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Review

The relevance of cognitive emotion regulation to psychotic symptoms – A systematic review and meta-analysis

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HIGHLIGHTS

- Emotion regulation (ER) is markedly impaired in patients with psychotic disorders.
- Maladaptive ER is more frequently and adaptive ER less frequently used.
- Maladaptive but not adaptive ER strategies are associated with severity of positive symptoms.
- No differences are evident in experimental studies, in which patients were instructed to use ER strategies.

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ABSTRACT

Numerous studies emphasise the pivotal role of negative affect in the formation and maintenance of positive symptoms, which moves emotion regulation (ER) as a contributing factor into focus. We systematically reviewed and meta-analysed case-control studies reporting cross-sectional, correlative and experimental data of ER strategies in patients with psychotic disorders. In total, 42 studies were eligible, providing data for 2498 subjects and 3381 healthy controls. Questionnaire-based cross-sectional data (k = 39) indicated strongest effects for rumination (g = -0,67 [-0,85 to -0,48]), self-blaming (g = -0,56; [-0,76 to -0,37]) and distraction (g = 0,55 [0,11 to 0,98]). Suppression was more frequently (g = -0,36 [-0,56 to -0,16]) and cognitive reappraisal less frequently used (g = 0,41 [0,28 to 0,55]), but heterogeneity was high. Correlative data (k = 6) supported the assumption of an association between maladaptive strategies and positive symptoms (r = 0,34 [0,22 to 0,44]). Less evidence of group differences was found in the experimental studies (k = 3). The findings support the notion that ER is markedly impaired in patients with psychotic disorders. However, future research will need to further clarify the extent to which difficulties continue to exist after controlling for context and emotion intensity. The large effects for rumination and self-blaming point to promising treatment targets but also raise questions concerning the specifity of findings.

1. Introduction

Current psychological conceptualisations of psychosis emphasise the relevance of negative affect, an umbrella term used for affective states and discrete emotions such as fear, shame, guilt and anger, to delusion formation and maintenance (Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001; Kuipers et al., 2006; Preti & Cella, 2010). For example, within the cognitive model of positive symptoms, Garety et al. (2001) assume negative affect along with cognitive biases to contribute to a delusional interpretation of anomalous or ambiguous experiences. Similarly, in Preti and Cella's heuristical approach, negative affect is ascribed a key role in emphasising the threatening value of neutral stimuli and thus increasing the likelihood of paranoid interpretations (Preti & Cella, 2010).

Numerous studies using a variety of research designs corroborate the relevance of negative affect in the formation, maintenance and exacerbation of delusions: Epidemiological studies point to high comorbidity rates with affective and anxiety disorders (50% for anxiety and 38% for depression) (Braga, Reynolds, & Siris, 2013; Buckley, Miller, Lehrer, & Castle, 2009). Longitudinal studies confirm negative affect, and particularly anxiety (Garety et al., 2005), to be a predecessor of subsequent delusions (Fowler et al., 2012; Freeman et al., 2012;

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Kramer et al., 2014; Lincoln, Marin, & Jaya, 2017). Experimental studies find anxiety to mediate the impact of stress on paranoia (Lincoln, Peter, Schäfer, & Moritz, 2009). Finally, the suggested prediction of psychotic symptoms through negative affect is also confirmed by studies applying the experience sampling method (ESM) (Ben-Zeev, Ellington, Swendsen, & Granholm, 2011; Delespaul, deVries, & van Os, 2002; Hartley, Haddock, Sa, Emsley, & Barrowclough, 2014; Thewissen et al., 2011).

