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Social and Emotional Functioning in Adolescents with Anxiety
vs. Depressive Disorders: Group differences in Empathy,
Hostility, Emotion Recognition, and Emotion Regulation

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Introduction and theoretical background

Adolescence marks a distinct developmental period, which is not only accompanied by rapid changes in social and emotional development but also often by mental health challenges. Globally, up to one in ten adolescents is estimated to suffer from depressive or anxiety disorders, making these the most prevalent mental health disorders among the youth (Kalin, 2021; Lu et al., 2024; Polanczyk et al., 2015). Not only is adolescence considered to be the peak age of onset for psychiatric disorders (Solmi et al., 2021), but hospitalization rates have also risen by 25% over the past ten years in the United States (Arakelyan et al., 2023; Sampathi et al., 2020) and acute medical ward admissions have increased up to 65% in the United Kingdom (Ward et al., 2025), indicating an alarming trend of increasing mental health issues. Adolescents who experience anxiety or depressive disorders are at high risk for these conditions persisting into early adulthood. In many cases, anxiety and depression in young adults are preceded by similar struggles in adolescence (Pine et al., 1998). Mental disorders originating in adolescence tend to be more severe and longer-lasting than those with an onset in adulthood (Raven et al., 2016). Even though adolescents generally experience a shorter delay in receiving treatment compared to adults, their disorders are often overlooked if the symptoms are not perceived as severe enough or are mistaken as typical aspects of their personality or development (Raven et al., 2016). Early intervention can reduce the persistence of symptoms, as well as prevent the development of comorbid mood disorders (Silk et al., 2019). Untreated anxiety disorders in adolescence can manifest in not only comorbid disorders but also in substance abuse (Essau et al., 2014) and functional impairment (Truong et al., 2019). Untreated depressive disorder in adolescence is associated with unemployment and early pregnancy (Clayborne et al., 2018) as well as with increased suicidality (Dwyer et al., 2020). Suicide, suicidal ideation, and self-harm are strongly associated with internalizing disorders and form a leading cause of death in adolescents globally (Keyes & Platt, 2023). Understanding anxiety and depressive disorders in the developmental period of adolescents is a key factor in reducing the long-term impact, promoting healthier transitions into adulthood, and gaining insight into specific forms of early intervention.

Diagnostic criteria, comorbidity, and symptom overlap are key factors for a comprehensive understanding of these disorders. As defined by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5, American Psychiatric Association, 2013), generalized anxiety disorder (GAD) is characterized by excessive anxiety and worry over various topics for at least six months and accompanied by the loss of control over one's worries. Furthermore, the anxiety and worry have to be accompanied by three to six of the following physiological or cognitive symptoms: 1) edginess or restlessness 2) tiring easily, fatigued 3) impaired concentration or feeling as though the mind goes blank 4) irritability 5) increased muscle tension 6) difficulty sleeping (due to trouble falling asleep or staying asleep, restlessness at night, or unsatisfying sleep). A more specified anxiety disorder is Social Anxiety Disorder, for which anxiety and worry revolve around one or more social situations in which one fears being negatively evaluated by others. Similarly to GAD, symptoms have to be consistent for at least six months and following symptoms should be present: 1) the same social situations nearly always trigger fear or anxiety 2) active avoidance of the situation 3) fear or anxiety is out of proportion to the actual threat 4) fear, anxiety, and/or avoidance cause significant distress or significantly impair social or occupational functioning. Within the DSM-5 (American Psychiatric Association, 2013), a new performance-only specifier has been established, which accounts for social anxiety limited to speaking or performing in public (Aune et al., 2023). Developmental stages could play a role in symptom expression, as adolescents tend to report higher anxiety levels than adults. Developmental differences in brain function may partly explain this discrepancy, as research has shown that, specifically during adolescence, emotional control systems are often underactive, while fear conditioning is still developing (Casey et al., 2008). Additionally, heightened activity in the reward and stress response systems can be observed (Xie et al., 2021).

For major depressive disorder (MDD), the DSM-5 (American Psychiatric Association, 2013) differentiates between primary and additional symptoms. For a diagnosis, at least five symptoms must be present for at least two weeks. Of those symptoms, at least one primary symptom, which is 1) depressed mood and 2) anhedonia (diminished interest or pleasure), must be present. The remaining secondary symptoms encompass: 3) excessive weight loss, 4) insomnia or excessive sleeping, 5) psychomotor agitation or retardation, 6) fatigue or loss of energy, 7) feelings of worthlessness or excessive guilt, 8) diminished ability to think or concentrate, 9) thoughts of death (American Psychiatric Association, 2013). Just as developmental differences in symptom profiles can be found for anxiety, similarly, symptom expression in adolescents seems to differ from that in adulthood. Even though research is

lacking in investigating symptom profile differences and findings are inconsistent, adolescents with depression seem to demonstrate more suicidal ideation than adults (Ho et al., 2023). Moreover, specifically for adolescents, loss of energy and insomnia were marked as central depressive symptoms (Rice et al., 2018). Given the high comorbidity between anxiety and depressive disorders, it is not surprising that they demonstrate a significant overlap of symptoms. With comorbidity rates ranging from 45 to 81% (Kessler et al., 2015; Lamers et al., 2011), many individuals often meet diagnostic criteria for both disorders. Even though both disorders can be seen as bidirectional risk factors (Jacobson & Newman, 2017), some studies suggest that anxiety disorder poses a significant risk for the development of comorbid depressive disorder (Lamers et al., 2011). Part of the high comorbidity could be seen in overlapping symptoms: common symptoms such as fatigue, loss of interest, inability to relax, sleep disturbance, difficulty concentrating, and heightened nervousness are shared between both disorders (Park & Kim, 2020; Zbozinek et al., 2012).

Apart from sharing some DSM-5 criteria of symptoms, both disorders have been associated with impairments in emotional and social functioning. Emotional functioning can be understood as a multidimensional psychological construct, encompassing emotion expression, recognition, knowledge, reactivity, and regulation (Milojevich et al., 2021). Especially, emotion recognition and emotion regulation have been repeatedly brought into the context of anxiety and depressive disorders in adolescence. Emotion recognition is the ability to identify emotional states in others based on nonverbal cues, such as facial expressions and body language (Khare et al., 2023; Tracy et al., 2015). Being able to identify others' emotional expressions accurately sets the basis for adequate social communication as well as regulating one's emotional process (Van Kleef, 2010).

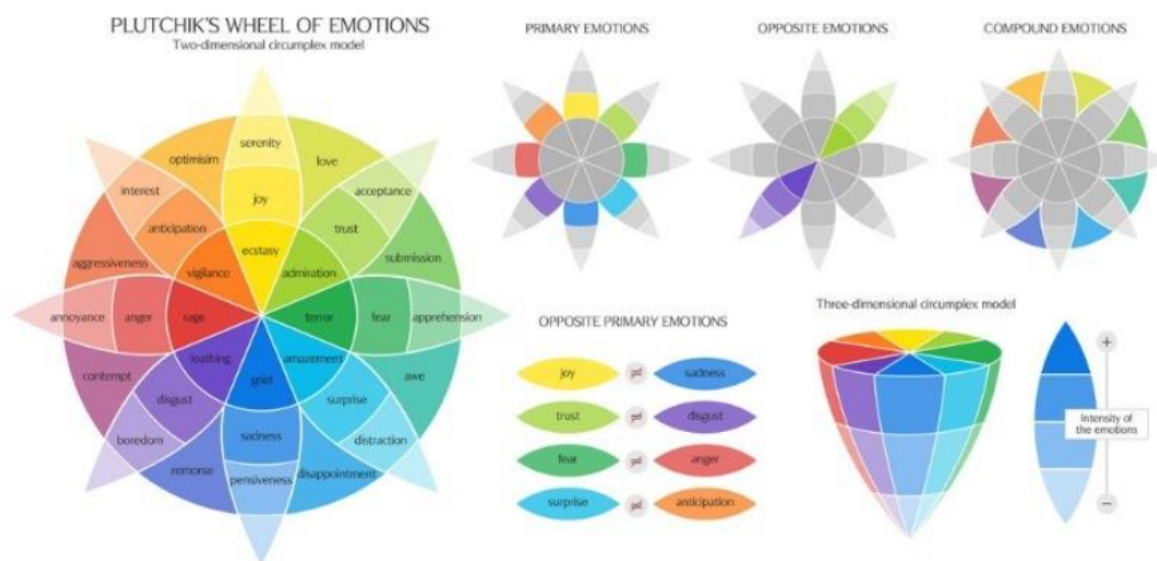
Although innumerable theories try to illuminate conceptual understandings of emotions, in the following, only those that are particularly relevant for understanding emotion recognition processes in the context of this study will be discussed. Ekman's Basic Emotion Theory (1992) is one of the foundational frameworks regarding emotion recognition. Ekman differentiates between seven distinct emotions that are universally experienced and expressed across cultures, age groups, and genders: happiness, sadness, fear, anger, surprise, disgust, and contempt. It is argued that these emotions are biologically inherent rather than socially constructed.

An extension of Ekman's discrete model can be seen in Plutchik's wheel of emotion model (Plutchik, 1982), which argues that eight primary emotions set the foundation for other,

more nuanced emotions. In this more dynamic conceptualization of emotion, joy, sadness, acceptance, disgust, fear, anger, surprise, and anticipation represent foundational universal emotions. Additionally, the model differentiates more nuanced emotions derived from the basic emotion based on intensity. The basic emotions represent a mid-intensity range from which joy, for example, leads to ecstasy if intensity increases or to serenity if intensity decreases. To add another layer, Plutchik proposed that each basic emotion forms a pair with its neighbor in the wheel, which creates a compound emotion. Rather than focusing solely on facial expressions like Ekman's Theory of Basic Emotion (Ekman, 1992), this model incorporates valence, intensity, and compound emotions to differentiate more nuanced forms of the basic expressions. A visual depiction of this model can be seen in Figure 1.

Figure 1

Plutchik's Wheel of Emotions



Note: Seconds, S. (2025, May 6). *Plutchik's Wheel of Emotions: Feelings Wheel*. Six Seconds. <https://www.6seconds.org/2025/02/06/plutchik-wheel-emotions/>

In contrast to understanding emotions as discrete and universally experienced and expressed, the 'Theory of constructed emotion' by Lisa Feldmann Barrett (2016) proposes emotions to be solely actively constructed. She argues that facial expression of emotions is learned mainly through cultural adaptation and tied to the emotional granularity of the

individual. Therefore, the range of emotional experiences of an individual is limited by their ability to label them precisely. Without the tool of language to describe and construct an emotional concept, the individual is thought to not experience a specific emotion but rather a general emotional experience ranging from pleasant to unpleasant. According to Barrett, the brain does not simply detect emotions in others but rather infers emotional meaning from sensory inputs, which are then aligned with learned emotion concepts that are continually shaped by language, culture, and personal experience. More nuanced emotional expressions may not be correctly recognized if the perceiver does not have the necessary emotional granularity or personal experience to do so.

Building on this notion that the internal representation of emotions of the perceiver influences the ability to recognize emotions, the ‘inside out model of emotion recognition’ by Keating and Cook (2023) argues that individual differences in consistency and distinction of emotional experiences affect emotion recognition accuracy. The more discrete and distinct an emotion is experienced by an individual, such that anger feels significantly different from joy, the more accurate their emotion recognition of others regarding these emotions. Contrarily, an individual who might experience emotions in a more overlapping manner, in which emotions are more easily confused for one another, is thought to demonstrate emotion recognition difficulties. A reduced ability to perceive emotions as discrete and distinct has been linked to facilitating internalizing disorders (Rieffe & De Rooij, 2012).

As the expression and recognition of emotion is a versatile and dynamic process, various measures such as self-report, physiological measures, or performance-based measures can be applied to investigate it. Among these, combining accuracy rates derived from performance-based tasks with eye tracking data has become a more widely used measure, especially in clinical populations. Since psychopathology is known to influence attentional processes, standard eye-tracking measures include pupil dilation, which indicates intensity of processing and thus mental effort (Eckstein et al., 2016). Apart from being an adaptation reflex, the size of the pupil changes, for example, in response to emotional stimuli as well as other psychological processes (Eckstein et al., 2016). This cognitive pupillometry can account for up to 20% of dilation (Zénon, 2019). Pupil size also allows conclusions to be drawn about neuronal activity, as it is primarily determined by the activity of the locus coeruleus (Eckstein et al., 2016). Moreover, current research indicates pupil dilation measures to function as objective biomarkers for neurodevelopmental disorders, thus making this eye-tracking indicator highly relevant in clinical settings (Keehn et al., 2021; Nobukawa et al., 2021).

