiety and depression in autistic adolescents and young adults. This led the authors to hypothesize that improving ER might have a widespread impact both on mood and anxiety symptoms in ASC, which is congruent with our findings (Conner et al., 2023). From a theoretical standpoint, these results are supportive of the view according to which, in autistic people, ED predisposes to and contributes to the maintenance of depression rather than the opposite (Conner et al., 2023; Charlton et al., 2002; Cai et al., 2018). This result is pivotal

given the high rates of depression in autistic adults (Hollocks et al., 2019), which are predictive of suicide ideation in this population (Hooijer & Sizoo, 2020). Therefore, our results suggest that depression and ED are linked in autistic adults, and that DBT is effective in alleviating depressive symptoms in autistic adults presenting with ED.

Similarly, quality of life, i.e., psychological health and physical health, improved significantly more in the DBT condition compared to the TAU condition post-treatment. It is worth noting that the psychological health dimension of the WHOQoL-BREF encompasses items related to a “life worth living” (e.g., satisfaction with one’s life, finding a meaning to one’s life) (The WHOQoL Group, 1998). Building a life that the client perceives as worth living is the ultimate aim of DBT (Coyle et al., 2019; Linehan, 1993). That is, solving problems and decreasing ED is not an end in itself in DBT, but rather a means of helping the clients build a life closer to their values (Linehan, 1993). Although we did not assess it directly, akin to the results relative to depression, we speculate that decreased ED partially mediated the effect of DBT on participants’ psychological health. Moreover, the significant improvement in the “physical health” dimension of quality-of-life in the DBT group compared to TAU (e.g., physical pain, energy level at a daily basis, sleep quality) might reflect the reciprocal influence reported in previous studies between ED and physical health (Calkins et al., 2019; Song et al., 2015).

Given the improvements post-therapy and at follow-up on ED, depression and quality of life, it is surprising that self-reported suicide ideation, anxiety and dysfunctional coping strategies did not decrease in the DBT condition compared to the TAU condition. These results are probably due to the spontaneous improvement in TAU participants. Indeed, like DBT participants, TAU participants also improved in the three measures, possibly due to the positive impact of anticipating the start of DBT at the end of the waitlist period. Indeed, improvements have been previously observed in waiting list controls in similar research protocols (Munder et

al., 2019; Minami et al., 2007; Posternack & Miller, 2001), suggesting that waiting list controls may underestimate the effects of psychotherapy (Munder et al., 2019). Hence, other control conditions are likely to circumvent this phenomenon, even though they might have their own disadvantages. One possibility consists of having a TAU condition without therapy at end of waiting period, but this option does not meet ethical standards (Arean & Alvidrez, 2002).

Given its links with ED in ASC (study 2 of axis 1), we were particularly interested in alexithymia. While in the pilot study (study 1 of axis 2; Bemmouna et al., 2022) self-reported alexithymia did not decrease significantly post-therapy, in the RCT, it improved significantly more in the DBT group compared to TAU at all measurement points, with improvements being sustained at follow-up. Furthermore, we found that the reduction in alexithymia partially mediated ED improvements following DBT. These findings highlight the following key points: (a) the crucial role of alexithymia in the emergence and maintenance of ED in ASC, consistent with previous findings (e.g., Morie et al., 2019), (b) the importance of targeting alexithymia when treating ED in autistic people, as it might be a key mechanism of change in DBT as suggested in BPD (Boritz et al., 2019), and (c) the efficacy of DBT in decreasing alexithymia when treating ED in autistic adults, akin to results in several disorders (Salles et al., 2022). It is worth noting that mindfulness scores also mediated the effect of DBT on ED. Given the strong negative correlation between enhanced mindfulness abilities and the level of alexithymia (Norman et al., 2019), these results are not surprising. Indeed, mindfulness aims to increase self-awareness, including emotional and interoception awareness (Aaron et al., 2020), which might reduce alexithymia (Aaron et al., 2020; Norman et al., 2019). In addition to improvements in mindfulness skills, self-reported DBT skills use improved significantly more in the DBT condition compared to the TAU condition, with this improvement being maintained at 6-month follow-up. These findings suggest that DBT in autistic adults is accompanied by enhanced ER abilities, including mindfulness. This is consistent with previous findings in BPD

