Subtypes in Borderline Personality Disorder

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Chapter 1

General introduction

Preface

After working many years in general psychiatry and afterwards with patients with a Borderline Personality Disorder (BPD) in the context of Dialectical Behavioral Therapy (DBT), I became more and more interested in the functioning of this patient group. As a clinician, I observed a lot of heterogeneity in diagnosis and treatment trajectories of patients with a BPD diagnosis. I became interested in doing research in this patient group with the goal to improve clinical practice for patients with BPD.

In 2014, under the encouragement of the Psychiatric Hospital Duffel, Prof. dr. B. Sabbe, and Prof. dr. L. Claes, I wrote a doctoral project in which I tried to clarify the heterogeneity in patients with BPD, as well as their treatment trajectories. The rationale for this project was to identify different BPD subtypes based on reactive and regulative temperament, to validate these subtypes and to investigate their treatment trajectories over time. These insights may support the development of more individually tailored treatment interventions, with the ultimate goal to increase the quality of the treatment of these patients.

This PhD dissertation consists of the research, that was performed at the Psychiatric Hospital Duffel and Psychiatric Hospital Sint-Camillus at Sint-Denijs-Westrem, supported by PH Duffel and the special PhD fellowship by the Research Foundation Flanders (FWO).

In this Introduction, we will first define the central concepts and the state of the art relevant to this thesis, secondly, we will describe the research aims and hypotheses, and thirdly, we will conclude the introduction with the outline of the PhD thesis.

1. Borderline Personality Disorder

The Borderline Personality Disorder (BPD) is a psychiatric illness characterized by difficulties regulating emotion causing a lot of suffering. BPD is characterized by disturbances across a broad range of functions, including identity, interpersonal, emotional, cognitive and behavioral domains (APA, 2013). The prevalence of BPD in the general population is estimated around 1.5%, and in clinical populations around 28.5% (Torgersen, 2012). Noteworthy, more than 50% of patients with BPD engage in repetitive non-suicidal self-injury (NSSI), and as many as 10% eventually commit suicide (McGlashan et al., 2000; Selby et al., 2012; Skodol et al., 2002). With treatment and over time, some BPD symptoms resolve, but many patients continue to have difficulties that require treatment (Gunderson et al., 2011; Zanarini et al., 2012; Zanarini et al., 2007). BPD is thus associated with severe functional impairment and substantial treatment utilization.

According to the current psychiatric classification system of the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013), BPD is manifested by a pervasive pattern of instability in interpersonal relationships, identity, impulsivity and affect (see Table 1). It characterizes BPD as having significant impairments in personality functioning, such as unstable self-image, excessive self-criticism or preoccupation with real or imagined abandonment. For a diagnosis of BPD, at least 5 of the 9 DSM-5 criteria must be met. This allows 151 to 256 different combinations of criteria to achieve the diagnosis of BPD, depending on the calculation (Linehan et al., 2001; Sanislow et al., 2002; Skodol et al., 2002; Gunderson, 2010).

Table 1. DSM-5, Section II criteria for Borderline Personality Disorder (BPD; APA, 2013, pp. 872)

A pervasive pattern of instability of interpersonal relationships, self-image, and affects, and marked impulsivity beginning by early adulthood and present in a variety of contexts, as indicated by five (or more) of the following:

(1) frantic efforts to avoid real or imagined abandonment.
(2) a pattern of unstable and intense interpersonal relationships characterized by alternating between extremes of idealization and devaluation
(3) identity disturbance: markedly and persistently unstable self-image or sense of self
(4) impulsivity in at least two areas that are potentially self-damaging (e.g., spending, sex, Substance Abuse, reckless driving, binge eating)
(5) recurrent suicidal behavior, gestures, or threats, or self-mutilating behavior
(6) affective instability due to a marked reactivity of mood (e.g., intense episodic dysphoria, irritability, or anxiety usually lasting a few hours and only rarely more than a few days)
(7) chronic feelings of emptiness
(8) inappropriate, intense anger or difficulty controlling anger (e.g., frequent displays of temper, constant anger, recurrent physical fights)
(9) transient, stress-related paranoid ideation or severe dissociative symptoms.

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2.   The heterogeneity in BPD and BPD subtypes

There is a great variability in the clinical presentation of patients with BPD. Understanding heterogeneity in BPD may be important to improve prediction of symptoms, prognosis in treatment (Leichsenring et al., 2011), and effectiveness of specific treatment approaches for patients with BPD (Kopala-Sibley et al., 2012). Differentiating meaningful BPD subtypes and empirical research on treatment outcome of these BPD subtypes may support the development of more tailored interventions and may guide treatment choices to optimize treatment outcome.

During the last decades, different attempts have been made to identify BPD subtypes clinically, theoretically and empirically. Already in 1993, Linehan mentioned two different types of patients with BPD observed in clinical treatment, namely the 'butterfly-like' and 'attached' type. The former has difficulties developing attachment, tending to "flutter" in and out relationships, while the "attached" type quickly develops stormy and intense relationships. Whereas 'attached' clients with BPD communicate often with therapists, rarely miss appointments and appear closely affiliated to their therapists, 'butterfly' clients do the opposite. Other researchers (e.g., Layden et al., 1993) have applied a cognitive framework to their clinical observations of heterogeneity in BPD. Efforts to empirically investigate subtypes in BPD have also been made using a variety of statistical procedures, methodologies and theoretical models. For example, a series of studies (e.g., Bradley et al., 2005; Conklin et al., 2006; Westen & Shedler, 1999a, 1999b) in which clinicians provided psychological descriptions of their patients claim to have identified replicable subtypes of BPD. Other studies have categorized patients with BPD using variables reflecting different theories, such as for example attribution style, interpersonal functioning (e.g., Digre et al. 2009; Liehener et al., 2003). Person-centered approaches in theoretical frameworks on underlying personality dimensions were lacking. Since 2017, phenotypes of BPD are parallel investigated based on personality traits and dimensional personality disorder features, demonstrating three or four subtypes (Frias et al., 2017;Smits et al., 2017). Based on the dimensional personality traits of the Five Factor Model, being Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness, Frias et al. (2017) identified four BPD subtypes, a hostile, self-sufficient, dependent and suspicious subtype. These subtypes with distinctive profiles differed also in terms of symptoms and comorbid personality disorder features. In the study of Smits et al. (2017), three subtypes were found clustering on dimensional personality disorder features. The 'core BPD' BPD subtypes, consisted of 76 percent of the patients, the 'extravert/externalizing' and 'schizotypal/paranoid subtype demonstrated gender-difference, with more men in the extravert/externalizing subtype, and differences in symptomatology. These studies represent an initial step towards increasing diagnostic specificity within BPD. However, up till now research on BPD subtypes, and their validation is scarce and research on the treatment responsiveness of these BPD subtypes is lacking. So, identifying meaningful BPD subtypes would be of interest to clinicians to know whether they respond differently to standard interventions such as DBT and whether different treatment approaches are required.

3. Dialectical behavior therapy and different treatment outcomes in BPD

Besides the diversity in clinical presentation, there is also a difference in treatment response in patients with BPD.

Dialectical behavior therapy (DBT; Linehan, 1993) has proven to be an efficacious evidence-based treatment for patients with BPD (Stoffers et al., 2012) and is therefore a recommended treatment (APA, 2014). DBT rest upon an approach that attempts to reconcile apparent contradictions — such as a focus on acceptance while also encouraging change. A DBT program involves four standard DBT modules with, weekly DBT skills group training in which adaptive skills are learned; weekly individual DBT psychotherapy to enhance motivation; a 24-h coaching for the patients to implement skill use; and therapist consultation team focusing on maintaining the motivation and capability of DBT therapists. Treatment goals are set during the individual psychotherapy, by using the standard DBT target hierarchy that ranks target behaviors in this order: life threatening behavior, therapy interfering behavior and quality-of-life interfering behavior. Diary cards are used to monitor parasuicidal and therapy interfering behavior. DBT skills training consist of mindfulness-skills, distress tolerance, emotion regulation and interpersonal effectiveness.

Previous studies (Bohus et al., 2004; Kleindienst et al., 2008; Kröger et al., 2006) found that a 3-month inpatient treatment program resulted in reduced self-rated general psychopathology, depression, anxiety, dissociation, and NSSI at post treatment and at one-month follow-up. Some BPD symptoms resolve (e.g., impulsivity) more easily than others (e.g., chronic dysphoria) (Zanarini et al., 2012; Gunderson et al., 2011; Zanarini et al., 2007). Yet, not every patient shows improvement after treatment. In a randomized controlled trial, Bohus et al. (2004) ascertained that only 41.9% of those patients receiving DBT had clinically recovered on general psychopathology, as assessed by means of the global severity index of the Symptom Checklist (SCL-90-R; Derogatis, 1977). No measures of psychopathology at admission or sociodemographic variables predicted treatment response.

An additional problem in the treatment of patients with BPD is the large number of dropout. In the meta-analysis of Kliem et al. (2010), an overall amount of dropout of more than 25% was reported, 24.7% in DBT treatment and 27.3% in control conditions. Investigating differences between completers and dropouts (Bohus et al., 2004; Kröger et al., 2006), a few between-group differences are raised. Rüsch et al. (2008) reported that experiential avoidance, trait anxiety, anger-hostility and low number of life-time suicide attempts might be associated with an increased dropout. Other features linked to dropout are the lack of motivation for change, substance use disorder, younger age, and antisocial personality disorder (Kröger et al., 2013; Soler et al., 2008).

The finding that there is a large drop out, and only half of the patients with BPD who remain in treatment demonstrate marked improvement (Bohus et al., 2001), has led some authors (e.g., Liehener et al., 2003; Bohus et al., 2004) to hypothesize that differences in

treatment process/outcome may be accounted for by different subtypes within the BPD population.

Up till now, only one study has been conducted to evaluate differences in treatment response between different BPD subtypes. Digre et al. (2009) assessed 74 BPD inpatients before and after six months of inpatient treatment consisting of some DBT skills training sessions. Applying a cluster analysis to various demographic, clinical, and psychological variables such as attribution style, they identified three BPD subtypes, namely a 'withdrawn–internalizing' subtype, an 'anxious–externalizing' subtype and a 'severely disturbed–internalizing' subtype. After six months of treatment, there was in general a significant reduction in suicide attempts, an improvement in depression and dissociation, but there was no significant difference in progress between the BPD subtypes. The authors nevertheless compared the treatment trajectories of the three subtypes. Different responses to treatment were reported, with the 'withdrawn–internalizing' subtype showing reduced levels of dissociation, but no differences for suicide attempts or self-harm, the 'anxious–externalizing' subtype responding only by a large reduction in levels of depression and the 'severely disturbed–internalizing' showing little or no improvement (Digre et al. 2009).

4. Temperament dimensions as a basis for the search of BPD subtypes

Importantly, the presence of meaningful BPD subtypes needs to be investigated in the context of a theoretical model of BPD. Linehan (1993) proposed a biosocial model to explain the etiology of BPD, in which predispositions or temperament variables are amplified through the interaction with an invalidating environment.

Temperament, and more specific reactive and regulative temperament dimensions, is a promising approach in understanding psychopathology (e.g., Nigg, 2006). Temperament dimensions can be described as a set of biologically based behavioral and emotional tendencies. These dimensions extend beyond single-disorder clinical symptoms to expand coverage of negative and positive emotion systems, as well as attentional capacities.

Reactive temperament can be conceptualized as driven by two systems controlling behavioral activity according the Reinforcement Sensitivity Theory (RST; Gray, 1982), namely the Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS). The BIS is related to punishment sensitivity, avoidance behavior and anxiety. The BAS is related to reward sensitivity, approach behavior and impulsivity. In addition, regulative temperament, also called self-regulation or effortful control (EC), enables people to modulate their reactivity (Nigg, 2006).

Previous studies have shown different subtypes based on temperament in different clinical samples, for example in obese patients, patients with an eating disorder, and patients with a substance use disorder (e.g., Claes et al., 2012; Muller et al., 2014; Santens et al., 2018, Turner et al., 2014). Furthermore, these subtypes demonstrate differential associations with psychopathology. Therefore, one could hypothesize that these subtypes also exist in patients

with BPD. However, this evidence is still lacking. Therefore, in the present PhD thesis, we will investigate the existence of subtypes based on reactive and regulative temperament dimensions in patients with BPD, and try to validate these subtypes based on associated psychopathology and coping strategies (**Chapter 2**), as well as differences in treatment trajectories (**Chapter 4**).

5.   Validity of BPD subtypes measured by self-report and experimental tasks

Although self-report is a valid measure to assess personality features (Widiger et al., 2009), research benefits by expanding data collection with other assessment methods, such as experimental tasks. Studies using experimental measures of emotional responding in BPD are mixed (Rosenthal, 2008). Temperament dimensions might account for some differences in emotional responding measured by experimental tasks (Posner et al., 2002). So, BPD subtypes based on temperament features might demonstrate differences in emotional responding and action tendencies to emotional stimuli.

For investigating emotion processing, there exist multiple experimental tasks that can be applied depending on the focus. In research on biased processing of emotional stimuli the Emotional Stroop Task (EST; e.g., Williams et al., 1996) has been extensively used to measure attentional bias. In this task, patients have to name the color of ink in which neutral words or emotional words (negative or positive words which may capture the attention) are printed, as fast as possible. Studies in patients with BPD have demonstrated a negative attentional bias (Kaiser et al., 2017), meaning that they require more time to name the color of negative words during the EST.

Research on the response to emotional stimuli or the approach and avoidance tendencies to emotional stimuli, also defined as action tendencies to emotional stimuli, is more rare. To investigate action tendencies to emotional stimuli (approach and avoidance) the Approach-Avoidance Task (AAT; Rotteveel and Phaf, 2004) had been developed. The AAT is a joystick-base task, in which people have to respond to pictures of facial emotional expression by pulling or pushing the joystick. Positive stimuli produce automatic approach tendencies (BAS), whereas negative stimuli produce automatic avoidance tendencies (BIS) (e.g., Chen et al., 1999). Previous studies, using approach avoidance measures, have found differences in these tendencies among patients with different psychopathologies. For example, in psychopathic offenders reduced avoidance tendencies towards negative stimuli are observed, as for socially anxious patients increased avoidance tendencies towards negative and also positive stimuli are observed using the AAT (Radke et al., 2013; Roelofs et al., 2010). Research on emotional action tendencies with the AAT in BPD samples is lacking. Therefore, in **Chapter 3**, we investigated whether BPD subtypes differed with respect to emotional responding and action tendencies towards emotional stimuli.

6. Alexithymia and non-suicidal self-injury in BPD

Alexithymia, literally "no words for emotions", is the inability to describe emotions with words. Alexithymia includes three dimensions, being (a) difficulties identifying and differentiating between feelings and the body sensations, (b) difficulties describing and verbalizing feelings to others, and (c) an externally oriented thinking style (Taylor et al., 1997). Alexithymia has been described in different psychiatric populations including BPD. Prevalence rates of alexithymia in BPD range from 65 to 80% (Derks et al., 2016). Non-suicidal self-injury (NSSI), defined as 'the repetitive, deliberate, direct, and socially unaccepted destruction or alteration of one's own body tissue (e.g., cutting, scratching,) without the intent to die' is one of the criteria to diagnose BPD (APA, 2013). More than 70% of patients with BPD report a history of multiple episodes of NSSI (Zanarini et al., 2008). Previous studies in clinical samples have reported a positive association between alexithymia and NSSI (e.g., Lüdtke et al, 2016), however evidence of this association between alexithymia and NSSI in a BPD sample is missing and will be the topic of **Chapter 5** of the PhD dissertation.

7. Research aims

Given the state of the art presented above, we developed a clinical study to identify BPD subtypes based on reactive and regulative temperament dimensions, to validate these clusters and to track differences in the therapeutic trajectories of the BPD subtypes during DBT inpatient treatment.

The main research questions in this PhD thesis are as follows:

a) Can we identify subtypes in a BPD sample based on reactive and regulative temperament dimensions and do they show differences in clinical symptomatology and coping based on self-report measures? (study 1 – **Chapter 2**)

b) Do the identified BPD subtypes demonstrate differences in emotion processing measured by experimental tasks, focusing on attentional bias and action tendencies to emotional stimuli? (study 2 –**Chapter 3**)

c) Do the identified BPD subtypes present a different treatment trajectory after three months of DBT treatment? (study 3 – **Chapter 4**)

d) Is there a relationship between alexithymia and non-suicidal self-injury (NSSI) in patients with BPD? (study 4 – **Chapter 5**)

8. Outline of the PhD thesis

In the following five chapters of the present PhD thesis studies are described which address the abovementioned research questions within a sample of patients with BPD who took part in a DBT inpatient treatment program. After the introduction (**Chapter 1**), the four studies are reported in the form of four manuscripts published in international journals (**Chapter 2 to 5**), followed by a general discussion (**Chapter 6**).

Chapter 1 is the introduction in which we defined the important concepts of the PhD thesis as well as the theoretical framework from which the research questions were derived.

Chapter 2 describes the identification of subtypes in borderline patients based on reactive and regulative temperament, and the validation of these subtypes by comparing them on clinical symptomatology, comorbid personality disorders and coping strategies assessed by means of self-report measurements.

Chapter 3 investigates differences in BPD subtypes with respect to attentional bias to emotional stimuli and approach-avoidance tendencies towards emotional stimuli measured by means of experimental tasks.

In Chapter 4, we looked into differences in treatment response of BPD subtypes after three months of DBT inpatient treatment.

In Chapter 5, the association between alexithymia and non-suicidal self-injury was investigated in patients with BPD.

Chapter 6, the final chapter of this PhD dissertation, comprises a general discussion in which we integrate the findings of each study and situate them in the light of the international literature. Furthermore, the strengths and the limitations of the studies are discussed, as recommendations for future studies are provided. Finally, we end with the clinical implications of our studies for the treatment of patients with a borderline personality disorder.

In Table 1, an overview of the different studies (i.e., study questions, sample, instruments, data analysis and major findings) is presented.

In the first study a total of 150 inpatient with BPD were recruited from two Psychiatric Hospitals specialized in DBT in Belgium. 100 patients were included from PH Duffel unit 'de Spinnaker', between May 2014 and November 2015; and 50 patients from PH Sint-Camillus at Sint-Denijs-Westrem, from November 2014 till November 2015. The second study is an extension of the first study with the same sample. The sample of the third study on trajectory consisted of 80 patients from PH Duffel from the first study and 65 new inclusions from PH Duffel collected till April 2017. The BPD sample of the fourth study on alexitymia and NSSI included all patients from study 1 and 35 new inclusions from PH Duffel (May 2014 – August 2016).

Table 1. Overview of the different studies in this PhD thesis

Study	Research question	Sample	Instruments	Data-analysis	Findings

Study 1 Chapter 2	1) Identification BPD subtypes with HCA based on temperament dimensions
	
	2) Differences in comorbid PD's, symptomatology and coping between BPD subtypes
		N = 150
		Female = 85.6%
		Age = *18-65*
		M Age = 29,28
		  (SD =8.36)
			SCID-II
			BIS/BAS
			ECS of ATQ
			ADP-IV
			BSI
			UCL
				-Hierarchical Cluster Analysis (HCA)
				-Multivariate analysis of variance (MANOVA's)
					1) 4 BPD subtypes:
					  a) Low Anxiety
					  b) Inhibited
					  c) High Self-control
					  d) Emotional/ Disinhibited
					
					2) The BPD subtypes demonstrate differential psychopathology.

Study 2 Chapter 3	1) Differences in emotion processing between BPD subtypes 2) Relationship between temperament dimensions and task performance	N = 146 Female = 86.6% Age = *18-65* *M* Age = 29,30 (SD =8.35)	SCID-II BIS/BAS ECS of ATQ EST AAT	-A series of hierarchical linear regression analyses	1) There are no significant differences on EST and AAT performance between the BPD subtypes. 2) There is no significant relationship between EST and temperament dimensions. There is a positive relationship between AAT and effortful control.

Study 3 Chapter 4	1) Identification BPD subtypes with MBC based on temperament dimensions
	
	2) Differences in treatment trajectory between BPD subtypes
		N = 145
		Female = 88.3%
		Age = *18-65*
		M Age = 29,72
		  (SD =9.32)
			SCID-II
			BIS/BAS
			ECS of ATQ
			ADP-IV
			BSI
			BSL
			DIS-Q
			UCL
				-Model-based Cluster Analysis (MBC)
				-Multivariate analysis of variance (MANOVA's)
				-Repeated measures ANOVA's
					1) 3 BPD subtypes:
					  a) 'Low Anxiety'
					  b) 'Inhibited'
					  c) 'Emotional/ Disinhibited'
					
					2) The 'Inhibited' and 'Emotional/ Disinhibited' subtype improved significantly in general and borderline symptomatology; in contrast to the 'Low Anxiety' subtype.

Study 4 Chapter 5	1) Prevalence NSSI and alexithymia in BPD
	
	2) Relationship between alexithymia and NSSI in BPD
		N = 185
		Female = 86.5%
		Age = *18-62*
		M Age = 30,03
		  (SD =8.62)
			SCID-II
			ADP-IV
			BSI (D)
			SIQ-TR
			TAS-20
				-T-tests
				-Pearson's correlations
				-Hierarchical binary logistic regressions
					1)82.7% NSSI life-time
					  52.9% current NSSI
					  71.3% Alexithymic
					
					2) Current NSSI is positively associated with alexithymia, even controlling for gender and depression.

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Chapter 2

Subtypes in borderline patients based on reactive and regulative temperament

Abstract

Considerable heterogeneity is observed among patients with a Borderline Personality Disorder (BPD). In the present study, we investigated whether we could identify and validate different personality subtypes in 150 BPD inpatients based on reactive and regulative temperament. We identified four BPD subtypes by means of cluster analysis on the Behavioral Inhibition and Behavioral Activation Scales (BISBAS) and the Effortful Control Scale (ECS): an Emotional/Disinhibited subtype (45%) scoring lowest on Effortful Control, an Inhibited subtype (24%) characterized by low levels of Behavioral Activation, a Low Anxiety subtype (21%) defined by low levels of Behavioral Inhibition, and a High Self-control subtype (10%) characterized by the highest score on Effortful Control. The four subtypes were validated by comparing them on clinical symptomatology, comorbid personality disorders, and coping. The current findings offer insight into meaningful differences among patients with BPD based on temperamental features, which can offer guidelines for the treatment of patients with BPD.

1. Introduction

The Borderline Personality Disorder (BPD) is the most prevalent personality disorder in clinical settings. Recently, the prevalence of BPD was estimated between 2% and 6% in community samples (Lang et al., 2012) and between 10% and 20% among inpatients and outpatients receiving treatment in mental health settings (Dubovsky et al., 2014). BPD is associated with significant psychosocial morbidity, reduced health-related quality of life and excess mortality (Zanarini et al., 2009).

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; 2013), defines the main features of BPD as a pervasive pattern of instability in interpersonal relationships, self-image, and affect, as well as impulsive behaviors. At least five of the nine DSM-5 criteria must be met for a diagnosis of BPD. This allows for 256 different combinations of the criteria from which it is possible for achieving a diagnosis of BPD (Gunderson, 2010), creating a "broad, heterogeneous, and fuzzy BPD category" (Paris, 2007, p. 462).

Understanding heterogeneity in BPD may be important for enhancing the effectiveness of assessment and specific treatment approaches for patients with BPD (Kopala-Sibley et al., 2012). Multiple attempts have been made to clinically or empirically determine BPD subtypes. For example, "Q" factor analysis based on the co-occurring Axis II features in BPD patients revealed three subtypes, namely Cluster A (elevated paranoid and schizotypal features), Cluster B (elevated narcissistic and histrionic features) and Cluster C (elevated avoidant and obsessive-compulsive features) (Critchfield et al., 2008). Worthwhile mentioning are also the studies in which BPD subtypes were identified using "Q" factor analysis based on clinicians' reports of the psychological characteristics of their BPD patients (Bradley et al., 2005; Conklin et al., 2006). Bradley et al. (2005) identified four coherent BPD subtypes among 55 female BPD patients, namely a 'high-functioning internalizing' subtype, a 'histrionic' subtype, a 'depressive internalizing' subtype, and an 'angry externalizing' subtype. Conklin et al. (2006) defined three BPD subtypes in 80 BPD adolescents, namely an 'internalizing-dysregulated' cluster characterized by intense emotional pain, engaging in self-harm and suicide attempts; an 'externalizing-dysregulated' cluster reacting to emotional pain with anger; and finally, a 'histrionic-impulsive' cluster with a mixture of intensive negative and positive emotions showing impulsive behaviors. Finally, Digre et al. (2009) assessed 74 BPD inpatients before and after six months of residential treatment. Applying a cluster analysis to various demographic, clinical, and psychological variables (such as attribution style), they identified three BPD subtypes, namely the 'withdrawn' internalizing', 'severely disturbed–internalizing' and 'anxious–externalizing' subtypes demonstrating different treatment trajectories.

In sum, there exists a growing body of evidence demonstrating the necessity to define and validate different subtypes of BPD patients to improve diagnosis and treatment. Therefore, the aim of the present study was to identify and validate BPD subtypes based on reactive and regulative temperament, since several authors have highlighted associations

with temperament as promising avenues for understanding psychopathology (e.g., Nigg, 2006). Temperament can be defined as 'constitutionally based differences in reactivity and self-regulation, as observed in the domains of emotionality, motor activity, and attention' (Rothbart et al., 2006, p. 466). According the Reinforcement Sensitivity Theory (RST; Gray, 1982) reactivity can be conceptualized as driven by two systems controlling behavioral activity, namely the Behavioral Inhibition System (BIS) and the Behavioral Activation System (BAS). The BIS is related to sensitivity to punishment, avoidance behavior and is the causal basis of anxiety. The BAS is related to sensitivity to reward and approach behavior and is the causal basis of impulsivity. In BPD samples, high levels of both BIS and BAS reactivity have been observed (e.g., Bijttebier et al., 2009).

