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EMPIRICAL RESEARCH

Emotion Regulation Strategies in Depressive and Anxiety Symptoms in Youth: A Meta-Analytic Review

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Abstract The role of emotion regulation in subclinical symptoms of mental disorders in adolescence is not yet well understood. This meta-analytic review examines the relationship between the habitual use of prominent adaptive emotion regulation strategies (cognitive reappraisal, problem solving, and acceptance) and maladaptive emotion regulation strategies (avoidance, suppression, and rumination) with depressive and anxiety symptoms in adolescence. Analyzing 68 effect sizes from 35 studies, we calculated overall outcomes across depressive and anxiety symptoms as well as psychopathology-specific outcomes. Age was examined as a continuous moderator via meta-regression models. The results from random effects analyses revealed that the habitual use of all emotion regulation strategies was significantly related to depressive and anxiety symptoms overall, with the adaptive emotion regulation strategies showing negative associations (i.e., less symptoms) with depressive and anxiety symptoms whereas the maladaptive emotion regulation strategies showed positive associations (i.e., more symptoms). A less frequent use of adaptive and a more frequent use of maladaptive emotion regulation strategies were associated with depressive and anxiety symptoms comparably in the respective directions. Regarding the psychopathology-specific outcomes, depressive and anxiety symptoms displayed similar patterns across emotion regulation strategies showing the strongest negative associations with acceptance, and strongest positive associations with avoidance and rumination. The findings underscore the relevance of adaptive and also maladaptive emotion regulation strategies in depressive and anxiety symptoms in youth, and highlight the need to further investigate the patterns of emotion regulation as a potential transdiagnostic factor.

Keywords Emotion regulation strategies · Meta-analysis · Adaptive · Maladaptive · Youth · Psychopathologies

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Introduction

Adolescence is a critical phase for the development of psychopathological symptoms up to full-blown mental disorders (Lee et al. 2014). During this time, individuals are prone to evolve a myriad of psychological problems and many mental disorders manifest for the first time (Casey et al. 2008; Lee et al. 2014; Paus et al. 2008; Spear 2000). Depressive and anxiety disorders rank among the most prevalent mental disorders in adolescence (Polanczyk et al. 2015). Depressive symptoms include sad, empty or irritable mood along with cognitive and somatic alterations which impact the individual's functioning as defined by the

Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association [APA] 2013). Anxiety symptoms may refer to excessive anxiety-related emotional and behavioral responses (e.g., avoidance) and related cognitive patterns (APA 2013). Subthreshold up to full-blown depressive and anxiety disorders in adolescence show a high comorbidity with other mental disorders, are predictive for the occurrence of mental disorders in adulthood (Bittner et al. 2007; Copeland et al. 2009; Fergusson et al. 2005; Wolitzky-Taylor et al. 2014), and pose precarious consequences for adaptive psychological development as well as social and academic adjustment (Beesdo et al. 2011; Fergusson and Woodward 2002; Thapar et al. 2012).

The developmental period of adolescence is characterized by endocrinological (e.g., hypothalamic-pituitary-adrenal axis), cognitive (e.g., working memory, decision making, perspective taking), and socio-emotional (e.g., higher sensitivity to social stressors) changes along with a more frequent and intense experience of negative emotions (de Veld et al. 2012; Spear 2009), which introduce numerous challenges into the individual's life. A heightened experience of negative emotions and stress is common; hence, adolescents may be at particular risk for dysfunctional emotion regulation (Ahmed et al. 2015). Emotion regulation can be defined as the processes involved in influencing which emotions we have, when we have them and how these emotions are experienced and expressed (Gross 1998).

Emotion regulation is closely intertwined with development and undergoes profound changes with the transition to adolescence (Eisenberg et al. 2010; Gross 2013; Thompson and Goodman 2010). While in early life, i.e., infancy and toddlerhood (0–2 years), emotion regulation is mainly characterized by extrinsic influences provided by the caregiver (Eisenberg et al. 2010; Stegge and Meerum Terwogt 2007; Thompson and Goodman 2010), with the transition through the preschool years (3–5 years) intrinsic processes gain importance, as well as social, interpersonal, and cultural factors (Riediger and Klipker 2014; Thompson and Goodman 2010). From middle childhood (6–12 years) onwards, neurological advances such as the development of executive functions facilitate a more profound awareness and management of emotions (Lane et al. 1990). With the transition to adolescence (13–18 years), these neurobiological achievements are reflected in the increasing use of cognitive and behavioral strategies (e.g., cognitive reappraisal, problem solving; Riediger and Klipker 2014; Thompson and Goodman 2010). During adolescence, cognitive processes that are crucial in emotion regulation, namely in the domain of high-level executive functions and social processes (e.g., working memory, inhibitory control, abstract thought, decision making and perspective taking), are subject to significant development (Blakemore and Robbins 2012; Dumontheil 2014; Somerville and Casey 2010).

Dysfunctional patterns in regulating emotional states play an important role in many psychopathologies (Gross et al. 2011; Gross 2013; Jazaieri et al. 2013) and problematic emotional patterns with regard to intensity, frequency, or regulation characterize many mental disorders such as affective and anxiety disorders as defined by the DSM-5 (APA 2013). Adaptive ways to regulate emotions are linked to academic success, better social functioning, psychological and physical well-being in adulthood (Gross 2013) as well as in childhood and adolescence (McLaughlin et al. 2011). As the majority of mental disorders manifest for the first time in adolescence (Paus et al. 2008), it may present a crucial developmental window and opportunity to foster functional emotion regulation (Ahmed et al. 2015; Stegge and Meerum Terwogt 2007). Strategies used to regulate emotions can be characterized on a dimension from maladaptive (i.e., associated with negative long-term outcomes) to adaptive (i.e., associated with beneficial long-term outcomes)[1] (Aldao et al. 2010). The goal of this meta-analytic review is to examine the relationship between the self-reported use of three prominent adaptive (cognitive reappraisal, problem solving, and acceptance) and three maladaptive (avoidance, suppression, rumination) emotion regulation strategies with depressive and anxiety symptoms in the pivotal stage of development in adolescence.

Emotion theories from ancient Greece (Aristotle, trans. 1941) to more modern approaches (Arnold 1960; Gross 1998; Lazarus 1966; Scherer 1984) have emphasized the role of cognitive appraisals in the generation of emotions. *Cognitive reappraisal* involves changing thoughts and beliefs about the meaning of a stimulus or situation and is generally seen as an adaptive emotion regulation strategy (e.g., Aldao et al. 2010). In youth samples, higher depressive and anxiety symptoms have been associated with a less frequent habitual use of cognitive reappraisal (Betts et al. 2009; Eastabrook et al. 2014; Lanteigne et al. 2014).

