Early Detection and Intervention for Adolescents with Borderline Personality Disorder

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submitted by

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ABSTRACT

Borderline personality disorder (BPD) is a severe mental disorder characterized by instability in personal relationships, self-image and affective experiences as well as high impulsivity. Its prevention and early intervention have been declared a public health priority. Although research has made progress in early detection and early intervention in adolescents, which is the period when the disorder most often emerges, gaps in knowledge remain. This work contributes to closing these gaps by advancing the early detection of and intervention for BPD in adolescents.

Study 1 examined risk and self-harm behaviors as markers of BPD in adolescents and determined that the combination of risk and self-harm behaviors tends to be a specific marker of BPD, whereas self-harm alone is transdiagnostic in nature. Study 2 evaluated the stepped care approach used in AtR!Sk, a specialized outpatient clinic for adolescents with risk-taking and self-harm behaviors. The evaluation revealed that stage 1 of the approach was effective in improving psychosocial functioning and reducing overall psychopathology and non-suicidal self-injury, and that the decision criterion for identifying those in need of further treatment was well chosen. However, stage 2 of the stepped care approach did not demonstrate any incremental therapeutic benefit. Study 3 delved deeper into psychotherapy process research in adolescents treated for full or subthreshold BPD. The aim was to examine the integration of physiological data into self-report-based assessment of the psychotherapy process to address bias and validity issues associated with self-reports of patients with BPD. The results indicated that the integration of physiological data into session evaluation does not replace self-reports but opens up new perspectives and could thus provide a more multifaceted view of psychotherapeutic processes in the treatment of adolescents with BPD.

Overall, the results provide important insights for improving early detection and intervention in adolescents. As an overall framework that integrates all pieces of the puzzle of BPD – from disorder-specific characteristics such as symptom trajectories and comorbidities through early identification and intervention options – and that is able to guide future research in a systematic way is still lacking, a transdiagnostic clinical staging model that addresses this gap is described in the further course of this work. The results of the three studies presented are subsequently embedded into this model and possibilities for future research are considered.

PUBLICATIONS INCLUDED IN THE PRESENT THESIS

1) Blaha Y., Cavelti M., Lerch S., Steinhoff A., Koenig J. & Kaess M. (2024). Risk-Taking and Self-Harm Behaviors as Markers of Adolescent Borderline Personality Disorder. *European Child & Adolescent Psychiatry*. https://doi.org/10.1007/s00787-023-02353-y

2) Cavelti, M., Blaha, Y., Lerch, S., Hertel, C., Berger, T., Reichl, C., Koenig, J. & Kaess, M. (2024). The evaluation of a stepped care approach for early intervention of borderline personality disorder. *Borderline Personality Disorder and Emotion Dysregulation*, 11(12). https://doi.org/10.1186/s40479-024-00256-1

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LIST OF ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
AIT	Adolescence Identity Treatment
APA	American Psychiatric Association
AtR!Sk	Specialized Outpatient Clinic for Risk-Taking and Self-Harm Behaviors
BPD	Borderline Personality Disorder
CAT	Cognitive-Analytical Therapy
CDP	Cutting Down Program
DBT-A	Dialectical Behavioral Therapy for Adolescents
DSM-5	Diagnostic and Statistical Manual - Fifth Edition
HPA	Hypothalamic-Pituitary-Adrenal Axis
HYPE	Helping Young People Early
ICD-11	International Classification of Diseases, 11th Edition
MBT-A	Mentalization-Based Treatment for Adolescent
NSSI	Non-Suicidal Self-Injurious Behavior
RCT	Randomized Controlled Study
RSB	Risk-Taking and Self-Harm Behaviors
SEQ	Session Evaluation Questionnaire
TAU	Treatment as Usual

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INTRODUCTION

Borderline personality disorder (BPD) is a mental disorder characterized by extreme affective instability, unstable relationships, and impulsivity. Among other things, people with BPD experience an immense fear of abandonment, difficulty regulating their emotions, and impulsive and risky behaviors (American Psychiatric Association [APA], 2013). BPD is associated with long-term negative and sometimes severely limiting outcomes such as difficulty maintaining stable relationships, an increased risk of self-harm behavior, a higher likelihood of suicidal thoughts or attempts, and an overall lower quality of life (Winograd et al., 2008). Due to the severity and high burden of BPD, prevention and early intervention have been declared a public health priority (Chanen et al., 2017). As the disorder often begins in adolescence, this stage of life is of particular importance in prevention and early intervention for BPD.

While considerable advances have been made in BPD research in recent years, gaps in knowledge remain that must be addressed to improve the early detection of and intervention for BPD in adolescents. This thesis aims to contribute to this important priority by highlighting different aspects of early detection and intervention of BPD in adolescents and adding to relevant research gaps. First, an overview of the disorder is provided, and the research gaps that this paper aims to address are highlighted. Second, the scientific contributions that were made as part of this work are summarized. Third, the results are discussed, and a framework is proposed that captures a holistic view of the findings.

Overview of Borderline Personality Disorder

Diagnosing BPD

The diagnostic criteria for BPD as defined in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013) include a broad spectrum of symptoms. Five out of nine criteria must be met for the diagnosis to be fulfilled, with a pervasive pattern of instability in interpersonal relationships, self-image, and affect, and marked impulsivity among the key features (see Table 1). For individuals under the age of 18, personality features must have been present for a minimum of one year in order to prevent mistaking the natural change in personality during adolescence with the development of BPD (APA, 2013).

Table 1

Diagnostic criteria for BPD according to DSM-5

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 money, 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.

Note. Diagnostic criteria adopted from DSM-5, American Psychiatric Association (2013).

Prevalence of BPD

The general and sex-specific prevalence of BPD varies greatly depending on the sample under consideration. In the general population, the prevalence of BPD in adolescents lies at around 3%, with no significant sex difference (Bernstein et al., 1993; Guilé et al., 2018, 2021; Zanarini et al., 2011). A prevalence of around 11% is reported for outpatient settings, again with no significant difference between the sexes (Chanen et al., 2004; Guilé et al., 2018). In the inpatient setting, the prevalence rises to 19%–53%, reaching up to 78% in adolescents who present to the emergency department due to suicidal behavior. In this setting, the sex difference becomes apparent, with a high proportion of females at around 80% (Guilé et al., 2018; Ha et al., 2014; Yen et al., 2013). However, it is assumed that the sex difference is less a true sex

effect and more a sampling bias as women generally seek more professional help for mental illness than men (Skodol & Bender, 2003). It should also be noted that studies on the prevalence of BPD in adolescents are methodologically highly heterogeneous, thus complicating direct comparison between individual studies (Bozzatello et al., 2024).

Development of BPD

There are various models for the development of BPD, with Marsha Linehan's (1993) biosocial model being one of the most prominent. This model emphasizes the role of emotional dysregulation in the development and maintenance of BPD, which is understood as the result of transactions between an innate emotional vulnerability and an invalidating social environment. The innate emotional vulnerability, representing the biological aspect of the model, manifests itself in high emotional sensitivity, a limited ability to regulate intense emotions, and a slow return to one's own emotional baseline. The invalidating environment, which represents the social aspect of the model, is characterized by an intolerance towards the expression of emotions, particularly in the absence of an obvious reason for an emotional reaction. Such an environment does not meet a child’s emotional needs and conveys that emotions should be regulated internally rather than externalized. As a result, children fail to learn how to label, regulate, or tolerate emotions and instead develop mistrust of their emotions, classify them as dangerous, and try to avoid them. The lack of appropriate emotional coping strategies can lead to the development of dysfunctional behaviors such as self-harm (Crowell et al., 2009; Linehan, 1993). The biosocial model was expanded into the biosocial developmental model, adopting a lifespan perspective and integrating impulsivity as an early trait, which plays an important role alongside emotional vulnerability and has been shown to be a predictor of emotional dysregulation and BPD traits (Crowell et al., 2009; Lee et al., 2023).

The biosocial model paved the way for the development of further models of the etiology of BPD. As the presentation of all these models is beyond the scope of this paper, interested readers are referred to Winsper (2018). This work provides an overview of the existing theories on the etiology of BPD and integrates them into a developmental perspective, from prenatal exposure and familial risk to early childhood temperament and deficits in parenting skills, later deficits in social cognition and emotion regulation to first BPD traits, and finally to the development of the disorder.

Trajectory: The Course of BPD

Like many mental disorders, BPD often emerges during adolescence (Chanen &

Thompson, 2019; Sharp et al., 2018; Solmi et al., 2022). BPD symptoms typically increase from early adolescence to early and middle adulthood. It was previously assumed that symptoms peak between the ages of 17 and 22 (Bornovalova et al., 2009; Cohen et al., 2005); however, a recent meta-analysis of 152 publications featuring data from a total of 25'053 people found a peak at around 30 years of age, leaving uncertainty about the specific age when symptoms peak (Aleva et al., 2023). After the peak, BPD symptoms appear to decrease again (Bornovalova et al., 2009; Cohen et al., 2005; Gunderson et al., 2011; Videler et al., 2019). The transition from adolescence to adulthood is typically accompanied by a symptomatic shift from acute symptoms (affective dysregulation, impulsivity, and suicidality) to chronic symptoms (maladaptive interpersonal functioning and persistent functional limitations; Videler et al., 2019). While impulsivity decreases throughout adulthood, affective symptoms and relationship difficulties tend to persist (Videler et al., 2019).

Longitudinal studies indicate that psychosocial functioning over the course of BPD also tends to improve, and symptomatic remission (i.e., when one meets less than five out of nine diagnostic BPD criteria) in the course of BPD is common, with remission rates ranging from 50%–70% (Álvarez-Tomás et al., 2019; Choi-Kain et al., 2020; Temes & Zanarini, 2018). However, compared to other personality disorders, remission seems to take more time, and recovery is more difficult to achieve. It should be noted that there is no clear, standardized definition of recovery, and the definitions provided in research mostly refer to a clinical perspective (Ng et al., 2016). Qualitative studies on the lived experience of BPD patients regarding recovery support that recovery is a highly individual experience and includes, but is not limited to, the experience of resilience, a fulfilling life with depth, and the freedom to make decisions independent of illness (Comtois et al., 2010; Liljedahl et al., 2023).

Impact: Consequences of BPD

Even if the overall prognosis is encouraging, BPD is associated with high mortality, with an assumed suicide rate of up to 10% (Paris, 2019). In addition, long-term negative consequences persist. These include impaired social and role functioning, lower educational and occupational attainment, fewer milestones achieved in adulthood, less partner involvement, lower life satisfaction, psychosocial impairment, lower mental health outcomes, and increased utilization of public assistance (Choi-Kain et al., 2020; Hastrup et al., 2022; Skodol et al., 2007; Winograd et al., 2008). From a societal perspective, BPD is associated with high mental healthcare costs due to frequent hospitalizations, intensive outpatient treatments, and the need for long-term mental health services. Studies estimating the financial societal burden found

annual costs of 31’130–40’411 euros per patient, compared with 2’440 euros per year for patients in a control group without a BPD diagnosis (Hastrup et al., 2019; Wagner et al., 2022). Given these substantial impacts, early detection and intervention are essential to minimize the burden on both patients and society.

Diagnosis in Adolescence: Relevance and Challenges

The assignment of a BPD diagnosis in adolescence has been and still is the subject of controversial debate (Cavelti et al., 2023). Critics who oppose diagnosis in adolescence argue that a) a BPD diagnosis in adolescence is not valid; b) individual characteristics of BPD, such as impulsivity and affective instability, are normative in adolescence and not clinically relevant; c) the personality in adolescence is not sufficiently stable for the diagnosis of personality disorders; d) BPD is not treatable; and e) the assignment of the BPD diagnosis is associated with excessive stigmatization for those affected (Kaess, Brunner, & Chanen, 2014; Sharp et al., 2018). This considerable uncertainty surrounding the assignment of a BPD diagnosis in adolescence was also reflected in the titles of various scientific articles, such as “The Diagnosis that Dare Not Speak Its Name” (Chanen & McCutcheon, 2008) or “Borderline Personality Disorder in Adolescents: The He-Who-Must-Not- Be-Named of Psychiatry” (Larrivée, 2013). However, current evidence clearly shows that a) BPD diagnosis is just as reliable and valid in adolescence as it is in adulthood (Miller et al., 2008). This is also confirmed by the DSM-5 (APA, 2013) and the International Classification of Diseases – 11th edition (ICD-11; World Health Organization, 2019), which have waived a minimum age for personality disorders. It has also been shown that b) adolescents who develop BPD can be reliably distinguished from healthily developing adolescents (Videler et al., 2019; Zanarini et al., 2017). While difficulties with impulsivity, identity, and affective instability decrease in healthily developing adolescents from early to late adolescence, these difficulties increase in adolescents with BPD. The difference between adolescents becomes more apparent over time (Videler et al., 2019). BPD in adolescence also shows c) similar stability to the disorder in adulthood (Sharp et al., 2018) and has proven to be d) treatable, with various forms of therapy available (Cristea et al., 2017; Storebø et al., 2020). Particularly noteworthy are Dialectical Behavioral Therapy for Adolescents (DBT-A; Fleischhaker et al., 2011) and Mentalization-Based Treatment for Adolescents (MBT-A; Taubner et al., 2018). These approaches, originally developed for adults and adapted for adolescents, have the largest evidence base of treatments available for adolescents with BPD and have been shown to be effective in reducing BPD symptoms, self-harm behavior, and suicide attempts, among others (Cristea et al., 2017; Johnstone et al., 2022;

Storebø et al., 2020). However, a meta-analysis of the effectiveness of psychological therapies for adolescents with BPD and subthreshold BPD found hardly any indications of the superiority of evidence-based BPD treatments over control conditions such as treatment as usual (TAU), standardized good clinical care, or enhanced usual care in terms of reducing BPD severity, depression, psychotic symptoms, self-harm, impulsivity, externalizing symptoms, substance dependence, or impaired functioning (Jørgensen et al., 2021). Finally, e) stigmatization persists or is even reinforced if the existing diagnosis is not named (Sulzer et al., 2016). In fact, the assignment of the diagnosis is essential to enable access to adequate treatment and to provide guidance for those affected and their families (Hutsebaut et al., 2023). Failure to diagnose BPD in adolescence and thus the denial of appropriate treatment is unethical and can have fatal consequences (Cannon & Gould, 2022). The importance of assigning the diagnosis was summarized by Campbell et al. (2020) as follows: "After all, we would not diagnose someone with type two diabetes who has clear symptoms of cancer as the treatment would likely result in unnecessary suffering and (ultimately) death. So why would we refuse to diagnose someone with BPD or diagnose them as having a differing mental illness (such as bipolar affective disorder) compromising effective recovery?"

However, recognizing the disorder in adolescents is not simple. On the one hand, this is due to the versatility with which the symptoms can present themselves (Lawrence et al., 2011). With 5 out of 9 criteria fulfilled, there are theoretically 126 ways in which the disorder, fully manifested, can present itself. Moreover, adolescents with BPD often have comorbid disorders, which further complicates diagnostic clarity (Sharp & Fonagy, 2015). For example, one study found rates of 70.6% for comorbid affective disorders, 67.3% for anxiety disorders, and 60.2% for externalizing disorders in adolescents with BPD who underwent inpatient treatment (Ha et al., 2014). Given the heterogeneity of clinical profiles and the major changes that occur during adolescent development, it is challenging for clinicians to distinguish between BPD symptoms and typical developmental behaviors of adolescence and to recognize the persistence of BPD symptoms (e.g., symptoms must persist for at least one year for the DSM-5) across various, mainly social situations and recurrent, abnormal functioning in affective situations (Guilé et al., 2018).

EARLY DETECTION & INTERVENTION

Due to the long-term consequences and chronic impairments caused by the disorder, as well as its high costs for the healthcare system, prevention and thus early detection and intervention in the context of BPD are particularly important (Chanen et al., 2017). The

overarching goal of prevention is to positively influence the course of the disorder as early as possible so that the negative consequences of BPD can be avoided or at least minimized (Stepp et al., 2016). When considering the relevant literature, it is noticeable that the terms "prevention and early intervention" are frequently used. "Prevention" in this context refers to indicated prevention, which focuses on individuals at high risk of developing a disorder (Chanen et al., 2017; Chanen & McCutcheon, 2013). These individuals show minimal but recognizable signs of a disorder without fully meeting the diagnostic criteria (National Research Council and Institute of Medicine, 2009). Early intervention targets individuals in the early stages of an illness, where the transition between health and illness is fluid, meaning that people can exhibit initial signs or precursors of a disorder or even an initial manifestation (Davis et al., 2000, p. 200). As both concepts overlap considerably, they are summarized hereafter with the term early intervention.

Early Detection

Early detection is an important prerequisite for early intervention. As discussed, identifying BPD in adolescents poses a major challenge, particularly before full manifestation. Various risk factors have been identified, including low socioeconomic status, stressful life events, family and school stressors, negative parenting style, and various forms of abuse and maltreatment (Stepp et al., 2016). Temperamental risk factors like affective instability, negative affectivity, poor emotional control, or impulsivity, in addition to psychopathological risk factors like externalizing and internalizing disorders, have also been found (Bellino et al., 2022). However, these risk factors lack specificity as they apply to a variety of mental disorders, limiting their usefulness in the specific early detection of BPD (Stepp et al., 2016).

Specific markers that signal the emergence of the disorder at an early stage are essential for effective early detection (Stepp et al., 2016). Acute symptoms of BPD, such as affective dysregulation, impulsivity, and suicidality, which predominate in adolescence, may therefore be more specific markers for the disorder (Kaess, Fischer-Waldschmidt, et al., 2017; Videler et al., 2019). In fact, subsyndromal BPD, in which one meets one to four BPD criteria, has so far proven to be the best indicator of the development of BPD (Cavelti & Kaess, 2020; Chanen & Thompson, 2018). Furthermore, specific signs of BPD need to be evaluated. Non-suicidal self-injurious behavior (NSSI) and suicidal behavior could serve as relevant markers as they occur particularly frequently in connection with BPD (Reichl & Kaess, 2021). The BPD criterion "self-injurious and suicidal behavior" is the most prevalent BPD criterion in adolescence, while 59% of adolescents with BPD experience "Active suicidal ideation" and 58% experience NSSI

(Guilé et al., 2018; Kaess, Fischer-Waldschmidt, et al., 2017). In addition, 33% of adult BPD patients who showed NSSI in the past reported that this behavior began before the age of 13, while 30% first experienced these behaviors between 13–17 years of age (Zanarini et al., 2006). Due to the high frequency of NSSI and suicidal behavior, the presence of both should always prompt screening for possible BPD (Guilé et al., 2018). However, it should be acknowledged that not all people with BPD also exhibit NSSI and vice versa. This is also reflected in the new, separate diagnosis of non-suicidal behavior disorder (DSM-5; APA, 2013), which is independent of BPD, although the overlap between these two diagnoses is high (Buelens et al., 2020).

Another phenomenon often associated with BPD is risk-taking and self-harm behavior (RSB). RSB can be defined as behavior that may threaten the physical or psychosocial development of a person, including but not limited to truancy, excessive media use, tobacco use, illicit drug and alcohol use, sexual risk behaviors, NSSI, and suicide attempts (Kaess, Brunner, Parzer, et al., 2014). RSB are widely prevalent in adolescence and can arise for a variety of reasons, such as to gain social acceptance within a peer group, to express the search for identity and the desire for autonomy, or as a coping mechanism to deal with the stress of developmental and environmental difficulties or even emerging mental health issues (Blaha et al., 2024; Hurrelmann & Raithel, 2005). Impressively, a large population-based sample of adolescents demonstrated that RSB has additional value for detecting mental disorders beyond psychopathology assessment alone (Kaess, Brunner, Parzer, et al., 2014).

However, the specificity of RSB as markers for BPD and the associated value in the context of early detection is not yet clear as some RSB, such as NSSI or excessive alcohol consumption, are not only linked to BPD but are further associated with other potentially highly comorbid psychiatric disorders, such as depression (Chanen et al., 2007; Heger et al., 2014). In addition, the relationship between RSB and BPD has been studied predominantly in non-clinical samples (Choukas-Bradley et al., 2020; Ghinea et al., 2019; Lazarus et al., 2017). It is therefore unclear whether these findings are transferable to clinical samples where RSB is already more frequent (Mangerud et al., 2014; Prince-Embury, 2015). Study 1 thus aimed to address these open research questions and addressed the value of RSB as early detection markers in adolescents with BPD.

Early Intervention

Early intervention for adolescents with BPD or early signs of BPD is crucial as it can positively influence the course of the disorder and reduce long-term psychosocial impairment.

Adolescence is a particularly critical period as personality traits are considered flexible and malleable during this time (Chanen & McCutcheon, 2013; Lenzenweger & Castro, 2005). Studies suggest that specific treatment programs tailored to the particular needs of these adolescents can contribute to better treatment outcomes (Johnstone et al., 2022; Kothgassner et al., 2021). Various early intervention efforts have been implemented for adolescents with early signs of BPD, some of which are presented below.

Helping Young People Early (HYPE)

Helping Young People Early (HYPE) is part of ORYGEN, a government-funded mental health service for young people aged 15–25 in Melbourne, Australia (Chanen, Mccutcheon, et al., 2009). In ORYGEN, referred individuals undergo a comprehensive diagnostic assessment. HYPE offers an early intervention program within ORYGEN for individuals who meet at least three BPD criteria. The program consists of 16 sessions of cognitive analytic therapy (CAT), combined with four post-therapy follow-up sessions, comprehensive case management, and general psychiatric support (Chanen et al., 2014; Chanen, Mccutcheon, et al., 2009). HYPE was investigated in a randomized controlled trial (RCT), with early intervention showing faster rates of improvement in externalizing and internalizing psychopathology relative to treatment as usual (Chanen, Jackson, et al., 2009). A comparison of different early intervention approaches (HYPE + CAT, HYPE + befriending, and a general youth mental health service + befriending) showed that all efforts led to an improvement in psychosocial functioning but that none was superior. The authors concluded that it is not so much specialized individual psychotherapy but rather youth-oriented clinical case management and psychiatric care per se that are central to the success of early interventions (Chanen et al., 2022).

Specialized Outpatient Clinic for Risk-Taking and Self-Harm Behaviors (AtR!Sk)

The Specialized Outpatient Clinic for Risk-Taking and Self-Harm Behaviors (AtR!Sk) offers low-threshold counseling, diagnostics, and therapy for adolescents with RSB between the ages of 12 and 17 at various locations, such as Heidelberg, Germany, and Bern, Switzerland (Kaess, Ghinea, et al., 2017). Adolescents with RSB can present during open consultation hours, where further diagnostics evaluate the RSB shown and any psychopathology present. Various therapeutic services are available, if indicated. AtR!Sk follows a stepped care approach, which provides a structured hierarchy of interventions ranging from low-threshold services to more intensive forms of therapy (Berger et al., 2022). Two types of stepped care concepts can be distinguished: The stratified approach aims to assign patients based on an initial

assessment to the most effective yet least intensive treatment, while the progressive approach, as applied in AtR!Sk, offers the same initial treatment step to all patients, starting with the least intensive, evidence-based approach. People who do not respond to this step move on to the next, more intensive step (Berger et al., 2022; Cavelti et al., 2024). The stepped care approach promotes efficient use of scarce healthcare resources and can also prevent over- or underuse (Straten et al., 2015). Although the stratified approach is the preferred goal, the progressive approach is currently often used as there are no criteria available to adapt the first treatment step to the patient.

As the first step of the stepped care approach in AtR!Sk, the Cutting-Down Program (CDP) is offered to adolescents with RSB seeking treatment, regardless of any BPD pathology. CDP is a cognitive-behavioral short-term therapy consisting of 10 sessions (Taylor et al., 2011). An RCT showed CDP to be as effective in reducing NSSI in the short and long term as a high-quality TAU (Kaess et al., 2020; Rockstroh et al., 2023). At the end of step 1, psychopathology is re-evaluated. Individuals who show a significant BPD pathology (decision criterion corresponds to at least three fulfilled BPD criteria and Zanarini score of at least six; Zanarini, 2003) progress to step 2, receiving treatment with DBT-A. DBT-A consists of 25 sessions and focuses on activating resources and teaching behavioral skills for dealing with strong, aversive feelings and situations (Fleischhaker et al., 2011). Although the stepped care approach has already been implemented in AtR!Sk, the current approach has not yet been evaluated and was therefore addressed in Study 2.

Challenges in Treating BPD

Treating patients with BPD is associated with numerous challenges. One significant challenge is the high dropout rate, which ranges from 15%–75% in randomized controlled trials (Jørgensen et al., 2021). Studies have revealed that a patient's decision to discontinue treatment is often not spontaneous but the result of a lengthy cost-benefit assessment, suggesting that there is a window of opportunity in which intervention is possible and treatment discontinuation can be prevented (Andersen et al., 2021; Desrosiers et al., 2020). Establishing and maintaining a strong therapeutic alliance is generally considered a buffer against dropout, but this can be hindered by the emotional instability, impulsivity, and relational difficulties inherent to BPD (APA, 2013; Barnicot et al., 2012; Chapman et al., 2024; Flückiger et al., 2018). A positive therapeutic alliance is an established predictor of treatment outcome in patients with BPD (Barnicot et al., 2012; Flückiger et al., 2018), with studies on adolescents with BPD supporting that improvements in working alliance dimensions over time are associated with better

treatment outcomes (Folmo et al., 2021). Unfortunately, little is known of the processes leading to challenges such as dropouts or a weak therapeutic alliance. A deeper understanding of therapeutic processes is of immense importance to enhancing treatment and its outcomes.

Psychotherapy process research, which examines how and why changes occur in therapy, is crucial for identifying ways to improve psychotherapy and increase its effectiveness (Tompkins & Swift, 2015). This research involves various methods, including observation of verbal and non-verbal behavior by external raters, interviews, and self-report questionnaires (Krause & Altimir, 2016). Self-report questionnaires capture the subjective experiences of patients, which are often invisible to external observers and are less time-consuming than interviews (Hardy & Llewelyn, 2015). However, self-report questionnaires can be problematic as responses might be biased due to impaired capacity for self-reflection, introspection, or social desirability. Psychopathological features characteristic of BPD can further influence self-report data, further putting their validity into question. For example, emotional and interpersonal instability in BPD patients can lead to fluctuating evaluations of therapists, with patients potentially using extreme positive or negative responses as a means of rewarding or punishing the therapist (Bo et al., 2022; McLeod, 2001).

To provide a more accurate and comprehensive assessment of the therapeutic process, integrating biological markers in conjunction with self-reports has been suggested (Cristea et al., 2019). This approach could help mitigate the biases associated with self-report questionnaires, improve their validity, and offer a more holistic understanding of the processes occurring during therapy. Biological markers reflect underlying physiological processes and offer a unique perspective on psychotherapeutic processes that differs from psychological assessments (Engel et al., 2022). Specifically, cortisol, a product of the hypothalamic-pituitary-adrenal (HPA) axis, is primarily secreted in response to psychosocial stress (Dickerson & Kemeny, 2004; Skoluda et al., 2015). This characteristic makes it a potentially valuable indicator for evaluating the course of therapy, especially since psychotherapy sessions themselves can act as psychosocial stressors. Assessing cortisol levels before and after therapy sessions enables clinicians to obtain objective insights into a patient's physiological response to therapy (Laufer et al., 2018). Currently, there are barely any studies that integrate biological markers into psychotherapy process research. Therefore, Study 3 aimed to contribute to filling this gap by exploring the combination of cortisol response and self-reported session evaluations in the treatment of adolescents with BPD features.

SCIENTIFIC CONTRIBUTION

Overall, despite significant progress in early detection and intervention of BPD in adolescence, several critical gaps remain. First, there is a pressing need to identify specific markers that can reliably detect BPD in adolescents at an early stage. Current diagnostic practices often struggle to distinguish BPD-specific markers from those indicative of general psychopathology, necessitating further research to improve early detection methods. Second, while a progressive stepped care approach has been implemented in AtR!Sk, supporting help-seeking adolescents with BPD, it has not yet been evaluated. Third, there is a significant need for research on the processes occurring during psychotherapy for adolescents with BPD. Relying solely on self-reported data can pose issues in terms of validity, particularly for BPD patients. Integrating objective measures such as biological markers could overcome these issues and provide a more nuanced view of therapeutic processes.

To contribute to closing these research gaps, the scientific studies that were conducted as part of this thesis are presented below.

Study 1: Risk-Taking and Self-Harm Behaviors as Markers of BPD

Appendix A

Blaha Y., Cavelti M., Lerch S., Steinhoff A., Koenig J. & Kaess M. (2024). Risk-Taking and Self-Harm Behaviors as Markers of Adolescent Borderline Personality Disorder. *European Child & Adolescent Psychiatry*. https://doi.org/10.1007/s00787-023-02353-y

To address the need for specific markers for early detection of BPD in adolescents, the present cross-sectional study investigated the associations between RSB and BPD pathology in a clinical sample of adolescents and explored whether RSB are specifically associated with BPD or also with depression.

A total of N = 405 help-seeking adolescents with RSB who presented in AtR!Sk (Kaess, Ghinea, et al., 2017) were examined (please refer to "Specialized Outpatient Clinic for Risk-Taking and Self-Harm Behaviors (AtR!Sk," p. 15, for more information on AtR!Sk). Patients were included in the study if they met at least one of the defined RSB of truancy, excessive media use, excessive tobacco, alcohol, or drug use, sexual risk behavior, NSSI, or suicide attempts.

The results showed that a higher frequency of almost all RSB was associated with a higher likelihood of a BPD diagnosis and higher BPD severity. In contrast, only NSSI and suicide attempts were associated with higher odds of a depression diagnosis and higher depression severity, while illicit drug use was associated with lower depression severity. In addition, a latent class analysis was conducted to identify classes of RSB and examine their association with BPD and depression. Two classes emerged, which differed in the probability of the occurrence of all RSB with the exception of excessive media use, NSSI, and suicide attempts. The class with high probabilities of RSB occurrence had a higher likelihood of a BPD diagnosis and met more BPD criteria, while no association was found between the classes and depression diagnosis or severity.