Besides reactive temperament, regulative temperament (also called self-regulation or effortful control) also plays an important role in psychopathology. Effortful control (EC) enables people to modulate their reactivity (Nigg, 2006), since it consists of behavioral and attentional forms of self-control (Claes et al., 2009). Posner et al. (2002) found higher scores on negative affect (BIS) and lower scores on EC in BPD patients making that they are poorer in conflict resolution and cognitive control. Hoermann et al. (2005) investigated EC in BPD patients and identified three BPD subtypes with different levels of EC. Subtype 1 (high EC) exhibited the fewest problems in symptoms, interpersonal functioning, and personality organization, whereas Subtype 3 (low EC) was characterized by the most severe problems in these areas. Subtype 2 (high in some aspects of EC) scored between Subtypes 1 and 3.

To our knowledge, the present study is the first to delineate different subtypes of BPD patients based on reactive (BISBAS) and regulative (EC) temperament. The second aim was to validate the subtypes by comparing them in terms of clinical symptoms, comorbid personality disorder features, and coping strategies. Although this study was exploratory in nature, several hypotheses were developed based on aforementioned theory. First, we hypothesized three or four BPD subtypes based on combinations of temperamental features: a more internalizing subtype as defined by Bradley (2005) and Conklin (2006) which could be linked to high BIS, low BAS and low EC; a more externalizing subtype which could be linked to high BAS and a resilient subtype identified as the 'high-functioning' subtype by Bradley et al. (2005), demonstrating high EC. Nevertheless, these delineations were tentative and we remained open to additional subtypes. Second, we hypothesized that the subtypes would differ in clinical symptoms, comorbid personality disorders, and coping. We hypothesized that the resilient subtype would exhibit the lowest levels of symptoms and the highest levels of adaptive coping strategies. The internalizing subtype would show more internalizing symptoms, cluster C personality traits and avoidant coping. The externalizing subtype would demonstrate more externalizing symptoms, cluster B traits, and low levels of active problem solving.

2. Methods

2.1. Participants and procedure

A total of 150 BPD inpatients were recruited from two Psychiatric Hospitals in Belgium, both specialized in Dialectic Behavior Therapy. Four patients were excluded on the basis of missing data and statistical outliers, resulting in a final sample of 146 BPD patients, whom 125 (85.6%) were female and 21 male (14.4%). The mean age of the sample was 29.28 years (SD = 8.36, range 18 to 65). Almost 14% of the BPD patients (13.7%, n = 20) followed lower secondary education; 63% (n = 92) higher secondary education, 19.2% (n = 28) high school, and 4.1% (n = 6) university. Most of the BPD patients (69.9%, n = 102) were single, 17.8% (n = 26) were living together/married, or 12.3% (n = 18) were divorced. A total of 82.2% of the patients used medication (64.4% antidepressants, 39.3% antipsychotics, 11.1% anxiolytics and 9.6% mood stabilizers).

All admitted patients, between May 2014 till November 2015, were invited to participate in the study. After providing written informed consent, patients were assessed by the first author. All subjects who met the BPD diagnosis as assessed by means of the SCID-II were included in the study. Patients were excluded from the study if they showed signs of mental retardation, symptoms of a psychotic disorder, or current substance dependence. Patients were allowed to be under pharmacological treatment. The study was developed in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Antwerp University and the local ethical committees of the participating hospitals. Participants did not receive any remuneration.

2.2. Measures

The Borderline Personality Disorder and other Personality disorders were assessed by means of the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; First et al., 1997; Dutch translation by Weertman et al., 2000). Interrater reliability of the SCID-II ranges from .90 to .98 for dimensional judgements and internal consistency coefficients range from .71 to .94 (Maffei et al., 1997).

Reactive temperament was assessed by means of the Behavioral Inhibition/Behavioral Activation System Scales (BIS/BAS; Carver & White, 1994; translated into Dutch by Franken et al., 2005). The BIS/BAS scales consist of 24-items, rated on a 4-point Likert scale, of which seven items assess BIS reactivity (α = .75 in the present study), reflecting sensitivity to punishment, and 13 items assess BAS reactivity (α = .75 in the present study), reflecting sensitivity to potentially rewarding outcome.

Regulative temperament was assessed by means of the 19-item Effortful Control Scale (ECS) from the short form of the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007). Participants rated their general ability to exert attentional and behavioral

control on a seven-point Likert scale. The ECS total score demonstrated acceptable internal consistency in the present sample (α = .78).

Clinical symptomatology was assessed by means of the Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983; translated into Dutch by de Beurs et al., 2005) consisting of 53 items, rated on a 4-point Likert scale, and 9 symptom scales, being somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. The test has demonstrated good psychometric properties, showing satisfactory indexes of internal consistency and test-retest reliability (Derogatis, 1993). The BSI scales demonstrated acceptable internal consistency in the present sample (except for psychoticism, α = .49), ranging from α = .72 (paranoid thinking) to α = .86 (depression).

Personality disorders were assessed by means of the Assessment of DSM-IV Personality Disorders (ADP-IV; Schotte and De Doncker, 1994), a 94-item Dutch self-report questionnaire used to assess the presence and severity of symptoms related to the 10 personality disorders defined in the DSM-IV-TR. Items on the ADP-IV are rated first for the degree to which they apply to the respondent (1='totally disagree' to 7='totally agree'). For items that are rated as relevant at a moderate or higher level (score 5 till 7), participants also rated the degree to which that trait results in problems or distress for the respondent or others (1='not at all', 3='most certainly'). Dimensional scores were computed by summing the trait scores on the individual items for each PD scale. The alpha coefficients in the present study ranged from α = .61 (schizoid PD) to α = .85 (paranoid PD). Schotte et al (2004) found kappa coefficients suggesting good levels of concordance between borderline diagnoses obtained with SCID-II and ADP-IV.

To assess coping strategies, we used the Utrecht Coping List (UCL; Schreurs, et al., 1993), consisting of 47 items, rated on a 5-point Likert scale, divided over seven scales, being active problem solving, palliative reactions, avoidance, social support seeking, depressive reactions, expression of emotions and self-soothing. Prior research has shown that the UCL is a valid and reliable instrument. In the present data, the different coping scales showed acceptable to good internal consistency: ranging from .62 (depressive reactions) to .89 (social support seeking).

2.3. Statistical analysis

To identify different BPD subtypes based on reactive and regulative temperament dimensions, we performed a two-step cluster analysis on the standardized BIS/BAS and EC scale scores (i.e., z-scores). Cluster analysis aims to group patients into relatively homogeneous clusters in such a way that patients within one cluster have more in common than they do with patients assigned to other clusters (Gore, 2000). First, a hierarchical cluster analysis was carried out using Ward's method based on squared Euclidian distances. The two- to five-cluster solutions were considered for further analysis. Second, these initial cluster centers were subsequently used as non-random starting points in a k-means clustering

procedure (MacQueen, 1967), resulting in an optimized cluster solution. To validate the clusters, we made use of the multivariate analysis of variance (MANOVAs) with the BPD subtypes as independent variable and clinical symptomatology, comorbid personality disorders, and coping as dependent variables.

3. Results

3.1. BPD subtype clusters

Cluster analysis on BISBAS and EC scale scores resulted in a solution of four clusters (see Figure 1), explaining 53%, 68%, and 59% of the variance in BIS, BAS and EC scores.

Figure 1. BPD clusters based on reactive and regulative temperament dimensions
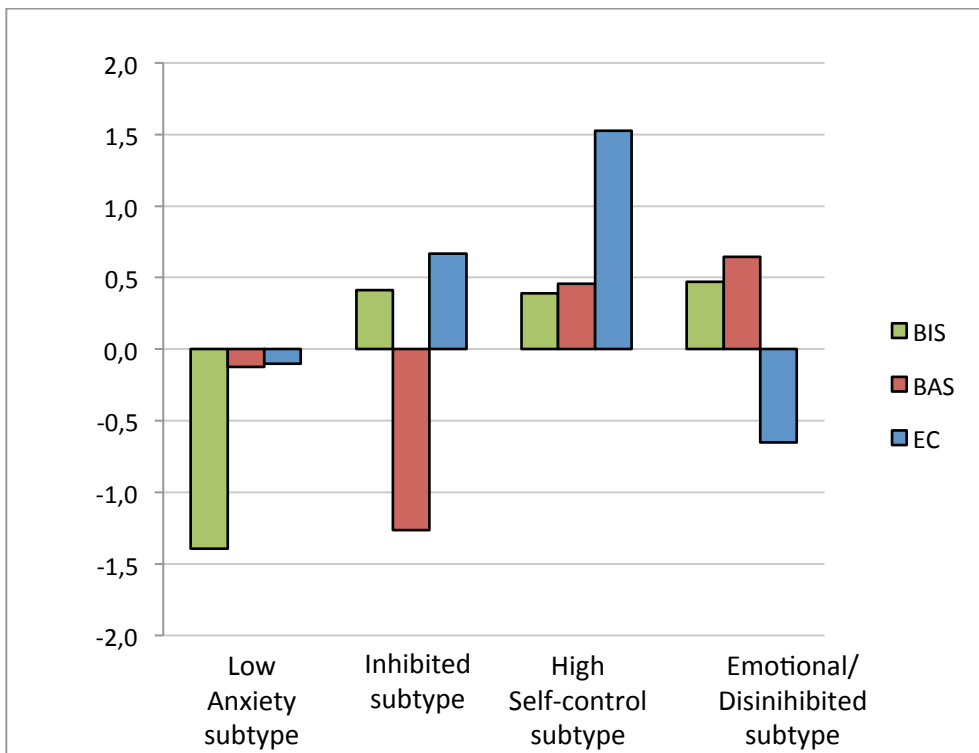
The first cluster (n = 31, 21%) was characterized by low BIS, average BAS, and average EC scores, and was tentatively labeled as the 'Low Anxiety subtype'. The second cluster (n = 34, 24%) was characterized by a low score on BAS and moderately high scores on BIS and EC; this cluster was tentatively labeled the 'Inhibited subtype'. The third cluster (n = 15, 10%), labeled as the 'High Self-control subtype', was characterized by high scores on EC, and moderately high scores on BIS and BAS. The fourth and largest cluster (n = 66, 45%), labeled as the 'Emotional/Disinhibited' subtype, showed moderately high scores on BIS and

BAS and moderately low scores on EC. The patients in the four clusters did not significantly differ with regard to gender [χ2(3) = 3.20, p = 0.36], age [$F(3,142)$ = 0.21, p = 0.89], education [χ2(9) = 8.54, p = 0.48] and marital status [χ2(6) = 5.42, p = 0.49]. Differences in overall medication use between the four clusters [yes/no: χ2(2) = 4.84, p = 0.18] and type of medication used [antidepressants: χ2(3) = 7.64, p = 0.05; antipsychotics: χ2(3) = 2.32, p = 0.51; anxiolytics: χ2(3) = 1.31, p = 0.73 and mood stabilizers: χ2(3) = 4.26, p = 0.23] were not significant.

3.2. BPD cluster differences on clinical symptoms

Table 1 displays the means and standard deviations of all BSI subscales for each BPD cluster. Overall, the MANOVA showed significant differences among the four BPD clusters with respect to clinical symptomatology (Wilks Lambda = 0.65; $F(3,144)$ = 2.29, p < 0.001). The hostility score was significantly higher for the Emotional/Disinhibited cluster compared to the Inhibited cluster. The Low Anxiety cluster scored significantly lower on interpersonal sensitivity and anxiety compared to the other 3 clusters.

Table 1. Means (standard deviations) of the Brief Symptom Inventory scales for the four BPD clusters.

BSI	Cluster 1 Low Anxiety	Cluster 2 Inhibited	Cluster 3 High Self-control	Cluster 4 Emotional/ Disinhibited			
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	F	η^2	Post-hoc comp.
SOM	9.39 (5.62)	11.21 (7.59)	10.67 (5.88)	11.82 (6.06)	1.06	0.02	
O-C	13.65 (4.38)	13.65 (5.86)	12.33 (4.08)	15.42 (5.32)	2.12	0.04	
I-S	7.71 (3.72)	10.41 (3.75)	10.13 (3.76)	11.18 (3.39)	6.67***	0.11	1<2,3,4
DEP	14.10 (6.05)	16.24 (5.45)	15.47 (534)	16.86 (5.04)	1.92	0.04	
ANX	10.23 (5.31)	14.18 (5.63)	15.13 (3.96)	15.24 (4.90)	7.26***	0.13	1<2,3,4
HOS	7.39 (5.54)	6.29 (4.88)	7.33 (4.44)	9.29 (5.13)	2.91*	0.58	2<4
PHOB	7.81 (4.79)	9.12 (5.70)	9.67 (4.48)	9.89 (4.63)	1.31	0.03	
PAR	8.71 (5.15)	10.06 (4.97)	10.93 (4.04)	10.53 (4.37)	1.26	0.02	
PSY	9.26 (4.14)	10.62 (4.43)	10.13 (3.83)	11.56 (3.64)	2.52	0.05	

Note. M = Mean; SD = Standard Deviation; SOM = somatization; O-C = obsessive-compulsive; I-S = interpersonal sensitivity; P = depression; ANX = anxiety; HOS = hostility; FOB = phobic Anxiety; PAR = paranoid ideation; PSY = psychoticism.
* *p*<0.05, *** *p*<0.001.

3.3. BPD cluster differences on comorbid personality disorders

Table 2 lists the means and standard deviations of each of the ADP-IV PD scales for each of the BPD clusters. The MANOVA showed significant differences among the four BPD clusters with respect to comorbid personality disorders (Wilks Lambda = 0.49; F(3,144) = 2.98, p < 0.001). Patients of the Low Anxiety cluster had a significantly higher score on total cluster B PD scale and antisocial personality disorder compared to the Inhibited cluster; and a significantly lower score on cluster C PD scale, obsessive-compulsive and depressive personality disorder compared to the Inhibited and the Emotional/Disinhibited cluster. Patients of the Inhibited cluster showed significantly higher scores on avoidant personality disorder, compared to the Low Anxiety cluster; and significantly lower scores on cluster B, antisocial, narcissistic and passive-aggressive personality disorders compared to the Emotional/Disinhibited cluster. Patients of the High Self-control cluster scored significantly lower on total cluster B PD scale and histrionic and dependent personality disorders compared to the Emotional/Disinhibited cluster. Patients of the Emotionally/Disinhibited cluster scored significantly higher on histrionic personality disorder compared to the Inhibited and the High Self-control clusters.

Table 2. Means (standard deviations) on the Assessment of DSM-IV Personality Disorders for the four BPD clusters.

ADP-IV	Cluster 1 Low Anxiety	Cluster 2 Inhibited	Cluster 3 High Self-control	Cluster 4 Emotional/ Disinhibited			
	M (SD)	M (SD)	M (SD)	M (SD)	F	η^2	Post-hoc comp.
Clust. A	82.24 (22.56)	91.82 (23.35)	87.27 (21.53)	90.27 (23.93)	1.06	0.23	
PAR	28.00 (10.50)	29.35 (9.10)	30.07 (8.90)	30.92 (10.25)	0.62	0.01	
SZ	22.24 (9.70)	25.82 (8.04)	21.40 (7.79)	22.59 (6.74)	2.16	0.04	
ST	32.00 (10.00)	36.65 (9.92)	35.80 (10.99)	36.75 (10.63)	1.54	0.03	
Clust. B	137.55(27.88)	116.79(18.03)	122.73(25.36)	146.05(29.56)	10.26***	0.18	2,3<4; 2<1
AS	27.97 (8.44)	18.79 (6.06)	20.93 (8.25)	25.86 (9.55)	8.08***	0.15	2<1,4
BDL	54.24 (9.11)	52.50 (7.83)	51.53 (9.21)	56.77 (7.74)	2.94	0.06	
HIS	31.14 (8.75)	26.29 (6.08)	28.33 (9.16)	35.58 (8.87)	10.23***	0.18	2,3<4
NAR	24.21 (8.54)	19.21 (5.86)	21.93 (7.17)	27.84 (10.73)	8.89***	0.11	2<4
Clust. C	89.14 (19.58)	104.06(19.99)	92.27 (20.23)	102.36(19.07)	4.46 **	0.09	1<2,4
AV	29.14 (9.28)	35.94 (7.31)	30.07 (9.98)	33.67 (8.01)	4.23 **	0.08	1<2
DEP	32.45 (7.75)	34.26 (10.10)	28.60 (8.93)	35.72 (8.65)	2.95*	0.06	3<4
OC	27.55 (7.85)	33.85 (8.46)	33.60 (6.52)	32.97 (8.22)	4.05**	0.08	1<2,4
DE	29.03 (8.34)	34.47 (7.57)	32.07 (7.90)	35.62 (6.44)	5.82***	0.11	1<2,4
PA	25.24 (8.14)	22.41 (6.89)	22.93 (5.79)	27.62 (8.14)	4.06**	0.08	2<4

Note. M = Mean; SD = Standard Deviation; PAR = paranoid; SZ = schizoid; ST = schizotypal; AS = antisocial; BDL = borderline; HIS = histrionic; NAR = narcissistic; AV = Avoidant; DEP = dependent; OC = obsessive-compulsive; DE = depressive; PA = passive-aggressive personality disorder.
* p<0.05, ** p<0.01, *** p<0.001.

3.4. BPD cluster differences on coping behavior

Table 3 displays the means (standard deviations) of the four BPD clusters on the UCL-coping scales. Overall, the MANOVA showed significant differences among the four clusters (Wilks Lambda = 0.63, F(3,144) = 3.26, p < 0.001). Patients of the Low Anxiety cluster scored significantly higher on palliative reactions (e.g., seeking distraction, drinking) compared to the Inhibited cluster. Further, patients of the Inhibited cluster scored significantly lower on expression of emotions compared to the Low Anxiety and Emotional/Disinhibited clusters. Patients of the High self-control cluster scored significantly higher on active problem-solving compared to the Emotional/Disinhibited cluster. And finally, patients of the Emotional/Disinhibited cluster used significantly less self-soothing thoughts compared to patients of the Low Anxiety cluster.

Table 3. Means (standard deviations) of the Utrecht Coping List scales for the four BPD clusters.

UCL	Cluster 1 Low Anxiety	Cluster 2 Inhibited	Cluster 3 High Self-control	Cluster 4 Emotional/ Disinhibited			
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*F*	η^2	Post-hoc comp.
Active Problem Solving	13.90 (6.39)	13.03 (3.61)	16.60 (3.50)	12.33 (3.67)	4.18**	0.08	4<3
Palliative Reactions	20.39 (4.84)	17.88 (3.57)	19.87 (3.44)	19.89 (3.21)	3.03*	0.06	2<1
Avoidance	19.55 (4.67)	19.38 (4.31)	17.47 (2.70)	18.88 (4.04)	0.98	0.02	
Social Support Seeking	10.84 (7.19)	9.91 (3.42)	10.80 (3.86)	11.61 (3.20)	1.11	0.02	
Depressive Reactions	16.58 (3.31)	17.15 (2.61)	16.40 (3.76)	18.23 (2.76)	3.15*	0.06	
Expression of Emotions	7.26 (2.35)	5.71 (1.96)	6.60 (2.26)	7.83 (2.24)	7.26***	0.13	2<1,4
Self-Soothing Thoughts	10.97 (4.48)	9.76 (2.62)	10.20 (2.57)	8.95 (2.50)	3.23*	0.06	4<1

Note. M = Mean; SD = Standard Deviation.
* p<0.05, ** p<0.01, *** p<0.001.

4. Discussion

The aim of this study was to identify BPD subtypes based on reactive and regulative temperament dimensions. We were able to identify four distinct clusters, which we labeled 'Low Anxiety', 'Inhibited', 'High Self-control', and 'Emotional/Disinhibited' subtypes.

The first cluster, the Low Anxiety, is characterized by low levels of BIS reactivity (low punishment sensitivity/low avoidance) compared to the other subtypes. Not surprisingly, patients of this subtype report significantly lower scores on anxiety and interpersonal sensitivity symptoms and significantly higher scores on cluster B antisocial personality disorder compared to the other subtypes. With respect to coping, they report higher expression of emotions (expressing tension and anger) and more palliative reactions (e.g., seeking distraction, drinking) compared to the other subtypes.

The second cluster is characterized by low levels of BAS reactivity (low reward sensitivity/low approach) and moderate levels of BIS reactivity and effortful control, and is therefore called the Inhibited subtype. This subtype scores high on the cluster C (avoidant and obsessive-compulsive) personality disorders and the depressive personality disorder compared to the other subtypes. These patients also experience multiple clinical symptoms, similar to patients of the Emotional/Disinhibited subtype. In contrast, patients of the Inhibited subtype are less likely to express their emotions, are more internalizing and are less hostile compared to the others BPD subtypes. This subtype can be linked to the Cluster C subtype of Critchfield (2008).

The third and smallest cluster is labeled as High Self-control subtype, given that these patients score high on effortful control. These patients seem to apply more adaptive coping strategies and experience fewer clinical and personality disorders compared to the other subtypes.

Finally, the fourth and largest cluster is named the Emotional/Disinhibited subtype, due to the fact that these patients score moderately high on the Behavioral Inhibition and Activation scales and very low on Effortful Control. This subtype seems to be the most 'prototypical' BPD subtype, characterized by intense emotions and disinhibition/impulsivity. As expected, this subtype scores high on anxiety, interpersonal sensitivity, and cluster B personality disorders, specifically the histrionic personality disorder, resembling the Cluster B subtype of Critchfield (2008).

To our knowledge, we are the first to investigate subtypes in BPD inpatients based on different temperamental features and the findings are consistent with prior research and clinical observations. The present study has a number of strengths, such as the uniformity of the assessment procedure and the use of an interview to assess BPD, besides the use of multiple self-report measures in a large BPD sample. However, besides these strengths, several limitations need to be addressed. The key limitation of this BPD-subtype research is its exclusive reliance on self-reports measures with its well-known advantages and disadvantages (Mc Donald, 2008). The clustering was based on self-reported measures of patients' temperament. Although self-reporting is a valid measure to assess personality features (Widiger et al., 2009), retrospective reporting of BPD patients is vulnerable to bias (Ebner-Priemer et al., 2006), so future research would benefit from supplementary data collection by means of other assessment methods, such as performance-based tasks. Inclusion of standardized behavioral measures of reactive tendencies and regulative control could enhance the validation of BPD subtypes (e.g., Claes et al., 2009). Second, while we have depended on the original RST, future research should be based on the revised RST (Gray et al., 2000) and apply the Reinforcement Sensitivity Theory of Personality Questionnaire (Corr et al., 2016). A third limitation is that the data were collected at two units specialized in the DBT-treatment of BPD patients, so the sample may not be representative of all people with BPD. Finally, we had an overrepresentation of female patients (85.6%), so future studies should also include more male participants.

Despite these limitations, the present study identified four different BPD subtypes based on reactive and regulative temperament, which could be validated by psychological symptoms, personality disorders, and coping strategies. Subtyping BPD could have important implications for the treatment of BPD patients. For example, for the inhibited subtypes treatment could perhaps benefit from focusing more on emotional expression as in the Radically Open DBT by Lynch et al. (2013). Given the promising outcomes, further research on the BPD subtypes is needed. Since there appears to be a relationship between subtypes and treatment-outcome (Digre et al, 2009), it is recommended to explore the treatment trajectories of the different BPD subtypes by means of longitudinal studies. Insight in the specific changing-processes of the different BPD subtypes might encourage the development of more person-tailored interventions and guide treatment choices to maximize the treatment response of BPD patients.

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Chapter 3

Are emotional action tendencies and attentional bias related to temperament dimensions in patients with borderline personality disorder?

Abstract

Disturbances in emotion regulation have been identified as a core feature of patients with a borderline personality disorder (BPD). Findings of studies using experimental measures of emotion processing are mixed, which may be partially explained by the heterogeneity of the BPD population. To address this issue, we investigated differences in experimental measures of emotional action tendencies (approach-avoidance behaviour) and attentional bias to emotional stimuli in BPD subtypes. Data of the Approach-Avoidance Task (AAT) and the Emotional Stroop Task (EST) were collected in 146 BPD patients, previously clustered into four BPD subtypes based on temperament dimensions. We investigated (1) the relationship between temperament dimensions and the performance on the AAT and EST and (2) compared performance on these tasks in previous defined BPD subtypes. The results of the present study demonstrated a positive relationship between effortful control (EC) and AAT effect-scores. A higher level of EC was positively associated with a general emotional action tendency towards faces with directed gaze, even when controlling for gender, age and BPD severity. Preliminary results on the comparison of the BPD subtypes demonstrated no significant differences in AAT and EST performance. These findings emphasize the relevance of EC in emotional action tendencies in BPD patients.

1. Introduction

Emotional dysregulation is viewed as a core feature of borderline personality disorder (BPD; e.g., Glenn and Klonsky, 2009). Emotion regulation deficits have been linked to impulsive or maladaptive behaviours such as non-suicidal self-injury, suicidal behaviour and treatment drop-out (e.g., Schmahl et al., 2014). Although characteristics of emotion processing in BPD have been extensively investigated, results of studies using experimental measures are mixed (Rosenthal et al., 2008). The inconclusive results may be partially explained by the heterogeneous traits present in the BPD population.

