

EMOTION REGULATION IN AUTISM SPECTRUM DISORDER: EFFECTS ON ANXIETY AND DEPRESSION

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Abstract

Comorbid conditions, such as anxiety and depression, pose diagnostic challenges due to their complex interaction with core autism spectrum disorder features. Emotion regulation is a key concept in the transdiagnostic framework which suggests shared cognitive and behavioral processes among mental disorders. The review aims to examine the emotion regulation effects on anxiety and depression in autism spectrum disorder. A systematic search was conducted from December 2022. to May 2023., using SCOPUS and Google Scholar, with predefined eligibility criteria. Analysis of the twelve included publications unveiled emotion regulation challenges in individuals with autism spectrum disorder. Importantly, these maladaptive strategies were found to be significantly linked to symptoms of anxiety and depression. These findings emphasize the need for interventions that specifically target and improve emotion regulation in individuals with autism spectrum disorder. By enhancing their emotional regulation skills, it may be possible to reduce the symptoms of anxiety and depression in this population.

Keywords: autism spectrum disorder, emotional regulation, emotional regulation strategies, anxiety, depression, mental health.

INTRODUCTION

Autism spectrum disorder (hereinafter referred to as ASD) is a neurodevelopmental condition marked by two primary domains of impairment. Individuals with ASD often exhibit deficits in socio-communicative abilities, which manifest as challenges in social-emotional reciprocity, impairments in non-verbal communication behaviors, and difficulties in forming and sustaining relationships. Additionally, ASD is characterized by core features that encompass restricted, repetitive patterns of behavior, interests, or activities (APA, 2013). Beyond this fundamental characteristics, individuals with ASD may have difficulties in other developmental domains. Of particular significance is the realm of emotional development, in which the discourse frequently centers on the (dys)regulation of emotions exhibited by individuals with ASD. The heterogeneous definitions of emotional regulation often remained insufficiently clarified and abstract. Thompson (1994) answered questions about emotional regulation (hereinafter referred to as ER) in his definition, which included several characterizations of emotional processes. According to his definition, ER consists of extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensity and temporal characteristics, aimed to achieve goals. The ability of an individual to regulate their own emotions is defined as intrinsic, while extrinsic ER refers to situations in which an individuals emotions are regulated by an external person (Gross, 2013). Emotional regulation has also been described as the process by which people try to manage emotions and adjust their emotional response (Gross, 2015). In the context of ASD and other neurodevelopmental disorders, the term emotional dysregulation (hereinafter referred to as ED) is often used, which is defined as a deficit in the ability to monitor and modify the valence, intensity, and expression of emotions (Davico et al., 2022).

Emotional regulation strategies

Emotion regulation strategies are widely defined differently. For example, Eisenberg and Spinrad (2004) talk about implicit and explicit strategies, Thompson, (1991) about intrinsic and extrinsic, Williams and Bargh (2004) about conscious and unconscious, while Mauss et al. (2007) about willing and unwilling strategies (Cai et al., 2017; Eisenberg and Spinrad, 2004; Thompson, 1991; Williams and Bargh, 2004; Mauss et al., 2007). Gross (1998)

proposed a process model of ER which asserts that strategies diverge in their primary influence on the emotion generation process (Gross, 2002; 1998). At a broader level, Gross and Munoz (1995) distinguished between two main ER forms: antecedent-focused ER and response-focused ER. The primary strategies within these categories are cognitive reappraisal, defined as an antecedent-focused adaptive approach involving the reinterpretation of emotionally evocative situations, and expressive suppression, a response-focused maladaptive strategy aiming to inhibit or mask ongoing emotional expressions (Gross & John, 2003; Gross & Levenson, 1993; Cutuli, 2014).

Cognitive Emotion Regulation Strategies (CERS)

Cognitive emotion regulation involves consciously managing emotionally arousing information within the broader context of ER, which encompasses processes responsible for monitoring, evaluating, and modifying emotional reactions (Garnefski et al., 2007; Thompson, 1994). While related to cognitive coping, this theory posits that thinking and acting involve distinct processes, thus considering Cognitive Emotion Regulation Strategies (hereinafter referred to as CERS) in a conceptually pure manner, separate from behavioral strategies (Garnefski et al., 2007; Garnefski et al., 2002). Nine CERS are: self-blame, rumination, catastrophizing, blaming others (maladaptive), and acceptance, positive redirection, refocusing on planning, putting into perspective, and positive reappraisal regarded as adaptive (Garnefski et al., 2007; Garnefski et al., 2002).

Emotion regulation and ASD

Schäfer et al. (2017) explored the developmental trajectory of ER from adolescence to adulthood, noting maladaptive changes during ages 12 to 15, coinciding with the onset of various disorders and mental health issues (Cai et al., 2017; Schäfer et al., 2017; Cracco et al., 2017; Kessler et al., 2005). Individuals with ASD frequently exhibit an increased occurrence of challenges related to emotional regulation and a propensity to use maladaptive strategies (Cai et al., 2017; Aldao et al., 2010; Eftekhari et al., 2009; Gross, 1998; Gross and John, 2003; Richards and Gross, 2000; Richards et al., 2003; Silk et al., 2003; Troy et al., 2010). Dysfunctional ER in typically developing individuals (hereinafter referred to as TD) is associated with adverse outcomes, including heightened negative emotions, mental health problems, memory issues, academic difficulties, and speech-language deficits (Cibralic et al.,

2019). Over-reliance on both adaptive and maladaptive strategies can lead to negative consequences. For example, Troy et al. (2013) found that the effectiveness of cognitive reappraisal in improving mental health depends on the context, with positive effects in only uncontrollable stress situations but adverse effects in controlled stressful contexts.