Building on this conceptual understanding of emotion recognition, research has investigated how the ability to recognize emotional expressions is affected in depressive and anxiety disorders. In a meta-analysis, Krause et al. (2021) found that individuals with depression show greater difficulty in accurately recognizing neutral faces and require facial expressions with greater emotional intensity to recognize happiness accurately compared to healthy controls. Moreover, a meta-analysis by Dalili et al (2014) indicated that emotion recognition in depressed individuals is impaired towards all basic emotions except sadness. This finding is supported by a meta-analytic review by Krause et al. (2021), which stated that depressed individuals recognized sad faces with the highest accuracy. Contrarily, children with anxiety tend to demonstrate more accurate recognition of happiness and fear (Pappaport et al., 2012). A study by Wieckowski et al. (2016), however, found that adolescents with high anxiety symptoms had decreased ability to recognize fearful faces compared to adolescents with low anxiety symptoms. Moreover, a meta-analysis by Demenescu and colleagues (2010) showed that only adults, not adolescents, with anxiety disorder have difficulties in recognizing emotions. This might indicate that developmental stages could influence recognition accuracy. Additionally, adolescents with anxiety were reported to show difficulties recognizing angry emotions, yet being able to identify neutral expressions accurately (Jarros et al., 2011).

Regarding pupillometry, adolescents with depressive disorder demonstrate increased pupillometry to emotional stimuli in general, compared to healthy controls (Burkouse et al., 2016). This finding indicates that processing emotional stimuli might require more cognitive effort and longer processing duration from depressed individuals compared to healthy controls. Sekaninova et al. (2019) found a differentiation between positive and negative stimuli, such that depressed individuals showed a greater dilation in response to positive stimuli and a faster dilation in response to negative stimuli. They furthermore argue that this hyperreactivity indicates central autonomous dysregulation. In contrast, De Zorzi et al. (2021) found depressed adolescents to be hyporeactive to emotional stimuli compared to neutral stimuli, whilst anxious adolescents showed pupillary hyperreactivity to emotional stimuli. In line with this finding regarding anxious individuals, children with social anxiety disorder and mixed anxiety disorder showed increased pupil dilation for emotional versus neutral faces (Keil et al., 2018). However, compared to healthy controls, a reduced dilation was found regarding happy and neutral faces (Keil et al., 2018).

These findings suggest that impairments in emotion recognition differ between depressive and anxiety disorders, yet the literature reveals inconsistent findings. Apart from age-related differences, measures of emotion recognition exhibit significant heterogeneity.

While impairments in emotion recognition are consistently observed in both disorders, specific deficient outcomes for basic emotions vary. More nuanced emotions remain largely unexplored, and only a limited number of studies have directly compared the two disorders, even fewer in adolescents.

Emotion recognition has been remarked as one key component for emotion regulation (Doré et al., 2016). Emotion regulation can be understood as influencing the duration, timing, and expression of an emotion (Gross, 1998). The intensity of an emotion can be maintained, enhanced, or diminished (Rottenberg & Gross, 2007). Furthermore, Gratz and Roemer (2003) understand emotion regulation to be composed of six abilities: ‘awareness of emotional responses, clarity of emotional responses, acceptance of emotional responses, access to emotion regulation strategies perceived as effective, controlling impulses when experiencing negative emotions, and engaging in goal-directed behaviors when experiencing negative emotions’.

Gross’s Process Model conceptualizes emotion regulation as a dynamic process that takes place before, during, or after an emotional response. Following Gross, emotion regulation strategies can be distinguished into being either antecedent, like influencing one’s emotions before their occurrence, which are thought to be adaptive, or response-focused, like suppression, which are often considered maladaptive.

Another highly influential model in this field was proposed by Gratz and Roemer (2003) with their ‘Difficulties with Emotion Regulation Questionnaire’ (DERS), which understands emotion regulation as being competency-driven. It is influenced by the degree to which an individual demonstrates efficiency in ‘(a) awareness and understanding of emotions, (b) acceptance of emotions, (c) ability to control impulsive behaviors and behave in accordance with desired goals when experiencing negative emotions, and (d) ability to use situationally appropriate emotion regulation strategies flexibly to modulate emotional responses as desired in order to meet individual goals and situational demands’. No component in and of itself represents a specific strategy; rather, it can be understood as contextual factors that influence the individual’s subjective perception of their abilities to regulate emotions. Moreover, it is noteworthy that Gratz and Roemer’s Model focuses on emotion dysregulation and particular aspects of difficulties with emotion regulation. Even though both models and their respective scales are used to measure emotion regulation, intercorrelations between both scales demonstrate that they both account for different aspects of emotion regulation (Bardeen & Fergus, 2014). Gross’s model can therefore be used to assess the employment of specific strategies with the ‘Emotion Regulation Questionnaire’ (Gross & John, 2003), whereas DERS

(Gratz & Roemer, 2003) assesses difficulties in emotion regulation and sheds light on the contextual factors of dysregulation. Based on the focus of dysregulation, DERS (Gratz & Roemer, 2003) is of high interest in clinical settings.

Difficulties in emotion regulation (DER) are strongly associated with internalizing disorders (Hallion et al., 2018). Both anxiety and depressive disorders are associated with ‘decreased emotional awareness, dysregulated emotion expression, and reduced use of emotion management strategies’ (Klemanski et al., 2016). Especially, the lack of access to strategies evokes ‘the belief that there is little that can be done to regulate emotions effectively once an individual is upset, which makes it difficult to manage and control emotions’ (Ruan et al., 2023). Although a clear link between DER and internalizing disorders in adolescence has been established, there is limited research on group comparisons in the literature. While some findings indicate that both disorders are equally impacted by DER (Solbakken et al., 2021), others associate a lack of emotional strategies more strongly with anxiety and a lack of emotional awareness more strongly with depression (Alado et al., 2009). Additionally, Raun et al. (2023) suggest that DER is generally more closely linked to depression than anxiety. The mixed results present in the current literature indicate a lack of differentiated understanding of how emotion regulation difficulties manifest in anxiety and depressive disorders.

As a transdiagnostic factor, emotion regulation and difficulties are linked to maintaining and contributing to the development of various mental health disorders (Igra et al., 2023; Koch et al., 2019). Differences in emotion dysregulation have been found to differ across psychiatric disorders, but results differ across studies (Aslan et al., 2024; Igra et al., 2023). Although differences between disorders have been observed, it has been argued that emotion dysregulation is not disorder-specific (Svaldi et al., 2012). There is a knowledge gap in understanding whether internalizing disorders show meaningful differences in emotion regulation difficulties.

Similarly to emotional functioning, social functioning has been defined in various ways, and the literature lacks uniform terminology. It can be understood as how a person operates in their social environment (Madrigal et al., 2021), addresses adequate development in social skills or the ability to form meaningful relations (John, 2001) and/or feels connected to others (Madrigal et al., 2021). Successfully fulfilling one’s social roles and adhering to norms is also often attributed to this concept (Lahiri et al., 2016). Social aspects of functioning become of great importance in adolescence as this stage introduces new social demands, changes in peer groups, and social needs that require adjustment. Impaired social functioning is commonly

observed across mental disorders and is understood both as a consequence of these conditions and as a risk factor for worsening symptoms and suicidal ideation (Kupferberg et al., 2016; Porcelli et al., 2019). As the concept of social functioning is broadly defined, various aspects that influence social interactions have been investigated in this context, such as empathy and hostility.

Empathy accounts for a complex mental state of inference in humans, which requires a combination of affective, cognitive, and self-awareness components. As numerous models conceptualize empathy, different contributing factors or mechanisms are highlighted as driving the development or expression of empathy. In their framework based on conceptual models of empathy, Decety and Moriguchi (2007) define empathy as ‘the capacity to share and understand emotional states of others in reference to oneself’. They argue that empathy equally relies on top-down as well as bottom-up processes, of which ‘shared neural representations, self-other awareness, mental flexibility and emotion regulation constitute the basic macro components of empathy’. The notion that empathy itself consists of a multitude of mental processes is important to develop an understanding of its complexity and possible points of intersection with psychopathology. Decety and Moriguchi (2007) propose that the following components and models are in constant interplay to produce empathy:

Affective sharing between individuals is thought to be based on perception-action-coupling and shared representations. The Perception-Action-Model (PAM) (Preston & De Waal, 2002) argues that the perception of another individual’s state automatically activates the representation of that state in the perceiver, which leads to automatically generated autonomic or somatic responses. This process then yields to emotional contagion, matching the emotional state of the individual, or complementary responses, reacting to the individual’s emotional state with e.g., consolation towards distress.

Self-awareness is thought to reinforce self-other distinction throughout the process of identifying someone else's emotions. The concept of self-other distinction is central to empathy research. It is defined as ‘the process by which one distinguishes between self- and other-related representations (cognitive, affective, sensorimotor, etc.)’ (Qesque et al., 2024). The research by Qesque et al. (2024) created a common lexicon of mental state attribution terms in which empathy was defined as ‘the ability to experience others’ affective states, while maintaining the distinction from one’s affective states’, thus highlighting the centrality of self-other distinction for empathy.

Perspective taking, e.g., ‘the process by which one represents others’ mental states, by adopting their perspective’ (Qesque et al., 2024), is also argued to be a central requirement

for empathy. As self-perspective, the bias to use one's knowledge about oneself and about one's perspective to understand others is set as the default cognitive mode; active effort in the prefrontal cortex must be undertaken to shift towards perspective taking.

Finally, emotion regulation processes are argued to be vital for empathy. In order for negative or distressing emotions, arising from autonomic or somatic responses or perspective taking, not to become overwhelming or aversive, individuals must be able to regulate and manage their emotional states. Effective emotion regulation allows one to react with empathetic concerns rather than personal distress. Accordingly, individuals with good emotion regulation abilities are thought to be more likely to experience empathy.

As psychopathologies often impact empathy (Eisenberg et al., 2024), understanding empathy is highly relevant in the clinical setting. Being able to react empathetically to the distress of others has been associated with improved health outcomes, yet having very strong empathetic tendencies can be a risk factor for internalizing disorders in adolescence (Tone & Tully, 2014). Even though well-developed empathy is generally associated with pro-social behavior (Yin & Wang, 2022), high-quality relationships (Boele et al., 2019), and mental well-being (Gupta et al., 2022), extreme empathy can lead to 'prolonged and exhausting empathetic reactions', causing personal empathetic distress (Calandri et al., 2019). Interestingly, empathetic distress has been associated with increasing friendship quality even though it increases anxiety and depression symptoms (Smith, 2015). When examining the relation between empathy and internalizing disorders, it is important to consider that empathy consists of two facets: cognitive empathy, i.e., being able to understand the emotional experience of others, and affective empathy, i.e., being able to share the emotional state of others (Thompson et al., 2021). Especially, a higher degree of affective empathy has been found to maintain or worsen symptoms of anxiety disorder and depressive disorder in adolescence (Nair et al., 2023; Yan et al., 2021). Affective empathy seems to be more pronounced in anxiety disorders and more diminished in depression disorder, whilst cognitive empathy arguably remains intact in both (Gambin & Sharp, 2018; Guhn et al., 2020; Nair et al., 2023; Yan et al., 2021). Heightened affective empathy has been especially observed in males with social anxiety disorder, possibly due to their unique attentional bias to threat (Pittelkow et al., 2021). In a meta-analysis, Pittelkow et al. (2021) found a weak association between social anxiety disorder and cognitive empathy but emphasized that current evidence is inconclusive. Both types of empathy may contribute to anxiety through shared links to rumination and worry, fostering 'over-attribution of mental states to others and hyper-vigilance to perceived rejection/disapproval' (Nair et al., 2013). Similarly, cognitive empathy may be as significantly impacted as affective empathy in

