



Emotional Dysregulation in Children and Adolescents With Psychiatric Disorders. A Narrative Review

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Background: Emotional dysregulation (ED) is a transdiagnostic construct defined as the inability to regulate the intensity and quality of emotions (such as, fear, anger, sadness), in order to generate an appropriate emotional response, to handle excitability, mood instability, and emotional overreactivity, and to come down to an emotional baseline. Because ED has not been defined as a clinical entity, and because ED plays a major role in child and adolescent psychopathology, we decided to summarize current knowledge on this topic based on a narrative review of the current literature.

Methods: This narrative review is based on a literature search of peer-reviewed journals. We searched the databases ERIC, PsycARTICLES, PsycINFO and PSYINDEX on June 2, 2020 for peer reviewed articles published between 2000 and 2020 in English language for the preschool, school, and adolescent age (2–17 years) using the following search terms: “emotional dysregulation” OR “affect dysregulation,” retrieving 943 articles.

Results: The results of the literature search are presented in the following sections: the relationship between ED and psychiatric disorders (ADHD, Mood Disorders, Psychological Trauma, Posttraumatic Stress Disorder, Non-suicidal Self-Injury, Eating Disorders, Oppositional Defiant Disorder, Conduct Disorder, Disruptive Disruptive Mood Dysregulation Disorder, Personality Disorders, Substance Use Disorder, Developmental Disorders, Autism Spectrum Disorder, Psychosis and Schizophrenia, and Gaming Disorder), prevention, and treatment of ED.

Conclusion: Basic conditions of ED are genetic disposition, the experience of trauma, especially sexual or physical abuse, emotional neglect in childhood or adolescence, and personal stress. ED is a complex construct and a comprehensive concept, aggravating a number of various mental disorders. Differential treatment is mandatory for individual and social functioning.

Keywords: emotional dysregulation, psychiatric disorders, treatment, psychopathology, children, adolescents, mental disorder

INTRODUCTION

Emotions are strong and visible feelings that allow us to adapt to our environment. These feelings emerge in reaction to pleasant or unpleasant internal or external stimuli, helping us to react even before we rationally may analyze and deal with the stimulus.

Emotion regulation (ER) is the ability to recognize, evaluate, modify, and manage emotions in a personal and socially acceptable way, in order to maintain mental control over strong feelings, and arrive at adaptive functioning (1–4). This is achieved by applying various goal oriented, adaptive strategies, e.g., acceptance, problem solving, and reappraisal (5). One frequently cited definition (1, pp. 27–8) states that ER “consists of the extrinsic and intrinsic processes responsible for monitoring, evaluating and modifying emotional reactions, especially their intensive and temporal features, to accomplish one’s goals.” Another attempt to define ER (2) emphasizes awareness, understanding, accepting emotions, and the ability to implement strategies that modulate emotional responses in a flexible and appropriate way, while considering situational demands.

Social cognition comprises the mental operations that enable social interactions. Social cognition and interactions need well-functioning ER abilities and (later on) intact theory of mind (TOM) capacities. Newborn infants and toddlers learn ER through the interaction with their sensitive and reliable attachment persons. ER helps in initiating, inhibiting and modulating actions that are triggered by emotions. TOM, the ability to reason about one’s own and others’ mental states, develops later, and is necessary to understand and predict the actions of other persons. It is learned by experiencing and analyzing synchronous and asynchronous social interactions.

Neurobiologically, the basic emotions are represented subcortically with projections throughout the brain, reaching the cingulate cortex, hippocampus, amygdala, and the insular cortex (6), and are modulated by forebrain structures. Glutamatergic/GABA-ergic balance plays an important role in emotional control (7). The “limbic cerebellum” is also involved in ER, and congenital malformations or later acquired lesions may lead to ED (8). ER neural circuits include rostral and subgenual regions of the anterior cingulate, the orbitofrontal and the dorsomedial prefrontal cortex (PFC), and regions involved in executive and attentional control, the dorsal anterior cingulate, ventrolateral PFC, and dorsolateral PFC (9, 10). Besides genetically determined malformations, genetic polymorphisms [e.g., (11)], and functional connectivity problems may cause structural damage. Acute and chronic stress may have long-term consequences. Especially longer lasting stressful life events

alter the CNS structures and functionality, leading not only to persisting neurological, social and behavioral dysfunctions but also contribute to the development of pre-disorders later in life.

The ability to regulate emotions develops in early childhood within a process starting at birth (12). Babies learn from interacting with their caregivers 1. To differentiate their primary emotional states (neutral, pleasurable, and not pleasurable), and 2. That these states are variable in intensity, and can be modified, later on by using self-control, self-soothing or distracting. Learning to recognize and understanding emotions in the interaction with a sensitive caregiver is a prerequisite for later self-regulation (13–15). At the age of 3 years, children already understand their emotions (16). Various processes, such as the development of executive functions and language influence the development of ER (17–19). Next to the encoding of internal emotional cues, ER involves accessing of coping resources, using a broad range of regulation strategies (20). The development of these strategies is complex, involving genetics, epigenetics, cognition, social experiences, and learning (20, 21). Children acquire their primary regulation strategies that include help seeking, avoiding, redirecting attention, suppressing impulses, and problem solving, by the age of seven (20). Later on, ER becomes more and more self-controlled.

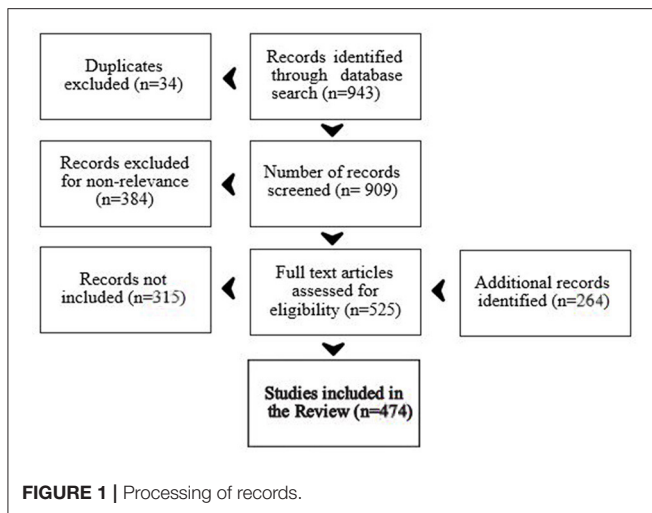
Internal and external factors determine the efficacy of ER: internal factors comprise neuroregulatory reactivity, temperament, cognitive abilities attachment and related positive internal working models; external factors are related to caregiving style, behavioral models, and experience (22).

Children express negative emotions in order to regulate their own emotions and to appropriately communicate with others. Under psychopathologic conditions, one or more negative emotions (such as sadness, panic, anger) are experienced either overly intense or exceedingly long, and fail to be adaptive (23). As such, healthy social–emotional functioning is contingent on being able to dynamically respond to contextual demands in a culturally appropriate way (19).

Emotion Dysregulation (ED), a trans-nosologic condition, manifests as maladaptive processing of external or internal stimuli when ER strategies and processes are impaired (24). Clinically, hyperarousal, mood instability, irritability, aggression, and temper tantrums are observed (25). Reactions appear excessive to social norms, and inappropriate or detrimental to a person’s interests (26). They are often influenced by internalizing or externalizing problems or comorbid disorders, such as anxiety, autoaggression, borderline personality disorder (BPD), post traumatic stress disorder (PTSD), uni- or bipolar affective disorders (21, 25, 27–29). ED reflects a limited set of problematic strategies to understand or accept one’s own emotional states, and disposing of a relatively limited set of strategies for dealing with one’s own emotional states (2). ED has received considerable attention in the last decades because of its negative effects on emotional development, cognitive and behavioral adaptation, self-efficacy, social relationships and functioning, and quality of life (27, 30).

Attempting to provide an overview on the various aspects of ED in children and adolescents with psychiatric disorders, focusing on clinical characteristics, prevention, and therapy, we

Abbreviations: ACE, Adverse Childhood Experiences; ADHD, Attention Deficit/Hyperactivity Disorder; AN, Anorexia Nervosa; ASD, Autism Spectrum Disorder; BD, Bipolar Disorder; BN, Bulimia Nervosa; BPD, Borderline Personality Disorder; CBT, Cognitive Behavioral Therapy; CD, Conduct Disorder; CU, Callous-Unemotional (traits); DBD, Disruptive Behavioral Disorder; DMDD, Disruptive Mood Dysregulation Disorder; EatD, Eating Disorder(s); ED, Emotional Dysregulation; ER, Emotional Regulation; LGB, Lesbian, Gay and Bisexual; MPH, Methylphenidate; NSSI, Non-Suicidal Self-Injuring; OB, Obesity; ODD, Oppositional Defiant Disorder; PFC, Prefrontal Cortex; PTSD, Post Traumatic Stress Disorder; RSA, Respiratory Sinus Arrhythmia; SES, Socio Economic Status; SUD, Substance Use Disorder; TD, Typically Developing.



explored the scientific literature for relevant contributions in the last 20 years.

METHODS

This narrative review is based on a thorough literature research in peer-reviewed journals. We searched the literature databases ERIC, PsycARTICLES, PsycINFO and PSYINDEX on June 29th, 2020 for peer reviewed articles on ED in children and adolescents, published in English language between January, 2000 and June, 2020 related to children and adolescents (2–17 years). Using the search terms, “emotional dysregulation” OR “affect dysregulation,” we retrieved 943 articles (cf **Figure 1**). After removing duplicates, 909 articles remained and were screened by title and abstract for the appropriateness of the contents. We thus excluded 384 articles: 1. dealing with subjects outside the target age range (≥ 2 years ≤ 17), 2. related to ED or affect dysregulation of the parents and the resulting parent-child interaction, 3. anecdotal or single case reports, 4. articles without ED or affect dysregulation being the main focus, such as articles on Disruptive Mood Disorder Dysregulation (DMDD), emotions and regulation of emotions without reference to ED, dysregulation of other functions, and articles on ED as future research objective without current data, 6. articles mainly dealing with neurobiology of the emotions, neuro-pathophysiology, and stress. Thus, excluding 384 articles, we thoroughly screened 525 articles for their relevance in terms of content and subjective importance, and retained 210 articles of primary research (excluding another 315 articles), and retrieved 264 additional articles seen as “necessary,” and retrieved during the course of the writing process. The additional, secondary references were retrieved in addition, related to 1. references on subtopics, 2. references cited in the initially retrieved references and estimated as important, 3. our own knowledge of the literature, 4. recommended by the two reviewers and the editor.

This sums up to a total of 474 articles cited in this narrative review (cf. **Figure 1** for a summary of article handling).

RESULTS

In the following, we describe various neuropsychiatric disorders that are related to or influenced by ED. We **first** describe the clinical picture, then the neuropsychiatric background and various facets of the disorder, and the impact of ED for the psychopathology of the disorder.

Psychopathology and ED ADHD

ADHD is a common, mostly inherited neuropsychiatric disorder with various degrees of severity (31, 32) and three predominant presentations that may change over time: inattentive, hyperactive – impulsive, and combined. Since 1995 (33), ED has been recognized as a key problem in children and later in adults with ADHD. Social, behavioral, and educational problems may already be present in early childhood (34), and continue into adulthood with severe clinical, personal, and vocational sequelae (35–37). A few studies have shown that ED occurs independent of the ADHD subtype (38, 39), whereas others (40, 41) found an increased incidence of ED in children with the combined type.

An underdeveloped working memory (18) and problems of impulse inhibition may contribute to ED. Thereby emotional impulsiveness and problems of impulse inhibition are associated with greater emotional and behavioral dysregulation (42, 43). Children with ADHD express more negative affect, a higher emotional instability, and difficulties in regulating and expressing their emotions (44–46). They also have difficulties in recognizing and understanding the emotions of others (44, 46). In addition, young children with ADHD have an attention bias toward positive emotions (47).