showing a significant increase in ER skills use following DBT (Lee et al., 2022). However, unlike findings reporting DBT skills use as a key mediator of ED outcomes following DBT, in our second study of axis 2, only mindfulness abilities emerged as a significant mediator of ED scores post-treatment (Mehlum, 2021; Boritz et al., 2019; Neacsiu et al., 2010).

While it is crucial to determine the mechanisms of change of DBT – e.g., through mediation analyses – it is as important to determine whether there are baseline variables that foster or mitigate its effects. To do so, we focused on several potential moderators of the effect of DBT on ED. Our results outlined two moderating effects on ED outcomes: **(a)** autistic traits, with higher autistic traits being associated with increased ED improvement at follow-up. This might be explained by the fact that the higher the ED at baseline, the greater the potential for improvement following DBT (i.e., regression toward the mean), as reported by some studies in BPD (e.g., Seow et al., 2020); and **(b)** marital status (single/in relationship), with being single being associated with less ED improvement at follow-up. This latter result sheds light on the negative impact of loneliness, specifically the lack of romantic relationships, on their chances of improving following DBT. In DBT, developing relationships of any kind can be “life worth living” goals, and thus be targeted in individual therapy (Coyle et al., 2019; Linehan, 1993). Since most autistic adults are interested in romantic relationships (Strunz et al. 2017) and dissatisfaction with this life domain may have detrimental effects on their mental health (Umagami et al., 2022; Mazurek, 2014), DBT therapists should pay particular attention to autistic clients’ satisfaction with their interpersonal relationships, especially given the moderating effect of relationship status on the efficacy of DBT on ED.

Overall, our results suggest that DBT is acceptable and efficacious in treating ED in autistic adults presenting with NSSI and/or suicidal behaviours. Importantly, DBT leads to decreased depressive symptoms partially through ED improvement. Moreover, following DBT, autistic adults report improved quality of life, consistent with DBT’s main aim. Alexithymia

and mindfulness mediate the effect of DBT on ED, adding to our results highlighting the importance of alexithymia in ED found in ASC. Since our results are the first to show that comprehensive DBT is feasible and efficacious in treating ED in autistic adults, it is essential to conduct more large-scale studies with active control groups (instead of a waiting list TAU group) to rule out the possibility of common factors explaining these results rather than DBT (Cuijpers et al., 2019).

IV. Future directions to further adapt DBT to autistic adults

1. Key treatment targets emerging from our empirical findings on ED in ASC

Findings from our second study of axis 1 suggested that emotional vulnerability, alexithymia, sensory sensitivities, and autistic camouflaging are key predictors of ED in autistic adults without intellectual disability. These variables can be targeted either directly or indirectly by psychotherapy to improve ED. Indeed, emotional vulnerability relies on biological underpinnings (Calkins et al., 2019), and we may consider the same to be the case of features intrinsic to ASC, such as sensory sensitivities (APA, 2013), but also of alexithymia (Hogeveen & Grafman, 2021; Meza-Concha et al., 2017). Through its holistic focus on ED, DBT leads to changes in each step of the emotional process, including the internal experience of emotion influenced by biological factors (Gross, 1998, 2014). Indeed, ER skills act at the different stages of the emotional process, from managing triggers to the behaviours adopted in the situation, including the components of the emotional experience (i.e., attention, interpretation, emotions, physiological activation, and urgency to act) (Gross, 1998, 2014). Thus, DBT may influence the emotional arousal and experience through the implementation of ER skills. Consistent with this, in BPD, fMRI findings have showed that DBT results in neural changes in areas involved in emotional arousal, including a decreased amygdala activation when facing emotional triggers (Iskric & Barkley-Levenson, 2021; Goodman et al., 2014).