In an earlier study (Sleuwaegen et al., 2017) an attempt was made to disentangle the heterogeneity in BPD based on differences in patients temperament. Reactive and regulative temperament traits were measured using the Behavioral Inhibition and Behavioral Activation Scales (BIS/BAS; Carver & White, 1994) and the Effortful Control Scale (ECS-ATQ; Evans & Rothbart, 2007) respectively. Results of the study enabled four BPD subtypes to be distinguished. The 'Low Anxiety' subtype (21%) was characterized by low levels of BIS reactivity (low punishment sensitivity/low avoidance). Patients of this subtype reported less anxiety, more expression of emotions and had higher scores relating to antisocial personality disorder (PD) features. The 'Inhibited' subtype (24%) was characterized by low levels of BAS reactivity (low reward sensitivity/low approach). These patients reported less hostility, less expression of emotions, and had higher scores relating to avoidant PD features. The last two subtypes showed similar reactive temperaments with moderate levels of BIS and BAS, but differed in their regulative temperament. The 'High Self-control' subtype (10%) was characterized by very high levels of effortful control. Patients of this subtype reported fewer clinical symptoms, more adaptive coping strategies and fewer comorbid personality disorder features. On the other hand, the 'Emotional/Disinhibited' subtype (45%) demonstrated very low levels of effortful control. These patient were characterized by higher levels of anxiety, less adaptive coping strategies and higher cluster B (histrionic) PD features (see Sleuwaegen et al., 2017). Thus, the two subgroups presenting with the lowest and highest levels of psychopathology ('High Self-control' and 'Emotional/Disinhibited') only differed on the level of effortful control.

In support of this, evidence from an earlier study found that levels of effortful control contributed to BPD symptoms (Hoermann et al., 2005). Using self-reported measures, BPD patients with the highest level of effortful control reported the least symptoms and fewest problems in interpersonal functioning and personality organization, whereas those with the lowest level of effortful control reported the most problems in these areas. An additional study demonstrated that lower effortful control and higher BIS in BPD patients resulted in worse performance on a task measuring cognitive control (conflict resolution) (Posner et al., 2002). Preti et al. (2016) therefore concluded that failure of regulatory processes negatively affects performances.

As evidence relating to emotion processing in BPD is inconclusive, temperament dimensions, specifically effortful control might account for some important differences in presentation and reactions to emotional stimuli as measured by performance on experimental tasks (Posner et al., 2002).

Recent studies in BPD patients have demonstrated a biased processing of emotional stimuli (Winter et al., 2016). Attentional bias to emotional stimuli is often investigated with interfering emotional stimuli being presented during a task. For example, in the Emotional Stroop Task (EST), patients have to name the colour of ink in which emotional or neutral words are printed as fast as possible. In this task, the emotional content of the words may capture attention. Kaiser et al. (2017) found that patients with BPD required more time to name the colour of negative words during the EST, suggesting a negative attentional bias in BPD patients. In addition, Portella et al. (2011) reported that higher severity of BPD psychopathology led to more difficulties in processing information measured by the EST.

Another important emotion-related process is the response to emotional stimuli, often labeled emotional action tendencies. Research on this topic has grown widely since the introduction of the Approach-Avoidance Task (AAT; Rotteveel and Phaf, 2004), where participants have to respond to pictures of happy or angry faces by pushing or pulling a joystick depending on the emotional expression. In general, people respond faster if asked to approach a happy face and to avoid an angry face, compared with the task of approaching an angry face and avoiding a happy face, which need more control to apply counterintuitive action (Roelofs et al., 2009). Disturbed approach-avoidance tendencies on the AAT are seen in different patient samples. In socially anxious patients, for example, increased avoidance tendencies toward angry and happy faces are observed, whereas in depressed patients a decreased overall approach tendency is observed (Radke et al., 2014; Roelofs et al., 2010). As far as we know, no research to date has explored the emotional action tendencies with the AAT in BPD patients.

As indicated by previous studies, the distinction between BPD patients based on temperament dimensions may provide a framework to better understand the mixed findings relating to emotion processing in BPD (Suvak et al., 2012; Unoka and Richman, 2016; Winter, 2016). To test this, (1) the relationship between temperament dimensions and performance on EST and AAT was investigated and (2) a comparison was made between the previously mentioned BPD subtypes based on temperament dimensions on these two experimental tasks.

Concerning research question 1, the associations between AAT and EST-effects and temperament dimensions were investigated. Since gender, age, and BPD severity may influence the aforementioned associations (e.g., Price et al., 2012), it was explored whether the associations would remain after controlling for these variables. The first hypothesis of this research question was that there would be positive associations between effortful control and both experimental measures (Posner et al., 2003) above and beyond gender, age and

BPD severity. It was additionally hypothesized that the level of effortful control would be related to AAT performance, since this task demands some voluntary counterintuitive actions. However, this association was mainly expected in the condition in which faces with a direct gaze were used, since they evoke more intense automatic activation (Roelofs et al., 2009; 2010). The final hypothesis of this research question was that EST performance may be explained by the level of effortful control, since this task depends on the ability to make subdominant responses.

Concerning research question 2, the four BPD subtypes were compared on their AAT and EST performance. Although the current study compared subtypes with limited sample sizes, it can provide preliminary evidence for differences on action tendencies and attentional bias to emotional stimuli between BPD subtypes. Since this part of the study was more explorative in nature, the only hypothesis was that there would be differences between the two BPD subtypes with contrasting effortful control. The High Self-control subtype (high EC) would perform better on the AAT and EST, while the Emotional/Disinhibited subtype (low EC) would display more approach-avoidance deficits and attentional bias to emotional stimuli (Portella et al., 2011; Posner et al., 2003).

2. Methods

2.1. Participants and procedure

The present study is an extension of research on BPD subtypes based on reactive and regulative temperament (see Sleuwaegen et al., 2017). The original sample consisted of 146 patients (85.6% female), recruited from two psychiatric hospitals in Belgium and diagnosed with BPD by means of the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; First et al., 1997). Within the context of the present study, the AAT and EST were administered in a session following the interview-session. Due to technical error, two patients (of the 'Emotional/Disinhibited' subtype) were excluded, resulting in a dataset of 144 patients. Of this BPD sample, 125 (86.8%) are female and 19 are male (13.2%), with a mean age of 29.30 years (SD = 8.35, range 18 to 65 years). 'Low Anxiety' (n = 31), 'Inhibited' (n = 34), 'High Self-control' (n = 15) and 'Emotional/Disinhibited' subtypes (n = 66) did not significantly differ with regard to gender, education, marital status or type of medication used (see Sleuwaegen et al., 2017). The study was developed in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Antwerp University and the local ethical committee of the participating hospitals.

2.2. Measures

Reactive temperament was assessed by means of the Behavioral Inhibition/Behavioral Activation System Scales (BIS/BAS; Carver & White, 1994; translated into Dutch by Franken et al. (2005)). The BIS/BAS scales consist of 24-items, rated on a 4-point Likert scale, of which seven items assess BIS reactivity (sensitivity to punishment) and 13

items assess BAS reactivity (sensitivity to reward). The BIS and BAS scales demonstrated acceptable internal consistency in the present sample (both α = 0.75).

Regulative temperament was assessed by means of the Effortful Control Scale (ECS) from the short form of the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007), consisting of 19-items, rated on a seven-point Likert scale. The alpha coefficient of the ECS in the present study was 0.78.

Severity of symptoms related to the Borderline Personality disorders were assessed by means of the Assessment of DSM-IV Personality Disorders (ADP-IV; Schotte and De Doncker, 1994), a 94-item Dutch self-report questionnaire used to assess the presence of 10 personality disorders defined in the DSM-IV-TR. Dimensional scores were computed by summing the trait scores on the individual items for each PD scale. The alpha coefficients in the present study for the BPD was α = .67.

Action tendencies to emotional stimuli were assessed by means of the gaze variant of Approach-Avoidance Task (AAT; developed by Heuer et al. (2007); Radke et al. (2013)). In this task, patients have to respond to pictures of facial expressions (happy, angry) of eight different actors (4 male, 4 female), with different gazes (direct or averted gaze), presented on a computer screen. Patients were instructed to respond to the emotional expression of the face by pushing a joystick away from themselves as fast as possible (avoid) which consequently shrinks the picture; or pulling a joystick toward themselves (approach) and enlarging the picture. All patients performed two blocks of trials with opposite instructions. In the affect-congruent block, patients had to pull the joystick (approach) when presented with a happy face and to push the joystick (avoid) when presented with an angry face. The affect-incongruent block required the opposite actions,, namely to pull following an angry faces and push following a happy faces. Each block consisted of 20 practice trials and 96 test trials. The order of the blocks was counterbalanced across patients. Reaction times (RTs) were transformed into their natural logarithm. Median RTs were calculated for movements (push, pull) for different emotions (happy, angry) and different gazes (direct, averted). The AAT effect scores were calculated by subtracting participants' median RTs in the pull conditions from median RTs in the push conditions. A positive effect score reflects facilitated approach patterns whereas negative effect scores represent faster avoidance patterns. To investigate a general emotional action tendency, AAT effect-score of combined emotions (push-pull happy minus push-pull angry) were calculated (for an extensive review of this task, see meta-analysis by Phaf et al., 2014).

Attentional bias was assessed by means of the Emotional Stroop Task (EST; e.g., Williams et al., 1996). The standard card version of the EST was used as opposed to the computerised version, since verbal responses seem to show higher interference scores than button responses (Kaiser et al., 2017). Three A4 cards were composed, each containing another emotional valence. The order in which the three cards were presented was counterbalanced across patients. Each card consisted of 10x10 neutral, negative, or positive

words printed in red, yellow, green or blue ink. The patients were asked to name the colour of the ink in which the words were printed as fast as possible. The total time needed to name the colours of a card was recorded. The resulting three mean colour naming times for neutral, positive or negative words are the sum of the reaction time and the duration of the verbal output. The total time was divided by the number of words (= 100), representing a colour naming per word in milliseconds. Positive attentional bias was defined as the difference between positive colour naming time and neutral colour naming time; negative attentional bias as the difference between negative and neutral colour naming time. Higher scores indicate more attentional bias to emotional stimuli (for an extensive review of this task see meta-analysis by Kaiser et al., 2017).

2.3. Statistical analyses

All analyses were performed using SPSS (v24). AAT trials with an extreme RT (< 150 ms or >1500 ms or exceeding 2.5 SD above the individual mean) or an extreme MT (> 400 ms) were excluded (< 4%). Four participants (of the Emotional/Disinhibited BPD subtype) with extreme RTs were excluded. RTs for the AAT and EST were transformed into their natural logarithm (all reported RTs are ln(RT)s). Statistical analyses were performed on median RTs (Roelofs et al., 2010).

To answer the first research question, i.e. the associations between the temperament dimensions (BIS, BAS and EC) and the experimental tasks (AAT and EST effects), Spearman's correlations were calculated.

In addition, three separate hierarchical linear regression analyses were performed with (1) AAT effect-scores (push-pull RT differences) of happy faces with direct gaze, (2) AAT effect-scores of angry faces with direct gaze and (3) general AAT effect-scores (push-pull RT happy minus push-pull RT angry) as dependent variables and temperament dimensions (BIS, BAS and EC) were simultaneously entered in block 1 as independent variable and BIS, BAS, EC, gender, age and BPD severity entered in block 2 as independent variable.

Next, two separate hierarchical linear regression analyses were performed for EST effects, (1) with positive bias (positive minus neutral) and (2) with negative bias (negative minus neutral) as dependent variables and temperament dimensions (BIS, BAS and EC) simultaneously entered in block 1 as independent variable and BIS, BAS, EC, gender, age and BPD severity entered in block 2 as independent variables.

To answer the second research questions, i.e. to compare the BPD subtypes with respect to the AAT/EST, three separate hierarchical linear regression analyses were performed (1) with general AAT effect-scores (push-pull RT happy minus push-pull RT angry), (2) with positive bias (positive minus neutral) and (3) with EST negative bias (negative minus neutral) as dependent variables and BPD subtypes (binary coded and the Emotional/Disinhibited subtype as reference BPD subtype) simultaneously entered in block 1

as independent variable and BIS, BAS, EC, gender, age and BPD severity entered in block 2 as independent variable.

3. Results

3.1. Preliminary analyses of the AAT and EST effects

AAT effect-scores were analyzed with a repeated-measure ANOVA with emotion (happy, angry), gaze (direct, averted). Results showed a significant main effect of emotion [$F(1,139) = 9.27$, $p = 0.003$], with the expected pattern of approach of happy faces (M=33.53) and avoidance of angry faces (M=-9.81). Increased AAT effects for faces with direct gaze were reflected by a significant main effect of gaze [$F(1,139) = 5.99$, $p = 0.016$]. There was a significant interaction between emotion and gaze [$F(1,139) = 3.91$, $p = 0.049$], caused by happy faces with direct gaze. Since these findings pointed to a greater effect of faces with direct gaze, it allowed us to focus on the direct gaze condition and omit the averted gaze condition in further analyses.

EST response time scores were analyzed with a repeated-measure ANOVA and revealed a significant difference between EST response time for neutral, positive and negative words [$F(2,137) = 12.44$, $p < 0.001$], with longer response time for negative words (M=807ms) and positive words (M=789ms) compared to neutral words (M=753ms). This result provides evidence for the measurement of attentional bias for emotional words with this EST.

3.2. Associations between temperament dimensions and AAT, EST effects

Table 1 presents the Spearman correlations between the self-reported temperament dimensions (BIS, BAS and EC) and AAT effect-scores on emotional faces with direct gaze and EST attentional bias scores in the total BPD sample. The results of the correlations showed that effortful control was negatively related to BIS and positively related to the AAT effect-scores towards happy and angry direct faces and to the general AAT effects scores.

Table 1. Correlations between temperamental dimensions and AAT and EST effects

	BIS	BAS	EC	AAT-effect Happy_ Direct	AAT-effect Angry _ Direct	AAT-effect H_A_Direct	EST Pos-Neutr	EST Neg-Neutr
BIS	1	.062	-.027	-.083	-.046	-.027	.070	.072
BAS	.062	1	-.386**	-.059	.136	-.160	-.022	-.031
EC	-.027	-.386**	1	.231**	-.221**	.283**	-.097	-.070
AAT-effect Happy_Direct	-.083	-.059	.231**	1	-.420**	.850**	.007	.126
AAT-effect Angry_Direct	-.046	.136	-.221**	-.420	1	-.807	.086	-.057
AAT-effect H_A_Direct	-.027	-.160	.283**	.850**	-.807	1	-.059	.111
EST Pos-Neutr	.070	-.022	-.097	.007	.086	-.059	1	.316**
EST Neg-neutr	.072	-.031	-.070	.126	-.057	-.111	.316**	1

Note. ** $p<0.01$

To investigate which temperament dimension had the strongest association with the AAT effect-scores (with direct gaze), three hierarchical linear regression analyses were performed.

The first hierarchical regression analysis, with AAT effect-scores towards happy faces as dependent variable and BIS, BAS and EC entered in block A, revealed a statistically significant model [$F(3,136) = 2.91$, $p = 0.037$, $R^2 = 0.040$]. The level of effortful control made a significant contribution to the model [$\beta = .225$, $t = 2.48$, $p = 0.014$], BIS and BAS not (both $p > 0.269$). However, after entry of gender, age and BPD in the second block, the model was not significant anymore [$F(3,136) = 1.84$, $p = 0.096$, $R^2 = 0.035$].

The second hierarchical regression analysis, with AAT effect-scores towards angry faces as dependent variable and BIS, BAS and EC entered in block 1, did not provide a significant model [$F(3,136) = 2.63$, $p = 0.053$, $R^2 = 0.055$]. Adding gender, age and BPD severity in block 2 revealed also no significant model [$F(3,136) = 1.71$, $p = 0.124$, $R^2 = 0.071$].

The third hierarchical regression analysis, with general AAT effects (as dependent variable and BIS, BAS and EC entered in block 1, revealed a significant model [$F(3,136) = 3.61$, $p = 0.015$, $R^2 = 0.074$]. The level of effortful control made a significant contribution to the model [$\beta = .251$, $t = 2.78$, $p = 0.006$, BIS and BAS not (both $p > 0.653$). The model with BIS, BAS, EC, gender, age and BPD severity in block 2 was still significant [$F(3,133) = 2.37$, $p = 0.033$, $R^2 = 0.097$]. This regression model revealed that effortful control remained significantly positive associated with general AAT effect-scores towards emotional faces with directed gaze [$\beta = .234$, $t = 2.45$, $p = 0.015$] after controlling for gender, age and BPD severity.

To investigate which temperament dimension had the strongest association with the EST effect-scores, two separate hierarchical linear regression analyses were performed.

The first hierarchical regression analysis, with EST positive bias effect-scores (positive minus neutral) as dependent variable and BIS, BAS and EC entered in block 1, and adding gender, age and BPD severity in block 2 did not provide significant results [resp. $F(3,135) = 0.09$, $p = 0.965$, $R^2 = 0.002$; $F(3,135) = 0.29$, $p = 0.939$, $R^2 = 0.013$].

The second hierarchical regression analysis, with EST negative bias effect-scores (negative minus neutral) as dependent variable and BIS, BAS and EC entered in block 1, and adding gender, age and BPD severity in block 2 did not provide significant results [resp. $F(3, 135) = 0.30$, $p = 0.823$, $R^2 = 0.007$; $F(3,135) = 0.90$, $p = 0.497$, $R^2 = 0.039$].

3.3. BPD subtypes and their performance on the AAT and EST

The mean (and SE) AA effect-scores per condition of the four BPD subtypes are presented in Figure 1. The means (and SE) of the time to name the colour of neutral, negative and positive words on the EST for the four BPD subtypes are presented in Figure 2.

Figure 1. Means (and SE) AAT effect scores (difference reaction times push and pull in ms) for direct and averted gaze stimuli for each emotion for the four BPD subtypes.

Note. Sample stimuli were obtained from Karolinska Directed Emotional Faces (Lundqvist et al., 1998) (identity AM29) with permission from the copyright holders.

Figure 2. Means (and SE) of the time to name the colour of neutral, negative and positive words on the EST for the four BPD subtypes.
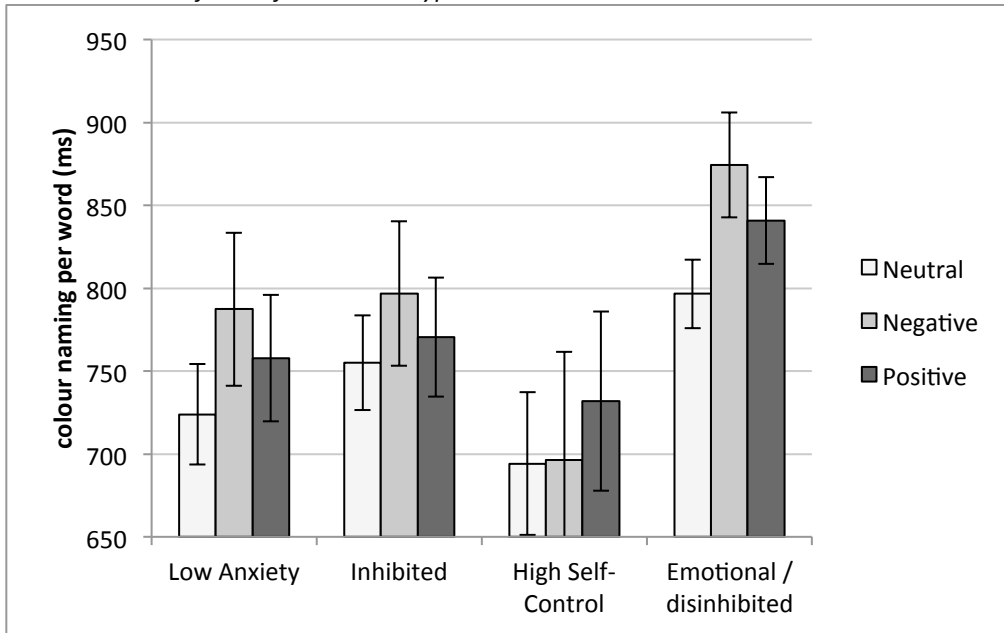
To compare the four BPD subtypes on the two experimental tasks, three hierarchical linear regression analyses were performed.

The first hierarchical regression analysis, with general AAT effect-scores as dependent variable and BPD subtypes entered in block 1 as independent variable, and adding gender, age and BPD severity in block 2, did not provide significant results [resp. $F(3, 136) = 1.87$, $p = 0.138$, $R^2 = 0.040$; $F(3, 136) = 1.79$, $p = 0.104$, $R^2 = 0.075$].

The second hierarchical regression analysis, with EST positive bias (positive minus neutral) as dependent variable and BPD subtypes entered in block 1, and adding gender, age and BPD severity in block 2, did not provide significant results [resp. $F(3, 136) = 0.52$, $p = 0.667$, $R^2 = 0.011$; $F(3, 136) = 0.48$, $p = 0.824$, $R^2 = 0.021$].

The third regression analysis with EST negative bias (negative minus neutral) as dependent variable and BPD subtypes entered in block 1, and adding gender, age and BPD severity in block 2, did not provide significant results [resp. $F(3, 136) = 1.20$, $p = 0.313$, $R^2 = 0.026$; $F(3, 136) = 1.27$, $p = 0.276$, $R^2 = 0.055$].

These findings revealed no significant differences between the four BPD subtypes on AAT effect-scores, EST positive and negative attentional bias.

4. Discussion

In this study, an investigation was conducted on the relationship between BPD temperament dimensions/subtypes and action tendencies (AAT) and attentional bias (EST) of emotional stimuli.

First, findings of the current study demonstrate a positive relationship between emotional action tendencies measured with the AAT and effortful control but no significant associations with BIS and BAS reactivity. The latter finding, confirms findings of previous studies which show no or low correlations between self-reported temperament dimensions and experimental tasks (Claes et al., 2012; Kobeleva et al., 2014; Voth et al., 2014; Roose et al., 2013). Kobeleva et al. (2014), for example, applied a joystick task measuring automatic approach/avoidance tendencies in BPD patients and found no significant correlations between BIS/BAS scores and performance on this task. In contrast, contrary to previous findings, results of the current study demonstrated that the level of effortful control was positively related to approach-avoidance tendencies to faces when the gaze was directed towards the participants and not when the gaze was averted. This is not surprising, since direct gaze, compared to averted gaze, is detected more efficiently and is perceived as a signal to interact, which evokes more intense automatic activation (Roelofs et al., 2010). Interestingly, the level of effortful control seems to be associated with a general emotional action tendency to directed faces, even when controlling for gender, age and BPD severity. This finding suggests that BPD patients with a higher level of effortful control show a better preferential response towards emotional interpersonal cues compared to the BPD patients who have a lower level of effortful control, above and beyond gender, age and severity of BPD psychopathology. In contrast, BPD patients with lower levels of effortful control show diminished approach-avoidance tendencies towards emotional faces, which may be linked to a higher level of difficulties in acting flexibly in different situations and problematic social interactions (Radke et al., 2014). This interpretation is consistent with the report by Hoermann et al. (2005) who found the highest reported problems in interpersonal functioning in BPD patients with the lowest level of effortful control. In general, these findings are in line with previous findings of disadvantageous performance in BPD patients with low levels of effortful control on tasks capturing emotion processing (Posner et al., 2003; Preti et al., 2016).

Results of the current study did not demonstrate any relationship between attentional bias measured with the EST and any of the self-reported temperament dimensions. In addition there was no evidence to support the hypothesis that attentional bias could be explained by the level of effortful control. Despite the evidence that the EST card version that was used measured attentional bias effect (longer colour naming time for emotional words compared to neutral words) this card version, in contrast to a computerised EST version, might not be specific enough to assess reaction times and errors for this purpose. Hence, based on the current findings, it cannot be concluded that temperament dimensions are associated with attentional bias.

The second aim of the present study was to explore differences in emotional action tendencies and attentional bias between four previous identified BPD subtypes based on temperament dimensions. Contrary to the hypothesis, no significant differences were found between the four BPD subtypes in approach-avoidance tendencies. In addition, there were no significant differences in EST performance between the four BPD subtypes. Unfortunately, the findings of the current study could not corroborate the findings of Portella et al. (2011), who found the slowest EST performance in patients with higher severity of BPD psychopathology compared to moderate-severe BPD patients.

Despite the strengths of our study, some limitations need to be addressed. First, for the second research question, BPD subtypes with small sample sizes were included, which restrict the statistical power to detect significant differences. Second, there was an overrepresentation of female patients (almost 87%) in the current study. Although gender was controlled in the analyses, further research should consider using a larger and more balanced sample. Despite these limitations, the data provide meaningful directions for further research. Future studies in which underlying dimensions in BPD samples are investigated, may help to further shed light into the differences between their temperament, 'severity' and responses to treatment.

To conclude, results of the current study indicate that an underlying temperament dimension of effortful control may be a critical component in emotion processing and in overall general functioning in BPD.

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Chapter 4

Do treatment trajectories differ after 3 months DBT intreatment according to borderline personality disorder subtypes?