Problem solving can be understood as an emotion regulation strategy in that it involves cognitive and behavioral responses aimed at altering unfavorable circumstances that elicit undesired emotions (Frye and Goodman 2000). D'Zurilla et al. (2004) distinguish two components of

[1] Note, that the flexibility with and the context in which an emotion regulation strategy is used, influence their psychopathological outcome as well. The context may determine whether the use of an emotion regulation strategy is effective or even harmful, i.e., the use of a habitually used maladaptive emotion regulation strategy may be advantageous in the short term or a distinct situation, respectively. Relatedly, the use of an emotion regulation strategy that is assumed to be adaptive may be unsuccessful or harmful when used in a rigid manner or an inappropriate context (Aldao 2013).

problem solving as *meta-cognitive schemata* about one's ability to solve problems and available problem solving *skills*. Deficits in problem solving have been linked to depressive and anxiety symptoms in youth (Becker-Weidman et al. 2010; Siu and Shek 2010).

Acceptance of one's emotions is well described by "allowing one's reactions to proceed without resisting them in any way" (Werner and Gross 2010, p. 30). Empirical evidence supports the notion that accepting internal events is an adaptive way of handling emotions (Hayes and Lillis 2014; Werner and Gross 2010). Werner and Gross (2010) also note that when emotions are accepted, dysfunctional reactions, such as judging or suppressing negative emotions, may be less likely. In youth, a higher level of habitual acceptance has been associated with lower levels of depressive and anxiety symptoms (Weinberg and Klonsky 2009).

It has been suggested that a low acceptance of emotions makes avoidant patterns of emotion regulation more likely to occur (Hayes and Lillis 2014). *Avoidance* can be generally viewed as a maladaptive emotion regulation strategy that can be applied in different ways: (1) *experiential avoidance* refers to the avoidance of internal psychological events such as emotions themselves that is related to detrimental psychological outcomes (Hayes et al. 1996); (2) *behavioral expressions of avoidance* which include the avoidance of external stimuli or situations (Werner and Gross 2010). Mowrer's (1947) two-factor theory offers an understanding of the underlying mechanisms of avoidance: it posits that the avoidance of certain stimuli is acquired via classical conditioning and maintained via operant conditioning (Mowrer 1947). While avoidance may reduce negative emotions in the short-term (negative reinforcement), its psychological long-term costs outweigh its benefits as negative emotions such as anxiety persist (Werner and Gross 2010). In youth, the more frequent habitual use of avoidance has been associated with depressive and anxiety symptoms (e.g., Siu and Shek 2010).

Besides avoidance, *suppression* is an emotion regulation strategy with negative long-term consequences for mental health. Suppression has been conceptualized in different ways, either as (1) referring to the suppression of *emotional expressions* (i.e., expressive suppression) or as (2) the internal suppression of *emotional experiences and thoughts* (Gross and Thompson 2007). The habitual use of suppression has been associated with detrimental psychopathological outcomes such as depressive and anxiety symptoms in youth (Eastabrook et al. 2014; Penza-Clyve and Zeman 2002).

In contrast to avoidance and suppression, which usually aim at a dampened emotional experience, *rumination* involves repetitively focusing on emotional experiences and their causes and consequences (Nolen-Hoeksema et al. 2008). Rumination has been linked with internalizing psychopathologies such as depression and anxiety in adults (McLaughlin and Nolen-Hoeksema 2011). A meta-analysis in youth samples identified rumination as to be consistently linked to depressive symptoms in youth (Rood et al. 2009). Moreover it has been linked to anxiety symptoms in youth (McLaughlin et al. 2011; Nolen-Hoeksema et al. 2007).

The Present Meta-Analytic Review

Aims and Objectives

Previous meta-analytic reviews have examined mixed age groups (Aldao et al. 2010) or focused on distinct emotion regulation strategies in one specific psychopathology (Rood et al. 2009). The current study focuses on adolescence, taking into account several adaptive and maladaptive emotion regulation strategies in depressive and anxiety symptoms in that age group. More specifically, this meta-analytic review aims to examine whether there is (1) a significant relationship between the self-reported use of prominent adaptive (cognitive reappraisal, problem solving, and acceptance) and maladaptive (avoidance, suppression, and rumination) emotion regulation strategies with depressive and anxiety symptoms in adolescence (13–18 years). To address the issue of specific vs. transdiagnostic importance, calculations in this meta-analytic review will be done both on a psychopathology-specific and an overall-psychopathology level. This yields to answer the question if (2) the combined psychopathology outcome (depressive and anxiety symptoms) differs from the psychopathology-specific outcome (separate calculations for each symptom group). Additionally, we aim to (3) examine the moderating effect of participants' age on the relationships examined.

Selection of Informant/Measure

Since the 1990s, a variety of measures such as self-report measures, reports from parents and teachers, observational measures and experimental work have been used to examine emotion regulation and related constructs in youth (Adrian et al. 2011). In recent years, a growing body of experiments in youth samples has further enriched the field (e.g., Carthy et al. 2010; Hilt and Pollak 2012; Rood et al. 2012; Samson et al. 2015). However, a comprehensive methodological review by Adrian and colleagues (2011) identified self-report as the measure used most frequently since the 1990s in the examination of emotion regulation in adolescence (Adrian et al. 2011). As methodological homogeneity of the included studies is a necessary precondition for meta-analytic calculations (Borenstein et al. 2009), we chose to focus on self-report measures as the

basis of our analyses which is also in accordance with previous literature (Aldao et al. 2010; Rood et al. 2009).

In the preparation of this meta-analytic review we followed the guidelines of the PRISMA-statement for systematic reviews and meta-analyses (Moher et al. 2009).

Methods

Literature Search

Our systematic literature search was conducted using the data bases PsycINFO and Medline, additionally we used references provided by selected articles and looked for articles in Google Scholar. We searched for articles published between 1990 and 2015 as most of the widely used instruments were developed in this time period (Gratz and Roemer 2004; Gross and John 2003; Penza-Clyve and Zeman 2002). In the data bases, we used combinations of emotion regulation strategies and psychopathologies as well as the participants' age group across all fields. Our key words, of which we used truncated versions, were the following: (1) emotion, emotion regulation, emotion dysregulation, acceptance, awareness, avoidance, problem solving, reappraisal, rumination, suppression, (2) depression, anxiety[2] and (3) childhood, children, adolescence, adolescents, and youth. The search process was started on July 9, 2015 by the first and second author. Figure 1 contains detailed information about the literature selection process.