Given the crucial role of negative affect for symptom formation, it is intuitive to presume that patients with psychosis show particular difficulties in regulating negative affect. Emotion regulation (ER) is defined as *"extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals"* (Thompson, 1994). Gross and Thompson's (2007) process model constitutes one of the most widely used frameworks, in which the various strategies are allocated in terms of their primary impact on the emotion-generative process (Gross, 1998; Gross & Thompson, 2007). Together with other frameworks (e.g. Koole, 2009), this model has guided the research in the field that has focused on investigating the distinct strategies proposed by Gross, including reappraisal, suppression and distraction (Bloch, Moran, & Kring, 2010; Webb, Miles, & Sheeran, 2012). Over time, researchers have postulated additional strategies. For example, Berking's model of adaptive ER, which describes ER as the interplay of nine different skills, includes the ability to accept one's emotions (Berking & Whitley, 2014), whereas other researchers have proposed a more fine-grained range of cognitive strategies, including those frequently found in clinical disorders, such as rumination and self-blaming (Garnefski, Kraaij, & Spinhoven, 2001). Thus, investigating ER involves taking into account the wide range of different strategies assumed to be relevant.

Cross-sectional research of ER strategies based on self-report data in patients with psychosis was aggregated by O'Driscoll, Laing, and Mason (2014). Their comprehensive meta-analysis covered the research conducted by May 2014 and included case-control studies, focusing on ER strategies as well as on broad constructs of emotional processes, such as alexithymia and dissociation. In line with the expectation that psychosis is associated with problems in ER, they found that less adaptive strategies, such as suppression, distraction and rumination are more frequently employed by patients with psychosis than by healthy controls, whereas the more adaptive strategy cognitive reappraisal is less frequently used. However, a basic literature research of the relevant search terms reveals an exponential growth, with a major increase of publications particularly in the last three years (e.g. more studies have been published in this realm between 2014 and 2017 than in all years before). Also, despite the thorough approach taken in this previous meta-analysis, several questions remain unanswered. For one, not all the relevant strategies included in recent conceptualisations of ER were covered. For example, the analysis did not include studies investigating acceptance and self-blaming, although these have been studied in psychosis in several recent studies (Lincoln, Hartmann, Köther, & Moritz, 2015a; Rowland et al., 2013a; Rowland et al., 2013). Furthermore, the available literature at that point was not sufficient to analyse the association between positive symptoms and the deployment of ER strategies. Additionally, the focus on self-report questionnaires is inevitably restricted to the analysis of how frequently people think they use certain ER strategies or as how effective they perceive the strategies to be, whereas in experimental designs participants are typically asked to either down- or up-regulate induced negative emotions, which provides insight into the actual success of using certain strategies. An updated review and meta-analysis of the constantly growing body of research in this field that also addresses these remaining research questions is likely to advance our understanding of which aspects of ER are associated with psychosis.

Whilst setting the rationale of this review, we were cognisant of the substantive definitional ambiguity of ER which is also reflected by the variety of measures employed (Bloch et al., 2010). The lacking consensus primarily concerns the distinction of *emotion regulation* and *coping*. The considerable overlap between these constructs becomes apparent by comparing the definition of ER by Thompson (1994, pp. 27-28)*"… processes responsible for monitoring, evaluating, and modifying emotional reactions… to accomplish one's goals"* (Thompson, 1994) to a prototypical definition of coping by Lazarus and Folkman (1984, p. 141) that defines coping as the "*…constantly changing cognitive and behavioural efforts to manage specific external and/or internal demands that are appraised as taxing.*" (Lazarus & Folkman, 1984). Moreover, Folkman et al. (1986, p. 993) describe "*two widely recognized major functions [of coping]: regulating stressful emotions… and altering the troubled person-environment relation causing the distress*" (Folkman et al., 1986). Gross' attempts to solve this definitional problem by confining coping to negative emotions and longer periods (e.g. bereavement) (Gross & Thompson, 2007). Another possible solution is to distinguish between regulating the emotion itself (ER) versus regulating the underlying features, such as the situation which triggered the emotion (coping) (Thompson & Calkins, 1996). Garnefski et al. (2001, p. 1313) narrow the concept down even further by focusing on the cognitive component of ER and defining cognitive ER as *"the cognitive way of managing the intake of emotionally arousing information"* rather than the emotion-eliciting situation (Garnefski et al., 2001). We used this conceptualisation as a framework of our meta-analysis as it is (1) viable and broad enough to provide a representative overview of the existing literature within the field of psychosis research but (2) narrow enough to allow for a substantive interpretation of the data.