Considering the core characteristics of ASD, poor ER can exacerbate externalized and internalized problems. While some studies reported lower use of adaptive strategies and greater reliance on maladaptive ones in individuals with ASD (Samson et al., 2015a; Jahromi et al., 2012; Laurent and Rubin, 2004; Konstantareas and Stewart, 2006; Samson et al., 2013), research on ER strategies in this population yielded mixed results, possibly influenced by assessment instruments that may not fully capture ER impairments and comorbidities (Conner et al., 2020; Bearss et al., 2016; Kerns and Kendall, 2012; Mazefsky et al., 2014; Scahill et al., 2019). Some authors propose a connection between core ASD symptoms, particularly restrictive and repetitive behaviors (hereinafter referred to as RRB), and ED (Cai et al., 2018c; Berkovits et al., 2017; Samson et al., 2015a). Additionally, avoiding eye contact in individuals with ASD may serve as a coping mechanism to mitigate heightened emotional responses triggered by eye contact (Dalton et al., 2005).

Emotional (dys)regulation as a transdiagnostic factor on mental health problems

Mental health is defined as a state characterized by emotional well-being, limited anxiety, sound behavioral adjustment, the ability to establish positive relationships, and effective coping with life's demands (APA, 2015). Mental health issues are defined by disruptions in cognition and emotions, unusual behaviors, compromised functioning, or a combination of these aspects. They exhibit a negative correlation with positive psychological well-being, suggesting that the contrasting facets of good mental health exist at opposite sides of the spectrum (Cai et al., 2018a). The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and the International Classification of Diseases by the World Health Organization (WHO) provide specific classifications of mental problems and disorders, and the term "psychopathological" is used to describe the cognitive and behavioral manifestations of such disorders (APA, 2015). In contemporary literature, a transdiagnostic approach is increasingly employed to investigate factors contributing to psychopathology. The National Institute of Mental Health has introduced a Research Domain Criteria (RDoC) framework that aligns with

this approach. Within this perspective, it is suggested that ER and ED are a transdiagnostic risk factors especially in individuals with internalizing issues (Insel et al., 2010; Aldao et al., 2010). The transdiagnostic view posits that mental disorders share common cognitive and behavioral processes linked to the onset or persistence of various pathologies (Sáez-Suanes et al., 2020). Although ER is maladaptive in all mental health disorders, the specific maladaptive nature and underlying mechanisms vary depending on the disorder (Aldao et al., 2010; Mazefsky and Herrington, 2014).

Symptomatology and prevalence of anxiety and depression in ASD

Anxiety involves persistent feelings of concern, psychological tension, and somatic tension, while depression is characterized by negative affect, sadness, pessimism, and associated behavioral, cognitive, and social changes (APA, 2015). The diagnosis of anxiety and depression in ASD poses difficulties due to the restricted verbal abilities and challenges in conveying emotions, even among individuals who are considered high-functioning (hereinafter referred to as HF ASD). Clinicians often rely on reports from caregivers, parents, and educators, monitoring changes in behavior and interests (Ghaziuddin & Greden, 1998; Matheis & Turygin, 2016). The authors Wood and Gadow (2010) expressed concerns about assessment instrument reliability and validity in ASD. These instruments, designed for TD youth, may not effectively depict the way psychopathological symptoms present in ASD leading to a lack of validated tools. This issue results in wide variations in prevalence rates of comorbid mental health problems. For example, Hollocks et al. (2018) noted prevalence percentages ranging from 70% for combined anxiety and depression to 5% for anxiety alone and less than 1% for depression. Ivanović (2021) also highlighted the variability in prevalence, with anxiety ranging from 1.47% to 54% and depressive disorders ranging from 2.5% to 47.1% among individuals with ASD. Also, diagnostic overshadowing which is defined as attributing anxiety or depression symptoms to core ASD features, is an issue (Wood & Gadow, 2010). Often RRBs are linked to anxiety and depression severity, with specific subtypes affected (Rodgers et al., 2012; Jiujiu et al., 2017; Gotham et al., 2012; Muskett et al., 2019).

Operationalization of key concepts

Emotion regulation is operationalized as a process where individuals monitor, evaluate, and adjust emotions to achieve specific goals by using various ER strategies (Thompson, 1994; Gross and John, 1998; Gross, 2013; Gross, 2015). This review includes the classification of ER strategies as adaptive (e.g., cognitive reappraisal) and maladaptive (e.g., expressive suppression), also including CERS. Furthermore, anxiety and depression are defined as significant symptoms based on clinical cut-off values, self-reported diagnosis, or clinical diagnosis by parents/caregivers. Given the prevalence of comorbid intellectual disabilities (ID), the review encompasses both ASD and ID populations. The term 'ASD' includes: Autism, Asperger's Syndrome, and Pervasive Developmental Disorder Not Otherwise Specified (hereinafter referred to as PDD-NOS). Additionally, the review includes participants of various ages to explore potential age-related heterogeneities within the utilization of ER strategies, considering conflicting opinions in recent studies on changes in the use of ER strategies during development.

Aim and Hypotheses

The primary objective of this review is to investigate the impact of ER on coexisting anxiety and depression in individuals with ASD by examining the utilization of adaptive and maladaptive ER strategies and their consequences on the presence and severity of anxiety and depression. Given the characteristic features of ASD and deviations from typical early development and ER, we hypothesize as follows:

Hypothesis 1 (H1): Individuals with ASD experience difficulties in emotional regulation and exhibit a higher prevalence of maladaptive ER strategy use, coupled with lower usage of adaptive strategies, compared to TD peers.