Abstract

Heterogeneity in Borderline Personality Disorder (BPD) drives the search for BPD subtypes to optimize the assessment and treatment of these patients. Therefore, the aim of the present study was: (1) to replicate previously identified BPD subtypes based on reactive and regulative temperament; (2) to compare them on symptomatology and coping; and (3) to investigate whether these subtypes show different treatment responses after 3 months of inpatient Dialectical Behavior Therapy (DBT). A total of 145 BPD inpatients were assessed by means of measures of temperament, symptomatology and coping. Through model-based clustering on the Behavioral Inhibition and Behavioral Activation Scales (BISBAS) and Effortful Control Scale (EC), we identified three BPD subtypes: an Emotional/Disinhibited subtype (15%, high BAS and low EC); a Low Anxiety subtype (41%, low BIS); and an Inhibited subtype (44%, low BAS). After 3 months of DBT, 75 patients completed the measures for a second time. Repeated measure ANOVA's demonstrated a general improvement on all symptoms and coping strategies. In addition, the BPD subtypes showed trajectory differences in clinical and borderline specific symptomatology and dissociation. These findings indicate that BPD subtypes based on temperament demonstrate different treatment responses, which can contribute to the search of more BPD subtype tailored treatment interventions.

1. Introduction

Given the heterogeneity of borderline personality disorder patients (BPD), recent studies investigated the existence of personality subtypes in BPD patients (Frias et al., 2017; Sleuwaegen et al., 2017; Smits et al., 2017). A person-centered approach in a theoretical framework can explain different phenotypes of BPD. Frias et al. (2017) identified four subtypes based on personality traits, and Smits et al. (2017) distinguished three subtypes based on dimensional PD features. Since temperament is a promising transdiagnostic process that underlies psychopathology, different temperament dimensions such as reactive and regulative temperament can define subtypes. Previous studies have displayed different subtypes based on temperament dimensions and their differential associations with psychopathology within various clinical samples (e.g. Muller et al., 2014). Subtypes based on temperament dimensions, characterized by differential psychiatric comorbidity, may demonstrate different treatment responses. In a previous study, Sleuwaegen et al. (2017) distinguished four BPD subtypes based on reactive (Behavioural Activation System reactivity; BAS and Behavioural Inhibition System reactivity; BIS) and regulative temperament (effortful control): an Emotional/Disinhibited subtype (low effortful control), characterized by the highest level of symptomatology and comorbid histrionic PD; an Inhibited subtype (low BAS), demonstrating low expression of emotions and comorbid cluster C personality disorder (PD); a Low Anxiety subtype (low BIS) characterised by low anxiety, high expression of emotions and comorbid antisocial PD; and a High Self-control subtype (high effortful control) showing the highest level of functioning.

The identification of such BPD subtypes may be important for enhancing the effectiveness of assessment and treatment of BPD patients (Kopala-Sibley et al., 2012), however the clinical utility of using BPD subtypes has not yet been proven. Insight in treatment trajectories of the different BPD subtypes may support the development of more tailored treatment interventions and may guide treatment choices to optimize treatment outcome.

Several effectivity studies of DBT inpatient treatment showed significant improvement in ratings of NSSI, general clinical symptomatology, borderline-related symptoms and dissociation after a 3-month DBT program in BPD samples (Bohus et al., 2004; Kröger et al., 2013). However, a third of the patients did not benefit from treatment (Kröger et al., 2013). In addition, in DBT the dropout rate was estimated around 27% and till now few predictors of dropout have been identified (e.g., Kliem et al., 2010). It is hypothesized that different BPD subtypes might show differences in treatment trajectories (e.g., Oldham, 2006) or in dropout, explaining the mixed treatment responses of BPD patients. To our knowledge, only one study so far, has evaluated differences in treatment responses between different BPD subtypes. Digre et al. (2009) assessed 74 BPD inpatients and identified three BPD subtypes focusing on attribution style. After six months of treatment, which consisted of some DBT skills training aspects, a significant improvement in depression, dissociation and less suicide attempts, but no significant change in NSSI was demonstrated. However, they did

not find significant trajectory differences between the different BPD subtypes for each of these symptoms.

The aim of this study was threefold: (1) to replicate the prior BPD subtypes based on reactive and regulative temperament dimensions (see Sleuwaegen et al., 2017) with model-based clustering, since this method only generates multiple clusters if the data provides evidence for them; (2) to investigate differences in symptomatology and coping between the BPD subtypes at baseline; and (3) to investigate the (potential differential) dropout rate and differences in symptomatology and coping of these BPD subtypes after 3 months of BPD inpatient treatment (Linehan, 1993). Although this study was exploratory in nature, several hypotheses were formulated based on prior research. First, we expected to find four BPD subtypes based on reactive and regulative temperament as in a previous study (Sleuwaegen et al., 2017). Second, we expected intergroup differences in general clinical symptomatology, borderline specific symptomatology, dissociation, NSSI and coping at baseline. The subtype with the highest level of BIS and BAS, and the lowest level of effortful control (Emotional/disinhibited cluster) would show the highest level of symptomatology and the worst coping compared to the other subtypes (Sleuwaegen et al., 2017). Third, it was expected that the total BPD sample and the BPD subtypes would show a good treatment response (main effect of time) on general clinical and borderline specific symptoms, dissociation, NSSI and coping styles (e.g., Kröger et al., 2013). Since the exploration of trajectory differences among the BPD subtypes based on temperament dimensions is new, we did not formulate hypotheses concerning potential differences in symptomatology and coping after three months of DBT inpatient treatment. However, we hypothesized a higher dropout rate in the subtype with the lowest BIS level, consistent with past research in samples with anti-social personality characteristics (Daughters et al., 2008).

2. Methods

2.1. Participants and procedure

Our participants consisted of 145 BPD inpatients (88.3% females) hospitalized in a treatment unit for BPD patients, based on the principles of DBT (Linehan, 1993). Participants were included between May 2014 and April 2017. Patients were included if they fulfilled the criteria of BPD and they were excluded if they suffered from a current psychotic disorder or a current substance use disorder. In case of current addiction, patients were referred to a specialized unit for detoxification and substance use disorder. Patients were allowed to be under pharmacological treatment. During the first week of admission, all patients were informed about the aims of the study and invited to participate. After giving written informed consent, patients were asked to fill out the questionnaires on a computer. All 145 patients (see Table 1 for more detailed information) met criteria for BPD diagnosis as assessed by means of the self-report Assessment of DSM-IV Personality Disorders - Borderline scale (ADP-IV; Schotte, 1994), and for 80 patients this BPD diagnosis was validated by the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; First et al., 1997; Dutch

translation by Weertman et al., 2000). Assessment after 3 months (13 to 16 weeks) was carried out as an element of routine outcome monitoring which is integrated into the regular treatment routine to evaluate treatment response. After 3 months of DBT treatment, 75 inpatients provided data concerning clinical symptomatology and coping. Table 1 displays the sample characteristics for the sample at T1 and the sample at T2. The study was developed in accordance with the Declaration of Helsinki and approved by the local research and participating hospitals ethics committees. Participants did not receive any remuneration.

Table 1. Sample characteristics for the total sample of BPD patients at baseline and for the subsample at 3 months assessment

	Total sample at T1	Sample at T2
	n=145	n=75
Gender – Female (%)	88.3	91.9
Age (*M*, *SD*)	29.72 (9.32)	28.75 (8.83)
Education (%)		
Lower secondary	19.7	18.9
Higher secondary	57.8	55.4
High School	17.6	18.9
University	4.7	6.8
Marital status (%)		
Single	71.4	71.6
Living together/Married	19.7	18.9
Divorced	8.8	9.5
Medication (%)	84.8	85.1
Antidepressants	71.7	70.3
Antipsychotics	48.3	44.6
Anxiolytics	6.2	6.8
Mood Stabilizers	11.7	10.8

Note. Antipsychotics provided as mood regulator

2.2. Measures

The diagnosis of BPD was assessed by means of the Assessment of DSM-IV Personality Disorders (ADP-IV; Schotte and De Doncker, 1994), a 94-item Dutch self-report questionnaire used to assess the presence and severity of the personality disorders as defined in the DSM-IV-TR (APA, 2000) and the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II; First et al., 1997; Dutch translation by Weertman et al., 2000). Schotte et al. (2004) indicated that the ADP-IV-BPD scale showed acceptable concordance with the SCID-II-BPD section (kappa= 0.54).

To replicate the BPD subtypes based on reactive/regulative temperament, we used the Behavioural Inhibition System/Behavioural Activation System Scales (BIS/BAS; Carver & White, 1994; Dutch translation: Franken et al., 2005) and the Effortful Control Scale (ECS) of the Adult Temperament Questionnaire-Short Form (ATQ-SF; Evans & Rothbart, 2007). The BISBAS scales consist of 24-items, rated on a 4-point Likert scale, of which seven items assess BIS reactivity (α = .72 in the present study), reflecting sensitivity to punishment, and 13 items assess BAS reactivity (α = .86), reflecting sensitivity to potentially rewarding outcome. Regulative temperament was assessed by means of the ECS scale with 19 items rated on a seven-point Likert scale. The internal consistency of the ECS scale was α = .77 in the present sample.

To validate the BPD subtypes and to investigate treatment response, several self-report measures were administered assessing clinical/BPD symptomatology and coping:

General clinical symptomatology was assessed by means of the Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983; translated into Dutch by de Beurs et al., 2005) consisting of 53 items, rated on a 4-point Likert scale. In the present study, the alpha coefficient for the total BSI-score was .95.

Borderline specific symptoms were measured by means of the Borderline Symptom List-23 (BSL-23; Bohus et al., 2009), in which patients rated 23 items on a 5-point Likert scale. Cronbach's alpha of the total BSL-score in the present study was .95.

Dissociation was assessed by means of the Dissociation Questionnaire (DIS-Q; Vanderlinden et al., 1993), consisting of 63-items to be rated on a 5-Likert scale. In this study the internal consistency coefficient of the total DIS-Q-score was excellent (α = .96).

Non-suicidal self-injury was assessed by means of the Self-Injury Questionnaire-Treatment Related (SIQ-TR; Claes & Vandereycken 2007). Participants had to answer in a yes/no question format whether they had ever intentionally engaged in self-injury without the intention to die (i.e., scratching, cutting, hitting, burning, picking or head banging) (life-time NSSI) and whether they were still engaging in NSSI at the current moment (current NSSI) (Claes & Vandereycken 2007).

Coping strategies were assessed by means of the Utrecht Coping List (UCL; Schreurs, et al., 1993), consisting of 47 items, to be rated on a 5-point Likert scale. Two coping styles can be distinguished: an active coping style (based on the subscales 'active problem solving' and 'self-soothing thoughts') and a passive coping style (based on the subscales 'avoidance', 'depressive reactions' and 'expression of emotions'; Schreurs et al., 1993). In this study the alpha coefficient for active coping style was .84 and for passive coping style .69.

2.3. Statistical analysis

Statistical analyses were performed with SPSS version 24 and R version 3.4.3. There were no missing data given that the assessment on the computer did not allow for missing values.

To identify different BPD subtypes based on reactive and regulative temperament dimensions, we performed a model-based cluster analysis (Fraley & Raftery, 1998) on the standardized BIS/BAS and EC scale scores (i.e., z-scores) using the mclust package version 5.4 (Scrucca et al., 2016). Compared to standard clustering techniques such as hierarchical clustering and k-means, Model-Based Clustering (MBC) allows for more flexible cluster distributions in terms of their volume, shape and orientation. As such, MBC, in general, yields cluster solutions of a higher quality. In particular, MBC fits a mixture of Gaussian distributions to the data and searches for the best model across a predefined set of models that differ in the volume, shape and orientation of their cluster distributions (see Scrucca et al., 2016). In our analysis, ten different models were tested with the number of clusters ranging from one to six (60 models in total). To overcome convergence problems when estimating the parameters of some of these models, we applied a Bayesian regularisation as recommended in Fraley and Raftery (2003). To choose the optimal model, we adopted the Bayesian information criterion (BIC), which balances model fit with model complexity (i.e., number of clusters and complexity of the cluster distributions). We additionally compared the best MBC cluster solution with solutions obtained from the hierarchical cluster analysis and k-means clustering procedure.

To compare the different BPD-subtypes with respect to general clinical symptomatology, BPD specific symptomatology, dissociation and coping styles, we performed a MANOVA with BPD subtypes as independent variable and clinical, BPD symptomatology, dissociation and coping as dependent variables. The association between categorical variables (presence/absence of NSSI) and BPD subtype at baseline were analysed using the Chi-square test statistic.

To investigate the association between the presence/absence of dropout and BPD subtypes we used the Chi-square test statistic. In addition, to evaluate differences in the level of general clinical symptomatology, BPD specific symptomatology, dissociation and two coping styles at baseline and after 3 month of treatment in function of BPD subtype, we performed five repeated measures ANOVA's with time (baseline and 3-months) as within-subject factor, BPD subtype as between-subject factor, and general clinical symptomatology,

BPD symptomatology, dissociation and two coping styles as dependent variables. Partial eta-squared value was reported as a measure of effect size (Cohen, 1988).

To calculate the association between BPD subtype and NSSI throughout time, we used the Chi-Square test statistic. NSSI was coded as follows: 0 = no NSSI baseline - no NSSI 3m; 1 = NSSI baseline - no NSSI 3m; 2 = NSSI baseline - NSSI 3m).

3. Results

3.1. BPD subtype clusters

BIS/BAS and EC scores were analyzed by means of a model-based cluster analysis to identify BPD subtypes. The three best fitting models were: a VVI (diagonal, varying volume and shape) model with 2 components, BIC = -1202.079; a VVV (ellipsoidal, varying volume, shape, and orientation) model with 2 components, BIC = -1205.934 and a VVI (diagonal, varying volume and shape) model with 3 components BIC = -1216.226. The other models all had a worse BIC value (BIC< -1231.189). The two best fitting models (VVI and VVV with two clusters) both clustered the patients into two groups that only differ in the BIS level. As these clusters are not very heterogeneous in terms of temperamental dimensions, which was the goal of our study, we elaborated further on the third best fitting model, the three cluster model (VVI-3). This model resulted in clusters with a more distinguished profile regarding the three temperamental dimensions (BIS/BAS/EC). As, to our opinion, this solution is readily interpretable and clinical more relevant than the best fitting solution, we decided to prefer the VVI model with three clusters over the best fitting VVI2 model. Note that the difference in BIC between both models is rather small. Moreover, the additional analyses with hierarchical and k-means clustering also favored a three-cluster solution.

The three BPD clusters showed substantively different means on the BIS/BAS and EC scale (see Figure 1). The first cluster was identified as the 'Emotional/Disinhibited' subtype (n = 22, 15%), characterized by moderately high scores on BIS, high scores on BAS and low scores on EC. The second cluster was named the 'Low Anxiety subtype' (n = 59, 41%), characterized by very low BIS, average low BAS, and neutral EC scores. The third and last cluster was called the 'Inhibited subtype' (n = 64, 44%), characterized by a high score on BIS, a low score on BAS and moderate score on EC. The patients in the three clusters did significantly differ with regard to gender [$\chi2(2)$ = 10.22, p = .006] with the Low Anxiety subtype containing relatively more males (22% male and 78% female) than the 'Emotional/Disinhibited' (4.5% males) and the Inhibited subtype (4.7% males). There were no significant difference between the three subtypes for age [$F(3,142)$ = .60, p = .55], education [$\chi2(6)$ = 2.96, p = .81], marital status [$\chi2(4)$ = .81, p = .94] and overall medication use [yes/no: $\chi2(2)$ = 1.16, p = .56].

Figure 1. BPD subtypes based on reactive and regulative temperament dimensions in 145 BPD patients.
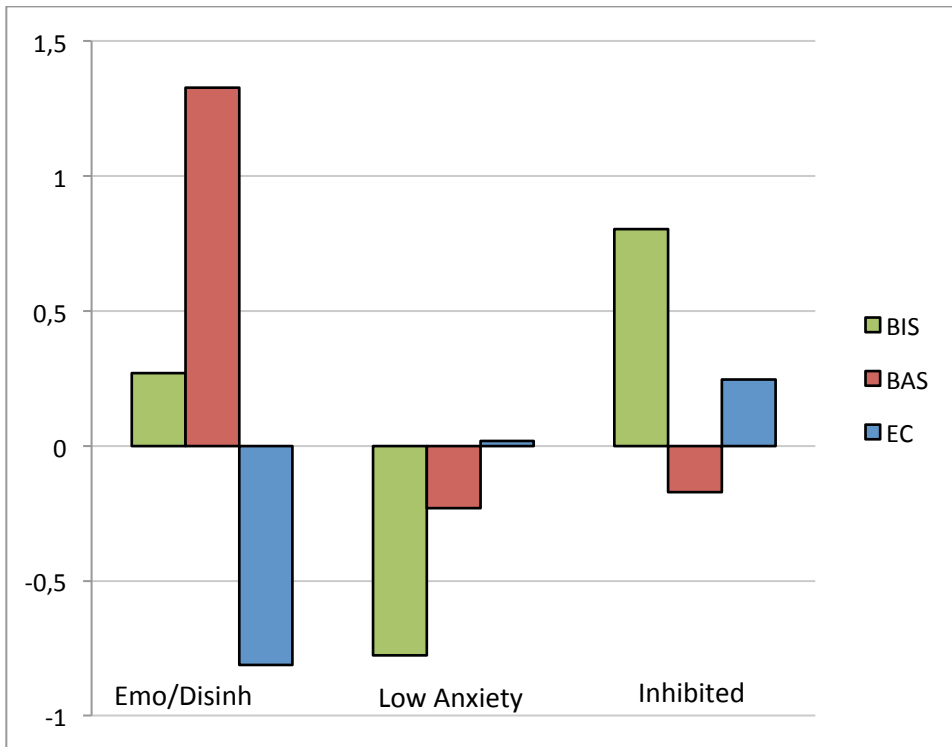
Note. BIS = Behavioural Inhibition System; BAS = Behavioural Activation System; EC = Effortful Control;
BPD Subtypes : Emo/Dis = Emotional/Disinhibited, Low Anx = Low Anxiety, Inh = Inhibited

3.2. Differences in symptomatology and coping of the three BPD subtypes at baseline

Table 2 lists the means and standard deviations of the different measures for each of the three BPD subtypes. The MANOVA showed only significant differences among the three BPD subtypes with respect to dissociation (total DIS-Q). The Emotional/Disinhibited subtype scored significant higher on the DIS-Q compared to the Inhibited subtype (p = .002), with a moderate effect size (partial η^2 = .089).

Table 2. Means (standard deviations) of the self-report scales at baseline for the three BPD subtypes.

	Emotional/ Disinhibited subtype (n=22)	Low Anxiety subtypes (n=59)	Inhibited subtype (n=64)			
	M (SD)	*M (SD)*	*M (SD)*	*F*	partial η^2	Post-hoc comparisons
BSI	123.59 (26.77)	108.78 (38.71)	122.02 (32.3)	2.80	.04	
BSL	50.55 (23.49)	48.78 (21.92)	55.02 (19.09)	1.39	.02	
DIS-Q	199.32 (25.87)	163.97 (42.70)	165.17 (42.32)	6.89*	.09	1<2,3
UCL-ACT	23.23 (7.02)	22.34 (6.19)	22.06 (5.01)	.33	.05	
UCL-PASS	49.23 (5.73)	46. 58 (6.74)	46.56 (6.28)	1.61	.02	

Note. BSI = Brief Symptom Inventory – total score, BSL = Borderline Symptom List – total score; DIS-Q = Dissociation Questionnaire, UCL-ACT = Utrecht Coping List – Active coping style score, UCL-PASS = Utrecht Coping List – Passive coping style score

* *p*<0.05.

There was no significant difference between the three BPD subtypes for presence of lifetime NSSI [Emotional/Disinhibited subtype: 81.8%, Low Anxiety: 84.7%, Inhibited: 79.7%; χ2(2) = .53, p = .765], nor for presence of current NSSI [resp. 51.6%, 61.0%, 36.4%; χ2(2) = 4.02, p = .134].

Finally, the three BPD subtypes showed no significant difference on the UCL active and passive coping styles (resp. p = .72 and p = .20).

3.3. Difference in dropout and treatment response after three months in the three BPD-subtypes

After three months of DBT inpatient treatment, 34.5% (n = 50) of all patients dropped out. There was no significant difference between the three BPD subtypes and the presence/absence of dropout [Emotional/Disinhibited subtype: 27.3% (n = 6), Low Anxiety subtype: 39% (n = 23), and Inhibited subtype: 32.8% (n = 21); χ2(2) = 1.11, p = .573].

Almost 80% of the 95 patients who were still in treatment completed the second measurement (n=75). Table 3 displays the means and standard deviations of the different self-report measures at baseline and after three months of DBT treatment for each of the three BPD subtypes; and Table 4 lists the results of each of the repeated measures ANOVA's.

Table 3. Means (standard deviations) of the self-report scales at baseline (T1) and after 3 months (T2) for the three BPD subtypes.

	Emotional/Disinhibited subtype (n=11)		Low Anxiety subtype (n=27)		Inhibited Subtype (n=37)	
	T1	T2	T1	T2	T1	T2
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
BSI	134.91 (17.77)	93.73 (18.69)	99.37 (33.12)	93.20 (42.70)	125.05 (30.90)	98.81 (41.64)
BSL	63.18 (17.71)	41.33 (14.54)	47.35 (20.28)	42.96 (23.65)	55.35 (19.03)	45.97 (24.14)
DIS-Q	207.82 (29.02)	164.91 (36.70)	154.30 (40.71)	143.59 (38.48)	162.97 (44.70)	146.00 (48.61)
UCL-ACT	24.64 (7.23)	29. 64 (7.70)	21.26 (5.75)	23.56 (5.50)	22. 81 (5.46)	26.81 (5.85)
UCL-PASS	50.18 (5.31)	43.91 (6.09)	45.26 (6.02)	43.19 (6.94)	45.27 (6.68)	42.08 (7.02)

Note. BSI = Brief Symptom Inventory – total score, BSL = Borderline Symptom List – total score; DIS-Q = Dissociation Questionnaire, UCL-ACT = Utrecht Coping List – Active coping style score, UCL-PASS = Utrecht Coping List – Passive coping style score

Table 4. Results for the Repeated Measurement ANOVA with time as within-subject factor, BPD subtype as between-subject factor, and clinical, BPD symptomatology and coping as dependent variables.

	Main effects Time			Main effects Subtype			Interaction effect Time * Subtype		
	$F(1,144)$	p	partial η^2	$F(2,143)$	p	partial η^2	$F(2,143)$	p	partial η^2
BSI	35.78	<.001	.335	2.91	.130	.056	4.96	.010	.123
BSL	21.19	<.001	.243	1.29	.280	.038	3.96	.024	.107
DIS-Q	27.07	<.001	.273	3.79	.027	.088	3.49	.036	.088
UCL-ACT	24.18	<.001	.251	3.65	.031	.092	1.07	.348	.029
UCL-PASS	19.12	<.001	.210	1.51	.227	.040	1.53	.222	.041

Note. BSI = Brief Symptom Inventory – total score, BSL = Borderline Symptom List – total score; DIS-Q = Dissociation Questionnaire, UCL-ACT = Utrecht Coping List – Active coping style score, UCL-PASS = Utrecht Coping List – Passive coping style score

We found significant main effects of time for all the self-report measures. The results clearly showed a decrease in general clinical symptomatology (BSI), borderline specific symptomatology (BSL), dissociation (DIS-Q) and passive coping style (UCL-PASS); and a significant increase in active coping style (UCL-ACT) from baseline till three month after DBT treatment with all large effect sizes (ranging from partial η^2 = .210 to .335).

Additionally, a significant interaction effect of time by BPD subtype was observed for BSI (p = .010) and BSL (p = .024) with large effect sizes (resp. partial η^2 = 0.123 and 0.107), and DIS-Q (p = .036) with a moderate effect size (partial η^2 = 0.088), see Table 4. Figures 2, 3 and 4 respectively illustrate the progress of general clinical symptoms, borderline specific symptoms and dissociation in the three BPD subtypes after three months of DBT treatment.