Children with ADHD perform worse in a go/no-go task when meaningful stimuli are provided in parallel (48). They also exhibit more parasympathetic dysregulation and less sympathetic reactivity, although López-Martín et al. (49) found no differences in autonomous activation during go/no-go task performance comparing children with and without ADHD. Children with ADHD need stronger activation of inhibition-related neural mechanisms in order to achieve a similar performance, especially in emotional contexts. This explains why children with ADHD have difficulties in controlling their behavior and emotions in an emotionally burdened situation. Furthermore, in boys, Seymour et al. found an association between ED unique subregion expansion in the right globus pallidus, putamen and amygdala (50).

ER mediates the association between ADHD and social skills in youth (51). Less distinct emotional and social competence could explain the higher degree of peer rejection in children with ADHD (52). In addition, the common sleep problems in children with ADHD will further aggravate their attentional and emotional dysregulation (53). Medication with methylphenidate reduces ED by reducing impulsivity in children with ADHD (39, 54, 55).

Mood Disorders

The spectrum of affective mood disorders comprises unipolar, bipolar, schizo-affective, dysthymic, cyclothymic, and adjustment

disorder with depressive reaction and has been conceptualized a disorder of ER. Mood disorders run in families but may also be triggered by negative experiences. The severity of mood disorders may vary, and typical manifestations are named major disorders (31, 32). Dysregulation of positive and/or negative affect in affective disorders include under- or overreactivity to stimuli, abnormalities in the time flow of an emotional response, for example, in maintaining or enhancing positive affect or in limiting sadness (56). FMRI studies showed an exaggerated amygdala response to negative, and attenuated amygdala responses in reaction to positive stimuli (57).

Depression

Depressive symptoms are linked to a disrupted regulation of negative emotions (58, 59). Some studies indicate that ER difficulties precede the onset of depressive symptoms (58, 60). Depressive symptoms have also been associated with overregulated negative affect (61). Children with depressive symptoms do not experience more difficulties than their peers in regulating positive affect but return more slowly to their emotional baseline following a depressive reaction to negative feedback (62).

Children and adolescents with depressive symptoms are more likely to engage in rumination than using active ER strategies, such as problem solving, distracting or cognitive reappraisal (63). Symptoms of depression might overstrain a child's ER capacities. Peer rejection and failing to down-regulate negative and up-regulate positive emotions may lead to diminished self-confidence and failing to perceive and control one's own feelings, thus aggravating depressive symptoms (21, 64).

Bipolar Disorder

Children diagnosed with bipolar disorder (BD) fail to remit depressive symptoms and affective instability (65). Structural abnormalities in the orbito-frontal and subgenual white matter are consistent with neuro-biological models that implicate dysregulated affective systems and impulsiveness in BD (66). Mood dysregulation centered around limbic overactivity and relative prefrontal underactivity, indicate decreased prefrontal influence on limbic structures mediating mood regulation (67). Functional dysconnectivity of the Inferior Frontal gyrus is involved in ER and accounts for trait abnormalities in children with BD (68). Severe dysregulation of affect and behavior is associated with difficulties in falling asleep and sleeping through (69, 70). In addition, ED is associated with a greater impairment of episodic memory (71).

Kim et al. (72) found abnormal gaze patterns as a potential endophenotype for difficulties of labeling emotions in patients with BD. Difficulties ascertaining the correct emotional tone of a spoken sentence may possibly contribute to ED in youth with BD (73). Non-verbal emotion labeling deficits such as misinterpreting facial expressions may reflect general abnormalities in emotion processing and contribute to poor emotion regulation skills (15, 74). Children with BD require higher levels of emotional intensity to accurately interpret emotional expressions and have difficulties in differentiating subtle variations in the intensity of facial expressions (75).

Cyclothymia

Cyclothymia manifests as early-onset, enduring reactive mood fluctuations. ED is one of its core features, manifesting with extreme mood instability and reactivity (76). In children and adolescents, cyclothymic temperament is one of the strongest predictors of BD (77) that, as mentioned above, is also strongly connected to ED. Akiskal et al. (78) described the prototypical emotional symptoms of cyclothymia in adolescents as intermittently intense emotionality (sullen, irritable, restless, boastful) that shifts from one phase to another.

Compared to other manifestations of affective disorders, such as depressed, hyperthymic, or irritable mood, cyclothymia is associated with the most severe emotional and behavioral problems, such as sleep anxiety, separation sensitivity, eating disorders in girls, and antisocial-aggressive behavior in boys. The association of cyclothymia, sleep anxiety, and antisocial-aggressive behavior increases with age and is related to both, internalizing and externalizing disorders (79).

Suicidality

Suicidality is strongly associated with psychiatric disorders and ED. Linehan's (80) biosocial theory suggests that ED is a key factor in maintaining suicidality: adolescents experiencing that their exaggerated emotional states are not well-accepted by their environment will experience feelings of guilt and shame. Suicidal ideation is then a strategy to reduce or avoid these overwhelming negative emotions (81). Interestingly, poor positive affect is a stronger predictor of suicidality than increased negative affect (82). Depression is the most common psychiatric condition leading to suicide (83). Difficulties in regulating emotions may contribute to increased reactivity toward interpersonal stressors in depressed and suicidal adolescents (84).

Psychological Trauma

Early, recurrent, severe, chronic interpersonal, developmental, cumulative traumatic experiences (defined by number, duration and severity of trauma), and poly-victimization, are associated with ED [e.g., (85, 86)], often presenting with severe dysregulation of physical, affective, behavioral, cognitive, and interpersonal functioning [e.g., (87)]. These symptoms are merely related to dysfunctional coping strategies [e.g., (85, 88)].

Interpersonal trauma experience (sexual, physical and emotional abuse) and post-traumatic stress is associated with various psychiatric comorbidities and psychosocial, developmental, and physical impairment [e.g., (87, 89)], and a reduced ability to understand and regulate emotions [e.g., (87, 90)]. Difficulties in regulating emotions is a consequence of trauma, as well as a predictor of psychopathology (91).

In traumatized children and adolescents, ED

- increases the risk of psychopathology (89)
- is a feature of developmental trauma disorder (DTD) (85, 92, 93)
- is related to increased negative affect (90), and negative mental health outcomes (94)
- mediates the relationship between childhood trauma and the resulting internalizing/externalizing behavior problems

[e.g., (86, 95–97)], between severe trauma experience and the resulting symptomatology (90, 98), and between maltreatment of children and their aggression toward peers (99)

- is a core feature accounting for the increased risk of acute and life-time impairment [e.g., (87)], and an important target for therapeutic interventions (87)
- mediates or moderates treatment related changes (100)

The DSM-5 classification relates three disorders to childhood trauma and maltreatment: PTSD, Reactive Attachment Disorder, characterized by low social-emotional responsiveness and ED, and Disinhibited Social Engagement Disorder, characterized by active approaches to and interactions with unfamiliar adults (101). Abusing and neglectful parents mostly suffer themselves from severe harmful personal experiences (102).

Child Misuse, Maltreatment, Neglect

Child misuse, maltreatment and neglect, later reported by about a third of adults (103), relate to significant harm, lead to impaired health or development, is responsible for about 45% of mental disorders in childhood (104), with effects persisting into adulthood (105). There is also a transgenerational risk of later abusive parenting (106). Warmingham et al. (107) described three often overlapping subgroups: 1. chronic multi-subtype maltreatment (57%), 2. only neglect in a single developmental period (31%), and 3. single subtype of maltreatment (emotional maltreatment, physical or sexual abuse) occurring in a single developmental period (12%).

According to the self-trauma theory (108, 109), a child's coping strategies with stressful experiences depend on intact ER skills. If a trauma occurs during the development of ER and interpersonal skills, it may interfere with the normal development, leading to an increased risk of becoming emotionally overwhelmed “by trauma reminders and future stressful events”. According to the betrayal trauma theory (110), post-traumatic symptoms, including ED, may develop if a child is repeatedly maltreated, physically or sexually abused or neglected by an originally trusted close person. Then, the post-traumatic symptoms (e.g., dissociation) develop in order to protect the child's attachment to his/her significant person because during this developmental phase, significant persons are not allowed to fail.

Betrayal Trauma and ED

Trauma negatively influences the ability to regulate anger and affect (111). Longitudinal studies demonstrated that higher levels of ED are associated with aggressive behavior over time [e.g., (112, 113)]. Symptoms of ED relate more to reactive (i.e., “hot,” impulsive aggression in response to perceived provocation or threats), than to proactive aggression (i.e., “cold,” instrumental, goal-oriented aggression) (114).

Adolescents exposed to betrayal trauma had severe difficulties with ER, reported more severe PTSD symptoms, and expressed a more aggressive communication style (115). ER difficulties mediated the relationship between betrayal trauma and negative interpersonal communication skills.

ED [undercontrolled/ ambivalent or overcontrolled/ unresponsive regulation (116)] resulting from adverse childhood experiences (ACE), and especially neglect (117), may manifest in response to stress (118) as biased perceptions of threat (119), increased responsivity to negative information with increased reactivity of the autonomous nervous system, based upon gene-environment interactions (117), and leading to increased irritability (120), poor problem solving skills (121), more negative emotionality (122), poor academic performance (123), and internalizing or externalizing reactions (89, 124, 125).

Internalizing and Externalizing Reactions

Internalizing reactions and victimization are associated with depression, anxiety disorders, addictive behaviors, painful medical conditions (126), self-harm (127), and PTSD (89). Externalizing reactions are associated with pervasive anger, aggression, impulsiveness, risky sexual behavior, intimate partner violence, and conduct problems, accentuating victim-perpetrator dynamics, and precipitating culprit-victim thinking and juvenile delinquency (122, 124, 128). Internalizing and externalizing problems may also appear as comorbid conditions (129), are mediated by ED (97), and may trigger suicidality (130) and early death (131). Witnessing violence (132) and harsh discipline (133) may lead to externalizing and aggressive behavior. Irritability may also be related to antisocial, borderline and narcissistic personality disorders, most frequently represented among delinquent and incarcerated youth (134) (cf. chapter Personality Disorders). Resilience in maltreated children is, however, rare (123).

Maternal Influences

Trent et al. (135), studying inpatient psychiatric patients with depressive symptoms and childhood exposure to maternal threatening behaviors, observed that maternal threatening behavior was related to the severity of depressive symptoms in those children who had more pronounced deficits in emotional clarity [which is defined by Gratz & Roemer as “the extent to which individuals are confused about the specific emotions they are experiencing” (2)]. Pat-Horenczyk et al. (28) confirmed maternal ER mediating the association between maternal PTSD and children's ED in a community sample of traumatized Israeli mothers and children.

Substance Misuse in Traumatized Patients

Substance misusing and socially disadvantaged mothers showed less observed emotional availability for their 12–42 months old children than mothers without social disadvantage and substance abuse (136). The former were also more often traumatized in childhood and exhibited more often borderline personality traits, such as higher levels of emotional distress and poor ER. Mothers having experienced childhood adversities had difficulties in providing appropriate caregiving when exposed to highly stressful conditions (136). At the same time, childhood trauma increases the risk of later substance abuse because of a limited access to ER strategies [e.g., (137)]. Furthermore, traumatic experiences during childhood are indirectly associated with suicidal ideation through non-acceptance of emotional

responses, limited access to functional ER strategies, and lacking emotional awareness (138).