Study Selection and Data Extraction

To be included in the meta-analytic review, a study had to fulfill the following criteria: (0) It had to be published in English in a peer-reviewed journal. (1) It had to examine the relationship between at least one of the defined emotion regulation strategies and symptoms of at least one of the psychopathologies selected. As many studies examined both depressive and anxiety symptoms as well as different emotion regulation strategies, we defined each of these combinations as separate constructs (Aldao et al. 2010; Augustine and Hemenover 2009). Note, it may be assumed that clinical samples differ from non-clinical samples with regard to the habitual use of emotion regulation strategies (Aldao et al. 2010). Therefore, in the context of this meta-analysis we focused on non-clinical samples. (2) A validated measure of psychopathological symptoms was used; if clinically relevant symptoms were not assessed, we excluded the study. A few studies examined emotion regulation in the context of broadly defined problem categories such as *social problems* or used mixed symptoms scales such as internalizing scores. These studies were not taken into account as we aimed to investigate specific psychopathologies. (3) A validated measure of emotion regulation strategies was used. Moreover, if no specific emotion regulation strategy was examined, but rather a general index of emotional dysfunction was described, we excluded the study, as no conclusions on specific strategies were possible. (4) The age range of the study did not exceed 18 years and the mean age was ≥13 and ≤18 years. (5) The study provided sufficient statistical data for the effect size calculations, i.e., raw correlation coefficients or means, standard deviations and group sizes. We did not include regression coefficients as their use is problematic in meta-analytic procedures (Hunter and Schmidt 1990). If a study did not provide data in a form that could be used for the statistical analyses or other inclusion criteria were unclear, we contacted the study's authors. If the necessary information could not be obtained, we excluded the study.

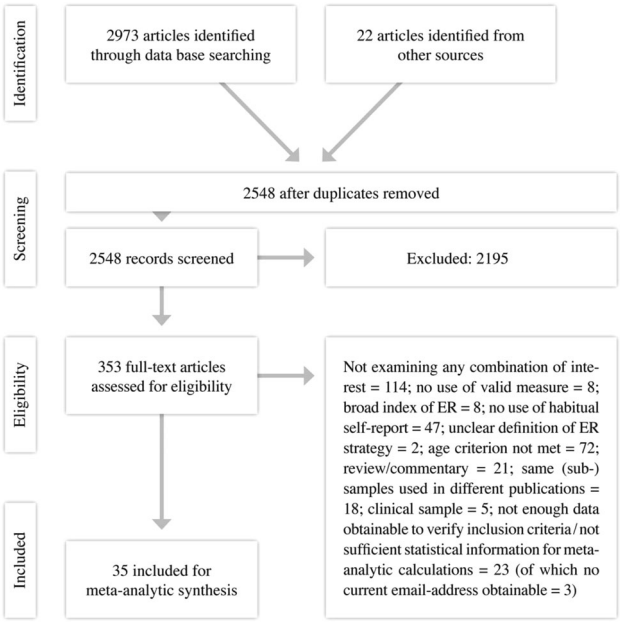

Fig. 1 PRISMA flow-diagram of the study selection process. *ER* emotion regulation

Coding Procedures

The first author and a master level research assistant coded the studies. Agreement between raters was very good, with kappa coefficients ranging from $\kappa = .91$ to $\kappa = 1$. For the dependent variables, we coded information on the emotion regulation strategies being examined (adaptive emotion

[2] In the initial search we also included eating disorder and borderline personality disorder symptoms which were not included for further analyses.

regulation strategies: cognitive reappraisal, problem solving, and acceptance; maladaptive emotion regulation strategies: avoidance, suppression, and rumination) and the symptom measures (depressive symptoms, anxiety symptoms). If a study provided several subscales for one strategy in one psychopathology, we averaged across subscales (if necessary we first computed *z*-scores in cases where the subscales used different measurement units). We reverse coded correlation coefficients so that higher coefficients would indicate an increased use of the strategy. The included studies and their characteristics are displayed in Table 1.

Data Analytic Plan

Calculation of Effect Sizes and Corrections

To achieve comparable effect sizes for analyses, we based our calculations on the effect size *r* (Borenstein et al. 2009). Effect size coefficients were either directly obtained from studies or first computed and transformed, respectively, where necessary (Lipsey and Wilson 2001). Correlation coefficients were then transformed to Fisher's *z*-values to avoid the problematic standard error formulation of *r*-values (Lipsey and Wilson 2001). Subsequently, we transformed the Fisher's *z*-values back to *r*-values to make their interpretation easier. According to Cohen's (1992) guidelines effect sizes of the *r*-metric should be interpreted as follows: small effect for $r \geq .10$, medium for $r \geq .30$, and large for $r \geq .50$.

Random Effects Models

Given the assumption that the effect sizes generated by the studies examined represent effects from an indefinite pool of effect sizes, we chose random-effects models. Hedges and Vevea (1998) note that random effects models with less than five effect sizes yield to results that are only approximate. Nonetheless, for many combinations of psychopathology and disorder, we found less than five effect sizes in the literature. We decided to still run the models, but we emphasize that their results must be interpreted with caution.

Moderator Analyses

Previous work identified certain emotion regulation strategies to be more strongly related to psychopathologies in older youth as compared to younger youth (rumination: Rood et al. 2009), and studies with mixed age groups found a stronger association for adults as compared to youth samples (suppression and problem solving: Aldao et al. 2010). Therefore, we modelled age as a continuous moderator variable via random effects meta-regression models. Due to the larger number of effect sizes for the overall outcomes (depressive and anxiety symptoms combined), we decided to run the meta-regression models for the overall, but not the psychopathology-specific outcomes, as it is recommended to include at least ten effect sizes per variable of interest in meta-regression (Higgins and Green 2011). We emphasize that the results must be interpreted with caution. As in small samples the *Q* statistic tends to underestimate an existing heterogeneity, we ran the analyses also in cases where *Q* was not significant as has been recommended (Rosenthal and DiMatteo 2001). The analyses were run using SPSS version 21 for Windows and the macros written by Lipsey and Wilson (2001).