The results revealed that the occurrence of RSB can differentiate between the highly comorbid disorders BPD and depression, even in a clinical sample in which RSB generally occurs frequently. The occurrence of self-harm behaviors such as NSSI and suicide attempts alone seems to have a transdiagnostic character, whereas the co-occurrence of risk and self-harm behaviors may represent a specific marker for BPD in adolescents. Overall, RSB appear to be valuable markers for the presence of BPD pathology. This is particularly relevant as some RSB, such as truancy, can be easily recognized by professionals such as teachers, counselors,

and healthcare workers, allowing early intervention to be initiated. RSB should therefore be systematically recorded as soon as they become apparent.

Despite these important findings, three points should be mentioned as limitations. First, there are currently no standardized definitions of RSB and their cut-offs. The cut-offs applied in this study were based on consensus within the research group. Further research is needed to develop clear definitions of RSB. Involving adolescents in defining the boundary between normative and risk-taking behaviors could be a valuable method for future research as adults' perspectives on adolescent behavior may be shaped by different norms and values than those of adolescents. Second, following the issues regarding the definition of RSB, there is no standardized, validated instrument to assess RSB. Such a tool would also be helpful for further research to enable comparison of the results between different studies. Such an instrument could also be used regularly in schools and healthcare facilities to systematically record RSB in terms of prevention. Third, our study focused on depression as a comorbid disorder occurring with BPD as this is particularly common (in our data, 58% of BPD patients also showed depression; other studies have found similar rates of 63% (e.g, Ha et al., 2014). However, RSB is also associated with other comorbid disorders such as attention deficit hyperactivity disorder (ADHD), which is why the specificity of RSB for BPD is only acceptable to a limited extent (Pollak et al., 2019).

Last but not least, further longitudinal studies are needed to examine the longitudinal course of RSB in relation to BPD and other mental disorders and thus further reveal their value as an early detection marker.

Study 2: Evaluation of the Stepped Care Approach in AtR!Sk

Appendix B

Cavelti, M., Blaha, Y., Lerch, S., Hertel, C., Berger, T., Reichl, C., Koenig, J. & Kaess, M. (2024). The evaluation of a stepped care approach for early intervention of borderline personality disorder. *Borderline Personality Disorder and Emotion Dysregulation*, 11(12). https://doi.org/10.1186/s40479-024-00256-1

This study evaluated the stepped care approach currently implemented in AtR!Sk. Specifically, this longitudinal study tested the value of the decision criterion between steps 1 and 2 regarding which individuals receive further treatment if they exhibit significant BPD pathology (at least three fulfilled BPD criteria and a Zanarini score (Zanarini, 2003) of at least six; hypothesis 1). In addition, the study determined whether step 2, which includes DBT-A, provides an incremental treatment benefit for patients beyond step 1 (hypothesis 2).

A total of N = 127 patients were recruited from two AtR!Sk sites in Bern and Heidelberg. Three groups were formed for the data analysis (see Figure 1): The "CDP only" group consisted of individuals who did not fulfill the decision criterion for further DBT-A. The "CDP + DBT-A" group met the decision criterion after CDP and received continued DBT-A. The "CDP no DBT-A" group met the decision criterion for further DBT-A but rejected further treatment. To test hypothesis 1, the two groups that only received CDP ("CPD only" and "CDP no DBT-A") were compared. For hypothesis 2, the two groups that met the decision criterion and were eligible for DBT-A ("CDP + DBT-A" and "CDP no DBT-A") were compared.

Figure 1

Overview of the groups formed for hypothesis testing

Note. 1 = hypothesis 1, 2 = hypothesis 2; "CDP only" = group received CDP

but did not fulfill the decision criterion for stepping up; “CDP + DBT-A” = group received CDP, fulfilled the decision criterion for stepping up and accepted DBT-A; “CDP no DBT-A” = group received CDP, fulfilled the decision criterion for stepping up but declined DBT-A.

Over the CDP period, all three groups showed an improvement in psychosocial functioning, severity of overall psychopathology (except “CDP no DBT-A”), and NSSI (except “CDP + DBT-A”). However, CDP did not lead to any change in the number of BPD criteria met, except in the “CDP no DBT-A” group, in which the number of criteria increased.

In testing hypothesis 1, the “CDP only” group met fewer BPD criteria, had better psychosocial functioning, and had a lower severity of overall psychopathology at one and two years follow-up compared to the “CDP no DBT-A” group. However, the two groups showed no differences in terms of NSSI, and the model on suicide attempts did not reach significance.

With regard to hypothesis 2, the question of the incremental value of DBT-A in step 2 had to be rejected as the “CDP+DBT-A” group did not differ from the “CDP no DBT-A” group.

The evaluation of the stepped care approach in AtR!Sk sheds light on early intervention in BPD and shows that CDP is a promising approach for improving psychosocial functioning and reducing the overall severity of psychopathology and NSSI. Notably, the results endorse the BPD pathology-based criterion used to identify individuals who are eligible for further, more intensive treatment. However, the study also raised questions regarding the stepped care approach. Specifically, the “CDP no DBT-A” group exhibited an increase in BPD symptoms over the course of CDP, challenging the effectiveness of a rigid, uniform treatment paradigm with pre-post evaluation only. However, further research is needed to evaluate whether continuous monitoring could counteract the development of symptoms and whether the number of BPD criteria met is a relevant outcome to measure, at least from the patient's perspective, given that psychosocial functioning improved regardless (regarding recovery, see also “Trajectory: The Course of BPD”, p. 9). The results of the second hypothesis also revealed that DBT-A (step 2) did not provide the expected additional benefit for patients with BPD symptoms exceeding the decision criterion threshold. However, two things should be noted: first, about half of the adolescents in the “CDP no DBT-A” group, which was compared to the “CDP + DBT-A” group for hypothesis 2, received psychotherapeutic treatment outside of AtR!Sk, potentially masking the actual effect of DBT-A. Second, the findings might also be attributed to the choice of treatment programs in steps 1 and 2 as the content of the CDP and DBT-A are highly similar.

Although the stepped care approach offers cost-effective and resource-efficient treatment, the results emphasize the importance of a more adaptive and individualized treatment strategy. The integration of comprehensive clinical case management along the lines of the HYPE clinic (Chanen, Mccutcheon, et al., 2009) could make treatment more effective by holistically addressing the diverse needs of adolescents and going beyond mere symptom management (Hellerstein & Aviram, 2017). Further research is necessary to explore whether non-responders to step 1 would benefit more from alternative treatments with different therapeutic content, such as MBT-A or Adolescent Identity Treatment (AIT; Schlüter-Müller et al., 2020). The results also underline the importance of identifying potential non-responders early in the course of treatment in order to specifically adjust their treatment plan. Future research could therefore examine the course of treatment more closely to identify individual patterns that indicate a positive or negative treatment response. This could help to enable intervention at an early stage and would not only minimize the risk of patients perceiving themselves as untreatable but also make more efficient use of valuable treatment time. In addition, it is essential to gain a deeper understanding of the psychotherapeutic processes during different treatment options in order to enable an optimal match between patient and therapy (Huibers et al., 2021).

Study 3: Integration of Physiological Data into Psychotherapy Process Research

Appendix C

Blaha Y., Cavelti M., Sele S., Koenig J., Zimmermann R., Schmeck K. & Kaess M. (2025). Beyond Self-Reports: Integrating Cortisol Measurement in Psychotherapy Process Research among Adolescents with Borderline Personality Pathology. *Psychotherapy & Psychosomatics.* https://doi.org/10.1159/000547941

To gain a deeper understanding of the changes occurring during psychotherapy and to address questions regarding the validity of self-reports in individuals with BPD, the present longitudinal study explored the combination of subjective self-report measurements and objective biological assessments of the endocrine stress response in the context of early intervention for BPD.

N = 56 patients were examined who met at least three BPD criteria. The data came from a previous study comparing the two treatment approaches of AIT and DBT-A in the treatment of adolescents with BPD pathology. A salivary cortisol sample was collected from all patients and their therapists before and after each session. In addition, all patients and their therapists completed the Session Evaluation Questionnaire (SEQ; Stiles, 1980, 2002) following each session. The SEQ consists of four subscales that measure the immediate treatment outcome at the end of a therapy session (deepness, smoothness) and the affective experience after a session (positivity, arousal). In addition, a single item measures the overall impression of the therapy session (goodness).

While no correlation was found between cortisol responses and session ratings in patients, in therapists, higher scores on smoothness, deepness, positivity, and goodness were associated with less pronounced cortisol responses, reflecting higher relaxation, and higher scores on arousal were associated with higher pronounced cortisol responses, reflecting higher tension. Additional moderator analyses revealed that depression severity impacted the relationship between cortisol responses and session ratings in patients, while age, identity diffusion, severity of BPD, and trauma did not.

There are several possible explanations for the difference found in the correlations between session ratings and the cortisol response between patients and therapists. On the one hand, therapists' ability to accurately perceive and report physiological processes could have contributed to the difference between patients and therapists; this strength might stem from specific training during psychotherapeutic education that increases therapists' interoceptive

ability, that is, the awareness of bodily processes. On the other hand, deficits in patients due to existing psychopathologies such as BPD or depression could account for the difference. Studies suggest that BPD patients have limited access to their internal processes and often present with alexithymia, limiting the identification and description of one's own emotions, which may impair their ability to appropriately interpret physiological states such as arousal or their momentary emotional experience as often required for self-reports, including the SEQ (Bourvis et al., 2021; Derks et al., 2017; Schmitz et al., 2023; Sleuwaegen et al., 2017). However, there may be other reasons for the lack of correlation between cortisol responses and session ratings in patients. These include an altered function of the HPA axis in BPD patients, which has already been described in detail in the literature (Aleknaviciute et al., 2016; Drews et al., 2019; Thomas et al., 2019; Walter et al., 2008), as well as possible response biases due to situation- or relationship-specific variables.

The results of this exploratory study offer initial insights into the expansion of self-report-based assessments in process research by integrating physiological data during the psychotherapeutic treatment of adolescents with BPD features. The integration of biological data into psychotherapy process research could valuably complement traditional approaches, yield a deeper understanding of underlying therapeutic processes, and improve issues regarding the validity of self-reports in BPD patients due psychopathological impairments. However, more research is needed to examine biological variables and their relationship with psychological variables in the psychotherapeutic process.

SYNTHESIS OF THE FINDINGS

The aim of this thesis was to shed light on different aspects of early detection and early intervention of BPD in adolescents and to contribute to closing relevant research gaps. Study 1 addressed the lack of specific markers for the early detection of BPD in adolescents. The results revealed that the combination of risk-taking and self-harm behaviors may be a specific marker for BPD, whereas self-harm behavior is a transdiagnostic marker. Many of the RSB studied represent behaviors that can be easily recognized and addressed by peers, parents, teachers, or other professionals. However, the specificity of these markers in relation to comorbid disorders requires further research.

Study 2 focused on early intervention and evaluated the progressive stepped care approach in AtR!Sk. The results demonstrated that CDP as a first interventional step can have a positive effect on symptom reduction. However, a more intensive step with DBT-A did not provide any significant incremental benefit. This suggests that more individualized tailoring of treatment is needed to increase the effectiveness of early interventions. Although the progressive stepped care approach is structured and resource-saving, progression through the treatment steps is characterized by trial and error (the next step is only initiated if the first treatment step does not respond; Arns et al., 2023; Cross & Hickie, 2017). There is a risk that patients will drop out of treatment if several steps are unsuccessful. Therefore, flexible treatment planning that adapts to the patient's condition and needs is required to improve treatment outcomes (Cross & Hickie, 2017).

Study 3 investigated the integration of the cortisol response as a physiological complement to self-report-based assessments in psychotherapy process research. The combination of these data sources allows for a more comprehensive assessment of psychotherapeutic processes by incorporating objective physiological changes (Marceau et al., 2018). The discrepancy between therapists and patients regarding the correlation between cortisol responses and session ratings showed that self-perception and physiological stress responses do not always match and are therefore complementary and not substitutive methods. The integration of physiological data may thus provide a deeper insight into the processes in psychotherapy and to address issues regarding the validity of self-reports in BPD patients, stemming from psychopathological characteristics like emotional instability or alexithymia. However, further research is needed to improve our understanding of these processes.

Where Is the Big Picture?

Early detection and early intervention of BPD are of great importance given the long-

term consequences associated with the disorder. The studies presented provide valuable insights for the continued development of these approaches. Despite much progress in research, it is challenging to keep track of all the pieces of the puzzle, such as risk factors, early detection markers, symptom trajectories, early intervention, and treatment strategies. Thus far, there is no framework that integrates all the findings and provides a holistic view of the disorder. On the one hand, such a framework would be relevant for research in order to examine the disorder in all its facets and progressions in a structured way and to integrate knowledge from different areas such as psychopathology, genetics, or neuroscience into one framework (Mei et al., 2019). On the other hand, a comprehensive "big picture" would also be useful for clinical practice in order to tailor treatment to individual patients and support clinicians in their decision-making (Mei et al., 2019). The current diagnostic system and the associated disorder-specific approach pursued by the DSM-5 and ICD-11 have their limitations in this regard, as they do not sufficiently take into account the dynamics and complexity of mental disorders, especially BPD (Dalgleish et al., 2020). Two points of criticism are highlighted below.

Problems with the Current Diagnostic System

The disorder-specific model, which focuses primarily on the diagnosis and treatment of full-threshold disorders, has significant limitations when it comes to addressing the dynamic nature of BPD. Subthreshold BPD, often conceptualized as meeting three to four diagnostic criteria, is associated with levels of impairment and intensive use of health services that are similar to those of full-threshold BPD (Kaess, Fischer-Waldschmidt, et al., 2017; Thompson et al., 2019). This emphasizes the importance of a life-course perspective and the implementation of early intervention strategies based on early signs (Videler et al., 2019). The current diagnostic approach unintentionally contributes to treatment delays as interventions are only prioritized once the disorder has fully manifested (Mei et al., 2019).

Furthermore, the current diagnostic system is based on a categorical view that leaves little room for the consideration of symptoms and disorders beyond the boundaries of specific diagnoses. This limited perspective contributes to a failure to consider the multifaceted and often overlapping psychological processes underlying various disorders. In adolescents with BPD, comorbid disorders are the norm (Shah & Zanarini, 2018), which complicates treatment and requires a more integrative treatment approach. Neglecting these comorbidities compromises the effectiveness of treatment strategies and increases the risk of undertreatment or mistreatment if the focus is on the "wrong" diagnosis.

These criticisms underscore the need to move beyond the traditional disorder-specific model and develop new perspectives that allow for a more holistic and flexible approach to mental healthcare. An integrated framework should consider the dynamic development of the disorder, subclinical symptoms, and comorbid conditions. A paradigm shift towards a transdiagnostic view that takes into account the broad spectrum of psychopathology could promote a more comprehensive understanding of BPD not only in adolescents but also in adults.

Clinical Staging Models

Clinical staging models provide a framework for mapping the development and progression of mental disorders. They originated in the somatic field, most prominently in cancer research (Scott & Henry, 2017). Rather than defining a threshold for meeting/not meeting a disorder, as the current DSM-5 and ICD-11 do, clinical staging models categorize the progression of mental disorders from early, non-specific symptoms to more severe, disorder-specific manifestations. Determining the stage of the disorder is used for treatment planning and prognosis. These models emphasize tailored interventions at each stage to prevent progression of the disorder and mitigate long-term effects. This approach not only emphasizes the dynamics of a disorder but also paves the way for early detection and intervention and a holistic treatment strategy that takes into account the complexity of BPD and its comorbidities. Clinical staging models make certain assumptions, such as a) patients at earlier stages respond better to interventions and have a better prognosis than patients at later, more chronic stages; b) interventions in early stages have a better risk-benefit ratio, meaning they are more effective with fewer adverse effects; and c) interventions in early stages are intended to prevent progression of the disease to a higher stage and counteract the chronicity of symptoms (McGorry et al., 2006; McGorry & Mei, 2021). Various clinical staging models have now been developed for BPD, three of which are described below.

BPD and Affective Disorders – Model by Chanen et al. (2016)

Due to the high overlap between BPD and affective disorders and shared risk factors, Chanen et al. (2016) developed a joint clinical staging model. The stages are defined by the extent of the symptoms that occur, with each stage being accompanied by corresponding suggested interventions. These tend to be more general in the early stages (e.g., self-help in stage 0) and become more specific as the stage progresses (e.g., case management or family psychoeducation to complement treatment in stage 2).

Focus on BPD – Model by Hutsebaut et al. (2019)

Hutsebaut et al. (2019) further developed the model of Chanen et al. (2016) and focused exclusively on BPD. The stages were defined based on the following criteria: a) the impairment of personality functioning, as measured by the manifestation, severity, and duration of BPD features; b) the impact on psychopathology and associated impairments, as measured by the manifestation and severity of comorbidities; c) the impact of this impairment on various areas of life and developmental tasks, as measured by the extent of impairment in social, relational, and occupational functioning.

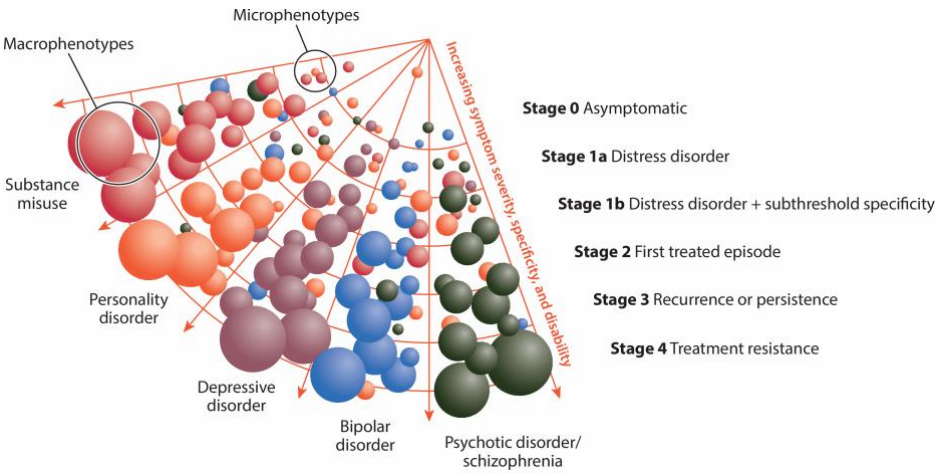
The models by Chanen et al. (2016) and Hutsebaut et al. (2019) take into account the dynamics of the development of BPD but only prove to be disorder-specific or transdiagnostic to a very limited extent and are therefore not described further. Interested readers are referred to Seiffert et al. (2020) for a comprehensive description and comparison of these models.

A Transdiagnostic Perspective – Model by McGorry et al. (2006)

A comprehensive transdiagnostic clinical staging model for mental disorders was developed by McGorry and colleagues (McGorry et al., 2006; Mei et al., 2019). Unlike the previous models, this one is not limited to a specific disorder and therefore recognizes the commonalities between different mental disorders. Stages are defined by the specificity, severity, and persistence of symptoms present, as well as impairment. Early clinical stages are therefore characterized by milder symptom severity and the absence of specific or fully developed syndromic features, and they present with less impairment. In contrast, later stages are characterized by higher symptom severity; increased feature specificity; greater functional impairment; a higher level of stable comorbidity; or clear evidence of syndromic stability, persistence, or recurrence (see Figure 2). The aim of the model is to move from a simple clinical classification to an evidence-based clinicopathological framework in which each syndrome stage is complemented by comprehensive psychological, neurobiological, and clinical phenotyping. This is intended to create the foundation for the selection of highly personalized and stage-specific interventions, secondary prevention, recovery-oriented practice, and the prediction of disease progression. Due to the transdiagnostic approach, this model also takes into account the multifinality of mental disorders, i.e. the development of different mental illnesses from the same symptoms and risk factors (McGorry & Mei, 2021; Mei et al., 2019)

Figure 2

Transdiagnostic clinical stage model in the context of mental illnesses by McGorry, Mei and colleagues (2006; 2021)



Note. Figure adopted from McGorry & Mei (2021).

Integrating Study Findings into Clinical Staging

The findings of the studies presented in this thesis can be embedded in the transdiagnostic clinical staging model and open up new perspectives. The results of Study 1 showed that RSB are important markers for the early detection of BPD in adolescents. This finding is particularly relevant for stage 1, in which initial signs but not yet a fully developed disorder occur and in which preventive measures and early interventions are considered particularly effective. In the previous discussion of Study 1, the question of whether the specificity of RSB in relation to BPD is also valid in relation to comorbid disorders other than depression (e.g., ADHD) remained unanswered. Within the transdiagnostic clinical staging model, the consideration of multifinality, whereby the same signs can lead to different disorders, opens up a new perspective that goes beyond the question of specificity. It also means that RSB may or may not develop into BPD. This underscores the need for careful monitoring and assessment of such behaviors in clinical practice and the implementation of interventions to reduce the risk of developing psychopathology, including BPD, and to promote mental health in adolescence.

The results of Study 2 evaluating the progressive stepped care approach show that a more flexible, adaptive approach is needed to meet the different needs, difficulties, and symptoms of patients. The stepped care approach is itself aligned with the clinical staging

model, in which treatment levels are also based on the progression of the disease (lower, less intensive treatment levels are intended for milder symptoms than the higher, more intensive levels; Cross & Hickie, 2017). However, the clinical staging model offers the possibility of suggesting different treatments for each stage, which can be adapted to the patient based on individual criteria. However, such criteria, which allow patient-treatment matching, are not yet clearly identifiable and are the subject of further research.

The clinical staging model also provides a framework for research, which can help further refine and adapt the model with emerging knowledge. Psychotherapy process research is important to investigate treatments and their challenges at different stages. The integration of physiological and psychological data as a strategy is reflected in the holistic approach of the clinical staging model, which aims to integrate data and findings from different disciplines. Study 3 also discussed differences in interoceptive abilities, alexithymia, and altered HPA axis function in patients, which may explain the differences in the correlation between cortisol responses and session ratings between patients and therapists. The transdiagnostic clinical staging model provides a framework to further investigate these hypotheses and to determine the relevance of these explanations across different stages and related disorders of BPD.

Overall, the transdiagnostic clinical staging model offers a promising framework to obtain an integrated, “big picture” of BPD across all its facets. Although the implementation of such a model in clinical practice might still be a long way off, this approach provides an exciting framework for structured research to advance understanding of BPD and the care of affected patients.

CONCLUSION

This thesis highlights various aspects of BPD in adolescents, from early identification and specific intervention approaches to the integration of physiological data into psychotherapeutic process research. The integration of the findings into the concept of the transdiagnostic clinical staging model emphasizes the importance of a nuanced, holistic approach to both guide future research and improve clinical understanding of the disorder and individual treatment. Despite significant advances in the field, continued research and development of methods for early detection and intervention of BPD in adolescents remains critical to providing enhanced support to individuals and their families in order to improve their quality of life in the long term.

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APPENDICES

Appendix A

Risk-Taking and Self-Harm Behaviors as Markers of Adolescent Borderline Personality Disorder

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ORIGINAL CONTRIBUTION

Risk-taking and self-harm behaviors as markers of adolescent borderline personality disorder

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Abstract

Adolescence is a critical period for early identification and intervention of borderline personality disorder (BPD). Risk-taking and self-harm behaviors (RSB) have been identified as promising early markers of BPD and correlates of depression in school-based samples. The present study aimed, first, to examine the association between RSB and BPD in a clinical sample of adolescents and, second, to examine whether RSB are also linked to depression. N = 405 participants (82.7% female) were recruited from an outpatient clinic for adolescents with RSB. RSB assessed included truancy, excessive media use, alcohol, tobacco, and illicit drug use, sexual risk-taking, and self-harm behavior. Regression analyses and generalized linear models were performed to examine the associations between individual RSB or patterns of RSB (identified using latent class analysis, LCA) and a diagnosis and severity of BPD or depression. All RSB (except excessive media use) were positively associated with BPD diagnosis and severity. In contrast, only non-suicidal self-injury (NSSI) and suicide attempts were positively associated with depression diagnosis and severity, while illicit drug use was negatively associated with depression severity. The LCA yielded two classes differing in the occurrence of RSB. The high RSB class was more likely to have a BPD diagnosis and greater BPD severity than the low RSB class. Classes did not differ regarding depression diagnosis or severity. As NSSI and suicide attempts were associated with both BPD and depression, the presence of additional RSB, besides self-harm behavior, may represent a specific risk marker for BPD in adolescents.

Keywords Borderline personality disorder · Adolescence · Risk-taking behaviors · NSSI · Suicide attempt

Introduction

Borderline personality disorder (BPD) is a severe mental disorder characterized by affect dysregulation, interpersonal and identity difficulties, and self-harm behavior [1]. Like most mental health problems, BPD begins in adolescence [2, 3], with symptoms peaking in early adulthood followed by a decline later in life [4, 5]. Prevalence ranges from approximately 3% of adolescents in the general population to ~ 11% of adolescents in outpatient settings and up to 78% of suicidal adolescents in emergency settings [6]. Although the BPD diagnosis in adolescence has long been controversial,

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there is convincing evidence suggesting that the diagnosis is reliable and valid in adolescence and that its assignment is clinically meaningful, because it paves the way for early intervention [5, 7, 8]. This has also been confirmed by recent guidelines in the field of BPD that summarize the current evidence on early detection and intervention [9]. BPD pathology in adolescence has been found to be associated with lower role and social functioning, life satisfaction, academic and occupational achievement, and partner involvement over the long-term [10]. Increasing evidence indicates that early treatment of BPD can positively impact life trajectories of the affected young people by preventing psychosocial impairment [5, 7, 11]. Therefore, adolescence is a critical time period for early identification of and intervention for BPD to reduce chronification and negative long-term consequences known to result from delayed treatment [12, 13]. Accordingly, identifying risk markers for BPD is an important precondition for early intervention efforts [12].

Risk-taking and self-harm behaviors (RSB) are defined as behaviors that may pose a threat to an individual's physical or psychosocial development. They include truancy, excessive media use, tobacco, illicit drug and alcohol use, sexual risk behavior, non-suicidal self-injury (NSSI), and suicide attempts [14]. RSB are common in adolescence and may occur for a variety of reasons, including social acceptance within the peer group, as an expression of the search for identity and of the desire for autonomy, or as a coping strategy to deal with the stress of developmental and environmental challenges or even emerging psychological problems [15]. In fact, although RSB in adolescents are normative to some degree, they have been found to be associated with BPD and other neuropsychiatric disorders in adolescent community samples [16, 17]. It was shown in a large population-based adolescent sample that RSB add incremental value to the detection of mental disorders beyond the assessment of psychopathology alone [14]. Previous studies have identified NSSI, risky alcohol use, and sexual risk behavior as promising markers for the development of BPD. Early age at onset and longer duration of NSSI in adolescent patients were found to be predictive of BPD in adulthood [18]. In addition, adolescent NSSI and alcohol consumption among community-dwelling adolescents were shown to be predictive of BPD pathology in the following year [19, 20]. Further, adolescents diagnosed with BPD were more likely to have a greater number of sexual partners [21]. Although a recent study found that inpatients with BPD were not more likely to engage in sexual risk behavior than others, they did have riskier attitudes and norms related to sexual risk behavior [22].

The general problem with identifying risk markers for psychiatric disorders is that they are usually not specific to a particular disorder or clinical entity. Indeed, NSSI and excessive alcohol use are not only associated with BPD but also with depression, which is highly comorbid with BPD [23–25]. In a previous study, for example, adolescents with more depressive symptoms exhibited more risky behaviors such as alcohol or illicit drug use or spent more time in front of a computer than adolescents with fewer depressive symptoms [26].

Taken together, most studies on the association between RSB and BPD have been conducted in non-clinical samples [19, 20, 27]. It is unclear if findings generalize to clinical samples where RSB are more common [28, 29]. Moreover, the question of whether RSB are specific signs of BPD or rather transdiagnostic markers of general psychopathology remains unanswered. Therefore, the aim of the current study was twofold: First, to investigate the associations between individual RSB and BPD diagnosis and severity in a clinical sample of adolescents. Second, to explore whether RSB are exclusively associated with BPD, or also with depression.

Methods

Participants and general procedures

Participants were recruited from a specialized outpatient clinic for RSB (AtR!Sk; Ambulanz für Risikoverhalten & Selbstschädigung) at the Department of Child and Adolescent Psychiatry, Center for Psychosocial Medicine, University Hospital Heidelberg, Germany. The service provides low-threshold initial contact, detailed and comprehensive diagnostic assessment of BPD features and evidence-based therapeutic intervention for adolescents with emerging or first presentation BPD [30]. Inclusion criteria for the study were: 12–17 years of age and the presence of at least one of the defined RSB (i.e., truancy, excessive media use, tobacco, alcohol and illicit drug use, sexual risk behavior, NSSI and suicide attempts) at the time of presentation at AtR!Sk. Exclusion criteria were: insufficient German language skills; acute psychotic disorder and/or intention to commit suicide or intention to harm others, requiring immediate inpatient admission; impairment of intellectual functioning; and a diagnosis of bipolar disorder, schizophrenia or schizoaffective disorder. All patients and their legal guardians (if under the age of 16 years) provided written informed consent (or assent, respectively). Assessments were part of the clinical diagnostic assessment at clinic entry. The AtR!Sk cohort study started in 2013 and was completed at the end of 2020. The study was approved by the local ethics committee (ID S-449/2013) and conducted in accordance with the Declaration of Helsinki [31].

Instruments

Demographic data

Demographic data were assessed by a set of standardized questions covering age, sex, and information on school/work, family and living situation.

Borderline personality disorder

The German version of the Structured Clinical Interview for DSM-IV-Axis II (SCID-II) [32] was used to assess the BPD criteria according to the DSM-IV that remained unchanged in the DSM-V. BPD diagnosis is met, if at least five of the nine BPD criteria are fulfilled. Although the SCID-II was originally developed for the use in adults, its application in the adolescent population has been validated [32, 33].

Depression

To obtain the diagnosis of depression (ICD-10 F32 or F33), the German version of the Mini-International Neuropsychiatric Interview for Children and Adolescents (M.I.N.I-KID 6.0) [34, 35] was used. The M.I.N.I-KID is a brief structured diagnostic interview for children and adolescents aged 6 to 17 that covers the major psychiatric disorders of the DSM-IV and ICD-10. To assess depression severity, the Depressionsinventar für Kinder und Jugendliche (DIKJ) [36] was applied. This 27-items questionnaire assesses symptoms of depression according to the DSM-5.