This review aims to meta-analyse and evaluate the existing literature in regard to (1) cross-sectional differences between patients with psychosis and healthy controls in the habitual deployment of cognitive ER strategies, expanding the existing meta-analysis by further strategies, such as acceptance, (2) the association between the extent of positive symptoms and the frequency of the various ER strategies, and (3) the differences in the success of various ER strategies after affect induction within experimental designs in patients with psychosis versus healthy controls.

2. Method

2.1. Search method for inclusion of studies

The analysis was conducted in line with the PRISMA guidelines (Moher et al., 2009). Relevant studies were identified by searching the databases PubMed, PsycINFO and MEDLINE, covering the time period until January 2018. Search terms were selected as in O'Driscoll et al., 2014 by compiling keywords into 1) psychosis related terms (psychosis [Title] OR delusion[Title] OR schizophrenia[Title]), 2) ER and related terms and 3) ER and coping scales (see supplementary data). Reference lists from related meta-analyses and primary studies were reviewed to complete the literature research. We did not seek unpublished data.

2.2. Selection of studies

Articles were considered relevant if they were (1) published in English and described (2) cross-sectional, correlational or experimental data of (3) ER strategies in (4) patients diagnosed with schizophrenia spectrum disorders compared to (5) healthy controls (studies that used pre-existing normative data as a control group were excluded) and (6) provided sufficient data for calculating effect sizes. Data from experimental research designs was included in the analyses if the study a) involved a controlled comparison of strategy versus non-strategy use in response to the induction of negative affect through emotion eliciting stimuli, and b) had included a self-report measure of negative affect following these manipulations. Thus, studies investigating only the neural (e.g. event-related potentials) or behavioural correlates (e.g. eye-movement) of ER were not included. Studies were reviewed for eligibility by the first author and checked by a second rater. In case of

multiple publications from the same study, we selected the one with the fullest description given. If different aspects and analyses based on the same data set were presented, we treated these as coming from one primary study. Any questions and discrepancies among the raters concerning the eligibility of a study were resolved in consensus between the first and the third author. A flow diagram of the systematic review outlining frequencies of reasons for exclusion can be found in the Appendix (A).

2.3. Quality appraisal

Methodological quality was assessed using an adaptation of the Newcastle-Ottawa Quality Assessment Scale for case-control studies (Wells et al., 2011) (supplementary data). Data was extracted and evaluated for quality independently by two raters.

2.4. Assessment of risk of bias

We assessed low, high or unclear risk of bias regarding selection bias, confounders and measurement bias following the classification scheme used by O'Driscoll et al. (2014), which is based on the Cochrane Collaboration's tool for assessing risk of bias (Higgins et al., 2011) (supplementary data). Two raters coded the risk of bias independently and any disagreements were resolved by another author. Funnel plots were produced and checked for asymmetry.