Figure 2. Reduction of general clinical symptoms after 3 months DBT treatment for the three BPD subtypes
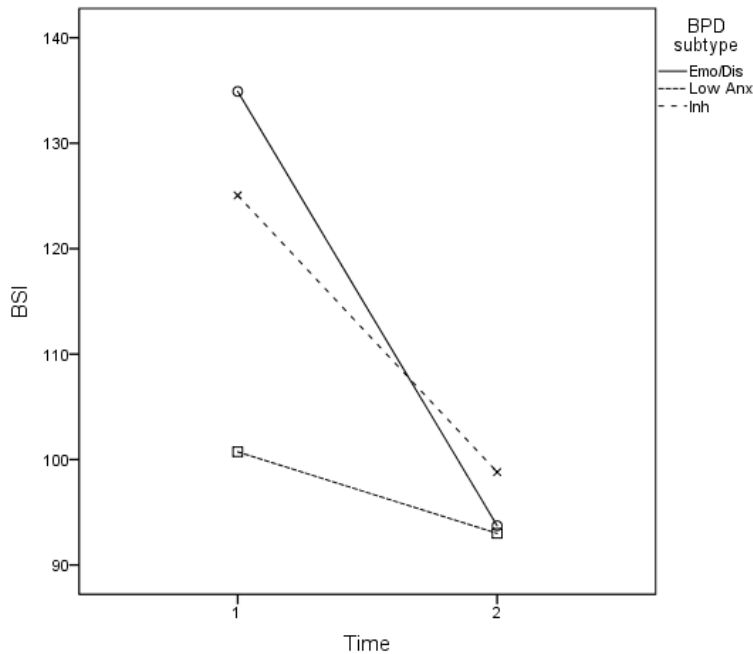
Note: BSI = Brief Symptom Inventory, T1 = baseline; T2 : after 3 months DBT inpatient treatment;
BPD Subtypes : Emo/Dis = Emotional/Disinhibited, Low Anx = Low Anxiety, Inh = Inhibited

65

Figure 3. Reduction of borderline specific symptoms after 3 months DBT treatment for the three BPD subtypes
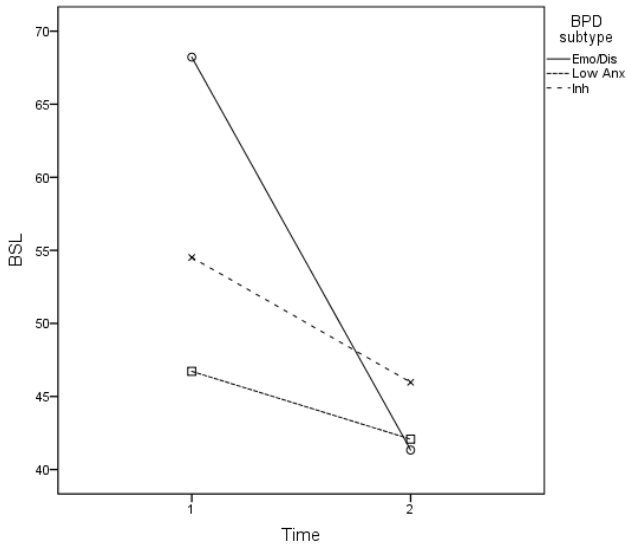
Note: BSL = Borderline Symptom List, T1 = baseline; T2 : after 3 months DBT inpatient treatment;
BPD Subtypes : Emo/Dis = Emotional/Disinhibited, Low Anx = Low Anxiety, Inh = Inhibited

Figure 4. Reduction of dissociation symptoms after 3 months DBT treatment for the three BPD subtypes

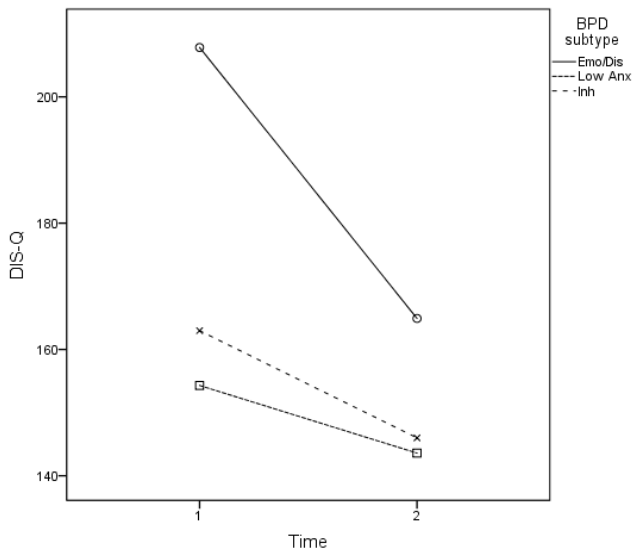Note: DIS-Q = Dissociation Questionnaire, T1 = baseline; T2 : after 3 months DBT inpatient treatment ;
BPD Subtypes : Emo/Dis = Emotional/Disinhibited, Low Anx = Low Anxiety, Inh = Inhibited

Since the interaction effect of time by subtype was significant for BSI (clinical symptoms), BSL (borderline symptoms) and DIS-Q (dissociation), we investigated time effect (baseline - 3 months) on the different symptom measures within each subtype using paired samples t-tests. For the Emotional/Disinhibited subtype, a significant decrease was found for BSI [t(10) = 5.97, p = .000], BSL [t(10) = 4.35, p = .002] and DIS-Q [t(10) = 2.75, p = .021]. For the Low Anxiety subtype, no significant difference was found in symptom measurements between baseline and 3 months (BSI [t(26) = 1.46, p = .156], BSL [t(26) = 1.15, p = .260], DIS-Q [t(26) = 1.77, p = .088]). For the Inhibited subtype, a significant decrease was found for BSI [t(36) = 4.36, p = .000], BSL [t(36) = 2.38, p = .023] and DIS-Q [t(36) = 3.41, p = .002].

In addition, no significant interaction effects of "time by subtype" were demonstrated for UCL active and passive coping style (resp. p = .35 and p = .22).

Finally, of all BPD patients who engaged in NSSI at baseline, 60.0% of the Emotional/Disinhibited subtype, 60.9% of the Low Anxiety and 62.5% of the Inhibited reported the absence of current NSSI at 3 months follow-up. Analysing the trajectory on current NSSI from baseline to 3 months after treatment for the three subtypes, revealed no difference in NSSI trajectory between the BPD subtypes [χ2(4) = 4.97, p = 0.290], indicating that the different subtypes showed the same improvement for NSSI.

4. Discussion

The aim of the present study was to confirm the existence of BPD subtypes based on temperament, to validate them in terms of symptomatology and coping, and to investigate their differences in treatment response after 3 months of DBT inpatient treatment. To replicate previously identified BPD subtypes, we performed a model-based cluster analysis on reactive and regulative temperament dimensions in a sample of 145 BPD patients who were treated at a DBT unit. We identified three subtypes, the 'Emotional/Disinhibited', 'Low Anxiety', and 'Inhibited' subtypes, demonstrating the same characteristics as the three dominant subtypes found in a previous study using a hierarchical cluster analysis and k-means clustering procedure (see Sleuwaegen et al., 2017). The fourth and smallest cluster found in the previous study, namely the 'High Self-control subtype' (characterized by high scores on EC and moderately high scores on BIS and BAS) was not found in this sample. In this sample, the Inhibited subtype is also characterized by low levels of BAS reactivity (low reward sensitive) and moderate effortful control, however a higher level of BIS was demonstrated. The Low Anxiety subtype is characterized by very low levels of BIS reactivity (low punishment sensitive) and low levels of BAS and a mean level of effortful control. The Emotional/Disinhibited subtype is characterized by a high level of BAS, moderate BIS and low effortful control. Patients of the Emotional/Disinhibited subtype reported a higher level of dissociation compared to the other two BPD subtypes. There was no difference in lifetime and current NSSI between the different BPD-subtypes.

The third, and most clinical relevant, aim of this study was to investigate differences in dropout and treatment response of these three BPD subtypes after 3 months of inpatient DBT treatment. Dropout rate in the total sample was 34.5%, however there was no significant difference in amount of dropout between the three BPD subtypes. Trajectory measurement on data of 75 patients who filled out the questionnaires at baseline and after 3 months DBT inpatient treatment, demonstrated a significant reduction in general clinical symptoms, borderline specific and dissociative symptoms with large effect sizes in all BPD subtypes. Moreover, there was a significant interaction effect (time by BPD subtype) on general clinical and borderline specific symptoms and dissociation, explaining a different evolution between the three subtypes on the level of symptomatology. The results demonstrated that, in contrast to the Emotional/Disinhibited subtype and Inhibited subtype, the Low Anxiety subtype did not improve significantly in general clinical and borderline specific symptoms and dissociation. These aforementioned results are in line with a previous study of Kröger et al. (2013), who also reported a reduction in clinical symptoms in almost all patients after a 3-month DBT program, but for borderline-specific symptoms only for half of them.

In the present study, almost 80% of the patients reported to engage in NSSI at baseline and 60% of these patients did not engage in NSSI anymore after 3 months of DBT inpatient treatment. However, the reduction of NSSI over time was not significant and there was no difference in NSSI trajectory between the three BPD subtypes, which is in line with the findings of Digre et al. (2009). Finally, concerning coping style, all BPD patients showed an increase in active coping and a decrease in passive coping after three month of treatment. However, there was no evidence for significant differences in coping progress between the three BPD subtypes.

In conclusion, there is a reduction in symptomatology and improvement in coping strategies in all BPD patients. The three subtypes show a different treatment trajectory. Compared to the Emotional/Disinhibited and Inhibited subtypes, the Low Anxiety subtype does not show a significant reduction in symptomatology after 3 months of DBT.

However, our study is not without limitations which need to be taken into account in future studies. The first limitation refers to the short follow-up period of three month of treatment and high dropout rate. Therefore, future studies should try to include more patients followed during a longer time period, to assess the treatment trajectories of different BPD subtypes. A second limitation is the fact that the data were collected in a specialized DBT unit, over-represented by female and medicated patients, which makes the sample not representative for the general BPD population. As a third limitation, all baseline/outcome assessments were solely based on self-report measures, with the known limitations (Mc Donald, 2008). In addition, since we have only patients with BPD in the sample, the associations between the temperamental dimensions may not be representative for other samples.

In conclusion, the present study confirms the existence of BPD subtypes based on reactive and regulative temperament. Furthermore, in addition to the finding that all subtypes show significant improvement in level of symptomatology and coping after three months of DBT inpatient treatment, this study provides evidence for trajectory differences on general clinical and borderline specific symptoms and dissociation between the three subtypes. The Low Anxiety subtype does not demonstrate a reduction in symptomatology compared to the two other subtypes. This finding is an incentive for future research on the trajectory of BPD subtypes based on temperament, in larger samples and with longer follow-up periods. The conclusions may guide treatment choices and/or the development of subtype-tailored treatment in the future, which would be of clinical and social benefit.

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Chapter 5

The relationship between non-suicidal self-injury and alexithymia in borderline personality disorder: "Actions instead of words"

Abstract

Borderline personality disorder (BPD) is a serious mental illness that centers on the inability to effectively regulate emotions. A large amount of BPD patients engage in non-suicidal self-injury (NSSI). Given the NSSI contributes to serious health risks, it is important to know why some BPD patients engage in NSSI and others do not. A possible associated factor of NSSI in BPD may be alexithymia, which reflects difficulties in identifying and communicating feelings. Therefore the aim of the present study was to investigate whether NSSI was associated with alexithymia and whether this association still stood when controlling for gender and depression. The current study explored the relationship between NSSI and alexithymia in 185 BPD patients by means of the Self-Injury Questionnaire-Treatment Related and the Toronto Alexithymia Scale-20 (TAS). Of the 185 BPD inpatients, 82.7% reported life-time NSSI, of whom 52.9% were still engaging in current NSSI; and 71.3% scored in the alexithymic range (cut-off score ≥ 61). Current NSSI was significantly associated with TAS-total. Additionally, when considering the separate TAS subscales Difficulties Describing Feelings (DDF), Difficulties Identifying Feelings (DIF) and Externally Oriented Thinking (EOT), only DDF was significantly associated with NSSI, even after controlling for gender and depression. These results suggest that NSSI in BPD patients is associated with alexithymia. More specific, difficulties describing feelings can lead to NSSI, independently of the depressive status of the BPD patient. The implications for clinical treatment of self-injurious BPD patients will be discussed.

1.   Introduction

The essential feature of the borderline personality disorder (BPD) is a pervasive pattern of instability in emotions, as well as impulsivity (APA, 2013). The inability to regulate emotions has been identified as the core feature of BPD (Crowell et al., 2009), and underlies many associated behaviors of BPD, including non-suicidal self-injury (NSSI) (In-Albon et al., 2013). In both, BPD patients and patients with NSSI, alexithymia or the incapacity to identify and communicate about emotions, is frequently described (Chapman et al., 2006; Klonsky et al., 2009; Norman et al., 2015). Therefore, it could be hypothesized that alexithymia is related to NSSI in BPD patients, however empirical evidence is needed to confirm this.

More than 70% of BPD patients report a history of multiple episodes of NSSI and the use of multiple methods of NSSI (Zanarini et al., 2008). NSSI can pose serious health risks, like the risk for severe tissue damage and a higher risk for suicidal behavior (Klonsky et al., 2013) and death by suicide (Hawton et al., 2007). NSSI is often implicated in the high levels of health care utilization among individuals with BPD (Zanarini, 2009). NSSI is defined as the repetitive, deliberate, direct, and socially unaccepted destruction or alteration of one's own body tissue without the intent to die (APA, 2013). Common methods of NSSI in BPD are cutting, scratching, burning, and hitting oneself as well as head-banging. More than 90% of the BPD patients use more than one method to engage in NSSI, with an average number of four methods (Kleindienst et al., 2008). Research indicates that NSSI can be considered as a dysfunctional emotion-regulation strategy (Klonsky et al., 2009). This is particularly true for individuals with BPD, of whom more than 95% engage in NSSI for emotional relief (Brown et al., 2002) or to communicate with or influence others (Nock, 2009). It still is unclear why some BPD patients engage in NSSI and other do not use this maladaptive strategy. Understanding the factors that contribute to NSSI can be an essential component in defining targets for the treatment of NSSI in BPD patients. A possible contributing factor of NSSI is the difficulties with describing emotions, as already suggested in 1981 by Doctors (1981) who related NSSI with difficulties in verbal expression of emotions. The inability to describe emotions with words is also known as alexithymia, literally "no words for emotions". The definition of alexithymia according to Taylor et al. (1997) includes three main factors: 1) difficulties identifying feelings and distinguishing between feelings and the body sensations of emotional arousal (DIF), 2) difficulties describing and verbalizing feelings to others (DDF), and 3) an externally oriented thinking style (EOT) (e.g., Taylor et al., 1997, 2013). Alexithymia, has been described in different psychiatric populations including BPD. For example, in a meta-analysis of Derks et al. (2016), a moderate positive relationship between Borderline Personality Pathology and alexithymia was demonstrated. The strongest associations were found between BPD and two alexithymia factors 'difficulties in identifying feelings' and 'difficulties describing feelings'. Six studies investigating alexithymia in BPD patients by means of the Toronto Alexithymia Scale (cut-off > 65) (Bagby et al., 1994), and all reported a high prevalence rate of alexithymia ranging from 65 to 80% (Andersen et al., 2012; Deborde et al., 2012; Domes et al., 2011; Guttman, 2002; Laos et al., 2012; New et al., 2012).

Previous studies have reported a positive association between alexithymia and NSSI (e.g., Lüdtke et al., 2016), but not yet in a BPD sample. In a systematic review of fifteen studies (7 studies in community and 8 in clinical samples) concerning the relationship between alexithymia and NSSI, Norman et al. (2015) reported that all studies found significantly higher levels of alexithymia (more specifically difficulties identifying and describing feelings) among individuals with NSSI compared to individuals without NSSI, a significant correlation between alexithymia and NSSI and/or alexithymia as a significant predictor of NSSI. In sum, Norman et al. (2015) stipulated that there is evidence that alexithymic individuals, who struggle to understand and communicate their feelings, might engage in NSSI to regulate their emotions, particularly in females. However, for men the results were less conclusive. For example, in students and addicted patients no differences in alexithymia were found between males with and without NSSI. Furthermore, in adolescent samples depression was found to be a partially or fully mediator between alexithymia and NSSI. So, it is suggested to investigate the link between NSSI and alexithymia in males too and also to integrate the role of confounding variables, such as depression, which may explain the relationship between alexithymia and NSSI (Norman et al., 2015).

Surprisingly, to our knowledge, no research so far has explored differences in alexithymia in BPD patients with and without NSSI. This is peculiar since NSSI and also alexithymia is highly prevalent in this patient group. Additionally, treatment for BPD patients usually focus on explicit emotion awareness and communicating emotions, as for example in Dialectic Behavior Therapy (DBT; Linehan, 1993). For this reason it seems important to know the relationship between alexithymia and explicitly difficulties identifying and/or describing feelings and the current NSSI engagement in a BPD inpatient population to get a more specific target in treatment. Therefore, the aims of the present study was threefold: (1) to describe NSSI and alexithymia characteristics in an inpatient BPD sample and to look at their interrelation, their correlation with depression and differences between gender (2) to investigate if current NSSI is associated with the alexithymia total score and if so, which alexithymia factor score would be most strongly associated with NSSI (3) to investigate if current NSSI is still associated with alexithymia total and factor scores after controlling for gender and depression, because of the inconsistency in effect of gender and the confounding effect of depression on the relationship between alexithymia and NSSI [4]. Although this study was exploratory in nature, several hypotheses were developed based on prior research. First, we expected a high prevalence of life-time and current NSSI and alexithymia in the BPD inpatients. Further, we expected positive correlations between current NSSI and total alexithymia and more specifically with the factors difficulties identifying feelings and difficulties describing feelings based on previous studies (Norman et al., 2015). Second, we hypothesized that current NSSI would be associated with total alexithymia and that this would be mostly explained by the factors difficulties identifying and difficulties describing feelings. This would mean that BPD patients who have the most difficulties with the identification and verbalization of emotions would engage the most in NSSI compared to the BPD patients who can identify and express their feelings verbally. Third, we hypothesized that

the association between current NSSI and total alexithymia and also by difficulties identifying and describing feelings would still stand after control for gender and depression.

2. Methods

2.1. Participants and procedure

Data from 185 inpatients with BPD were recruited, between 2014 and 2016, in two specialized treatment units for BPD in Belgium. Both units provide inpatient-treatment based on the principles of Dialectical Behavior Therapy, involving the four standard DBT modules with individual DBT psychotherapy twice a week, weekly DBT skills group training, 24-h coaching and therapist consultation team (Linehan, 1993). Patients admitted in the units need a normal intelligence to participate in the DBT program, and a current substance abuse or symptoms of a psychotic disorder are considered as exclusion criteria. During the first weeks of admission, all patients, were informed about the study and invited to participate. After providing written informed consent, patients received the questionnaires on paper or were asked to fill them out on a computer in the clinic or at home. Patients were included in the study when they fulfilled the diagnosis of BPD. Of the total sample of 185, 150 patients met the BPD diagnosis as assessed by means of the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II, First et al., 1997; Dutch translation Weertman et al., 2000) and cross-validated with the self-report Assessment of DSM-IV Personality Disorders - Borderline scale (ADP-IV; Schotte et al., 1994) to confirm the diagnosis. The other 35 patients were included solely based on the BPD diagnosis as assessed by means of the ADP-IV self-report ratings, i.e. they fulfilled at least 5 out of the 9 BPD diagnostic criteria according to the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) (APA, 2000).

All patients included in the study were Caucasian, between 18 and 64 years of age, and were allowed to be under pharmacological treatment. The study was developed in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the allied University and the local ethical committees of the participating hospitals. Participants did not receive any remuneration, however, they could receive individual feedback concerning their own test result.

2.2. Measures

The Borderline Personality Disorder was assessed by means of the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II, First et al., 1997; Dutch translation, Weertman et al., 2000). Inter-rater reliability of the SCID-II ranges from .90 to .98 for dimensional judgments and internal consistency coefficients range from .71 to .94 (Maffei et al., 1997).

The Borderline Personality Disorder and other personality disorders were assessed by means of the Assessment of DSM-IV Personality Disorders (ADP-IV) (Schotte et al., 1994), a 94-item Dutch self-report questionnaire used to assess the presence and severity of

symptoms related to the 10 personality disorders defined in the DSM-IV-TR (APA, 2000). Items on the ADP-IV are rated first for the degree to which the traits apply to the respondent (1='totally disagree' to 7='totally agree'). For items that are rated as relevant at a moderate or higher level (score 5 till 7), participants also rated the degree to which that trait results in problems or distress for the respondent or others (1='not at all', 3='most certainly'). A categorical rating of a PD disorder can be obtained according to the DSM-IV threshold (APA, 2000), by counting the number of items (i.e., criteria) that are scored at least 5 on the trait scale and at least 2 on the distress scale (Trait>4, Distress>1). Dimensional scores can be computed by summing the Trait scores on the individual items for each PD scale. The dimensional ADP-IV scales display acceptable internal consistency values, with Cronbach's alphas ranging from .64 to .88 and shows good convergent validity with the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II) (SCID; First, et al., 1997; Weertman et al., 2000; Schotte et al, 2004).. The alpha coefficient for all the PD dimensional scores in the present study ranged from α = .61 (schizoid PD) to α = .84 (paranoid PD), with α = .63 for BPD. Schotte et al. (2004) indicated that the ADP-IV-Borderline scale showed acceptable concordance with the Structured Clinical Interview for DSM–IV Axis II borderline personality disorder section (SCID-II – Borderline section), for the BPD dimensional score (Pearson correlation = 0.57) and for the categorical diagnosis (kappa= 0.54) (Schotte et al., 2004).

Clinical symptomatology was assessed by means of the translated Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983; translated into Dutch by de Beurs et al., 2005). The BSI consists of 53 items, to be rated on a four-point Likert-style scale ranging from 0 ('not at all') to 4 ('extremely'). Besides a global severity index (BSI – total), the BSI provides 9 symptom scales, being somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism. In previous studies, the BSI has demonstrated good psychometric properties, showing satisfactory indexes of internal consistency and test-retest reliability, with internal reliability coefficients showing an average rating above .70 for the scales and the range for test-retest reliability .68 to .91 (Derogatis, 1993). In the present study, the BSI scales demonstrated acceptable internal consistency coefficients (except for psychoticism, α = .46), ranging from α = .69 (paranoid thinking) to α = .84 (depression) and α = .90 for BSI–total.

Non-suicidal self-injury was assessed by means of the Self-Injury Questionnaire-Treatment Related (SIQ-TR; Claes & Vandereycken 2007). Participants had to answer whether they had ever engaged in self-injury without suicidal intention (yes/no format), and if yes, to indicate if they had engaged in scraping, scratching, cutting, bruising, burning, pricking or head banging and if they currently engage in NSSI. The age of onset of NSSI and frequency of NSSI (1-5 days/during the last year, 6-10, 11-15, more than 15) were assessed. NSSI Versatility, which can be considered as a measure of NSSI severity, was calculated by counting the number of different methods endorsed, ranging from 1 to 7. The localization of NSSI on the body (e.g., head, arms) was also assessed. In addition, functionality of NSSI was investigated by means of 18 function items to be rated on 5 point Likert scale. Designed

specifically for use in clinical populations, the reliability and validity of the measure have been demonstrated in clinical groups (Claes & Vandereycken, 2007). The alpha coefficient of the different types of NSSI was 0.62 in a previous study (Claes & Vandereycken, 2007) and 0.61 in our sample.

Alexithymia was assessed by means of the Toronto Alexithymia Scale – 20 (TAS-20; Bagby et al., 1994), a standardized self-report questionnaire to assess the presence and severity of the alexithymia construct. The questionnaire included 20 items to be rated on a 5-point Likert scale ranging from 1 ('strongly disagree') to 5 ('strongly agree'); assessing the total and three alexithymia factors, being Difficulty Describing Feelings (DDF), Difficulty Identifying Feelings (DIF), and Externally Oriented Thinking (EOT). Research using the TAS-20 demonstrates adequate levels of reliability and discriminant, convergent, and concurrent validity (Boyle et al., 2014). The present sample showed adequate alpha coefficients, except for EOT, which was similar to earlier studies (Nowakowski et al., 2013), with total TAS-score: α = .83, DDF: α = .79, DIF: α = .81 and EOT: α = .48.

2.3. Statistical analysis

Statistical analyses were performed with SPSS – version 23. There were no missing data given that the assessment on the computer did not allow for missing values and given that the paper and pencil questionnaires were checked for missing data. To describe the characteristics of NSSI and alexithymia features (aim 1), multiple descriptive statistics were used. To detect differences in NSSI lifetime between gender the Chi-square test statistic was used. T-tests were used to compare different NSSI features (versatility, frequency, methods) and also alexithymia features (TAS – Total, DDF, DIF, EOT) between females and males. Multivariate analysis of variance's (MANOVA) with Wilks Lambda was used to detect differences between gender in functions of NSSI. To detect differences in gender, educational level, marital status and medication between BPD patients with and without current NSSI the Chi-square test statistic was used. T-tests were used to detect differences in clinical symptoms (BSI) and comorbid personality disorders (ADP-IV) between BPD patients with and without current NSSI. In addition, to evaluate the interrelation between NSSI and alexithymia features and their correlation with depression, Pearson's correlations were calculated. For the second aim, binary logistic regressions were used to examine whether and to what extent first total TAS-20 score and next the three TAS-subscale scores were associated with current NSSI. Also for the third aim, hierarchical binary logistic regression models were used to investigate whether and to what extent first total TAS-20 score and next the three TAS-subscale scores were associated with current NSSI above and beyond gender and depression. Analysis were conducted to ensure no violation of the assumption of collinearity in the regression analyses and indicated that multi-collinearity was not a concern.

3. Results

3.1. BPD sample characteristics

The sample of 185 BPD patients consisted of 160 females (86.5%) and 25 males (13.5%). The mean age of the sample was 30.03 years (*SD* = 8.62, range 18 to 62). Of the 185 BPD patients 17%, (*n* = 31) followed lower secondary education; 58.9% (*n* = 109) higher secondary education, and 24.3% (*n* = 45) high school or university. Most of the BPD patients (67.6%, *n* = 125) were single, 21.6% (*n* = 40) were living together/married, or 10.8% (*n* = 20) were divorced. There was no significant relationship between gender for education [χ2 (2) = .90, *p* = .636]; however marital status was significant related to gender [χ2 (2) = 6.72, *p* = .035], with more females being single and males being divorced. Concerning medication use, data was available of 175 patients of whom 78.6% used medication (60.5% antidepressants, 42.2% antipsychotics, 11% anxiolytics and 8.7% mood stabilizers).

3.2. NSSI in the BPD sample

Of the 185 BPD inpatients, 82.7% (*n*=153) reported to have engaged in at least one type of NSSI behavior during their life-time, with no differences in function of gender [χ2 (1) = 0.03, *p* = .85]. All the characteristics of the different NSSI features and differences between men and women who reported life-time NSSI can be seen in Table 1.