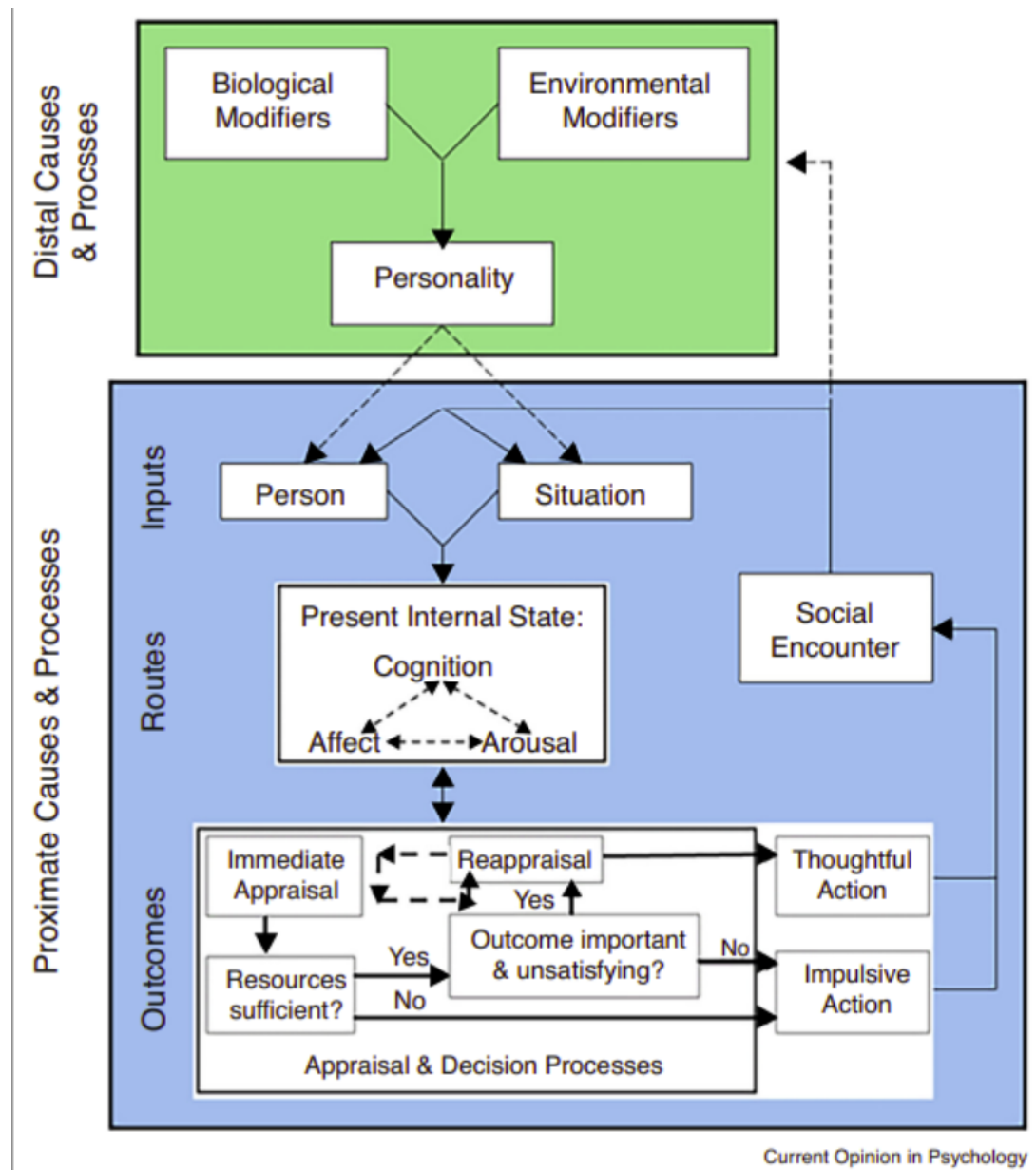
depression, as higher depression severity is associated with reduced perspective-taking abilities (Nestor et al., 2022). While both anxiety and depressive disorder have been associated with impaired affective and cognitive empathy, findings remain inconclusive, and disorder-specific patterns have not yet been established.

Hostility is widely understood as a negative, distrustful attitude towards others, irritability, ill will, and a tendency to perceive others' intentions as harmful (Gasse et al., 2020; Pasquariello et al., 2020; Strong et al., 2005). According to the APA dictionary, hostility can also be defined as 'the overt expression of intense animosity or antagonism in action, feeling or attitude' (APA Dictionary of Psychology, n.d.).

Aggression, as part of hostility, could be understood through the General Aggression Model (GAM) (Allen et al., 2017). The model proposes that, apart from biological modifiers (e.g., hormone imbalance) or environmental modifiers (e.g., cultural norms), aggressive behavior is oftentimes a result of personal, situational factors and/or cognitive and affective processes. Personal factors (e.g., normative acceptance of aggression) and situational factors (e.g., noisy environment) can either add up or interact with each other to influence cognition, affect, and arousal, thus shaping the internal state of the individual. These factors can lead to an internal cascade as 'interpreting a situation in a hostile manner can increase anger, which in turn can increase arousal' (Allen et al., 2017). Input from personal and situational factors can either activate cognition briefly or chronically, making aggressive concepts and thoughts strongly accessible and potentially leading to hostile attribution bias. Depending on the significance of the situation and the availability of cognitive and emotional resources, individuals may either act on automatic response patterns triggered by their initial appraisal and internal state or engage in deliberate reevaluation and choose a more thoughtful course of action. Reappraisal can reduce or intensify the emotional response, shaping whether the reaction is aggressive or not. This response then influences social interaction and can restart the emotional cycle. A visual representation of this model can be seen in Figure 2.

Figure 2

The General Aggression Model (GAM): proximal and distal cause and processes



Note: Allen, J. J., Anderson, C. A., & Bushman, B. J. (2017). The general aggression model. *Current Opinion in Psychology*, 19, 75-80

Both anxiety disorder and depressive disorder are closely linked to hostility and aggression in adolescents (Rizanaj, 2021). Adolescent depression can manifest as hostility, at times making the underlying internalizing disorder, leading to the diagnosis being overlooked

(Venkatesan et al., 2023). Depression disorder is equally associated with inward-directed hostility and aggression as it is with outward-directed hostility and aggression. Greater irritability and anger have been linked to more persistent and severe depression (Gasse et al., 2020). Aggressive individuals often interpret ambiguous social cues as hostile, which can lead to reactive aggression as a defensive response to perceived threats (Bailey & Ostrov, 2007). Similarly, individuals with depression tend to exhibit a more substantial hostile interpretation bias compared to non-depressed individuals, regardless of their levels of trait hostility (Smith et al., 2016). This bias may play a unique role in maintaining depression. Interestingly, hostility bias has been explicitly associated with callous-unemotional traits (Dapprich et al., 2023), which are positively associated with depressive disorder (Derks et al., 2024). In contrast, while individuals with social anxiety disorder also experience hostile feelings and perceive others as hostile, they tend to refrain from outwardly expressing these feelings through aggression (DeWall et al., 2009). Instead of hostile attribution bias, social anxiety has been linked explicitly to threatening interpretation bias, resulting in avoidance behavior (Dapprich et al., 2023). Individuals with anxiety disorders often respond to stress with irritability and hostility and show generally increased anger, potentially linked to the hypervigilance characteristic of anxiety (Thompson & Schmidt, 2021). Generalized anxiety disorder has been linked to ‘high levels of trait anger and internalized anger expression’ (Deschênes et al., 2012). Even though different anxiety disorders show elevated anger levels, they might be largely explained by co-occurring depressive symptoms (Moscovitch et al., 2007). Whilst some studies suggest that depressive disorder is more strongly linked to anger and hostility than anxiety disorder (Koh et al., 2002), the distinct facets of hostility and their expression during adolescence underlie significant heterogeneity, and very few direct comparisons have been made between the two disorders.

In summary, this study aims to investigate the emotional and social functioning of adolescents with anxiety disorder and depressive disorder. Emotion functioning in this context focuses on the role of emotion regulation difficulties and emotion recognition, whereas social functioning encompasses empathy and hostility. This study intends to explore how these processes manifest differently across the two disorders, seeking to identify any disorder-specific patterns and/or group differences. This is particularly important, as existing literature has yielded inconsistent findings regarding these aspects, leaving gaps in the differentiation of these socio-emotional processes in adolescents’ mental health. By addressing these gaps, this work aims to inform more targeted interventions for adolescents, improving early identification and treatment strategies. Understanding the distinct ways in which social and emotional

functioning is affected in anxiety disorder and depressive disorder could significantly enhance long-term outcomes and offer crucial insights into the development of effective, disorder-specific interventions for this vulnerable population.

Aims of the present study

This study aims to investigate differences in emotional functioning (via measures of emotion recognition and emotion regulation) as well as in social functioning (via measures of hostility and empathy) between adolescents with anxiety and adolescents with depressive disorders. Additionally, this study aims to explore disorder-specific interactions between these variables, as impairments in emotional and social functioning manifest differently in each disorder.

Primary hypotheses

1. Adolescents with anxiety disorders are expected to differ in their emotion regulation difficulties, hostility, and empathy on related psychological rating scales from adolescents with depressive disorders.
2. Adolescents with anxiety disorders are expected to differ in their emotion recognition accuracy in the emotion recognition task from adolescents with depressive disorders, and this difference is expected to be moderated by the emotional intensity (low vs. high) of the stimuli.
3. Adolescents with anxiety disorder are expected to differ in pupil dilation in the emotion recognition task from adolescents with depressive disorder.
4. Depressive symptoms significantly predict individual subscales and total scores of emotion regulation difficulties, hostility, and empathy across the entire sample.
5. Anxiety symptoms significantly predict individual subscales and total scores of emotion regulation difficulties, hostility, and empathy across the entire sample.

Exploratory hypotheses

1. Do adolescents with anxiety disorder differ in the recognition of specific emotions from adolescents with depressive disorder, and which emotions are generally the most difficult to identify?
2. Is greater pupil dilation during the emotion recognition task positively associated with accuracy in emotion recognition?

Methods and Materials

Study Design

This cross-sectional correlational study utilizes questionnaires and an eye-tracking task, which are part of a baseline assessment in a larger study (eBRAIN; Konicar et al., 2022). The larger study, conducted by Konicar and colleagues (2022), aims to investigate changes in emotion regulation following transcranial direct-current stimulation therapy in adolescents with problems in emotion regulation and anxiety, depressive, or conduct disorders.

Participants, Inclusion & Exclusion Criteria

To be included in the basic eBRAIN study, similarly like to the data collection of the current work, participants had to meet an age requirement of being between 13 and 18 years old and fulfill a primary diagnosis of either depressive or anxiety disorder according to ICD-10 (F32, F33, or F40.1, F41.1, respectively). The diagnosis had to be given by a clinical psychologist prior to study inclusion. Following the completion of the FEEL-KJ Questionnaire (Grob & Smolenski, 2009), participants had to show clinically significant deficits in emotion regulation (T-value <40 or >60). Furthermore, an IQ score above 70 was needed for study participation. If no prior assessment of intelligence could be provided, intelligence was assessed using standardized tests such as the Wechsler Adult Intelligence Scale for Children-Fifth Edition (WISC-V, Wechsler, 2017) or the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV, Wechsler, 2012). Any prescribed psychopharmacological treatment, such as methylphenidate, selective serotonin reuptake inhibitors (SSRIs), antipsychotics, or neuroleptics, as well as ongoing psychotherapy, must remain stable throughout participation. The informed consent of the participants, as well as that of their legal guardians, was obtained before they participated in the study. Exclusion criteria encompass continuous benzodiazepine medication, severe neurological or medical conditions, acute suicidality, epilepsy or related seizure disorders, non-removable metallic implants, and failure to follow the instructions.

Participants were recruited over three years between August 2022 and February 2025. Recruitment was conducted at the Department of Child and Adolescent Psychiatry at the Medical University of Vienna. Additionally, participants were reached through flyers and brochures distributed in hospitals, the offices of clinical psychologists and psychiatrists, schools, youth welfare centers, crisis centers for children and adolescents, child and adolescent psychiatry clinics, and other public spaces.