Risk-taking behaviors

Six risk-taking behaviors including truancy, excessive media use, tobacco use, illicit drug use, alcohol use, and sexual risk behavior were assessed, based on evidence from the existing literature (e.g., excessive media use [19, 37], truancy [23], substance use (i.e. tobacco, alcohol, and illicit drug use) [19, 38], sexual risk behavior [27]). Since there are no fixed definitions for when a behavior is considered as risky, the cut-offs were set through consensus between research group members by considering previous publications [14, 19]. The respective items and thresholds for each RSB are described in detail in the Online Resource, Table A.

Self-harm behavior

To obtain a detailed assessment of NSSI and suicide attempts, the German version of the Self-Injurious Thoughts and Behavior Interview was applied [39, 40]. It has been validated for the use in adolescents and shows good psychometric properties. In the current study, having at least one day with NSSI or at least one suicide attempt during the past 12 months were used as dichotomous predictor variables in the analyses. A low threshold for NSSI was chosen because recurrent NSSI has not been shown to be a stronger marker than sporadic NSSI [19].

Statistical analyses

Separate univariate logistic regression analyses were conducted to assess the associations between each individual RSB (risk cut-off met versus not-met) and the presence of a diagnosis of BPD or depression (diagnosis met versus not-met). Odds-ratios (OR) were derived from the respective models as measures of effect size. Generalized linear models (binomial distribution with nine trials) were used to examine the associations between individual RSB (risk cut-off met versus not-met) and the number of fulfilled binominal BPD criteria as a proxy for BPD severity. To examine the relationships between RSB and depression severity, linear regression was applied.

Three sensitivity analyses were conducted. First, as the main analyses were not controlled for age, sex or comorbidity to avoid producing "theoretical" results that would hardly have any application in practice, additional analyses were conducted with age and sex as covariates to gain deeper insight on their influence. Second, to account for comorbidity between BPD and depression, separate bivariate logistic regression analyses were performed to assess the association between each individual RSB and the co-occurrence of BPD and depression. Bivariate logistic regression models the marginal probabilities of BPD and depression—like in the univariate logistic regression—, and additionally estimates the common (joint) odds ratio (COR) for the co-occurrence of BPD and depression, depending on RSB (for details on the statistical approach, see [41] and [42]). We tested if the ratio between the COR for subjects with RSB relative to subjects without RSB is equal to one, to check whether RSB influences comorbidity. Third, to account for the conceptual overlap between BPD criterion 4 (i.e., impulsivity) and alcohol use, drug use, and sexual risk behavior, and between BPD criterion 5 (i.e., self-harm behavior) and NSSI and suicide attempts, respectively, we rerun the univariate regression models with adapted BPD severity scores. For this, when building the sum score, the respective criterion was omitted and the new sum score was multiplied by 9/8 to match the original range of BPD criteria (0–9).

All analyses were adjusted for multiple testing using the Benjamini–Hochberg correction. This correction adjusts the false discovery rate (FDR), leading to more power in finding true positives [43].

To explore patterns of RSB and their potential associations with BPD and depression, a 3-step Latent Class Analysis (LCA) was conducted [44]. First, to estimate the optimal number of classes, models with different numbers

of latent classes were specified. Model fit was compared based on fit indices including the Akaike's Information Criterion (AIC) [45], Schwarz's Bayesian Information Criterion (BIC) [46], and the relative entropy values [47]. AIC and BIC are both based on the log-likelihood but include an additional penalty for model complexity to prevent overfitting of the data. Smaller values of the AIC and the BIC mean a better model fit. The relative entropy (from here on referred to as entropy) reflects the degree of overlap of the latent classes of a model and can take values between 0 and 1. The higher the value, the better the delineation of the individual classes from each other [48]. Second, each subject was assigned to the most probable class based on modal class assignment. Contrasts of each RSB between classes were performed and adjusted for multiple comparisons using the Šidák correction [49], which controls for the family wise error rate (FWER). Third, the regression models predicting BPD and depression diagnosis and severity were repeated with class as the predictor variable.

All analyses were performed using Stata/SE (17.0, Stata Corp LLC, College Station, TX, USA), except from the bivariate logistic regression that was estimated using the packages VGMA in R version 4.1.2 [50]. An alpha level of 0.05 was applied in analyses.

Results

Participants

A total N = 782 patients were invited to take part in the study, of whom n = 678 eventually participated (participation rate of 86.7%). Since the study did not include the assessment of RSB prior to 2015, only data from patients as of that date were included in the current analyses (n = 406 patients). As for one patient only questionnaire data was available, this patient was excluded from the analyses, resulting in a final sample of n = 405. A detailed description of the sociodemographic and clinical characteristics of the total sample (as well as for the subsamples with and without a diagnosis of depression or BPD, respectively) is provided in Table 1.

Associations between RSB and BPD or depression

All RSB, except for excessive media use, were associated with the presence of a BPD diagnosis, increasing the likelihood of being diagnosed with BPD 1.82- to 5.46-fold (see Table 2). Additionally, all RSB were significant predictors of BPD severity, with the presence of RSB increasing the number of BPD criteria by 0.22 to 1.07 criteria. Adolescents who reported at least one occasion of NSSI or one suicide attempt during the past 12 months had a 2.68-fold, respectively, a 2.01-fold increased risk of being

Table 1 Sample characteristics

	Total (N = 405)	No BPD diagnosis (n = 301)	BPD diagnosis (n = 104)	No diagnosis of depression (n = 194)	Diagnosis of depression (n = 211)
Age in years, M (SD)	15.0 (1.5)	14.9 (1.6)	15.4 (1.1)	14.9 (1.6)	15.1 (1.4)
Female sex, n (%)	335 (82.7)	242 (80.4)	93 (89.4)	150 (77.3)	185 (87.7)
BPD, n (%)	104 (25.7)	0 (0.0)	104 (100.0)	44 (22.7)	60 (28.4)
Number of DSM-IV BPD criteria, M (SD)	3.1 (2.1)	2.0 (1.3)	6.0 (1.1)	2.9 (2.3)	3.2 (2.0)
Depression, n (%)	211 (52.1)	151 (50.2)	60 (57.7)	0 (0.0)	211 (100.0)
Severity of depression (N = 349), M (SD)	28.6 (9.6)	27.2 (9.7)	33.2 (7.6)	25.1 (10.2)	31.8 (7.7)
RSB, n (%)					
RSB[a], M (SD)	3.41 (1.6)	3.15 (1.6)	4.16 (1.5)	3.42 (1.7)	3.40 (1.6)
Truancy	95 (23.5)	60 (19.9)	35 (33.7)	43 (22.2)	52 (24.6)
Media usage	268 (66.2)	196 (65.1)	72 (69.2)	126 (64.9)	142 (67.3)
Alcohol	236 (58.3)	159 (52.8)	77 (74.0)	112 (57.7)	124 (58.8)
Illicit drugs	78 (19.3)	47 (15.6)	31 (29.8)	42 (21.6)	36 (17.1)
Tobacco	203 (50.1)	133 (44.2)	70 (67.3)	105 (54.1)	98 (46.4)
Sexual risk behavior	141 (34.8)	94 (31.2)	47 (45.2)	73 (37.6)	68 (32.2)
NSSI	360 (88.9)	259 (86.0)	101 (97.1)	163 (84.0)	197 (93.4)
Suicide attempts	139 (34.3)	86 (28.6)	53 (51.0)	51 (26.3)	88 (41.7)

RSB Risk and self-harm behavior

[a]Mean number of fulfilled RSB, range 0–8

Table 2 Separate univariate associations of RSB with BPD and depression diagnosis and severity

	Truancy	Excessive media use	Alcohol use	Illicit drug use	Smoking	Sexual risk behavior	NSSI	Suicide attempt
BPD diagnosis								
OR	2.04	1.21	2.55	2.29	2.60	1.82	5.46	2.60
95% CI	[1.24; 3.34]	[0.75; 1.95]	[1.56; 4.17]	[1.36; 3.87]	[1.63; 4.16]	[1.15; 2.87]	[1.65; 18.01]	[1.64; 4.11]
p^a	***0.009***	*0.527*	***0.001***	***0.004***	***< 0.001***	***0.017***	***0.009***	***< 0.001***
Number of BPD criteria								
OR	1.57	1.25	1.73	1.77	1.75	1.58	2.92	1.94
95% CI	[1.34; 1.83]	[1.08; 1.44]	[1.50; 2.00]	[1.50; 2.10]	[1.53; 2.02]	[1.37; 1.82]	[2.22; 3.84]	[1.69; 2.24]
p^a	***< 0.001***	***0.007***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***	***< 0.001***
Diagnosis of depression								
OR	1.15	1.11	1.04	0.74	0.74	0.79	2.68	2.01
95% CI	[0.72; 1.82]	[0.74; 1.68]	[0.70; 1.55]	[0.45; 1.22]	[0.50; 1.09]	[0.52; 1.19]	[1.38; 5.20]	[1.32; 3.06]
p^a	*0.636*	*0.659*	*0.833*	*0.338*	*0.179*	*0.340*	***0.007***	***0.003***
Severity of depression								
β	1.25	1.74	0.52	− 4.35	0.38	− 0.94	10.56	3.86
95% CI	[− 1.20; 3.70]	[− 0.37; 3.86]	[− 1.51; 2.55]	[− 7.00; − 1.69]	[− 1.64; 2.40]	[− 3.09; 1.21]	[7.52; 13.60]	[1.76; 5.97]
p^a	*0.405*	*0.161*	*0.677*	***0.003***	*0.735*	*0.482*	***< 0.001***	***0.001***

All models without age and sex as covariates

[a]Benjamini-Hochberg corrected *p*-values for multiple testing

diagnosed with depression. Further, depression severity increased by 10.56 points (range of depression severity scale: 0–54) in the presence of NSSI and by 3.86 points in the presence of a suicide attempt. Depression severity decreased by 4.35 points when fulfilling illicit drug use as one of the RSB.

When the analyses were repeated with age and sex as covariates (sensitivity analysis 1), the results remained mostly unchanged, with three exceptions (see Online Resource, Table B): Sexual risk behavior was no longer associated with a BPD diagnosis ($p = 0.149$), illicit drug use was no longer associated with depression severity ($p = 0.100$), and NSSI was no longer associated with the diagnosis of depression ($p = 0.061$).

The bivariate logistic regression analysis (sensitivity analysis 2) revealed that none of the RSB were significantly associated with the co-occurrence of BPD and depression, except for suicide attempts (see Online Resource, Table C). The presence of at least one suicide attempt during the past year exhibited the most substantial increase in the probability of a depression alone (probability = 0.424) followed by the probability of the co-occurrence of BPD and depression (probability = 0.209), none of the disorders (probability = 0.194), and of BPD alone (probability = 0.173). For a visual representation of these probabilities, please see Online Resource, Figure A).

When the linear regression models were rerun with adjusted BPD severity scores to account for conceptual overlap between RSB and the BPD criteria 4 and 5 (sensitivity analysis 3), the results did not change (see Online Resource, Table D).

Patterns of RSB and their associations with BPD and depression

The LCA resulted in a two-class model as the best fitting model (see Table 3). This model had the lowest BIC value and a higher entropy value than the three-class model. The difference in the AIC values between the two-class and the three-class models was very small. Since the BIC penalizes free parameters more strongly than the AIC, slightly more weight was assigned to the BIC.

Table 3 Fit indices for LCA models

Nr. of classes	BIC	AIC	Entropy
1	3843.20	3811.17	
2	3604.38	3536.31	0.74
3	3637.81	3533.71	0.60

BIC Bayesian information criteria, *AIC* Akaike's information criteria; Models with one, two and three latent classes are reported

Class 1 (hereinafter called *low RSB class*) comprised 54.7% (n = 222) of the sample and was characterized by adolescents with low endorsement probabilities for all RSB (estimated mean endorsement probabilities between $M = 0.01$ to $M = 0.32$), except from excessive media use ($M = 0.63$) and NSSI ($M = 0.92$). Class 2 (hereinafter called *high RSB class*) comprised 45.3% (n = 183) of the total sample and was characterized by adolescents with high endorsement probabilities for all RSB (endorsement probabilities between $M = 0.39$ to $M = 0.93$). Classes significantly differed in their probabilities for all RSB, except from excessive media use ($\chi^2_{(1)} = 2.15$, p = 0.708), NSSI ($\chi^2_{(1)} = 3.23$, $p = 0.451$), and suicide attempts ($\chi^2_{(1)} = 6.98$, $p = 0.064$; see Fig. 1 and Online Resource, Table E).

Belonging to the high RSB class was associated with a 2.62-fold increased likelihood of having a BPD diagnosis and increased the number of BPD criteria by 0.57 compared with belonging to the low RSB class. In contrast, the two classes did not differ in the likelihood of a diagnosis or in severity of depression (Table 4). When the analyses were repeated with age and sex as covariates, the results remained unchanged (see Online Resource, Table F).

Discussion

This study examined the associations of RSB with BPD and depression (diagnosis and severity) for the first time in a clinical sample of adolescents, extending the existing literature based primarily on non-clinical samples. Results show that higher frequencies of all RSB (except from excessive media use) were associated with a higher likelihood of BPD diagnosis and higher BPD severity. In contrast, only NSSI and suicide attempts were associated with a higher

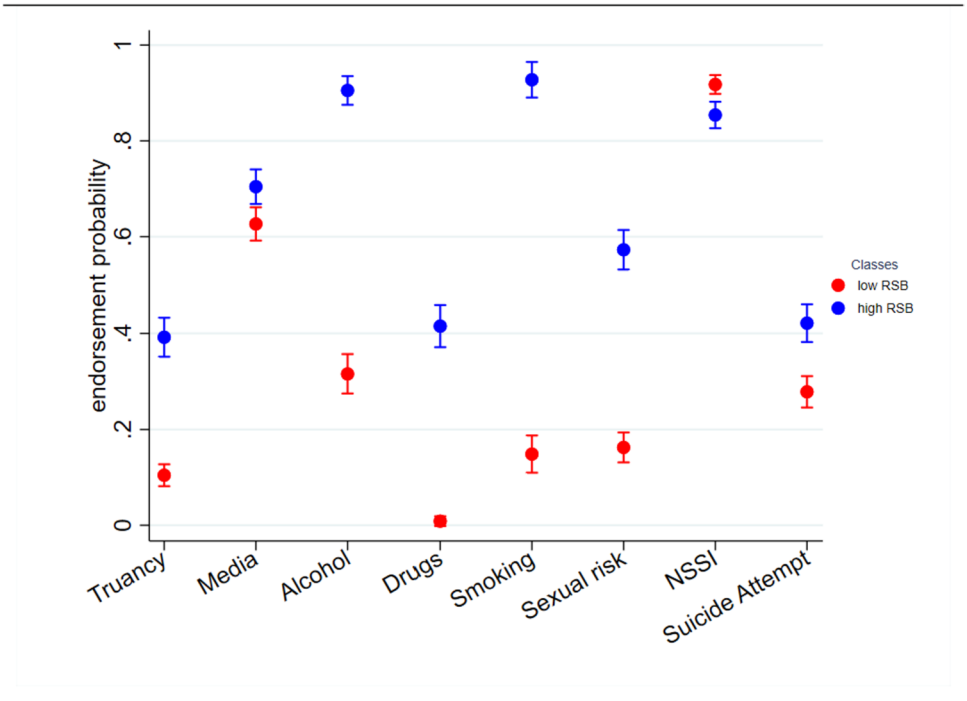

Fig. 1 Two-class model of LCA with the probabilities for each RSB by class. Classes were labeled as "low RSB" and "high RSB" based on the general pattern of endorsement probabilities

Table 4 Univariate associations of BPD and depression diagnosis and severity with LCA classes

	Low RSB class		High RSB class		Class differences				
	M (SE)	95% CI	M (SE)	95% CI	OR	β	SE	95% CI	p^a
BPD diagnosis	0.13 (0.03)	[0.08; 0.18]	0.26 (0.04)	[0.19; 0.34]	2.62		0.62	[1.65; 4.15]	*< 0.001*
Number of BPD criteria	2.17 (0.12)	[1.96; 2.38]	3.16 (0.12)	[2.92; 3.40]		0.57	0.07	[0.43; 0.71]	*< 0.001*
Diagnosis of depression	0.48 (0.43)	[0.40; 0.57]	0.42 (0.04)	[0.34; 0.50]	0.86		0.17	[0.58; 1.27]	*0.436*
Severity of depression	25.62 (0.81)	[24.03; 27.21]	25.94 (0.84)	[24.28; 27.60]		− 0.57	1.04	[− 2.61; 1.47]	*0.583*

All models without age and sex as covariates

LCA Latent Class Analysis; *OR* odds ratio for high RSB class, β regression coefficient

[a]p-values were not adjusted for multiple testing

likelihood of a depression diagnosis and higher depression severity, whereas illicit drug use was associated with lower depression severity. The results remained largely unchanged when the analyses were adjusted for sex and age as covariates, the co-occurrence of BPD and depression, and the conceptual overlap between RSB and BPD. LCA resulted in a two-class solution, with classes differing in the likelihood of occurrence of all RSB except excessive media use, NSSI, and suicide attempts. The high RSB class showed a higher likelihood of a BPD diagnosis and of endorsing more BPD criteria, whereas no associations were found between the classes and depression diagnosis or severity.

In the current study, RSB were able to differentiate between typically highly comorbid BPD and depression, even in a clinical sample in which RSB are generally more common [28]. For instance, substance use (i.e., alcohol, drug, and tobacco use) was positively correlated with BPD pathology, while illicit drug use was negatively correlated with depression severity. These findings are consistent with the results of previous studies that BPD is associated with problematic alcohol use and illicit drug use, independently of anxiety and depressive symptomatology [19, 22, 38]. Thus, substance use may represent a maladaptive coping strategy to avoid negative emotions or to cope with stress associated with BPD symptoms [51, 52]. In contrast to adolescents with BPD pathology, depressed adolescents tend to withdraw themselves from social contacts and therefore lack the opportunity to experiment with substances in the peer context [53].

The finding suggesting sexual risk behavior to serve as specific marker for BPD pathology in adolescents is in line with previous evidence that BPD symptoms are linked to a higher number of romantic partners and that higher numbers of BPD symptoms at age 14 were associated with greater increases in sexual risk behavior over time, but not vice versa [23, 54]. Sexual risk behavior could represent an attempt to avoid partner rejection and abandonment or it may result from relationship instability associated with multiple sexual partners [27]. The underlying mechanisms are not yet fully understood. In addition, individuals with BPD were previously found to have higher rates of sexually transmitted infections compared with individuals without or with other personality disorders [23], suggesting that sexual risk behavior is not only an important early marker for preventing chronicity of BPD but also for preventing long-term sexual health risks. It should be noted, however, that the association between sexual risk behavior and BPD diagnosis disappeared when the models were adjusted for covariates.

Truancy showed similar effect sizes as sexual risk behavior. Likewise, a previous study found that individuals with BPD had more truancy days compared to individuals without or with other personality disorders [23]. Truancy could be an important early sign of BPD particularly as it is an easily identifiable behavior for both schoolteachers and educators. Therefore, a strong network between educational institutions such as schools and mental health services becomes even more important.

Excessive media use was the most common RSB in the entire sample, with a prevalence of 66%, but was not associated with BPD diagnosis and only weakly associated with BPD severity. In fact, there is limited evidence to date of the association between media use and BPD. A study on the longitudinal association between RSB and BPD found a significant association between onset of excessive media use (OR = 1.52) and subsequent BPD diagnosis, but this disappeared completely when models were adjusted for covariates [19]. In addition, previous findings showed an association between pathological Internet use (PIU) and several psychiatric disorders, including BPD [55]. The corresponding authors hypothesized that in patients with PIU, difficulties with identity might be compensated for by excessive Internet use, which could also apply to individuals with BPD. However, further studies are needed to assess the additional value of excessive media use as a risk marker for BPD and psychopathology in general.

In contrast to the other RSB studied, NSSI and suicide attempts demonstrated associations with both BPD and depression pathology. On one hand, this finding is reasonable, given that suicidal behavior is part of the diagnostic criteria according to DSM-5 for both BPD and depression. Additionally, NSSI is recognized as a strong predictor of future suicide attempts [56, 57] and serves as a critical transdiagnostic marker of psychological distress [58]. Although NSSI presents as one of the most common symptoms of BPD in adolescents [59], it has also be found to be a correlate of affective disorders [60] as well as a predictor of depression in particular, even though this relationship is not consistently observed [61–63]. On the other hand, the association of NSSI and suicide attempts with both, BPD and depression, raises the question of whether it is the result of the high comorbidity between BPD and depression. Our sensitivity analyses revealed that while NSSI demonstrated connections with both disorders, it was not linked to the co-occurrence of BPD and depression. In contrast, suicide attempts exhibited a heightened likelihood of the co-occurrence of BPD and depression; however, this probability was outweighed by the higher likelihood of experiencing depression alone. These findings underscore that the associations between NSSI or suicide attempts with BPD or depression are not solely attributable to the high comorbidity between the two disorders. Moreover, the other RSB studied showed no relationship with the co-occurrence of BPD and depression but displayed clear associations with BPD. This highlights the distinct significance of RSB for BPD, which is not explained by co-occurring depression.

The additional sensitivity analyses with age and sex as covariates led to three changes in the results: There was no longer an association between (1) sexual risk behavior and BPD diagnosis, (2) NSSI and depression diagnosis, and (3) illicit drug use and depression severity. In all cases, female sex and, in cases (1) and (2), older age were associated with the BPD and depression outcome variables, respectively. To some extent, the results certainly reflect the higher prevalence of BPD and depression in women in clinical samples, and thus the strong influence of sex in these two disorders [1], as well as the time it takes for a disorder to develop.

The fact that the high RSB class was associated with a higher likelihood of BPD diagnosis and more BPD criteria, while at the same time no associations were found between either class and depression pathology, suggests that the occurrence of risk behaviors, notably multiple risk behaviors, may be a specific indicator of BPD pathology. It should be noted that both classes had an average of BPD criteria that was below the diagnostic cut-off of 5 BPD criteria. However, previous studies have shown that subthreshold BPD (i.e., 3–4 BPD criteria) is already associated with significant impairment in quality of life and psychopathological distress compared with individuals without BPD (i.e., < 3 BPD criteria), which is not different from individuals with a full diagnosis [59]. Thus, the presence of various RSB may help to identify individuals who are at a very early, subclinical stage of BPD development and, therefore, being in need of indicated prevention [64, 65]. In addition, both groups showed a high likelihood of NSSI and suicide attempts, suggesting that these behaviors are more transdiagnostic in nature [60, 66, 67]. It appears that the occurrence of self-harm behaviors along with risk behaviors may be an indicator of evolving BPD pathology in adolescents.

Clinical implication

Recording RSB may yield a valuable indication of the presence of BPD pathology in adolescents, especially when risk behaviors and self-harm behaviors co-occur. As some RSB, such as truancy, may be particularly well identified by teachers, schools and mental health services should work closely in the assessment of RSB to inform early intervention efforts.

Limitations

First, due to the cross-sectional design of the study, no causal interpretation of the temporal associations between RSB and BPD or depression are warranted. Future studies should examine the impact of RSB on the developmental course of BPD and depression over time using longitudinal designs. Second, participants were predominantly female and collected from a specialized outpatient clinic for RSB, resulting in high prevalence rates of RSB in the sample. This limits the generalizability of the present findings to male participants and other psychiatric samples. Third, RSB that are clustered among male adolescents such as delinquent behavior [68] or risky driving [69] have not been assessed. Further studies are needed to examine RSB that may be early markers of BPD in male adolescents. Fourth, the thresholds for RSB are not consistent across the literature and were expert-based rather than evidence-based in the current study. To create consistent evidence, it would be necessary to examine the frequency and time frame in which a behavior must occur to be considered as RSB.

Conclusion

Overall, the results suggest that the presence of self-harm behavior alone is associated with both BPD and depression and may, therefore, represent a somewhat transdiagnostic marker for psychopathology in general [60, 66, 67], whereas the co-occurrence of both self-harm and risk behaviors may be a specific marker for BPD pathology in adolescents. The findings are of particular relevance to clinical practice, as some of these behaviors are readily identifiable, increasing the chance of detecting BPD in adolescents at an early stage to prevent serious long-term consequences and chronicity.

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Author contribution MK designed the study. JK. SL and YB run the analyses. YB and MC wrote the first draft. All authors contributed to, reviewed, and approved the final version of the manuscript.

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Data and/or code availability Data a is available upon request from the corresponding author.

Declarations

Conflict of interests The authors have no conflict of interest to declare. All authors declare that they have no financial or non-financial competing interests relevant to the content of this article.

Ethics approval The AtR!Sk cohort study was approved by the Ethical Committee of the Medical Faculty, Heidelberg University, Germany (Study: ID S-449/2013) and carried out in accordance with the declaration of Helsinki (World Medical Association, 2013).

Consent to participate Written informed consent (or assent, respectively) was obtained from all participants, and also from a parent or legal guardian for those under the age of 16 years.

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Supplement to:

Risk-Taking and Self-Harm Behaviors as Markers of Adolescent Borderline Personality Disorder

European Child and Adolescent Psychiatry

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Table A
Operationalization of RSB

Behavior	Risk Cut-Off	Question	Response [a]
Truancy	… being absent from school for 20% (≥1 month) or more during the past 6 months with less of these days absent being excused	*In the past 6 months, how many days have you been absent from school (excluding school holidays) / at work/training/internship/FSJ (excluding vacations)?*	≤ 5% 10% **20%** **30%** **40%** **50%** **60%** **70%** **80%** **90%** **100%**
		How many days were excused?	**none** **25%** **50%** **75%** all
	or		
	… being absent from school for at least 6-10 additional single hours during the past 6 months with less of these hours being excused.	*In the past 6 months, did you have any extra missing hours from School/Work/Training/Internship/FSJ?*	0 1-5 **6-10** **11-15** **16-20** **21-25** **> 25**
		How many of these missing hours were excused?	**none** **25%** **50%** **75%** all
Excessive media use	… being online for at least 5-6 hours during weekdays	*In the past year, how many hours on average were you engaged in computer games or other online activities on a weekday (Monday to Friday)?*	< 1 hour 1-2 hours 3-4 hours **5-6 hours** **7-8 hours** **> 8 hours**
	or		
	… being online for at least 5-6 hours during weekend/holidays	*In the past year, how many hours on average were you engaged in computer games or other online activities on a single day during the weekend / holidays / public holidays?*	< 1 hour 1-2 hours 3-4 hours **5-6 hours** **7-12 hours** **> 12 hours**
Alcohol use	… consuming alcohol on at least one day per month during the past year	*In the past year, on how many days did you drink at least one glass of alcohol?*	never occasionally **at least 1 once per month** **at least once per week** **2-3 times per week** **almost daily**

			daily
	or		
	… consuming alcohol at least 1-2 times during the past month	*In the past 30 days, on how many days did you drink at least one glass of alcohol?*	0 days **1-2 days** **3-5 days** **6-9 days** **10-19 days** **20-29 days** **daily**
	or		
	… at least 3 events with consuming 3 glasses of alcohol within 3 hours during the past year	*In the past year, did you drink 3 or more alcoholic drinks in one day? And did you drink 3 or more alcoholic drinks within 3 hours at these times? And have you done this 3 times or more in the past year?*	no **yes**
Illicit drug use	… consuming illicit drugs at least occasionally during the past year	*In the past year, on how many days did you consume illicit drugs?*	never **occasionally** **at least 1 once per month** **at least once per week** **2-3 times per week** **almost daily** **daily**
	or		
	… consuming illicit drugs on at least 1-2 days during the past month	*In the past 30 days, on how many days did you consume [specified illicit substance] at least once?*	0 days **1-2 days** **3-5 days** **6-9 days** **10-19 days** **20-29 days** **daily**
Tobacco use	… using tobacco on at least one day per month during the past year	*In the past year, on how many days did you smoke tobacco?*	never occasionally **at least 1 once per month** **at least once per week** **2-3 times per week** **almost daily** **daily**
	or		
	… using tobacco on at least 1-2 days during the past month	*In the past 30 days, on how many days did you smoke tobacco at least once?*	0 days **1-2 days** **3-5 days** **6-9 days** **10-19 days** **20-29 days** **daily**

Sexual risk behavior	… having sex with at least 1 person during the past year or	*In the past year, with how many different people have you had sexual intercourse?*	0 **1** **2-3** **4-7** **≥ 8**
	… having unprotected sex at least 1-2 times during the past year or	*In the past year, how often have you had sex without using contraception?*	0 times **1-2 times** **3-5 times** **6-10 times** **11-15 times** **16-20 times** **> 20 times**
	… having sex without condom at least 1-2 times during the past year	*In the past year, how often have you had sex without using a condom?*	0 times **1-2 times** **3-5 times** **6-10 times** **11-15 times** **16-20 times** **> 20 time**
NSSI	… at least 1 occasion of intentional non-suicidal self-injury during the past year	*In the past year, how many times have you engaged in NSSI?*	**Reported at least once**
Suicide attempts	… having had at least one suicide attempt during the past 12 months	*In the past year, how many suicide attempts have you made?*	**Reported at least once**

Note. [a]The response categories in bold represent the cut-offs for the corresponding risk behaviors.