Results

Overall and Psychopathology Specific Outcomes for Each Emotion Regulation Strategy

We calculated random effects models for the effect sizes for each emotion regulation strategy yielding an overall outcome across depressive and anxiety symptoms and a psychopathology-specific outcome, which will be presented in this order for each emotion regulation strategy. All six emotion regulation strategies were substantially associated with depressive and anxiety symptoms (see Table 2): Adaptive emotion regulation strategies were negatively associated with depressive and anxiety symptoms; cognitive reappraisal (overall outcome: $r = -.30$; $k = 10$; 95 % CI = [−.36; −.23]; depressive symptoms: $r = -.31$; $k = 7$; 95 % CI = [−.37; −.24]; anxiety symptoms: $r = -.29$; $k = 3$; 95 % CI = [−.47; −.09]); problem solving, (overall outcome: $r = -.34$; $k = 9$; 95 % CI = [−.44; −.24]; depressive symptoms: $r = -.34$; $k = 7$; 95 % CI = [−.46; −.21]; anxiety symptoms: $r = -.34$; $k = 2$; 95 % CI = [−.43; −.24]); acceptance, (overall outcome: $r = -.46$; $k = 4$; 95 % CI = [−.56; −.35]; depressive symptoms: $r = -.50$; $k = 2$; 95 % CI = [−.56; −.44]; anxiety symptoms: $r = -.42$; $k = 2$; 95 % CI = [−.60;−.19]). Maladaptive emotion regulation strategies were positively associated with psychopathologies such as avoidance (overall outcome: $r = .51$; $k = 6$; 95 % CI = [.42; .59]; depressive symptoms: $r = .55$; $k = 4$; 95 % CI = [.43; .65]; anxiety symptoms: $r = .43$; $k = 2$; 95 % CI = [.34; .52]), suppression (overall outcome: $r = .22$; $k = 14$; 95 % CI = [.15; .28]; depressive symptoms: $r = .22$; $k = 10$; 95 % CI = [.15; .30]; anxiety symptoms: $r = .21$; $k = 4$; 95 % CI = [.03; .38]), and rumination (overall outcome: $r = .50$; $k = 25$; 95 % CI = [.45; .54]; depressive symptoms: $r = .51$; $k = 18$; 95 % CI = [.44; .57]; anxiety symptoms: $r = .46$; $k = 7$; 95 % CI = [.41; .51]).

Table 1 Study characteristics of the studies included in the meta-analytic procedures

Authors	*N*	Sample type/age group	Psychopathology measures	Emotion regulation measures
Abela et al. (2009)	367	School sample (14.1y)	Depressive symptoms (CDI)	Rumination (CRSQ)
Auerbach et al. (2012)	151	School sample (15.1; 12–18y)	Anxiety symptoms (MASC)	Rumination (RSS)
Betts et al. (2009)	88	Study sample[a] (13.9; 12–16y)	Depressive symptoms (RADS-2)	Reappraisal; Suppression (ERQ)
Brenning and Braet (2013)	310	School sample (14.3; 11–18y)	Depressive symptoms (CDI)	Suppression (ERI)
Burwell and Shirk (2007)	168	School sample (13.6; 12–15y)	Depressive symptoms (CDI)	Rumination (RRS)
Connell et al. (2013)	59	Study sample[a] (13.7; 11–17y)	Depressive symptoms (CDI)	Reappraisal; Suppression (ERQ)
Dumont and Provost (1999)	297	School sample (15.6y)	Depressive symptoms (BDI)	Avoidance; Problem solving(Ways of Coping Questionnaire)
Eastabrook et al. (2014)	123	School sample (14.5; 13–16y)	Anxiety symptoms (SAS-A); Depressive symptoms (CDI)	Reappraisal; Suppression (ERQ)
Erdur-Baker (2009)	250	School sample (15.4; 13–18y)	Depressive symptoms (CDI)	Problem solving (PSI); Rumination (RDQ)
Frye and Goodman (2000)	75	School sample (13.2; 12–14y)	Depressive symptoms (BDI)	Avoidance; Problem solving (SPSI-R)
Hankin (2008)	350	School sample (14.5; 11–17y)	Anxiety symptoms (MASQ); Depressive symptoms (CDI)	Rumination (CRSQ)
Jose et al. (2012)	575	School sample (13–16y)	Anxiety symptoms (SAS-A)	Rumination (RSQ)
Kuyken et al. (2006)	326	School sample (15.3; 14–18y)	Depressive symptoms (BDI-II)	Rumination (RRS)
Lanteigne et al. (2014)	49	School sample (14.4; 12–17y)	Anxiety symptoms (SAS-A); Depressive symptoms (CDI)	Reappraisal; Suppression (ERQ)
Larsen et al. (2012)	1465	School sample (13.8y)	Depressive symptoms (CES-D)	Suppression (ERQ)
Lougheed and Hollenstein (2012)	177	Community Sample (13.6; 12–17y)	Anxiety symptoms (BAI); Depressive symptoms (BDI-II)	Reappraisal; Suppression (ERQ)
Marcotte et al. (1999)	306	School sample (15.3; 14–17y)	Depressive symptoms (BDI)	Problem solving (PSI)
Muris et al. (2009)	231	School sample (15.3; 12–18y)	Anxiety symptoms (RCADS); Depressive symptoms (RCADS)	Rumination (CRSS, RSQ)
Muris et al. (2004)	337	School sample (14.0; 12–17y)	Anxiety symptoms (SCARED); Depressive symptoms (CDI)	Rumination (CRSS)
Neumann et al. (2010)	870	School sample (14.3; 11–17y)	Anxiety symptoms (SCARED); Depressive symptoms (RADS-2)	Acceptance (DERS)
Nolen-Hoeksema et al. (2007)	496	School sample (13.5; 11–15y)	Depressive symptoms (SADS);	Rumination (RSQ)
Orue et al. (2014)	1170	School sample (13.4; 13–17y)	Anxiety symptoms (SAS-A); Depressive symptoms (CES)	Rumination (CRSS)
Özdemir et al. (2013)	413	School sample (15.7; 14–17y)	Depressive symptoms (BSI)	Problem solving (SPSI-R)
Papadakis et al. (2006)	223	School sample (14.5; 11–18y)	Depressive symptoms (CDI)	Rumination (RSQ)
Park et al. (2010)	166	Study sample[a] (13.0; 11–15y)	Depressive symptoms (CDI)	Suppression (STAXI)
Ruijten et al. (2011)	455	School sample (14.3; 12–18y)	Depressive symptoms (BDI-II)	Rumination (RRS)
Shapero et al. (2013)	216	Study sample[a] (14.0y)	Anxiety symptoms (MASC); Depressive symptoms (CDI)	Rumination (CRSQ)
Siu and Shek (2010)	235	School sample (13.2; 11–15y)	Anxiety symptoms (STAI); Depressive symptoms (BDI)	Avoidance; Problem solving (SPSI-R)
Skitch and Abela (2008)	161	School sample (15.2; 12–18y)	Depressive symptoms (CES-D)	Rumination (RSS)