Study Procedure

Participants and their legal guardians were invited for an initial interview prior to the start of the study. Within this one-to-two-hour psychological-clinical study interview, detailed information about the study procedure, as well as inclusion and exclusion criteria was discussed. Prior psychological tests and diagnoses were checked. Following the consent of both parties, a digital version of the Assessment of Emotion Regulation in Children and Adolescents (FEEL-KJ; Grob & Smolenski, 2009) was sent out via e-mail.

Once included, participants and their legal guardians received a welcome mail containing an individual link to a comprehensive questionnaire. Completing these questionnaires as part of the pre-intervention measures took approximately 1.5 hours. The behavioral measure took place after the completion of the questionnaire. Participants were seated in front of the Tobii TX300 eye-tracker and asked to sit still during the following task. Before the task could be administered, calibration had to be done. Participants were asked to position themselves approximately 60 cm away from the screen. If the visual depiction of the participant's eyes were positioned in the center of a green square on the screen, the distance requirements would be met. The distance specifications provided by the program were checked by the project staff conducting the session. Once distance requirements were met, the participant was asked to follow a moving dot with their gaze, without blinking or moving their head, i.e., an eye calibration task. If data loss was reported to be under five %, the administration of the test could begin. Otherwise, the calibration process would have to be repeated. Before each task, instructions would be verbally delivered, and written instructions were additionally provided on the screen.

Materials and Instruments

The basic randomized-controlled eBRAIN trial (see Konicar et al., 2022) applies various psychological self- and parental ratings, eye tracking, emotion recognition and memory tasks, as well as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) data, collected over multiple time points. For the purpose of

the current work, only the conduct disorder subscale of the Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche-III (DISYPS-SSV; Döpfner & Görtz-Dorten, 2017), the depressive disorder subscale of the Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche-III (DISYPS-DEP, Döpfner & Görtz-Dorten, 2017), the anxiety subscale of Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche-III (DISYPS-ANG; Döpfner & Görtz-Dorten, 2017), the State-Trait-Ärgerausdruck-2 für Kinder und Jugendliche Questionnaire (STAXI-2 K-J; Fischer & Rohrmann, 2016), the Difficulties in Emotion Regulation Questionnaire (DERS; Gratz & Roemer, 2003), the Inventory of Callous-Unemotional Traits Questionnaire (ICU; Frick, 2004), the Basic Empathy Scale (BES; Jolliffe & Farrington, 2005) and the Emotion Recognition Task were of interest and presented as follows:

Emotion regulation abilities were assessed through the Difficulties in Emotion Regulation Questionnaire (DERS, Gratz & Roemer, 2003). The DERS is a self-report questionnaire consisting of 36 items being measured on a 5-point Likert-type scale, ranging from one ('almost never') to five ('almost always') (Gratz & Roemer, 2004). The first ten items focus on the ability to differentiate emotional experiences, such as Item 4 'Ich weiß nicht, wie ich mich fühle' ('I do not know how I am feeling'), whereas the remaining 26 items focus on dealing with negative emotions, such as Item 32 'wenn ich negative Gefühle habe, verliere ich die Kontrolle über mein Verhalten' ('When I experience negative emotions, I lose control over my behavior'). As nine items are positively stated (Item 1, 2, 6, 7, 8, 10, 17, 20, 22, 24, and 34), their scores had to be reversed. The questionnaire includes six subscales assessing distinct facets of emotion regulation difficulties: Nonacceptance of emotional response, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Subscale scores were calculated by summing up the relevant items as defined in the instrument's manual. The total score is calculated by adding all items and relates to the severity of emotion regulation difficulties, with higher scores indicating more difficulties.

The DERS shows good split-half reliability with $r_{tt} = .93$ and internal consistency with Cronbach's $\alpha = .95$ (Gutzweiler & In-Albon, 2018). Regarding convergent validity, the scores on the DERS correlated strongly with internalizing behaviors ($r = .706, p < .001$) and, to a lesser extent, externalizing behaviors ($r = .368, p < .001$) (Gutzweiler & In-Albon, 2018).

Emotion recognition is measured using a behavioral emotion recognition task (ERT) via eye tracking. The task consists of brief videos taken from the validated EU-Emotion Stimulus Database (O'Reilly et al., 2015). Within this database, 21 distinct emotions and mental states are depicted, of which 14 are used in the present task: afraid, angry, ashamed, disappointed, disgusted, frustrated, happy, hurt, interested, jealous, joking, sad, surprised, and neutral. These emotions are conveyed through a combination of facial expressions and body language that provides contextual information. The stimuli feature child and adult actors from various ethnic backgrounds to ensure representation across different demographic groups. See Figure 3 for a visual representation of an emotional stimulus of the EU-Emotion Stimulus Database used in the emotion recognition task. For the ERT, a brief video with an emotional stimulus is shown, after which a forced choice task appears with the demand to choose the label that best describes the demonstrated emotional expression. The task consists of six choice options, from which one describes the target emotion, four control items, and one stating 'None of the above'. Errors in emotion classification occurred primarily for conceptually similar emotions, supporting the task's content validity. Correlations between recognition, valence, arousal, and intensity measures were generally low ($R^2 \approx .05$), except for the expected high correlation between arousal and intensity ratings ($r \approx .90$) (O'Reilly et al., 2015).

Figure 3

Exemplary Stimulus from the EU-Emotion Stimulus Database used in the Emotion Recognition Task



Note: Emotional Stimuli are shown in the form of a brief video

For eye-tracking during the experiment, a Tobii TX300 device was used, featuring a 23-inch screen and the Tobii Pro Lab software (version 1.171.34906, x64, Tobii, Stockholm) for data collection. The system operates with a sampling rate of 300 Hz, ensuring minimal variability of less than 0.3%, even in suboptimal conditions. The stimuli were shown in HD resolution (1920x1080 pixels). The device accommodates a small degree of head movement and can adjust to differences in individual facial features and skin tone. Participants were positioned approximately 65 cm away from the monitor for optimal tracking. Pupil size was recorded in millimeters using Tobii's infrared eye tracking system, which estimates physical diameter based on image analysis and a 3D eye model.

Empathy was measured using the Basic Empathy Scale (BES, Jolliffe & Farrington, 2005). The German version of the BES is a self-report questionnaire containing 12 items, of which six items address cognitive empathy, and six items address affective empathy (Heynen et al., 2016). Each item is rated on a 5-point Likert-type scale, ranging from one ('no agreement') to five ('full agreement'). The cognitive empathy subscale measures the ability to understand others' thoughts and perspectives, as reflected in items such as Item 3 'Ich verstehe, dass meine Freunde sich freuen, wenn sie etwas gut gemacht haben' ('I understand that my friends feel happy when they have done something well'). The affective empathy subscale assesses the ability to share or respond emotionally to others' feelings, as seen in Item 5 'Ich lasse mich leicht durch die Gefühle anderer beeinflussen' ('I am easily influenced by the emotions of others'). A total score for empathy can be obtained by summarizing all items, resulting in a minimum score of 12 for low empathy and a maximum score of 60 for high empathy. The cognitive empathy and affective empathy scale demonstrate good construct validity and internal consistency with Cronbach's α of .79 and .85, respectively (Cabedo-Peris et al., 2021).

Hostility was measured through three different self-reporting questionnaires, namely the conduct disorder subscale of the DISYPS-III SVV (Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche-III; Döpfner & Görtz-Dorten, 2017), STAXI-2 KJ-S (State-Trait-Ärgerausdruck-2 für Kinder und Jugendliche Questionnaire; Fischer & Rohrmann, 2016) and the ICU (Inventory of Callous-Unemotional Traits Questionnaire; Frick, 2004), which will be described in the following.

The DISYPS-III test battery includes various measures for psychopathologies according to ICD-10 and DSM-5 for children and adolescents ranging from 11 to 18 years old (Döpfner & Görtz-Dorten, 2017). Through calculation of characteristic values, an associated

Stanine value can be used for clinical interpretation. Stanine values range from 1 (unremarkable) to 9 (pronounced conspicuousness).

The conduct disorder subscale for ages 11 to 18 consists of 38 items, rated on a four-point Likert scale ranging from one ('strongly disagree') to four ('strongly agree'). An exemplary item can be seen in item 4 'Ich ärgere andere häufig absichtlich' ('I often deliberately provoke others'). A total score is calculated by summing up the ten item scores, with higher scores indicating more severe conduct disorder symptoms. The conduct disorder subscale demonstrated acceptable to very good internal consistency in both the representative and clinical samples, with Cronbach's α ranging from $\alpha = .65$ to $\alpha = .92$ (Döpfner & Görtz-Dorten, 2017).

The ICU questionnaire consists of 24 items, rated on a four-point Likert scale ranging from zero ('strongly disagree') to three ('strongly agree') (Frick, 2004). An example of an item is Item 4: 'Es ist mir egal, wen ich verletze, um zu bekommen was ich will' ('I do not care who I have to hurt to get what I want'). The ICU is divided into three subscales: the callous dimension consists of 11 items, 10 of which are positively phrased and reflect higher CU traits (e.g., 'Es ist mir egal, wen ich verletze, um zu bekommen was ich will' ('I do not care who I have to hurt to get what I want')), while the uncaring dimension includes eight negatively phrased items (e.g., 'Ich versuche immer mein bestes zu geben' ('I always try my best')). The unemotional dimension consists of five items. In total, the ICU contains twelve items that need to be reverse-scored. The ICU has demonstrated acceptable internal consistency across studies, with Cronbach's alpha values of $\alpha = .83$ for the total scale, $\alpha = .75$ for the callous subscale, $\alpha = .80$ for the uncaring subscale, and $\alpha = .71$ for the unemotional subscale (Cardinale & Marsh, 2017). Regarding convergent validity, the ICU showed a medium to large association with psychopathy, with $r = .43$ for the callous subscale and $r = .40$ for the uncaring subscale. The unemotional subscale showed a smaller association with psychopathy, with $r = .16$. Acceptable external validity is demonstrated with moderate associations between the total ICU score, as well as the callous ($r = .35$) and uncaring ($r = .29$) subscales and externalizing outcomes. Contrarily, the unemotional subscale ($r = .06$) consistently shows near-zero associations with externalizing behaviors. The total score furthermore shows a medium negative association with empathy ($r = -.42$) (Cardinale & Marsh, 2017).

The STAXI-2 is a self-report questionnaire divided into three sections with a total of 51 items for the adult (18-63 years old) and 34 items for the child (9-16 years old) version (Fischer & Rohrmann, 2016). The state anger subscale assesses how the respondent feels in the present moment, as seen in Item 2 of the children's questionnaire 'Ich bin genervt' ('I am

annoyed'). The subscale consists of 10 items in the child and 15 items in the adult version, that are ranked on a four-point Likert scale ranging from one ('not at all') to four ('very much'). The trait anger subscale consists of ten items in both versions, that are rated on a scale from one ('almost never') to four ('almost always'), reflecting the frequency with which the respondent experiences certain feelings, as seen in item 13 'Ich ärgere mich schnell' ('I get angry easily'). The remaining 14 items in the child and 26 in the adult version are rated on a scale from one ('almost never') to four ('almost always') and assess the respondents' emotional and behavioral expression of anger. This subscale differentiates between outward-directed anger expression, inward-directed anger expression, and anger control. STAXI-2 shows adequate internal consistency with alpha coefficients above .70 for all scales (Lievaart et al., 2016).

Depressive Symptoms were measured through the depressive disorder subscale of the DISYPS-III DEP (Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche-III; Döpfner & Görtz-Dorten, 2017). The depressive disorder subscale for ages 11-18 consists of 42 items that are ranked on a four-point Likert scale ranging from one ('not at all') to four ('very pronounced'). The first 29 items relate to symptom criteria and form a total score of a minimum of 29 and a maximum of 116. Higher scores indicate stronger symptom severity. The remaining 13 items comprise two additional subscales. Five items assess functional impairment and level of suffering, while eight items evaluate competencies.

Anxiety Symptoms were measured through the anxiety disorder subscale of the DISYPS-III ANG (Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche-III; Döpfner & Görtz-Dorten, 2017). The anxiety disorder subscale for ages 11-18 consists of 57 items that are ranked on a four-point Likert scale ranging from one ('not at all') to four ('very pronounced'). The first 44 items relate to symptom criteria and form a total score of a minimum of 44 and a maximum of 176. Higher scores indicate stronger symptom severity. The remaining 13 items comprise two additional subscales. Five items assess functional impairment and level of suffering, while eight items evaluate competencies.