2.5. Analysis of questionnaire-based data

Self-reported questionnaire-based data from relevant subscales on ER was extracted and compiled into the following ER strategies: *cognitive reappraisal, acceptance, awareness, managing emotions, suppression, rumination, distraction* and *self-blaming.*Table 1 provides a description of the inventories considered and indicates the specific subscale used. Group contrasts were presented throughout in the primary studies. Means and standard deviations were extracted to calculate standardised mean differences (SMD; Hedges' *g*). As an approximate guide we interpreted effect sizes as small (0,2), moderate (0,5) and large (0,8) (Cohen, 1992). We used a random-effect model since studies differ in various ways (e.g. patient population) and we did not assume them to share a common effect size. We estimated the between-study variance with DerSimonian-Laird (DL) method and reported a 95% confidence interval to address the uncertainty in the estimate. Additionally, we calculated the I^2 statistic to estimate the percentage of observed variation in effect size due to variation in true effects and interpreted the I^2 statistic in terms of low (25%), moderate (50%) and high (75%) inconsistency (Higgins, Thompson, Deeks, & Altman, 2003). In order to combine correlational data between ER strategies and positive symptoms, we used the Fisher's Z-transformation and then back transformed the Fisher's Z coefficients to raw correlation coefficients (Borenstein, Hedges, Higgins, & Rothstein, 2009). Because the low number of primary studies for this question prevented the effect integration for the individual strategies, we compiled the strategies into adaptive and maladaptive strategies following a commonly used distinction made on the basis of their associated immediate behavioural, affective and cognitive effects (for an overview see Aldao & Nolen-Hoeksema, 2012). To avoid violation of the assumption of independence in those cases, in which multiple effect sizes from one study were available for the adaptive or maladaptive category (e.g. a study reporting on rumination as well as suppression, which were both classified as maladaptive strategies), we formed the composite effect size by averaging the dependent effect sizes.

2.6. Analysis of data extracted from experimental study designs

For each study providing self-report data from experimental studies, we described the design and the ER strategies with which participants were asked to down-regulate these emotions. Where available we also described the neurophysiological indicators (e.g. EEG, fMRT) of ER (Appendix B). In line with the primary studies, we operationalised success of ER as a reduction of self-reported negative affect after the use of an instructed strategy compared to the control condition. We computed the difference in standardised mean change for pretest-posttest control group designs (Morris, 2008). Mean change scores were calculated for each group by dividing the difference in self-reported negative affect between the control (viewing) and experimental condition by the standard deviation of the control condition. We then calculated the difference in mean change between patient and healthy control groups. This type of effect size for experimental data indicates how much larger (or smaller) the reduction of negative affect in the patient group was when compared to the healthy control group. In keeping with the procedure chosen for self-report data, we integrated effect sizes in cases where more than one study reported on the same instructed ER strategy applied to the same valence of emotion-eliciting stimuli.

Statistical analyses were carried out in R (Version 3.4.3) using the meta-analysis package metafor (Version 2.0-0).

3. Results

In total, 42 studies (of which 22 were not included in the meta-analysis by O'Driscoll et al., 2014) fulfilled the inclusion criteria, providing data for 2498 subjects (mean age 39,40; range 20-62 years) and 3381 healthy controls (mean age 40,34; range 22-63 years). Thirty-nine studies investigated habitual ER, using a range of different self-report questionnaires in a cross-sectional design. Eight of those studies provided additional correlative data on the association between the extent of positive symptoms and the frequency of ER strategies in the patient sample. In the remaining three studies, experimental paradigms were used. Among those, two studies additionally used standardised self-report questionnaires investigating habitual ER. Individual study characteristics are listed in the main table (Appendix B).

3.1. Quality and risk of bias

The quality of the studies ranged from 4-10 on the adapted Newcastle-Ottawa Quality Assessment Scale (with possible maximum score of 10) (supplementary data). The median score was 8 (IQR 7-9). As can be seen in Fig. 1, the criteria receiving the lowest ratings were the matching of subjects and controls as well as the definition of controls. Assessment of risk of bias indicated low levels of potential bias overall (Fig. 1). Individual quality and risk of bias scores are listed in the study characteristics (Appendix B). We visually inspected funnel plots. Overall, publication bias was not evident (supplementary data).