As we have outlined previously, several studies suggest that alexithymia is a key difficulty strongly related to ED (Preece et al., 2023), making it a crucial target when treating ED (Preece et al., 2023). Consistent with previous findings in BPD (Salles et al., 2022; Boritz et al., 2019), our RCT results of DBT in autistic adults (the second study of axis 2) are congruent with this, as alexithymia significantly improved following DBT, and it seems to be a key mechanism of change of DBT. Furthermore, mindfulness also mediated the effect of DBT on ED, further suggesting the key role played by alexithymia – i.e., mindfulness primarily increases emotional awareness and therefore reduces alexithymia (Subic-Wrana et al., 2014). Together, these empirical findings – from study 2 of axis 1 and study 2 of axis 2 – support the growing literature highlighting the importance of further investigating the role of alexithymia in ED in ASC and the mechanisms through which it contributes to ED. One possible explanation is related to interoception deficits (Scarpazza et al., 2021; Brewer et al., 2016; Mul et al., 2018). However, given that alexithymia is a multi-faceted construct (i.e., difficulty identifying feelings, difficulty describing feelings, and externally oriented thinking; Goerlich, 2018), it is possible that other mechanisms – e.g., social cognition, flexibility – are related to alexithymia and ED in ASC (Scheerer et al., 2021; Ozsivadjian et al., 2021).

Autistic camouflaging, on the other hand, may result from repetitive invalidation that comes about when autistic individuals have to deal with a non-autistic world. From this standpoint, we can argue that it belongs to the social component of the biosocial model (study 1 axis 1) and may contribute to ED. While it is not possible to change past invalidation (with change oriented DBT skills), some skills taught in DBT might be beneficial for dealing with the emotional pain that may be associated with self-stigma and camouflaging. Such is the case for instance of radical acceptance, FAST¹⁴, checking the facts and self-validation (Linehan,

¹⁴ FAST skills are part of the interpersonal effectiveness module. FAST acronym (be Fair, no unjustified Apologies, Stick to values, and be Truthful) gathers skills that aim to balance keeping relationships with keeping respect for oneself.

2015). Since autistic camouflaging has been associated with internalized ASC-related stigma (Perry et al., 2022) and poor social skills (Scheerer et al., 2021), these skills might reduce the need for autistic camouflaging through the enhancement of self-acceptance and the assertion of one's values and needs in interpersonal interactions (Linehan, 2015). In addition to the use of these skills, DBT therapists working with autistic people must be aware of the conflicting valence of camouflaging, which may act as a double-edged sword. This awareness may increase the flexibility needed to navigate dialectically in therapy, while both supporting and empowering clients and helping them to accept and solve problems associated with their status as a minority in a non-autistic world. In study 1 of axis 1 we also warrant clinicians to use our application of Linehan's (1993) biosocial model to provide psychoeducation about camouflaging and its impact on mental health and their sense of identity. Despite the importance of targeting autistic camouflaging in therapy, it is noteworthy that early ASC diagnosis may prevent the development of autistic camouflaging (McQuaid et al., 2022), as it may allow autistic individuals to understand their functioning earlier, to develop self-acceptance and self-compassion while evolving with their neurodivergent functioning (Wilson et al., 2023), as well as to access targeted psychological interventions since childhood (Elder et al., 2017).

Finally, in line with existing studies (Cazalis et al., 2022; Ohlsson Gotby et al., 2018), our empirical findings showed that autistic women are more concerned by sexual abuse compared to autistic men; the rate of sexual abuse in autistic women is similar to that of women with BPD (study 2 axis 1). This emphasizes the need to promote preventive interventions based on psychoeducation about sexual and romantic life for autistic women, raising their awareness about consent and boundaries in sexual relationships, as well as assertiveness programs to teach them how to assert one's desires and boundaries (Pecora et al., 2020; Solomon et al., 2019). Of course, the prerequisite for the effective provision of such preventive interventions is the diagnosis of autism. Since women are diagnosed later than men, which is partly due to their

increased of camouflaging and the misdiagnosis of autism as other conditions (e.g., BPD; Darling Rasmussen, 2023; Dell’Osso et al., 2023), it is of the utmost importance to foster early ASC diagnosis in women (McCrossin, 2022).