Statistical Analysis

Descriptive and inferential statistical analysis was performed by using RStudio (Version 4.5.0), with a significance level set at $p < .05$ for all tests. To control for Type I error due to multiple comparisons, a False Discovery Rate correction was applied to adjust the significance threshold. Outliers were defined as datapoints exceeding $\pm$ three standard deviations from the sample mean and were inspected but not retained, as they represent authentic variability in symptoms.

Prior to analyses, assumptions were assessed separately for each statistical procedure. Normality was assessed using Shapiro-Wilk tests, Q-Q plots, and calculating Kurtosis and skewness. Where assumptions were violated, non-parametric tests were conducted. Linearity and homoscedasticity were evaluated by examining scatterplots of predicted values versus residuals, Q-Q plots, and visual inspection of standardized residuals, as well as conducting a Breusch-Pagan test. Whenever homoscedasticity was violated, robust standard errors were used to compute linear regressions. Independence of observations was assumed based on the randomized controlled trial (RCT) design. To assess multicollinearity, the Variance Inflation Factor (VIF) values and bivariate correlations between predictors were reviewed. Homogeneity was assessed using Levene's Test.

Self-reports of empathy, callous-unemotional traits, conduct disorder, difficulties in emotion regulation, and state-trait anger were compared between both diagnostic groups using Mann-Whitney U tests. Subjective data on symptom severity, regarding anxiety and depression symptoms, were investigated in the entire sample. To understand the influence of depressive symptoms and anxiety symptoms on social-emotional functioning, a series of linear regression analyses were conducted on all subscales and total scales of the aforementioned self-report measures. Linear regressions were conducted separately for anxiety symptoms and depressive symptoms.

Eye tracking-related data encompassed emotion recognition accuracy, mean pupil dilation, emotion intensity, and emotion classification. Group differences in emotion recognition accuracy and a potential moderating effect of emotion intensity were investigated using logistic regression, for exploratory analysis regarding group differences concerning individual emotional expressions, Chi2 and Fisher's exact test were conducted. To identify which emotions were most or least frequently recognized across all participants, descriptive statistics were inspected. Group differences in pupil dilation were investigated using Mann-Whitney U tests. An exploratory analysis regarding the effect of pupil diameter size on emotion recognition accuracy was conducted using logistic regression.

Results

The sample consisted of 62 participants (89.9% girls, $N = 52$, 16.1% boys, $N = 10$). Of these participants, 44 were diagnosed with depressive disorder and 18 with anxiety disorder. Due to missing data, the sample regarding eye-tracking and pupil dilation analyses consisted of 43 participants, of whom 38 were diagnosed with depressive disorder and 15 with anxiety

disorder. Their ages ranged from 13 to 18 ($M = 15.4$, $SD = 1.42$). Table 1 provides an overview of the sample's demographic profile, detailing participants' gender and age.

Table 1

Demographic Characteristics of Participants by Diagnostic Group (Depression vs. Anxiety)

	Anxiety Disorder $n_1=18$	Depressive Disorder $n_2= 44$
Gender (male/female)	3/15	7/37
Age (years)		
Mean	15.40	15.40
SD	(1.50)	(1.40)

Note. Mean values and standard deviations in parentheses

Further, Table 2 presents means and standard deviations for all relevant psychological constructs from the diverse self-report scales and subscales.

Table 2

Mean and Standart Deviation of Subscales and Total Scores for Adolescents with Anxiety Disorder, Depression Disorder, and the entire sample

Self-report	Anxiety Disorder Group ($n = 18$) M (SD)	Depressive Disorder Group ($n = 44$) M (SD)	Total ($N = 62$) M (SD)
Affective Empathy	22.89 (5.66)	24.50 (4.07)	24.03(4.59)
Cognitive Empathy	21.56 (3.45)	22.34 (5.30)	22.11 (4.82)
BES Total	44.44 (8.33)	46.84 (8.33)	46.15 (8.33)
Callous	17.89 (4.01)	18.14 (4.96)	18.06 (4.67)
Uncaring	16.94 (5.05)	16.45 (4.64)	16.60 (4.72)

Self-report	Anxiety Disorder Group (<i>n</i> = 18) <i>M</i> (SD)	Depressive Disorder Group (<i>n</i> = 44) <i>M</i> (SD)	Total (<i>N</i> = 62) <i>M</i> (SD)
Unemotional	14.56 (3.93)	15.20 (3.34)	15.02 (3.50)
ICU Total	49.39 (8.30)	49.80 (9.57)	49.68 (9.15)
SSV Total	54.72 (11.49)	57.52 (14.05)	56.71 (13.33)
DERS Total	119.11 (28.60)	124.07 (20.40)	122.63 (22.95)
Awareness	20.22 (5.99)	20.14 (4.65)	20.16 (5.03)
Clarity	18.22 (4.17)	18.16 (4.71)	18.18 (4.53)
Goals	19.06 (5.93)	19.64 (4.58)	19.47 (4.96)
Impulse	16.83 (5.94)	17.68 (6.05)	17.44 (5.99)
Nonacceptance	17.11 (6.60)	17.91 (5.83)	17.68 (6.02)
Strategies	27.67 (9.01)	30.55 (6.50)	29.71 (7.36)
Trait-Anxiety	0.04 (0.89)	0.46 (1.14)	0.33 (1.08)
State-Anxiety	-0.25 (0.60)	-0.04 (0.92)	-0.10 (0.83)
Depressive Symptom Score	94.39 (19.03)	96.57 (14.44)	95.94 (15.78)
Anxiety Symptom Score	93.17 (24.09)	95.98 (24.68)	95.16 (24.35)

In the subsequent section, each hypothesis is examined regarding self-report, behavioral responses, and physiological data.

Hypothesis 1: Adolescents with anxiety disorders are expected to differ in their emotion regulation difficulties, hostility, and empathy on related psychological rating scales from adolescents with depressive disorders

The performed Mann-Whitney U test revealed no significant differences between diagnostic groups. For example, regarding empathy, the anxiety group ($Mdn = 46.00$) and the depression group ($Mdn = 47.50$) did not significantly differ ($U = 331, p = .316, r = .12$). All p -values exceeded .18, suggesting no statistically relevant group differences. See Table 3 for full results.

Table 3

Mann-Whitney U-Test Results for Differences Across Self-Reports Between Anxiety Disorder and Depressive Disorder Groups

Variable	Median (Anxiety Disorder)	Median (Depressive Disorder)	<i>U</i>	<i>p</i>	<i>r</i>
Affective Empathy	23.5	25	329	.69	.03
Cognitive Empathy	22	23	335	.69	.16
Empathy (BES Total)	46.00	47.50	331	.69	.12
CU Traits (ICU Total)	33.00	35.00	291	.81	.18
Conduct Problems (SSV Total)	17.00	20.00	285	.77	.07
Emotion Regulation (DERS Total)	88.00	90.00	292	.77	.06
State Anger (z)	-0.30	-0.07	289	.70	.05
Trait Anger (z)	0.14	-0.08	318	.77	.03

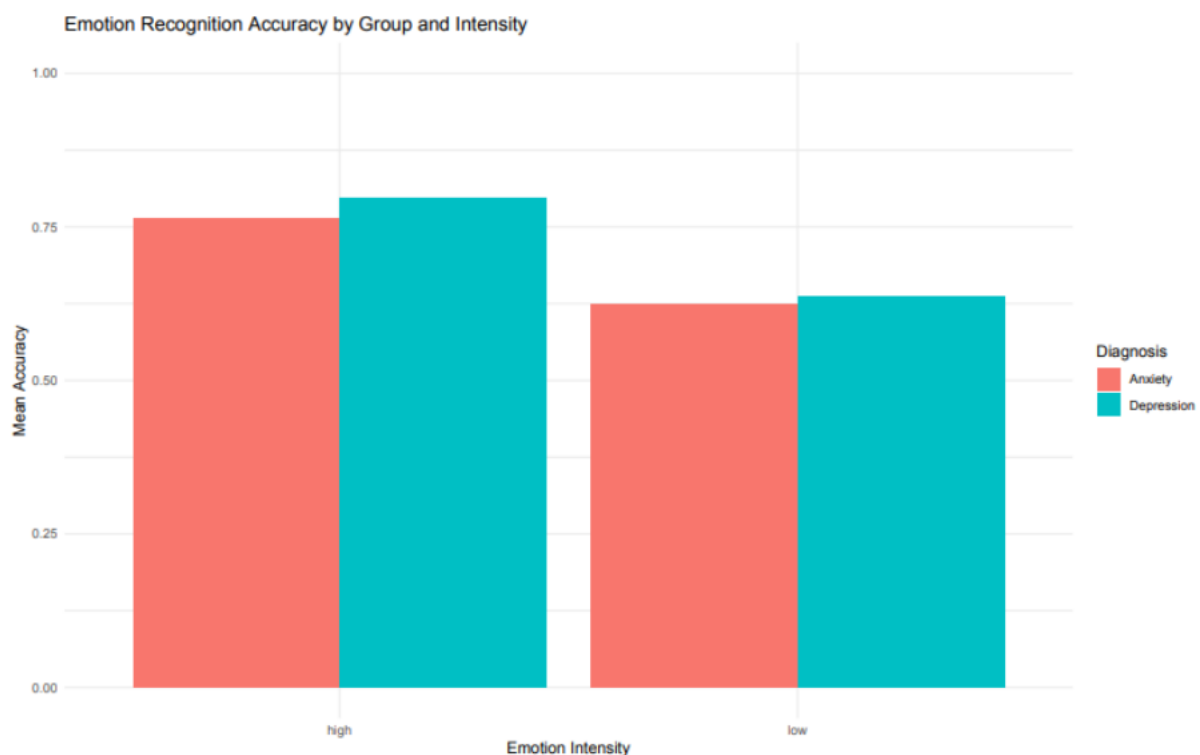
Note: U = Mann-Whitney U statistics; r = effect size ($r = Z / \sqrt{N}$); p values are exact

Hypothesis 2: Adolescents with anxiety disorder are expected to differ in their emotion recognition accuracy from adolescents with depressive disorder, and this difference is expected to be moderated by the emotional intensity (low vs. high) of the stimuli.

A binary logistic regression analysis revealed a significant main effect of emotional intensity ($B = -.66$, $SE = .28$, $z = -2.33$, $p = .02$, 95% $CI [.30, .90]$). The odds of accurately recognizing the displayed emotion were 48% lower when the emotion was presented with low compared to high intensity. Neither the main effect of the diagnostic group ($p = .331$) nor the interaction between the diagnostic group and emotional intensity ($p = .676$) reached significance. For a visual representation, see Figure 4.

Figure 4

Mean accuracy of emotion recognition by diagnostic group (anxiety vs depression) and emotional intensity (high vs. low)



Hypothesis 3: Adolescents with anxiety disorder are expected to differ in their pupil dilation in the emotion recognition task from adolescents with depressive disorder.

The Mann-Whitney U test revealed no significant difference ($U = 259$, $p = .615$) between adolescents with anxiety disorder ($Mdn = 3.07$, $IQR = .28$, $n = 15$) and adolescents

with depressive disorder ($Mdn = 3.08$, $IQR = .36$, $n = 38$). The rank biserial effect size was very small ($r = .07$).

Hypothesis 4: Depressive symptoms significantly predict individual subscales and total scores of emotion regulation difficulties, hostility, and empathy.

Results showed that higher depression scores were significantly associated with more difficulties in emotion regulation (DERS; Gratz & Roemer, 2003), particularly with the subscales ‘strategies’ ($\beta = .289$, $p < .001$), ‘goals’ ($\beta = .185$, $p < .001$), and Total difficulties ($\beta = .818$, $p < .001$). Significant positive associations were also observed with ‘impulse control difficulties’ ($\beta = .146$, $p < .001$) and ‘nonacceptance’ ($\beta = .155$, $p = .012$). No association was found for ‘awareness’ ($\beta = -.036$, $p = .666$) or ‘clarity’ ($\beta = .071$, $p = .164$).