Table B

Separate univariate associations of RSB with BPD and depression diagnosis and severity, adjusted for covariates

	Truancy	Excessive media use	Alcohol use	Illicit drug use	Smoking	Sexual risk behavior	NSSI	Suicide attempt
BPD Diagnosis								
OR	1.88	1.14	2.08	2.52	2.46	1.48	5.01	2.42
95% CI	[1.13; 3.15]	[.70; 1.87]	[1.23; 3.55]	[1.41; 4.49]	[1.52; 3.99]	[.92; 2.39]	[1.45; 17.25]	[1.51; 3.86]
p[a]	***.029***	*.631*	***.015***	***.005***	***.001***	*.149*[b]	***.023***	***.001***
Number of BPD criteria								
OR	1.49	1.20	1.55	1.90	1.68	1.41	2.73	1.84
95% CI	[1.26; 1.74]	[1.04; 1.40]	[1.33; 1.81]	[1.58; 2.27]	[1.46; 1.94]	[1.21; 1.63]	[2.05; 3.65]	[1.59; 2.12]
p	***<.001***	***.028***	***<.001***	***<.001***	***<.001***	***<.001***	***<.001***	***<.001***
Diagnosis of depression								
OR	1.10	1.07	.87	.75	.68	.66	2.18	1.88
95% CI	[.68; 1.76]	[.70; 1.63]	[.56; 1.35]	[.44; 1.29]	[.45; 1.02]	[.42; 1.02]	[1.06; 4.47]	[1.23; 2.88]
p	*.726*	*.756*	*.581*	*.371*	*.096*	*.101*	*.061*[c]	***.009***
Severity of depression								
β	1.64	1.68	.89	-2.55	.95	-1.37	7.48	3.22
95% CI	[-.69; 3.98]	[-.31; 3.68]	[-1.20; 2.99]	[-5.23; .14]	[-1.00; 2.90]	[-3.48; .74]	[4.20; 1.76]	[1.20; 5.23]
p	*.222*	*.143*	*.459*	*.100*[d]	*.402*	*.258*	***<.001***	***.005***

Note. All models were run with age and sex as covariates; [a]Benjamini-Hochberg corrected p-values for multiple testing; Adjustment for covariates yielded the following changes in the results: [b]Sexual risk behavior was no longer associated with a BPD diagnosis (p = .149; $OR_{(age)}$ = 1.32, $p_{(age)}$ = *.002*; $OR_{sex(female)}$ = 2.56, $p_{sex(female)}$ = *.009*); [c]NSSI was no longer associated with the diagnosis of depression (p = .061; $OR_{(age)}$ = 1.18, $p_{(age)}$ = *.022*; $OR_{sex(female)}$= 1.87, $p_{sex(female)}$ =*.036*); [d]Illicit drug use was no longer associated with depression severity *(*p = .100; $OR_{sex(female)}$ = 8.20, $p_{sex(female)}$ <*.001*).

Table C

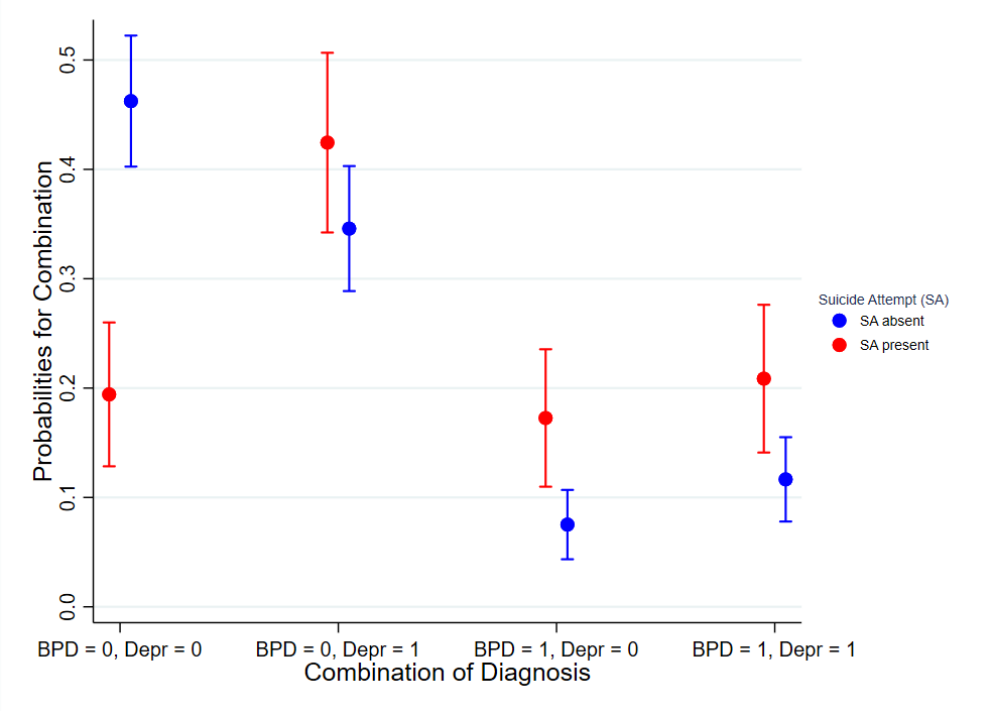
Effect of RSB on the comorbid occurrence of BPD and depression diagnoses based on bivariate logistic regression

	Truancy	**Excessive media use**	**Alcohol use**	**Illicit drug use**	**Smoking**	**Sexual risk behavior**	**NSSI**	**Suicide attempt**
$\frac{COR(RSB = present)}{COR(RSB = absent)}$	.83	1.26	.53	1.01	.73	2.25	.23	.27
95% CI	[.30; 2.24]	[.48; 3.30]	[.19; 1.48]	[.35; 2.90]	[.28; 1.93]	[.89; 5.68]	[.02; 2.94]	[.10; .69]
p^a	*.807*	*.855*	*.605*	*.984*	*.842*	*.348*	*.520*	***.048***

Note. [a]Benjamini-Hochberg corrected *p*-values for multiple testing. All models without age and sex as covariates.

Figure A

Probabilities for combinations of BPD and depression diagnoses and suicide attempts.



Note. SA = Suicide Attempt. BPD / Depr = 0: Respective diagnosis is absent. BPD / Depr = 1: Respective diagnosis is present. Probabilities describe the likelihood of the occurrence of specific combination of diagnoses, given the condition that at least one suicide attempt was present / absent during the past year.

Table D

Separate univariate associations of RSB with BPD diagnosis and severity with adjusted BPD severity for conceptual overlap between diagnostic BPD criteria and RSB

	Truancy	Excessive media use	Alcohol use	Illicit drug use	Smoking	Sexual risk behavior	NSSI	Suicide attempt
Number of BPD criteria (no impulsivity)								
β			.47	.37		.32		
95% CI			[.32; .62]	[.19; .54]		[.16; .47]		
p^b			***<.001***	***<.001***		***<.001***		
Number of BPD criteria (no self-harm)								
β							.76	.63
95% CI							[.48; 1.04]	[.47; .79]
p^b							***<.001***	***<.001***

Note. [a]Benjamini-Hochberg corrected p-values for multiple testing; [b]p-value has not been adjusted for multiple testing. All models without adjustment for age and sex.

Table E

Two-class model of LCA with the probabilities for each RSB by class

	Low RSB class			High RSB class			*Group differences*
	Mean	SE	95% CI	Mean	SE	95% CI	p^a
School	.10	.02	[.07; .16]	.39	.04	[.32; .47]	***<.001***
Media	.63	.03	[.56; .69]	.70	.04	[.63; .77]	*.706*
Alcohol	.32	.04	[.24; .40]	.90	.03	[.83; .95]	***<.001***
Illicit drugs	.01	.01	[.00; .08]	.42	.04	[.33; .50]	***<.001***
Smoking	.15	.04	[.09; .24]	.93	.04	[.81; .97]	***<.001***
Sex risk	.16	.03	[.11; .23]	.58	.04	[.49; .65]	***<.001***
NSSI	.92	.02	[.87; .95]	.85	.03	[.79; .90]	*.451*
Suicide Attempts	.28	.03	[.22; .35]	.12	.04	[.35; .50]	*.064*

Note. All models without age and sex as covariates; LCA = Latent Class Analysis; RSB = Risk-taking and self-harm behavior; [a]Šidák-corrected p-values for multiple testing.

Table F

Univariate associations of BPD and depression diagnosis and severity with LCA classes adjusted for covariates

	Low RSB class		High RSB class		Models with age and sex as covariates				
	M (SE)	CI	M (SE)	CI	OR	*β*	SE	CI	*p*[a]
BPD diagnosis	.13 (.03)	[.08; .18]	.26 (.04)	[.19; .34]	2.45		.61	[1.51; 3.99]	***<.001***
Number of BPD criteria	2.17 (.12)	[1.96; 2.38]	3.16 (.12)	[2.92; 3.40]		.53	.07	[.39; .68]	***<.001***
Diagnosis of depression	.48 (.43)	[.40; .57]	.42 (.04)	[.34; .50]	.78		.17	[.51; 1.19]	*.248*
Severity of depression	25.62 (.81)	[24.03; 27.21]	25.94 (.84)	[24.28; 27.60]		.32	1.03	[-1.71; 2.35]	*.756*

Note. All models without age and sex as covariate; LCA = Latent Class Analysis; OR = odds ratio for high RSB class; *β* = regression coefficient; [a]p-values were not adjusted for multiple testing.

Appendix B

The Evaluation of a Stepped Care Approach for Early Intervention of Borderline Personality Disorder

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Borderline Personality Disorder and Emotion Dysregulation

RESEARCH

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The evaluation of a stepped care approach for early intervention of borderline personality disorder

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Abstract

Background The current study evaluated the stepped care approach applied in AtR!Sk; a specialized outpatient clinic for adolescents with BPD features that offers a brief psychotherapeutic intervention (Cutting Down Program; CDP) to all patients, followed by a more intensive Dialectical Behavioral Therapy for Adolescents (DBT-A) for those whose symptoms persist.

Methods The sample consisted of 127 patients recruited from two AtR!Sk clinics. The number of BPD criteria, psychosocial functioning, severity of overall psychopathology, number of days with non-suicidal self-injury (NSSI; past month), and the number of suicide attempts (last 3 months) were assessed at clinic entry (T0), after CDP (T1), and at 1- and 2-year follow-up (T2, T3). Based on the T1 assessment (decision criteria for DBT-A: ≥ 3 BPD criteria & ZAN-BPD ≥ 6), participants were allocated into three groups; CDP only ($n = 74$), CDP + DBT-A (eligible and accepted; $n = 36$), CDP no DBT-A (eligible, but declined; $n = 17$).

Results CDP only showed significantly fewer BPD criteria (T2: $\beta = 3.42$, $p < 0.001$; T3: $\beta = 1.97$, $p = 0.008$), higher levels of psychosocial functioning (T2: $\beta = -1.23$, $p < 0.001$; T3: $\beta = -1.66$, $p < 0.001$), and lower severity of overall psychopathology (T2: $\beta = 1.47$, $p < 0.001$; T3: $\beta = 1.43$, $p = 0.002$) over two years compared with CDP no DBT-A, while no group differences were found with regard to NSSI and suicide attempts. There were no group differences between CDP + DBT-A and CDP no DBT-A, neither at T2 nor at T3.

Discussion The findings support the decision criterion for the offer of a more intense therapy after CDP. However, there was no evidence for the efficacy of additional DBT-A, which might be explained by insufficient statistical power in the current analysis.

Keywords Borderline personality disorder, Adolescence, Stepped care, Dialectical behavioral therapy, Cutting down program, Early intervention

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Introduction

Borderline personality disorder (BPD) in young people has become a public health priority, because it is a common, disabling, and even fatal disorder [1]. Early diagnosis and treatment ("early intervention") for BPD is indicated to prevent or attenuate the adverse personal, social, and economic consequences. Although still controversially discussed among mental health professionals and individuals with lived experiences alike [2, 3], there is a firm evidence base suggesting that BPD is a reliable and valid diagnosis in adolescence [4]. Furthermore, evidence suggests that structured psychological therapies can result in clinically relevant improvements, particularly with regard to reduction of self-harming behavior which is a predominant feature of BPD in youth [5–8]. However, the evidence is limited by inconsistent meta-analytic findings, a low number of randomized controlled studies, high heterogeneity of samples and control interventions, and high risk of bias [9, 10].

Most adolescents with BPD pathology face multiple barriers when trying to get professional help [11], including the limited availability of evidence-based therapies that are highly specialized and lengthy, and require intensive training and clinical resources [12]. A stepped care approach to treatment delivery has been proposed to address the gap between the high demand for and the limited availability of evidence-based therapies for people with BPD [11, 13–20]. Thereby, the most effective, but least intensive treatment is delivered first, with the opportunity to step up to a more specialized and intensive treatment, based on ongoing assessment of distress, needs, and preferences. Stepped care can be applied using either a stratified or a progressive approach. The stratified approach assigns individuals to the most effective, but least intensive treatment based on an initial assessment, while the progressive approach offers the first-step treatment to all individuals, with the opportunity to step up for those who do not respond [21]. Stratified stepped care may be ultimately the most efficient approach, but it requires knowledge concerning which patient would benefit from particular interventions before the interventions are assigned. Clinical staging may inform the stepped care approach for young people with emerging BPD [5, 22–25]. It takes into account that young people often present with sub-threshold, mixed, and frequently changing symptoms that may not meet yet the diagnostic threshold, but are already associated with emotional burden, a decline in psychosocial functioning, and risk for self-harm, and determine the appropriate treatment according to the stage of the developing disorder [26]. The assumption is that early-stage treatments have a more favorable risk–benefit ratio and can be less specialized and intensive than later-stage treatments [27].

The aim of the current study was to evaluate the progressive stepped cared approach applied in AtR!Sk; a specialized outpatient service that provides evidence-based early intervention for adolescents with BPD features [7]. All patients presenting with any risk-taking or self-harming behavior receive a brief, low-intensity psychotherapeutic intervention for non-suicidal self-injury (NSSI), the Cutting Down Program (CDP) [28, 29]. The presence of any risk-taking and self-harming behavior was chosen as entry criterion into the specialized treatment program as evidence indicates that these behaviors may constitute a risk marker for BPD in adolescents [6, 7]. In line with the expert consensus that early intervention is indicated in the presence of at least 3 BPD criteria [30, 31], patients with persistent BPD symptoms (≥ 3 BPD criteria and a severity score of ≥ 6) after CDP are offered a longer, more intensive Dialectical Behavioral Therapy for Adolescents (DBT-A) [8, 32]. In the current study, we first examined the adequacy of the decision criteria for the transition from the first to the second step of treatment. This was achieved by comparing patients who were not considered eligible for DBT-A after CDP, as their BPD symptoms were below the pre-defined cut-off (i.e., "CDP only group"), with patients who were considered in need of DBT-A after CDP, as their BPD symptoms were above the pre-defined cut-off, but declined the additional therapy offer (i.e., "CDP no DBT-A group"). We hypothesized that the CDP only group would demonstrate lower levels of BPD pathology, general psychopathology, and self-harm, and higher levels of psychosocial functioning one and two years after baseline compared with the CDP no DBT-A group (hypothesis 1). Second, we examined the incremental clinical utility of the second step of treatment by comparing patients who were considered eligible for DBT-A after CDP and accepted the offer (i.e., "CDP + DBT-A group") with the CDP no DBT-A group. We assumed that the CDP + DBT-A group would show lower levels of BPD pathology, general psychopathology, and self-harm, and higher levels of psychosocial functioning at follow-ups compared with the CDP no DBT-A group (hypothesis 2).

Methods

Participants and procedures

The data for the current analyses were pooled from two cohort studies. Participants were consecutively recruited from AtR!Sk (German: Ambulanz für Risikoverhalten & Selbstschädigung) at the Department of Child and Adolescent Psychiatry, University Hospital Heidelberg, Germany, and its pendant at the University Hospital of Child and Adolescent Psychiatry and Psychotherapy, Bern, Switzerland [7]. After the baseline assessment (T0) at clinic entry, all patients presenting with at least one

risk-taking or self-harming behavior (i.e. NSSI, suicide attempts, alcohol or drug misuse, sexual risk behavior, delinquent behavior, truancy, and excessive media usage) irrespective of any BPD criteria receive CDP, followed by a second assessment (T1). If patients still meet three or more BPD criteria in the Structured Clinical Interview for DSM-IV-Axis II Personality Disorders (SCID-II; [33, 34]) and reach an overall severity score of 6 or higher in the Zanarini Rating Scale for BPD (ZAN-BPD; [35]), DBT-A is offered. The decision criteria were chosen in line with the expert consensus that early intervention for BPD is indicated in the presence of three or more BPD criteria [36]. Both treatments have been evaluated in randomized-controlled trials (RCTs) [28, 29, 32, 37] and are described in more detail in the Supplementary Materials (SM).

At T0, patients were invited to take part in the cohort study. Inclusion criteria were: 12–17 years of age and any type of risk-taking or self-harming behavior. Exclusion criteria were insufficient German language skills. All participants and their legal guardians (if under the age of 16 years in Germany or under the age of 14 in Switzerland, respectively) provided written informed consent (or assent, respectively) before inclusion in the study. T0 and T1 assessments were part of the routine clinical procedure. Further assessments were conducted one year (T2) and two years (T3) after baseline. All assessments were conducted by trained clinical psychologists or PhD students. Participants were reimbursed 20 Euros (AtR!Sk Heidelberg) and 85 CHF (AtR!Sk Bern), respectively, for each follow-up assessment. The studies were approved by the local ethics committees (Heidelberg: ID S-449/2013; Bern: ID 2018–00942). The cohort study in Heidelberg started in 2013 and was completed at the end of 2020. The cohort study in Bern started in November 2018 and is still running. Data release for the current study was on the 18th of December 2023.

Measures

Sociodemographic information including age and sex was assessed. The German version of the *Mini-International Neuropsychiatric Interview for Children and Adolescents* (MINI-KID; [38]) was applied to assess psychiatric diagnoses according to the DSM-IV and ICD-10. BPD features and diagnosis according to DSM-IV were measured by the German version of the SCID-II [33, 34], with well-established psychometric properties [39]. BPD diagnosis is met, if at least five of the nine BPD criteria are fulfilled. The diagnostic criteria have remained unchanged in the DSM-5. The severity of each present BPD criterion was rated with regard to the past week using the ZAN-BPD [35]. It is a clinician-administered scale ranging from 0 (=no symptoms) to 4 (=severe symptoms). Psychosocial functioning was assessed by the German version of the *Social and Occupational Functioning Assessment Scale* (SOFAS; [40]) in Bern, and the Global Assessment of Functioning (GAF; [41–43]) in Heidelberg. Scores range between 0 and 100, with higher scores indicating better social and educational/occupational functioning. The SOFAS differs from the GAF by focusing on psychosocial functioning independently of the severity of psychopathology. For the current analyses, a composite score "Level of Functioning (LoF)" was generated by the standardized values of the SOFAS and GAF. Z-standardization was achieved by subtracting the mean at baseline from each value, and dividing each difference by the standard deviation at baseline. The German version of the *Clinical Global Impression Scale—Severity* (CGI-S; [44]) was applied to estimate severity of overall psychopathology within the past seven days, ranging from 1 (=not ill at all) to 7 (=severely ill). The German version of the *Self-Injurious Thoughts and Behaviours Interview (SITBI-G)* [45] was used to capture the number of days with NSSI in the past month, and the number of suicide attempts in the last three months in Bern or in the past month and the last six months in Heidelberg, respectively. For participants from Heidelberg, linear interpolation was used to estimate the number of suicide attempts in the last three months, using the values for the number of suicide attempts in the past month and the last six months. The interpolated values were rounded to the next integer to assure count data. In only 3.7% of all cases differed the number of suicide attempts in the past months from the number of suicide attempts in the last six months, justifying the interpolation.

Statistical analyses

T0 (baseline), T1 (decision criteria), and T2 (retrospective assessment of received therapy) data was necessary to test the hypotheses. Therefore, only participants who completed all three assessments were included in the analyses. There were five participants, who were below the cut-off for DBT-A after CDP, but did nonetheless receive DBT-A due to clinical considerations. Those five participants were allocated to the CDP only group for testing hypothesis 1, and to the CDP + DBT-A group for testing hypothesis 2. Backward stepwise logistic regression minimizing the Bayesian Information Criterion (BIC) was conducted to explore differences between participants who were and were not lost to follow-up with regard to age, sex (female, male), place of recruitment (Heidelberg, Bern), number of BPD criteria (SCID-II), psychosocial functioning (LoF), severity of overall psychopathology (CGI-S), number of suicide attempts (last three months; SITBI-G), and number of days with NSSI (past month; SITBI-G).

To test hypothesis 1, separate mixed-effect linear regressions for the number of BPD criteria (SCID-II), psychosocial functioning (LoF), and severity of overall psychopathology (CGI-S) were conducted, with time (T0, T1, T2, T3), group (CDP only, CDP + DBT-A, CDP no DBT-A), the interaction time x group, and the control variables age, sex (female, male), place of recruitment (Heidelberg, Bern), and other therapy than DBT-A (yes / no) between T1 and T2, and between T2 and T3, respectively, as fixed effects, and subject ID as random effect. For the number of suicide attempts (last three months; SITBI-G) and the number of days with NSSI (past month; SITBI-G), mixed-effect Poisson regression and mixed-effect negative binomial regression, respectively, were applied, using the same fixed and random effects as described above. The decision for either Poisson or negative binomial regression for count data was based on a model comparison using the Akaike Information Criterion (AIC) and BIC, with lower values indicating better model fit (not reported). Before analysis, one outlier with unrealistic values for the number of suicide attempts (i.e., 8, 0, 30, and 30 suicide attempts within the last three months at T0, T1, T2, and T3), and one patient with an impossible value for the number of days with NSSI (i.e., 40 days with NSSI within the past month) were excluded. For all outcome variables, contrasts between the CDP only group and the CDP + no DBT-A group at T1 and T2 were conducted.

Two additional post-hoc analyses were conducted to get a deeper insight into the findings: Firstly, to better understand who benefitted from the CDP in the first step — what might have had an impact on whether patients received the DBT-A offer and whether they accepted or declined it -, the differential trajectories between T0 and T1 were explored across groups. This was achieved by contrasts comparing each outcome variable at T1 versus T0 for each group separately. Secondly, to assess the suitability of the decision criteria used in the AtR!Sk progressive stepped care approach for a future stratified stepped care model, we calculated the proportion of patients allocated to either the CDP only or the two DBT-A groups (i.e., CDP + DBT-A, CDP no DBT-A) who had already met the criteria at baseline.

To test hypotheses 2, the mixed-effect linear regressions for the number of BPD criteria (SCID-II), psychosocial functioning (LoF), and severity of overall psychopathology (CGI-S) described above were repeated, including the outcome variable at T0 and T1 as additional fixed effect. For the number of suicide attempts (last three months; SITBI-G) and the number of days with NSSI (path month; SITBI-G), Poisson and negative binomial regressions, respectively, were conducted, based again on model comparisons using AIC and BIC (not reported). In the prediction model for the number of suicide attempts the random effect was omitted, as it was estimated to be zero. Contrasts between the CDP + DBT-A group and the CDP no DBT-A group at T1 and T2 were calculated.

All statistical analyses were conducted using Stata 17 software [46]. The significance level was set at $\alpha = 0.05$.

Results

Participants

Of $N = 925$ participants (Heidelberg: $n = 673$, Bern: $n = 252$) assessed at T0, $n = 208$ (Heidelberg: $n = 79$, Bern: $n = 129$) took part in the T1 assessment, $n = 500$ (Heidelberg: $n = 351$, Bern: $n = 149$) in the T2 assessment, and $n = 373$ (Heidelberg: $n = 263$, Bern: $n = 110$) in the T3 assessment. The analysis of the losses to follow-up revealed that those who did not attend the T1 assessment ($n = 717$) were more likely to have ICD-10 F8 (i.e., intellectual disabilities) diagnoses (OR = 15.23, $p = 0.009$, 95% CI = 1.96, 117.94) and less likely to be assessed in Bern (OR = 0.13, $p < 0.001$, 95% CI = 0.09, 0.19) compared to those who did attend ($n = 208$). No differences were found between those who missed the T2 assessment ($n = 425$) and those who completed it ($n = 500$). Finally, participants who did not complete the T3 assessment ($n = 552$) were more like to have ICD-10 F9 (i.e., behavioral and emotional disorders with onset usually occurring in childhood and adolescence, such as attention deficit hyperactivity disorder (ADHD) and conduct disorder) diagnoses (OR = 1.63, $p = 0.003$, 95% CI = 1.18, 2.27) compared to those who did ($n = 373$).

There were $n = 127$ participants (Heidelberg: $n = 43$, Bern: $n = 84$) who took part in the T0, T1, and T2 assessments, and were, thus, included in the current analyses. Thereof, $n = 74$ participants (Heidelberg: $n = 23$, Bern: $n = 51$) completed the T3 assessment. The analysis of the losses to follow-up revealed that those who did not attend the T3 assessment ($n = 53$) were more likely to have ICD-10 F6 diagnoses (i.e., disorders of adult personality and behavior; OR = 3.2, $p = 0.004$, 95% CI = 1.45, 7.04) compared with those who did ($n = 74$). Of the 127 participants, 79 were assigned to the CDP only group (74 for testing hypothesis 2), 31 to the CDP + DBT-A group (36 for testing hypothesis 2), and 17 to the CDP + no DBT group. Sample characteristics at baseline for the three groups and for the total sample are provided in Table 1. Mean and standard deviations of the outcome variables (i.e., number of BPD criteria, psychosocial functioning (LoF), severity of overall psychopathology (CGI-S), number of suicide attempts (last 3 months), number of days with NSSI (past month) per group and time point (T0, T1, T2, T3) are depicted in Table 1 in the SM. Notably, at baseline, 19 patients did not meet any BPD criteria,

Table 1 Sample characteristics at baseline

	CDP only (*n* = 74)	CDP + DBT-A (*n* = 36)	CDP + no DBT-A (*n* = 17)	Total (*N* = 127)
Age, M (SD)	15.04 (1.63)	15.53 (1.61)	15.24 (1.39)	15.20 (1.60)
Sex, n (%)				
Female	70 (94.6)	34 (94.4)	16 (94.1)	120 (94.5)
Male	4 (5.4)	2 (5.6)	1 (5.9)	7 (5.5)
Place of recruitment, n (%)				
Heidelberg (D)	23 (31.1)	10 (27.8)	10 (58.8)	43 (33.9)
Bern (CH)	51 (68.9)	26 (72.2)	7 (41.2)	84 (66.1)
Number of BPD criteria, M (SD)	2.04 (1.80)	4.97 (2.36)	4.47 (1.74)	3.20 (2.39)
Days with NSSI (past month)				
M (SD)	6.08 (7.67)	5.39 (5.50)	7.71 (9.51)	6.10 (7.38)
Md (IQR)	3.00 (7.00)	3.50 (7.00)	4.00 (11.00)	3.00 (7.00)
Number of suicide attempts (last 3 months)				
M (SD)	0.16 (0.52)	0.50 (1.38)	0.29 (0.59)	0.28 (0.87)
Md (IQR)	0.00 (0.00)	0.00 (1.00)	0.00 (0.00)	0.00 (0.00)
Psychosocial functioning (LoF)[a], M (SD)	0.30 (0.94) / *n* = 72	-0.23 (0.93) / *n* = 35	-0.21 (0.79)	0.08 (0.95) / *N* = 124
Severity of overall psychopathology (CGI-S), M (SD)	4.11 (0.93) / *n* = 72	4.74 (0.95) / *n* = 35	5.00 (0.61)	4.41 (0.96) / *N* = 124
ICD-10 diagnoses, n (%)[2]				
F0	0	0	0	0
F1	7 (9.5)	9 (25.0)	3 (17.6)	19 (15.0)
F2	0	0	0	0
F3	48 (64.9)	28 (77.8)	15 (88.2)	91 (71.7)
F4	33 (44.6)	21 (58.3)	7 (41.2)	61 (48.0)
F5	2 (2.7)	3 (8.3)	1 (5.9)	6 (4.7)
F6	11 (14.9)	22 (61.1)	6 (35.3)	39 (30.7)
F7	0	0	0	0
F8	0	1 (2.8)	0	1 (0.8)
F9	11 (14.9)	5 (13.9)	7 (41.2)	23 (18.1)
Other therapy than DBT-A between T1 and T2, n (%)	30 (40.5)	0 (0)	9 (52.9)	39 (30.7)
Other therapy than DBT-A between T2 and T3, n (%)	21 (46.7) / *n* = 45	0 (0)	4 (44.4) / *n* = 9	25 (27.8) / *N* = 90

The 5 participants who received DBT-A even though they did not meet the criteria are allocated to the CDP + DBT-A group

BPD borderline personality disorder, *CDP* Cutting Down Program, *CGI-S* Clinical Global Impression Scale – Severity, *DBT-A* Dialectical Behavioral Therapy for Adolescents, *IQR* interquartile range, *LoF* Level of Functioning, *M* mean, *Md* median, *NSSI* non-suicidal self-injury, *T1* after CDP, *T2* 1-year follow-up, *T2* 2-year follow-up, *SD* standard deviation, *F0* Organic, including symptomatic, mental disorders, *F1* Mental and behavioral disorders due to psychoactive substance use, *F2* Schizophrenia, schizotypal, delusional, and other non-mood psychotic disorders, *F3* Affective disorders, *F4* Neurotic, stress-related and somatoform disorders, *F5* Behavioral syndromes associated with physiological disturbances and physical factors, *F6* Disorders of adult personality and behavior, *F7* Intellectual disabilities, *F8* Pervasive and specific developmental disorders, *F9* Behavioral and emotional disorders with onset usually occurring in childhood and adolescence

[a] The reported values of psychosocial functioning are z-standardized scores of the SOFAS and the GAF, respectively. To enhance interpretability, the means, SD and respective values of z = -1, z = 0 and z = 1 are reported here: SOFAS: M = 62.38, SD = 12.18, $SOFAS_{z=-1} = 50.21$, $SOFAS_{z=0} = 62.39$, $SOFAS_{z=1} = 74.57$; GAF: M = 49.49, SD = 11.33, $GAF_{z=-1} = 38.15$, $GAF_{z=0} = 49.49$, $GAF_{z=1} = 60.81$

23 patients did not report NSSI in the past month, and 5 patients did neither meet any BPD criteria nor report NSSI in the past month and were, therefore, offered CDP for other risk-taking behaviors.