Table 1 continued

Authors	*N*	Sample type/age group	Psychopathology measures	Emotion regulation measures
van der Veek et al. (2012)	617	School sample (14.1; 7–18y)	Anxiety symptoms (RCADS); Depressive symptoms (RCADS)	Suppression (EAQ)
Verstraeten et al. (2009)	304	School sample (14.3; 11–18y)	Depressive symptoms (BDI)	Rumination (CRSQ)
Weinberg and Klonsky (2009)	428	School sample (13–17y)	Anxiety symptoms (PHQ-A); Depressive symptoms (PHQ-A)	Acceptance (DERS)
Winkeljohn Black and Pössel (2013)	92	Study sample[a] (13.6; 13–15y)	Depressive symptoms (SBB-DES)	Rumination (RRS)
Winkeljohn Black and Pössel (2015)	462	School sample (16.0; 13–18y)	Depressive symptoms (CES-D)	Rumination (RRS)
Zhao and Zhao (2015)	504	School sample (16.9; 16–18y)	Depressive symptoms (CES-DC)	Reappraisal; Suppression (ERQ)

[a] Samples from studies with a wider scope; instruments used in our calculations

Abbreviations: BAI Beck Anxiety Inventory, *BDI (II)* Beck Depression Inventory (II), *BSI* Brief Symptom Inventory, *CDI* Child Depression Inventory, *CES-D(C)* Center for Epidemiological Studies-Depression Scale (for Children), *CRSQ* Children's Response Styles Questionnaire, *CRSS* Children's Response Style Scale, *DERS* Difficulties in Emotion Regulation Scale, *EAQ* Emotion Awareness Questionnaire, *ERI* Emotion Regulation Inventory, *ERQ* Emotion Regulation Questionnaire, *MASC* Multidimensional Anxiety Scale for Children, *MASQ* Mood and Anxiety Symptom Questionnaire, *PHQ-A* Patient Health Questionnaire-Adolescents, *PSI* Problem Solving Inventory, *RADS-2* Reynolds Adolescent Depression Scale 2nd Edition, *RCADS* Revised Child Anxiety and Depression Scale, *RDQ* Response to Depression Questionnaire, *RRS* Ruminative Responses Scale, *RSQ* Response Style Questionnaire, *RSS* Responses to Stress Scale, *SADS* Schedule for Affective Disorders and Schizophrenia, *SAS-A* Social Anxiety Scale for Adolescents (revised short form), *SBB-DES* Self-Report Questionnaire Depression, *SCARED* Screen for Child Anxiety Related Disorders, *SPSI-R* Social Problem Solving Inventory-Revised, *STAI* State-Trait Anxiety Inventory, *STAXI* State-Trait Anger Expression Inventory

Moderator Analyses across Depressive and Anxiety Symptoms Combined

We examined age as a continuous moderator variable for each combination of the overall psychopathology outcome (depressive and anxiety symptoms) with each emotion regulation strategy in meta-regression models, none of which reached significance.

Publication Bias

The publication bias or "file drawer problem" (Rosenthal 1979) describes the circumstance that studies providing non-significant results are less likely to be published. This is problematic in meta-analysis as it may lead to the over-estimation of an effect if null-results are not published, and thus not included in the analyses. We used the publication bias tool from Comprehensive Meta Analysis (Version 2; Borenstein et al. 2005) to assess publication bias in this meta-analytic review.

Among emotion regulation strategies and depressive and anxiety symptoms, the number of effect sizes varied substantially. To visualize this variety, we created a funnel plot with the included effect sizes for adaptive and maladaptive strategies separately. In the absence of publication bias, one would expect the effect sizes to be symmetrically distributed around the mean (Rothstein 2008). The shape of the scatterplot approximates a funnel for adaptive strategies, while for maladaptive emotion regulation strategies there are a few effect sizes outside the "cloud" (Figs. 2 and 3).

Due to the possible inaccuracy of visual inspection only, further analyses are recommended to check for publication bias. Classic fail safe *N* analyses (Rosenthal 1979) suggest that for each effect size observed in this review 154 effect sizes would be needed for the adaptive emotion regulation strategies and 686 effect sizes for the maladaptive emotion regulation strategies to nullify the observed effect. Orwin's (1983) fail safe *N* analyses indicate that there would have to be 61 effect sizes of 0 for the adaptive and 156 effect sizes of 0 for the maladaptive emotion regulation strategies to make the results we found non-significant. Rank correlations (Kendall's τ) for the effect sizes in our study (Begg and Mazumdar 1994) were not significant for either adaptive ($\tau_b = -.02$; $p = .45$) or maladaptive ($\tau_b = -.06$; $p = .29$) emotion regulation strategies. Accordingly, Trim and Fill analyses (Duval and Tweedie 2000) suggested that no studies were missing for either adaptive or maladaptive emotion regulation strategies. In conclusion, the risk for publication bias in this study can be considered low.

Table 2 The six emotion regulation strategies and their overall and psychopathology-specific outcome

ER strategy	Psychopathology	Mean ES	95 % CI		*p*-value	*k*	*Q* (*p*-value)
Adaptive							
Cognitive reappraisal	Overall	−.30	−.36	−.23	<.0001	10	ns
	Depressive symptoms	−.31	−.37	−.24	<.0001	7	ns
	Anxiety symptoms	−.29	−.47	−.09	<.01	3	<.05
Problem solving	Overall	−.34	−.44	−.24	<.0001	9	<.0001
	Depressive symptoms	−.34	−.46	−.21	<.0001	7	<.0001
	Anxiety symptoms	−.34	−.43	−.24	<.0001	2	ns
Acceptance	Overall	−.46	−.56	−.35	<.0001	4	<.01
	Depressive symptoms	−.50	−.56	−.44	<.0001	2	ns
	Anxiety symptoms	−.42	−.60	−.19	<.001	2	<.01
Maladaptive							
Avoidance	Overall	.51	.42	.59	<.0001	6	<.01
	Depressive symptoms	.55	.43	.65	<.0001	4	<.05
	Anxiety symptoms	.43	.34	.52	<.0001	2	ns
Suppression	Overall	.22	.15	.28	<.0001	14	<.001
	Depressive symptoms	.22	.15	.30	<.0001	10	<.01
	Anxiety symptoms	.21	.03	.38	<.05	4	<.01
Rumination	Overall	.50	.45	.54	<.0001	25	<.0001
	Depressive symptoms	.51	.44	.57	<.0001	18	<.0001
	Anxiety symptoms	.46	.41	.51	<.0001	7	<.05