Table 1. Characteristics of NSSI features of 185 BPD patients (153 with lifetime NSSI) (numbers and percentages).

NSSI Characteristics	Total NSSI sample n=153 (of n=185; 82.7%)	Females with NSSI n=132 (of n=160; 82.5%)	Males with NSSI n=21 (of n=25; 84%)	Difference	
	n (%)	*n (%)*	*n (%)*	χ^2	*p*
Current NSSI	81 (52.9)	68 (51.5)	13 (61,9)	0.78	.37
Methods					
Scraping	85 (556)	75 (56.8)	10 (47.6)	0.62	.434
Scratching/abrading	98 (64.1)	84 (63.6)	14 (66.7)	0.07	.790
Cutting	113 (73.9)	99 (75.0)	14 (66.7)	0.65	.423
Bruising	80 (52.3)	69 (52.3)	11 (52.4)	0.01	.993
Burning	51 (33.3)	46 (34.8)	5 (23.8)	0.99	.320
Pricking	52 (34.0)	44 (33.3)	8 (38.1)	0.18	.671
Head banging	62 (40.5)	53 (40.2)	9 (42.9)	0.05	.816
Body parts injured					
Arms, hands, fingers	127 (83)	111 (84.1)	16 (64)	0.80	.374
Legs, feet, toes	39 (25.5)	36 (27.3)	3 (14.3)	1.60	.207
Belly, torso, thights	38 (24.8)	32 (24.2)	6 (28.6)	0.18	.672
Head, neck	35(22.9)	34 (25.8)	1 (4.8)	4.53	.001
Genitals, breasts	5 (3.3)	5 (3.8)	0	0.82	.368

Note. Phi = measure of degree of association

NSSI Characteristics	Total NSSI sample *n*=153	Females with NSSI *n*=132	Males with NSSI *n*=21
Frequency (days last year)			
0	27 (17.6)	25 (18.9)	2 (9.5)
1-5	26 (17.0)	22 (16.7)	4 (19)
6-10	10 (6.5)	9 (6.8)	1 (4.8)
11-15	11 (7.2)	10 (7.6)	1 (4.8)
More than 15	79 (51.6)	66 (50)	13 (61.9)
Total numbers of methods			
1 method	34 (22.4)	31 (23.5)	3 (14.3)
2 methods	27 (17.6)	21 (15.9)	6 (28.6)
3 methods	24 (15.8)	19 (14.4)	5 (23.8)
4 methods	28 (18.4)	26 (19.7)	2 (9.5)
5 methods	25 (16.5)	21 (15.9)	4 (19)
6 methods	15 (9.9)	14 (10.6)	6 (4.8)

Severe cutting, superficial cutting, scratching/abrading and hitting oneself were the most prevalent NSSI methods used. Looking at the NSSI methods, 22% just used one method, the others used several methods, with a mean NSSI versatility (severity) of 3.23 (*SD* = 1.69), with no gender differences [*t*(150) = 0.42, *ns*]. The mean age of NSSI onset was 16.5 years (*SD*= 7.2, range 4-45 years), with females [*M* (*SD*) = 15.95 (6.22)] being significant younger than males when starting with NSSI [*M* (*SD*) = 19.81 (11.45); *t*(150) = -2.30, *p* = .023]. Assessing frequency, 17.5 % of the BPD patients reported that they did not engage in NSSI during the last year, half of the patients reported to engage in NSSI more than 15 days during the last year, and the others between 1 and 15 days. The body parts that were most often injured included the arms (83%), followed by the chest, legs, head and neck. The five most reported functions of NSSI are in descending order 'to avoid or suppress negative feelings' (*M* = 3.91, *SD* = 1.24), 'self-punishment' (*M* =3.54, *SD* = 1.55), 'to avoid negative images or memories' (*M* = 3.42, *SD* = 1.47), 'to avoid feelings of emptiness' (*M* = 3.35, *SD* = 1.38) and 'to escape from a numb state' (*M* = 3.23, *SD* = 1.43), with no significant overall gender variation [Wilks Lambda = 0.99, *F*(5,146) = 0.31, *p* = 0.91].

3.3. Characteristics of the BPD sample with life-time NSSI

Of all patients ever engaging in NSSI (*n*=153), more than half of them (52.9%, *n*=81) were still engaging in NSSI at the moment of assessment (current NSSI). Table 2 displays the means (standard deviations) and percentages and the comparisons between the characteristics of BPD patients with and without current NSSI. Overall, both groups did not significantly differ with regard to gender, age, educational level, marital status and medication use. However, patients with current NSSI scored significant higher on some clinical symptoms (interpersonal sensitivity, depression, anxiety, phobic anxiety, paranoid ideation and psychoticism) and comorbid personality disorders (schizoid, avoidant,

dependent and obsessive-compulsive disorder-dimensions) compared to patients without current NSSI (see Table 2).

Table 2. Demographic and clinical information of BPD patients with/without current NSSI (n=153)

	Current NSSI	No current NSSI	Difference		
	n=81	n=72	χ^2(df)	*p*	Phi
Gender – Female (%)	84.0	88.9	0.03 (1)	.854	.014
Education (%)			0.68 (2)	.713	.067
Lower secondary	17.3	18.1			
Higher secondary	59.3	63.9			
High School/ University	23.4	15.3			
Marital status (%)			5.43 (2)	.066	.188
Single	65.4	70.8			
Living together/ Married	28.4	15.3			
Divorced	6.2	13.9			
Medication (%)	85.9	74.6	3.49 (1)	.062	.155
Antidepressants	66.7	56.9	1.27 (1)	.259	.094
Antipsychotics	46.2	43.3	0.18 (1)	.671	.035
Anxiolytics	14.1	11.9	0.17 (1)	.675	.035
Mood Stabilizers	10.3	7.5	0.38 (1)	.539	.051

	Current NSSI n=81	No current NSSI n=72			
	M (SD)	*M(SD)*	*t*	*p*	Cohen's *d*
Age	27.99 (8.3)	30.49 (7.9)	1.89	.060	.308
BSI-TOT	114.54 (34.1)	100.61 (29.9)	-2.63	.008	.434
BSI-SOM	11.49 (6.8)	11.56 (5.6)	0.06	.952	.011
BSI-COG	15.53 (4.9)	14.00 (5.0)	-1.90	.059	.309
BSI-INT	11.70 (3.3)	9.56 (3.4)	-3.95	.000	.638
BSI-DEP	17.63 (4.9)	15.51 (5.0)	-2.64	.009	.428
BSI-ANX	15.46 (5.2)	13.74 (5.0)	-2.07	.040	.337
BSI-HOS	8.73 (5.1)	7.97 (5.0)	-0.92	.361	.150
BSI-FOB	10.89 (4.7)	8.50 (4.7)	-3.13	.002	.508
BSI-PAR	11.10 (4.5)	9.65 (3.9)	-2.08	.039	.344
BSI-PSY	12.01 (4.0)	10.13 (3.2)	-3.17	.002	.519
ADP-TOT	281.74 (52.7)	265.93 (50.6)	-1.90	.059	.306
ADP-BDL	57.96 (7.3)	54.65 (7.4)	-2.77	.006	.450
ADP-PAR	31.35 (10.2)	29.50 (8.4)	-1.21	.228	.198
ADP-SZ	24.57 (8.1)	21.92 (5.7)	-2.34	.021	.378
ADP-ST	36.74 (10.2)	36.19 (10.4)	-0.32	.744	.053
ADP-AS	24.91 (9.1)	24.44 (8.6)	-0.32	.745	.053
ADP-HIS	31.91 (8.9)	33.13 (8.7)	0.84	.399	.138
ADP-NAR	25.00 (10.1)	25.06 (9.0)	0.03	.972	.006
ADP-AV	36.04 (7.5)	30.72 (7.9)	-4.24	.000	.690
ADP-DEP	36.72 (8.2)	33.97 (8.7)	-1.99	.048	.325
ADP-OC	34.51 (8.1)	31.00 (8.2)	-2.65	.009	.430
ADP-DE	35.79 (7.4)	34.14 (10.1)	-1.16	.249	.186
ADP-PA	27.02 (8.7)	25.25 (7.1)	-1.38	.169	.223

Note. M = Mean; SD = Standard Deviation; Phi = measure of degree of association; BSI = Brief Symptom Inventory SOM = somatization; O-C = obsessive-compulsive; I-S = interpersonal sensitivity; DEP = depression; ANX = anxiety; HOS = hostility; FOB = phobic Anxiety; PAR = paranoid ideation; PSY = psychoticism. ADP = Assessment of DSM-IV Personality Disorders (dimensional scores); BDL = borderline ; PAR = paranoid; SZ = schizoid; ST = schizotypal; AS = antisocial; HIS = histrionic; NAR = narcissistic; AV = Avoidant; DEP = dependent; OC = obsessive-compulsive; DE = depressive; PA = passive-aggressive personality disorder.

3.4. Alexithymia in the BPD sample

Using the alexithymia cut-off score (≥61) for the TAS-20 [18], 71.3% (*n*=132) of the BPD inpatients were found to be alexithymic. The mean total TAS score was 65.66 (*SD* = 11.6), DDF 19.51 (*SD* = 4.3), DIF 25.85 (*SD* = 5.7) and EOT 20.3 (*SD* = 4.6) and was unrelated to gender [resp. $t(183) = -0.49$, $p = 0.62$; $t(183) = -0.80$, $p = .030$; $t(183) = -0.48$, $p = 0.63$; $t(183) = 0.12$, $p = 0.90$].

3.5. Associations between depression, NSSI features and alexithymia

Depression was positively related with current NSSI (r = .17; p <.05). Table 3 lists the correlations between depression and NSSI features and alexithymia.

Table 3. Bivariate correlations among alexithymia and NSSI and depression (n = 185 BPD patients)

	TAS - total	TAS - DDF	TAS - DIF	TAS - EOT	NSSI versatility	NSSI frequency	DEP
TAS - total	-	0.86**	0.86**	0.64**	0.10	0.08	0.27**
TAS - DDF		-	0.72**	0.32**	0.13	0.16*	0.24**
TAS - DIF			-	0.26**	0.12	0.06	0.26**
TAS - EOT				-	-0.01	-0.04	0.15*
NSSI versatility					-	0.32**	0.26**
NSSI frequency						-	0.23**
DEP							-

Note: TAS-total = Toronto Alexithymia Scale total score; TAS-DDF = difficulty describing feelings; TAS-DIF = difficulty identifying feelings; TAS-EOT = externally oriented thinking; NSSI versatility/frequency = versatility/frequency of non-suicidal self-injury; DEP = BSI - Depression scale
* p < .05; ** p < .01.

Positive correlations were found between depression and NSSI versatility (r = .26; p <.01) and frequency of NSSI (r = .23; p <.01). Positive correlations were also found between depression and TAS-total (r = .27; p <.01), DIF (r = .26; p <.01), DDF (r = .24; p <.01) and EOT *(r = .15; p <.05). In addition, frequency of NSSI was positive correlated with DDF (r = .16; p <.05).

3.6. Current NSSI is associated with total alexithymia and by alexithymia factors

First, logistic regression analysis was performed with current NSSI as dependent variable and total TAS-20 score as independent variable (see Table 4). Total TAS-20 score seems to have a significant positive association with current NSSI [Exp(B) = 1.03, p = .041]. Next, we estimated a logistic regression with current NSSI as dependent variable and the three TAS-subscale scores of DDF, DIF and EOT as independent variables to investigate which subscale had the strongest association with current NSSI, when all subscales were entered simultaneously (see Table 4). This analysis revealed that only difficulties describing feelings had a significant positive association with current NSSI [Exp(B) = 1.16, p = .017].

Table 4. Logistic Regression Analysis with TAS-total/TAS-subscales as independent variables and the presence/absence of current NSSI as dependent variable (n=153)

Current NSSI	β	*SE* β	odds ratio	95% CI
R^2=.028 (Cox &Snell), R^2=.038 (Nagelkerke)				
TAS - total	.03*	.01	1.03	1.00-1.06
R^2=.057 (Cox &Snell), R^2=.076 (Nagelkerke)				
TAS - DDF	.15*	.06	1.15	1.03-1.30
TAS - DIF	-.03	.04	.97	.89-1.06
TAS - EOT	-.01	.04	.98	.91-1.06

Note: TAS-TOT = Toronto Alexithymia Scale total score; TAS-DDF = difficulty describing feelings; TAS-DIF = difficulty identifying feelings; TAS-EOT = externally oriented thinking; Depression = BSI Depression scale; * *p* < .05; ** *p* < .01.

3.7. Current NSSI is associated with alexithymia controlled for gender and depression

Next, using a hierarchical logistic regression analysis, we estimated the association between TAS scores and current NSSI, also controlling for gender and depression (see Table 5).

Table 5. Hierarchical Logistic Regression Analysis with TAS-total/TAS-subscales as independent variables and the presence/absence of current NSSI as dependent variable controlling for gender and depression (n=153)

Current NSSI	β	*SE* β	odds ratio	95% CI
Step 1 R^2=.005 (Cox &Snell), R^2=.005 (Nagelkerke)				
Gender	.42	.48	1.53	.59-3.93
Step 2 R^2=.046 (Cox &Snell), R^2=.062 (Nagelkerke)				
Gender	.57	.49	1.77	.67-4.68
Depression	**.52***	**.21**	**1.68**	**1.11-2.55**
Step 3 R^2=.059 (Cox &Snell), R^2=.079 (Nagelkerke)				
Gender	.53	.50	1.70	.64-4.52
Depression	**.44***	**.22**	**1.56**	**1.01-2.40**
TAS - total	.02	.01	1.02	.99-1.05
Step 1 R^2=.005 (Cox &Snell), R^2=.005 (Nagelkerke)				
Gender	.42	.48	1.53	.59-3.93
Step 2 R^2=.046 (Cox &Snell), R^2=.062 (Nagelkerke)				
Gender	.57	.49	1.77	.67-4.68
Depression	**.52***	**.21**	**1.68**	**1.11-2.55**
Step 3 R^2=.087 (Cox &Snell), R^2=.115 (Nagelkerke)				
Gender	.52	.50	1.69	.63-4.50
Depression	**.45***	**.22**	**1.57**	**1.01-2.48**
TAS - DDF	**.14***	**.06**	**1.15**	**1.02-1.30**
TAS - DIF	-.04	.04	.96	.88-1.05
TAS - EOT	-.02	.04	.98	.91-1.05

Note: TAS-TOT = Toronto Alexithymia Scale total score; TAS-DDF = difficulty describing feelings; TAS-DIF = difficulty identifying feelings; TAS-EOT = externally oriented thinking; Depression = BSI Depression scale; * $p < .05$; ** $p < .01$.

In the first step, we added gender as independent variable. In the second step, we added depression, and in the last step we entered the total TAS-20 score. This first analysis revealed that gender had no significant association with NSSI [Exp(B) = 1.53, p = .378] in contrast to depression [Exp(B) = 1.68, p = .014]. The total TAS-20 significant did not have an association with current NSSI above and beyond gender and depression [Exp(B) = 1.02, p = .153]. The same analysis was used to investigate the influence of the TAS-20 subscales in the association with current NSSI after control for gender and depression. This second analysis, showed that DDF did remain significant associated with current NSSI [Exp(B) = 1.15, p = .023] after control for gender and depression.

4.   Discussion

In this study, our main aim was to investigate the relationship between NSSI, alexithymia and depression in a sample of 185 BPD inpatients. First, we hypothesized that the majority of the BPD patients would have a high level of NSSI and alexithymia. Not surprisingly more than four out of five patients reported NSSI during lifetime, and half of them still engaged in current NSSI, which is comparable with other studies (e.g., Zanarini et al., 2008). In the present sample 71.3% of the BPD patients were alexithymic, meaning that most of the BPD inpatients have difficulties identifying and communicating their feelings, a prevalence rate which was also found in previous research (see Derks et al., 2016). We found significant correlation between depression and current NSSI, NSSI frequency and NSSI versatility and also with all alexithymia scales. The frequency at which patients engage in NSSI was also positive correlated with difficulties describing feelings. So for this BPD sample, difficulties in verbally expressing emotions and finding the right words to describe feelings seems to be linked with depression and also with an increased tendency to engage in NSSI.

Regarding the second research question, current NSSI seems to be associated with alexithymia. This main finding suggests that if BPD patients are confused about their feelings and have problems to give words to them, they are more likely to engage in NSSI. More specific, it is the subscale difficulties describing which is most associated with current NSSI. So, in BPD inpatients particular the problems with the verbalization and communication about emotions and not the identification or distinguishing of them seems to be related to the engagement in NSSI. Difficulties describing emotions is related to inhibited emotional expression and consistent with ambivalence over emotional expression (Lumley, 2004), which may lead to NSSI instead of the verbally communication of feelings 'actions instead of words'. These finding also support previous studies, which show that low levels of reflective functioning or hypo-mentalisation (often related to alexithymia), are associated with NSSI (Badoud et al., 2015).

Negative affectivity such as depression seems to be linked to alexithymia (Marchesi et al., 2014), as also shown by the results in our sample. Furthermore, since depression might mediate the association between alexithymia and NSSI (Garisch et al., 2010; Lambert et al. 2007), we took depression into account. We investigated whether current NSSI is associated with total alexithymia score and by the three TAS-subscale scores above and beyond gender and depression. Our results revealed that the subscale difficulties describing feelings is still associated with current NSSI even after controlling for gender and depression. This findings suggests that the main problem, namely problems with verbalizing and communicating feelings, can lead to NSSI, independently of the depressive status of the BPD patient.

The results emphasize the importance of targeting emotion regulation by improving alexithymia, and specifically to express feelings in an adaptive way. Therefore, it is not surprisingly that all evidence-based treatments for BPD such as DBT (Linehan, 1993), mentalisation-based therapy (MBT; Bateman & Fonagy, 2006) and transference focused

psychotherapy (TFP; Clarkin et al., 2006) focus on the improvement of emotion regulation. In DBT the first step to increase emotion regulation skills is learning to observe and describe one's own emotions and react to the emotions in a more constructive way instead of engaging in NSSI (Bohus et al., 2004; Fleischaker et al., 2011; McKay et al., 2007). The act of labeling an emotional experience in itself decreases the intensity of that emotion, meaning this is a powerful emotion regulation function and may help to prevent the perceived need to engage in NSSI (Zaki et al., 2013). Fortunately, patients with alexithymia have been shown to benefit from psychotherapeutic treatment and to be able to improve their emotional processing (Ogrodniczuk et al., 2011), so emotion regulation skills training to identify, but even more important, to verbalize the emotions can be an important value in treating NSSI in BPD patients. Follow-up assessment during DBT-training is set up to investigate the impact of skill-training on alexithymia in BPD patients and to test this assumption.

Several limitations of our study should be mentioned. First, the key limitation of this study is its exclusive reliance on self-report measures with its well-known advantages and disadvantages, such as response biases, a distorted or lack of self-knowledge (McDonald, 2008). So, although the use of self-report measures is a meaningful start to investigate this topic, future research using a wider range of measurements, such as structured interviews or observer's rating scales to have a more detailed assessment of Axis-I and Axis-II diagnoses, and alexithymia. Additionally, we did not include an intelligence measure of our BPD patients, given that a normal IQ was a prerequisite to be included in the study. However, future studies could include a standardize measured of intelligence to take IQ into account. Second, although the study population is a large sample with 'real-world' inpatients diagnosed with BPD, the majority was female and the male sample consisted of only 25 males. It should also be kept in mind that most of the patients were under medication, which may influence self-reporting. This context limits generalization to other BPD patients. In addition, unfortunately, it is not possible, in the absence of longitudinal data, to make conclusions about the causality of the relation between alexithymia, difficulties describing feelings, depression and NSSI. Longitudinal studies are needed to establish the nature of these interactions.

In conclusion, the results of this study confirm that most BPD inpatients engage in NSSI and are alexithymic. Above this, it suggests that BPD patients who have problems describing and verbalizing their feelings have the tendency to engage in NSSI and this independently from the depressive status. So, in therapy focus on the identification of emotions is needed, but even more important is the improvement of the communication about the emotions in a more adaptive way.

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Chapter 6

General discussion

1. Discussion of the main findings

In this final chapter, I will discuss the main findings of our studies, discuss the strengths and the limitations and formulate suggestions for future research. The discussion will be finalized with the clinical implications of this project.

In clinic practice, it is most striking how much variability there is in presentation and treatment response of patients with a borderline personality disorder (BPD). This is even so in the inpatient psychiatric unit where I work - 'de Spinnaker' – where thirty (almost all) 'borderline' patients are treated according to dialectical behavior therapy (DBT; Linehan, 1993). In addition, we notice a high level of dropout and different treatment response during and after DBT treatment in this population. Also in research investigating BPD samples, heterogeneity has become a hindrance to achieve clear findings. As discussed in the general introduction of the current PhD thesis (**Chapter 1**), the current diagnosis of BPD according to DSM-5 (APA, 2013) criteria, and corresponding treatments are often inadequate because of the variability and heterogeneity of the patients. Indeed, previous research in BPD samples demonstrate a dropout amount of approximately one out of four and only in one out of two a marked improvement in general psychopathology (see **Chapter 1**). In most specialized psychiatric units evidence based treatment is provided in group by means of a standard protocol as a 'one size fits all' approach. However, in this context, it seems worthwhile investigating patients groups with common features guiding the development of interventions. A possible answer could be to delineate BPD subtypes and tailor treatment towards these subtypes to optimize treatment effect. Therefore, the overall aim of this PhD thesis was to disentangle the heterogeneity in patients with BPD, by identifying clinical meaningful BPD subtypes. The findings may have important implications for the development of novel interventions and specific treatment approaches for patients with BPD. Tailoring interventions to clinically relevant subtypes in psychiatric populations has already been proposed as a strategy for improving treatment response (NIMH, 2008).

In last decades, evidence has shown that in samples of patients with a BPD diagnosis according to DSM criteria, different BPD subtypes can be differentiated (e.g., Bradley et al., 2005; Conklin et al., 2006; Critchfield et al., 2008). However, previous studies searching for BPD subtypes used different methodologies, theoretical models and statistical procedures in order to define the subtypes. At first, BPD subtypes were based on clinical observations and theoretical postulations (e.g., Linehan, 1993; Millon & Davis, 1996). On a theoretical basis Millon and Davis (1996) hypothesized a 'discouraged' subtype characterized by avoidant, dependent features and unexpressed anger, an 'impulsive' subtype being thrill-seeking and manipulative, a 'self-destructive' subtype characterized by depressive features and attention seeking and reckless behavior and a 'petulant' subtype described by negativistic features and an explosive temper. Next, subtypes were identified on empirical grounds. The research group of Bradley et al. (2005) and Conklin et al. (2006) identified subtypes based on clinician-rated affect experience and regulation. In an adult sample, they identified three subtypes, a 'histrionic' subtype with the tendency to express emotions in an exaggerated manner, to

attach quickly and act impulsively; an 'internalizing' subtype with intense dysphoria; and an 'externalizing' subtype demonstrating intense anger and blame others (Bradley et al., 2005). This research group identified similar subtypes in adolescents (Conklin et al., 2006). Other studies have approached BPD subtypes using different variables in the context of different theories, such as interpersonal theories, and Kernberg's model of borderline personality organization (Lenzenweger et al., 2008, Liehener et al., 2003). Of importance in the context of our study, Critchfield et al. (2008) identified three BPD subtypes based on co-occurring personality disorder criteria, a 'cluster A' with schizotypal and paranoid features, a 'cluster B' with narcissistic and histrionic features and a 'cluster C' with avoidant, obsessive compulsive features.

However, these aforementioned and other studies investigating BPD subtypes were limited by ratings from single clinicians, the use of solely self-report measures, restricted statistical methodology and/or small sample sizes. In the light of the recent ongoing research on alternative models of personality, encouraged by the DSM-5 Section III dimensional trait model (APA, 2013), it seems warranted to focus on dimensional traits. In DSM-5, there is a shifting towards a more dimensional conceptualization of psychopathology, and DSM-5 Section III proposes an Alternative Model on Personality Disorders (AMPD, Skodol et al. 2015). This AMPD is an alternative hybrid dimensional-categorical model in which a distinguish is made between criterion A defining the severity of impairment and criterion B presenting a trait model listing pathological personality traits. This trait model is based upon and informed by other important trait models of personality and personality pathology that can be seen as consensual (Widiger & Simonsen, 2005; Wright et al, 2012). The trait model resulted in five pathological higher order domains, namely negative affect, detachment, antagonism, disinhibition and psychoticism (APA, 2013; Widiger et al., in press). These DSM-5 maladaptive traits are associated with the five higher order factors of the Five Factor Model (FFM) personality traits, Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness. Indeed, negative affectivity align with Neuroticism, detachment with Introversion, antagonism with low Agreeableness, disinhibition with low Conscientiousness and psychoticism with Openness. Also recently, the Hierarchical Model of Psychopathology (HiTOP; Kotov et al., 2017) is proposed as an alternative for the categorical classification, with at the highest level a general factor of psychopathology, at the second level the broad domains of internalizing, externalizing, and thought disorder (Caspi et al., 2014) and on the third level five domains of detachment, antagonistic externalizing, disinhibited externalizing, thought disorder, and internalizing, which are also associated with the five domains of the DSM-5 Section III dimensional trait model (APA, 2013; Widiger et al., in press).