Sexual Abuse and Sex Trafficking

Especially sexual abuse is associated with post traumatic symptoms, such as dissociation, significant impairment of psycho-social adjustment and self-regulatory abilities, and ED. Because disclosure of maltreatment would lead to serious consequences within the family, the child remains helpless, cannot stop maltreatment, even not express his/her emotions, and has to adapt to the dysfunctional environment (139). The consequences are impaired emotion recognition and management, the development of maladaptive coping strategies, such as dissociation, self-injurious behavior (140, 141), and internalizing or externalizing behavior, interrupting the emotional development and the developing of constructive peer relationships, causing peer rejection, with sequelae persisting into adulthood (95, 139, 141–143). 30% of sexually abused children are <7 years old (144), putting this most vulnerable group at extreme risk for later (transgenerational) malfunctioning, and severe health-related problems. Because especially small children need sensitive and functional caregivers, they may dissociate their experiences of abuse and blame themselves. This will lead to ED, sleep difficulties, and poor attachment behavior. Later on, females are at increased risk of developing sexual anxiety and re-victimization in romantic relationships (145). Sexual assaults on adolescent girls will lead to PTSD, complex PTSD, and life-impairing disturbances in self-organization, ED, negative self-concept, and interpersonal problems, leading in about 40% to continued traumatization (146).

Research on the impact of developmental trauma on juvenile victims of sex trafficking is limited. Greenbaum (147) summarized the (limited) knowledge about child sex trafficking. Using qualitative research methods, Hopper et al. (148), analyzed hospital charts of sex trafficking youth and found that already existing ED and behavioral problems increased the vulnerability for sex trafficking. Thus, a vicious cycle of ED in traumatized children may be detected: on one hand, ED can be seen as a consequence of trauma (91), on the other hand, children and adolescents with ED are at risk to be exposed to traumatizing situations.

Trauma and ED

The neurological regions of interest for the regulation of emotions are the prefrontal cortex and the amygdala (149). If the maturation of the associated pathways is delayed until early adulthood, this asynchronous development may lead to problems of ER and decision-making. Neurobiologically, stressful situations in early life lead to early and persistent changes in the amygdala circuitry and function (150). According to Cohen and colleagues, these functional changes do not seem to recover even after the stressor is eliminated, and to persist despite developmental changes in the prefrontal regions for regulating emotions. In a study on 553 children aged 10–12 years, Fishbein et al. (151) found that exposure to personal stressors affected at least one neurocognitive function: community stressors were

related to problems of recognizing emotions and problem-solving abilities, neglect was related to problems of recognizing emotions and deficits of intellectual abilities, and physical abuse was related to disturbed problem-solving abilities. Cicchetti et al. (152) found decreased afternoon cortisol levels in children experiencing early physical and sexual abuse in 168 school aged maltreated children, indicating persistent neuro-endocrine dysregulation of the HPA axis. Maltreated children present with neuro-endocrine dysregulation of the HPA axis only if they experienced physical or sexual abuse in the first 5 years of life, and if they suffered from depression or other internalizing problems (152).

Early experiences of maltreatment and neglect, leading to ED is extremely common (98%) in adopted children (153, 154). There is also a high comorbidity of ADHD and conduct and attachment disorders, and in about 2/3 with continued, severe personal and social difficulties despite happy placements. 38% do not achieve a stable adoption. Studies of the hypothalamic-pituitary-adrenal (HPA) axis showed that 6 months after adoption, morning cortisol levels were improved but, also post adoption, dysregulation of the HPA axis was associated with more emotional and behavioral problems (129), possibly increasing the risk of negative developmental outcomes. Therefore, early interventions, even involving out of home care are justified to enable a sustainable development of vulnerable children if no change of the detrimental environment may be expected (155). The effect of such serious measures will not be paramount but will at least represent an opportunity (153), especially if appropriate care is established before the age of 6 months (156).

Posttraumatic Stress Disorder

PTSD is a disorder of ED (94, 157), and represents an individual's attempt to achieve an emotional equilibrium following severe traumatic experience(s) (157). Intrusions emerge from emotional under-regulation, whereas emotional numbing, avoidance, and dissociation are indicative of emotional over-regulation (158). ED is a critical risk factor for developing [e.g., (89, 94, 159–162)] and maintaining PTSD [e.g., (89, 160–162)].

Examining neural underpinnings of ED in pediatric PTSD, Wolf & Herringa (163) found that adolescents with severe PTSD showed abnormal function and connectivity in prefrontal-amygdala circuits. These changes are related to threat processing and fear regulation. Adolescents with PTSD demonstrated an age-related decline of dorsomedial PFC activation, inversely related to the severity of PTSD, and an age-related decrease of the PFC - amygdala connectivity. The authors suggested abnormal developmental processes to influence key emotional pathways of pediatric PTSD.

Age Dependent Characteristics

Infants and toddlers are especially vulnerable to traumatic experiences, and therefore at high risk of developing severe PTSD, ED, internalizing and/or externalizing symptoms, and long-term impairment (89, 164–166). PTSD in toddlers differs from PTSD in older children and adults in relation to the severity and number of symptoms, e.g., toddlers express less avoidance or numbing [e.g., (167, 168)].

Difficulties of ER, especially emotional clarity (2), play an essential role in trauma-related psychopathology. Viana et al. (169) showed that lower emotional clarity, a sub-dimension of ED, indirectly influences the severity of PTSD because of an increased sensitivity for anxiety. Viana et al. (170) also found lower emotional clarity in traumatized adolescents to be related to suicidal ideation at higher (and not lower) levels of distress tolerance.

Younger age at traumatization (below the age of 14 years) relates to increased psychopathology, including ED and PTSD (159, 171). ED, negative self-concept, interpersonal problems and core PTSD symptoms represent moderately correlated dimensions in traumatized adolescents (146). There is an ED related link between

- Violence exposure and PTSD (172),
- Depressive symptoms and PTSD (173),
- Traumatic exposure and reactive aggression (174).

Assessing the inter-generational impact of ED, Powers et al. (94) investigated 105 African American mother-child dyads and found PTSD significantly associated with childhood trauma experience, maternal depressive symptoms, ED, and maternal child abuse. The authors considered ED a trans-diagnostic treatment target across the life span, and recommended treating maternal ED in order to reduce traumatizing of the next generation. PTSD includes various heterogeneous symptom clusters - specific factors, such as type of trauma exposure or ED - influencing the severity of symptoms within these clusters and leading to distinct clinical phenotypes of PTSD (175). Empirically, there are various facets of ED, such as lack of emotional awareness, lack of clarity of emotions, difficulties of controlling behavior, achieving goal-directed behavior, non-acceptance of emotional responses, and limited access to problem-solving strategies. These facets act as indirect pathways through which trauma is associated with specific DSM-5 PTSD symptom clusters, such as intrusion, avoidance, negative alterations and arousal (175).

PTSD and Behavior

PTSD predicts aggressive and delinquent behavior in youth, especially in those who are also experiencing high levels of ED (174). Miller and Marsee (176) compared two groups of incarcerated boys, a low reactivity group with symptoms of emotional numbing and callous-unemotional (CU) traits, and a high reactivity group with symptoms of hyper-arousal and ED. Frequent violent offending, CU traits, and proactive aggression correlated with emotional numbing and combined hyper-arousal symptoms. Delinquent adolescents experienced high levels of ED (141, 175), girls more than boys (141, 177). ED also predicted a higher risk for subsequent offending behavior (177). Especially interpersonal trauma exposure corresponds to negative effects on youth's psychological functioning, severe PTSD symptoms [e.g., (146, 175, 178, 179)], poor ER strategies [e.g., (95)], and difficulties in self-organization [e.g., (146)]. Delinquent adolescents who experienced sexual abuse may show higher rates of PTSD (141).

Poly-Victimization

Experiencing repeated traumatic events is an important predictor for developing PTSD [e.g., (94, 180)]: Lehmann et al. (101) found a strong association between the number of self-reported potentially traumatic events and the development of PTSD in a sample of adolescents raised in foster care. Youth living in foster care had an increased risk of developing PTSD (101, 181, 182). PTSD and ED were significant predictors of depressive symptom trajectories, more pronounced in females than in males (182). The risk of more severe ER difficulties, ED, and PTSD is higher in poly-victimized adolescents, having experienced multiple types of interpersonal and non-interpersonal childhood traumata (101, 175, 183–185), girls again being more severely affected than boys (101, 185).

Charak et al. (186) investigated a large sample of incarcerated adolescents, and studied associations between poly-victimization, ED, DSM-5 PTSD symptoms, and related behavioral health problems, including alcohol/drug misuse, anger, irritability, depression, anxiety, somatic complaints, and suicide ideation. The authors distinguished three distinct sub-groups:

1. violent environment (such as being exposed to natural disasters, accidents, war, physical abuse or assault, witnessing physical violence, unexpected death of a beloved person, facing a dead body (excluding at funerals), painful medical treatment, and acts of violence)
2. poly-victimization (such as, serious injuries, psychological abuse, domestic violence, family members being badly injured or sick, parental drug use, unexpected death of someone close, removal from parental custody or parental threats of abandonment, neglect, and sexual abuse); psychopathology on all four DSM-5 PTSD symptoms clusters, as well as depression/anxiety, somatic complaints, and suicidality)
3. mixed adversity (such as, a parent being incarcerated, or someone they knew had attempted suicide, or was severely injured or ill, experience of physical abuse). Youth in the "mixed adversity class" reported about exposure to traumatic events (such as severe accidents), and were less likely having been exposed to violent victimization.

There is a positive relationship between developing and maintaining PTSD, and avoiding trauma-related emotions, thoughts and activities (187). Woodward et al. (188) confirmed this theory for traumatized inpatient adolescents, showing positive associations of emotional non-acceptance and greater distraction- coping in relation to more severe PTSD.

Influence of Comorbid Disorders

Various psychiatric disorders increase the risk of being exposed to traumatic events (189). For Dvir et al. (87), bipolar disorder is the best example of psychopathology involving ED. Biederman et al. (189) indicated that children with Bipolar-I disorder are at a 20-fold risk to develop full or subthreshold PTSD compared to healthy children. In patients with early non-affective psychosis, Liu et al. (190) found maladaptive ER strategies (catastrophizing, ruminating, and blaming others), global ED, and poor cognitive insight as psychological risk factors for PTSD.

Developmental Trauma Disorder

The complexity of early childhood developmental trauma is not optimally covered by a PTSD diagnosis. Hence, Developmental Trauma Disorder (DTD) is a proposed diagnosis for children, who have experienced disrupted attachment and multiple or chronic exposure to developmentally disabling interpersonal traumata, such as emotional or sexual abuse, abandonment, threats to physical integrity. Seven levels of functioning are involved in DTD (88, 191):

1. Attachment (e.g., restricted attachment in the form of a distrustful behavior pattern toward attachment figures as well as toward protective social institutions).
2. Biology (e.g., stress hormones).
3. Cognition (e.g., depersonalization, derealization, confusion, sense of safety).
4. ER (impairments in the regulation of e.g., anger, fear, resignation, defeat).
5. Behavioral control (e.g., acting out, cutting, re-enacting).
6. Dissociation.
7. Self-concept (e.g., self-attribution, self-hate, self-blame). Most often, DTD involves complex traumatic experiences in childhood, usually corresponding to sexual, physical abuse or war experiences in early childhood (92).

Non-suicidal Self-Injury and Suicidality

According to the biosocial theory of Marsha Linehan (80), individuals use deliberate self-harm and self-injurious behavior as maladaptive ER strategies against overwhelming intense negative emotions [e.g., (127, 192)]. Because of their increased emotional reactivity and lability, and their immature prefrontal control, adolescents have a higher risk for engaging in extreme dysfunctional ER strategies, such as Non-Suicidal Self-Injury (NSSI) [e.g., (193)]. NSSI therefore typically begins in adolescence (192). NSSI:

1. is defined as direct and deliberate damage of body tissue without conscious suicidal intent [e.g., (192, 194–196)], and for not culturally sanctioned purposes (31).
2. is triggered by ED (80), and predominantly goes along with high levels of emotional distress (197).
3. assists in the escape, management, or regulation of emotion (198), in particular in the escape of negative emotional states, such as anger, depression, loneliness and frustration, and unwanted thoughts (199).
4. is maintained by positive and negative reinforcement in intra- and interpersonal domains (192).
5. has a serious impact on health and well-being [e.g., (200)], and
6. increases the risk of later suicide (201), especially if low emotional clarity (2) is linked to high distress tolerance (169).