Depressive symptoms were also positively related with conduct problems (SSV: $\beta = .359$, $p = .022$). No significant associations were found between depressive symptoms and empathy (‘affective’, ‘cognitive’, or total (BES; Jolliffe & Farrington, 2005)), callous-unemotional-traits (‘callous’, ‘unemotional’, ‘uncaring’ or total (ICU; Frick, 2004) or with state and trait anger (STAXI-KJ; Rohrmann et al., 2013) (all $p > .063$). A full summary of regression results for depressive symptoms is presented in Table 4.

Table 4

FDR corrected Regression Results for Depressive Symptoms

Self-Reports	β	p
DERS Total	.818	<.001
Subscale: Strategies	.289	<.001
Subscale: Goals	.185	<.001
Subscale: Impulse	.146	.011
Subscale: Nonacceptance	.155	.012
Subscale: Awareness	-.036	.736
Subscale: Clarity	.071	.164
SSV Total	.359	.022
ICU Total	.165	.183
Subscale: Uncaring	-.002	.985
Subscale: Unemotional	.055	.145
BES Total	.048	.764
Subscale:	.047	.671
Affective Empathy		
Subscale:	.001	.985
Cognitive Empathy		

Self-Reports	β	p
State Anger	-.001	.966
Trait Anger	-.006	.764

Hypothesis 5: Anxiety Symptoms significantly predict individual subscale scores of emotion regulation difficulties, hostility, and empathy.

Regression analyses with anxiety scores revealed a similar pattern of associations with emotion regulation difficulties as observed for depressive symptoms. Anxiety was significantly related to the DERS (Gratz & Roemer, 2003) Total score ($\beta = .459, p = .003$), as well as to the ‘strategies’ ($\beta = .146, p = .005$), ‘goals’ ($\beta = .112, p = .003$), ‘nonacceptance’ ($\beta = .101, p = .022$), and ‘impulse’ ($\beta = .101, p = .039$) subscales. No significant association was found with ‘awareness’ ($\beta = -.019, p = .994$) or ‘clarity’ ($\beta = .017, p = .692$).

Anxiety scores were also positively associated with conduct problems (SSV: $\beta = .207, p = .028$). No significant associations were observed between anxiety symptoms and CU-traits (ICU; Frick, 2004), state-trait anger (STAXI-KJ; Fischer & Rohrmann, 2016) or empathy (‘affective’, ‘cognitive’ or total (BES; Jolliffe & Farrington, 2005)) (all $p > .22$). A complete overview of the regression results for anxiety is displayed in Table 5.

Table 5

FDR corrected Regression Results for Anxiety Symptoms

Self-Reports	β	p
DERS Total	.459	.003
Subscale: Strategies	.146	.005
Subscale: Goals	.112	.003
Subscale: Impulse	.101	.039
Subscale: Nonacceptance	.101	.022
Subscale: Awareness	-.019	.692
Subscale: Clarity	.017	.692
SSV Total	.207	.028
ICU Total	.033	.692
Subscale: Uncaring	-.026	.692
Subscale: Unemotional	.001	.692
BES Total	.054	.692
Subscale: Affective	.040	.612
Subscale: Cognitive	.013	.732
State Anger	-.003	.692
Trait Anger	.001	.875

Exploratory

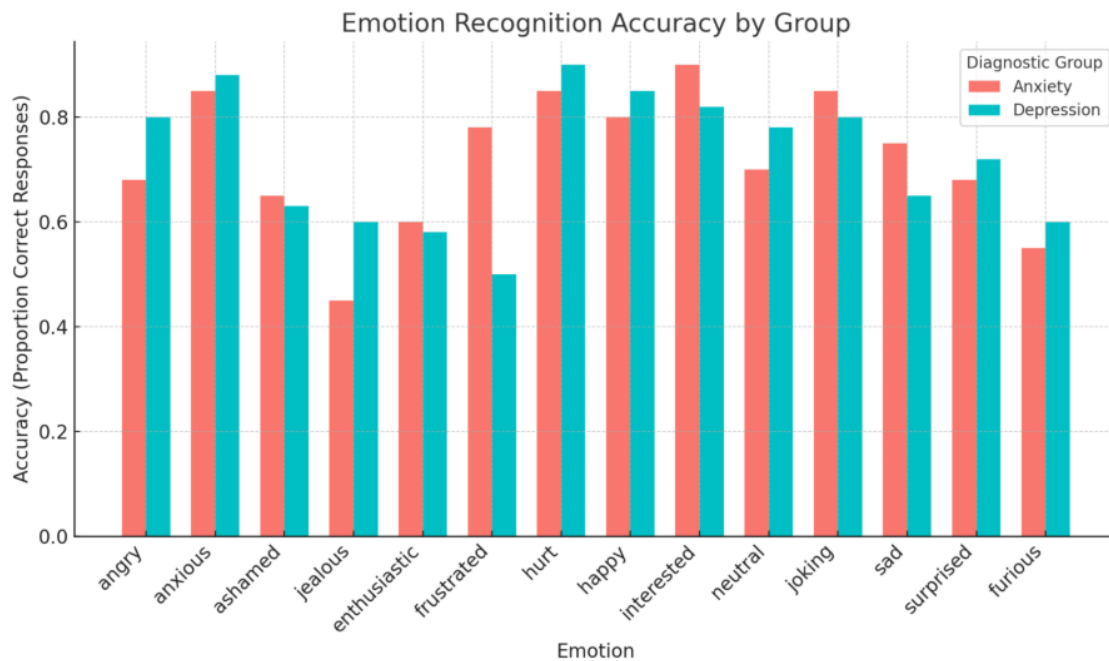
Research Question 1: Do adolescents with anxiety disorder differ in the recognition of specific emotions from adolescents with depression disorder, and which emotions are generally the most difficult to identify?

Chi2 and Fisher's exact tests showed no significant group differences in emotion recognition accuracy across 14 emotions. Although the result for 'gekränkt' (hurt) was statistically significant before correction ($p = .039$), it did not survive correction for multiple comparisons. Although not significant, slight differences across groups could be observed as adolescents with anxiety disorder performed better in accurately recognizing the emotions 'gekränkt' (hurt) ($d = +.31$) and 'traurig' (sad) ($d = +.09$). Contrarily, adolescents with depressive disorder more easily recognized the emotion 'frustriert' (frustrated) compared to adolescents with anxiety disorder.

Descriptive data revealed that the emotions 'enttäuscht' (disappointed) (55.6%), 'gekränkt' (hurt) (59.2%), 'wütend' (angry) (59.2%) represent the least accurately recognized emotions across both diagnostic groups. 'Ängstlich' (afraid) (94.4%), 'glücklich' (happy) (87.8%), and 'scherzhaft' (joking) (84.9%) were most easily identified. For a visual representation, see Figure 5.

Figure 5

Mean emotion recognition accuracy per emotion and diagnostic group (anxiety vs. depression)



Research Question 2: Is greater pupil dilation during the emotion recognition task positively associated with accuracy in emotion recognition?

Logistic regression showed that mean pupil dilation was not a significant predictor of emotion recognition accuracy ($B = .16$, $SE = .15$, $z = 1.07$, $p = .28$). The odds ratio was 1.18 (95% CI [.87, 1.58]). After listwise exclusion of missing data, a total of 1506 trials were available for analysis.

Discussion

This study investigated differences in social and emotional functioning between adolescents with anxiety disorder and depressive disorder using self-report questionnaires, a behavioral measure, and eye-tracking data. This research aimed to explore how socio-emotional processes manifest across the two disorders, seeking to identify any disorder-specific patterns. It was expected that the diagnostic groups would differ in socio-emotional outcomes, and that symptom severity would be associated with distinct facets of socio-emotional functioning. Results demonstrated no significant differences across socio-emotional processes, yet emotional intensity significantly predicted emotion accuracy across diagnostic groups, and anxiety, as well as depressive symptom severity, significantly predicted emotion regulation difficulties and conduct disorder symptoms.

Contrary to expectations, the result of comparing both diagnostic groups across different social and emotional functioning aspects indicated no statistically significant differences. This finding is partly inconsistent with prior literature. Even though direct group comparisons are rare, distinct associations for empathy-, emotion regulation difficulties-, emotion recognition-, hostility-, and pupil dilation-related outcomes have been repeatedly reported for individuals with depressive and anxiety disorders. Whilst increased affective empathy has been associated with anxiety disorder (Gambin & Sharp, 2018; Nair et al., 2023), the opposite has been shown for depressive disorder (Guhn et al., 2020). Cognitive empathy has generally been shown to stay intact in both disorders (Bray et al., 2021), although some studies found weak associations with social anxiety (Pittelkow et al., 2021). Emotion regulation difficulties as well as hostility-related measures have been more strongly associated with depressive disorder than anxiety disorder (Koh et al., 2002; Ruan et al., 2023). Additionally, impairment in emotion recognition has been found to be more prominent in individuals with depressive disorder (Demenescu et al., 2010). Increased pupil dilation during emotional processing has been associated with both anxiety and depressive disorders (Burkhouse et al., 2016; De Zorzi et al., 2021). Whilst greater pupil dilation in response to positive stimuli has been observed in individuals with depressive disorder (Sekaninova et al., 2019), reduced dilation in response to happy faces has been found in individuals with anxiety disorder (Keil et al., 2018). Even though none of these findings could be replicated within the present work, many of the previous studies mostly investigated each disorder individually and relied on symptom levels rather than diagnostic groups, limiting comparability. Furthermore, emotion recognition and associated physiological responses like pupil dilation showed noticeable

heterogeneity in their task design. Additionally, prior studies rarely used dynamic representations of emotions via video clips and instead demonstrated static pictures.

The lack of group differences in this clinical sample could be due to several factors. First of all, the sample consisted of two predominantly female groups unequal in size, which may have limited informative value. Additionally, descriptive statistics indicated that both diagnostic groups had similar average symptom scores on the DISYPS questionnaires (Döpfner & Görtz-Dorten, 2017), indicating considerable clinical overlap. The overlap in clinical presentation could be attributed to high comorbidity rates among female adolescents (Schuch et al., 2013). More broadly, it raises questions about how to conceptualize internalizing disorders. This finding could support the notion of conceptualizing mental disorders more dimensionally rather than categorically, aligning with the network model of psychopathology (Borsboom, 2017). Central to this approach is the idea that mental disorders are not categorical but rather varying patterns within a shared symptom network, in which symptoms interact. Following, anxiety and depression may not reflect separate disorders, but rather different individually dominant configurations within the same network. Moreover, it is important to consider that the current study did not differentiate between subtypes of depressive or anxiety disorders. Although taking potential subgroups into account would have underpowered the analyses, not distinguishing between subtypes may have limited the ability to detect effects that are specific to particular forms of depressive or anxiety disorders. Prior research suggests that, for example, social anxiety is uniquely associated with emotion regulation difficulties in the realm of ‘lack of emotional clarity’, whereas generalized anxiety disorder is uniquely associated with ‘emotion modification’ (Mathews et al., 2014). The absence of group differences may thus be partly influenced by heterogeneity within diagnostic criteria, as opposing effects could have canceled each other out.

Apart from the above-mentioned factors, the lack of group differences in emotion recognition accuracy might reflect distinctive impairment profiles. Even though some research suggests that depressive disorder is generally more strongly associated with impaired emotion recognition (Demenescu et al., 2010), prior work rarely examines overall accuracy. Most research investigated emotion-specific biases, such that depressive disorder is linked to impaired recognition of happy faces (Krause et al., 2021), which is not the case for anxiety disorder (Rappaport et al., 2021), whereas anxiety disorder is sometimes specifically associated with decreased fear recognition (Wieckowski et al., 2016). One could argue that both disorders may be equally impaired in their overall recognition ability, but that their difficulties are distributed differently.