In addition, associations exist between the abovementioned personality traits and the major domains of temperament, namely reactive and regulative temperament. As described in **Chapter 1** of this thesis, reactive temperament as described by the Reinforcement Sensitivity Theory (RST; Gray, 1982), consists of Behavioral Inhibition system (BIS) or sensitivity to punishment facilitating anxiety; and Behavioral Activation System (BAS) or sensitivity to reward facilitating impulsivity. Regulative temperament or effortful control

(EC) is described by Rothbart (1989) as the capacity to regulate temperamental activity. As such, BIS is often related to FFM Neuroticism, BAS to FFM Extraversion and EC to FFM Conscientiousness (Smits & De Boeck, 2006)

In this context, and as discussed in the introduction of this thesis (**Chapter 1**), temperament dimensions are, in my opinion, key constructs to define BPD subtypes. Therefore we decided in this thesis to identify BPD subtypes based on reactive and regulative temperament, to validate these subtypes based on self-report measures and experimental tasks, and to investigate their treatment trajectories over time.

In what follows, I will further discuss the findings on the identified BPD subtypes, their validation and treatment response in the light of previous studies as well as clinical practice. In addition, it will be demonstrated that our findings can give some input to current trends in research on personality disorders.

1.1. BPD subtypes based on temperament dimensions and their validity

In our first study (**Chapter 2**), we differentiated four BPD subtypes based on hierarchical clustering, the 'Low Anxiety' subtype characterized by a low level of BIS (low punishment sensitivity/low avoidance); the 'Inhibited' subtype demonstrating a low level of BAS (low reward sensitivity/low approach); the 'High Self-control' subtype characterized by a high level of effortful control; and the 'Emotional/Disinhibited' subtype demonstrating a high level of BIS and BAS and a low level of effortful control. In addition, we validated the four BPD subtypes by comparing them with respect to five higher order traits of the Five Factor Model (FFM). The Inhibited and Emotional/Disinhibited subtype (high BIS) demonstrated the highest level of Neuroticism, in comparison to the Low Anxiety subtype (low BIS) with a significant lower level of Neuroticism. The High Self-control subtype (high EC) was characterized by the highest level of Conscientiousness. The Inhibited subtype (low BAS) demonstrated low levels of Extraversion as well. Furthermore, our identified BPD subtypes clearly resemble the four BPD subtypes based on the FFM traits as described by Frias et al. (2017). Frias' 'Self-sufficient subtype' was characterized by high Neuroticism and low Extraversion, and resembles our Inhibited subtype; the 'Suspicious subtype' was characterized by low Extraversion and high Openness, corresponding to our Emotional/Disinhibited subtype; the 'Hostile subtype' showed low Neuroticism, Agreeableness and Conscientiousness, and resembles our Low Anxiety subtype and finally, Frias' 'Dependent subtype' was characterized by high Conscientiousness, Extraversion, Agreeableness, and corresponds with our High Self-control subtype.

Additionally, BPD subtypes are only meaningful, when the subtypes can be by differentiated by means of clinical characteristics and if they show different treatment trajectories.

In **Chapter 2**, we investigated differences between the four different BPD subtypes on clinical, borderline-specific symptomatology, personality disorder (PD) features and

coping. Significant differences were found in clinical symptomatology, personality features and coping. In summary, it seems that patients of the Low Anxiety subtype (low BIS) have lower levels of anxiety and interpersonal sensitivity, have more cluster B antisocial PD features and use expression of emotions and their feelings of tension and anger and seek distraction as coping strategies. Patients of the Inhibited subtype (low BAS) experience multiple clinical symptoms, but are more internalizing with corresponding cluster C PD features and the tendency to keep their feelings for themselves. Patients of the Emotional/Disinhibited subtype (low EC), the 'prototypical' BPD patients with the highest level of cluster B PD features, are more externalizing, express their feelings of depressiveness and anger, seek social support because they can not self-sooth themselves. In contrast, patients of the High Self-control subtype (high EC) report the lowest level of symptomatology, and comorbid PD features, and use more adaptive coping strategies.

In addition, we were also interested in potential differences between the four BPD subtypes in suicidal threats/attempts, non-suicidal self-injury (NSSI) and use of drugs, since these characteristics are important features of treatment. These maladaptive behaviors are considered as dysfunctional emotion regulation strategies (Klonsky et al., 2009.) In DBT suicidal and parasuicidal behaviors have the highest priority in the hierarchy of treatment. The goals of DBT include the reduction and ending of suicidal behavior and parasuicidal behaviors, such as NSSI and destructive substance use.

Comparing the four BPD subtypes on these features, revealed some interesting findings, not reported in previous chapters. Not surprising, patients of the Emotional/Disinhibited subtype (low EC) report high numbers of suicidal threats/attempts, life-time NSSI, use of drugs. Patients of the High Self-control subtype, in contrast, report the fewest suicidal threats/attempts, life-time NSSI as compared to patients of the other subtypes. Most interesting, our results demonstrated that patients of the Inhibited subtype (low BAS) seem to engage more often in current NSSI (NSSI in period of assessment), and have the highest NSSI severity level (amount of different methods used) and less in the use of drug, compared to the patients of the other subtypes. In addition, patients of the Low Anxiety subtype (low BIS) report almost the same high amount of suicidal threats/attempts as patients of the Emotional/Disinhibited subtype. In my opinion, these characteristics extend the description of the BPD subtypes in an important clinical way to guide interventions according to BPD subtype.

Besides differences between the BPD subtypes in psychopathological characteristics, based on self-report questionnaires, we were also interested in comparing these subtypes by means of indirect measures of reactive and regulative tendencies. This is clearly an added value, since all previous research only used direct measurements. Indirect measurements such as measures to capture behavior responses and reaction times are recommended (see **Chapter 1**). In **Chapter 3** we focused on emotion processing, consisting of emotional sensitivity and emotional reactivity, since previous studies demonstrate inconclusive results in

patients with BPD and suggested that differences in emotional processing could depend on subtypes in BPD samples (e.g., Portella et al., 2011; Rosenthal et al., 2008).

In **Chapter 3** we explored differences in emotion processing, more specific in emotional action tendencies, measured with the Approach-Avoidance Task (AAT) and in attentional bias towards emotional stimuli, measured with the Emotional Stroop Task (EST) between the four BPD subtypes identified in **Chapter 2**, i.e., the Low Anxiety (low BIS), the Inhibited (low BAS), the High Self-control (High EC) and the Emotional/Disinhibited (lo EC) subtype.

The results of this study revealed no significant differences between the four BPD subtypes in approach-avoidance tendencies (AAT) and in attentional bias (EST). This was surprising, since Portella et al. (2011) demonstrated slower EST performance in patients with higher severity of BPD psychopathology compared to moderate-severe BPD patients. Although the differences between the four subtypes were not significant, we still compared AAT and EST performances of the Emotional/Disinhibited and the High Self-control subtype, due to their extreme levels in effortful control. Previous research has already demonstrated evidence that BPD patients with a lower level of effortful control demonstrated worse performance on experimental tasks measuring emotional processing compared to patients with BPD having a higher level of effortful control (Posner et al., 2003; Preti et al., 2016). When comparing the High Self-control subtype (high EC) and the Emotional/Disinhibited subtype (low EC), we indeed found differences in approach-avoidance tendencies on emotional faces with direct gaze. The High Self-control subtype showed altered approach-avoidance tendencies on emotional faces with direct gaze, compared to the Emotional/Disinhibited. This finding could be interpreted as a sign that the BPD subtype with a higher level of effortful control has a higher tendency to approach happy faces and avoid angry faces, which is a more 'normal' reaction, compared to a subtype with a lower level of effortful control. So, this is in line with the results reported by Posner et al. (2003) and Preti et al. (2016). In addition, a new study by Bertsch et al. (2018) comparing AAT performance in an MRI scanner, between anger-prone patients with BPD and healthy controls, revealed comparable findings. In their study, anger-prone patients with BPD reported higher tendencies to act out anger, and were also faster in approaching than avoiding angry faces. So, angry-prone patients with BPD, seem less tended to avoid rather than approach signals of interpersonal threats, similar to our Emotional/Disinhibited subtype with the lowest level of effortful control (Bertsch et al., 2018). So, not only differences in response to emotional stimuli may be observed between BPD patients and healthy controls, but also between different BPD subtypes.

Additionally, we aimed to replicate our former identified BPD subtypes. We performed a model-based clustering in another BPD sample in our third study (**Chapter 4**). In **Chapter 4** the three largest subtypes of the four BPD subtypes previously found, namely the Low Anxiety, the Inhibited and the Emotional/Disinhibited subtype were replicated, providing evidence for these three major BPD subtypes.

1.2. BPD subtypes based on temperament dimensions and previous identified subtypes

To provide a general overview of our three identified major BPD subtypes found in both BPD subtypes studies (**Chapter 2** and **4**), in the context of previous BPD subtype research, we provide a succinct description of the temperament profiles of our BPD subtypes and some corresponding BPD subtypes identified by other authors.

1) Patients of the **Low Anxiety subtype** are characterized by low levels of BIS reactivity, low levels of anxiety, impulsivity, anger, and high antisocial PD features. This subtype clearly resembles BPD subtypes from previous studies. Millon and Davis (1996) theoretical hypothesized an 'Impulsive' subtype being thrill-seeking and manipulative. In the research group of Bradley et al. (2005, 2006) clinicians also described an 'Angry externalizing' and 'Externalizing-dysregulated' subtype and based on the FFM traits Frias et al. (2017) identified a 'Hostile' characterized by resembling characteristics.

2) Patients of the **Inhibited subtype** are characterized by low levels of BAS reactivity and moderate levels of BIS and effortful control. They suffer from multiple clinical symptoms, but are more internalizing, less impulsive and less likely to communicate their emotions, confirmed by cluster C, avoidant PD features. The profile of the Inhibited subtype resembles the 'Discouraged' subtype by Millon and Davis (1996), characterized by avoidant, dependent features and unexpressed anger; also the group of Bradley et al. (2005, 2006) identified a 'Depressive internalizing' and 'Internalizing-dysregulated' subtype, Critchfield et al. (2008) found a 'Cluster C' BPD subtype and Frias et al. (2017) described a 'Suspicious' subtype demonstrating cluster C features.

3) Patients of the **Emotional/Disinhibited subtype** are characterized by high levels of BIS and BAS reactivity and very low levels of effortful control. These patients are most characterized by intense emotions and disinhibition/impulsivity 'severe' symptomatology and histrionic features and demonstrate altered emotional action tendencies. This profile can be found in most BPD subtype studies, on a theoretical basis Millon and Davis (1996) hypothesized a 'Petulant' subtype described by negativistic features and an explosive temper; the research group of Bradley et al. (2005, 2006) similarly identified a 'Histrionic' and 'Histrionic-impulsive' type was identified; and based on comorbid PD features Critchfield et al. (2008) identified a 'Cluster B' BPD subtype.

Taking these evaluations together, there seems some support for three existing BPD subtypes or sub-dimensions demonstrating psychopathological differences grounded on differences in temperament profile. Another predominant finding of our BPD subtype research is the distinction between subtypes characterized by internalizing and by externalizing features. As also suggested by Smits et al. (2017), an internalizing-externalizing

dimension might be a key factor in the heterogeneity of BPD. In our study, the Inhibited subtype seems clearly associated with an Internalizing style (high BIS/Neuroticism, low BAS/Extraversion), the Low Anxiety subtype demonstrates components of the Externalizing style and the Emotional/Disihhibited subtype seems associated with an Externalizing style (high BAS/Extraversion, low EC/ Conscientiousness).

1.3. BPD subtypes and their treatment trajectory

As mentioned earlier (**Chapter 1**), BPD subtypes are only meaningful when they can be differentiated by means of clinical characteristics and if they show different treatment trajectories in such a way that we can tailor treatment towards the different BPD subtypes. In spite of a large theoretical interest in how BPD subtypes may indicate different treatment trajectories, studies with pre-post treatment measures in BPD subtypes are scarce (e.g., Linehan, 1993; Oldham, 2006). Therefore, the major aim of **Chapter 4** was to investigate differences in dropout rate, clinical symptomatology, borderline-specific symptomatology and coping of BPD subtypes after 3 months of inpatient DBT treatment at 'de Spinnaker'.

Our study did not reveal significant differences in the amount of dropout between the three BPD subtypes after 3 months. On the contrary, we did find significant differences in evolution of general clinical and borderline specific symptoms and dissociation between the three different BPD subtypes. The results showed that, in contrast to the Emotional/Disinhibited subtype and Inhibited subtype, the Low Anxiety subtype did not improve significantly in general clinical and borderline specific symptoms and dissociation after 3 months of inpatient DBT treatment.

To explain the different treatment responses between the Low Anxiety subtype and the two other subtypes, a few explanations can be put forward. The first explanation may be that patients of the low anxiety subtype (with antisocial tendencies) have a more biased responding on self-report measures focusing on symptomatology (Widiger et al., 1998). In future, measurements on interpersonal problems and observer's rating scales may provide more information. A second possible explanation is that patients of the Low Anxiety cluster do improve due to DBT, but that their improvement is not detected by the self-report outcome measures that were used in our study. And finally, perhaps the characteristics of these patients of the Low Anxiety subtype, i.e. a low BIS and antisocial features, are contra-indicative for DBT inpatient treatment and need alternative treatments (see clinical implications). Especially this last assumption should be interpreted with caution, and needs replication in future research.

To conclude, it seems that the three BPD subtype show a differential response to our 3 months DBT inpatient treatment. Patients of the Inhibited and Emotional/Disinhibited subtype demonstrate a better evolution than patients of the Low Anxiety subtype.

1.4. Effortful Control and psychopathology and emotion processing in BPD

When comparing the BPD subtypes in emotional action tendencies (AAT) and attentional bias towards emotional stimuli (EST), another question arose concerning the relationship between the three temperament dimensions (BIS/BAS/EC) and emotional action tendencies and attentional bias. In most research on the relationship between self-reported temperament dimensions and experimental tasks no correlations are found (e.g., Claes et al., 2012; Kobeleva et al., 2014). In our study, a positive relationship was demonstrated between the level of effortful control and emotional action tendencies (AAT) to faces with a direct gaze, even when controlling for gender, age and BPD severity (**Chapter 3**). This finding suggests that BPD patients with a higher level of effortful control show a better preferential response towards emotional interpersonal cues. Accordingly, a recent study by De Panfidis et al. (2015) has proven that effortful control is involved in connecting rejection sensitivity (RS) to BPD features. This study indicated that a high level of effortful control might allow high rejection sensitivity people to overcome their automatic tendencies to make immediate defensive overreactions that are typical of BPD (i.e., behavioral and emotional dysregulation). All these findings provide evidence that a lower level of effortful control may be related to more complicated emotional acting, intrusive interpersonal problems and interpersonal distress (Cain et al., 2013; Radke et al., 2014).

In sum, our findings suggest that especially the level of effortful control may be important in both overall general functioning in BPD and emotion processing. In general, current theories of psychopathology emphasize the role of effortful control, regarded as a major domain of cognitive functioning, as a protective factor and a risk factor for psychopathology across lifespan (Nigg, 2006; NIMH RDoC, 2012). In contrast to the extensive research on effortful control in children and adolescents, studies in adults and clinical samples are scarce. On the other hand, broad research is done on similar concepts such as self-regulation, self-control, cognitive control and executive functioning. These features are used interchangeably, however there are arguments for both differences and similarities between them (Nigg, 2016). We argue for the inclusion of effortful control measures in future research and in clinical practice. The three dimensions of effortful control, namely the abilities to voluntarily manage attention (attentional regulation) and inhibit (inhibitory control) or activate behavior as needed to adapt (activational control), seem promising avenues to investigate in patients with BPD. In my opinion, patients with BPD can benefit from the knowledge of their level of functioning on the three dimensions of effortful control and the transposition to DBT skills. When patients have difficulties to manage their attention, mindfulness skills training can be recommended to increase attentional regulation. Previous research indicates that mindfulness training modifies and strengthens attention, such as enhancing the ability to voluntarily shift focus of attention (e.g., Hölzel et al., 2011). New studies, including this important dimension in this field of research, as for example in outcome research, may be very interesting.

1.5. Alexithymia and NSSI in BPD

In clinical practice, it strucked me how many patients with BPD experience difficulties in describing their emotions. When asking a patient with BPD at the beginning of treatment to define her/his feelings a standard answer is 'bad' or 'I don't know'. This inability to identify and communicate about emotions, is called alexithymia, which consists of difficulties identifying and describing feelings; and an externally oriented thinking style (Taylor et al., 1997). Previous research reports high levels of alexithymia in patients with BPD (e.g., Andersen et al., 2012). In addition, most patients with BPD engage in NSSI (Zanarini et al., 2008). An important question, not answered yet, was if there is a relationship between alexithymia and NSSI in BPD patients. So, the aim of the last study (**Chapter 5**) was to explore whether NSSI in BPD patients is associated with alexithymia even after controlling for gender and depression.

Our study replicated the high prevalence rates of life-time NSSI (83%) and current NSSI (53%) with high severity (an average use of almost four different methods of NSSI) in inpatients with BPD (Kleindienst et al.2008; Zanarini et al., 2008). In addition, we also found a high prevalence of alexithymia (72%) in the BPD sample, which is comparable with other studies (Derks et al., 2016).

Most importantly, our results showed that current NSSI is associated with alexithymia, and more specific with the dimension "difficulties describing feelings". So, it is not the distinguishing or identification of existing feelings that are related to NSSI, but the problem with verbalizing and communicating the existing feelings. Additionally, we found that this relationship also subsisted after controlling for gender and depression. Meaning that, independently of the gender and depressive status of the BPD patient, problems with describing emotions is linked to NSSI.

In sum, the results of this study show that patients who have the largest difficulties with the verbalization of emotions will engage more often in NSSI compared to the BPD patients who can identify and express their feelings verbally, independent of gender and depressive symptoms. So, these findings highlight again the importance of targeting emotion regulation, especially the verbalization of emotions in treatment. So, we have to motivate BPD patients to move to 'words instead of actions'. DBT provides emotion regulation skills, such as the understanding of emotions, cope ahead and opposite action, which increase emotional resiliency. From clinical experience and empirical studies (Linehan, 2015), it is clear that most patients with BPD benefit from this skill module; insight in the function of emotion and differentiating them is eye opening, although also perceived as the most difficult and 'intense' skill module. A remaining question is whether the level of alexithymia will increase while the level of NSSI decreases during and after DBT inpatient treatment. Although in our clinical view this seems obvious, it is worthwhile investigating it.

1.6. Strengths and limitations

The design of this PhD study project was a longitudinal design, assessing reactive and regulative temperament dimensions, clinical symptomatology, personality disorder features and coping every three months during 6 or 9 months of DBT treatment. The findings of the present PhD thesis provide an extension of previous knowledge on BPD subtypes. There are several strengths of our studies, which are worth mentioning.

A first strength is the sample size of our studies. We included, in all studies, around 150 patients with BPD, which is not for granted in this domain of research. A second strength is the specificity of the samples, since all studies were conducted in one or two specialized DBT settings. A third strength is the uniformity of the assessment of the patients with an interview administered by the same researcher, self-report questionnaires and experimental tasks.

However, in addition to the strengths of the studies, several shortcomings on the level of participants, assessment and design, need to be considered when interpreting our findings.

Participants

A first limitation is the sample size of our BPD subtypes in the studies. Although we had large sample sizes of BPD patients, when clustering, the sample sizes of each subtype were rather small, which restricted the statistical power to detect significant differences. However, such sample sizes are not uncommon in studies of BPD (e.g., Verheul et al., 2003).

A second limitation, concerned the generalizability of our findings to other patients with BPD. Our sample consists of inpatients with BPD with more severe dysfunctioning compared to patients with BPD who are not hospitalized. In addition, as in most BPD research, our sample was characterized by an overrepresentation of female patients (on average about 85%) and most of them were using medication (on average about of 85%). All these characteristics influence self-reporting and performance on experimental tasks and therefore can influence the representativeness of our sample.

Assessment

Although we combined self-report measures and experimental tasks, a limitation was the predominant reliance on self-reports. The cluster analyses in Chapter 1 and Chapter 2 were based on self-reported temperament. Also the assessment of symptomatology and coping in all studies was based on self-report questionnaires. This approach is consistent with most studies relating to personality disorders (e.g., Rosenthal et al., 2008), however it is a disadvantage because of response biases, memory errors, a distorted or lack of self-knowledge (Ebner-Priemer et al., 2006, Mc Donald, 2008, Tourangeau, 2000). Information of the problems that patients experience through self-report scores is only valid to the extent

that patients are aware of the difficulties they experience (Lundh et al., 2002). Especially the investigation of features as alexithymia (Chapter 3) with the TAS-20 can be limited by the fact that people with alexithymia, by definition, have difficulties to report their psychological state.

Design

An additional limitation concerns the cross-sectional designs of three studies (Chapter 2, 3, and 5) included in this PhD thesis. So, we are not able to draw conclusions about the causality of the relationship between temperament dimensions and emotional action tendencies and attentional bias as reported in Chapter 3; and the relationship between alexithymia, depression and NSSI as described in Chapter 5. In addition, the longitudinal study described in Chapter 4, only reports on the response after three months, due to missing data after 6 months of treatment. So, the questions about stability and response of the BPD subtypes on a longer term are not yet answered.

1.7. Future research avenues

Future research should therefore investigate the stability, validity and clinical utility of the clusters identified in this study project.

Participants

An interesting direction for future research is the investigation of temperament profiles within non-hospitalized patients with BPD, but also individuals with and without other personality disorders and psychopathology (for example patients with anxiety disorders, depression and healthy controls). Since former studies (see introduction) identified comparable subtypes in other clinical samples, it would be worthwhile to review the differences and similarities and aggregate these findings.

Assessment

It is suggested that future studies should incorporate multiple assessment techniques, such as structured interviews, observer's rating scales and/or experimental tasks. We believe that in future research a mixed method approach (quantitative and qualitative study) and multi-informant approach would have an added value to investigate clinically relevant features of BPD and BPD subtypes. In addition, basic science methodologies, such as laboratory bio-behavioral measures (including neuroimaging and psychophysiological measures), could also be of interest (Rosenthal et al., 2008).

Design

Of course, the replication of our subtype-study in larger samples and for a longer follow-up period during and after treatment is a must. Longitudinal data could shed more

light into the stability/instability of the temperament profiles and the treatment trajectories over time.

1.8. Clinical implications

In sum, the findings of the present thesis demonstrate the validity of three different BPD subtypes and offer some insight in treatment trajectories of these subtypes. We are convinced that these findings can bear already some benefits for the diagnosis and treatment of patients with BPD, which will be discussed below.

On the diagnostic level, it is advisable to not only assess a BPD diagnosis according to the DSM-5, section II classification, but also to assess the underlying temperament/ personality dimensions to create a more specific profile of the individual patient with BPD. This approach is also in line with the recommendations in DSM-5 Section III (APA, 2013). As discussed in the first section of this discussion, Criterion B of the Alternative Model for Personality Disorders was constructed with the idea that these pathological personality traits would replace the diagnostic criteria used in DSM-IV/DSM-5, Section II. For each specific PD, the model specifies the traits that should be elevated in order to meet criteria for diagnosis. To diagnose a borderline personality disorder, these domains and traits are Negative Affectivity, (characterized by Emotional lability, Anxiousness, Separation insecurity and Depressivity), Disinhibition (characterized by impulsivity and risk taking), and Antagonism (characterized by Hostility). Of course, treatment protocols according to present dimensional traits would allow more tailored treatment plans. However, the development of treatment protocols specifically for dimensional traits is still in its infancy. To the best of our knowledge, only empirically validated treatments exist for the treatment of Neuroticism, namely the Unified Protocol (Barlow et al., 2011) and a mindfulness approach (Armstrong & Rimes, 2016).

On the treatment level, we believe that patients with BPD could benefit from more subtype-tailored interventions. Our treatment trajectory study demonstrated that patients of the Emotional/Disinhibited BPD subtype and patients of the Inhibited subtype did improve significantly in symptomatology after 3 months of DBT inpatient treatment. On the contrary, patients of the Low Anxiety subtype, compared to the others, did not make significant progress on the outcome measures. Based on these results, we try to formulate some tentative suggestions.

In our study, it remains unanswered why patients of the Emotional/Disinhibited and Inhibited subtypes did improve and the Low Anxiety subtype did not. There is enough evidence that standard DBT provides an effective intervention targeting emotion regulation for patients with BPD with prominent emotion dysregulation (Linehan et al., 2014). DBT treatment has proven to be effective, especially for patients with high severity of BPD pathology, in borderline-relevant outcomes, suicidal behavior and NSSI and other clinical outcomes, such as dissociation, depression and anxiety (e.g., Kliem et al, 2010). However, there is limited research on the specific mechanisms of change in DBT. Recent research supports that the use of DBT behavioral skills mediates the improvement in suicidal behavior,

expression of anger and interpersonal problems (Neacsiu et al., 2010). With this context in mind, it is not evident to provide answers why some BPD subtypes do progress after DBT, and why others not. However, there are several possible explanations that could elucidate these differences in progress.