NSSI and Borderline Personality Disorder

“The relationship between NSSI and BPD features in adolescence seems to be more controversial than in adulthood” (203, p. 24). Recurrent NSSI is a core feature of BPD (31) and often precedes suicidal behaviors in adolescents [e.g., (202)]. Specific aspects of ED, such as lack of emotional awareness, poor coping strategies,

and non-acceptance of emotions, predict repeated NSSI [e.g., (2, 203)] and are highly prevalent among suicidal adolescents, regardless of their psychiatric diagnoses [e.g., (82)].

NSSI is included in the DSM-5 (31) as a condition requiring further study, and classified as an independent diagnostic entity since 2013. ED and NSSI are closely related [e.g., (193, 204–206)]. ED in NSSI is considered

- A risk factor [e.g., (141, 207)], and a core feature of NSSI [e.g., (208, 209)],
- The primary drive for NSSI in adolescents [e.g., (81)],
- A major factor for developing (200) and maintaining NSSI [e.g., (210)].

NSSI and BPD overlap in adolescents, 52% of adolescents practicing NSSI suffer from BPD (193). Underlying mechanisms for both disorders, although to a different degree, include affective instability (i.e., ED), and interpersonal instability (i.e., instability of attachment to significant others). Interpersonal instability in BPD is more generalized, extending beyond family functioning to peer relationships (205).

Sadeh et al. (211) investigated the relationship between BPD symptoms and NSSI: BPD affective dysregulation was associated with intra- (e.g., affect regulation, anti-dissociation and self-punishment) but not interpersonal functions (i.e., peer relations, autonomy) of NSSI. In contrast, BPD interpersonal dysfunction was associated with inter- rather than intrapersonal functions of NSSI. These data indicate that clusters of BPD symptoms show unique relationships with functions of NSSI in adolescents. Somma et al. (201) found a moderate association between self-reported features of BPD and NSSI in a sample of non-clinical adolescents, not fully explained by ED. The authors suggested that NSSI may represent just one of several dysfunctional ER strategies in adolescents at risk for BPD, and that NSSI in adolescence may not represent an exclusive ER strategy but may fulfill various other intra- and interpersonal needs.

Nakar et al. (212) found three distinct developmental trajectories for self-reported harmful behaviors in a community-based adolescent sample: self-injurious behavior, suicidal behavior, and substance misuse.

High-risk trajectories for the three behaviors greatly overlapped (80–90%), and this overlap was significantly associated with higher levels of BPD. The authors found a symptom shift, typically associated with BPD in adolescents: the high-risk trajectory of self-injurious behavior, and the high-risk trajectory of suicidal behavior had a high initial degree of engagement with decrease over time, while the high-risk trajectory of substance misuse had a medium initial degree of engagement with increase over time.

Influencing Factors

NSSI is maintained more frequently because of intrapersonal functions, such as affect regulation, self-punishment, and because of interpersonal functions, such as peer bonding, autonomy, that are especially relevant in youth with interpersonal difficulties (211, 213, 214).

Neurobiologically, adolescents with NSSI are less able to interpret social cues and regulate their emotions (215): female

adolescents with NSSI but without BPD showed an increased activity in amygdala regions, the anterior cingulate cortex (ACC), and the inferior and middle orbitofrontal cortex, as well as a reduced sensitivity in the cuneus and right inferior frontal cortex during an emotional processing task.

ED moderates the longitudinal relationship between NSSI and disordered eating: Turner et al. (216) found a strong relationship between disordered eating and later NSSI, together with high levels of ED but no significant moderating effect of ED for predicting concurrent NSSI and vice versa (217). Internalizing symptoms predicted NSSI in inpatient adolescent girls (218). Female adolescents with higher levels of depression had a higher risk of utilizing NSSI for regulating strong emotions (219). Both, ED and depressive symptoms, are related to the frequency of NSSI in adolescents [e.g., (127, 195)].

Environmental factors, such as stimuli that elicit emotional arousal, promote NSSI (209): there is a significant relationship between ED, interpersonal problems, and NSSI [e.g., (208, 220, 221)]. Interpersonal problems with the family and peers have independent negative effects on ED, with ED mediating the influence of interpersonal problems on the frequency and severity of NSSI. Higher levels of conflict and lacking support for ER in family and peer relationships went along with higher ED in adolescent girls hospitalized for psychiatric problems (208).

Children and adolescents with severe ED are at higher risk of NSSI when facing stressful life events (199). Especially child maltreatment increases the risk for NSSI (127, 222, 223). ED mediates the relationship between childhood maltreatment and the frequency of NSSI [e.g., (195, 223)]. Peh et al. (127) demonstrated ED to mediate the association between severity of child maltreatment and frequency of self-harm, while controlling for depressive symptoms in adolescent psychiatric outpatients. The authors considered exposure to childhood maltreatment as a distal, and ED as a more proximal associative factor, linking maltreatment exposure to self-harm.

A history of sexual abuse is strongly related to NSSI, particularly in girls. Chaplo et al. (141) investigated associations between sexual abuse and NSSI in traumatized delinquent youth on the basis of the dual mediating variables, ED and dissociation: higher levels of dissociation were associated with more frequent NSSI.

ER mediates the relationship between sexual orientation and NSSI in lesbian, gay and bisexual (LGB) adolescents. LGB youth are exposed to a greater risk of NSSI (224), probably related to bullying and peer harassment (225), and possibly parental rejection.

Suicidality

Suicidality is based on mental suffering, lacking self-respect, respect by others or of the feeling of being not loved by others (226). Erwin Ringel (227) described a presuicidal syndrome with 3 principal components, constriction, inhibited aggression turned toward the self, and suicidal fantasies (nowadays suicidal ideation, “escaping from a predicament”). The transition to suicide is characterized by the idea of hopelessness, feelings of anhedonia and severe anxiety, and direct planning of committing suicide (228). Suicidality is linked to depression but

not exclusively (228). The risk of completing suicide increases with the number of suicide attempts, mental narrowing, and the emergence of a stressor, such as separation, loss of support. 90% of completed suicides are associated with psychiatric disorders, namely major depression and alcohol or substance abuse. The prevalences of suicide ideation, plans, and attempts are 2%, 0.6%, and 0.3% (229). The lifetime prevalence of suicidal ideation is 9.2%, and of attempted suicide 2.7% (230).

NSSI and ED

ER skills play a key role in the ability of adolescents to adequately identifying emotions, and helping them in selecting adequate coping strategies that may reduce suicidal ideation (231). Pan et al. (232) with the example of processing slightly angry faces, suggested that dysfunctions of the neural circuitry involved in processing emotions could smooth the path to suicidality in adolescents. Selby et al. (233) found ED to interfere with the ability to activate adequate emotional processing, and therefore would evoke suicidal thoughts. More specifically, ED is a well-established risk factor or even an underlying mechanism for suicidal ideation, suicide plans and suicide attempts in youth (130, 234, 235). The readiness for attempting suicide may be increased by impulsiveness and dysregulated behaviors (236). Comparing adolescents who attempted a number of suicides with those experiencing only one attempt, the former reported stronger deficits in ER and poorer impulse control (237).

Eating Disorders

Eating disorders (EatD) comprise anorexia nervosa (AN), with the subtypes, restrictive and binge-purging, bulimia nervosa (BN), and obesity (OB) (31, 238).

According to the affect regulation model, EatD serve as maladaptive coping strategies for pervasive emotional and behavioral dysregulation (239–242). ED is a key trans-diagnostic characteristic, arising from emotional vulnerability, combined with an invalidating familial environment that commonly can be targeted (243–245).

ED in Eating Disorders

Adolescents with EatD are significantly more impaired in their ability to regulate emotions compared to non-clinical samples [e.g., (244)]. In this study, patients with EatD scored higher in the Difficulties in Emotion Regulation Scale (DERS total score and subscale scores, “Non-Acceptance,” “Awareness,” “Strategies,” and “Clarity”). Symptoms were most strongly associated with “Strategies.” ED also plays a role in obesity, particularly among girls with self-reported loss-of-control (LOC) and binge eating (183). In contrast to individuals with adult-onset obesity, individuals with childhood-onset obesity showed a higher prevalence of EatD, particularly BN (246). The severity of an eating disorder relates to the severity of ED (241, 244, 247). High levels of parental ED are also associated with the severity of the children’s EatD pathology (248). Maladaptive adolescent attentional bias toward anger and social threats predict a strong association between maladaptive parental responses to emotions and adolescent ED (249). There are specific emotional factors in developing and maintaining adolescent EatD:

- deficient ER strategies across a variety of domains (183, 241, 243, 250–257),
- “emotional” eating, defined as eating for emotional reasons in response to negative emotional states and in order to escape from negative affect (240, 251, 258, 259),
- poor emotional awareness (244, 250, 251, 257), and
- high and low approach on dysregulated positive emotions, such as avoiding positive affect and rewards (251).

Dysfunctional metacognitions represent another vulnerability factor for ED: Laghi et al. (257) found interaction effects between metacognitions and emotional functioning in binge eating adolescents. Metacognitions, the need to control thoughts, moderated the relationship between lack of emotional awareness and binge eating.

Jakovina et al. (256) found significantly higher levels of attachment related anxiety and avoiding strategies in adolescents with BN compared with controls, but only attachment related anxiety predicted BN symptoms, and was mediated by ER.

Monell et al. (244), comparing patients with various EatD subtypes, found only a few meaningful differences in relation to ED: patients with AN, binge-purging subtype showed more difficulties in controlling impulses than those with AN, restrictive subtype. Individuals with binge-eating disorders had higher impulsiveness scores than those with AN, restrictive or binge-purging subtypes, and EatD otherwise specified. The authors concluded that differences between EatD subtypes may depend on the study design, and possibly also on other factors than the eating disorder type. In contrast to Monell et al. (244), other authors [e.g., (255, 260)] found higher ER deficits in individuals with BN and binge-purging AN compared to individuals with restrictive AN. Across ages, Anderson et al. (255) found less self-reported acceptance of emotional responses, higher impulsiveness, fewer ER strategies and low emotional clarity (2) in patients with AN binge-purging type or BN, whereas patients with restrictive AN showed more goal-directed behaviors in stressful situations than those with BN, and a better awareness of emotions than in those with binge-purging AN.

Influence of Emotional Child Abuse

Emotional child abuse may induce the development of severe ED and severe eating disorder (EatD), including AN. A number of studies support the strong psycho-pathological relationship and long-term comorbidity of the two disorders (252, 261). ED mediates the relationship between emotional child abuse and AN. Nature and magnitude of this influence do not differ regardless of the AN subtype (252). AN is also associated with higher levels of comorbid depressive or anxiety disorders, OCD, PTSD, and interpersonal problems. Individuals with binge-purging AN had experienced more severe maltreatment, neglect (261), and sexual abuse (252) than those with restrictive AN. McDonald et al. (262) found binge-purging AN to co-occur more frequently with BD than with restrictive AN. Patients with BD and EatD usually are more impulsive and have more severe EatD. They also suffer more from alcohol and substance abuse, suicidality and mood instability than patients with BD only. Slane et al. (263) investigated monozygotic twins with dysregulated BN and

comorbid alcohol use disorders at ages 17 and 25 years. They found non-shared environmental effects (i.e., factors that create differences in monozygotic twins) that did not influence the association between BN and alcohol use disorder.