Furthermore, the next assumption is that these difficulties in ER, including ED and/or heightened utilization of maladaptive strategies, significantly contribute to anxiety symptoms in individuals with ASD. Conversely, higher utilization of adaptive ER strategies is expected to be negatively correlated with anxiety symptoms. This leads to the formulation of the following hypothesis:

Hypothesis 2 (H2): Emotional (dys)regulation and the greater use of maladaptive ER strategies are positively correlated with anxiety symptoms, while heightened usage of adaptive ER strategies is negatively correlated with anxiety symptoms in individuals with ASD.

Same assumptions were extended to the context of depression resulting in the following hypothesis:

Hypothesis 3 (H3): Emotional (dys)regulation and the greater use of maladaptive ER strategies are positively correlated with depressive symptoms, while heightened usage of adaptive ER strategies is negatively correlated with depressive symptoms in individuals with ASD.

METHOD

From December 2022. to May 2023., a systematic search was conducted on the SCOPUS online database and Google Scholar using the keywords: “autism spectrum disorder”, “emotional regulation”, “anxiety”, “depression”, and “mental health”. Before defining more detailed criteria for inclusion in this review, the initial search resulted in a total of 573 publications. In this phase, the following inclusion criteria were applied:

- (1) Publications must contain the keywords in the title;
- (2) Publications must be in the English language;
- (3) Publications must be peer-reviewed and available in the searched databases.

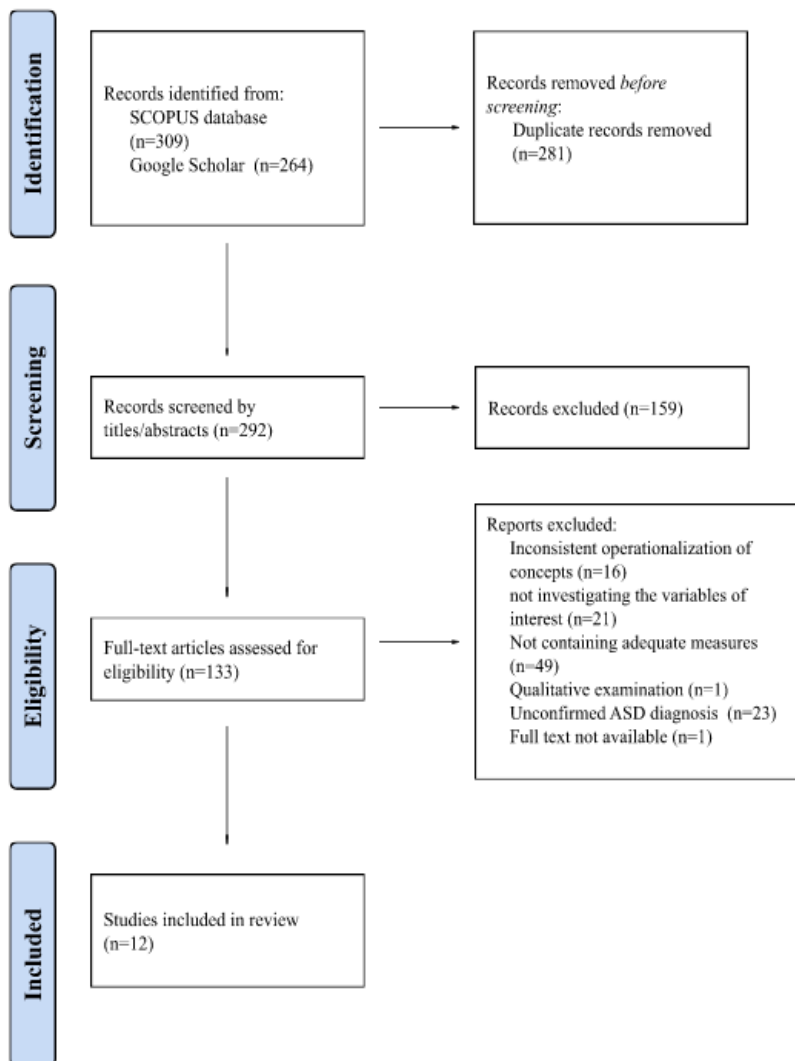
Considering that both ASD and ER are dynamic fields of research, a 10-year time frame was deemed appropriate for this study. This timeframe was selected to ensure the incorporation of the most pertinent and contemporary research findings in these domains. Deviating from this specific timeframe, either by extending or shortening it, would have resulted in an overwhelming or insufficient amount of relevant information. These considerations, alongside various other factors, influenced the establishment and application of the subsequent inclusion criteria for this current review:

- (1) Publications were limited to the timeframe spanning from December 2022. To May 2023. including the most recent research available within the searched online database;
- (2) The participants in the studies were diagnosed and/or had confirmed ASD diagnosis by the end of the research;

- (3) Participants in the publications included in this review possessed clinical diagnoses of anxiety or depression, exhibited scores exceeding clinical thresholds on questionnaires and assessment scales, self-reported the diagnosis, and/or were reported as such by their parents or caregivers;
- (4) The selected publications specifically incorporated measures related to ASD, ER, anxiety, and depression.

Following the application of the aforementioned criteria, a total of twelve (n=12) publications were selected for inclusion and subsequent analysis.

Figure 1. PRISMA Flow Diagram



RESULTS

Within the manuscript's ongoing sections, tables that include participant demographic characteristics and a thorough summary of included publications are provided. This summary encompasses details on the measurement instruments employed for assessing the variables of interest and offers insights into the outcomes observed.