However, an exploratory analysis of emotion recognition accuracy showed no significant differences across fourteen different facial expressions. Even though not significant, slight tendencies could be seen as adolescents with anxiety disorder more often correctly identified the emotions of hurt and sadness, and adolescents with depressive disorder more often correctly recognized frustration. Furthermore, across all participants, the emotions of disappointment, hurt, and anger were recognized the least frequently, whereas fear, happiness, and joking were best recognized. These findings do not align with previous research, which suggests emotion-specific differences such that individuals with anxiety more easily recognize happiness (Rappaport et al., 2021) or that adolescents with depression recognize sadness with the highest accuracy (Dalili et al., 2014; Krause et al., 2021). The absence of group differences may indicate broad similarities in emotional processing between adolescents with anxiety disorder and adolescents with depressive disorder, not only regarding basic emotions, but also regarding a broad range of nuanced emotional expressions. This is especially insightful, as previous research rarely examined emotions beyond basic expressions in clinical populations. Regarding the descriptive patterns of overall recognition accuracy in the full sample, the findings partially align with previous research. Findings are generally mixed but suggest that individuals with internalizing disorders tend to struggle with accurately identifying anger (Anderson et al., 201; Jarros et al., 2011), yet at least individuals with anxiety disorders may find happy expressions generally easier to recognize (Rappaport et al., 2021). However, contrary to the present results, fear is among the least accurately recognized emotions in individuals with depression (Anderson et al., 2011; Lenti et al., 2000), whereas adolescents with anxiety disorder often demonstrate heightened sensitivity to fearful expressions (Reeb-Sutherland et al., 2014). Arguably, the low accuracy for ‘anger’, ‘hurt’, and ‘disappointment’ in this sample could be due to their contextual complexity. These emotions can be seen as socially complex expressions, as they frequently arise in interpersonal contexts and often co-occur in situations involving conflict. Importantly, the emotional stimuli in this study were always shown in isolation and not in any form of (social) interaction. According to the Theory of Constructed Emotion (Barrett, 2016), individuals require well-developed emotion concepts, derived from prior knowledge, experience and, social expectations, to recognize expressions accurately. As adolescents with internalizing disorders may tend to experience negative emotions in an overlapping manner (Demiralp et al., 2012), they may rely more strongly on contextual cues to place the notion of ‘anger’, ‘hurt’, and ‘disappointment’ clearly. If adolescents already lack differentiated emotional concepts, the absence of socially relevant

contextual cues to guide their expectations makes it even harder to recognize these emotional states.

Despite the lack of group differences regarding emotion accuracy, the intensity of the emotional stimuli significantly influenced accuracy rates across diagnostic groups. Across participants, emotional stimuli that were presented with low intensity were significantly less likely to be identified correctly than those with high intensity. Notably, only some basic emotions (happiness, anger, sadness, surprise, disgust) were presented in a low intensity version; all other emotions were only presented with high intensity. This finding aligns with prior research, which indicated that depressed individuals struggle to identify lower-intensity emotional stimuli compared to healthy controls (Csukly et al., 2009) and that social anxiety can lead to misclassification of low intensity emotions (Button et al., 2013). The difficulty in accurately identifying low-intensity emotional expressions may be influenced by how adolescents with internalizing disorders process emotional experiences. Prior research has indicated that individuals with internalizing disorders tend to struggle to differentiate between distinct negative emotional states (Demiralp et al., 2012). Following the ‘inside out model’ (Keating & Cook, 2023), more discrete and distinct experiences of an emotion lead to higher accuracy of these emotional states in others. Additionally, Plutchik’s wheel of emotions (Plutchik, 1982) understands low-intensity variants of the basic emotions as qualitatively separate emotions, such that a milder form of disgust becomes boredom, and a milder form of sadness becomes pensiveness. If adolescents with internalizing disorders already struggle to experience medium intensity emotions as discrete states, these closely related subtler forms may hardly be distinguishable. Accordingly, a lack of discrete and distinct experiences of negative or low-intensity emotions in individuals with depression and anxiety disorder might partly explain the difficulty of recognizing subtler forms of expression of some basic emotions.

Additionally, and contrary to expectations, no group difference in overall or emotion-specific pupil diameter in response to emotional stimuli was found. Even though increased pupil dilation in response to emotional stimuli has been reported for individuals with anxiety disorder (De Zorzi et al., 2021; Keil et al., 2018) and individuals with depressive disorder (Burkhouse et al., 2016; Sekaninova et al., 2019), prior research did not investigate if one disorder is associated with overall larger pupil dilation during emotional processing compared to the other. However, depressive disorder has been specifically associated with increased dilation in response to positive stimuli (Sekaninova et al., 2019), whereas individuals with anxiety showed reduced dilation in response to happy facial expressions (Keil et al., 2018). Apart from the above-mentioned factors that limit group comparability, the lack of group

difference could be due to some unique factors in the task design and statistical analysis. Firstly, the emotional stimuli in this study design were presented through dynamic videos. Even though the videos were of short durations (approximately seven seconds), facial expressions and gestures developed over the course of the stimulus presentation, whereas other studies mostly relied on static, high-contrast pictures of facial expressions. A static image that delivers the entirety of emotional information at once might cause greater dilation differences than a video sequence in which facial information unfolds continuously. Moreover, previous studies often analyzed changes in dilation diameter in relation to baseline diameter (Mahanama et al., 2022). In this study, however, mean dilation values were used for statistical analysis in the present study. The usage of mean instead of peak values might have masked differential effects. As pupil dilation usually peaks around 1000ms (Van Rij et al., 2019), the remaining six seconds might have blunted the actual extent of pupil diameter and thus decreased between-subject variance. Furthermore, no baseline pupil diameter of each participant was assessed prior to the demonstration of emotional stimuli. Therefore, without baseline correction, inter-individual differences in pupil diameter have not been taken into consideration.

Apart from differential effects between diagnostic groups, the association between pupil diameter and emotion recognition accuracy has been investigated within an exploratory analysis. Larger pupil diameter did not significantly affect emotion recognition accuracy across the entire sample. As previous research suggested that increases in pupil dilation partially represent increases in mental effort (Eckstein et al., 2016; Zénon, 2019), one could have expected that these increases in cognitive effort either facilitate emotion recognition or that they represent a state of mental overwhelm, which hinders recognition, yet neither pattern emerged. This might be due to not taking emotion-specific effects into account, as a larger pupil diameter might only predict accuracy for highly arousing expressions.

Even though no significant differences between diagnostic groups could be identified, symptom severity related slightly differently to various facets of socio-emotional processes. Symptom severity of depression and anxiety significantly predicted overall difficulties in emotion regulation as well as difficulties in the subscales ‘nonacceptance of emotional responses’, ‘difficulties engaging in goal-directed behavior’, ‘impulse control difficulties’, and ‘limited access to emotion regulation strategies. Furthermore, depressive and anxiety symptoms significantly predicted hostility in terms of more severe conduct disorder symptoms. Depressive and anxiety symptoms were not significantly linked to the subscales ‘lack of awareness’ and ‘lack of emotional clarity’, other hostility facets such as callous-unemotional traits or state-trait-anger, nor empathy-related outcomes.

These findings are partially consistent with previous findings. Points of convergence and discrepancy with prior literature will be discussed separately for each outcome variable of socio-emotional processing.

The current results emphasize overlapping emotional regulation difficulties between individuals with depression and anxiety symptoms. Whilst in this study, both disorder symptoms were similarly associated with most DERS domains (Gratz & Roemer, 2003), depressive symptoms showed a stronger effect size in the prediction of overall difficulties of emotion regulation. This might indicate a slightly more severe form of dysregulation in depressed adolescents compared to anxious adolescents. These findings support the notion that internalizing symptomology is closely linked to emotional dysregulation and may hinder the effective use of regulatory strategies, such as impulse control mechanisms. Prior research has consistently demonstrated a strong link between both depressive and anxiety symptoms and difficulties in emotion regulation (Aldao et al., 2009; Klemanski et al., 2016; Solbakken et al., 2021), with some evidence suggesting a stronger association for depressive symptoms overall (Raun et al., 2023). Additionally, certain DERS facets (Gratz & Roemer, 2003), like lack of access to emotion regulation strategies, have been found to relate more to anxiety disorder, whilst lack of emotional awareness relates more to depressive disorder (Alado et al., 2009). Interestingly, in this study, differences across the DERS facets (Gratz & Roemer, 2003) could not be observed between anxious and depressed individuals. One possible explanation might be the high comorbidity of depression and anxiety generally, but also particularly in this study sample. As adolescents demonstrated equally severe depression and anxiety symptoms, this overlap might have diluted unique associations with specific regulation difficulties, even though separate regressions were conducted. Additionally, no significant relationship was found between depressive or anxiety symptoms and emotional awareness or clarity, even though prior studies described the link between lack of awareness and depressive symptoms to be even stronger than in other internalizing disorders (Alado et al., 2009). This non-significant result concerning DERS subscales ‘lack of awareness’ and ‘lack of clarity’ (Gratz & Roemer, 2003) might be explained by characteristics of the sample, including potential gender and sampling biases. Participants in this study were recruited as part of a larger randomized controlled trial investigating the effect of transcranial direct current stimulation and emotion regulation abilities. As part of the inclusion criteria, participants had to score on the FEEL-KJ questionnaire (Grob & Smolenski, 2009), potentially leading to a sample that was particularly inclined to experience difficulties with emotion regulation. At the same time, these adolescents might demonstrate high levels of awareness and clarity about their emotional states and

regulation difficulties, which might have even led them to participate in an intervention study targeting emotion regulation. As many participants have had prior experiences in therapeutic interventions, these could have enhanced their insight into their emotional states and thus positively influenced awareness and clarity. Additionally, the sample, which mainly consisted of female participants, might have influenced the results, as research suggests that girls might be more likely to be aware of and able to verbally express their emotional states compared to boys (D'Amico & Geraci, 2022).

Regarding hostility-related measures, mixed results emerged. Based on the GAM model (Allen et al., 2017), one might expect that depressive or anxious symptoms could heighten internal states like anger or hostile attribution, thus increasing hostility-related outcomes. However, in the current study, depressive and anxiety symptom severity only predicted conduct disorder symptoms, but was not associated with state or trait anger, nor with callous-unemotional traits.

The finding that depressive and anxiety symptom severity significantly predicted conduct disorder symptom severity builds on and extends prior literature. Notably, depressive symptoms showed a stronger effect size in predicting conduct disorder symptoms compared to anxiety symptoms, suggesting that conduct disorder-related difficulties might be more linked to depressed affect. Even though most studies focused on conduct disorder symptoms as a predictor of later depression (Reich & Schatzberg, 2023), the current findings suggest that both symptoms may also contribute to the development or maintenance of conduct-related problems. This aligns with the growing body of work proposing a bidirectional relationship between internalizing and externalizing symptomatology (e.g., Blain-Arcaro & Vaillancourt, 2017; Katsantonis, 2024; McElroy et al., 2018).

Contrarily and diverging from previous findings, depressive and anxiety symptoms did not significantly predict callous-unemotional traits and state or trait anger. Whilst all are positively associated with depressive symptoms (Derks et al., 2024; Gasse et al., 2020), anger has been shown to be predicted by depressive symptoms in prior findings (Koh et al., 2002). Similarly, anxiety has been particularly linked to trait and state anger (Deschênes et al., 2012; Thompson & Schmidt, 2021). One possible explanation for the discrepancy may lie in the nature of trait constructs. Both trait anger and callous-unemotional traits are considered to be relatively stable dispositional tendencies and have been conceptually understood more as a predictor of depressiveness or anxiousness than a consequence (Pezzoli et al., 2024; Veenstra et al., 2017). The lack of significant correlation between both symptoms and state anger could be attributed to the environmental setting in which state anger was surveyed. State anger is

highly context-dependent and often arises in response to specific provocations or irritations. As the setting in which participants filled out the questionnaire might not have been particularly anger-inducing, only low-intensity, baseline levels that did not vary meaningfully with depressive or anxiety symptoms may have been captured.

Concerning empathy, no significant predictive relationship was found between either depression or anxiety symptoms and affective empathy, cognitive empathy, or overall empathy (Basic Empathy Scale, Jolliffe & Farrington, 2005). This finding contrasts with prior findings, which have generally reported significant associations between internalizing symptoms and empathy, particularly lower cognitive empathy and reduced affective empathy in adolescents with higher depression severity (Guhn et al., 2020; Yan et al., 2021). Conversely, anxiety has been particularly associated with heightened affective empathy states (Gambin & Sharp, 2018). One possible explanation for the absence of significant predictive associations in the present study may relate to the non-linearity of empathy. Early or moderate stages of depression might lead to heightened emotional sensitivity, whereas more severe depressive symptoms might be associated with emotional blunting and disengagement. Likewise, moderate stages of anxiety could relate to hyperarousal, whereas severe anxiety might be associated with avoidance or emotional overwhelm. Alternatively, limited variability in empathy related to symptom severity might have hindered the detection of a linear relationship. Furthermore, as empathy in and of itself consists of multiple bottom-up and top-down mechanisms (Decety & Moriguchi, 2007), internalizing symptoms alone might not explain variance in empathy. Internalizing symptoms per se might not lead to empathy impairments, but rather the co-occurrence of severe symptom severity and poor self-other distinction or regulation.