Oppositional Defiant Disorder, Conduct Disorder, and Disruptive Mood Dysregulation Disorder

Oppositional Defiant Disorder

Oppositional Defiant Disorder (ODD) is a disruptive behavior disorder (DBD) of childhood and adolescence that can be described as recurrent, persistent, developmentally inappropriate patterns of anger, irritability, negativity, defiance, disobedience and deliberate hostility toward others, resulting in functional and social impairment (31). Children with ODD commonly experience dysregulated emotions such as temper tantrums, intense fears, inconsolable despair, problems to feel and express emotions, and a low tolerance to frustration (264), co-occurring with externalizing behavior problems (265, 266).

For these children, emotions seem uncontrollable or absent. They tend to think simplistically, rigidly, and reactively, and are led by defiance and aggression (264). Adolescents with ODD and higher scores on the Child Behavior Checklist, Dysregulation Profile (CBCL-DP) possess poor abilities to regulate affect, behavior and cognition, and are more likely to present with auto-aggression (267). ODD is associated with impairments of social, academic, occupational and family relationships over the lifespan (268). Most studies concentrate on the association between ED and externalizing behavioral problems (269, 270). Studies on the relationship between ODD and ED are lacking, except for a few studies suggesting a strong association between ED and ODD (270–273). It is unclear if ODD criteria are uni-dimensional, if ODD is better conceptualized as an ER disorder (271), or if ODD is a multidimensional construct and better conceptualized as a disorder of mood regulation (273, 274).

Conduct Disorder

Conduct disorder (CD) is a behavioral and emotional disorder characterized by functional impairment that includes intentional violations of the rights of others, societal norms or rules (31). Children with CD typically show aggressive, antisocial behavior, and callous-unemotional (CU) traits including low prosocial emotions and behaviors, such as blunted affect, lack of guilt, physiological under-arousal, and lack of empathy (275). Antisocial behavior of children with ODD or CD have partly been explained by deficits of information processing and ER. The combination of misinterpreting social cues in a negatively biased and stereotypic way, limited strategies for coping with anger, and lack of behavioral control, especially difficulties in response inhibition, lead to inappropriate handling of distressing emotions and impulsive behavior (264, 273). Fehlbauer (275) investigated adolescents with CD in a controlled fMRI study.

Both groups were confronted with an emotional stimulus and a Stroop task with varying cognitive load. Adolescents with CD made significantly more errors, while reaction times were not significantly different compared to typically developing (TD) youths. In children with CD, left amygdala activity failed to be down-regulated in response to incongruent trials, and anterior

insular activity increased during the Stroop task. The authors concluded that children with CD could not adequately process distracting emotional information and suppress impulsive thoughts, leading to antisocial behavior. They also concluded that rather their neurological problems than ED was responsible for their inappropriate behavior.

Mitchison et al. (273) examined the relationship between ED, ODD symptoms and conduct problems in preschool children: problematic behavior occurred more often at home than in the kindergarten setting, and there was a strong relationship between ED, ODD symptoms and conduct problems especially regarding lability/negativity. Boys had more severe ED problems than girls. Furthermore, ED was found to be a strong, gender-independent predictor of ODD symptoms and conduct problems. This is also supported by the work of Schoorl et al. (276). Multimodal extensive treatment is recommended including socio-therapy, individual and family psychotherapy, and medication. Methodologically sound controlled trials are still lacking (265).

Influence of Comorbid Disorders

ODD is very frequently (almost 50–60%) comorbid with ADHD (277). Children with ADHD and comorbid ODD showed significantly more negative emotional lability compared to children without ODD, involving impairment in the regulation of a variable, intense pattern of emotional responses (278).

There is an association between early traumatic experiences and later aggressive, impulsive and antisocial behavior [e.g., (279–281)].

Another study focused on CU traits, manifesting as a consequence of traumatic experience and resulting deficits in ER. Adolescents with high expression of CU traits showed impaired emotional responses and exhibited severe aggressive-dissocial behavior. Potentially traumatized adolescents with highly expressed CU traits showed significantly more external-dysfunctional ER strategies than traumatized adolescents with low CU expression (282).

Investigating incarcerated adolescents, Sevecke et al. (111) observed ED and psychopathic traits to occur only in boys. Hoskins et al. (283) found past trauma exposure in three quarters of first-time offending, court-involved, non-incarcerated Latino youth. Traumatized girls presented with more severe internalizing symptoms and affect dysregulation, traumatized boys with more externalizing symptoms.

ED and antisocial behavior are commonly observed in juvenile offenders, depending on the co-occurrence of emotional neglect. Physical abuse in incarcerated boys was related to ED only in those with co-occurring emotional neglect (117).

ED was associated with more severe aggressive behavior in urban adolescent boys and girls who witnessed community violence (284). Ford (264) developed a three-step model explaining the relationship between trauma and victimization in childhood:

1. “survival coping” characterized by dysregulation of emotions and deficient social information processing (77)

2. “oppositional-defiant” behavior, involving covert or overt aggression and PTSD
3. “victim coping” in a chronological sequence.

Plattner et al. (285), comparing delinquent adolescents and high-school students, observed that delinquents had higher levels of negative emotions (fear, sadness, and anger) as state and trait conditions, probably linked to childhood trauma experience. The duration of trauma exposure influenced trait emotions, and the severity of trauma (emotional abuse and witnessing violence) had an impact on state emotions. When stressed, delinquent adolescents showed more state emotions of sadness, anger, and a wider range of negative emotions.

There are also associations between deficient executive functions and ADHD: Landis et al. (286) reported that children with dysexecutive problems (operationalized by a questionnaire and a well-established survey tool) were classified as more inattentive and hyperactive. Both, hyperactivity and inattention, were associated with ED.

Disruptive Mood Dysregulation Disorder

A new and controversial disorder of children similar to ODD is Disruptive Mood Dysregulation Disorder (DMDD) (31). The disorder is characterized by severe, chronic, non-episodic irritability, frequent temper tantrums, and verbally or behaviorally expressed outbursts that are disproportionate to the trigger and inappropriate to their developmental level. Children with DMDD generally present annoyed, touchy, and persistently angry, with mood swings and irritability (287–289). They have poor ER abilities and frequently lose behavioral control, contributing to rising frustration and distress (290). It remains controversial whether DMDD is a unique entity or if it is closely related to ODD (290, 291). According to Dougherty et al. (292), a DMDD diagnosis is associated with concurrent and predictive indicators of emotional and behavioral dysregulation, and poor social functioning. They also noted that temperamental surgency, a construct reflecting high levels of activity, reward seeking, low shyness and impulsiveness, of 3-year old children predicted DMDD at the age of 6. Zepf et al. (293) reported about diminished cognitive flexibility in children with DMDD, assessed by a reversal learning task (294), and poor motor inhibition (295).

Personality Disorders

ED plays a substantial role in personality disorders (PD) with the majority of research focusing on borderline personality disorder (BPD). We only found a few recent studies, investigating ER problems in adolescents with PDs other than BPD. Compared with healthy controls, children with obsessive compulsive personality disorder exhibit more alexithymia (296), impulsivity, behavioral activation (297), and poorer effective ER strategies (296, 298).

Borderline Personality Disorder

BPD is a serious mental illness that includes ED and interpersonal problems. Based on the bio-psycho-social developmental model of BPD (80) there is a predisposition toward increased emotional sensitivity and intensity of responses to emotional stimuli with a slow return to baseline following emotional responses, and

adverse social influences. ED mediates the relationship between BPD, emotional vulnerability (299), and over-mentalizing (excessive inaccurate mentalizing, i.e., excessive Theory of Mind, TOM) (300). In accordance with Linehan (80), Carpenter and Trull (301) conceptualized ED in BPD as consisting of four components: 1. emotional sensitivity, 2. heightened and labile negative affect, 3. deficits of appropriate regulation strategies, and 4. excessive maladaptive regulation strategies.

BPD and ADHD share a number of common features, such as impulsiveness, ED, deficits in attention and decision-making, comorbid major depression; brain volume reductions and impairments of connectivity in prefrontal, anterior cingulate and limbic areas (302, 303).

Results of studies assessing neural correlates of ED in adolescents with BPD are heterogeneous. Comparing female adolescents with BPD and healthy controls, Krauch et al. (304) found increased activation in the left posterior insula and left dorsal striatum as well as in the inferior frontal gyrus and parts of the mentalizing network. This suggests an enhanced emotional reactivity to interpersonal threat- or rejection-related situations early in the development of BPD.

Attachment, ED, and BPD are strongly interrelated [e.g., (80, 305, 306)]. Disordered attachment plays a significant role in the pathogenesis of BPD (307, 308). Maternal ED mediates the relationship between maternal BPD and child functioning (309). There is an interplay between disordered attachment and features of BPD mediated through ED (310). Secure attachment to the father functioned as a buffer against adolescent BPD via enhanced positive ER strategies, while negative ER strategies served as a potent correlate of clinically significant levels of BPD, weakening the protective effects of attachment and positive regulation strategies.

Genetic and environmental effects are likely to influence attachment patterns and personality disorders (311). In monozygotic twins, the associations between self-reported anxious attachment (i.e., fears of abandonment and difficulties in regulating worries about the availability of attachment persons) and PDs were mostly explained by genetic factors, while self-reported avoidant attachment (i.e., discomfort with close relationships and depending on others) was entirely influenced by non-shared environmental effects. Factor analyses revealed that anxious attachment loaded on ED, while avoidant attachment loaded on inhibitedness. Attachment anxiety correlated with affective lability and self-harm (characteristic for BPD), increased self-satisfaction (characteristic for narcissistic PD), oppositionality, submissiveness, and the lack of self-fulfillment (characteristic for identity problems). The authors suggested that probably different sets of genes contribute to the specific associations observed between these variables to explain why anxious attachment correlates with different psychopathologies. Neither avoidant nor anxious attachment showed any relationship with PD scales indexing dissociative behavior or compulsivity, suggesting that these dimensions of personality pathology are not related to attachment styles (311).

More severe features of BPD are significantly associated with increased hypermentalization, ED, and internalizing or

externalizing symptoms (312). Hypermentalization and ED mediates the relationship between attachment coherence and features of BPD. Hypermentalization and ED are independently related to BPD. Kalpakci et al. (313) investigated relations between ER, hypermentalization (i.e., incorrect, over-inference of thoughts and feelings of self and others), and cognitive and affective empathy in inpatient adolescents with and without BPD. In both groups, ED was related to increased affective empathy.

There are differences between BPD and healthy controls in information processing (80, 314): patients with BPD showed alterations in early validation processes that determine the emotional response and trigger ED (315). Analyzing patterns of emotional responses to stimuli, patients with BPD showed significantly greater arousal and greater valence (more positive emotions) than healthy controls when looking at unpleasant and neutral images, but lower dominance (greater insecurity and discomfort) when looking at positive images. These results are similar to the pattern found in depressive patients (315).

Features of BPD were associated with significantly higher levels of experiential avoidance (i.e., the unwillingness to remain with uncomfortable thoughts, emotions, sensations, memories and urges by escaping or avoiding them), and difficulties in ER. Experiential avoidance partially mediated the relationship between difficulties in ER and features of BPD. The authors suggested a reciprocal relationship between ER and features of BPD - difficulties in ER being associated with both, experiential avoidance and features of BPD (316).

Trait impulsiveness and the three dimensions of ED (difficulties in controlling impulsive behaviors when distressed, limited access to effective ER strategies, and lack of emotional clarity) were significantly associated with BPD features in two independent non-clinical samples of Italian adolescents (317).