First, we found the largest improvement in level of symptomatology in patients of the Emotional/Disinhibited subtype. We already denoted these patients as 'prototypical' patients with BPD or can label them as the 'core BPD' since they are, in underlying temperament, impulsive (high BIS), less self-regulative (low EC), and histrionic. In our opinion, standard DBT, based upon the biosocial theory (Linehan, 1993), was specifically developed for these patients, patients who experience intense emotions and react with impulsivity and extraversion (i.e. suicide threats). During the 3 months of the DBT treatment in our study, patients learned already the 'core mindfulness' and 'distress tolerance skills' by means of weekly group skills training. In addition, they made a treatment target hierarchy, and parasuicidal behavior is monitored by means of diary cards and chain analysis during weekly individual psychotherapy. So, from the beginning our standard DBT treatment places an emphasis on emotion regulation, which is obviously necessary and also proven effectively in our study for this patient subgroup.

Our results also demonstrated that our DBT treatment has a positive influence on patients of the Inhibited subtype as well. Compared to the Emotional/Disinhibited, they are anxious internalizing (high BIS), more self-regulative (high EC) and avoidant. So, it can be suggested to clinicians to encourage this patient group to engage more actively in social contacts, so they can experience more positive reinforcement and emotions, instead of their withdrawn reactions. In our opinion, the DBT core mindfulness skills such as 'being non-judgmental' about themselves and others may be helpful. Another suggestion is that specifically this patient group could also benefit from Radically Open-Dialectical Behavior Therapy (RO-DBT) developed by Lynch et al. (2008, 2015). These authors proposed a modified DBT for the treatment of disorders that share over-control as a determining psychological factor associated with the severity of the symptomatology, such as chronic depression and avoidant personality disorder. In DBT emotion dysregulaton is seen as the core problem, in RO-DBT emotional loneliness secondary to low openness and social-signaling deficits. RO-DBT promotes openness and flexibility in interaction, practice disinhibition, while reducing rigid thinking. In our opinion, this could be effective for the patients of the Inhibited subtype.

Most interesting, our findings demonstrated that, compared to patients of the Emotional/Disinhibited and Inhibited subtype, patients of the Low Anxiety subtype did not improve in symptomatology after 3 months DBT. Those patients, characterized by lower levels of BIS and more antisocial features, seem to report the lowest level of symptomatology at the beginning and after 3 months it seems not to decrease a lot. Since one explanation may be that these patients are less indicated for a DBT inpatient treatment, other suggestions can be made. The first option may be individual psychotherapy, instead of group therapy that may interfere with the incorporation of new learned DBT skills for themselves and others. The

second suggestion is Mentalization-Based Treatment (MBT; Bateman & Fonagy, 2006), which could be indicated for these patients. Previous research on BPD outpatients with comorbid antisocial PD has proven that MBT is successful in improving symptoms related to aggression, anger, hostility, paranoia, frequency of self-harm and suicide attempts, as well as general psychiatric symptoms, interpersonal problems, and social adjustment (Bateman et al., 2016).

A last avenue for future studies is the investigation of the impact of pharmacotherapy on treatment trajectory in BPD subtypes. Although little evidence of efficacy of medication for BPD exists, a targeted approach for specific symptoms is sometimes needed (Starcevic & Janca, 2018). Oldham (2002) proposed five subtypes based on theories of the etiology of BPD, namely the affective, impulsive, aggressive, dependent and empty subtype. He hereby suggested that for each type of BPD, a different combination of psychotherapy and pharmacotherapy is indicated. For the first three types adjunct pharmacotherapy is required, such as selective serotonin reuptake inhibitors until affect regulation and impulse control have stabilized, or low-dose antipsychotics for cognitive-perceptual symptoms. For the last two types reliance on psychotherapy will be greater (Oldham, 2002). However, evidence is still lacking.

1.9. Conclusion

The current PhD thesis provides evidence for the existence of BPD subtypes based on temperament dimensions, characterized by meaningful differential psychopathology characteristics. Additionally, BPD subtypes seem to demonstrate a different treatment response after 3 months of DBT inpatient treatment. The clinical implications of the findings and the evaluation of their benefits are key directions for future research and treatment improvement for patients with BPD.

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Chapter 7

Summary & Nederlandse vertaling

Summary

The aim of the research presented in this thesis was to investigate borderline personality disorder (BPD) subtypes based on reactive and regulative temperament. We developed a clinical study to identify subtypes, to validate the identified BPD subtypes by comparing them on psychopathological characteristics and emotional processing; and to explore their treatment trajectory after 3 months of inpatient treatment according to dialectical behavior therapy (DBT).

In previous research BPD subtypes were identified based on clinical descriptions, self-reported characteristics such as attribution style, interpersonal patterns.

In this thesis we opted to identify BPD subtypes based on temperamental dimensions. According to the biosocial theory, explaining the etiology of BPD, BPD is a result of the interaction between temperamental features and environmental features. Temperament includes reactive and regulative temperament. Reactive temperament consists of two temperament systems, namely the Behavioral Activation System (BAS) related to punishment sensitivity, avoidance and anxiety; and the Behavioral Inhibition System (BIS) related to reward sensitivity, approach and impulsivity. Regulative temperament or effortful control (EC) is a deliberately control to manage reactivity.

In the first study (chapter 2) we performed a hierarchical cluster analysis on the temperamental dimensions (BIS/BAS/EC) of 150 patients with BPD. The results revealed four BPD subtypes, a Low Anxiety (low BIS), High Self-control (high EC), Inhibited (low BAS) and Emotional/Disinhibited subtype (high BIS, BAS and low EC) of which the High Self-control is a subgroup of the latter two (chapter 2). In chapter 4, a more sophisticated model based cluster analysis replicated the three major BPD subtypes, namely the Low Anxiety, Inhibited and Emotional/Disinhibited subtype.

To validate the BPD subtypes, we compared the four BPD subtypes with respect to clinical symptomatology, comorbid personality disorders and coping mechanisms and found significant differences (chapter 2).

Description of the BPD subtypes:

(1) the 'Low Anxiety' subtype (low BIS/low punishment sensitivity/low avoidance) characterized by low anxiety and interpersonal sensitivity, high expression of emotions (expressing tension and anger) and more palliative reactions (e.g., seeking distraction, drinking) and comorbid antisocial PD

(2) the 'Inhibited subtype' (low BAS/low reward sensitivity/low approach), demonstrating a high level of symptomatology, but more internalizing, low expression of emotions and comorbid cluster C (avoidant) PD

 (3) the High Self-control subtype (high effortful control) showing the highest level of functioning and least symptomatology and comorbid PDs

(4) the 'Emotional/Disinhibited' subtype (low effortful control), characterized by the highest level of symptomatology and comorbid cluster B (histrionic) PD.

Investigating differences between the subtypes in emotion processing measured by experimental tasks, focusing on emotional action tendencies and attentional bias revealed no differences between the four BPD subtypes (chapter 3).

In addition, in chapter 3, the relationship was investigated between temperamental dimensions and emotional action tendencies and attentional bias. Results of the current study did not demonstrate any relationship between attentional bias and temperamental dimensions. In contrast, a positive relationship was demonstrated between emotional action tendencies measured with the AAT and effortful control, but no significant associations with BIS and BAS reactivity. The level of effortful control was positively related to approach-avoidance tendencies to faces when the gaze was directed towards the participants and not when the gaze was averted. This is not surprising, since direct gaze is detected more efficiently and is perceived as a signal to interact. The level of effortful control seems to be associated with a general emotional action tendency to directed faces, even when controlling for gender, age and BPD severity. This finding suggests that patients with BPD possessing a higher level of effortful control show a better preferential response towards emotional interpersonal cues. Patients with BPD with lower levels of effortful control show diminished approach-avoidance tendencies towards emotional faces, which may be linked to a higher level of difficulties in acting flexibly in different situations and problematic social interactions (Radke et al., 2014).

The most important aim of this project was to investigate differences in dropout and treatment response of BPD subtypes after 3 months of inpatient DBT treatment. The results of this study are reported in chapter 4. There was no significant difference in amount of dropout between the three BPD subtypes. Trajectory measurement after 3 months of DBT demonstrated a different evolution between the three subtypes on the level of general clinical, borderline specific symptoms and dissociation, but not in level of non-suicidal self-injury or coping. The most interest finding is the contrast in treatment response between the Low Anxiety subtype and other subtypes. The Emotional/Disinhibited subtype and Inhibited subtype did improve significantly in general clinical and borderline specific symptoms and dissociation, the Low Anxiety subtype did not show any improvement on the used outcome measurements.

The aim of the last study, described in chapter 5, was threefold:

(1) to describe NSSI and alexithymia characteristics in an inpatient BPD sample and to look at their interrelation, their correlation with depression and differences between gender

(2) to investigate if current NSSI is associated with the alexithymia total score and if so, which alexithymia factor score would be most strongly associated with NSSI

(3) to investigate if current NSSI is still associated with alexithymia total and factor scores after controlling for gender and depression.

Of the 185 patients with BPD almost 83% reported to have engaged in a NSSI behavior during their life-time, with no differences in function of gender. More than half of them were still engaging in NSSI at the moment of assessment (current NSSI). These patients reported more clinical symptoms (interpersonal sensitivity, depression, anxiety, phobic anxiety, paranoid ideation and psychoticism) and comorbid personality disorders (schizoid, avoidant, dependent and obsessive-compulsive disorder-dimensions) compared to patients without current NSSI. In addition, almost 72% of the patients with BPD were found to be alexithymic. Current NSSI seems to be associated with alexithymia and more specific with difficulties describing feelings. So, it is not the distinguishing or identification of emotions that is related to NSSI, but the verbalization and communication about these emotions, even independently of the depressive status of the patient with BPD.

Nederlandse samenvatting

Borderline Persoonlijkheidsstoornis (BPS) is de meest voorkomende persoonlijkheidsstoornis, gekenmerkt door een patroon van instabiliteit op het vlak van emoties, cognities, zelfbeeld en sociaal functioneren. Er is echter een grote diversiteit in klinische presentatie en verloop. Het doel van dit doctoraatsonderzoek, gepresenteerd in deze thesis, was om na te gaan of er verschillende BPS subtypes bestaan op basis van temperamentdimensies en of deze een ander behandelingsverloop kennen binnen een dialectisch gedragstherapeutische (DGT) behandelingssetting. Het uiteindelijke doel is om de bevindingen mee te nemen in het zoeken naar een meer aangepaste aanpak van patiënten met een borderline persoonlijkheidsstoornis in de klinische praktijk.

In voorgaande onderzoeken werden reeds BPS subtypes geïdentificeerd op basis van beschrijvingen van patiënten door clinici en zelf-gerapporteerde kenmerken van patiënten zoals bijvoorbeeld attributiestijl, interpersoonlijke patronen en klinische variabelen vanuit diverse theoretische kaders. Echter, deze verschillende methodologieën maken het vergelijken moeilijk en zijn niet gericht op de nieuwste ontwikkelingen binnen het onderzoek naar persoonlijkheidsstoornissen die steeds meer dimensioneel is gericht. Daarenboven is er nog weinig onderzoek gedaan naar mogelijke verschillen in uitkomst van behandeling tussen BPS subtypes, wat net belangrijk is om na te gaan of ze daadwerkelijk een ander traject kennen en daaraan behandeling kunnen aanpassen.

We hebben er in ons project voor geopteerd om patiënten met BPS te clusteren op basis van temperamentdimensies. Temperamentdimensies, die aan de basis liggen van persoonlijkheid, worden steeds belangrijker geacht in recente onderzoeken. Volgens het biosociale model, die de etiologie van BPS verklaart, is BPS het resultaat van een wisselwerking tussen temperamentkenmerken en omgevingskenmerken. Temperament, omvat reactief en regulatief temperament. Het reactief temperament bestaat uit twee temperamentele systemen, namelijk het gedragsinhibitiesysteem (BIS; Behavioral Inhibition System) dat gerelateerd is aan strafgevoeligheid, vermijdingsgedrag en angst, en het gedragsactivatiesysteem (BAS; Behavioral Activation System) dat gerelateerd is aan beloningsgevoeligheid, toenaderingsgedrag en impulsiviteit. Het regulatieve temperament of effortful control (EC) is een doelbewuste controle om met de reactiviteit om te gaan (bv. impulsen onderdrukken).

In de eerste studie (Hoofdstuk 2) beschrijven we de resultaten van een hiërarchische clusteranalyse van de drie temperamentdimensies (BIS/BAS/EC). Bij de 150 patiënten met BPS werden 4 BPS subtypes teruggevonden: het 'Laag Angstige' subtype, het 'Hoge zelf-controle' subtype, het 'Geïnhibeerde' subtype en het 'Emotioneel/Gedisinhibeerde' subtype. Deze BPS subtypes rapporteerden aan de hand van vragenlijsten duidelijke verschillen op vlak van klinische symptomatologie, comorbide persoonlijkheidskenmerken en coping strategieën (Hoofdstuk 2). We kunnen dus concluderen dat de statistisch bekomen subtypes op basis van temperament ook daadwerkelijk gekenmerkt worden door verschillende

psychopathologische karakteristeken. We kunnen hierdoor de de vier BPS subtypes als volgt beschrijven:

(1) het 'Laag Angstige' subtype (lage BIS/lage straf gevoeligheid/laag vermijdend/laag neurotisch) is gekarakteriseerd door weinig angst en interpersoonlijke gevoeligheid, een hoge expressie van emoties (uiten van spanning en kwaadheid) en de neiging meer palliatieve reacties te vertonen (bv., afleiding zoeken, drinken). Dit subtype wordt getypeerd door antisociale persoonlijkheidskenmerken

(2) het 'Hoge zelf-controle' subtype (hoge EC, betere zelf-sturing) is gekarakteriseerd door het hoogste niveau van functioneren, de minste symptomen en het laagste niveau van comorbide persoonlijkheidsstoornissen

(3) het 'Geïnhibeerde' subtype (lage BAS/ laag beloningsgevoelig/laag toenaderend) vertoond een hoge mate van symptomatologie, maar is meer internalizerend, gekenmerkt door weinig expressie van emoties en meer vermijdende persoonlijkheidskenmerken

(4) het 'Emotioneel/Gedisinhibeerde' subtype (hoge BIS, BAS en lage EC) is gekenmerkt door de hoogste mate van symptomatologie en meeste comorbide cluster B en histrionische persoonlijkheidskenmerken

Naast karakteristieken gerapporteerd aan de hand van vragenlijsten werd ook de emotionele verwerking van de verschillende BPS subtypes nagegaan door de prestaties op twee experimentele taken te vergelijken (Hoofdstuk 3). Emotionele actietendensen, met name toenaderings- en vermijdingstendensen op emotionele stimuli, werden nagegaan door middel van een 'Approach-Avoidance' taak (AAT) waarbij men met een joystick dient te reageren op emotionele gezichten (blij, boos) met een bepaalde kijkrichting (aankijkend, wegkijkend). De aandachtbias voor emotionele stimuli werd onderzocht door middel van een emotionele strooptest, waarbij de kleur van kleurwoorden moet genoemd worden bij woorden met een emotionele lading (blij, boos, neutraal). Wanneer we de resultaten van de vier BPS subtypes vergeleken zagen we geen significante verschillen. Wanneer echter de twee subtypes met meest contrasterende mate van effortful control werden vergeleken, konden we vaststellen dat patiënten van het subtype met de hoogste mate van effortful control (Hoge Zelf-controle subtype) sterkere toenaderings/vermijdingstendensen vertoonden op aankijkende gezichten in vergelijking met patiënten van het subtype met de laagste mate van effortful control (Emotioneel/ Gedisinhibeerde subtype). Dit impliceert dat patiënten van het subtype met een lagere mate van effortful control minder de neiging hebben om blije mensen te benaderen en boze mensen te ontwijken. Deze bevinding is in overeenstemming met voorgaande studies die minder goede prestaties op soortgelijke taken vaststelden bij patiënten met BPS en een lagere mate van effortful control.

Daarnaast werd binnen deze studie (Hoofdstuk 3) ook de relatie onderzocht tussen de drie temperamentdimensies en emotionele actietendensen en aandachtsbias. Deze resultaten toonden geen relatie aan tussen temperamentdimensies en aandachtsbias voor emotionele stimuli. Anderzijds werd er wel een positieve relatie vastgesteld tussen emotionele actie neigingen gemeten met de AAT en effortful control. De mate van effortful control bleek positief gerelateerd aan toenadering-vermijdingstendensen voor gezichten wanneer de blik gericht is naar de deelnemer en niet wanneer de blik gericht is naar elders. Dit is niet verbazend, aangezien een gerichte aanblik sneller gedetecteerd wordt en ook ervaren wordt als een rechtstreeks signaal om te interageren. Deze relatie bleef zelfs bestaan wanneer er gecontroleerd werd voor geslacht, leeftijd en ernst van BPS pathologie. Deze bevinding suggereert dat BPS patiënten met een hogere mate van effortful control een betere preferentiële respons vertonen op emotionele interpersoonlijke signalen. BPS patiënten met een lagere mate van effortful control vertonen verminderde toenadering-vermijdingstendensen voor emotionele gezichten, wat gelinkt kan worden aan moeilijkheden in sociale interacties.

Aangezien het belangrijk is de bevindingen van BPS subtypes op basis van temperament te kunnen repliceren, werd een meer gesofisticeerde model-based clusteranalyse uitgevoerd op een andere BPS popluatie (Hoofdtuk 4). Hierbij werden de drie voornaamste BPS subtypes teruggevonden, namelijk het 'Laag Angstige', het 'Geïnhibeerde' en het 'Emotioneel/Gedisinhibeerde' subtype. Om duidelijkheid te krijgen of behandeling zou kunnen verbeteren door een aanpassing naar BPS subtypes, dient geweten te zijn of BPS subtypes ook daadwerkelijk een ander therapieresultaat kennen. De belangrijkste doelstelling van dit doctoraatsonderzoek was dan ook om na te gaan of er een verschil is tussen de BPS subtypes in mate van vroegtijdige therapiestop en behandelingsrespons na 3 maand residentiële Dialectische Gedragstherapie (DGT). In het algemeen toonde de responsmeting voor en na 3 maanden DGT behandeling aan dat er voor de totale groep van patiënten met BPS een significante verbetering was op vlak van klinische en borderlinespecifieke symptomatologie, comorbide persoonlijkheidsstoornissen en coping strategieën (Hoofdstuk 4). Wanneer de drie BPS subtypes voor en na behandeling werden vergeleken, bleek er geen verschil in aantal patiënten die de behandeling vroegtijdig stopzetten. Daarnaast was de meest interessante bevinding vanuit het trajectonderzoek dat er een verschil bleek te zijn in behandelingsuitkomst na 3 maanden DGT behandeling tussen de drie BPS subtypes. De 'Geïnhibeerde' en 'Emotioneel/Gedisinhibeerde' subtypes toonden een significante verbetering op vlak van klinische en borderlinespecifieke symptomen en dissociatie, en dit in tegenstelling tot het 'Laag Angstige' subtype dat geen verbetering vertoonde op deze uitkomstmaten (Hoofdstuk 4).

Het doel van het laatste onderzoek beschreven in hoofdstuk 5 was drievoudig: (1) om ZVG en alexithymie karakteristieken van een residentiële BPS-populatie te beschrijven, en hun interrelatie, hun correlatie met depressie en geslachtsverschillen te onderzoeken (2) om te onderzoeken of huidig ZVG geassocieerd is met de totale alexithymie score en als dit zo zou zijn, na te gaan welke alexthymie factorscore het meest geassocieerd zou zijn met ZVG (3) om

te onderzoeken of huidig ZVG nog steeds geassocieerd zou zijn met totale alexithymie score en factorscores na het controleren voor geslacht en depressie.

Van de 185 patiënten met BPS rapporteerden bijna 83% ooit ZVG vertoond te hebben gedurende hun leven, waarbij er geen geslachtsverschil was. Meer dan de helft vertoonde nog zelfverwondend gedrag (ZVG) op het moment van bevraging (huidig ZVG). Deze patiënten rapporteerden meer klinische symptomen (interpersoonlijke gevoeligheid, depressie, angst, fobische angst, paranoïde ideatie en psychoticisme) en meer comorbide persoonlijkheids-stoornissen (schizoïde, vermijdende, afhankelijke en obsessieve-compulsieve persoonlijk-heidsstoornis) in vergelijking met patiënten met BPS die geen huidig ZVG vertonen. Ons onderzoek toonde aan dat 72% van de patiënten met BPS alexithymisch zijn. Daarenboven bleek huidig ZVG positief geassocieerd met alexithymie en meer specifiek met 'moeilijkheden met het beschrijven van gevoelens'. Aldus is niet het onderscheiden of identificeren van gevoelens gerelateerd aan ZVG, maar wel het niet kunnen verwoorden en communiceren van deze gevoelens, en dit zelfs losstaand van de depressieve status van de BPS-patiënt (Hoofdstuk 5).

Additional information

List of abbreviations

Curriculum Vitae

List of publications

List of abbreviations

AAT   Approach-Avoidance Task
ADP-IV   Assessment of DSM-IV Personality Disorders
AMPD   Alternative Model for Personality Disorders
BAS   Behavioral Activation System
BIS   Behavioral Inhibition System
BIS/BAS   Behavioral Inhibition/Behavioral Activation System Scales
BPD   Borderline Personality Disorder
BSI   Brief Symptom Inventory
BSL   Borderline Symptom List-23
DBT   Dialectical Behavior Therapy
DDF   Difficulties Describing Feelings
DIF   Difficulties Identifying Feelings
DIS-Q   Dissociation Questionnaire
DSM   Diagnostic and Statistical Manual of Mental Disorders
EC   Effortful Control
ECS-ATQ   Effortful Control Scale of the Adult Temperament Questionnaire
EOT   Externally Oriented Thinking
EST   Emotional Stroop Task
FFM   Five Factor Model
MBT   Mentalization-Based Treatment
NSSI   Non-Suicidal Self-Injury
PTSD   Post-Traumatic Stress Disorder
RO-DBT   Radically Open-Dialectical Behavior Therapy
RST   Reinforcement Sensitivity Theory
SCID-II   Structured Clinical Interview for DSM-IV Axis II Personality Disorders
SIQ-TR   Self-Injury Questionnaire-Treatment Related
TAS   Toronto Alexithymia Scale
UCL   Utrecht Coping List

Curriculum Vitae

Personal data

Ellen Sleuwaegen,
Born on 2th February 1973, Brussels, Belgium
Married to Wim Dens and mother of Flor (23/11/2004) and Lisa (14/12/2006)

Professional training

2009:   University Department of Psychiatry, Campus Psychiatric Hospital Duffel
               Training 'Dialectic Behavior Therapy' (DBT)

1998-2001:   University Hospital Antwerp
               Training 'Cognitive Behavior Therapy' (CBT)

1997-1998:   Vrije Universiteit Brussel
               Academic Teacher Course 'Psychology and Pedagogical Science'

1991-1996:   Vrije Universiteit Brussel
               Master (Lic.) Psychology – Clinical Psychology

1984-1991:   Capital Atheneum Karel Buls Brussel II
               Science-Mathematics-History

Professional career

- March 2014 - today: Phd Student UAntwerp – Fac. Medicine
                          Title research project: Research on temperament/personality and
                          emotion regulation in Borderline Personality Disorder.
                          Supervisor: Prof. dr. B. Sabbe and Prof. dr. L. Claes

- March 2013 - today: Trainer Intensive course Dialectic Behavioral Therapy (DBT)
                          unnually – PH Duffel

- June 2012 - today: Unpaid non-statutory academic personnel (BAP) - UAntwerp
                          Collaborative Antwerp Psychiatric Research Institute (CAPRI)

- August 2009 - today: Psychologist at the University Department of Psychiatry, Campus
                          Psychiatric Hospital Duffel, unit 'de Spinnaker'

- July 1998 - July 2009: Psychologist at ZNA - Campus Stuivenberg - Psychiatry - Unit Z2

- October 1996 - June 1998: Study Counselor - Vrije Universiteit Brussel -
                          Unit Study Consultation.

Oral Presentations

- 'Presentatie studie project naar BPS subtypes' - Symposium 'Zelfregulatie en psychopathologie' - 3th October 2014, Duffel
- 'BPS subtypes' - BAPS meeting - 24th May 2016, Leuven
- 'BPS subtypes' - ESSPD Congress - 8-10th September 2016, Vienna
- 'Emotional processing in BPD subtypes' - ISSPD Congress - 26-28th September 2017, Heidelberg
- 'NSSI and Alexithymia in BPS' - ISSS Congress - 22-23th June 2017, Brussels
- 'BPS subtypes en hun behandelingstraject' - GGZ Congres - 18-19th September 2018, Antwerp
- 'BPS subtypes and their treatment trajectory' - ESSPD Congress - 27-29th September 2016, Barcelona

Co-promotor of Thesisses

- Emotieregulatie en zelfverwondend gedrag bij patiënten met een BPS. - Axelle Beirens - Master Thesis Psychology, KULeuven/PPW, 2015-2017
- Impulsregulatie en zelfverwondend gedrag bij patiënten met een BPS. - Elena Van Campenhout - Master Thesis Psychology, KULeuven/PPW, 2015-2017
- Zelfverwonding gedrag bij patiënten met een BPS binnen DGT. - Frauke Van Engeland - Bachelor Verpleegkunde, Thomas More, 2016

Teaching

- Intensive course Dialectic Behavioral Therapy (DBT), 10 days - PH Duffel, annually
- 'Meet the expert – DBT', CBT – VU Brussel, annually
- In Company Trainings

Reviewer invited by peer-reviewed journals

- European Journal of Psychological Assessment, 2014
- Psychiatry Research, 2017

Important grants and awards

- Scientific Research Foundation – Flanders (FWO) - Special PhD fellowship (2016-2017) [1901317N] Title project: "Subtypes within the Borderline personality disorder, their validation and treatment trajectory.

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