Hypothesis 1: testing the decision criteria for DBT-A as second step treatment

Figure 1 shows the trajectories of the three groups over time separately for each outcome variable, and Table 2 provides full results from the regression analyses testing whether the CDP no DBT-A group demonstrates higher levels of psychopathology and lower levels of psychosocial functioning one and two years after baseline compared with the CDP only group. The effects of control variables are reported in Table 2 of the SM. As depicted in Table 2, the regression models for all outcome variables were statistically significant, with the exception of the model predicting the number of suicide attempts in the last three months (with and without inclusion of the outlier). Contrasts revealed

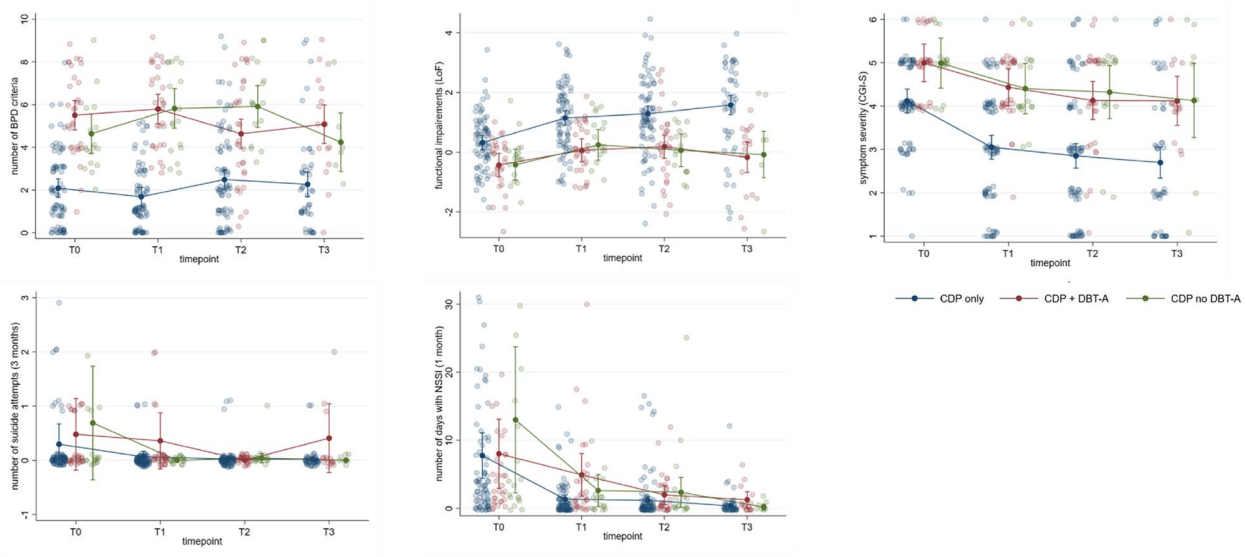

Fig. 1 Courses of outcome variables over time (T0 = baseline, T1 = after CDP, T2 = 1-year follow-up, T3 = 2-year follow-up) separated by group (CDP only, CDP + DBT-A, CDP no DBT-A). CDP = Cutting Down Program; DBT-A Dialectical Behavioral Therapy for Adolescents; BPD = borderline personality disorder; LoF = Level of Functioning; CGI-S = Clinical Global Impression Scale – Severity; NSSI = non-suicidal self-injury. Shaded points represent the raw data point with additional 5% spherical jitter. The connected solid points represent the marginal predicted mean by the model with the 95% confidence interval

Table 2 Results from regression analyses testing whether the CDP no DBT-A group demonstrates higher levels of psychopathology and lower levels of psychosocial functioning one and two years after baseline compared with the CDP only group (hypothesis 1)

Outcome	Model fit	Number of observations	Main effects		Contrasts: CDP only versus CDP no DBT-A				
						β	SE	p	95% CI
Number of BPD criteria	$\chi^2(15) = 212.87, p < 0.001$	446	Time	$\chi^2(3) = 4.52, p = 0.210$	T2	3.42	0.53	< 0.001	2.37, 4.47
			Group	$\chi^2(2) = 134.52, p < 0.001$	T3	1.97	0.74	0.008	0.51, 3.42
			Time x group	$\chi^2(6) = 26.31, p < 0.001$					
Psychosocial functioning (LoF)	$\chi^2(15) = 145.96, p < 0.001$	439	Time	$\chi^2(3) = 29.37, p < 0.001$	T2	-1.23	0.30	< 0.001	-1.81, -0.64
			Group	$\chi^2(2) = 65.23, p < 0.001$	T3	-1.66	0.42	< 0.001	-2.49, 0.84
			Time x group	$\chi^2(6) = 11.17, p = 0.083$					
Severity of overall psychopathology (CGI-S)	$\chi^2(15) = 164.20, p < 0.001$	439	Time	$\chi^2(3) = 44.05, p < 0.001$	T2	1.47	0.33	< 0.001	0.81, 2.12
			Group	$\chi^2(2) = 56.62, p < 0.001$	T3	1.43	0.46	0.002	0.52, 2.34
			Time x group	$\chi^2(6) = 5.49, p = 0.483$					
Number of suicide attempts (last 3 months)	$\chi^2(15) = 23.75, p = 0.069$	440	Time	-	T2	-	-	-	-
			Group	-	T3	-	-	-	-
			Time x group	-					
Number of days with NSSI (past month)	$\chi^2(15) = 141.38, p < 0.001$	440	Time	$\chi^2(3) = 73.06, p < 0.001$	T2	0.69	0.51	0.172	-0.30, 1.68
			Group	$\chi^2(2) = 7.14, p = 0.028$	T3	-0.66	1.23	0.592	-3.07, 1.75
			Time x group	$\chi^2(6) = 11.86, p = 0.065$					

BPD borderline personality disorder, *CDP* Cutting Down Program, *CGI- S* Clinical Global Impression Scale – Severity, *DBT-A* Dialectical Behavioral Therapy for Adolescents, *LoF* Level of Functioning

that the CDP only group had significantly fewer BPD criteria, higher levels of psychosocial functioning, and lower severity of overall psychopathology at both T2 and T3 compared with the CDP no DBT-A group, while no group differences were found with regard to the number of days with NSSI in the past month. To ensure that the five patients who showed neither NSSI nor BPD criteria at baseline did not affect the results,

we repeated the analyses excluding these five patients. The findings regarding the group differences (i.e., contrasts between the CDP only group and the CDP + no DBT-A group) did not change.

The first post-hoc analysis exploring the differential trajectories of the groups between T0 and T1 revealed that the CDP only group showed significant improvements in psychosocial functioning ($p < 0.001$), severity of overall psychopathology ($p < 0.001$), and NSSI ($p < 0.001$), with no significant change in the number of BPD criteria. The CDP no DBT-A group showed significant improvements in psychosocial functioning ($p = 0.036$), and NSSI ($p = 0.001$), with no significant change in the severity of overall psychopathology, and a significant increase in the number of BPD criteria ($p = 0.031$). In contrast, the CDP + DBT-A group showed significant improvements in psychosocial functioning ($p = 0.038$), and severity of overall psychopathology ($p = 0.027$), with no changes in the number of BPD criteria and NSSI. As the main model for suicide attempts (including the interaction time x group) was not significant, we aimed to examine the main effects only by rerunning the analysis without the interaction time x group. This simplified model revealed a significant improvement in suicide attempts between T0 and T1 for all groups ($p = 0.004$). Full results are given in Table 3 of the SM.

For the second post-hoc analysis only data of 100 patients could be used, as 27 patients had missing values in the ZAN-BPD at baseline. Of the 71 patients assigned to the CDP only group at T1, 58 (82%) did not reach the cut-off for DBT-A at baseline, while 13 patients (18%) did. In addition, of the 29 patients assigned to one of the DBT-A groups at T1, 25 (86%) met the cut-off for DBT-A at baseline, while 4 patients (14%) did not.

Hypothesis 2: testing the benefit of DBT-A as second step treatment

Table 3 shows full results from the regression analyses testing whether CDP + DBT-A group shows lower levels of psychopathology and higher levels of psychosocial functioning one and two years after baseline compared with the CDP no DBT-A group. All models were statistically significant, with the exception of the model predicting the number of suicide attempts in the last three months. Contrasts revealed no significant group differences at T1 or T2. The effects of control variables are reported in Table 4 of the SM.

Discussion

This study examined the progressive stepped care approach applied in AtR!Sk; a specialized outpatient service for adolescents with risk-taking and self-harming behavior that offers CDP, followed by DBT-A for those with persistent symptoms. Two main findings emerged.

First, adolescents who were not considered in need of more additional treatment after brief CDP showed fewer BPD symptoms, higher levels of psychosocial functioning, and lower severity of overall psychopathology over two years compared with those who declined DBT-A after CDP even though they were considered eligible due to elevated BPD symptoms. No group differences were found in NSSI or suicide attempts at follow-ups. We interpret this finding in support of the decision criterion for DBT-A as second-step treatment that was chosen in line with the expert consensus that early intervention for

Table 3 Results from regression analyses testing whether CDP + DBT-A group shows lower levels of psychopathology and higher levels of psychosocial functioning one and two years after baseline compared with the CDP no DBT-A group (hypothesis 2)

Outcome	Model fit	Number of observations	Contrasts: CDP + DBT-A versus CDP no DBT-A				
				β	SE	p	95% CI
Number of BPD criteria	$\chi^2(11) = 88.70, p < 0.001$	192	T2	-1.10	0.68	0.104	-2.43, 0.23
			T3	0.94	0.88	0.285	-0.79, 2.67
Psychosocial functioning (LoF)	$\chi^2(11) = 70.12, p < 0.001$	181	T2	0.13	0.39	0.733	-0.64, 0.90
			T3	0.20	0.53	0.706	-0.83, 1.23
Severity of overall psychopathology (CGI-S)	$\chi^2(11) = 66.23, p < 0.001$	181	T2	-0.13	0.42	0.757	-0.94, 0.69
			T3	-0.36	0.52	0.492	-1.38, 0.66
Number of suicide attempts (last 3 months)	$\chi^2(11) = 18.57, p = 0.069$	188	T2	-	-	-	-
			T3	-	-	-	-
Number of days with NSSI (past month)	$\chi^2(11) = 33.64, p < 0.001$	188	T2	0.09	0.73	0.905	-1.12, 1.61
			T3	1.89	1.41	0.182	-0.89, 4.66

BPD borderline personality disorder, *CDP* Cutting Down Program, *CGI- S* Clinical Global Impression Scale – Severity, *DBT-A* Dialectical Behavioral Therapy for Adolescents, *LoF* Level of Functioning

BPD is indicated in the presence of three or more BPD criteria [36]. This interpretation is further supported by the post-hoc analyses, which demonstrated that both the CDP only and CDP no DBT-A groups experienced a reduction of self-harming behavior in the period of CDP delivery, while this was not the case for the CDP + DBT-A group. Notably, there was no change in BPD symptoms in the CDP only and CDP + DBT-A groups and even a worsening of these symptoms in the CDP no DBT-A group in the period of CDP delivery. Taken together, it appears that for adolescents that primarily show self-harming behavior the brief and low intense CDP specifically addressing NSSI seems to be sufficient for many individuals. This may be partially explained by impaired inhibitory control, which correlates with NSSI and contributes to the superiority of shorter treatments over longer ones [47, 48]. In contrast, adolescents that demonstrate more severe difficulties in self and interpersonal functioning (as indicated by higher mean levels of BPD symptoms in the CDP no DBT-A group and the CDP + DBT-A group) are in need of a more comprehensive therapy addressing the core of BPD [49]. This is in also in line with findings of a community-based study [50], which identified two distinct pathways to self-harm; a "psychopathological pathway" with emotion dysregulation, bullying, and caregivers' emotional challenges from an early age, and an "adolescent risky behavior pathway" with risky behavior and less security with peers/family emerging with adolescence. It could be assumed that CDP is enough for patients on the risky behavior pathway, but not for those on the psychopathological pathway. Finally, it could be hypothesized that the lack of improvement in BPD symptoms during the period of CDP delivery in the CDP no DBT-A group may have contributed to their rejection of the DBT-A offer because they were no longer confident that therapy could help them. This interpretation is in line with evidence suggesting that reducing hopelessness and fostering the belief that change is possible is an important factor for long-term improvement among patients with BPD features [51, 52]. Further research is warranted to investigate whether the chosen decision criteria could be used for a stratified stepped care approach, differentiating those adolescents requiring CDP for self-harming behavior from those requiring a more intense and comprehensive treatment such as DBT-A for emerging BPD directly after clinic entry. Preliminary evidence for the suitability of the chosen decision criteria for a stratified stepped care approach was given by the post-hoc analysis suggesting that the majority of patients would have been allocated to the same group if the criteria had been applied at clinic entry (T0) instead of after the completion of the first step treatment (at T1).

Second, no clinical differences were found at the follow-ups between adolescents who accepted and those who declined DBT-A after CDP. This finding is somewhat surprising as both groups showed a clear indication for early intervention for BPD and DBT-A has been found to be effective in reducing BPD features in adolescents in the short-term [32, 37, 53–55]. Approximately half of the adolescents in the CDP no DBT-A group received treatment outside AtR!Sk, which may have contributed to the non-significant group differences in clinical outcomes at the follow-ups. Another explanation is the lack of power in the current study due to the small sizes of the groups to whom DBT-A was offered, suggesting that the finding has to be interpreted with caution. However, with enough power, the effect may be detectable, but still small, calling into question the cost/benefit yield of DBT-A as the step-up intervention, as it requires intensive training and clinical resources. As both groups (i.e., adolescents who accepted and those who declined DBT-A) exhibited still clinically relevant BPD features and psychosocial impairments two years after baseline (see Table 1 in the SM), further research is warranted to examine the incremental efficacy of more intense care and what kind of therapy could be a scalable and effective option for the step-up offer. Finally, the finding highlights the need to identify (early) non-responders [56], as the CDP + DBT-A group did not seem to benefit from either the CDP or the DBT-A.

Limitations and direction for future research

The current study examined a stepped-care approach in the treatment of adolescents with BPD features in a naturalistic design. As a consequence, group allocation occurred not at random, which may have contributed to group differences in clinical variables. To adjust for this, we considered subject matching based on the propensity score, but discarded this approach because of insufficient overlap between groups. Future studies using innovative, experimental designs to examine adaptive interventions (e.g., Sequential, Multiple Assignment, Randomized Trial Design [57]) in the context of early intervention for BPD are warranted. The analyses of the losses to follow-up suggest that adolescents with ICD-10 F8 (i.e., intellectual disabilities) and F9 diagnoses (e.g., ADHD or conduct disorders) were underrepresented in the sample, restricting generalizability of findings. A major limitation of the study is the small size of the CDP + DBT-A and the CDP no DBT-A groups, limiting statistical power to detect group differences. Future studies with larger samples are required to corroborate our findings and to investigate the utility of the three BPD criteria as cut-off for a stratified stepped care approach that assigns individuals to the most effective, but least intensive treatment immediately

after the assessment at clinic entry. Furthermore, future studies should consider additional or alternative decision criteria beyond the number of BPD symptoms. A primary candidate could be the degree of self- and interpersonal dysfunction or psychosocial deficits, as the main goal of early intervention for BPD involves prevention of serious health, social, and educational/occupational impairment [58]. Another important factor is age, given that early intervention is effective across adolescence, but manifests differently, necessitating more developmentally adapted therapeutic interventions [59].

Conclusions

The current study provides evidence for three BPD criteria as cut-off for specialized and more intense early intervention comprehensively addressing difficulties in self and interpersonal functioning, while for those presenting primarily with self-harming behavior a short-term problem-focused intervention may be sufficient. While the current findings support CDP as an efficient and scalable option for the first-step treatment, no evidence was found for the efficacy of DBT-A as the step-up treatment.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40479-024-00256-1.

Supplementary Material 1.

Authors' contributions

MK led the study at both sites. CR was involved in study management. SL and YB performed the statistical analyses. MC and YB wrote the first draft. All authors contributed and approved the final version of the manuscript.

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Availability of data and materials

The data that support the findings of this study are available on request from the corresponding author.

Declarations

Ethics approval and consent to participate

The AtR!Sk cohort studies were approved by the local ethics committees (Heidelberg: ID S-449/2013; Bern: ID 2018–00942). Written informed consent (or assent, respectively) was obtained from all participants, and also from a parent or legal guardian for those under the age of 16 years (Germany) or 14 years (Switzerland), respectively.

Consent for publication

N/A.

Competing interests

The authors declare no competing interests.

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Publisher's Note

Supplementary Materials for

"The evaluation of a stepped care approach for early intervention of borderline personality disorder"

Interventions

The CDP is a manualized, 10-session cognitive-behavioral intervention that has been specifically developed to reduce NSSI in adolescents. It is one of the few evidence-based interventions for this patient group [1]. In a RCT comparing CDP with treatment as usual (TAU), both treatments were equally effective in reducing the frequency of NSSI, but the treatment effect occurred faster in the CDP group compared with the TAU group, even though the former group received fewer therapy sessions than the latter [2]. In the AtR!Sk clinic, the CDP program is also applied to patients who do not report NSSI, but risk-taking behavior, such as alcohol or drug misuse, sexual risk behavior, delinquent behavior, truancy, and excessive media usage.

DBT-A includes 25 individual and 20 group therapy sessions and has been found to be effective in reducing self-harm and BPD symptoms pre-post, with mixed findings regarding the maintenance of the effects and functional improvements [3–6].

During both CDP and DBT-A, patients received family therapy sessions, psychiatric management, and specialist crisis involvement (e.g., outpatient crisis interventions or time-limited admission to the acute ward) when necessary.

Table 1. Mean and standard deviation for the outcome variables per group and time point

	T0			T1			T2			T3		
	CDP only (n = 74)	CDP + DBT-A (n = 36)	CDP + No DBT (n = 17)	CDP only (n = 74)	CDP + DBT-A (n = 36)	CDP + No DBT (n = 17)	CDP only (n = 74)	CDP + DBT-A (n = 36)	CDP + No DBT (n = 17)	CDP only (n = 45)	CDP + DBT-A (n = 20)	CDP + No DBT (n = 9)
Number of BPD criteria, M (SD)	2.04 (1.80)	4.97 (2.36)	4.47 (1.74)	1.65 (1.47)	5.14 (2.46)	5.65 (1.97)	2.40 (2.02)	4.78 (2.67)	6.06 (1.84)	2.02 (2.01)	5.10 (2.65)	4.29 (1.89)
Days with NSSI (past month) , M (SD)	6.08 (7.67)	5.39 (5.50)	7.71 (9.51)	1.84 (5.29)	3.86 (6.10)	1.88 (2.83)	1.49 (3.40)	2.41 (4.23)	2.94 (6.51)	0.46 (1.92)	1.30 (1.98)	0.14 (0.38)
Number of suicide attempts (last 3 months) , M (SD)	0.16 (0.52)	0.50 (1.38)	0.29 (0.59)	0.04 (0.20)	0.17 (0.51)	0.00 (0.00)	0.04 (0.20)	0.88 (5.14)	0.06 (0.25)	0.05 (0.22)	1.70 (6.68)	0.00 (0.00)
Psychosocial functioning (LoF)[1], M (SD)	0.30 (0.94)	-0.23 (0.93)	-0.21 (0.79)	1.19 (1.10)	0.14 (0.82)	0.45 (0.77)	1.25 (1.27)	0.25 (1.30)	0.09 (0.86)	1.58 (1.50)	0.00 (1.41)	-0.03 (1.64)
Severity of overall psychopathology (CGI-S) , M (SD)	4.11 (0.93)	4.74 (0.95)	5.00 (0.61)	3.00 (1.34)	4.28 (0.91)	4.41 (0.87)	2.83 (1.47)	4.09 (1.36)	4.44 (1.09)	2.59 (1.53)	4.10 (1.12)	4.14 (1.95)

Note. Mean and SD of primary outcomes at each time of assessment (T0 = baseline, T1 = after CDP, T2 = 1-year follow-up, T3 = 2-year follow-up) separated by group (CDP only, CDP + DBT-A, CDP no DBT-A). CDP = Cutting Down Program; DBT-A Dialectical Behavioural Therapy for Adolescents; BPD = borderline personality disorder; LoF = Level of Functioning; CGI-S = Clinical Global Impression Scale – Severity; NSSI = non-suicidal self-injury. [1]The reported values are z-standardized scores of the SOFAS and the GAF, respectively. To enhance interpretability, the means, SD, and respective values of z = -1, z = 0 and z = 1 are reported here: SOFAS: M = 62.38, SD = 12.18, $SOFAS_{z=-1}$ = 50.21, $SOFAS_{z=0}$ = 62.39, $SOFAS_{z=1}$ = 74.57; GAF: M = 49.49, SD = 11.33, $GAF_{z=-1}$ = 38.15, $GAF_{z=0}$ = 49.49, $GAF_{z=1}$ = 60.81.

Table 2. Effect of control variables of all models conducted in hypothesis 1.

Outcome	**Model fit**	**Number of observations**	**Control variables**				
				β	SE	p	95% CI
Number of BPD criteria	$\chi^2(15) = 212.87$, $p < 0.001$	446	Age	0.17	0.08	*0.037*	0.01, 0.33
			Sex (male)	-1.14	0.54	*0.036*	-2.20, -0.07
			Dataset (Bern)	0.41	0.27	0.130	-0.12, 0.95
			Therapy (Yes)	0.48	0.30	0.114	-0.11, 1.07
Psychosocial functioning (LoF)	$\chi^2(15) = 145.96$, $p < 0.001$	439	Age	0.02	0.04	0.611	-0.06, 0.11
			Sex	0.18	0.29	0.544	-0.39, 0.75
			Dataset (Bern)	-0.67	0.15	*<0.001*	-0.96, -0.38
			Therapy (Yes)	-0.25	.17	0.148	-0.59, 0.09
Severity of overall psychopathology (CGI-S)	$\chi^2(15) = 164.20$, $p < 0.001$	439	Age	-0.00	0.05	0.970	-0.10, 0.10
			Sex	-0.45	0.34	0.183	-1.12, 0.21
			Dataset (Bern)	-0.13	0.17	0.434	-0.47, 0.20
			Therapy (Yes)	0.16	0.19	0.401	-0.21, 0.53
Number of suicide attempts (last 3 months)	$\chi^2(15) = 23.75$, $p = 0.069$	440	Age	-	-	-	-
			Sex	-	-	-	-
			Dataset (Bern)	-	-	-	-
			Therapy (Yes)	-	-	-	-
Number of days with NSSI (past month)	$\chi^2(15) = 141.38$, $p < 0.001$	440	Age	0.00	0.07	0.972	-0.14, 0.15
			Sex	-1.32	0.55	*0.017*	-2.41, -0.23
			Dataset (Bern)	0.50	0.25	*0.046*	0.01, 0.10
			Therapy (Yes)	0.42	0.34	0.219	-0.25, 1.08

Note. BPD = borderline personality disorder; LoF = Level of Functioning; CGI-S = Clinical Global Impression Scale – Severity; NSSI = non-suicidal self-injury.

Table 3. Results of the post-hoc contrasts exploring the differential trajectories of the groups between T0 and T1

Outcome	**Contrasts: T1 vs. T0**				
	Group	β	SE	p	95% CI
Number of BPD criteria	CDP only	-0.41	0.25	0.110	-0.90, 0.09
	CDP + DBT-A	0.29	0.40	0.473	-0.50, 1.08
	CDP no DBT-A	1.18	0.55	0.031	0.11, 2.25
Psychosocial functioning (LoF)	CDP only	0.82	0.15	<0.001	0.53, 1.12
	CDP + DBT-A	0.49	0.24	0.038	0.03, 0.96
	CDP no DBT-A	0.66	0.32	0.036	0.04, 1.28
Severity of overall psychopathology (CGI-S)	CDP only	-1.07	0.16	<0.001	-1.38, -0.75
	CDP + DBT-A	-0.56	0.25	0.027	-1.06, -0.06
	CDP no DBT-A	-0.59	0.34	0.084	-1.26, 0.08
Number of suicide attempts (last 3 months)	CDP only	-1.10	0.38	0.004	-1.85, -0.34
	CDP + DBT-A	-1.10	0.38	0.004	-1.85, -0.34
	CDP no DBT-A	-1.10	0.38	0.004	-1.85, -0.34
Number of days with NSSI (past month)	CDP only	-1.76	0.25	<0.001	-2.25, -1.27
	CDP + DBT-A	-0.49	0.36	0.172	-1.19, 0.21
	CDP no DBT-A	-1.61	0.50	0.001	-2.58, -0.63

Table 4. Effect of control variables of all models conducted in hypothesis 2.

Outcome	**Model fit**	**Number of observations**	**Control variables**				
				β	SE	p	95% CI
Number of BPD criteria	$\chi^2(11) = 88.70$, $p < 0.001$	192	Age	-0.01	0.12	0.906	-0.24, 0.21
			Sex (male)	-0.77	0.79	0.329	-2.32, 0.78
			Dataset (Bern)	0.61	0.39	0.117	-0.15, 1.37
			Therapy (yes)	0.63	0.35	0.071	-0.05, 1.31
			Number of BPD criteria T0	0.16	0.13	0.350	-0.13, 0.37
			Number of BPD criteria T1	0.12	1.67	0.390	-1.84, 4.72
Psychosocial functioning (LoF)	$\chi^2(11) = 70.12$, $p < 0.001$	181	Age	-0.012	0.06	0.846	-0.14, 0.11
			Sex	0.24	0.44	0.588	-0.62, 1.10
			Dataset (Bern)	-0.18	0.24	0.443	-0.65, 0.28
			Therapy (yes)	-0.33	0.22	0.130	-0.77, 0.10
			LoF T0	0.31	0.12	*0.008*	0.08, 0.54
			LoF T1	0.27	0.11	*0.015*	0.05, 0.49
Severity of overall psychopathology (CGI-S)	$\chi^2(11) = 66.23$, $p < 0.001$	181	Age	-0.04	0.07	0.616	-0.18, 0.11
			Sex	-0.63	0.49	0.199	-1.59, 0.33
			Dataset (Bern)	-0.01	0.25	0.975	-0.50, 0.49
			Therapy (yes)	0.21	0.22	0.324	-0.21, 0.63
			CGI-S T0	0.25	0.13	0.052	-0.00, 0.51
			CGI-S T1	0.34	0.10	*0.001*	0.14, 0.53
Number of suicide attempts (last 3 months)	$\chi^2(11) = 18.57$, $p = 0.069$	188	Age	-0.11	0.20	0.587	-0.49, 0.28
			Sex	-15.27	2839.90	0.996	-5581.38, 5550.83

			Dataset (Bern)	1.29	1.10	0.243	-0.87, 3.46
			Therapy (yes)	1.68	1.11	0.130	-0.49, 3.86
			Suicide Attempts T0	-0.10	1.01	0.324	-2.97, 0.98
			Suicide Attempts T1	0.67	0.60	0.263	-0.50, 1.84
Number of days with NSSI (past month)	$\chi^2(11) = 33.64, p < 0.001$	188	Age	-0.06	0.12	0.610	-0.30, 0.18
			Sex	-1.74	1.11	0.116	-3.92, 0.43
			Dataset (Bern)	0.34	0.45	0.444	-0.54, 1.23
			Therapy (yes)	0.76	0.47	0.108	-0.17, 1.68
			NSSI T0	0.02	0.03	0.528	-0.04, 0.07
			NSSI T1	0.14	0.05	*0.007*	0.04, 0.23

Note. BPD = borderline personality disorder; LoF = Level of Functioning; CGI-S = Clinical Global Impression Scale – Severity; NSSI = non-suicidal self-injury.

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Appendix C

Beyond Self-Reports: Integrating Cortisol Measurement in Psychotherapy Process Research among Adolescents with Borderline Personality Pathology

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Beyond Self-Reports: Integrating Cortisol Measurement in Psychotherapy Process Research among Adolescents with Borderline Personality Pathology

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Short Title: Cortisol Response and Self-Reports in Psychotherapy Process Research

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Keywords: Borderline Personality Disorder, Adolescence, Cortisol, HPA axis, Session Ratings

Abstract

Introduction: Psychotherapy is the primary treatment for adolescent Borderline Personality Pathology (BPP), yet its mechanisms remain unclear. Given potential self-report biases due to alexithymia and impaired interoception, this study examined cortisol responses as a physiological stress marker alongside session ratings from adolescent BPP patients and their therapists to assess its potential as a complementary measure in psychotherapy process research.

Methods: N = 56 adolescents (94.6% female) with BPP (≥ 3 DSM-IV BPD criteria) receiving Adolescent Identity Treatment or Dialectical Behavioral Therapy and their therapists provided pre- and post-session salivary cortisol samples and completed the Session Evaluation Questionnaire. Residual Dynamic Structural Equation Modelling examined associations between cortisol responses and session ratings, with moderation by age, depression, BPP severity, identity diffusion, and trauma.

Results: Cortisol responses did not correlate with session ratings in patients. In therapists, higher cortisol responses were associated with lower session smoothness (r = -.164; $p < .001$) and deepness (r = -.086; $p = .004$), as well as with lower positivity (r = -.145; $p < .001$) and higher arousal (r = .072; $p = .012$) post-session. Higher depression levels moderated the association between cortisol responses and session deepness in patients (β = -.009, $p = .007$).

Conclusion: While session ratings and cortisol responses correlated in therapists, no such correlation was found in patients. Possible mechanisms include altered interoceptive abilities, dysregulated hypothalamic-pituitary-adrenal (HPA) axis function, or increased variability in self-ratings or cortisol due to BPP. While physiological markers and self-reports offer complementary insights into psychotherapy processes, future studies should include healthy and clinical controls and baseline investigation of HPA axis function (i.e. stress reactivity) in both groups, along with additional hormonal markers.

Introduction

Borderline personality disorder (BPD) poses a significant challenge for those affected, their families, and societies. BPD is characterized by intense emotional fluctuations, unstable interpersonal relationships and sense of self, and marked impulsivity [1]. It often begins in adolescence and can lead to negative long-term outcomes like lower educational and occupational attainment, and reduced life satisfaction [2,3]. Thus, early detection and treatment of BPD is crucial, particularly in adolescence when BPD traits are still modifiable [4,5]. First-line treatment for adolescents with Borderline Personality Pathology (BPP) is psychotherapy [6–9].

Despite the increasing evidence for the efficacy of psychotherapeutic approaches such as Dialectical Behavioral Therapy (DBT-A), Mentalization-Based Treatment for adolescents (MBT-A) or Adolescent Identity Treatment (AIT) in reducing BPD symptoms [10,11], treating adolescents with BPP presents several challenges. For instance, dropout rates among patients with BPP are high, ranging from 15-75% in randomized controlled trials [10]. Establishing and maintaining a strong therapeutic alliance is generally considered a buffer against dropout, but can be hindered by emotional instability, impulsivity, and relational difficulties inherent in BPP [1,12–14]. A positive therapeutic alliance is an established predictor of treatment outcome in patients with BPP [12,13], with studies on adolescents with BPP showing that improvements in the working alliance dimensions over time are associated with better treatment outcomes [15]. However, the exact processes that occur during psychotherapy sessions among adolescents with BPP and that can determine treatment outcomes are still little understood and require further research.