Aggressiveness most substantially differentiated between patients with and without BPD. Parents rating adolescents on BPD scales described them as presenting with more anger, hostility, and indirect aggression (318). ED and trait anger sequentially mediated the association between BPD and reactive aggression, generated by increased interpersonal threat sensitivity (319, 320). Banny et al. (321) observed features of BPD predicting increases in reactive (i.e., impulsive/dysregulated) relational aggression and proactive (i.e., premeditated/controlled) relational aggression, and decreases in proactive physical aggression in girls 1 year later. Measurements of systolic and diastolic blood pressure, and skin conductance reactivity supported the hypothesis that aggression is a strategy for girls with features of BPD to cope with overwhelming intense negative affect in the context of ED, more precisely in response to stressful peer interactions (threats or exclusion).

Yen et al. (318) compared suicidal adolescent inpatients with and without BPD. They found that suicidal patients with BPD had more Axis I co-morbidities, higher levels of aggression, and a greater likelihood of a history of serious suicide attempts. There were no significant differences in ED between the two groups. The authors suggested that affective dysregulation may be more trans-diagnostic and not specific for BPD, particularly in a high-risk sample of suicidal adolescents.

There is a close relationship between interpersonal trauma experience and PD (87). ED is a consequence of exposure to direct or indirect physical or sexual violence associated with posttraumatic stress symptoms [e.g., (184)] and BPD pathology [e.g., (322, 323)]. Ford and Courtois (324) provide an extensive summary of the role of trauma and ED in BPD. Buckholdt et al. (172) examined the mediating role of ED in the relation between exposure to violence and PTSD or BPD pathology in adolescents. They found that patients exposed to violence presented with more ED, which, in turn, was related to more PTSD and BPD pathology. ED mediated the association between exposure to violence and PTSD or BPD pathology.

For BPD and NSSI, please refer to the section on Eating Disorders. Frequently observed comorbidities of BPD are bipolar disorder (BD), ADHD, and disordered sleep. The number of BPD symptoms is correlated with the severity of BPD (325). The BPD factors, affective dysregulation, involving affective instability, fear of abandonment, and inappropriate anger, is associated with BPD chronicity and severity. In addition, threat sensitivity and impulsivity in the context of negative affect were related to a higher risk of BPD (65). Preliminary research indicates that patients with BPD and comorbid sleep disturbance have an increased risk of suicidality [e.g., (326)], suggesting impulsivity and ED as potential psychological mechanisms driving the insomnia – suicide link in BPD.

There is a strong negative relationship between personal life objectives, ED, and BPD. Patients with BPD have a lower feeling of meaning in life than mentally handicapped individuals without BPD. Marco et al. (327) designed a multi-axial model, consisting of the axes, “ED,” “emotional suppression,” “satisfaction and meaning in life” (subscale and overall score), and “personal life objectives.” The model explained more of the variance in BPD symptoms than the ED scales alone.

Narcissistic Personality Disorder

Narcissistic personality disorder with its various manifestations is associated with ED beyond personality characteristics and constitutes an important factor in the psychopathology of the disorder (328, 329). The latter authors studied 1,018 undergraduate students, based on the narcissistic admiration and rivalry concept model and the related questionnaire (330). They found that merely narcissistic rivalry was associated with problematic responses to and poor recognition of emotions, whereas persons with the admiration variant could regulate emotions more effectively.

Psychopaths

Higher levels of psychopathic traits were associated with increased brain tissue volumes in the left putamen, left ansa peduncularis, right superomedial prefrontal cortex, left inferior frontal cortex, right orbitofrontal cortex, and right medial temporal regions, and reduced brain tissue volumes in the right middle frontal cortex, left superior parietal lobule, and left inferior parietal lobule (331).

Substance Use Disorder

Adolescents with ED are at high risk for substance use and misuse disorder (SUD) (332). Adolescents with ED start misuse earlier, and transition more rapidly into SUD. Longitudinal studies identified externalizing symptoms in early adolescence predicting SUD in late adolescence and early adulthood [e.g., (333)]. Differences in brain cortical thickness have been described in association with problems of ED, inhibition, and behavioral control in female adolescents with SUD (334). Disturbance of the endocannabinoid signaling in the amygdala-prefrontal cortical circuit may lead to abnormalities in the processing of emotionally salient information, learning, and memory (335). ADHD has been identified as a risk factor for early substance use [e.g., (336)]. Disturbances of the circadian rhythm and sleep are associated with affect dysregulation, increased drug and alcohol misuse, and other risky behaviors in adolescents (337). Poor emotional control is related to the frequency of alcohol, marijuana and cigarette use in adolescence, mediated by proximal influences like exposure to negative experiences and social motives for substance use (332). Consistent with these observations, affect dysregulation is associated with a history of misusing various substances, including marijuana, alcohol, cocaine and downers (338, 339). This may indicate a general tendency to engage early in risky behaviors, being more susceptible to peer influences, or attempting to control emotions by substance use (340).

Although negative sequelae have to be feared, adolescents engage in binge drinking because they are emotionally, behaviorally, or cognitively dysregulated (113). Cortical thickness - to be specific, thinner dorsolateral prefrontal cortex and inferior frontal cortex in early adolescence - is predictive of binge drinking and externalizing symptoms in late adolescence (341). Theory and research about emotionally labile youth suggests that lacking of internal regulation resources is frequently associated with exposure to external maladaptive coping strategies, such as alcohol misuse (342). This is consistent with self-medication theories where consuming alcohol serves as a coping strategy for overcoming negative emotions (343).

Marijuana use (occasional, heavily increasing, chronic) is associated with ED, nicotine and alcohol abuse and dependency (344). Adolescents with poor ER strategies may be prone to regular use of marijuana (345, 346) that may impair cognitive abilities and emotional reactivity. Marijuana and alcohol use are associated with white matter disorganization, which in turn predicts ED (347, 348).

Nicotine dependence among adolescents is a widespread health concern (349). ED predicts adolescent smoking behaviors (342, 350), and SUD (351). High levels of distress combined with ED may predict smoking-naïve adolescents to develop positive expectations about social acceptance with smoking. This may promote the decision to start smoking [e.g., (352, 353)]. Longitudinal data suggest that low levels of ER predict initial adolescent attempts to start smoking, as well as the transition to regular smoking (350). The higher the ED the higher the risk of smoking (338). Following the self-medication model of Khantzian (343), poor regulation of negative affect (especially of anger) increases the vulnerability to smoking and SUD [e.g.,

(354, 355)]. Adolescents may engage in cigarette smoking or substance use, in order to cope with anger-related distress (355). Personal motives, such as reducing negative affect, are among the most common reasons for cigarette smoking [e.g., (356–358)], a process that - besides nicotine dependency - reinforces and maintains smoking behavior (359). Padovano et al. (360) found high positive or negative arousal related to smoking relapse, again highlighting the importance of affective dysregulation as a risk factor for adolescent smoking. Therefore, smoking prevention and intervention programs for high risk adolescents should include practicing cognitive and behavioral ER strategies [e.g., Contextual Emotion-Regulation Therapy; (361)].

Recent studies identified ED as a mediator between drug abuse and SUD (184, 362). As an example, the (weak) opioid agonist, tramadol, is misused in order to enhance positive mood and to perceive pleasant emotions (363). Ghorbani et al. (137) suggested that lacking ER strategies may be related to heroin craving in individuals with heroin dependence who experienced a history of CT.

Prenatal cocaine exposure is associated with long-term dysregulation of arousal (364). Neuroimaging data confirm these observations by findings that prenatal cocaine exposure has deleterious long-term effects on the arousal regulation system (365).

Developmental Disorders Including Autism Spectrum Disorder

Autism spectrum disorder (ASD) is defined as a neurodevelopmental disorder, characterized by impaired social communication and interaction as well as repetitive behaviors or restricted interests (31). ASD also goes along with various emotional and behavioral difficulties, such as ED (366–368). Although ED is not considered a core feature of ASD, the prevalence of ED in the context of ASD is up to 50 or 60% (369, 370), significantly higher than in other clinical disorders or in children with normotypical development (291, 369–376). In general, ER problems manifest especially in a more frequent use of maladaptive ER strategies, such as avoiding (377), or a less frequent or ineffective utilization of adaptive strategies for regulating emotional states (98, 367, 368, 378, 379). ED often leads to increased problems of social adaptation, school related problems (380, 381), higher rates of social and general anxiety (382–384), and other difficulties (385–387). Moreover, ED is associated with higher rates of repetitive behavior, communication and social skills deficiencies (370, 371). Owing to the intensifying effect of ED on ASD specific symptoms, various studies aimed at identifying predictors of this co-occurrence (366, 370, 371, 375, 380, 388–390).

Gadow et al. (380) described a modulating effect of dopaminergic polymorphisms on ED in the context of ASD. Fenning et al. (388) suggested problems of internalizing and generalizing parental ER strategies to promote ED in ASD patients. This assumption is supported by observations that parental scaffolding helps children in overcoming frustrating situations and in improving ER. Children with ASD seem to benefit less of this support (372, 388). Samson et al. (98, 379) found that therapy programs focusing on teaching adaptive

ER strategies improved both, ED and ASD-related symptoms. There are also observations that pharmacotherapy with the β -blocking agent, propranolol, acting on the consolidation of anxiety memories, improves problem-solving skills and ED in children with ASD (274). Thus, approaching ED may improve the complex association of ASD and ED (390–392).

The diagnosis of ED may be facilitated by using specific inventories. Mazefsky et al. developed and evaluated the Emotion Dysregulation Inventory for assessing deficient ER in the context of ASD (391, 392). Future research should focus on this interesting topic because specific diagnostic and therapeutic instruments are still scarce (370).

Psychosis and Schizophrenia

Schizophrenia is considered a “severe and persisting brain disorder” (393) with psychotic symptoms that may occur as a single episode or (in the majority of cases) as recurrent chronic disorder. The lifetime prevalence of schizophrenia is ~1%, children and adolescents having a lower risk of 0.018% (393–395). Schizophrenia usually goes along with intrusive thoughts, impaired cognitive functions, marked changes of personality, and symptoms of ED (97, 393, 396).

The clinical characteristics of schizophrenia are manifold, symptoms may be non-specific. Usually positive (such as hallucinations, delusions) and negative symptoms (such as affective flattening, avolition, catatonia) are distinguished (397). Symptoms are not exclusively characteristic for schizophrenia but have been refined since the development of the DSM-IV. Symptoms may vary with age and also depend on comorbid problems, such as affective dysregulation. Jerrell et al. (393) described symptoms of ED, especially in older adolescents needing in-ward treatment. ED has a moderating effect on the severity of schizophrenia associated “positive” symptoms, such as acoustic and optic hallucinations in relation to the severity of ED (398–400). In addition, subclinical changes of personality seem to be associated with more accentuated manifestations of ED. For example, pronounced schizotypal personality may be considered a subclinical stage of schizophrenia and associated with a higher risk of developing schizophrenia (401–405). This close relationship between ED and schizophrenia or schizotypal disorder suggests a genetic link for this co-occurrence (405). This could help improving the specificity and sensitivity of diagnostics of ED in schizophrenia, and especially in adapting multimodal treatment approaches individual needs (402).

Gaming Disorder

The use of electronic media (computers, internet, video and mobile phone use) has dramatically increased in the last two decades, especially in children and adolescents. Daily electronic media use has increased to a mean of 7.4 h in 8–18 year old adolescents (406). The gain in entertainment and knowledge acquisition is opposed to reductions of real social and physical activities, and has a negative impact on physical and mental health. ER abilities also become compromised (407). Available data are, however, limited, especially for children and adolescents.

Adolescents having difficulties in regulating their emotions, are especially prone to problematic technology use (408, 409). The association between ED and problematic internet use (more than 4 h/day) is partly mediated by meta-cognitions in young adults (410). Donald et al. (411) found ED to be correlated to the amount of problematic internet use. Playing internet games is used to regulate unpleasant emotions. In addition, escapism is another important motivator for excessive gaming (412). Problematic internet use promotes ED, such as difficulties in recognizing emotions and goal setting.