3.2. Measuring instruments

Table 1 depicts the measures and the subscales considered for the effect integration and their associated psychometric properties, as well as a description of the construct assessed by the respective measure. The Emotion Regulation Questionnaire (ERQ (Gross & John, 2003)), a measure of reappraisal and suppression, and the Mayer-Salovey-Caruso Emotion Intelligence Test (MSCEIT (Mayer, Salovey, & Caruso, 2002)), a measure of Emotional Intelligence, were the most frequently used inventories (Table 1). Although emotional intelligence is a different construct, we included studies using the MSCEIT, because it is found to be closely related to ER and leading researchers in the field thus advocate an integration of both constructs (Peña-Sarrionandia, Mikolajczak, & Gross, 2015). Only the subscale *managing emotions* from the MSCEIT was considered for the effect integration. It constitutes one of four components of emotional processing and is measured on the basis of vignettes describing various situations with possible ways of dealing with the depicted emotions.

Table 1
Psychometric properties of measures used in the meta-analysis.

Inventory	Authors	Construct being assessed	Description	Subscales	Subscales considered within meta-analysis	Psychometric properties	Studies from review
CERQ (cognitive emotion regulation questionnaire)	(Garnefski et al., 2001)	Cognitive ER strategies	9 subscales, 36 items in total, 5-point Likert scale	Self-blame, acceptance, rumination, positive refocusing, refocus on planning, positive reappraisal, putting into perspective, catastrophizing, blaming others	Self-blame (=self-blaming), acceptance, rumination, positive reappraisal (=cognitive reappraisal)	Cronbach's alpha ranged from α = .66-.81, test-retest-reliability (5-month) ranging between r_{tt} = 0.41-0.63 factor analysis supported the 9-factor structure[a]	(Rowland, Hamilton, Lino, et al., 2013; Rowland, Hamilton, Vella, et al., 2013)
CISS (coping inventory for stressful situations)	(Endler & Parker, 1990)	Reactions to difficult, stressful, or upsetting situations	3 subscales, 48 items, 5-point Likert scale	Task-focused coping, avoidance-focused coping, emotion-focused coping	Task-focused coping (=cognitive reappraisal)	Cronbach's alpha ranging from α = .82-.90 factor analysis supported the 3-factor structure (Cosway, Endler, Sadler, & Deary, 2000)	(Allott et al., 2015; Ponizovsky, Grinshpoon, Sasson, & Levav, 2004; Ponizovsky, 2013; Ritsner et al., 2006)
CRI (coping response inventory)	(Moos, 1993)	Approach and avoidance coping responses	8 subscales, 48 items, 4-point Likert scale	Logical analysis, positive reappraisal, seeking guidance and support, problem solving, cognitive avoidance, acceptance or resignation, seeking alternative rewards, emotional discharge	Positive reappraisal (=cognitive reappraisal)	Cronbach's alpha ranging from α = 0.58-0.74[b]	(Ventura, Nuechterlein, Subotnik, Green, & Gitlin, 2004)