Psychotherapy process research aims at examining how and why changes occur in therapy, helping to identify possible ways to improve psychotherapy in order to increase its effectiveness [16]. It involves various methods, including observation of verbal and non-verbal behavior during the therapy session by external raters, interviews, and self-report questionnaires [17]. Self-report questionnaires capture the subjective experiences of patients, which are often invisible to external observers, and are less time-consuming than interviews [18], thus providing a viable tool for clinical practice. The Session Evaluation Questionnaire [SEQ; 19,20] is a widely used instrument in psychotherapy process research, capturing both patients' and therapists' perceptions of each session [18,21]. The SEQ assesses two dimensions - deepness and smoothness - to evaluate session progression, and two additional dimensions - positivity and arousal - to measure a person’s affective state after the session as immediate outcomes of the therapeutic encounter [19,22].

Research has shown that these constructs are related to treatment outcomes, therapeutic alliance, and dropout rates. Higher perceived deepness and smoothness during sessions have been found to be associated with better treatment outcomes [23–29]. Similarly, higher perceived positivity and arousal after sessions tend to correlate with improved outcomes, though the evidence is somewhat limited [23,28,29]. Additionally, deepness and smoothness are closely related to the strength of the therapeutic alliance [23]. Conversely, sessions with lower deepness have been identified as a risk factor for therapy dropout [25,30].

The SEQ's constructs are largely independent of specific therapeutic orientations, making it a versatile tool for assessing session impact across various therapy modalities [22]**.** However, in BPP patients in particular, self-report instruments such as the SEQ can be affected by reduced emotional awareness, impaired introspection and psychopathological features such as interpersonal instability and emotional dysregulation including alexithymia [31,32]. In particular, the tendency to idealize or devalue therapists - typical of interpersonal instability in BPP - may lead to overly positive or negative ratings [33,34]. In addition, self-reports may reflect subjective perceptions of functioning rather than actual functioning itself [35]. Self-reports nevertheless offer a unique insight into a patient's inner experience. However, the many sources that can influence self-reports, particularly in individuals with BPP, emphasize the importance of including additional layers of information to gain a more comprehensive understanding of the therapeutic process.

Biological markers, reflecting underlying physiological processes, may offer unique insights into the psychotherapy process and thus enrich self-report data with an important complementary perspective [36]. Cortisol, a hormone produced by the hypothalamic-pituitary-adrenal (HPA) axis, is of particular interest as it is released in response to psychosocial stress [37,38]. Since psychotherapy sessions themselves can be a source of psychosocial stress, monitoring cortisol levels before and after sessions can inform on a patient's physiological stress response to therapy sessions [39], potentially providing an objective measure of relaxation or tension during the respective session. Combined with subjective self-report data such as data from the SEQ, this approach could offer a more comprehensive understanding of the therapy processes [40].
However, most studies examining cortisol in the psychotherapeutic context have focused on pre-therapy cortisol levels as predictors of treatment outcomes. Studies investigating cortisol changes during therapy are scarce and mostly concentrating on disorders like depression and social anxiety [41]. For instance, one study on adult patients with major depressive disorder found that therapist cortisol change from before to after the therapy session moderated the relationship between patients' cortisol change and their post-session affect, indicating that the social environment influences the cortisol-affect relationship [42]. Another study on therapists working with recently suicidal clients with BPD traits found that while greater perceived session difficulty was unrelated to cortisol changes from before to after therapy session, a stronger working alliance was associated with greater cortisol reductions [43].
Taken together, while the combination of subjective session ratings (such as the SEQ) and biological markers of the stress response during therapy sessions (such as cortisol changes) might overcome the validity issues associated with the sole use of self-reports in BPP patients, to the best of our knowledge, no study today has applied this approach to adolescents with BPP. To address this gap, this study aimed to investigate the association between cortisol response as a physiological marker of stress and subjective session ratings in both patients and therapists within the context of early intervention for adolescents with BPP. The following hypotheses were stated:

- A decrease in cortisol levels from before to after therapy session is associated with higher scores on the SEQ scales deepness, smoothness, positivity, and goodness after the session.
- An increase in cortisol levels from before to after therapy session is associated with an increase on the SEQ scale arousal.

Furthermore, we explored whether individual differences such as sex, age, depression severity, BPD severity, identity diffusion, and trauma history affected the relationship between cortisol response and subjective session ratings in patients. By doing so, we intended to contribute to a better understanding of the psychotherapy process in adolescents with BPP.

Methods

Participants and General Procedures

This is a secondary analysis of data derived from a non-randomized, non-inferiority trial, comparing Adolescent Identity Treatment (AIT) with Dialectical Behavioral Therapy for Adolescents (DBT-A) in treating adolescents with BPP features. Participants were recruited from the Child and Adolescent Psychiatric Hospital of the Psychiatric University Hospitals Basel, Switzerland (AIT), and the Clinic of Child and Adolescent Psychiatry, Centre for Psychosocial Medicine, University of Heidelberg, Germany (DBT-A). Adolescents aged 13-19 years, displaying ≥ 3 DSM-IV BPD criteria and experiencing identity diffusion (as indicated by a total T-score > 60 on the Assessment of Identity Development in Adolescence [AIDA]), were included. Exclusion criteria encompassed an IQ < 80, psychotic or pervasive developmental disorders, severe somatic or neurological disorders, substance addiction, antisocial personality disorder (excluding age-related criteria), and the need for inpatient treatment. All participants provided written informed consent prior to the study. For all patients under the age of 18 years in Germany, and for those in Switzerland that were younger than 14 years of age, additional parental informed written consent was obtained. This was in line with the respective

national legal regulations. In addition, therapists gave a written declaration of consent for study participation. The recruitment phase spanned from 2015 to 2018. For further details on the methodology and the main outcomes of the trial, see [44,45]. Ethical approval for the study was obtained from the local ethics committees (Basel: EKNZ 2015-230, Heidelberg: ID S-425/215).

Psychometric Measures

Session Evaluation. The Session Evaluation Questionnaire [SEQ; 19,20] evaluates both the treatment progress and immediate outcome of a therapy session [22]. It comprises 21 bipolar items rated on a scale from one to seven, aggregating into four factors: “deepness” (i.e., session perceived as deep, valuable, powerful, full and special rather than shallow, worthless, weak, empty and ordinary), “smoothness” (i.e., session perceived as smooth, easy, pleasant, relaxed and comfortable rather than rough, difficult, unpleasant, tense and uncomfortable), “positivity” (i.e., person feels happy, pleased, definite, confident and friendly rather than sad, angry, uncertain, afraid and unfriendly after the session) and “arousal” (i.e., person feels moving, excited, fast, energetic and aroused rather than still, calm, slow, peaceful and quiet after the session) [20]. In addition, the overall session is evaluated with an extra item for “goodness” (i.e., “This session was: good – bad”). Each item is answered on a scale from 1 to 7. Individual items must be reversed before the respective items, five items per subscale, are added up and divided by 5 to obtain a score for each subscale. It has to be noted that although this four-factor structure was found for the American and English versions, the dimension “arousal” was not replicated for the German version [22,46,47].

Depression. The Beck Depression Inventory [BDI-II; 48] is one of the most frequently used instruments for measuring severity of depression. It consists of 21 items. Every item offers four response options, which increase in intensity from 0 to 4 (e.g., sadness: 0 - I am not sad. 1 - I am sad very often. 2 - I am sad all the time. 3 - I am so sad or unhappy that I cannot bear it). The items are summed to give a total score, with higher scores reflecting higher depression severity. Although the BDI-II was designed for adults, it has been validated in adolescent samples [49,50].

Trauma. The German version of the short form of the Childhood Trauma Questionnaire [CTQ; 51,52] was used to assess childhood maltreatment. The questionnaire consists of 28 items, which are rated on a 5-point Likert scale ranging from 1 "never true" to 5 " very often true". In the current analysis, the total sum score was used, ranging from 25 to 125 and reflecting the overall severity of traumatic childhood experiences.

Borderline Personality Disorder. The presence of BPD criteria was determined using the BPD section of the Structured Clinical Interview for DSM-IV Axis II Disorders [SCID-II; 53], which remained unchanged in the DMS-5. The interview assesses the nine diagnostic criteria for BPD, of which five must be met to fulfil the diagnosis. The SCID-II has been validated in adolescent populations [53,54].

Identity diffusion. The Assessment of Identity Development in Adolescence [AIDA; 55], a 58-item questionnaire with a five-step response format (0 = no, 1 = more no, 2 = part/part, 3 = more yes, 4 = yes), is used to discern pathological identity diffusion from typical adolescent identity crises. The items are summed up to a total score, reflecting the degree of identity diffusion. This instrument's psychometric properties have been validated in several culturally adapted versions [55,56].

Psychopathology. The German version of the Mini-International Neuropsychiatric Interview for Children and Adolescents (M.I.N.I-KID 6.0) [57,58] was used to obtain psychiatric diagnoses. The M.I.N.I-KID is a brief structured diagnostic interview for children and adolescents aged 6 to 17 that covers the major psychiatric disorders of the DSM-IV and ICD-10.

Biological Samples

Cortisol. Saliva cortisol levels (nmol/L) were collected from both patients and therapists before and after each therapy session. The collection process involved chewing on a Salivette® cotton swab (Sarstedt, Nümbrecht, Germany) for one minute. Stored at -20°C, these samples were later centrifuged at 3’000 rpm for 5 minutes, producing a clear, low-viscosity supernatant. Cortisol

concentrations were then quantified using a highly sensitive chemiluminescence immunoassay (IBL International, Hamburg, Germany). The assay's precision is noted by its intra- and interassay coefficients, which were below 10% respectively, in this study. Cortisol values ranged from 0.15-531.5 nmol/L. Previous studies reported cortisol reference ranges of 1.69-12.81 nmol/L for children and adolescents aged 6-14 years [59], and 1.0-53.9 nmol/L for those aged 7-15 years [60]. Thus, to account for clear outliers, cortisol values above 60 nmol/L were excluded from the analyses. The cortisol response over the therapy session was calculated as $cortisol_{post\text{-}session} - cortisol_{pre\text{-}session}$.

Statistical Analyses

The association between the cortisol responses and the five subscales of the SEQ (deepness, smoothness, positivity, arousal, goodness) over all sessions of the treatment period was analyzed using Residual Dynamic Structural Equations Modeling [RDSEM; 61]. RDSEM allows for the analysis of within-person covariation between physiological (cortisol) and psychological (session ratings) variables. Session number was included as a predictor to account for temporal trends. As RDSEM does not provide an index to evaluate model fit directly, we applied the model based on the conceptual fit between the longitudinal data and the RDSEM as suggested by Rodebaugh and colleagues [61,62] . The final model specified is illustrated in Figure 1. For more details on the (R)DSEM approach refer to Asparouhov & Muthén [63].

To address concerns regarding multiple testing, we specified an omnibus test to examine whether any of the session rating variables were related to the cortisol responses in patients and therapists (5 parameters therapists, 5 parameters patients). Additionally, a Wald test was performed for the 5 patient-specific association parameters only [64].

As the patient sample included only three male patients, a sensitivity analysis was also conducted to examine the impact of sex on the results. Therefore, the RDSEM was modeled on the data of all female patients and their therapists, excluding the three male patients in the sample.

Finally, moderator analyses were run to examine whether the association between cortisol responses and session ratings in patients is influenced by age, identity diffusion (AIDA), depression severity (BDI-II), BPD severity (SCID-II) or overall traumatization (CTQ total score).

All analyses were conducted using Stata/SE (17.0, Stata Corp LLC, College Station, TX, USA) and Mplus [Version 8.10; ,65]. Bayesian estimation was used within this framework, focusing on the size and uncertainty of the estimated effects rather than significance testing based on p-values. An alpha level of .05 with consideration of the credible interval was applied. Please note that a one-sided p-value is reported as this is the standard in Mplus. All reported data from the analyses performed are standardized coefficients. In order to evaluate the size of the effects found, the standardized coefficients of the RDSEM, which reflect Pearson correlation coefficients in case of the covariance parameters, are interpreted according to Cohen [66; small effect: r =|.10|, medium effect: r = |.30|, large effect: r = |.50|].

Please insert Figure 1 here.

Results

Participants

Seventy-nine participants were assessed for eligibility, of which 60 (75.9%) were finally enrolled in the study. For more details on the participant flow please refer to Schmeck et al. [44]. For the present analysis, four participants had to be excluded as they did not have any session data available. This resulted in a final sample size of 56 participants (70.9%), with 33 participants receiving DBT-A (Heidelberg, 58.9%) and 23 receiving AIT (Basel, 41.1%). A total of 1026 sessions with SEQ data and 1002 sessions (patient) and 1008 sessions (therapist) respectively with cortisol data were available for the data analysis (Table 1).

Please insert Table 1 here.

Pearson correlation coefficients of the SEQ subscales are reported in Table 2, indicating moderate to strong correlations between some of the subscales. Cortisol responses of all patients and therapists over the course of psychotherapy are depicted in Supplementary, Figure 1. For illustrative purposes, the data of all SEQ subscales and the respective cortisol responses of one patient and their therapist is depicted in Supplementary, Figure 2.

Please insert Table 2 here.

Association between cortisol responses and session ratings

The omnibus test confirmed a significant relationship between session ratings and cortisol responses (Wald(10) = 37.95, $p < .001$). The Wald test for the patient-specific association however was non-significant (Wald(5) = 3.00, $p = .700$). In therapists, a decrease in cortisol levels from before to after therapy session was associated with higher scores on smoothness, deepness, positivity, and goodness and an increase in cortisol levels was associated with higher scores on arousal. In contrast, no correlation was found between the cortisol response over the sessions and the session ratings (SEQ subscales) after the sessions in patients (see Table 3). To further explore the relationship between cortisol levels and session ratings in patients, individual trajectories were visualized, enabling for an additional qualitative inspection (see Supplementary, Figure 3). The session number, included in the model as a within-level predictor, did not reveal any significant temporal trends in cortisol responses or session ratings over the course of the therapy sessions. As a sensitivity analyses, data were re-calculated on a female patient only sample with their therapists, and the results remained unchanged (see Supplementary, Table 1).

Please insert Table 3 here.

Moderator analysis

The moderator analysis conducted in the patient sample revealed that depression severity impacts the relationship between cortisol responses and session ratings, while age, identity diffusion, severity of BPD, and trauma did not (see Table 4). Specifically, the negative relationship between cortisol responses and perceived deepness became stronger with increasing depression severity.

Please insert Table 4 here.

Discussion

This study aimed to gain a deeper understanding of the processes during psychotherapy sessions for adolescents with BPP by examining the relationship between subjective session ratings with objective cortisol change over therapy sessions. Interestingly, we found differences in the correlation between session ratings and cortisol responses between patients and therapists. In therapists, a decrease in cortisol levels from before to after the therapy session was correlated to higher scores on smoothness, deepness, positivity, and goodness, where an increase in cortisol levels was associated with higher scores on arousal. However, in patients no correlation between the cortisol responses and session ratings were found. Therefore, our hypotheses were partially confirmed. Notably, in patients, when potential moderating factors were explored, a negative relationship between cortisol responses and deepness-ratings of sessions with increasing depression severity emerged, while no moderating effect was found for sex, age, identity diffusion, BPD severity, and trauma.

Several explanatory mechanisms may have contributed to the divergence in findings between patients and therapists. One possible explanation lies in differences in HPA axis functioning. Research in both adult and adolescent samples suggests that patients with BPP have elevated continuous cortisol levels and a blunted cortisol response to psychosocial stressors [67–74], which may have contributed to the non-connection between session ratings and cortisol responses in patients. A study even indicated that cortisol responses to stressors in BPP patients are delayed, peaking 40 minutes after the stressor rather than 20 minutes as seen in non-BPP individuals [71]. With a therapy session duration of approximately 60 minutes, the timing of the second cortisol measurement (immediately post-session) may also have been too early to capture changes in cortisol. These results may provide an initial indication that attenuated biological stress reactivity in patients with BPP can also be observed during psychotherapy sessions. However, the presence of an attenuated cortisol response to psychosocial stress and its potential impact on the therapeutic process in patients with BPP should be further investigated by future research [75,76].

Alternatively, the observed differences between patients and therapists in the correlations between session ratings and cortisol responses may be explained by differences in interoceptive abilities. Interoception – the awareness of internal bodily signals – is essential for emotional experience, self-perception and situational awareness [77–79]. Therapists, due to their training, may more accurately observe and interpret their physiological states, leading to greater alignment between their subjective experience and cortisol responses. Conversely, patients with BPP often show deficits in interoception and alexithymia, which limits access to internal states and hinders the interpretation of momentary arousal or emotion, as required by the SEQ [31,78,80,81]. Supporting this interpretation, previous studies have shown that individuals with BPD tend to underestimate stress, with observer ratings often proving more accurate [82], possibly due to dissociative coping mechanisms that suppress emotional arousal. Dissociation is also frequent in mental disorders commonly comorbid with BPD, including PTSD and depression [83–87], and is linked to early invalidating experiences, which may foster a habitual disregard of bodily cues for emotions [88].

Lastly, relationship-specific factors may have influenced patients' evaluations of therapy sessions. Considering the interpersonal difficulties characteristic of BPP, social desirability or tendencies to reward or punish their therapist may have impacted patients' response behaviors [18,19].

Our findings suggest that the severity of depression moderated the relationship between cortisol responses and session ratings in patients, with higher depression severity being associated with a stronger negative correlation between cortisol levels and perceived deepness of sessions. This might be explained by a tendency to interpret ambiguous information in a negative manner, which is a common characteristic in depression [89]. Thus, BPP patients with greater depression severity may not only struggle with recognizing bodily signals but also tend to interpret these signals more negatively, intensifying the physiological stress response and thus the negative correlation between cortisol responses and perceived deepness of therapy sessions [90]. These findings might indicate that patients with BPP and pronounced depressive symptoms might benefit from interventions aimed at improving awareness and the accurate interpretation of bodily sensations. For example, mindfulness-based or emotion-focused techniques could help these patients reframe physiological arousal as less overwhelming or threatening, potentially improving patients' ability to meaningfully engage in therapy and integrate therapeutic experiences more effectively. However, these conclusions should be considered preliminary, given that our moderation analyses were not corrected for multiple comparisons and require replication in future studies.

Limitations

The interpretation of our results is subject to several limitations. First, the study is based on a rather small sample with a limited amount of measurement points, questioning the statistical power to detect effects, particularly in the moderation analyses. As no correction for multiple testing was applied, results – particularly those from the exploratory moderation analyses – should be interpreted with caution.

Second, our sample was predominately female. While the sex distribution aligns with common clinical presentations of BPD [91], it limits the applicability of our results to the male population in particular, as well as to the overall BPD population.
Third, several limitations regarding the assessment of cortisol must be acknowledged. No information was available on the exact time of salivary cortisol sampling. Sessions in the outpatient setting generally took place at similar times for each individual, and we focused on pre-post-session changes rather than absolute cortisol levels. However, due to the well-known circadian rhythm of cortisol, we cannot fully rule out confounding effects related to the time of day [92]. In addition, only one cortisol sample was collected directly after the therapy session. Due to possible delayed cortisol responses in BPP patients, the full physiological response may not have been recorded [71]. Moreover, no menstrual cycle related data was available, which is a relevant factor in cortisol secretion, especially in the present predominantly female sample. Lastly, while information on comorbid patient diagnoses and medication use is reported in Table 1, these variables were not included as covariates in the analyses (mainly to not overload the model with a large number of additional variables), and no corresponding data were available for therapists. This limits our ability to account for potential confounding effects of psychotropic or somatic medication use or relevant medical conditions [93–95].
Fourth, although several potential explanatory mechanisms for the observed discrepancies between therapist and patient results have been discussed, the study's design precludes direct testing of these mechanisms.
To advance the investigation of the relationship between physiological stress response markers and subjective self-report, future studies would benefit from including both a healthy control group and a clinical control group as well as a baseline investigation of HPA axis function (i.e. reactivity to stress) in both groups. A healthy control group would help establish normative baselines for cortisol reactivity to stress, enabling the identification of potential pathophysiological alterations specific to individuals with BPP. In parallel, a clinical control group – comprising individuals with other psychiatric diagnoses – would allow researchers to determine whether observed physiological responses to therapy sessions are unique to BPP or reflect broader effects of psychopathology. In addition, future research would benefit from incorporating complementary biological markers, such as oxytocin or prolactin, which were found to be related to social engagement and trust, emotion regulation, and dissociative processes [96,97] – all of which are highly relevant to the dynamics of therapy session experiences.
Finally, we did not examine how session ratings and cortisol responses relate to treatment outcomes, mainly due to insufficient sample size for research questions on the between-person level. Future research including larger treatment samples should explore whether session-specific markers – both physiological and subjective – predict therapeutic engagement, symptom reduction, and functional improvements over time.

Conclusion

This study highlights the potential of integrating biomarkers, such as cortisol measurements, into psychotherapy process research to complement self-report measures and gain a more comprehensive understanding of the psychotherapy process, including consideration of biological processes, which may finally inform ways to improve psychotherapy in order to increase its effectiveness for adolescents with BPP.

Statements

Statement of Ethics

Study approval statement: The study of which data was derived was approved by the Ethical Committee of Northwest and Central Switzerland (Reference: EKNZ 2015-230) and the Ethical Committee of the Medical Faculty, Heidelberg University, Germany (Study: ID S-425/215) and carried out in accordance with the declaration of Helsinki (World Medical Association, 2013).
Consent to participate statement: Written informed consent (or assent, respectively) was obtained from all participants prior to the study. For all patients under the age of 18 years in Germany, and for those in Switzerland that were younger than 14 years of age, additional parental informed written consent was obtained. This was in line with the respective national legal regulations. Therapists gave a written declaration of consent for study participation.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

M.K. and K.S. designed and directed the study, J.K. and R.Z. were responsible for the implementation and data collection during the study. S.S. and Y.B. run the analyses. Y.B. and M.C. wrote the first draft of the manuscript. J.K. supported the editing process of the manuscript. All authors contributed to, reviewed, and approved the final version of the manuscript.

Data Availability Statement

The data that support the findings of this study are not publicly available due to privacy reasons but are available from the corresponding author upon reasonable request.

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Figure Legends

Fig. 1 ***Note.*** SEQ = Session Evaluation Questionnaire, each subscale was individually entered into the model. Cort = Cortisol-Delta ($Cortisol_{post\text{-}session}$ - $cortisol_{pre\text{-}session}$). Additionally, sessions were included as a covariate on the within-level of the model to account for temporal trends (not shown in figure).

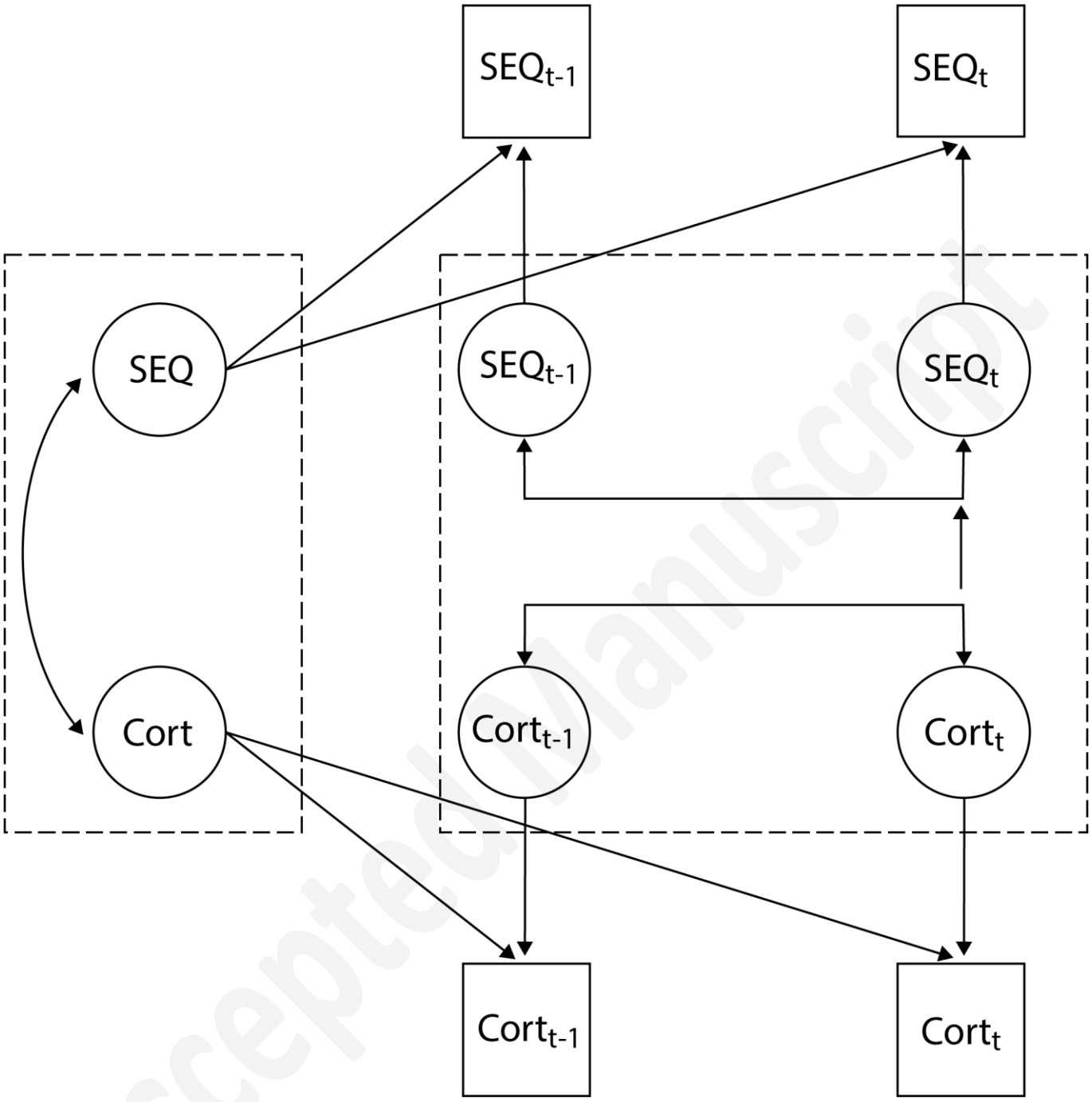

Table 1

Demographic information of patients and therapists

	Patients N = 56	Therapists N = 17
Age, M (SD)	15.9 (1.4)	30.9 (3.9)
Sex, n (%)		
Female	53 (94.6)	13 (76.5)
Male	3 (5.4)	4 (23.5)
Place of recruitment, n (%)		
Heidelberg (D)	23 (31.1)	9 (52.9)
Basel (CH)	51 (68.9)	8 (47.1)
Training level		
Psychotherapist in training	-	9 (52.9)
Psychotherapist fully trained	-	3 (17.6)
Child and Adolescent Psychiatrist		5 (29.4)
Years of practice, M (SD)	-	3.6 (2.8)
Therapeutic orientation	-	
Behavioral therapy		13 (76.5)
Depth Psychology		4 (23.5)
Number of patients per therapists, M (SD) *(range 1-9)*		3.3 (2.4)
Psychotherapy sessions attended, M (SD) *(range 1-25)*	13 (7.21)	-
Number of BPD criteria[1], M (SD) *(range: 0-9, scale range: 0-9; SCID-II)*	3.9 (2.2)	-
Depression severity[2], M (SD) *(range: 0-59, scale range: 0-63; BDI)*	30.7 (16.3)	-
Identity diffusion[3], M (SD) *(range: 32-209, scale range: 0-232; AIDA)*	129.2 (41.3)	-
Trauma[4], M (SD) *(range: 25-90, scale range: 25-125; CTQ)*	49.0 (16.4)	-

ICD-10 diagnoses[5], n (%)		-
No diagnoses	4 (7.1)	
F0	0 (0.0)	
F1	10 (17.9)	
F2	0 (0.0)	
F3	36 (64.3)	
F4	29 (51.8)	
F5	10 (17.9)	
F6	40 (71.4)	
F7	0 (0.0)	
F8	0 (0.0)	
F9	10 (17.9)	
Medication[5], n (%)		-
No medication	39 (69.6)	
Any medication	17 (30.4)	
Antidepressiva	12 (70.6)	
Psychostimulantien	5 (29.4)	
Anxiolytika	2 (11.8)	
Neuroleptika	3 (17.6)	
Hypnotika / Sedativa	1 (5.9)	
Kontrazeptiva	1 (5.9)	

Note. [1]Number of BPD criteria assessed by SCID-II, range: 0-9, scale range: 0-9; [2]Depression severity assessed by BDI, range: 0-59, scale range: 0-63; [3]Identity diffusion assessed by AIDA, range: 32-209, scale range: 0-232; [4]Trauma assessed by CTQ, range: 25-90, scale range: 25-125; [5]Multiple responses by person possible.

Table 2

Correlation of SEQ subscales for patients and therapists

Patient	Smoothness		Arousal		Deepness		Goodness	
	r	SD	r	SD	R	SD	r	SD
Arousal	-.26	.03						
Deepness	.10	.03	.13	.03				
Goodness	.52	.02	-.04	.03	.48	.03		
Positivity	.70	.02	-.28	.03	.16	.03	.50	.03
Therapist								
Arousal	-.23	.03						
Deepness	-.04	.03	.26	.03				
Goodness	.46	.03	.02	.03	.53	.02		
Positivity	.65	.02	-.24	.03	.24	.03	.59	.02

Note. *r* = Correlation coefficient; SD = Standard deviation

Table 3

Correlation between cortisol response and session ratings

Variable	r	SD	CI		p^a
			lower 2.5%	upper 2.5%	
Patient					
Smoothness	-.011	.033	-.076	.053	*.369*
Arousal	-.025	.032	-.088	.036	*.221*
Deepness	-.032	.034	-.098	.032	*.167*
Goodness	-.049	.033	-.112	.016	*.070*
Positivity	-.014	.033	-.079	.051	*.329*
Therapist					
Smoothness	-.164	.032	-.225	-.102	***<.001***
Arousal	.072	.033	.008	.137	***.012***
Deepness	-.086	.032	-.149	-.022	***.004***
Goodness	-.130	.032	-.192	-.066	***<.001***
Positivity	-.145	.032	-.208	-.082	***<.001***

Note. [a] = One-sided p-value; r = Correlation coefficient; CI = Credible Interval. RDSEM models are estimated in a Bayesian estimator, therefore the 95% credible intervals are reported.