In addition to problematic internet use, the use of video and computer games is also increasing. The median prevalence of internet gaming disorder is about 2% for children and adolescents (413). Excessive use of computer or video games leads to impairments or distress depending on the amount of activity. As early as in the preschool age, the presence of ED has been shown to be a predictor of media use and GD symptoms 5 years later (at about age 9) (414). Difficulties in impulse control and a limited access to emotions is associated with problem video gaming (415, 416). Wichstrom et al. (417) showed that ER deficits in 8 year olds predicted symptoms of internet gaming disorder at 10 years.

Prevention and Treatment

In the following, we will describe meaningful preventive and therapeutic strategies for improving ER or ameliorating ED. Because of the complex background of ED, prevention and therapy will primarily focus on recognizing risk factors such as personality, familial and social conditions, underlying disorders, such as ADHD, affective or trauma related disorders and their comorbidities. Especially familial factors will be susceptible to parental training, youth welfare support, and in case of not sufficiently improvable conditions, early placement in suitable foster families may be necessary.

Therapies for treating underlying disorders, such as medication for ADHD or affective disorders, for decreasing internal tension or improving stability and reactivity may be necessary. In addition, building-up or improving sensitivity and appropriate coping strategies in social or self-regulatory skills training will be beneficial (see below, section Treatment). In the following, we will describe specific measures and strategies that have proved to be successful.

Prevention

Prevention of ED includes identifying risks and learning or applying appropriate measures in order to prevent damage. This has been shown e.g., by treatment of postpartum depression (418), positive parenting programs (419), or early placement in care families or adoption of children from maltreating families (cf. chapter Psychological Trauma). The results of such preventive measures to date are disappointing (too late, too inefficient, too many children missed) (420). In fact, only a few studies reported about effective prevention methods.

Adolescents attending alternative schools because of behavioral and emotional problems, and youth at odds with the law have difficulties in managing strong emotions. This may also concern their sexual behavior. Effective Human

immunodeficiency virus (HIV) prevention programs for adolescents should include the training of keeping a cool head dealing with strong emotions in sexual relationships. Affect management skills for reducing the risk of HIV infection are comparable to techniques used in dialectical behavioral therapy (DBT), and have successfully been applied (421, 422).

Teachers working in schools with socially and economically disadvantaged children have been trained for improving their children's social skills and emotional self-regulation, to reduce their conduct problems, and involve the parents in their supporting role. Results indicate that teachers in the intervention group used more positive classroom management strategies, their students were better in applying social skills and emotional self-regulation, and had less conduct problems compared to the non-intervention control group (423).

Transdiagnostic interventions for internalizing disorders target common underlying mechanisms and may attract a larger proportion of these youths than concepts developed for single disorders (424). As an example, the recently developed CBT-based transdiagnostic prevention program, EMOTION (425) for internalizing disorders, includes techniques for improving children's ER skills, psychoeducation, behavioral activation, cognitive restructuring, building of a problem hierarchy and exposure to feared or until now avoided situations. The 10 weeks lasting program has been shown to improve children's ER skills.

Deplus et al. (426) tested an intervention adapted from mindfulness-based cognitive therapy aiming at enhancing self-regulation skills in adolescents. The nine sessions' program was well-accepted and increased self-reported mindfulness. In addition, depressive symptoms, impulsivity (dealing with urges, and lack of perseverance), and dysfunctional strategies of ER improved.

Guendelman et al. (427) extensively reviewed mindfulness-based therapies from a neurobiological, psychological and clinical perspective. They reported changes in ER based on clinical and functional data (e.g., decreased activation changes in the amygdala, hippocampus, anterior insula, anterior cingulate cortex), following mindful meditation even in novices. We found only one randomized trial (428) comparing hypnotherapy and self-care in juvenile post cancer patients, showing evidence for the efficacy of hypnosis in improving ER. Targeted real-time fMRI-neurofeedback, downregulating amygdala activation, may induce longterm improvements of ED in patients with PTSD, BPD and schizophrenia (429).

Treatment

ED symptoms occur in many psychiatric disorders, often as promoting or comorbid condition. Since ED may significantly influence the development of children and adolescents, effective and available treatment is of utmost importance. Psychotherapy may be divided into four groups: (i) Dialectic Behavioral Therapy [reviewed by Courtney-Seidler et al. (430)], (ii) Behavioral and Cognitive Behavioral Therapy (including Schema Therapy) [recently reviewed by López-Pinar et al. (431)] in adults, (iii) multimodal treatment (including, e.g., parental interventions, pharmacotherapy, and others), (iv) other therapies, such

as analytic group therapy, hypnotherapy, neurofeedback, and others.

Garrett et al. (432) studied pre-post effects of 4 months psychotherapy in youth with ED and a risk of BD in an fMRI setting, presenting a facial expression task. At baseline they found hypoactivation of the dorsolateral prefrontal (DLPFC) and posterior cingulate cortex compared to matched healthy controls.

Following treatment, activation of the DLPFC increased, and decreased in the amygdala, paralleling the improvement of symptoms.

Dixius and Möhler developed a low threshold program START showing positive impact on ER in traumatized teenagers (433). Thornback and Muller (91) investigated the relationship between improvement of ER and improvement of trauma related symptoms in children receiving trauma focused cognitive behavior therapy: improvement in ED was associated with improvement in the child's internalizing, externalizing, and PTSD symptoms. Mindfulness based group therapy can improve ER in children with ADHD (41, 434).

Because ED is very common, especially in children and adolescents (although only in the focus in the last decade), various treatment options primarily concentrate on this dimension (426, 435–444).

Mode Deactivation Therapy [MDT; (436, 438)], and Modular Approach to Therapy for Children with Anxiety, Depression, Trauma, or Conduct Problems [MATCH; (443)] were particularly effective. MATCH, a cognitive behavioral therapy, improves ED faster than other programs. Apsche et al. (436) and Bass & Apsche (438) described an extended version of cognitive behavioral therapy (MDT) superior to conventional cognitive behavioral therapy, especially in reducing anger and aggressive behavior in adolescents and juvenile offenders (435) (see **Tables 1, 2**). Since up to 90% of children with ED meet criteria for a categorized disorder (441), a number of treatments are available for treating the primary disorder. Most therapies also help in improving ED (91, 100, 164, 210, 258, 430, 432, 445–448, 450–457). Only the Light Therapeutic Procedure (447), and the Emotion Regulation Training (ERT) for adolescents with BPD (455) showed no improvement (for details, see **Tables 1, 2**).

Tables 1, 2 summarize evaluated therapies focusing on ED. The tables are organized depending on ED being the primary therapeutic target (**Table 1**) or, if the underlying disease was the primary, and treatment of ED the secondary target (**Table 2**). The order of the listed studies is alphabetical according to the name of the first author of the respective study.

Pharmacotherapy

ED leads to psychopathology and a number of externalizing and internalizing symptoms, including anxiety, mood dysregulation, impulsiveness, behavioral issues, and serious debilitating social problems. Two forms of stress related sequelae have to be considered: (i) acute emotional cues triggering experiential, behavioral, central and peripheral physiological systems (458), and (ii) chronic mental stress resulting from continuous burdens, such as maltreatment or familial discord, leading to personality modification, ED, and related problems.

To date, there is no substance available for a causal treatment of ED. Among the available pharmaceuticals, the following

classes of medication have been shown to alleviating symptoms of ED:

- Antipsychotics - sedating and distancing from mental tension (459, 460)
- Antidepressants and mood stabilizing medication - alleviating anxiety, improving mood, and decreasing maniac symptoms (458, 461)
- Sedatives/anxiolytics - sedating and alleviating anxiety
- ADHD Medication (55, 462)
- Combined medication (463)
- Experiential therapies, such as oxytocin (464)

Other Therapies

fMRI neurofeedback produces promising lab results for improving ER by changing the bloodflow to the amygdala, and the interconnection between the amygdala and the prefrontal cortex in patients with BPD (429, 465), MDD (466), or PTSD (467). The disadvantages lie in the poor availability and the complexity of the technology. Relaxation and mindfulness based therapy have been shown to reduce chronic stress activation interacting with the impaired threat perception of ED (468). Biofeedback has been shown to produce relaxing, threat and stress reducing effects within a short training time, depending on the patients' hypnotic ability (469). There are, however, only a few uncontrolled observational studies and single case reports supporting this approach.

Early parenting programs are effective in preventing or changing unfavorable environmental conditions. These programs focus on sensitivity, acceptance, making aware and avoiding self-defeating strategies, such as harsh educational measures, and help in improving empathic understanding, clarity, fairness, decision making, and coming to a decision (22). There are, however, reports of failing parenting programs [e.g., (470)], possibly related to the timing of the intervention and the already established dysfunctions on both sides, the caregivers and the children.

DISCUSSION

ED influences most child and adolescent psychiatric disorders by interfering with cognitive processes that interact with reactive processes. In some disorders, such as ADHD, psychosis, or affective disorders, ED is an essential but often neglected part of the related psychopathology.

Several mechanisms lead to the development of ED, with reference to anatomical, functional, family, social and relational bases. This causes severe stress, misunderstandings, relationship-difficulties, maladaptive ER strategies such as self-injurious behavior, externalizing and internalizing responses, endangerment of self, self-perception and social relationships.

The relationship between ED and nosology according to ICD or DSM has not been clarified as yet. The further development of this topic raises more questions than answers:

- Is ED the lowest common denominator of psychological disorders?

TABLE 1 | Clinical trials focusing on ED as primary target.

References	A: primary target, B: secondary target	Treatment	Age groups participants (n)	Results
Apsche et al. (436)	A: ED, B: -	MDT vs. CBT	Male adolescents (14–18 years) n = 84	MDT was more effective than CBT for the treatment of externalizing and internalizing disorders & ED. MDT especially reduced the dysregulation of anger and aggression in male adolescents to a greater extent
Bass et al. (438)	A: ED, B: -	MDT	Male adolescents (14–18 years) n = 84	Replication of findings of Apsche et al. (436)
Deplus et al. (426)	A: ED, B: Depression; impulsive behavior	Mindfulness-based CT	Adolescents (11–19 years) n = 21	Reduction of depressive symptoms, impulsive behavior and ED
Dixius and Möhler (433)	A: ED B. PTSD	START	Adolescents (13–17) n = 66	Treatment significantly improved emotional regulation
Döpfner et al. (441)	A: ED, B: -	ADOPT	children (8–12 years) n = 597	Versions of ADOPT (i.e., ADOPT online/institution etc.) were associated with an improvement of ED symptoms
Ducharme et al. (437)	A: ED, B: -	DBT, CBT	Children & adolescents (9–17 years) n = 37	Reduction of anger scores caused by decrease of ED
Evans et al. (443)	A: ED, B: -	Match (BT) vs. other treatments	Children & adolescents (7–13 years) n = 175	General improvement of ED symptoms. MATCH led to faster decrease of ED compared to other standard treatments; ES = 0.49
Pardo et al. (444)	A: ED, B: impulse control disturbance	DBT	Adolescents (\bar{O} = 15.4 years) n = 20	General improvement of ED and symptoms of impulse control. Qualitative reports of adolescents: positive statement of adolescents who terminated the treatment program
Ravindran et al. (439)	A: ED of parents, B: -	MFWSB	Parents of children (4–8 years) n = 84	Reduction of ED only in mothers of children
Simpson et al. (442)	A: ED, B: -	Mindfulness-Based Intervention	male incarcerated youth (18–21 years) n = 48	Improvement of ED, sleeping quality, stress-level etc.; ES (impulsivity) = 0.72, ES(mental well-being) = 0.50, ES (inner resilience) = 0.35, ES (mindfulness) = 0.32
Thoder and Cautilli (435)	A: ED, B: -	MDT	Juvenile offenders (14–17 years) n = 39	Decrease of internalizing and externalizing symptoms (i.e., ED). Reduction of aggressive and delinquent behavior. Positive effects on relapse risk
West et al. (440)	A: ED, B: -	Sensory room	Adolescents (12–18 years) n = 112	Reduction of stress level, especially aggressive behavior, general improvement of ED symptoms
Winiarski et al. (445)	A: ED, B: -	MST	Adolescents (12–17 years) n = 180	Decrease of physiological and behavioral indicators of ED, significant differences between male and female adolescents: females had higher responder-rates

ADOPT, Affective Dysregulation–Optimizing Prevention and Treatment; BT, Behavioral Treatment; CBT, Cognitive Behavioral Treatment; DBT, Dialectic Behavioral Treatment; ERIC, Emotion Regulation and Impulse Control Treatment; ERT, Emotion Regulation Training; ES, effect size; iGST, Individual / Group Supportive Therapy; MATCH, Modular Approach to Therapy for children with anxiety, Depression, Trauma or Conduct Problems; MDT, Mode Deactivation Therapy; MFWSB, More Fun with Sisters and Brothers; MIT-G, Metacognitive Interpersonal Therapy in Groups; MMT, Mindfulness Meditation Therapy; MST, Multisystemic therapy; START, Stress-Trauma-Symptoms-Regulation-Treatment; TAU, Treatment as Usual.