Table 1. Demographic characteristics of the participants

<i>Authors</i>	<i>Participants (N)</i>	<i>Sex/gender</i>	<i>Age</i>	<i>Mean age</i>	<i>Race/ethnicity (n;%)</i>
1. Samson et al., 2014	N=43 (ASD n=21; TD n=22)	ASD male n=12 M, n=3 F; TD n=16 M, n=6 F	8-20 years old	ASD 12.71; TD 13.00	Caucasian 68.3%; Mexican 2.4%; Chinese 9.8%; Indian 4.9%; Southeast Asian 2.4%; other 7.3%; declined to answer 4.9%
2. Samson et al., 2015	N=59 (ASD n=31; TD n=28)	ASD n=27 M, n=4 F; TD n=21 M, n=7 F	8-20 years old	13.26	Caucasian 62.7%; Asian 20.3%; Hispanic 5.1%; African-American 1.7%; other ethnicities 10.2%
3. Bruggink et al., 2016	N=242 (ASD n=121; TD n=121)	ASD n=95 M, n=2 F; TD n=95 M, n=26 F	18-62 years old	34.87	N/A
4. Cai et al., 2017	N=61 (ASD only)	n=43 M, n=18 F	14-24 years old	18.18	N/A
5. Cai et al., 2018a	N=56 (ASD only)	30% F	14.42-24.66 years old	18.15	Caucasian 87,5% ; Asian 5,4% ; Aborigines 5,4%
6. Cai et al., 2018b	N=121(ASD only)	n=61 M, n=56 F, n=4 O	14-79 years old	32.18	N/A
7. Patel et al., 2018	N=47 (ASD n=25; TD n=22)	N/A	12-19 years old	15.40	N/A
8. Cai et al., 2019	N=44 (ASD n=24; TD n=20)	ASD n=16 M, n=8 F; TD n=10 M, n=10 F	ASD 17.48-65.3; TD 19.63-56.86	PSA 31.36; TD 35.45	Oceanian n=28; Asian n=5; Europeans n=7; North African and Middle Eastern n=1; Sub-

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						Saharan African n=1; People of the Americas n=1; declined to answer n=1
9. Sáez-Suanes et al., 2020a	N=121 (ASD only)	(ASD only)	n=81 M, n=40 F	18-62 years old	35.46	N/A
10. Conner et al., 2020	N=1107 (ASD only)	(ASD only)	n=881 M, n=226 F	6-17 years old	12.08	White race n=1020; Black race n=65; Asian race n=24; Native american n=23; Other n=45; Unknown n=4
11. Sáez-Suanes et al., 2020b	N=121 (ASD only)	(ASD only)	n=81 M, n=40 F	18-62 years old	35.46	N/A
12. Sáez-Suanes et al., 2022	N=121(ASD only)	(ASD only)	n=81 M, n=40 F	18-62 years old	35.46	N/A

Note. F = female; M = male; O = other (study authors reported a range of genders included as 'other' such as non-binary, genderfluid, transgender male, transgender female).

Table 2. Summary of publications included in the current review

Authors	Participants	Age and mean age (M)	Sex/gender	Dg	ASD measures
1. Samson et al., 2014	N=43 (ASD n=21; TD n=22)	8-20 years old (ASD 12.71; TD 13.00)	ASD n=18 M, n=3 F; TD n=16 M, n=6 F	ASD	Expert clinical evaluation (J.M.P. and A.Y.H.) - based on DSM-IV-TR); Autism Diagnostic Interview Revised (ADI-R); Autism Diagnostic Observation Schedule (ADOS)
2. Samson et al., 2015	N=59 (ASD n=31; TD n=28)	8-20 years old (13.26)	ASD n=27 M, n=4 F; TD n=21 M/n=7 F	ASD	Expert clinical evaluation based on DSM-IV-TR or DSM-5; Autism Diagnostic Interview Revised (ADI-R); Autism Diagnostic Observation Schedule (ADOS); Social

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					Responsiveness Scale (SRS); Revised Repetitive Behavior Scale (RBS-R);
3. Bruggink et al., 2016	N=242 (ASD n=121; TD n=121)	18-62 years old (34.87)	ASD n=95 M, n=26 F; TD n=95 M/n=26 F	ASD	Autism Diagnostic Interview Revised (ADI-R); NICE guidelines for autism in adults (NICE CG142)
4. Cai et al., 2017	N=61 (ASD only)	14-24 years old (18.18)	n=43 M, n=18F	ASD	Autism Spectrum Quotient Short (AQ-short)
5. Patel et al., 2017	N=47 (ASD n=25; TD n=22)	12-19 years old (15.40)	N/A	N/A	Clinical diagnosis of ASD according to the Diagnostic and Statistical Manual of Mental Disorders (4th edition; DSM-IV); Autism Diagnostic Interview Revised (ADI-R); Autism Diagnostic Observation Schedule (ADOS); Social Responsiveness Scale (SRS);
6. Cai et al., 2018a	N=56 (ASD only)	14.42-24.66 years old (18.15)	30% female sex/gender	ASD (n=19); Autism (n=2); Asperger's syndrome (n=25); HF Autism (n=9); PDD-NOS (n=1)	Autism Spectrum Quotient Short (AQ-short)
7. Cai et al., 2018b	N=121(samo PSA)	14-79 years old (32.18)	n=61/n=56; other n=4	ASD (n=34); Autism (n=3); Asperger's syndrome (n=71); HF Autism (n=11); PDD-NOS (n=1); N/A (n=1)	Autism Spectrum Quotient Short (AQ-short)
8. Cai et al., 2019	N=44 (ASD n=24; TD n=20)	ASD 17.48-65.3; TD 19.63-56.86 (ASD	ASD n=16 M,n=8 F; TD n=10 M, n=10 F	ASD (n=10); Asperger's syndrome (n=12); HF Autism	Autism Spectrum Quotient Short (AQ-short) Autism diagnostic observation schedule-2. edition (ADOS-2)