Note: *k*=number of effect sizes

ER emotion regulation

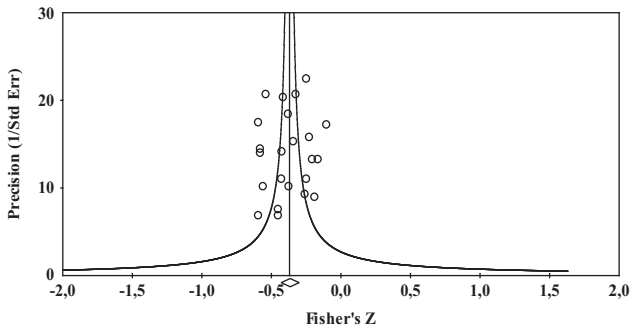

Fig. 2 Funnel plot of the effect sizes found for adaptive emotion regulation strategies ($n = 23$) in the meta-analytic review

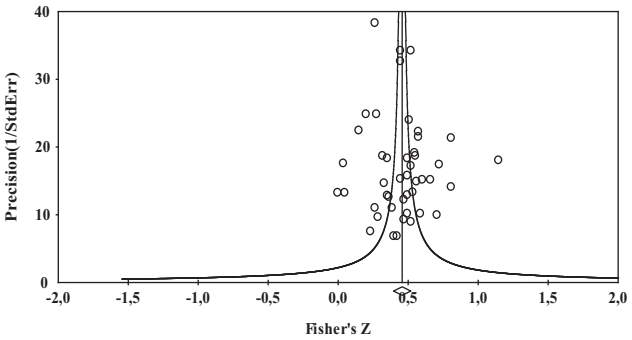

Fig. 3 Funnel plot of the effect sizes found for maladaptive emotion regulation strategies ($n = 45$) in the meta-analytic review

Discussion

Depressive and anxiety symptoms rank among the most prevalent psychopathological symptoms in adolescence and pose a critical threat to meeting central developmental demands in areas of psychological, social and academic functioning (Beesdo et al. 2011; Fergusson and Woodward 2002; Thapar et al. 2012). Thus, the importance of understanding the multifactorial processes underlying these symptom areas with respect to developmental aspects cannot be understated and may have fruitful implications for clinical prevention and intervention in adolescence (Ahmed et al. 2015). It is assumed that emotion regulation strategies may play a crucial role in depressive and anxiety symptoms in this age group (McLaughlin et al. 2011); however, their role currently remains not well understood. Therefore, the goal of this meta-analysis was to examine the relationship between depressive and anxiety symptoms with six prominent emotion regulation strategies in adolescence (adaptive emotion regulation strategies: cognitive reappraisal, problem solving, and acceptance and maladaptive emotion regulation strategies: avoidance, suppression, and rumination). Including 68 effect sizes from 35 studies, we found that all adaptive and maladaptive emotion regulation

strategies were significantly related with depressive and anxiety symptoms in adolescence. Thus, our findings indicate the importance of emotion regulation strategies in depressive and anxiety symptoms in this developmental period. Despite the significant findings, there were only few effect sizes available for many of the combinations examined and therefore, the results should be interpreted with great caution.

Our core findings are in line with the main findings of the meta-analysis by Aldao and colleagues (2010) in that the emotion regulation strategies considered to be helpful showed negative associations with depressive and anxiety symptoms and those considered to be harmful showed positive associations. This finding is meaningful as it suggests that the habitual use of emotion regulation strategies may have similar correlates across different age groups. Importantly, in this study we focused exclusively on adolescence (13–18 years), which allows us to draw more specific conclusions for this relevant developmental period. From a developmental perspective of psychopathology, we would like to argue that emotion regulation may play a uniquely important role in adolescence that can only be appropriately grasped on the background of the developmental factors that characterize adolescence, i.e., the profound and ongoing development of social-affective and neuro-cognitive processing along with changing social contexts (Blakemore and Robbins 2012; Crone and Dahl 2012; Somerville and Casey 2010). In adolescence, there is a heightened demand to regulate emotions as novel, more frequent, and more intense emotions increase with the transition from childhood to adolescence (Gilbert 2012). With the growing independence from parental support in emotion regulation, new autonomous ways of adequately responding to emotions need to be established in changing social and academic contexts (Casey et al. 2010). Moreover, emotion regulation strategies such as problem solving, reappraisal, and acceptance may require (1) cognitive maturity and cognitive skills that have not fully developed with the transition to adolescence and (2) the experience of the effectiveness of these strategies in responding to negative emotions (Hofmann et al. 2012). Adaptive emotion regulation strategies may be particularly protective against psychopathological symptoms as they may enable the individual to adequately cope with emotionally challenging situations that characterize adolescence (McLaughlin et al. 2011). In contrast, the habitual use of maladaptive emotion regulation strategies such as rumination and avoidance may result in prolonged and intensified experiences of negative emotions (Ehring and Watkins 2008; Gross and John 2003; Werner and Gross 2010).

In our analyses, an overall outcome across depressive and anxiety symptoms and a psychopathology-specific outcome were calculated. The results for both types of calculations will be discussed in the following paragraphs. In the domain of adaptive emotion regulation strategies, we found an effect size on the threshold of a medium effect for the negative association of cognitive reappraisal with the overall psychopathology outcome, and we found a medium effect size for depressive symptoms and a small effect almost reaching threshold for a medium effect size for anxiety symptoms. Our results indicate that the increased use of cognitive reappraisal may be beneficial with regard to depressive and anxiety symptoms in youth. This finding is particularly interesting as adolescence is a developmental period in which cognitive skills, namely executive functions and social cognition are not yet fully developed and cognitive strategies may be less accessible as compared to adulthood (Ahmed et al. 2015; Rood et al. 2012). Recent experimental work in non-clinical adolescents demonstrated that the instructed use of cognitive reappraisal helped in reducing negative emotions (Rood et al. 2012) and lowering levels of state rumination (Hilt and Pollak 2012). As cognitive reappraisal and rumination are both characterized as cognitive strategies, which primarily focus on cognitive content rather than behavioral or physical attempts, a potential link between these strategies may be worth examining. The negative association of habitual cognitive reappraisal and the intriguing results of recent experimental work in non-clinical and clinical populations (Carthy et al. 2010; Hilt and Pollak 2012; Rood et al. 2012; Samson et al. 2015) point to the need of future research to more fully understand the potential benefits of cognitive reappraisal.