Table 4

Moderation Analysis

	Variable	*β*	SD	CI		*p*[a]	Wald	df	*p*
				lower 2.5%	upper 2.5%				
Age	Arousal	-.020	.027	-.071	.033	*.236*	.783	5	*.978*
	Deepness	-.005	.028	-.062	.050	*.429*			
	Goodness	-.008	.028	-.062	.047	*.376*			
	Positivity	-.009	.028	-.066	.044	*.362*			
	Smoothness	.004	.029	-.054	.060	*.436*			
Identity diffusion (AIDA)	Arousal	.002	.002	-.002	.005	*.183*	3.739	5	*.588*
	Deepness	-.002	.002	-.005	.002	*.189*			
	Goodness	-.001	.002	-.004	.002	*.246*			
	Positivity	.000	.002	-.003	.003	*.455*			
	Smoothness	-.002	.002	-.006	.001	*.088*			
Depression severity (BDI)	Arousal	-.007	.004	-.015	.001	*.043*[b]	11.575	5	***.041***
	Deepness	-.009	.004	-.016	-.002	***.007***			
	Goodness	-.005	.004	-.0122	.002	*.066*			
	Positivity	.002	.004	-.005	.009	*.304*			
	Smoothness	.000	.004	-.008	.008	*.494*			
Number of DSM-IV BPD criteria (SKID-II)	Arousal	-.001	.027	-.055	.051	*.484*	.404	5	*.995*
	Deepness	-.002	.027	-.057	.050	*.465*			
	Goodness	-.001	.026	-.050	.051	*.475*			
	Positivity	.004	.027	-.048	.055	*.432*			
	Smoothness	-.016	.027	-.071	.037	*.275*			
	Arousal	.000	.003	-.005	.005	*.452*	.620	5	*.987*

Table 4

Moderation Analysis

	Variable	*β*	SD	CI		p^a	Wald	df	*p*
				lower 2.5%	upper 2.5%				
Trauma (CTQ)	Deepness	-.001	.003	-.006	.004	*.341*			
	Goodness	-.001	.002	-.006	.003	*.281*			
	Positivity	.000	.002	-.005	.005	*.500*			
	Smoothness	-.001	.003	-.006	.004	*.318*			

Note. [a] = One-sided p-value, [b] = This value is not considered as significant, as zero (0) is not included in credible interval. *β* = Standardized egression coefficient. CI = Credible Interval. RDSEM models are estimated in a Bayesian estimator, therefore the 95% credible intervals are reported. AIDA = Assessment of Identity Development in Adolescence, BDI = Becks Depression Inventory, BPD = Borderline Personality Disorder (severity), CTQ = Child Trauma Questionnaire.

Supplement to:

Beyond Self-Reports: Integrating Cortisol Measurement in Psychotherapy Process Research among Adolescents with Borderline Personality Pathology

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Short Title: Cortisol Response and Self-Reports in Psychotherapy Process Research

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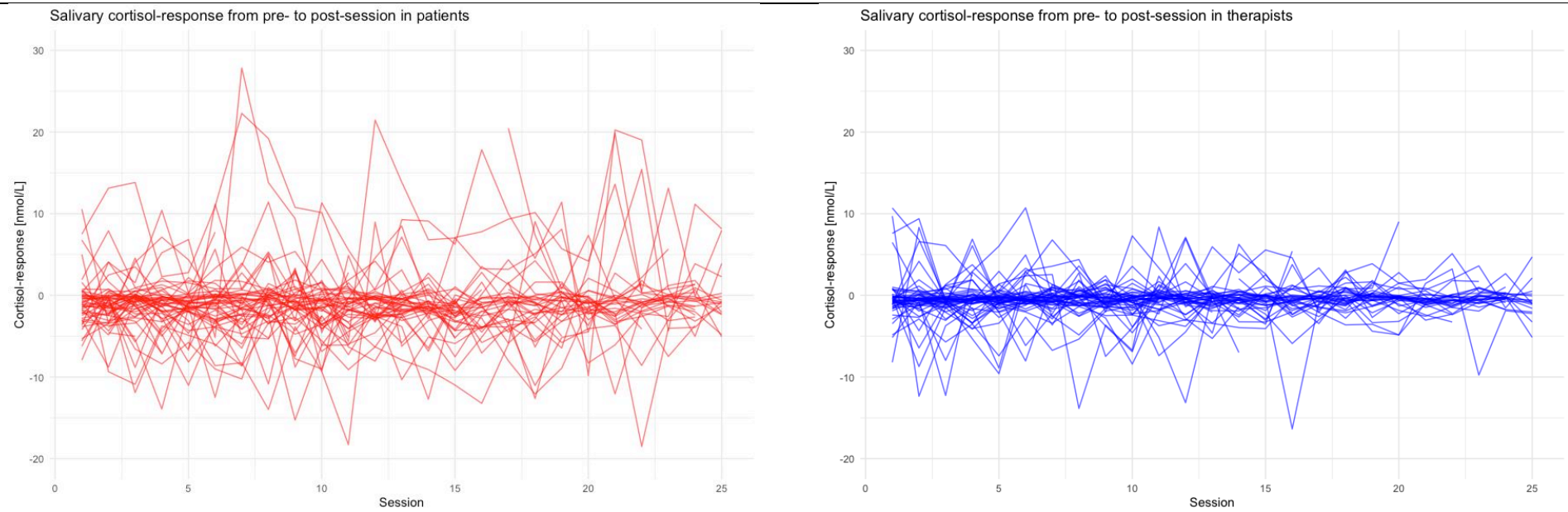
Keywords: Borderline Personality Disorder, Adolescence, Cortisol, HPA axis, Session Ratings

Figure 1

Cortisol-responses for patients and therapists over the course of therapy sessions.

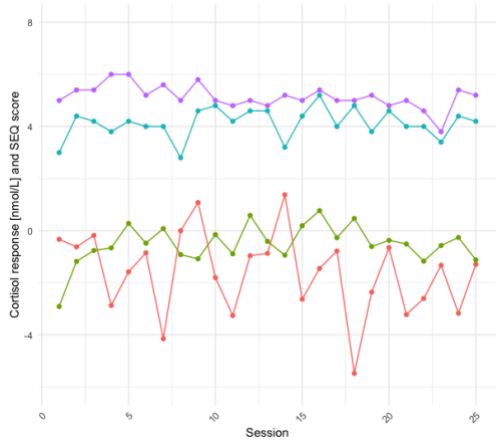


Note. The cortisol response over the therapy session was calculated as $cortisol_{post\text{-}session} - cortisol_{pre\text{-}session}$.

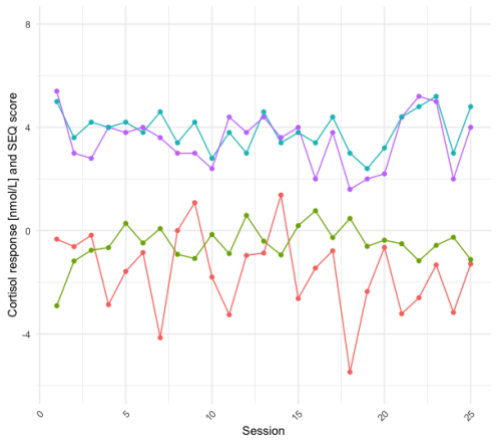
Figure 2

Cortisol-response and SEQ-subscales of one participant and their therapist for illustration purposes.

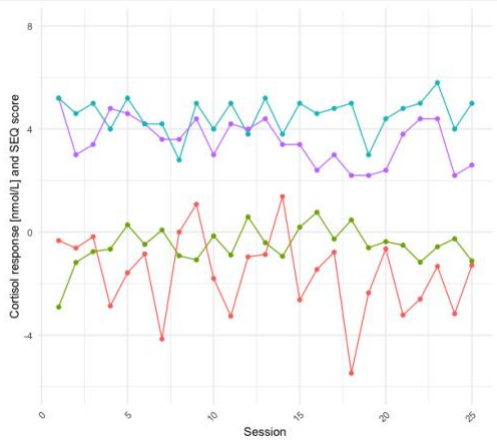
Deepness



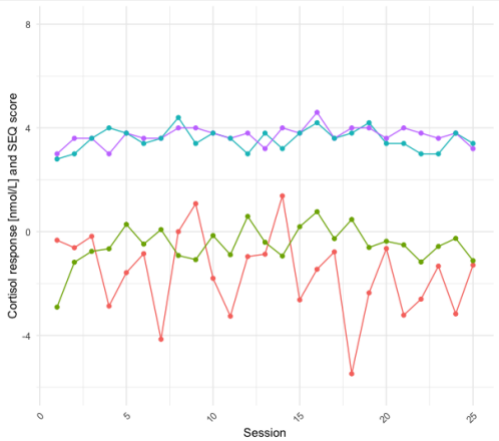
Smoothness



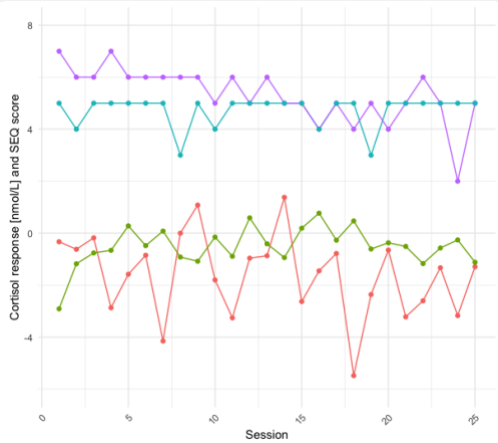
Positivity



Arousal



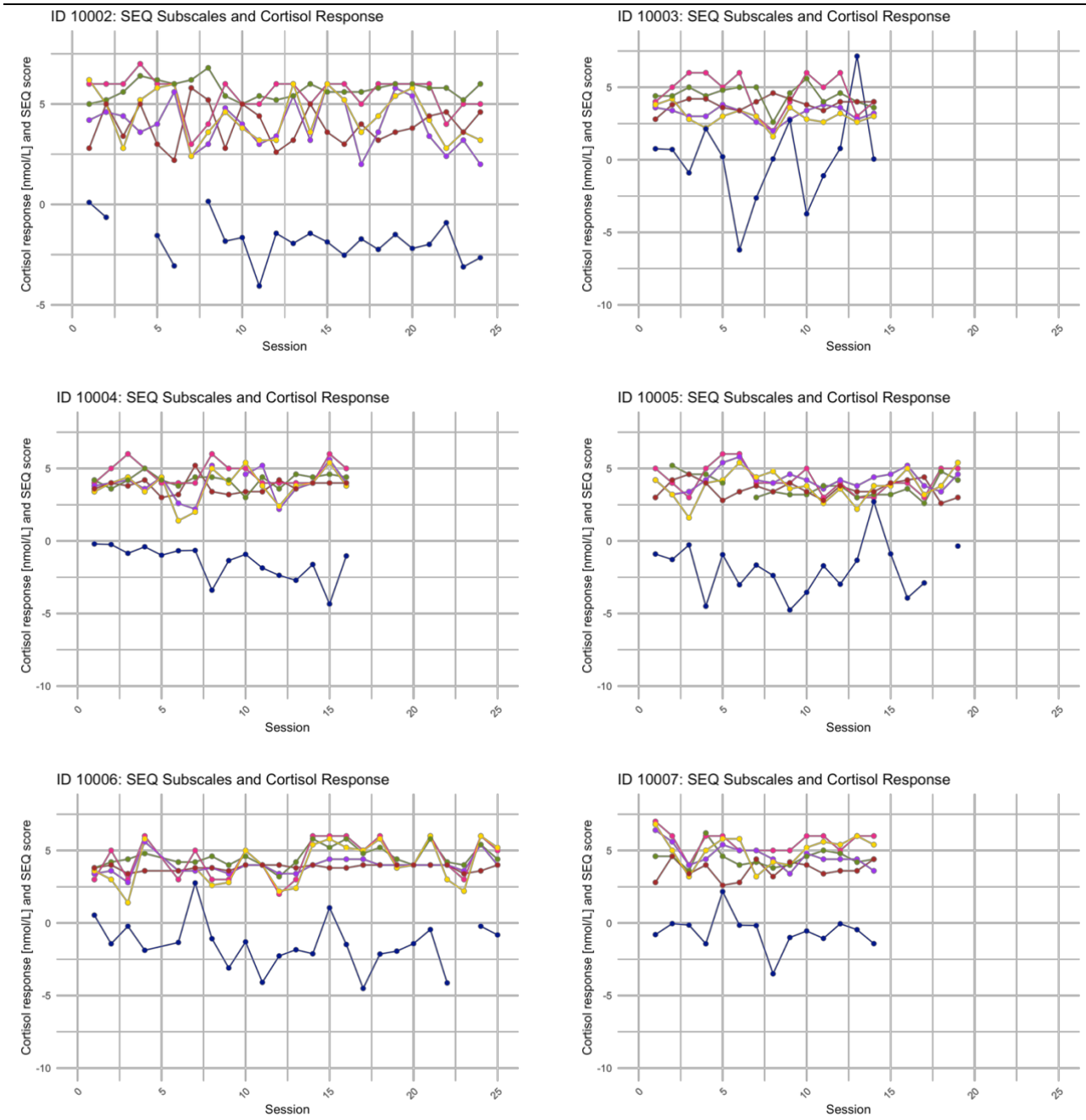
Goodness

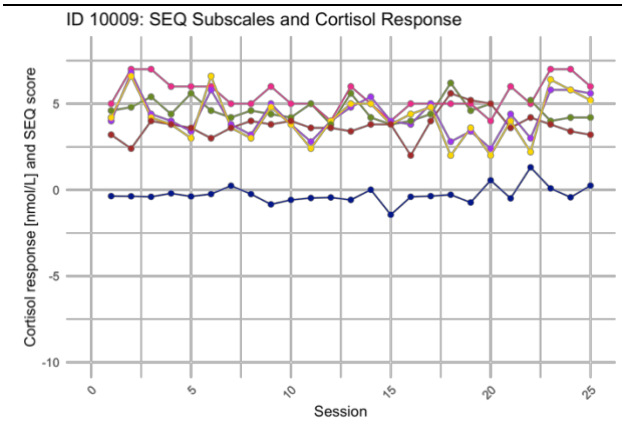


Note. SEQ = Session Evaluation Questionnaire; red = patient cortisol response, green = therapist cortisol response, blue = SEQ therapist rating, violet = SEQ patient rating.