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				31.36; TD 35.45)			(n=1); PDD- NOS (n=1)	
9.	Sález-Suanes et al., 2020a	N=121 only)	(ASD	18-62 years old (35.46)	n=81 n=40 F	M,	ASD and ID (Mild ID n=19; Moderate ID n=38; Severe ID n=29; Profund ID n=25; ID not specified n=10)	Diagnostic Behavioral Assessment for Autism Spectrum Disorder Revised (DiBAS-R)
10.	Conner et al., 2020	N=1107 only)	(ASD	6-17 years old (12.08)	n=881 n=226 F	M,	ASD and ID (without ID n=460; Mild ID n=397; Severe ID n=188; N/A n=62)	Social Communication Questionnaire (SCQ); Social Responsiveness Scale, Second Edition (SRS-2)
11.	Sález-Suanes et al., 2020b	N=121 only)	(ASD	18-62 years old (35.46)	n=81 n=40 F	M,	ASD and ID (Mild ID n=19; Moderate IT n=38; Severe ID n=29; Profund ID n=25; ID not specified n=10)	Diagnostic Behavioral Assessment for Autism Spectrum Disorder Revised (DiBAS-R)
12.	Sález-Suanes et al., 2022	N=121 only)	(ASD	18-62 years old (35.46)	n=81 n=40 F	M,	ASD and ID (Mild IT n=19; Moderate ID n=38; Severe ID n=29; Profound ID n=25; N/A n=10)	Diagnostic Behavioral Assessment for Autism Spectrum Disorder Revised (DiBAS-R)

Table 3. Continuation of Table 2.

	ER measures	ER strategies (adaptive; maladaptive)			Anxiety and depression measures	Other measures	Outcomes
1.	Adapted Situational Reactivity and	cognitive reappraisal	/	/		Full Intelligence Quotient <i>The Kiddie</i> Scale	Less frequent use of adaptive ER strategies and more frequent use

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Regulation Task (ERT)				<i>Schedule for Affective Disorders and Schizophrenia</i> School-Age Children-Present and Lifetime Version (K-SADS-PL); The Stanford-Binet Intelligence Scales – Fifth Edition (SB-5)	of maladaptive strategies in ASD group
2. Emotion Regulation Questionnaire (ERQ)	cognitive reappraisal	expressive suppression	The <i>Child Behavior Checklist (CBCL)</i>	The Stanford-Binet Intelligence Scales – Fifth Edition (SB-5); <i>The Kiddie Schedule for Affective Disorders and Schizophrenia</i> School-Age Children-Present and Lifetime Version (K-SADS-PL); The Positive and Negative Affect Schedule (PANAS)	Individuals with ASD used fewer adaptive strategies but did not use more maladaptive ones
3. Cognitive Emotion Regulation Questionnaire (CERQ)	positive reappraisal, positive refocusing, refocus on planning, acceptance, putting into perspective	self-blame, rumination, catastrophizing, blaming others	Symptom Check List (SCL-90, subscales ‘Depression’ and ‘Anxiety’)	Negative life event questionnaire (NLE)	Individuals with ASD reported significantly more use of the maladaptive strategy of ‘blaming’ ; TD controls used ‘positive reappraisal’ more frequently
4. Emotion Regulation Questionnaire (ERQ)	cognitive reappraisal	expressive suppression	Diagnostic and Statistical Manual of Mental Disorders-5 Dimensional Anxiety Scale (DSM-5 DAS); Patient Health Questionnaire (PHQ-9)	Intolerance of Uncertainty Scale – 12 (IUS-12)	The ERQ ratio strongly correlated with anxiety and depression symptoms; cognitive reappraisal and expressive suppression were not related to anxiety symptoms; suppression was not associated with depressive symptoms
5. Anger Rumination Scale (ARS);	/	rumination	Mood and Feelings Questionnaire (SMFQ); Youth	Early Adolescent Temperament Questionnaire-Revised (EATQ-R)	The ASD group reported significantly more rumination

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				Self-Report Form (YSR)		compared to the TD group
6.	Emotion Regulation Questionnaire (ERQ)	cognitive reappraisal	expressive suppression	Diagnostic and Statistical Manual of Mental Disorders-5 Dimensional Scale of Generalized Anxiety Disorder (DSM-5 GAD-D); Patient Health Questionnaire (PHQ-9); Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)	/	HSLR cluster group participants had the most symptoms of anxiety and depression; greater use of expressive suppression was associated with higher levels of depression
7.	Emotion Regulation Questionnaire (ERQ)	cognitive reappraisal	expressive suppression	Patient Health Questionnaire (PHQ-9);	/	Cognitive reappraisal and suppression scores were significantly associated with depression scores; The HSLR group had higher depressive symptoms compared to the HSHR group
8.	Emotion Regulation Questionnaire (ERQ)	cognitive reappraisal	expressive suppression	DSM-5 Cross-cutting Dimensional Scale (DSM-5 CROSS-D); Patient Health Questionnaire (PHQ-9); Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)	Online survey-demographic data; Wechsler Abbreviated Scale of Intelligence - Second Edition (WASI-II)	Greater use of maladaptive strategies; anxiety symptomatology in correlation with ED;
9.	Emotional regulation checklist (ERC-scale lability)	Adaptive (specific strategies not listed)	Maladaptive (specific strategies not listed)	Autism Spectrum Disorders - Adult Comorbidity (ASD-CA); Anxiety Scale for Adults with ASD (ASA-ASD-I); Glasgow Depression Scale for People with Learning Disabilities (GSD-LD)	Children's Yale-Brown Obsessive-Compulsive Scale, Parent Report Format (CY-BOCS-PR); Dysexecutive Behavior Assessment Questionnaire (DEX); Intolerance of Uncertainty Scale - Parent Version (IUS-12-P)	ER impairments predicted anxiety levels and were strongly associated with anxiety;