2. Key adaptations emerging from our empirical findings on DBT in autistic adults

In our RCT, 52 (89.38%) of the participants completed the therapy. Among the 6 dropouts, only one was due to acceptability-related issues, i.e., overwhelming anxiety caused by the group setting of the skills training. In addition, another participant needed accommodation to attend the last three group sessions due to anxiety and fatigue. Overall, our data show that comprehensive DBT is acceptable. Nevertheless, some participants found the comprehensive DBT format intense and demanding (study 3 axis 2). Indeed, some participants interviewed for our qualitative study reported that the therapy was costly in terms of time and energy. Hence, to extend the accessibility of the therapy, it might be worth considering ways of adapting the program to the needs of some participants’, especially in terms of fatigue. Here are a few suggestions: **(a)** shortening the duration of group sessions while reducing the number of participants, **(b)** providing remote group sessions, and **(c)** considering mid-session breaks of at least 30 minutes. Therapists must also consider targeted adaptations on a case-by-case basis if necessary. In addition, for participants for whom the group setting might be too challenging, clinicians might consider providing skills training within an individual setting. In BPD, individual skills training associated with individual sessions have been found to be as effective as the standard DBT format (Andión et al., 2012). However, it should be noted that these cases were rare in our study (i.e., only two participants), which suggests that, for most autistic adults with ED, comprehensive DBT in its standard format is acceptable (Keenan et al., 2023).

Moreover, the end of the therapy was experienced as abrupt and anxiety provoking for many participants (study 3 of axis 2). In a qualitative study with adolescents who received DBT, a similar experience was reported (Ohlis et al., 2023). Given that high sensitivity to change is

among the core ASC features (APA, 2013), the end of the therapy should be prepared and probably occur gradually when working with autistic individuals. This could be achieved, for instance, through the planning of booster sessions after the end of therapy. Additionally, therapists should anticipate the end of therapy with clients, discussing it in advance and identifying DBT skills that can help them cope effectively. Another aspect emphasized by participants is related to the therapy manuals. In DBT, participants receive handouts and worksheets, which are essential tools to promote the learning and generalization of skills (Linehan, 2015). The manuals provided to our autistic participants were adapted by adding illustrations and significantly reducing the amount of text (Bemmouna et al., 2022). Nevertheless, in our qualitative study, some participants pointed to the need to further adapt the manuals by simplifying certain texts and adding more images. This is in line with Keenan et al.'s (2023) report, which emphasizes the need of using visuals and graphics when adapting DBT for autistic adults.

In addition to the use of visuals, in their personal account of DBT, Keenan et al. (2023) also encouraged clinicians to incorporate autistic adults' focused interests in the therapy, as they may serve a motivational purpose. It is worth noting that this was one of the adaptations that we used in both the feasibility and the efficacy trials. However, the participants in our qualitative study did not highlight that this was helpful to them, even though the individual therapy was highly appreciated. This might be explained by the fact that focused interests are not systematically present in all autistic people (May et al., 2021). In addition, for those who have focused interests, the use of their focused interests in sessions might have passed unnoticed – as this may be a usual topic of conversation for them. Overall, these results point to the fact that ASC is highly heterogeneous, albeit sharing common features (Masi et al., 2017), and adaptations should be elaborated on a case-to-case basis. As an example, in our samples of autistic participants, some people required considerable therapist support to complete the diary

card and/or the home practices, particularly those with executive problems. However, most people did not need such a support. Thus, it is crucial to be knowledgeable of ASC features and include them in the case conceptualisation if needed (Moseley et al., 2019), but also to remain dialectical and creative throughout the therapy. In addition, since there is a growing interest in DBT for autistic adults (Bemmouna et al., 2022; Ritschel et al., 2022; Huntjens et al., 2020), it seems crucial that future studies evaluate the relevance of the adaptations highlighted here (Figure 7). To do so, the use of qualitative approaches is warranted.