- How specific is its predictive value for explaining psychological disorders? Or does it rather sum up to one single concept concerning all psychological disorders?
- Would it therefore be the “Grand Unifying Theory” of psychological disorders?

ED may possibly be a new concept, allowing psychological disorders to be defined by their essential nature instead of being defined by their phenotype and objectively measured symptoms. ER and emotion processing would be more meaningful than single well-defined symptoms. It would render the individual personality and the dynamics of social relationships and communication more understandable.

As part of the health care system, many hospitals and psychotherapists are required to provide ICD-10 or DSM-5

diagnoses. These symptom-based and descriptive nosologies are useful for improving the accuracy and consistency of clinical diagnostics and form the basis for effective treatments.

Other transdiagnostic approaches can be seen as a very good supplement to traditional categorical diagnoses using the DSM or ICD thesauri. The approach of systemic therapy, for example, sees psychological symptoms, disorders, and their change, embedded in interactive and narrative structures.

Another very significant transdiagnostic approach are the Research Domain Criteria (RDoC) (471). Fernandez et al. proposed conceptualizing ER as a new, sixth domain in the RDoC matrix (472).

It is argued that in order to understand causes and mechanisms of mental disorders, many clinical symptoms can be

TABLE 2 | Clinical trials focusing on ED as secondary target.

References	A: primary target, B: secondary target	Treatment	Age groups participants (n)	Results
Adrian et al. (450)	A: NSSI & suicidality, B: ED	DBT vs. IGST vs. other treatments	Adolescents (\bar{X} = 14.89 years) $n = 99$	DBT appears to be more effective for the treatment of suicidal adolescents with higher levels of ED than IGST
Bjureberg et al. (210)	A: NSSI, B: ED	ERITA online (BT)	Adolescents (13–17 years) $n = 25$	After treatment reduction of NSSI and ED in adolescents & improvement of parental adaptive behavior ES (past month NSSI frequency) = 0.88, ES (global functioning) = 1.01, ES (ED) = 0.75, ES (NSSI versatility) = 0.63 (number of different types of NSSI behaviors)
Blader et al. (447)	A: ADHD, B: DMDD	Family-based BT	Children (6–13 years) $n = 156$	Reduction of DMDD symptoms. Decrease of aggressive behavior in 51%
Bogen et al. (448)	A: Depression, B: ED	Light therapy	Adolescents (12–17 years) $n = 57$	No improvement of ED, but ED could eventually be enhanced by amelioration of sleep & circadian rhythm; partial η^2 (sleep quality) = 0.02, partial η^2 (restorative sleep) = 0.09, partial η^2 (circadian preference) = 0.22
Boutelle et al. (258)	A: Eating Disorder, B: ED	PEER (BT)	Adolescents (13–17 years) $n = 53$	Significant reduction of emotional eating situations. Trend toward reduction of ED; ES = 0.32
Ford et al. (449)	A: PTSD, B: ED	TARGET vs. ETAU	Female delinquent adolescents (13–17 years) $n = 59$	Both therapies reduced anxiety, anger, depression, and posttraumatic cognitions (medium effect sizes). Interaction effect between TARGET and time with respect to PTSD, anxiety, posttraumatic cognitions, and emotion regulation
Ford et al. (473)	A: PTSD, B: ED	TARGET	Detained adolescents (11–16 years) $n = 394$	TARGET was associated with fewer disciplinary incidents and seclusion
Garrett et al. (432)	A: Depression/Mania, B: ED	Multimodal therapy	Adolescents (13–17 years) $n = 24$	Improvement of mood dysregulation was associated with increased activation in DLPFC, decreased activation in amygdala, and reduced maniac symptoms; ES(maniac symptoms) = 0.59, ES(CDRS) = 0.56
Goldstein et al. (451)	A: Bipolar Disorders, B: ED	DBT	Adolescents (12–18 years) $n = 10$	Significant improvement of all symptoms (NSSI, suicidality, depressive, maniac, and ED symptoms) ES(ED) = 0.3
Heinrich et al. (452)	A: ADHD, B: ED	Neuro-feedback	Children (8–12 years) $n = 30$	Improvement of ED symptoms & cognitive and behavioral dysregulation. Decrease of ADHD specific symptoms,
Kaufman et al. (453)	A: Self-injury, B: ED	DBT	Female adolescents (13–17 years) $n = 60$	Reduction of self-injury and ED symptoms
Kiani et al. (434)	A: ADHD, B: ED & executive functions	MMT	Female adolescents (13–15 years) $n = 30$	Improvement of ED symptoms and executive functions scores ES = "large"
Marco et al. (454)	A: ODD, B: ED	DBT	Female adolescents (12–18 years) $n = 2$	Reduction of impulsive behaviors, maladaptive ER strategies
Marrow et al. (474)	A: PTSD, B: ED	TAU & trauma training for staff (CG) vs. TAU & environmental modifications (trauma training for staff, trauma affect regulation) (EG)	Detained adolescents (11–19 years) $n = 74$	Significant reduction in depression, threatening of staff, use of physical restraints, seclusion rates in the intervention program
McCauley et al. (164)	A: suicidality & NSSI, B: ED	DBT	Adolescents (12–18 years) $n = 173$	Improvement of all outcomes: Decrease of NSSI, risk of lifetime suicide attempt and ED; ES (end of active treatment) = 0.34, ES (end of follow up) = 0.11
Popolo et al. (446)	A: Personality disorder, B: ED & Alexithymia	MIT-G	Adolescents & young adults (16–25 years) $n = 17$	Improvement of specific symptoms of personality disorder and of functioning. Reduction of ED symptoms; ES(different symptoms) = 0.14–1.17
Schuppert et al. (455)	A: BPD, B: ED	ERT vs. TAU	Adolescents (14–19 years) $n = 43$	ERT had no additional effect on symptoms of BPD (including ED). Only TAU (medication, psychotherapy, systemic therapy ...) improved BPD-symptoms (including ED)

(Continued)

TABLE 2 | Continued

References	A: primary target, B: secondary target	Treatment	Age groups participants (n)	Results
Sharma-Patel et al. (100)	A: PTSD, B: ED	Tf-CBT	Children & adolescents (4–17 years) <i>n</i> = 118	Decrease of PTSD symptoms (ED included)
Sloan et al. (456)	A: SAD, B: ED & Anxiety & Depression	ERIC	Adolescents & young adults (16–20 years) <i>n</i> = 79	Significant reduction of ED in 60%, significant decrease of depression and anxiety ratings in 50–60%; ES = −0.53
Suveg et al. (457)	A: Anxiety disorders, B: ED	CBT	Children & adolescents (7–15 years) <i>n</i> = 37	Significant reduction of anxiety symptoms, improvement of ED and coping strategies for only one emotion (“worry”); ES = 0.82
Thornback and Muller (91)	A: PTSD, B: ED	Tf-CBT	Children (7–12 years) <i>n</i> = 107, 44 at follow up	Significant reduction of PTSD symptoms, decrease of the use of maladaptive ER strategies. ED was the best predictor for improvements of PTSD symptoms; ES (pre treatment to 6 months follow up) = 0.36

BT, Behavioral Treatment; CBT, Cognitive Behavioral Treatment; Tf-CBT, Trauma-focused Cognitive Behavioral Treatment; CDBT, Dialectic Behavioral Treatment; CDRS, Children's Depression Rating Scale Revised; ERIC, Emotion Regulation and Impulse Control Treatment; ERITA, Emotion Regulation Individual Therapy for Adolescents; ES, effect size; ERT, Emotion Regulation Training; ETAU, Enhanced Treatment as Usual; IGST, Individual/Group Supportive Therapy; MATCH, Modular Approach to Therapy for children with anxiety, Depression, Trauma or Conduct Problems; MDT, Mode Deactivation Therapy; MFWSB, More Fun with Sisters and Brothers; MIT-G, Metacognitive Interpersonal Therapy in Groups; MMT, Mindfulness Meditation Therapy; PEER, Preventing Emotional Eating Routines; TARGET, Trauma Affect Regulation, Guide for Education and Therapy; TAU, Treatment as Usual; Tf-CBT, Trauma-focused Cognitive Behavioral Treatment.

viewed as being caused by emotionally dysregulated processes. In this way, the underlying structure of the mental disorder can be captured better (at least complementarily) than by a pure ICD or DSM approach. In the area of interventions, treatments that target common features of multiple disorders should be developed on this basis. ED is to be considered as such a common feature.

ER and ED concepts are relatively new on the agenda, therefore, specific treatments are still under development – including child and adolescent psychotherapies, positive parenting initiatives, sedating and mood stabilizing medication. To date no causal pharmacologic treatment is available. Research in patients with ASD suggests that oxytocin might be a candidate for future treatment options. Available treatment tools, such as CBT, DBT or mindfulness training need to be explored and evaluated more extensively.

Our narrative review, although carefully prepared and elaborated, bears the limitations of subjective selection of references and setting of priorities. The explained search strategy is not sufficient to conduct a systematic review because considerable heterogeneity in the definitions used by researchers and the possible variants of the label are not taken into account. Moreover, the review was apparently not conducted following PRISMA guidelines, as usually requested and expected, and the search was not preregistered on an international database of systematic reviews such as PROSPERO. Due to the complexity of the association of ED with numerous mental disorders, a systematic literature review as well as work based on the PRISMA criteria was not feasible. On the other hand, this review covers a very broad spectrum of major psychiatric disorders in general, rather than a specific one.

In addition, our review includes a limited age range of children and adolescents between 2 and 17 years. Therefore, ED in infancy has not been covered in this review.

Our review sheds light on a central topic of individual and social functioning that to date has been more regarded in its

dysfunctional aspects of single psychiatric disorders. The concept of ED will probably help in discovering basic approaches to the understanding, diagnosis and treatment of psychiatric disorders especially in children and adolescents but will probably also prove a key issue in adult psychiatry.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. We searched the literature databases ERIC, PsycARTICLES, PsycINFO and PSYINDEX on June 29th, 2020 for peer reviewed articles, published in English language in between January, 2000 and June, 2020, and related to children and adolescents (2–18 years).

AUTHOR CONTRIBUTIONS

FP: idea, conceptualization, structure of the work, preparations, literature analysis, methods section, several chapters, tables, the figure, corrections, and discussion. SO: several chapters, tables, and corrections. EM and PP: corrections and discussion. CP: several chapters, structure of the work, tables, literature, corrections, and discussion. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsy.2021.628252/full#supplementary-material>

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