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10.	Emotional Dysregulation Inventory (EDI)	Adaptive (specific strategies not listed)	Maladaptive (specific strategies not listed)	Parent Anxiety Scale-ASD (PRAS-ASD)	/	ER and ER strategies were good predictors of depression; depressive symptomatology was correlated with ED variables; maladaptive strategies positively correlated and adaptive strategies inversely related to depressive symptoms
11.	Emotional Regulation Checklist (ERC)	Adaptive (specific strategies not listed)	Maladaptive (specific strategies not listed)	Autism Spectrum Disorders - Adult Comorbidity (ASD-CA); Glasgow Depression Scale for People with Learning Disabilities - Caregiver Version (GDS-LD);	Dysexecutive Behavior Assessment Questionnaire for Dysexecutive Syndrome (DEX);	Self-blame, rumination, and catastrophizing correlated positively with anxiety and depression symptoms in ASD individuals; Positive refocusing and positive reappraisal were negatively related to depressive symptoms, but no links were found between cognitive reappraisal and depressive symptoms, or between positive refocusing, cognitive reappraisal, and anxiety symptoms.
12.	Emotional Regulation Checklist (ERC)	Adaptive (specific strategies not listed)	Maladaptive (specific strategies not listed)	Anxiety Scale for Adults with ASD (ASA-ASD-I);	/	Anxiety symptomatology is correlated with ED

Emotion regulation difficulties and the use of ER strategies

Using an adapted Reactivity Task, Samson et al. (2015) found that individuals with ASD exhibited reduced cognitive reappraisal and increased expressive suppression usage during emotionally engaging situations, with challenges noted in generating reappraisal strategies. Nonetheless, there were no statistically significant differences noted in the use the other

strategies. Differing from these findings, no significant differences between ASD and TD groups in cognitive reappraisal and expressive suppression were found by Samson et al. (2014). According to parental reports, individuals with ASD used cognitive reappraisal less but showed no significant differences in expressive suppression. Self-reports indicated that individuals with ASD used both cognitive reappraisal and expressive suppression less frequently, with no evidence of expressive suppression being more common than cognitive reappraisal. Additionally, Bruggink et al. (2016) noted differences in CERS in adults with ASD, with more frequent use of 'blaming others' in the ASD group and 'positive reappraisal' in the TD group. No significant differences were found in other strategies. Furthermore, Patel et al. (2017) explored rumination in individuals with ASD, discovering higher rumination frequency in adolescents with ASD, particularly related to anger and frustration. A small but significant correlation was observed between ASD symptoms and rumination across both ASD and TD groups, suggesting a link between ASD and rumination.

Correlation between ED, ER strategies and anxiety symptoms

Higher anxiety prevalence in individuals with ASD compared to TD individuals were noted and ER deficits were identified as a contributing factor to this comorbidity (Sáez-Suanes et al. 2020b). However, the precise relationship between anxiety and ASD remains uncertain due to various contributing factors (Sáez-Suanes et al., 2020b; Moss, Mandy, & Howlin, 2017). Pearson's correlation analysis revealed a relationship between ED and anxiety symptomatology ($r = .28$; $p = .00$). Thus, anxiety symptomatology was correlated with transdiagnostic ED variables. Moderation analyses by Conner et al., (2020) revealed a significant positive association between anxiety scores and increased EDI reactivity ($\beta = .36$, $p < .001$) and younger age ($\beta = -.09$, $p = .001$), without IT ($\beta = -.13$, $p < .001$). Moreover, ER impairment predicted clinical levels of anxiety even after controlling for ASD severity, suggesting that ER may play a role in anxiety development. However, the mean correlation between ER and PRAS-ASD suggested that these instruments do not measure the same construct and thus the authors suggest that, although this study was cross-sectional, impairment in ER could potentially serve as a mechanism or route for the emergence of anxiety. Similar to their previous work in 2020., Sáez-Suanes et al. (2022) found significant correlation between ED and anxiety symptoms ($r = 0.280$; $p = 0.002$), consistent with previous

research (Sáez-Suanes et al., 2022; Jenkinson et al., 2020; Joyce et al., 2017; Maisel et al., 2016). Moreover, a positive and significant correlation emerged between anxiety and ASD symptoms ($r=0.322$; $p=0.000$), as well as between ED and ASD symptoms ($r=0.521$; $p=0.000$). Maladaptive CERS, including avoidance, rumination, and self-blame, were identified as contributors to anxiety symptoms, with a gender moderation effect, particularly among females. Elevated levels of anxiety were found in those who reported increased expressive suppression use (Cai et al., 2017). The ERQ-R (ERQ-cognitive reappraisal) correlated moderately with DSM-5 DAS ($r = .390$, $p = .002$), but the ERQ ratio showed a stronger association with anxiety severity. In a cluster analysis, Cai et al. (2018a) categorized participants into four groups based on ER strategy use. The low suppressors and high reappraisers (LSHR) cluster reported the lowest anxiety symptoms, while the high suppressors and low reappraisers (HSLR) cluster had the highest anxiety symptoms. Authors Cai et al. (2019) adopted the widespread classification of ER strategies into adaptive cognitive reappraisal and maladaptive expressive suppression, as well as the transdiagnostic model of mental health problems (Cai et al., 2019; Lazarus and Alfert, 1964; Gross and Levenson, 1993). The cognitive reappraisal scores were negatively associated with ASD symptomatology and anxiety scores, while suppression scores were positively associated with anxiety. Authors Bruggink et al. (2016) investigated CERS in adults with ASD, finding higher anxiety scores in individuals with ASD ($M = 21.72$, $SD = 8.71$) compared to TD controls ($M = 13.21$, $SD = 5.44$) ($t = 8.4$, $p = 0.000$). Additionally, individuals with ASD reported more frequent use of the CERS strategy "blaming others" than TD individuals, while TD individuals reported greater use of 'cognitive reappraisal' than individuals with ASD. However, no significant differences were observed in other CERS strategies. The study revealed a significant positive correlation between the anxiety subscale and maladaptive CERS, including self-blame, rumination, catastrophizing, and blaming others.