In addition to the aspects identified in our studies, we highlight the importance of including targeted interventions for family members (if needed). In individuals with BPD and suicidal adolescents, the inclusion of family members in DBT rather than focusing exclusively on the client is highly encouraged (Darrow et al., 2022; Hoffman et al., 2005). This can be achieved through several ways, including the provision of structured group psychoeducation programs, such as *Family Connections* for the relatives of people with BPD (Fernández-Felipe et al., 2021; Hoffman et al., 2005). This systemic approach is also increasingly advocated more generally in the field of mental health interventions (Ingoldsby, 2010). In DBT for autistic adults, this seems relevant as well, especially given Linehan's (1993) biosocial perspective. Indeed, autistic adults may lack social support from their relatives, experience isolation and misunderstanding towards their atypical functioning (Moseley et al., 2021; Crane et al., 2021). As a result, the continued experience of invalidation might contribute to the maintenance of ED, as this is the case in BPD (Crowell et al., 2009; Linehan, 1993), but also in autistic people (Greenlee et al., 2021; McDonnell et al., 2019). Hence, targeting the environment (which is one of the 5 functions of DBT) may be important to reduce ED and improve autistic adults' satisfaction with their close relationships.

Figure 7. *Summary of key adaptations of DBT to autistic adults from our empirical data.*

- (a)** Making the treatment less intensive and less energy consuming (e.g., reducing the group sessions duration and the number of participants, remote sessions, increasing mid-session breaks' duration).
- (b)** Providing DBT in a fully individual setting for autistic clients for whom the group setting might be highly challenging.
- (c)** Targeting autistic camouflaging through DBT skills.
- (d)** Planning a progressive end to therapy.
- (e)** Optimizing therapy conditions: quiet room with adapted lighting, avoiding group sessions on Fridays.
- (f)** Adapting participants' manual by adding visuals, graphics and reducing and/or simplifying the text.
- (g)** Including some targeted interventions for the autistic client's family members if needed.
- (h)** Incorporating focused interests in the therapy practices if needed.
- (i)** Providing support in planning and writing home practices if needed.
- (j)** Introducing necessary accommodations on a case-by-case basis when needed.

General conclusion

Together, our findings are of clinical and scientific interest, as they improve our understanding of ED in ASC in comparison to BPD. Moreover, they are the first to provide data on the feasibility and efficacy of comprehensive DBT to treat ED in autistic adults. Our results point to the need to further explore the role played by alexithymia and invalidating experiences in the emergence and the maintenance of ED in ASC. Regarding DBT, larger-scale replication studies are needed, including a larger-scale RCT using an active control condition. In addition, based on our qualitative results, it appears crucial to foster DBT's acceptability by further exploring the key adaptations to be introduced when providing it to autistic adults.