Problem solving was related to depressive and anxiety symptoms with a medium effect size in the present meta-analytic review for the overall and the psychopathology-specific outcome, which indicates that problem solving may play an important role with regard to depressive and anxiety symptoms in adolescence. Problem solving in the context of emotion regulation often includes attempts to ameliorate social situations that induce negative emotions (D'Zurilla et al. 2004) and it requires a set of cognitive and behavioral skills, such as knowledge about how situations influence emotions and how they can be modified (Eisenberg et al. 2010; Zimmer-Gembeck and Skinner 2011). While especially younger children often consult their parents about feeling negatively (Thompson and Goodman 2010), a central developmental demand of adolescence is to learn how to adaptively cope with negative emotional events while parental support decreases (Steinberg and Avenevoli 2000). Therefore, it seems coherent that the use of problem solving is related to a lower level of depressive and anxiety symptoms as it may aide adolescents in coping with demanding emotional events. Future studies should aim at understanding the role of problem solving further and optimizing its use for youth.

Acceptance showed a medium effect size for the association with depressive and anxiety symptoms in the present

meta-analytic review (both for the overall and the psychopathology-specific outcome). Adolescents experience heightened emotional reactivity and stress, which may put them at risk for dysfunctional regulation attempts (Ahmed et al. 2015; Gilbert 2012; McLaughlin et al. 2011). Using acceptance could provide the individual with the experience that negative emotions are tolerable and transient, which may be helpful in regulating emotions (Singer and Dobson 2007). However, from the small number of effect sizes available in our analyses, no conclusive results can be drawn. As acceptance is closely related to the construct of mindfulness, future research may be advanced by examining acceptance in the context of mindfulness (Hilt and Pollak 2012). In conclusion, more work is needed to better understand acceptance's putatively helpful role in adolescent emotion regulation (Braet et al. 2014).

As we laid out in the introduction, it has been postulated that acceptance of emotions makes avoidant responses less likely (Werner and Gross 2010). In this meta-analytic review, we found a large effect size for the overall and the depressive symptoms outcome and a medium effect size for anxiety symptoms, which suggests that the more frequent use of avoidance may be associated with more depressive and anxiety symptoms. Again, due to the small number of effect sizes for this emotion regulation strategy, the results have to be interpreted with great caution. Both experiential and behavioral ways of avoidance are assumed to play an important role in the etiology and maintenance of psychopathologies (Werner and Gross 2010). Therefore, regulating emotions with avoidance may be obstructive as it may prevent the habituation of negative emotions (through which negative emotions would decrease over time) as well as positive corrective experiences and self-efficacy in dealing with negative emotions, respectively (Werner and Gross 2010). To better understand the possible differential ways in which experiential and behavioral expressions of avoidance are associated with depressive and anxiety symptoms in adolescence, both types of avoidance and their role in adolescent psychopathology will have to be further examined. Moreover, it should be explored how emotion regulation strategies such as acceptance and avoidance interact or may counteract each other as still relatively little is known about how emotion regulation strategies may influence one another (Aldao 2013).

Suppression showed a small effect size for the overall and the psychopathology-specific outcome. It is assumed that older children (from about 10 years of age) have developed a relatively complete understanding of expressive suppression in social contexts (e.g., smiling at a present one is disappointed with) and are able to intentionally apply this emotion regulation strategy (Stegge and Meerum Terwogt 2007). The effect of suppressing inner emotions and cognitions seems to be of relevance to psychopathological symptoms as it may lead to paradoxical effects and heightened or maintained negative emotions (Gaskell et al. 2001). In future studies it would be worthwhile to examine the subtypes of suppression (i.e., suppression of expression of emotion vs. suppression of emotional or cognitive content/experience) and their possibly differential role in youth depressive and anxiety symptoms.

For rumination, we found an effect size on the threshold to large for the overall psychopathology outcome, a large effect size for the relationship with depressive symptoms, and a medium effect size for anxiety symptoms. These findings corroborate the importance of rumination in depressive and anxiety symptoms in adolescence and point to the need to fully understand the role of rumination in the etiology and maintenance of psychopathological symptoms. Rumination is one of the few emotion regulation strategies that has been examined in a longitudinal approach (McLaughlin et al. 2011; Nolen-Hoeksema et al. 2007) and has been shown to be predictive of future depressive symptoms in youth (for a meta-analysis see Rood et al. 2009). Furthermore, it has been postulated that rumination may be linked to other maladaptive patterns of emotion regulation that may include behaviors related to symptom areas such as disordered eating and substance abuse (Nolen-Hoeksema et al. 2007). On this background, rumination appears as a critically important emotion regulation strategy with relation to psychopathological outcomes. As we mentioned above, rumination and cognitive reappraisal are both characterized as cognitive strategies. Future research may benefit from exploring not only a potential link between these emotion regulation strategies, but also a potential benefit of using reappraisal trainings to help reduce rumination.

We included age as a continuous moderator in our overall psychopathology outcome analyses. As meta-regression should ideally be run with ten effect sizes or more, we decided not to run meta-regression models for the depressive and anxiety symptoms separately as the number of effect sizes was too small. None of the meta-regression models we ran across both depressive and anxiety symptoms was significant, which may be noteworthy. In our view, several reasons may account for these findings. First, as for some emotion regulation strategies (i.e., acceptance and avoidance) there were few effect sizes available, the results of meta-regression may lack reliability. Second, as we looked particularly at adolescence, effects that occur with maturing from childhood into adolescence or adolescence to adulthood, respectively, may not manifest in our results. For instance Rood and colleagues (2009) found rumination to be more strongly related with depressive symptoms in older youth as compared to child samples below the age of 12. However, Aldao and colleagues (2010) did not find a significant moderating effect for rumination

between adult and youth samples. It could be that, for instance, rumination as a cognitive emotion regulation strategy is less used by younger youths, but develops a more consistent relationship with depressive and anxiety symptoms over time. This would fit with the assumption that the use of emotion regulation strategies may become more consistent with increasing age (Abela et al. 2002; Abela et al. 2004).

Implications and Future Directions

One of the main implications of this meta-analytic review may be that the use of adaptive emotion regulation strategies seems helpful as they are negatively associated with psychopathologies. Adaptive emotion regulation strategies may be protective against psychopathological symptoms as they enable the individual to adequately cope with emotionally challenging situations which are frequent in adolescence (McLaughlin et al. 2011). Therefore, adolescence may constitute a critical time period to boost the use of the adaptive emotion regulation strategies. In additional analyses, we computed an outcome for all adaptive emotion regulation strategies as well as all maladaptive emotion regulation strategies combined. We found that in a combined score both adaptive ($r = -.35$) and maladaptive ($r = .42$) emotion regulation strategies were related to depressive and anxiety symptoms with a medium effect size, a finding corroborated by recent studies in youth samples (Braet et al. 2014). Critically, our results suggest that adaptive emotion regulation strategies may be comparably important as maladaptive emotion regulation strategies in adolescence. In this respect, our results differ from those by Aldao and colleagues (2010) who found maladaptive emotion regulation strategies to be more strongly related to psychopathological symptoms than adaptive emotion regulation strategies in a meta-analysis mainly focusing on adults.