CSI (coping strategies inventory)	(Tobin, Holroyd, Reynolds, & Wigal, 1989)	Subjects are asked to describe a specific stressful event; indication of the extent to which they used specific coping strategies	8 subscales, 72 items[c], 5-point Likert scale	Problem solving, cognitive restructuring, social support, express emotions, problem avoidance, wishful thinking, social withdrawal, self-criticism	Cognitive restructuring (=cognitive reappraisal), self-criticism (=self-blaming)	Cronbach's alpha ranging from α = 0.71-.94, Test-retest reliability ranging from r_{tt} = .67-.83	(Marquez-Arrico, Benaiges, & Adan, 2015)
CSQ (coping style questionnaire)	(Wang, Wang, & Ma, 1999)	Coping styles	6 subscales, 62 items	Problem solving, self-blame, help seeking, fantasy, avoidance, rationalization	Self-blame (=self-blaming), Avoidance (=suppression)	Test-retest reliability ranging from r_{tt} = 0.63-0.73[b]	(Xu et al., 2013)
ECQ2 (emotional control questionnaire)	(Roger & Najarian, 1989)	Responses to emotional arousal	4 subscales, 56 items, dichotomous format (true/false)	Labeled rehearsal, emotional inhibition, aggression control, and benign control	Labeled rehearsal (=rumination), emotional inhibition (=suppression)	Kuder-Richardson reliability ranging from r_{tt} = 0.77-.86, Test-retest reliability (7-week) ranging from r_{tt} = 0.73-0.92, factor analysis supported the 4-factor structure	(Suslow, Roestel, Ohrmann, & Arolt, 2003)
ERQ (emotion regulation questionnaire)	(Gross & John, 2003)	Habitual use of reappraisal and suppression	2 subscales, 10 items, 7-point Likert scale	Reappraisal, suppression	Reappraisal (=cognitive reappraisal), suppression	Cronbach's alpha for reappraisal ranging from α =.75-.82; for suppression ranging from α =.68-.76 Test-retest reliability r_{tt} =.69 for both scales; factor analysis supported the 2-factor structure	(Badcock, Paulik, & Maybery, 2011; Grezellschak et al., 2016, 2015; Henry, Rendell, Green, McDonald, & O'Donnell, 2008; Horan, Hajcak, Wynn, & Green, 2013; Kimhy et al., 2012; Kimhy et al., 2016; Livingstone et al., 2009; Perry, Henry, & Grisham, 2011; Van der Meer et al., 2014; Van der Meer & Aleman, 2009; Zou, Y. min, Ni, K., Yang, Z. ya, Li, Y., Cai, X. lu, Xie, D. jie, … Chan, R. C. K., 2017)
ERSQ-ES (emotion-specific emotion regulation skill questionnaire)	(Ebert, Christ, & Berking, 2013)	Adaptive ER skills separately for specific emotions	27 items, 5-point Likert scale	Awareness, clarity, sensations, understanding, acceptance, tolerance, self-support, readiness to confront distressing situations, modification	Acceptance, awareness	Cronbach's alpha ranging between α = .70-.97[d] test-retest reliability r_{tt} = .41-.70	(Lincoln et al., 2015a; Lincoln et al., 2015b)