Strength of the study

Firstly, the study employed a robust design by combining multiple self-report questionnaires with behavioral and pupillometry data. This multi-method approach allowed for a more comprehensive assessment of socio-emotional processes and thus increased the validity of the findings. Secondly, investigating internalizing disorder symptoms in a clinical sample with confirmed diagnoses enhances clinical relevance and allows for more meaningful insights into symptom-related patterns. Furthermore, differentiating diagnostic groups allows for the generalizability of the findings to real-world therapeutic or intervention settings. Additionally, integrating pupillometry data with behavioral data represents a relatively novel approach in investigating emotion recognition. Even though emotion recognition has been commonly

assessed via accuracy rates or gaze patterns, the use of pupil dilation remains relatively rare, especially in combination with accuracy rates. Regarding emotion recognition, it is noteworthy that this study included both basic and more nuanced emotional expressions with varying intensity, an aspect that has been largely overlooked in previous research.

Limitations of the study

There are several limitations in this study. First of all, the sample consisted mainly of participants who were recruited from the Child and Adolescent Psychiatry, potentially leading to a sampling bias towards more severely impacted socio-emotional functioning and potentially higher comorbidity rates than in other adolescents with internalizing disorders from outpatient clinics. Moreover, the sample was predominantly female. As gender differences have been observed across socio-emotional variables, this gender bias may have skewed the results and further limited generalizability. Regarding pupil dilation data, the lack of baseline diameter assessment and the use of mean values likely obscured informative value. Additionally, several associations were significant before correction but did not remain significant after FDR correction. Due to the limited power of this study, some effects may have been masked. Future studies with larger sample sizes should investigate if these associations remain stable. Lastly, the unequal group size of diagnostic groups and the substantial overlap in clinical presentation might have limited statistical power and reduced the ability to detect disorder-specific patterns. The comorbid symptom presentation complicates interpretation of group differences and might have obscured meaningful differences in adolescents with non-comorbid depressive or anxiety disorders.

Clinical Implication

The substantial overlap in symptoms between adolescents with depressive and anxiety disorders observed in this study underscores the well-established bidirectional risk for comorbidity. As comorbid internalizing disorders oftentimes take a more serious course with longer duration, persisting into adulthood, early identification and targeted interventions become of even greater importance. Therefore, efforts should be directed at increasing sensitization in adolescents' environments. Psychoeducational or peer-education programs in school, recreational, or social media settings, as well as programs directed at parents, teachers, or other caregivers, could play a vital role in sensitizing the adolescents' environment for early

warning signs and fostering destigmatization. As a result, help-seeking behavior and early access to mental health care could be supported.

As adolescents' anxiety and depressive symptoms severity were associated with similar socio-emotional impairments, transdiagnostic procedures should be emphasized in clinical practice. Specifically, emotion regulation difficulties and conduct disorder symptoms seemed to be predicted by both internalizing symptoms; therefore, these areas should be the central first target for treatment. As almost all sub-facets of the DERS (Gratz & Roemer, 2003) are equally affected in these adolescents, evidence-based interventions may target the facet that is most intuitively accessible to the adolescent, such as cognitive-behavioral strategies for impulse control. Additionally, the findings may suggest that interventions focusing exclusively on increasing awareness, despite their popularity, might not address core regulation difficulties of internalizing disorders. Nevertheless, awareness-focused interventions could serve as an accessible entry point in therapeutic settings.

As the recognition of emotions with low intensity, as well as the expression of hurt, disappointment, and anger, were impaired across both diagnostic groups, interventions may integrate emotion recognition training. Impaired recognition of subtler forms of emotions may contribute to interpersonal misunderstandings and social stress, and may contribute to difficulties in the social functioning of adolescents. Emotion recognition training should consider nuanced emotions as well as varying intensity.

Future Directions

Future research should aim to replicate current findings in a larger sample with more equal group sizes and a more balanced gender distribution. Investigating sub-facets of socio-emotional variables used in this study with more statistical power could indicate whether associations that were shown to be significant before correction might reflect consistent effects. Considering the high comorbidity in symptom presentation, future studies could try to get a more diverse sample, which demonstrates more variability in symptom severity and thus decreased comorbidity. Alternatively, the lack of differentiation could be an incentive to adopt network analysis in future studies investigating internalizing disorders and their manifestation. Otherwise, future research could aim to differentiate between subtypes and account for comorbidities to capture disorder-specific differences in socio-emotional functioning better.

Furthermore, future studies should implement a multimethod approach including self-report, behavioral, and physiological assessment to gain more comprehensive insight into social-emotional functioning. This approach could also extend to the assessment of additional perspectives of parents or peers. Additionally, future studies should integrate paradigms or experimental settings that better account for context-sensitive constructs such as state anger. Pupillometry has shown promising results in prior research to serve as a biomarker for certain disorders, yet the use of such physiological data is still rather rare. Advanced technologies such as eye tracking will likely become more feasible in clinical settings in the future and could provide valuable information about disorder-specific impairments, and might lead to more valid insight into socio-emotional processes than self-report only. In order for the proper integration of such measures in clinical practice, current research needs to explore their potential and limitations.

Conclusion

This study highlights the complexity of social and emotional functioning in adolescents with internalizing disorders. Adolescents have to face new social and emotional demands and challenges during this distinct development period, in addition to their mental health struggles. Internalizing disorders show a significant impact on some socio-emotional processes, which may contribute to upholding symptomatology. Contrary to expectations, this study could not identify differences in the way depressive disorder and anxiety disorder in adolescence manifest across socio-emotional domains. Additionally, pupil dilation did not significantly predict emotion accuracy across diagnostic groups. However, intensity of emotional stimuli significantly predicted recognition accuracy across diagnostic groups, with lower intensity leading to decreased accuracy ratings. Symptom severity of either disorder predicted difficulties in emotion regulation facets and conduct disorder-related symptoms, but was not associated with other hostility or empathy-related aspects. Because multi-method studies of social and emotional functioning in clinically diagnosed adolescents with anxiety and depressive disorders are rare, the similarity observed in this study offers particularly valuable insight and argues for a transdiagnostic approach in clinical practice. Interventions that train emotion recognition, strengthen different facets of emotion regulation skills, and address conduct problems are likely to be beneficial regardless of whether their primary disorder is depressive or anxiety-related. These findings extend the body of literature by emphasizing shared mechanisms of both disorders and underscore the importance of sensitizing adolescents'

social environments to the socio-emotional impact of internalizing disorders and integrating support systems accordingly. Limitations include, among others, a predominantly female sample, unequal group sizes, and lack of comorbidity controls, all of which should be addressed in future research. As depressive and anxiety disorders are amongst the most prevalent mental disorders in adolescence, identifying shared and distinct socio-emotional impairments is essential for designing interventions that maximize treatment success. Further research, ideally using multi-method designs, is needed to refine our understanding of nuanced socio-emotional impairments and how to integrate physiological measures such as eye-tracking into clinical practice. The more internalizing disorders are investigated in the context of the vulnerable and critical developmental period of adolescence, the more these mental health challenges can be destigmatized – a goal to which the findings of this study contribute.

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List of Abbreviations

APA	American Psychological Association
BES	Basic Empathy Scale
DERS	Difficulties in Emotion Regulation Questionnaire
DER	Difficulties in Emotion Regulation
DISYPS-III	Diagnostik-System für psychische Störungen nach ICD-10 und DSM-5 für Kinder und Jugendliche - III
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
EEG	Electroencephalography
ERT	Emotion Recognition Task
GAD	Generalized Anxiety Disorder
GAM	General Aggression Model
ICU	Inventory of Callous-Unemotional Traits
MDD	Major Depressive Disorder
PAM	Perception-Action Model
SSRIs	Selective Serotonin Reuptake Inhibitors
STAXI-2 KJ-S	State-Trait-Ärgerausdruck-2 für Kinder und Jugendliche

Appendix

Abstract

Adolescence marks a crucial time for the onset of internalizing disorders, such as depressive disorder and anxiety disorder, and is often accompanied by distinct changes in social and emotional development. Even though both disorders have been associated with impairments in socio-emotional functioning in adolescence, disorder-specific patterns remain largely unexplored. This study aimed to investigate disorder-specific differences between adolescents with diagnosed depressive or anxiety disorders and examine how symptom severity relates to facets of empathy, emotion recognition, difficulties in emotion regulation, and hostility. A multimethod approach was used, combining self-report questionnaires, a behavioral task, and pupillometry-based eye-tracking. Results showed no significant difference between diagnostic groups regarding self-report measures of empathy, difficulties in emotion regulation, and hostility. Furthermore, no significant group difference regarding accuracy in emotion recognition, nor regarding physiological arousal as measured through pupil dilation, could be found. However, across groups, higher emotional intensity significantly improved recognition accuracy. Greater pupil diameter did not significantly predict emotion recognition accuracy. Anxiety and depressive symptoms significantly predicted overall and facets of difficulties in emotion regulation as well as conduct disorder symptoms. Results support a transdiagnostic understanding of socio-emotional processes and suggest a focus on emotion regulation, conduct-related difficulties, and emotion recognition training in clinical interventions.

Die Adoleszenz ist ein entscheidender Zeitpunkt für das Auftreten von internalisierenden Störungen wie depressiven Störungen und Angststörungen und geht oft mit deutlichen Veränderungen in der sozialen und emotionalen Entwicklung einher. Obwohl beide Störungen mit Beeinträchtigungen der sozio-emotionalen Funktionsfähigkeit in der Adoleszenz in Verbindung gebracht werden, ist bislang wenig darüber bekannt, wie sich Angst- und depressive Störungen hinsichtlich ihrer sozial-emotionalen Verarbeitungsprozesse unterscheiden. Ziel der Studie ist es mögliche Unterschiede zwischen Jugendlichen mit diagnostizierten Angst- und depressiven Störungen zu untersuchen und zusätzlich zu prüfen, wie der Schweregrad der Symptome mit Facetten der Empathie, Emotionserkennung, Schwierigkeiten bei der Emotionsregulation und Feindseligkeit zusammenhängt. Dafür wurde

ein multi-methodischer Ansatz verwendet, der Selbstauskunftsfragebögen, eine Verhaltensaufgabe und Pupillometrie-basiertes Eye-Tracking kombiniert. Die Ergebnisse zeigen keinen signifikanten Unterschied zwischen den Diagnosegruppen in Bezug auf die Selbsteinschätzung von Empathie, Schwierigkeiten bei der Emotionsregulation und Feindseligkeit. Darüber hinaus konnte kein signifikanter Gruppenunterschied hinsichtlich der Genauigkeit der Emotionserkennung oder auch nicht hinsichtlich physiologischer Reaktionen, gemessen anhand der Pupillenerweiterung gefunden werden. Jedoch zeigte sich über beide Gruppen hinweg, dass eine höhere emotionale Intensität die Erkennungsgenauigkeit signifikant verbesserte. Ein größerer Pupillendurchmesser hatte jedoch keinen signifikanten Einfluss auf die Genauigkeit der Emotionserkennung. Zudem sagen Angst und depressive Symptome die Gesamtschwierigkeiten in der Emotionsregulation, sowie einige ihrer Facetten, und Symptome einer Störung des Sozialverhaltens vorher. Die Ergebnisse unterstützen ein transdiagnostisches Verständnis sozial-emotionaler Verarbeitungsprozessen bei Jugendlichen mit internalisierenden Störungen. Sie sprechen für klinische Interventionsansätze die transdiagnostisch ausgerichtet sind und die Verbesserung der Emotionsregulation, verhaltensbezogener Schwierigkeiten und der Emotionserkennung gezielt adressieren.