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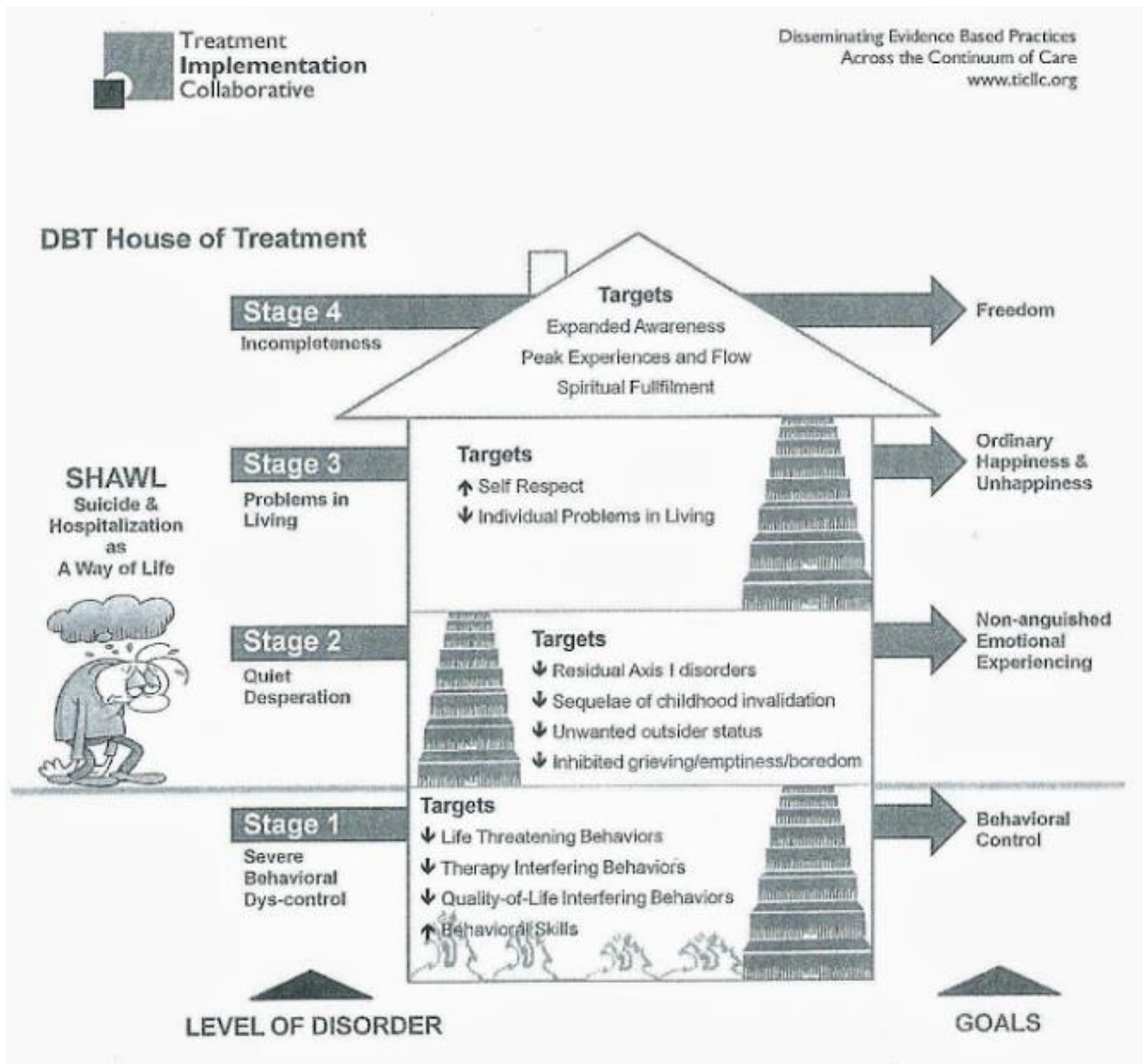
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**Appendix A - DBT house of treatment (Swenson, 2016; Linehan, 1993),
adaptation by Treatment Implementation Collaborative (TIC)**

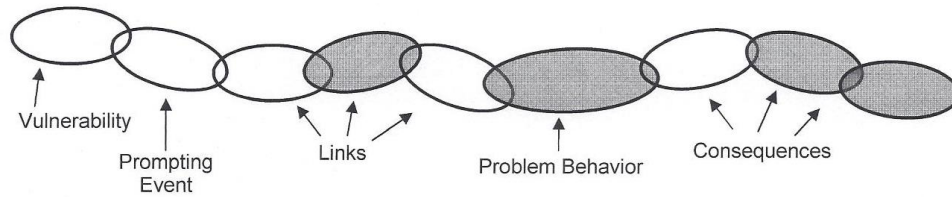


Appendices

Appendix B - An example of a DBT diary card (Linehan, 1993)