(*continued on next page*)

Table 1 (*continued*)

Inventory	Authors	Construct being assessed	Description	Subscales	Subscales considered within meta-analysis	Psychometric properties	Studies from review
MAX (maladaptive and adaptive coping style questionnaire)	(Moritz et al., 2016)	Maladaptive and adaptive coping styles	3 dimensional structure, 21 items, 4-point Likert scale	Adaptive coping, maladaptive coping, avoidance coping	Suppression[e]	Cronbach's alpha for adaptive coping subscale α = .87, maladaptive subscale α = .85, avoidance subscale α = .65; test-retest reliability ranging from r_{tt} = .59-.75, factor analysis supported 3-dimensional structure	(Moritz et al., 2016)
MSCEIT (mayer-salovey-caruso emotional intelligence test)	(Mayer, Salovey, Caruso, & Sitarenios, 2003)	Emotional intelligence, assessed via vignettes describing possible ways of dealing with depicted emotions	4 branches; each with 2 subtasks, in total 141 items	Perceiving emotions, using emotions to facilitate thoughts, understanding emotions, managing emotions (a. emotion management = actions characters may engage in to change their emotional states; b. emotional relations = actions characters may engage in to change others emotional states)	Managing emotions	Full-test split-half reliability r = .93, the four branch scores range between r = .76-.91, factor analysis supported the 4-factor structure	(Cicero, Klaunig, Trask, & Neis, 2016; Dawson, Kettler, Burton, & Galletly, 2012; Fan et al., 2013; Frajo-Apor, Pardeller, Kemmler, Welte, & Hofer, 2016; Green et al., 2012; Kee et al., 2009; Kern et al., 2011; Kimhy et al., 2012; Lee et al., 2013; Pietrzak et al., 2009; Rajji et al., 2013; Tso, Grove, & Taylor, 2010)
RRS (ruminative response scale)	(Treynor, Gonzalez, & Nolen-Hoeksema, 2003)	Rumination	2 subscales, 10 items, 4-point scale	Reflection, brooding	Total score (= rumination)	Cronbach's alpha for reflection subscale α = .72, brooding subscale α = .77, test-retest reliability for reflection subscale r_{tt} = .60, brooding subscale r_{tt} = .62	(Badcock et al., 2011; Vorontsova, Garety, & Freeman, 2013)
RSQ (response style questionnaire)	(Nolen-Hoeksema & Morrow, 1991)	Responses to negative moods	2 subscales, 71 items, 4-point scale	Distraction subscale, rumination subscale	Rumination subscale	Cronbach's alpha for rumination subscale α = .89, distraction subscale α = .80	(Siegle, Condray, Thase, Keshavan, & Steinhauer, 2010)
STAXI (state-trait-anger expression inventory)	(Spielberger, 1988)	Trait anger and anger expression	4 subscales, 4-point scale	Trait anger, anger-in, anger-out, anger-control	Anger-in (= suppression)	Cronbach's α = .90[b]	(Ille et al., 2010)
TCQ (thought control questionnaire)	(Wells & Davies, 1994)	Strategies used to control unpleasant or unwanted thoughts	5 subscales, 30 items, 4-point Likert scale	Distraction, social control, worry, punishment, reappraisal	Punishment (= self-blaming), reappraisal (= cognitive reappraisal), distraction	Cronbach's alpha ranging from α = 0.64-0.79, Test-retest reliability, total score r_{tt} = 0.83	(Morrison & Wells, 2000)
TMMS (trait meta-mood scale)	(Salovey, Mayer, Goldman, Turvey, & Palfai, 1995)	Perceived emotional intelligence	3 subscales, 30 items, 5-point Likert scale	Attention, clarity, mood repair	Mood repair (= cognitive reappraisal)	Cronbach's alpha ranging from α = 0.82-.87, factor analysis supported the 3-factor structure	(Tabak et al., 2015)