Correlation between ED, ER strategies and depression symptoms

In the research by Cai et al. (2017), a depression incidence rate within the midrange of previously reported rates in adults with ASD, ranging from 15% to 70% was documented (Cai et al., 2017; Lainhart 1999; Hofvander et al., 2009; Mazzone et al., 2012; Lugnegard et al., 2011; Sterling et al., 2008). Female sex/gender individuals self-reported higher levels of

depression, aligning with general population findings indicating greater internalizing symptoms in female sex/gender (Cai et al., 2017; Gater et al., 1998; Hankin, 2009; McLean et al., 2011; Nolen-Hoeksema, 2000). However, no significant differences were found in ER strategy use. Correlation analysis revealed a moderate association between ERQ-R and PHQ-9 for depression ($r = -.393$, $p = .002$), with a strong correlation observed between the ERQ ratio and PHQ-9 ($r = .500$, $p = .000$). Individuals with ASD who preferred expressive suppression over cognitive reappraisal reported more pronounced depressive symptoms. In other study by Bruggink et al. (2016), individuals with ASD exhibited higher levels of depressive symptoms ($M = 38.73$, $SD = 13.46$) compared to TD controls ($M = 23.30$, $SD = 9.40$) ($t = 10.34$, $p = 0.000$). They also reported greater reliance on the maladaptive strategy 'blaming others' compared to the TD group, but no notable differences were observed in other ER strategy utilization. A positive correlation emerged between the depression subscale and maladaptive CERS. 'Catastrophizing' exhibited a stronger association with depression in the TD control group ($\beta = 0.50$, $p = 0.000$) compared to the ASD group. A significant negative correlation was identified between the depression subscale and the adaptive CERS 'positive refocusing'. The multiple regression analysis for depression unveiled a noteworthy interaction effect for maladaptive CERS but no significant interaction were observed between specific ER strategies and anxiety. In the research conducted by Cai et al. (2018a), among four identified clusters, the group with low suppression and high reappraisal (LSHR) showed the lowest depressive symptoms. Further analysis revealed that the HSLR (high suppressors and low reappraisers) group reported significantly higher self-reported depression levels ($U = 31$, $z = -2.20$, $p = 0.028$, $r = 0.45$) compared to the LSHR group. During the same year, Cai et al. (2018b) conducted research that was motivated by the recognition that ER impairments have been identified as contributing to emotional and behavioral challenges in individuals with ASD (Cai et al., 2018b; Weiss et al., 2014). Nearly half of the sample (43.8%) scored 10 or higher on the PHQ-9, indicating major depression (Cai et al., 2018b; Kroenke et al., 2001). The differences in ERQ - suppression ($t = 0.96$, $p = 0.341$) or ERQ - cognitive reappraisal ($t = -1.07$, $p = 0.289$) between male and female sex/gender were not significant. Correlation analyses unveiled significant relationships between ERQ-suppression and ERQ-cognitive reappraisal scores with PHQ-9 scores. Higher depression was associated with lower cognitive reappraisal scores and higher suppression scores, consistent with previous research in non-

ASD populations (Cai et al., 2018b, Campbell-Sills et al., 2006; Garnefski et al., 2001; Joormann and Gotlib, 2010). Emotion regulation emerged as a statistically significant predictor of depression ($\beta = .487$, $t = 6.051$; $p = .000$), with ER strategies also demonstrating predictive value (Sáez-Suanes et al., 2020a). Also, ER played a mediating role between ASD symptomatology and depression symptomatology, a relationship that was statistically significant ($F[1,119] = 15.174$, $p = .000$; $a2b2 = .108$, $SE = .030$, $[.053, .170]$). Specifically, the lability/negativity scale emerged as a significant mediating variable between ASD symptoms and depressive symptomatology ($F[3,119] = 18.715$, $p = .000$; $a3b3 = 0.064$, $SE = 0.025$, $[.020, .119]$). The results of independent samples Mann-Whitney U tests in the study by Patel et al. (2017) revealed statistically significant differences between the ASD group and the control TD group in terms of total scores related to rumination. Adolescents with ASD reported a higher frequency of rumination when compared to their TD peers. The effect sizes (r_s) for these comparisons ranged from 0.42 to 0.47, indicating medium to large effects. More specifically, it was observed that rumination exhibited a strong correlation with depressive symptoms. Cai et al. (2019) reported that expressive suppression scores were moderately positively associated with depression scores.