Dialectical Behavior Therapy Diary Card				Initials	ID#	Filled out in session? Y N		How often did you fill out this side? _____ Daily _____ 2-3x _____ Once				Date Started									
Day & Date	Use	Suicide	S-H	Pain	Sad	Shame	Anger	Fear	Illicit		ETOH		Prescrip		OTC		S-H	Lying	Joy	Skills	R
	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	#	Specify	#	Specify	#	Specify	#	Specify	Y/N	#	0-5	0-7	✓
Mon																					
Tues																					
Wed																					
Thur																					
Fri																					
Sat																					
Sun																					
									*USED SKILLS 0 = Not thought about or used 1 = Thought about, not used, didn't want to 2 = Thought about, not used, wanted to 3 = Tried but couldn't use them						4 = Tried, could do them but they didn't help 5 = Tried, could use them, helped 6 = Didn't try, used them, didn't help 7 = Didn't try, used them, helped						
				Before	After	Belief in control of . . .			Before		After		BRTC Diary Card Copyright 1999 Marsha M. Linehan, Ph.D.								
Urge to use (0-5):						Emotions:															
Urge to quit therapy (0-5):						Behaviors:															
Urge to harm (0-5):						Thoughts:															

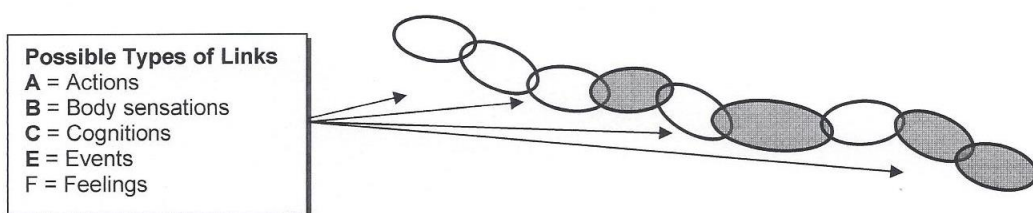
Appendix C - Behaviour chain analysis (Linehan, 1993)



What exactly is the major **PROBLEM BEHAVIOR** that I am analyzing?

What **PROMPTING EVENT** in the environment started me on the Chain to my problem behavior?
Start day: _____

What things in myself and my environment made me **VULNERABLE**?
Start day: _____



LINKS

List actual, specific behaviors and then list new, more skillful behaviors to replace ineffective behaviors:

	1 st _____ 2 nd _____ 3 rd _____ 4 th _____ 5 th _____ 6 th _____
--	--

Appendices

What exactly were the major **CONSEQUENCES** in the environment?

Immediate:

Delayed:

What exactly were the major **CONSEQUENCES** in the myself?

Immediate:

Delayed:

What **PROMPTING EVENT** in the environment started me on the Chain to my problem behavior?
Start day: _____

Doha BEMMOUNA

**Emotion dysregulation in autistic adults without intellectual disability:
Characteristics and treatment with Dialectical Behaviour Therapy
La dysrégulation émotionnelle chez les adultes autistes sans déficience
intellectuelle: Caractéristiques et traitement par la Thérapie
Comportementale Dialectique**

Résumé en français

La dysrégulation émotionnelle (DE) est communément associée au trouble de la personnalité borderline (TPB). Toutefois, des études récentes montrent qu'elle consiste en une difficulté transdiagnostique, aussi prévalente parmi les adultes autistes sans déficience intellectuelle. De plus, la DE a été associée aux comportements auto-dommageables sans intention suicidaire (NSSI) et aux comportements suicidaires chez les adultes autistes. Toutefois, la DE est encore sous-étudiée dans l'autisme, en particulier chez les adultes autistes, et les modèles existants sur son étiologie dans l'autisme se sont principalement focalisés sur le rôle des traits autistiques et de la psychopathologie cooccurrence. Il n'est donc pas surprenant de constater que les interventions psychothérapiques empiriquement fondées ciblant la DE chez les personnes autistes sont manquantes, en particulier pour les adultes autistes sans déficience intellectuelle. Pour répondre à ces besoins dans la littérature, cette thèse visait, d'une part, à étudier les caractéristiques de la DE et de ses prédicteurs biosociaux chez les adultes autistes en comparaison avec les adultes avec un TPB et, d'autre part, à évaluer la faisabilité, l'acceptabilité et l'efficacité de la thérapie comportementale dialectique (TCD) pour traiter la DE chez les adultes autistes. Nos résultats ont mis en évidence un niveau de DE élevé chez les adultes autistes par rapport aux sujets témoins, toutefois moins élevé que dans le TPB. Les femmes et les hommes autistes présenteraient des niveaux de DE comparables, avec une exposition accrue des femmes autistes à certains facteurs de risque, tels que les