Figure 3

Cortisol-response and SEQ-subscales for every patient

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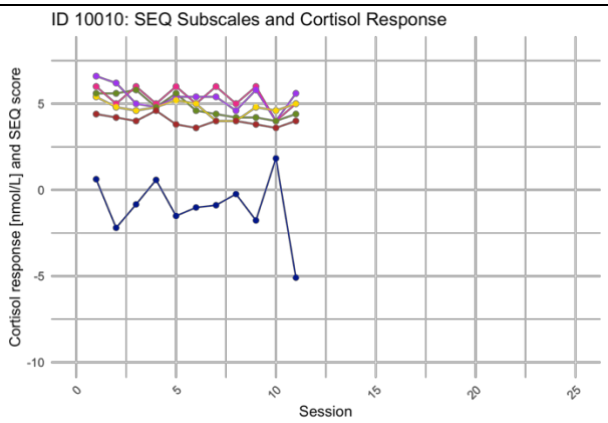
Cortisol response [nmol/L] and SEQ score
Session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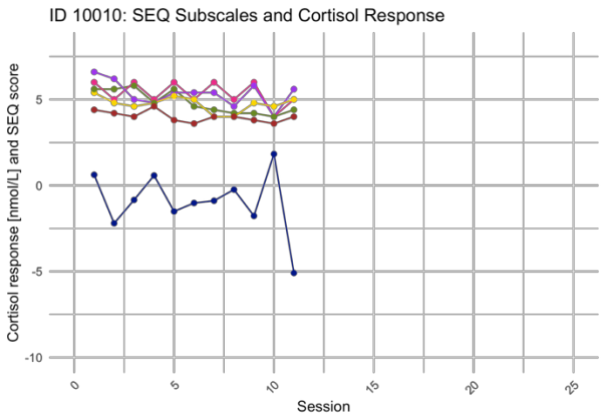
Cortisol response [nmol/L] and SEQ score
Session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Cortisol response [nmol/L] and SEQ score
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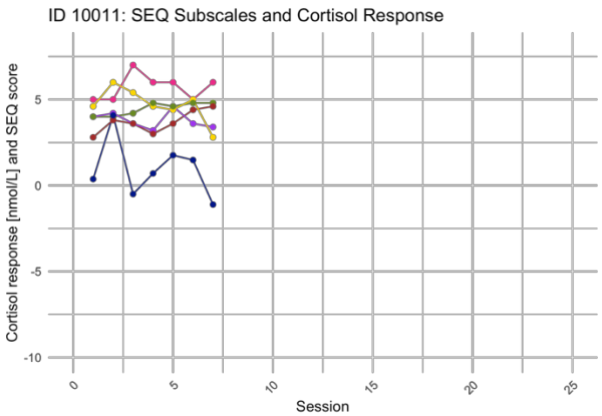
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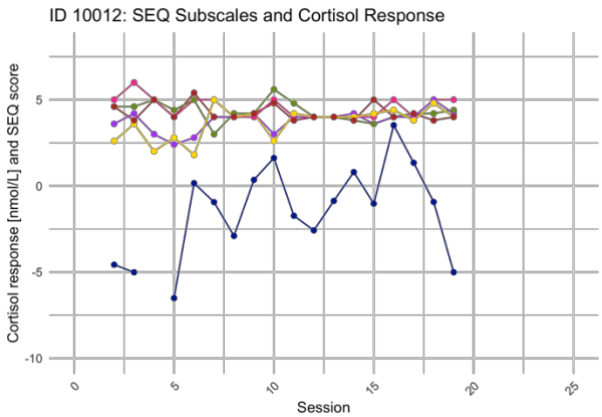
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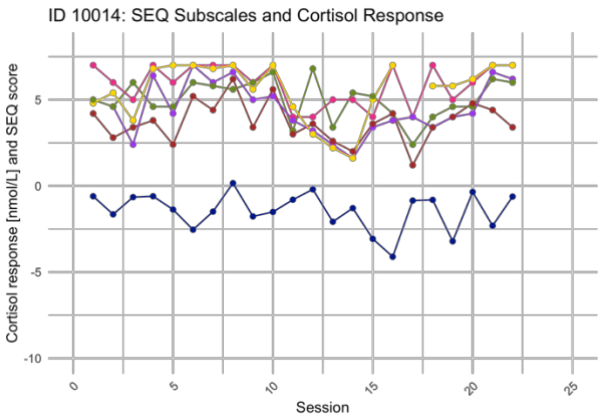
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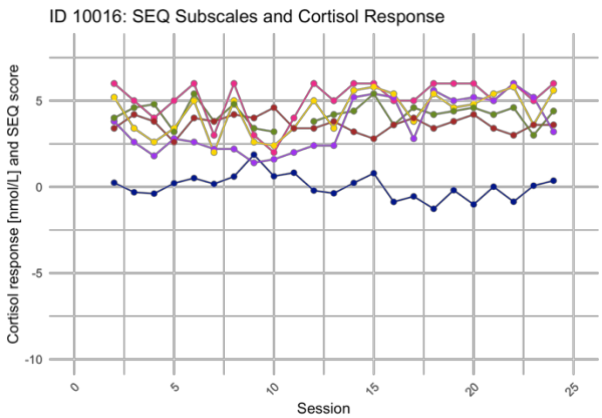
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Cortisol response [nmol/L] and SEQ score
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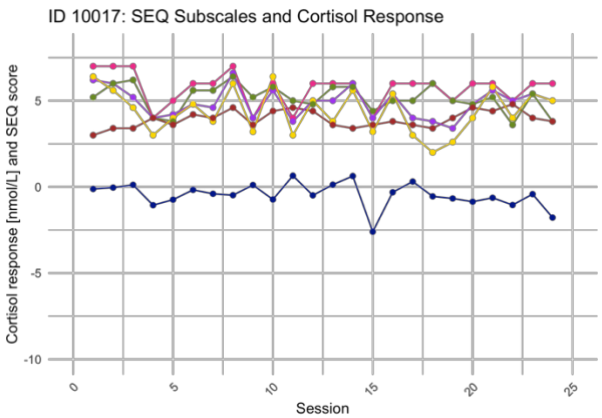
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Cortisol response [nmol/L] and SEQ score
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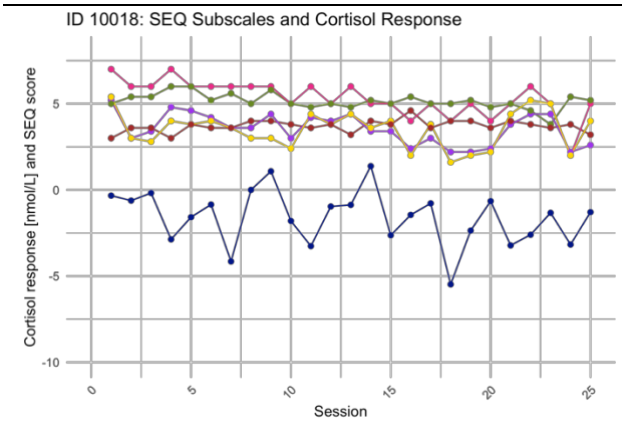
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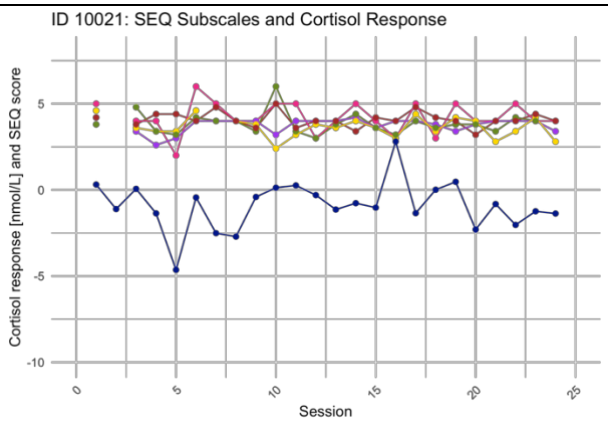
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Cortisol response [nmol/L] and SEQ score
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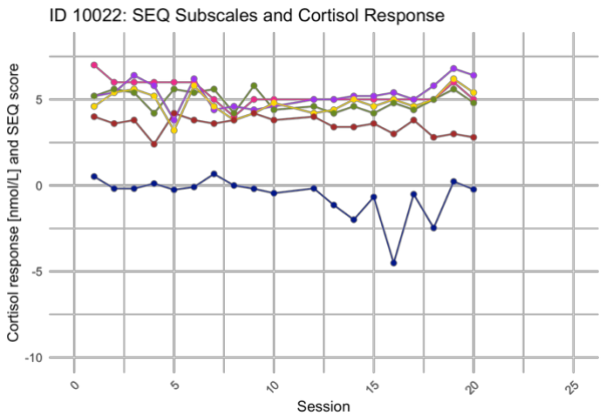
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Cortisol response [nmol/L] and SEQ score
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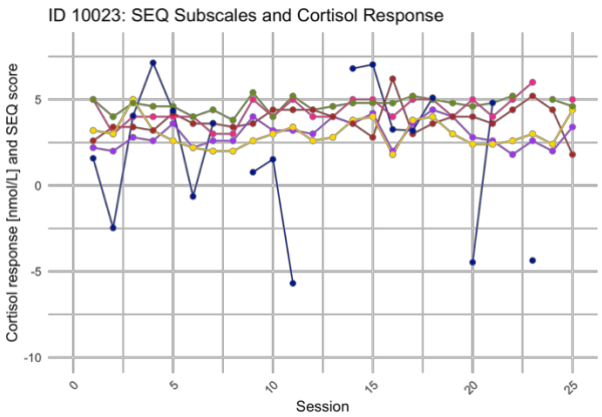
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Cortisol response [nmol/L] and SEQ score
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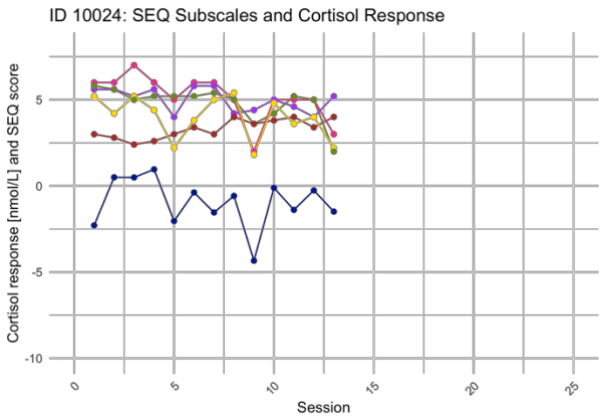
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Cortisol response [nmol/L] and SEQ score
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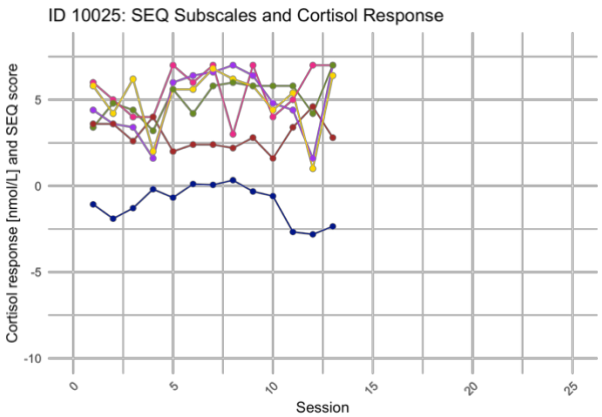
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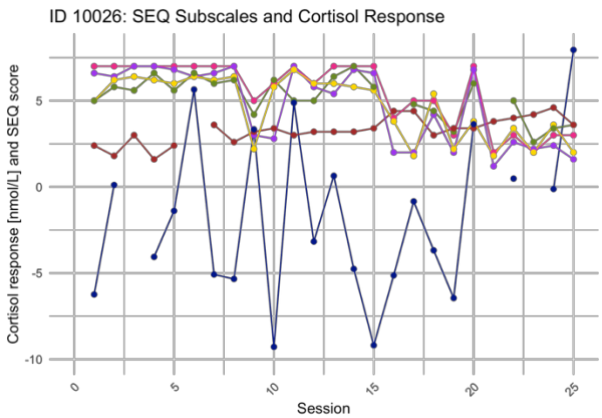
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Cortisol response [nmol/L] and SEQ score
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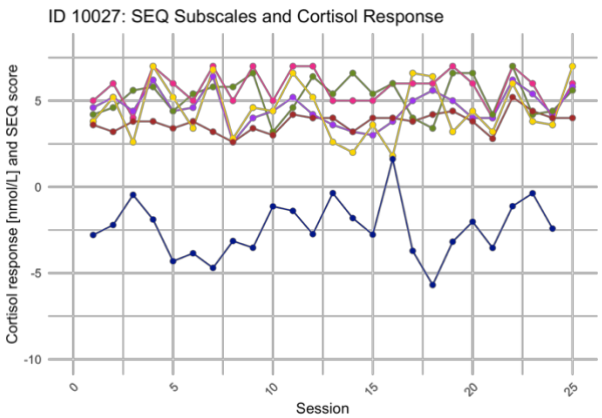
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Cortisol response [nmol/L] and SEQ score
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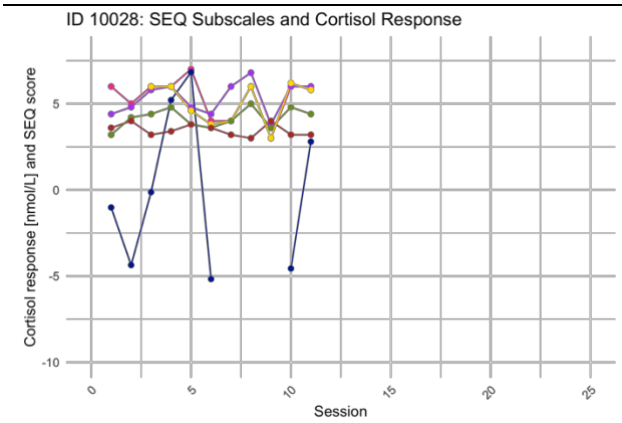
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Cortisol response [nmol/L] and SEQ score
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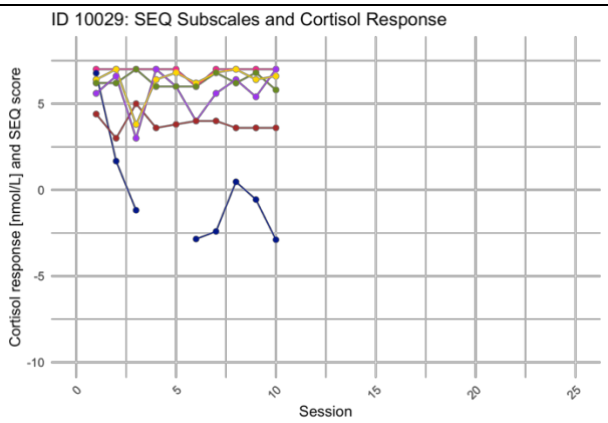
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Cortisol response [nmol/L] and SEQ score
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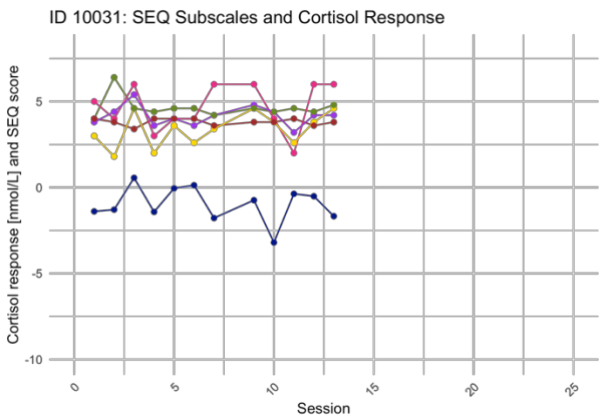
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Cortisol response [nmol/L] and SEQ score
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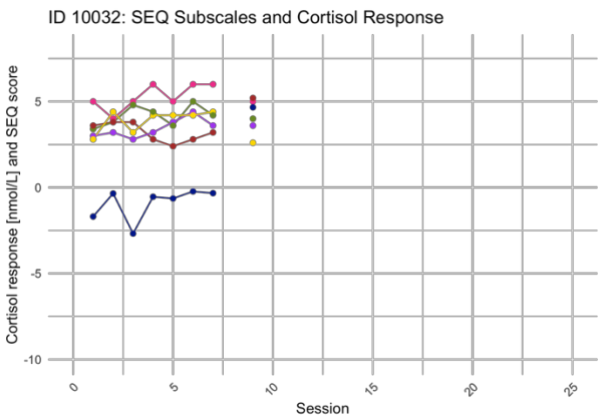
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Cortisol response [nmol/L] and SEQ score
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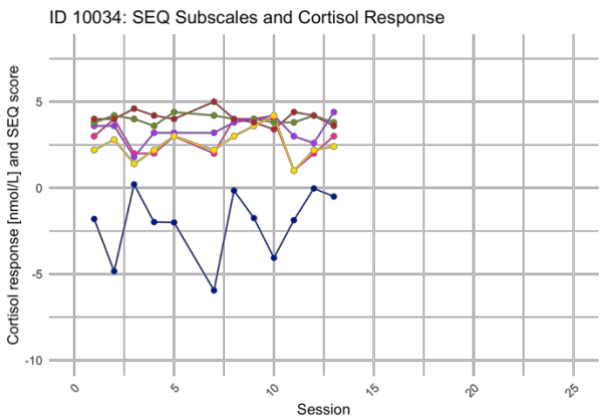
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Cortisol response [nmol/L] and SEQ score
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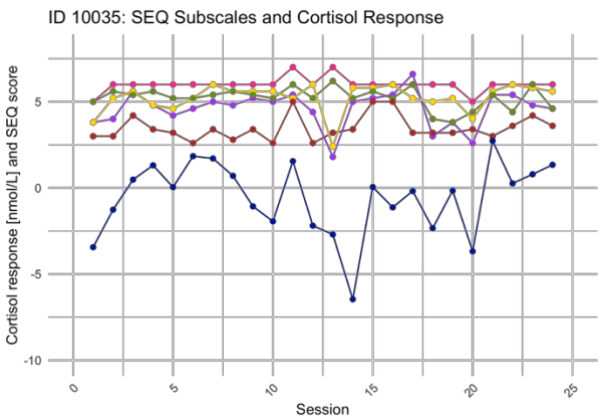
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Cortisol response [nmol/L] and SEQ score
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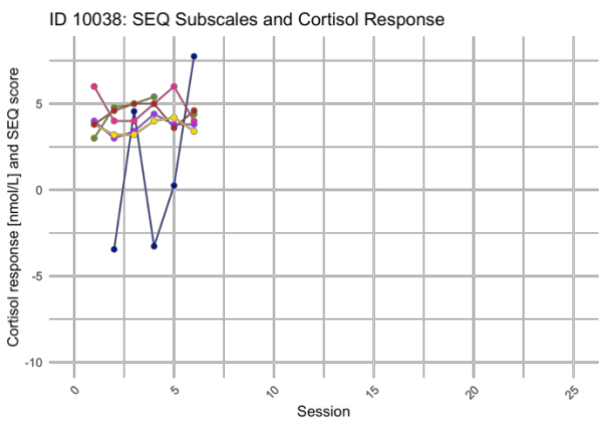
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Cortisol response [nmol/L] and SEQ score
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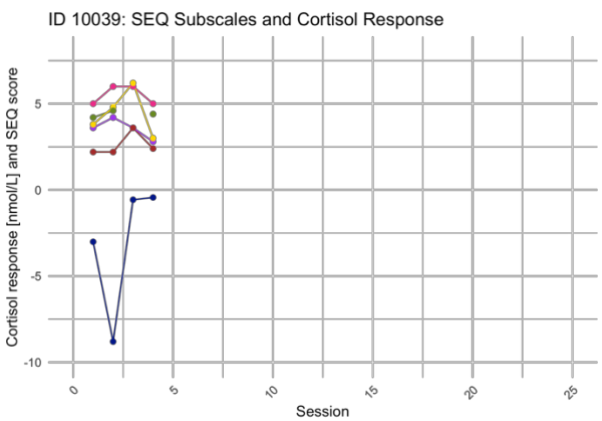
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Cortisol response [nmol/L] and SEQ score
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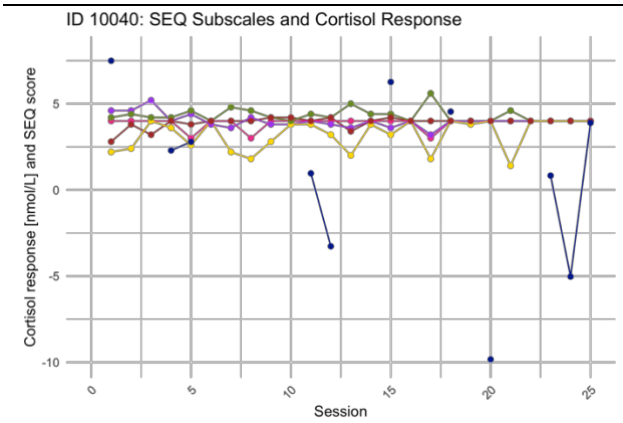
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Cortisol response [nmol/L] and SEQ score
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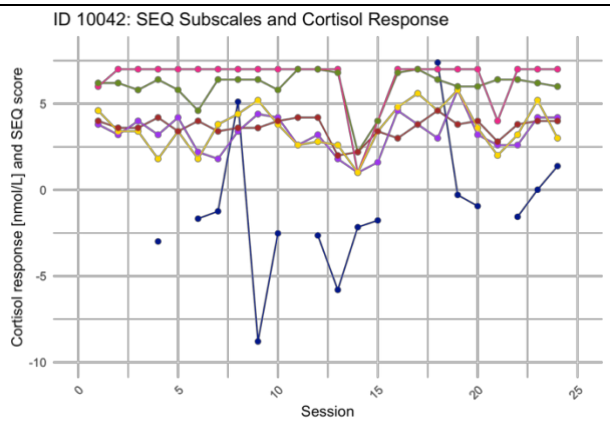
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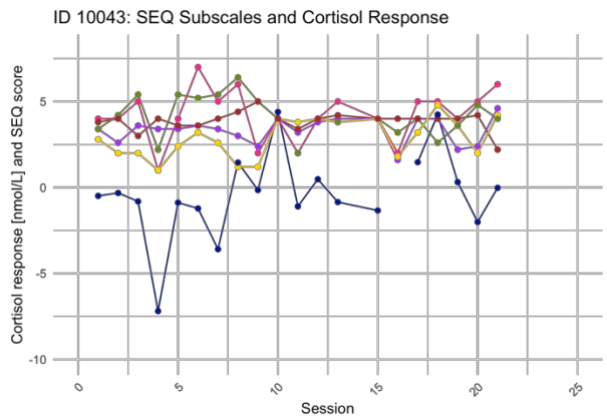
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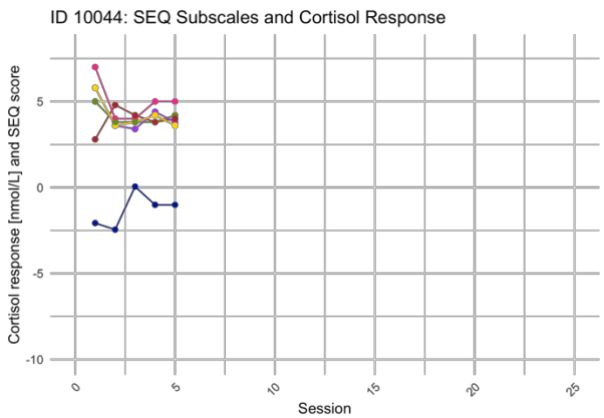
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Cortisol response [nmol/L] and SEQ score
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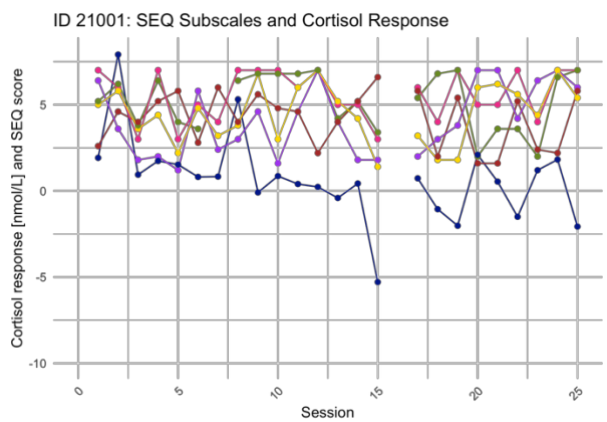
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Cortisol response [nmol/L] and SEQ score
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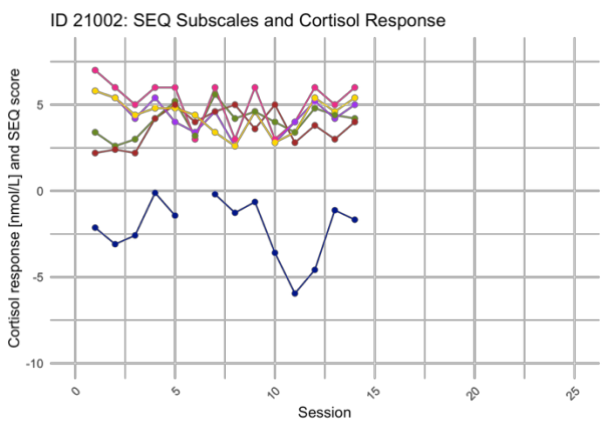
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Cortisol response [nmol/L] and SEQ score
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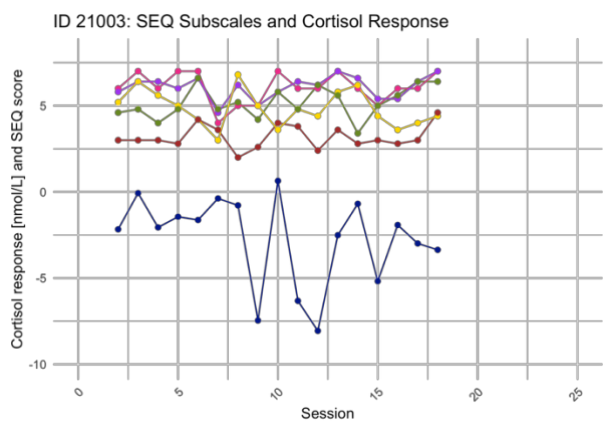
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Cortisol response [nmol/L] and SEQ score
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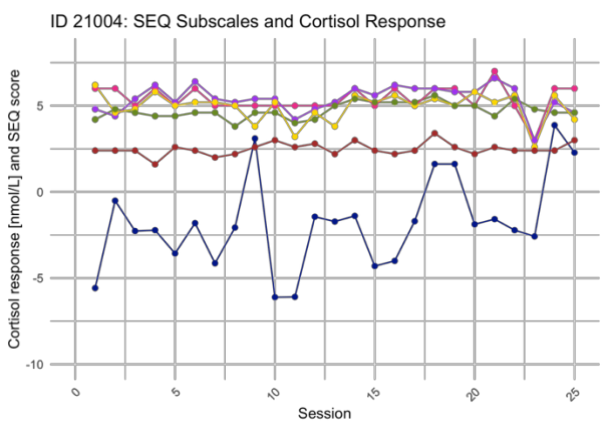
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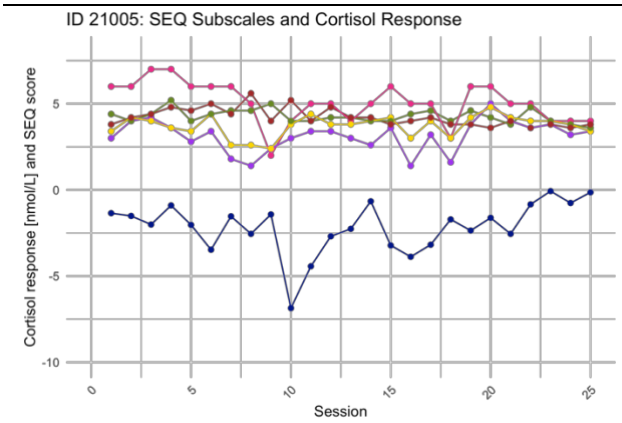
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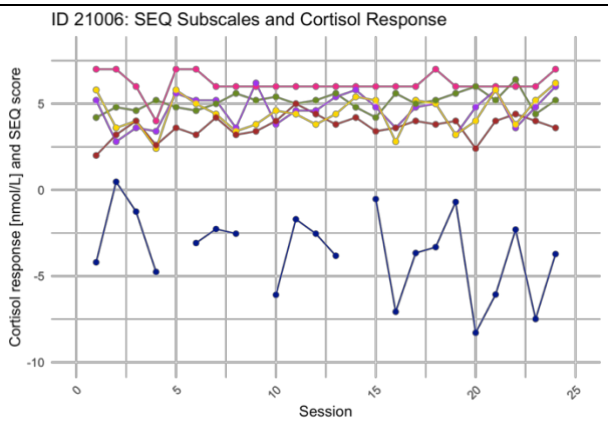
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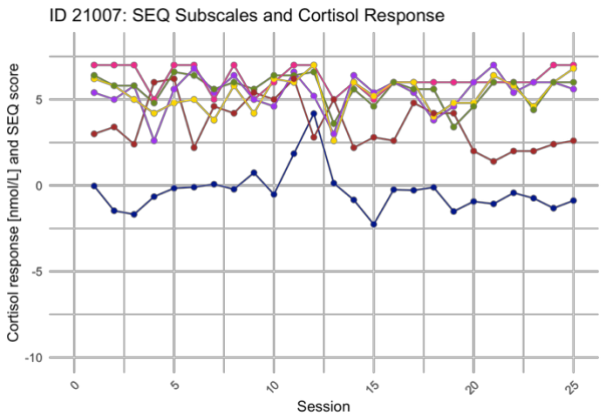
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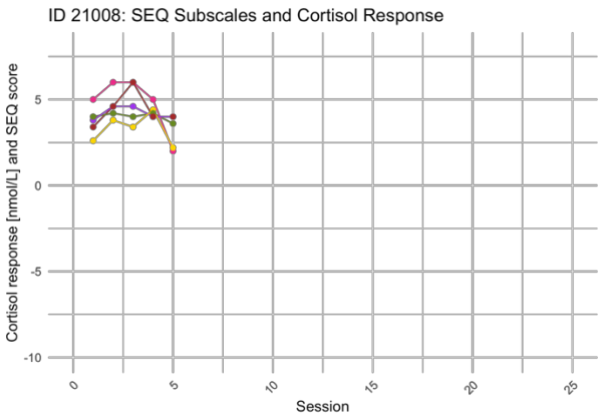
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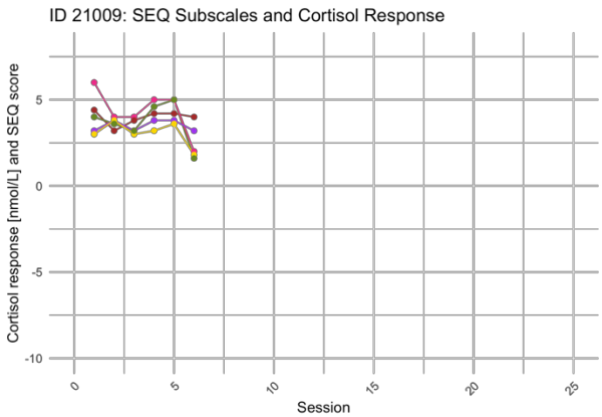
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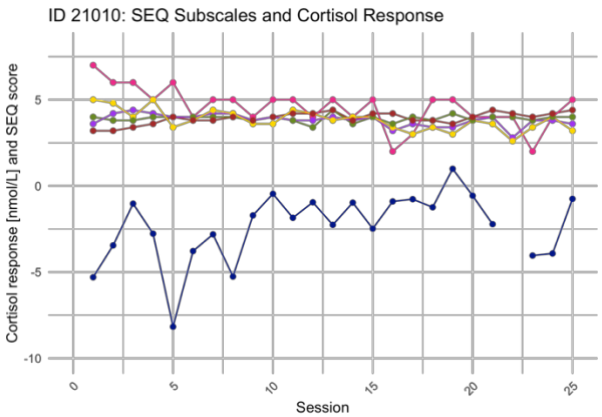
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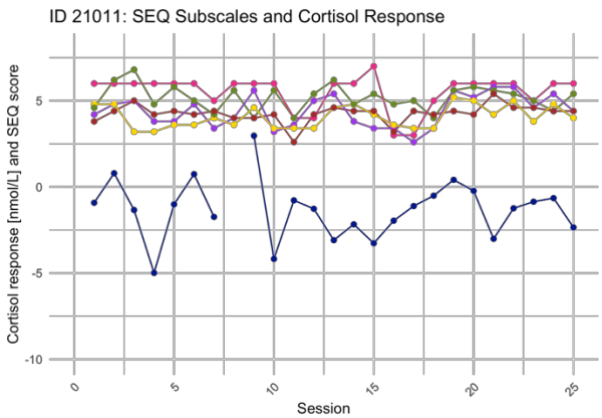
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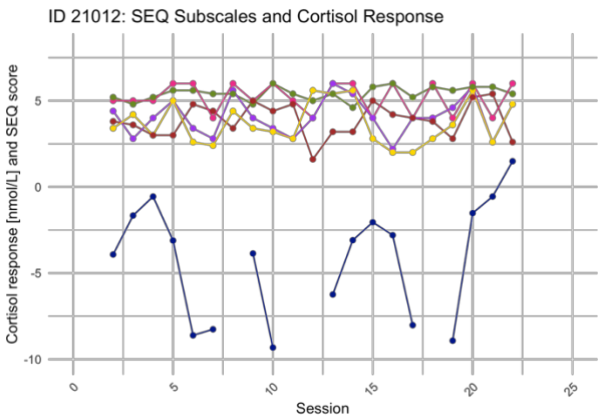
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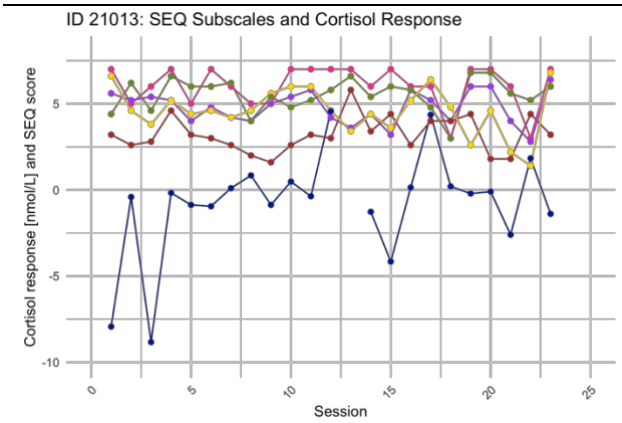
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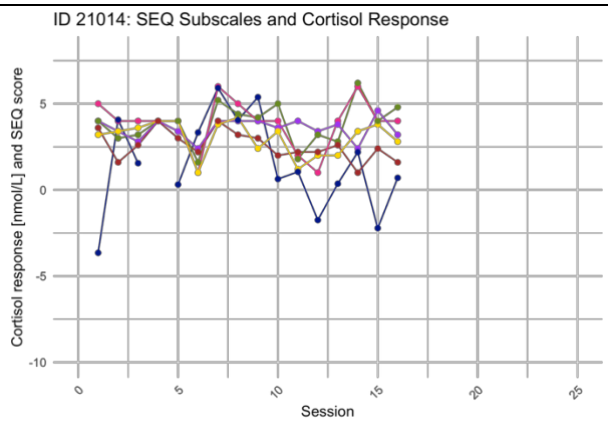
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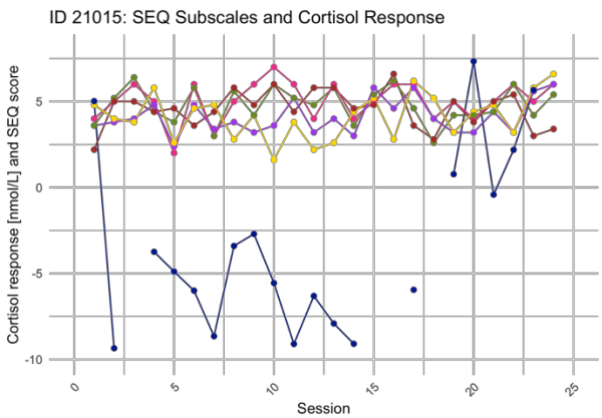
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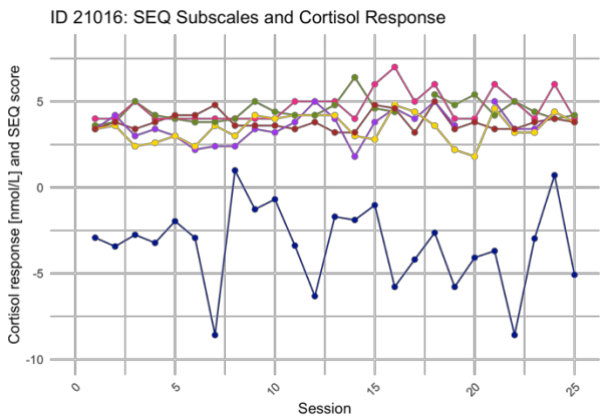
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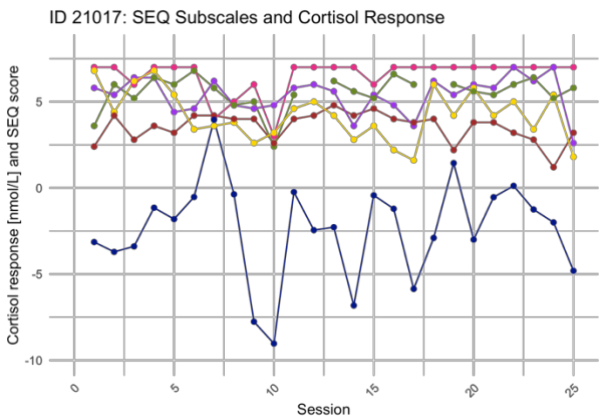
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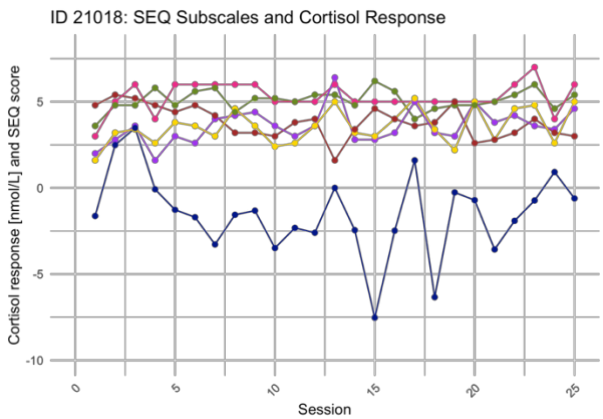
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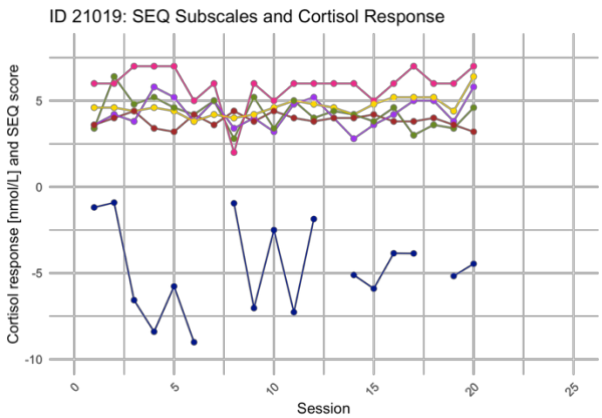
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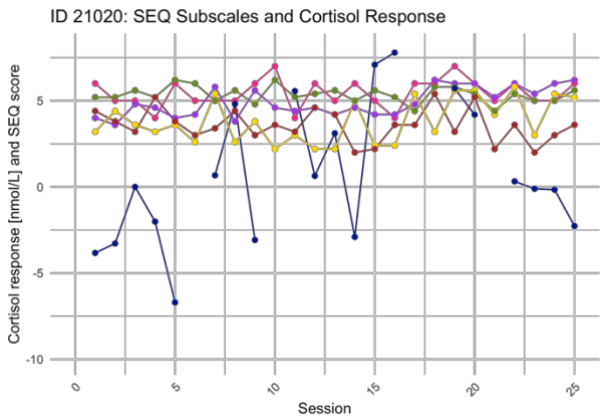
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Cortisol response [nmol/L] and SEQ score
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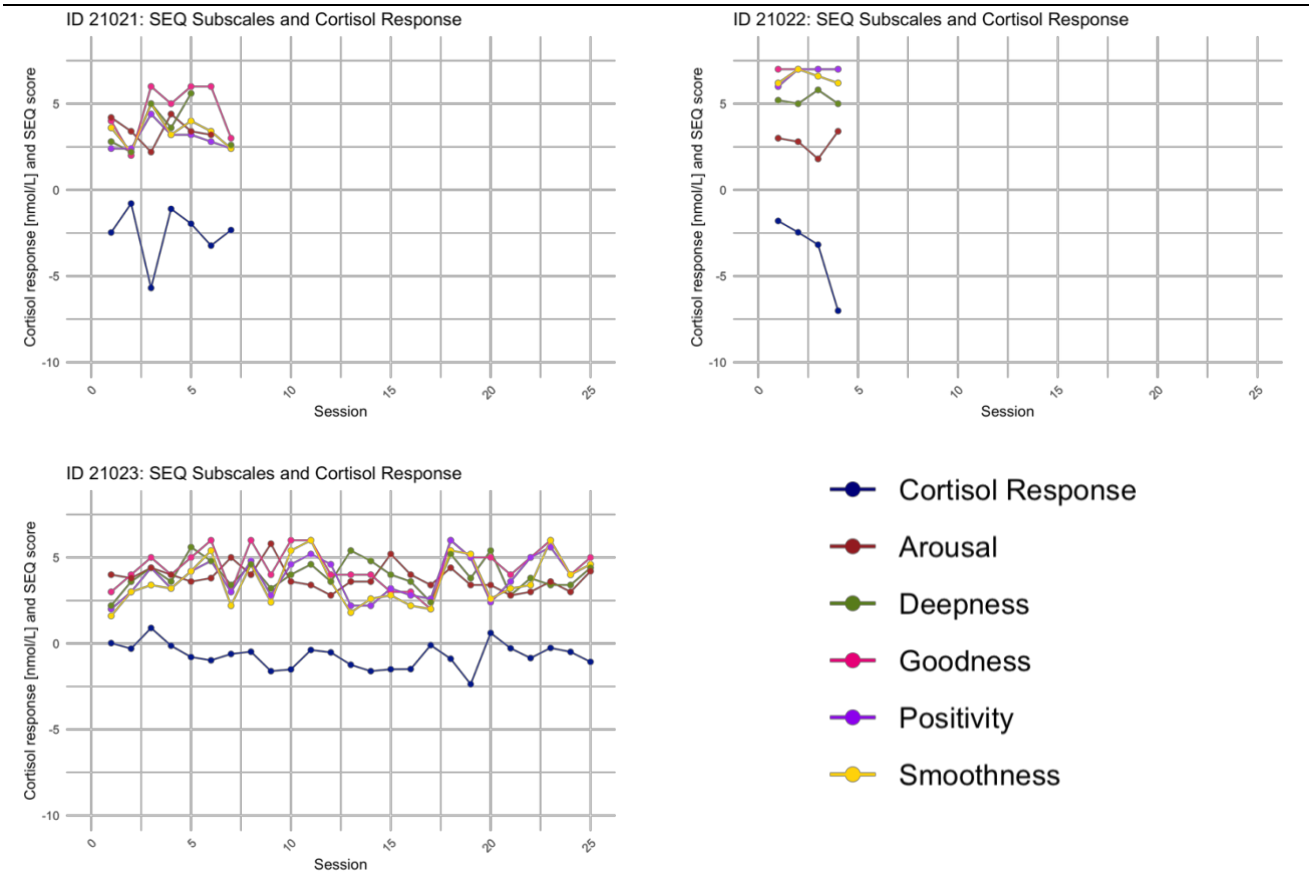

Note. The cortisol response over the therapy session was calculated as $cortisol_{post\text{-}session} - cortisol_{pre\text{-}session}$.

Table 1

Correlation between cortisol response and session ratings, female only sample

Variable	r	SD	CI		p^a
			lower 2.5%	upper 2.5%	
Patient					
Smoothness	-.004	.035	-.073	.066	*.447*
Arousal	-.026	.034	-.093	.041	*.227*
Deepness	-.031	.035	-.099	.036	*.195*
Goodness	-.046	.035	-.113	.024	*.096*
Positivity	-.011	.035	-.079	.058	*.375*
Therapist					
Smoothness	-.162	.033	-.226	-.096	***<.001***
Arousal	.075	.034	.009	.140	***.013***
Deepness	-.080	.034	-.147	-.014	***.007***
Goodness	-.127	.034	-.190	-.060	***<.001***
Positivity	-.146	.033	-.209	-.079	***<.001***

Note. [a] = One-sided p-value; *r* = Correlation coefficient; CI = Credible Interval. RDSEM models are estimated in a Bayesian estimator, therefore the 95% credible intervals are reported.

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Erklärung zur Dissertation

Hiermit bestätige ich, dass ich die Dissertation (Titel):

Early Detection and Intervention for Adolescents with Borderline Personality Disorder

im Fach **Psychologie**

unter der Leitung von **PD. Dr. Corinna Reichl und Prof. Dr. Thomas Berger**

ohne unerlaubte Hilfe ausgeführt und an keiner anderen Universität zur Erlangung eines akademischen Grades eingereicht habe.

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Unterschrift