In order to yield a more profound understanding of the multifactorial processes underlying emotion regulation and depressive and anxiety symptoms in adolescence, we propose that it will be vital to simultaneously model developmental aspects, namely neurocognitive, emotional, social and physical factors, that may likely influence the relationship between emotion regulation strategies and depressive and anxiety symptoms (Ahmed et al. 2015). Future research will benefit from including these factors in longitudinal, multi-method, and experimental approaches that enable the examination of multiple factors and causal relationships. Evidence suggests that there may be a causal link from emotion regulation to the occurrence of psychopathological symptoms in adolescence. One meta-analysis by Rood and colleagues (2009) found that rumination was predictive of depressive symptoms in youth; McLaughlin and colleagues (2011) showed in a structural equation model approach that emotion regulation strategies (e.g., rumination) at Time 1 predicted the occurrence of psychopathological symptoms at Time 2; however psychopathological symptoms (including depressive and anxiety symptoms) at Time 1 did not predict emotion regulation strategies at Time 2. These findings preliminarily indicate a potentially causal role of emotion regulation in the etiology of psychopathological symptoms in youth that should be further explored in future research by including a broader range of psychopathological symptoms and emotion regulation strategies.

Further, it may also be promising to explore if emotion regulation strategies are best understood as distinct from each other or if emotion regulation strategies are better described on a continuum that takes into account potential interactions of strategies. In this line of thought, multi-level analyses should be used to be able to examine the role of different emotion regulation strategies in different areas of psychopathological symptoms at the same time (Aldao and Nolen-Hoeksema 2010) to expand on the "univariate" approach of the present meta-analytic review (Aldao and Nolen-Hoeksema 2010).

Beyond that, our findings may suggest a transdiagnostic importance of distinct emotion regulation strategies with regard to depressive and anxiety symptoms. In future studies, it will be important to compare different diagnostic groups to examine transdiagnostic aspects of emotion regulation strategies. With a better understanding of the differential importance of emotion regulation strategies in adolescence, future programs may be tailored to the individual needs of youth. Based on the data presented in this meta-analysis, such programs may likely benefit from both the enhancement of adaptive and the reduction of maladaptive emotion regulation strategies.

Limitations of the Literature

A substantial limitation of the literature consists in the varying degree to which different emotion regulation strategies have been examined to date. This results in an asymmetry of effect sizes that may restrict the generalizability of the effects. While for instance a large body of studies examined rumination in anxiety and depressive symptoms ($n = 25$), only few effect sizes were available for other strategies such as acceptance ($n = 4$). We used random effects models, however, to increase the generalizability and yield more conservative results. Future research should try to address this asymmetry to come to more compelling conclusions regarding the role distinct emotion regulation strategies play in these psychopathologies in adolescence. However, for those emotion regulation strategies with only few effect sizes, future analyses with a larger number of

effect sizes may yield more precise and reliable results. Future research may also benefit from examining the differential impact of emotion regulation strategies at different developmental stages (e.g., pre-adolescence, during adolescence, post-adolescence) in relation to further possible moderators. While age may be seen as a proxy for developmental stages, other factors such as emotional understanding and awareness and specific aspects of cognitive processing such as the ability to use imagery (Burnett Heyes et al. 2013), as well as IQ and social factors may further add to the understanding of the mechanisms at work.

Limitations of the Meta-Analytic Review

To provide a methodologically homogenous body of studies, we included only self-report data as they systematically vary from other informant data. Self-report measures bear distinct advantages and disadvantages: They are economic in use, usually provide data on the experience of an individual over time, and are considered an adequate instrument for youth (Betts et al. 2009). At the same time, there are systematic as well as non-systematic influences on self-report data. Response tendencies and social desirability may influence the data as well as current mood states and (meta-)cognitive factors (Zeman et al. 2007). These factors can limit the validity of self-report data and should not be neglected. Social, parental, and peer influences are assumed to have a critical impact on the development of adaptive and maladaptive emotion regulation in youth (Brennan et al. 2002; Buckholdt et al. 2014; Eisenberg et al. 2010; Han and Shaffer 2013) and information from such studies is not included here. Thus, the analyses of self-report data only may restrict the generalizability of our findings. It will be pivotal for future meta-analytical work to combine the information of diverse informants (parents, teachers, and peers) and explore their possible moderating effects on the examined relationships. Further, for many of the examined relationships, significant heterogeneity of the included studies needs to be assumed as indicated by significant Q-statistics. Due to the small number of effect sizes, however, these could not be adequately followed up by moderator analyses.

An additional concern lies in a possible item overlap between clinical assessment measures and emotion regulation assessment instruments (Aldao et al. 2010). In this regard, items that measure affective facets of psychopathologies may overlap with items intended to measure emotion regulation. A methodological solution could be item and factor analyses to better distinguish between constructs (Aldao et al. 2010). In this review, we focused on non-clinical samples as they are assumed to differ from clinical samples to ensure comparability between samples and due to a very small number of studies conducted in clinical samples so far. However, this sample composition may have led to an underestimation of the strength of effect sizes as it is likely that clinical samples show stronger effects (as in Aldao et al. 2010) than non-clinical populations. Future studies should also include clinical samples to yield precise conclusions for clinical populations.

Conclusion

This meta-analytic review aimed to examine the association between six emotion regulation strategies and depressive and anxiety symptoms in adolescence. We found empirical support for the link between emotion regulation strategies and depressive and anxiety symptoms in adolescence, as all emotion regulation strategies were significantly related to depressive and anxiety symptoms. Moreover, we found that both the less frequent use of *adaptive* emotion regulation strategies and the more frequent use of *maladaptive* emotion regulation strategies were both important for psychopathological outcomes. Furthermore, our results suggest that it will be fruitful to examine specific emotion regulation strategies in their potential transdiagnostic role in depressive and anxiety symptoms. Our results underline the possible benefit of focusing on emotion regulation strategies in psychological treatment programs in youth, particularly to aim at decreasing the use of maladaptive and increasing the use of adaptive emotion regulation strategies. It will be of particular interest to examine how emotion regulation strategies can be strengthened for this age group.

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Authors' Contributions JS conceived of the study, conducted the literature search and the meta-analytic calculations and wrote the manuscript; EN conceived of the study, conducted the literature search and the meta-analytic calculations and wrote the manuscript; EAH conceived of the study, interpreted the data and wrote the manuscript; BTC conceived of the study, interpreted the data and wrote the manuscript; ACS conceived of the study, interpreted the data and wrote the manuscript. All authors read and approved the manuscript.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no competing interests.

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