DISCUSSION

The review aimed to explore how ER affects anxiety and depression in people with ASD, focusing on three hypotheses from existing literature. Hypothesis 1 investigated ER differences between ASD and TD individuals. Results from three of the four studies supported this hypothesis, finding that individuals with ASD used maladaptive strategies more often and individuals with TD used more adaptive strategies such as positive reappraisal and cognitive reappraisal. The authors speculated that reduced emotional self-awareness and alexithymia may contribute to their difficulties in generating cognitive reappraisal strategies. Also, they stated that it's possible that insight into one's emotional functioning is not necessarily needed to use maladaptive ER strategies because using maladaptive strategies is not something that people consciously do. Furthermore, adolescents with ASD tended to be more ruminative than their TD peers, suggesting a link between ASD symptomatology and rumination characteristics. The growing literature and research on rumination raises questions about the very conceptualization of rumination. Rumination entails persistent, repetitive thoughts

centered around negative emotions or situations. It is an involuntary process that can be time-consuming and mentally taxing (Patel et al., 2017; Nolen-Hoeksema, 2000). One possibility is that rumination is an extension of the tendency to persevere, which is considered part of the core symptomatology of ASD, and previous studies of TD individuals have found that more ASD symptoms are associated with more rumination (Patel et al., 2017; Pugliese et al., 2015). In the Hypothesis 2, the studies highlighted the relationship between specific ER strategies and anxiety severity, with cognitive reappraisal showing a negative correlation with ASD symptoms and anxiety scores. Maladaptive CERS, like 'blaming others,' were linked to increased anxiety in ASD (Bruggink et al., 2016). In other research conducted by Cai et al. (2017), while sex/gender differences in anxiety levels were evident, no disparities in the use of these adaptive and maladaptive strategies were found. Furthermore, specific strategy effects on anxiety were inconclusive, except when the ERQ ratio was employed for correlation analysis, a strong link to anxiety symptom severity emerged. Overall, the analysis of these studies supported the second hypothesis of this review, confirming the relationship between ED, reliance on maladaptive ER strategies, and anxiety.

Similarly, Hypothesis 3 paralleled the anxiety findings with depression. Individuals with ASD relied more on expressive suppression than cognitive reappraisal and tended to exhibit more severe depressive symptoms. Maladaptive ER strategies emerged as significant predictors of depression. However, it's worth noting that Bruggink et al. (2016) didn't observe the correlation between expressive suppression and depression, which contrasts with the findings of Cai et al. (2018a) who reported significantly higher depression levels in the group favoring expressive suppression. The discrepancy in results may be attributed to the use of different measurement instruments to assess cognitive reappraisal. Specifically, Bruggink et al. (2016) employed the 4-item cognitive reappraisal subscale of the Cognitive Emotion Regulation Questionnaire (CERQ), while Cai et al. (2018a) used the 6-item cognitive reappraisal subscale of the Emotion Regulation Questionnaire (ERQ). These subscales vary in wording and focus, potentially contributing to the differing outcomes (for example, CERQ "I think that the situation also has its positive sides") is worded quite differently from the 6-item ERQ "When I want to feel positive emotions, I change the way I think about the situation"). Although the questioning is based on cognition, the purpose is to modify emotions, thus a lack of emotion-related expression was observed in the items used in the CERQ. Consistent findings emerged

from all the other studies. It's important to note that anger rumination, in the study conducted by Patel et al. (2017) was not exclusively linked to depression but rather showed its strongest association with a measure of dysregulation, which encompassed attention problems, anxiety and depression symptoms, and aggression. These findings further support the argument that a common underlying mechanism related to emotional regulation, specifically rumination in this case, may contribute to the intricate landscape of dysregulated emotions and behaviors frequently observed in individuals with ASD (Patel et al., 2017; Mazefsky et al., 2013; Weiss, 2014). Summarily, the analysis of results consistently supported the third hypothesis, emphasizing the influence of ED and ER strategies on depression. The central challenge appears to be the inflexible adherence to an inadequate selection of ER strategies.

Limitations

Future research should explore various mechanisms interconnected with ER (including executive functions, intolerance of uncertainty, overall emotional and cognitive functioning) and their mediating roles in both internalized and externalized behaviors. Moreover, this review was based on two intermediate classifications of ER strategies, which limited our findings. Forthcoming research should encompass the broader spectrum of ER strategy classifications to provide a more comprehensive perspective. While our analysis did not reveal significant disparities related to age as a variable, for more precise insights it's advisable to narrow the focus to specific chronological and life age groups. A similar emphasis on ASD diagnostics and comorbid conditions is warranted. Due to the limited number of studies exclusively involving individuals with ASD and without ID, this review did not restrict its scope solely to individuals with ASD without ID. The decision to include individuals with ID was made to encompass a broader range of symptomatology, characteristics, and manifestations of ASD, acknowledging the high prevalence of comorbid ID diagnoses among individuals with ASD. In the analysis of publications, no significant distinctions in ER components were observed between ASD only and those with ASD and ID. It's worth noting that studies that involved participants with ASD and ID often utilized adapted or alternative measures to assess ER, anxiety, and depression. Consequently, considerable efforts would be requisite to assemble a homogeneous sample that could furnish more nuanced insights. Lastly, longitudinal research holds promise in yielding the most reliable outcomes regarding potential

variations in ER, the employed strategies, and their impact on anxiety and depression across various chronological and life stages.

CONSLUSION

This review offers insight into the link between emotional regulation and mental health in individuals with ASD. It highlights the need for more precise assessments of overlapping conditions like anxiety and depression. Detecting these symptoms in individuals with ASD is challenging due to shared psychopathological symptoms. Acknowledging mental health's importance in this population is crucial, given the co-occurrence of psychopathological symptoms and underlying challenges. While emotional regulation issues, anxiety, and depression are not exclusive to ASD, their impact can be more pronounced due to specific neurodevelopmental deficits. The inflexible reliance on maladaptive ER strategies in individuals with ASD is strongly correlated with heightened anxiety and depression, exacerbating and predicting these conditions. Experts should consistently consider emotional regulation difficulties when diagnosing and treating anxiety and depression in ASD individuals. Recognizing the bidirectional relationship between emotional regulation, anxiety, and depression emphasizes the potential for interventions to improve emotional regulation and address these conditions, benefiting both domains simultaneously.

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