violences sexuelles et le camouflage autistique. De plus, nos résultats ont montré que trois variables, à savoir les traits du TPB, l'alexithymie et la vulnérabilité émotionnelle, formeraient un noyau de prédicteurs forts de la DE partagés entre l'autisme et le TPB, alors que les sensibilités sensorielles et le camouflage autistique pourraient être spécifiques à la DE dans l'autisme. En ce qui concerne la TCD pour les adultes autistes sans déficience intellectuelle présentant des NSSI et/ou des comportements suicidaires, nos résultats suggèrent qu'un programme complet de TCD de 18 semaines est faisable, acceptable et serait efficace pour traiter la DE chez cette population. L'alexithymie a émergé comme un médiateur majeur de l'amélioration de la DE suite à la TCD, alors que les traits autistiques et le statut marital (célibataire/en couple) se sont avérés être des modérateurs forts de l'évolution de l'ED. Des études de réplication à plus grande échelle sont nécessaires pour approfondir les recherches sur la DE et ses corrélats biosociaux dans l'autisme, ainsi que sur l'efficacité de la TCD pour traiter la DE chez les adultes autistes.

Mots clés :

Autisme, adultes, trouble de la personnalité borderline, dysrégulation émotionnelle, comportement auto-dommageables, suicidalité, thérapie comportementale dialectique.

Résumé en anglais

Emotion dysregulation (ED) is strongly associated with borderline personality disorder (BPD). However, recent findings suggest that ED is a transdiagnostic difficulty also prevalent among autistic adults without intellectual disability. Importantly, ED has been found to be related to non-suicidal self-injury (NSSI) and suicidal behaviours in autistic adults. However, ED has been understudied in autism spectrum condition (ASC), especially in autistic adults, and existing frameworks on the aetiology of ED in ASC have focused mainly on the role of ASC traits and co-occurring psychopathology. Given this, it is not surprising that evidence-based psychotherapies targeting ED in autistic people, especially autistic adults without intellectual disability, are lacking. To address these gaps in the literature, this thesis aimed, on the one hand,

to investigate the phenomenology of ED as well as its biosocial predictors in autistic adults compared to adults with BPD. On the other hand, our work aimed to evaluate the feasibility, acceptability, and efficacy of dialectical behaviour therapy (DBT) to treat ED in autistic adults. Our findings indicated that ED is heightened in autistic adults compared to non-clinical controls, while it is milder than in BPD. Autistic women and men were found to present with similar levels of ED, even though autistic women presented with more ED risk factors, such as high rates of history of sexual violence and increased use of autistic camouflaging. In addition, our results showed that three clinical features, i.e., BPD traits, alexithymia and emotional vulnerability, strongly predicted ED scores in both ASC and BPD, whereas sensory sensitivities and autistic camouflaging were specific to ED in ASC. Regarding DBT for ED in autistic adults, our results suggested that an 18-week comprehensive DBT program was feasible, acceptable, and effective to treat ED in autistic adults with NSSI and/or suicidal behaviours. Interestingly, alexithymia emerged as a strong mediator of ED improvement following DBT, while ASC traits and marital status (single/married) emerged as strong moderators of ED outcomes. Larger-scale replication studies are needed to further investigate ED and its biosocial correlates in ASC, as well as the efficacy of DBT to treat ED in autistic adults.

Keywords :

Autism spectrum condition, adults, borderline personality disorder, emotion dysregulation, self-harm, suicidality, dialectical behaviour therapy.