[a] If not otherwise specified, psychometric properties have been derived from original study cited in the column "authors".
[b] Psychometric properties have been derived from the reviewed article cited in the column "studies from review".
[c] Spanish version used by Marquez-Arrico et al. (2015) contains 41 items.
[d] Clinical sample.
[e] Unpublished data retrieved from the authors of the study for the subscale "suppression" – consisting of three items (cognitive as well as expressive suppression).

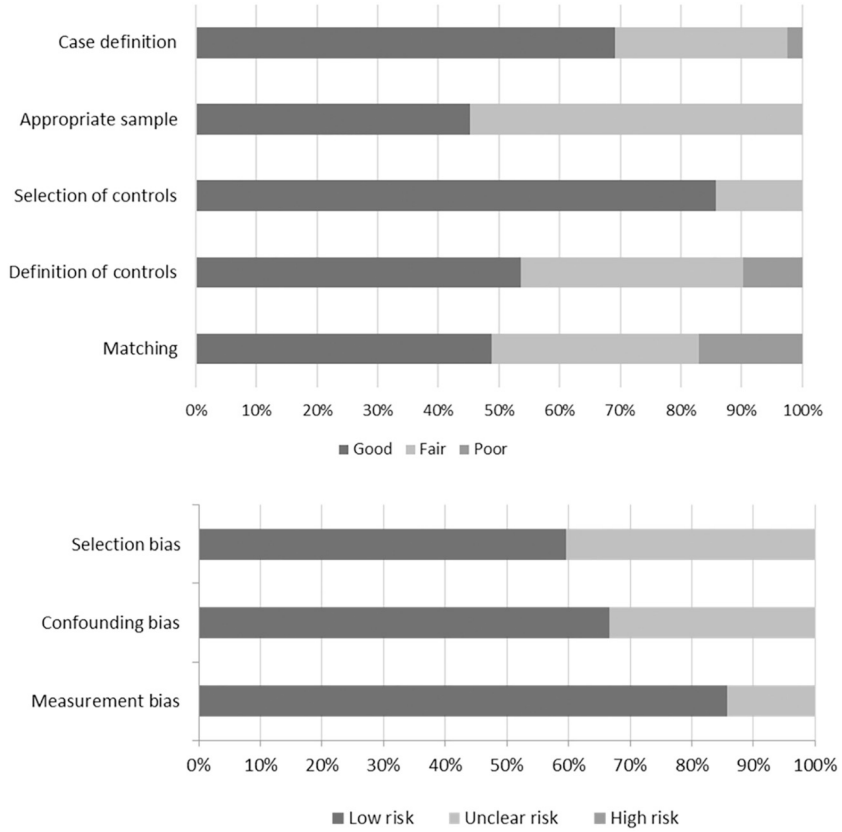

Fig. 1. Quality appraisal by modified Newcastle-Ottawa Quality Assessment Scale and Risk of bias based on Cochrane Collaboration's tool for assessing risk of bias, author's rating of each quality item across all included studies.

3.3. Questionnaire-based cross-sectional data

The 39 studies reporting on habitual ER provided data for six common ER strategies which were reported on in at least two different primary studies (suppression, rumination, self-blaming, distraction, cognitive reappraisal and acceptance), and for managing emotions as measured by the MSCEIT. The mean effect sizes for the comparison between patients with psychosis and healthy controls were significant for all but one strategy (acceptance).

3.3.1. Suppression

The mean effect size for suppression was small to moderate with g = -0,36 (95% CI; -0,56 to -0,16, k = 16), indicating that patients with psychosis report to habitually use suppression to a larger extent than healthy controls (Fig. 2). There was high heterogeneity (I^2 = 72,25%).

3.3.2. Rumination

The mean effect size for rumination was moderate to large with g = -0,67 (95% CI; -0,85 to -0,48, k = 6), indicating that patients with psychosis habitually used rumination to a larger extent than healthy controls (Fig. 2).

3.3.3. Self-blaming

The mean effect size for self-blaming was moderate with g = -0,56 (95% CI; -0,76 to -0,37, k = 4), indicating that patients with psychosis habitually used self-blaming to a larger extent than healthy controls (Fig. 2).

3.3.4. Distraction

The mean effect size for distraction was moderate with g = 0,55 (95% CI; 0,11 to 0,98, k = 2), indicating that patients with psychosis habitually used distraction to a lesser extent than healthy controls (Fig. 3).

3.3.5. Cognitive reappraisal

The mean effect size for cognitive reappraisal was small to moderate with g = 0,41 (95% CI; 0,28 to 0,55, k = 22), indicating that participants with psychosis habitually used cognitive reappraisal to a lesser extent than healthy controls (Fig. 3). There was moderate to high heterogeneity (I^2 = 58,74%).

3.3.6. Acceptance

The mean effect size for acceptance was non-significant with g = 0,30 (95% CI; -0,54 to 1,14, k = 3) (Fig. 3). There was high heterogeneity (I^2 = 91,48%), with inconsistent directions of the effect sizes in the original studies in this subgroup analysis.

3.3.7. Managing emotions

The mean effect size for managing emotions was large with g = 0,93 (95% CI; 0,75 to 1,11, k = 12), indicating that participants with psychosis described more difficulties in managing emotions than healthy controls (Fig. 3). There was moderate heterogeneity (I^2 = 56,32%).

3.4. Questionnaire-based correlational data

Six studies reported on the association between the extent of positive symptoms and the frequency of adaptive ER strategies (including cognitive reappraisal, acceptance and awareness) within the psychosis samples. Overall, these yielded a non-significant mean effect size of r = -0,16 (95% CI; -0,37 to 0,06, k = 6) (Fig. 4). There was moderate to high heterogeneity (I^2 = 62,98%). Whilst the majority of studies provided data on positive symptoms in general, Grezellschak, Jansen, and Westermann (2016) reported on the association with paranoia as one specific positive symptom (Grezellschak et al., 2016). Removal of this study resulted in a smaller, and also non-significant effect of r = - 0,11

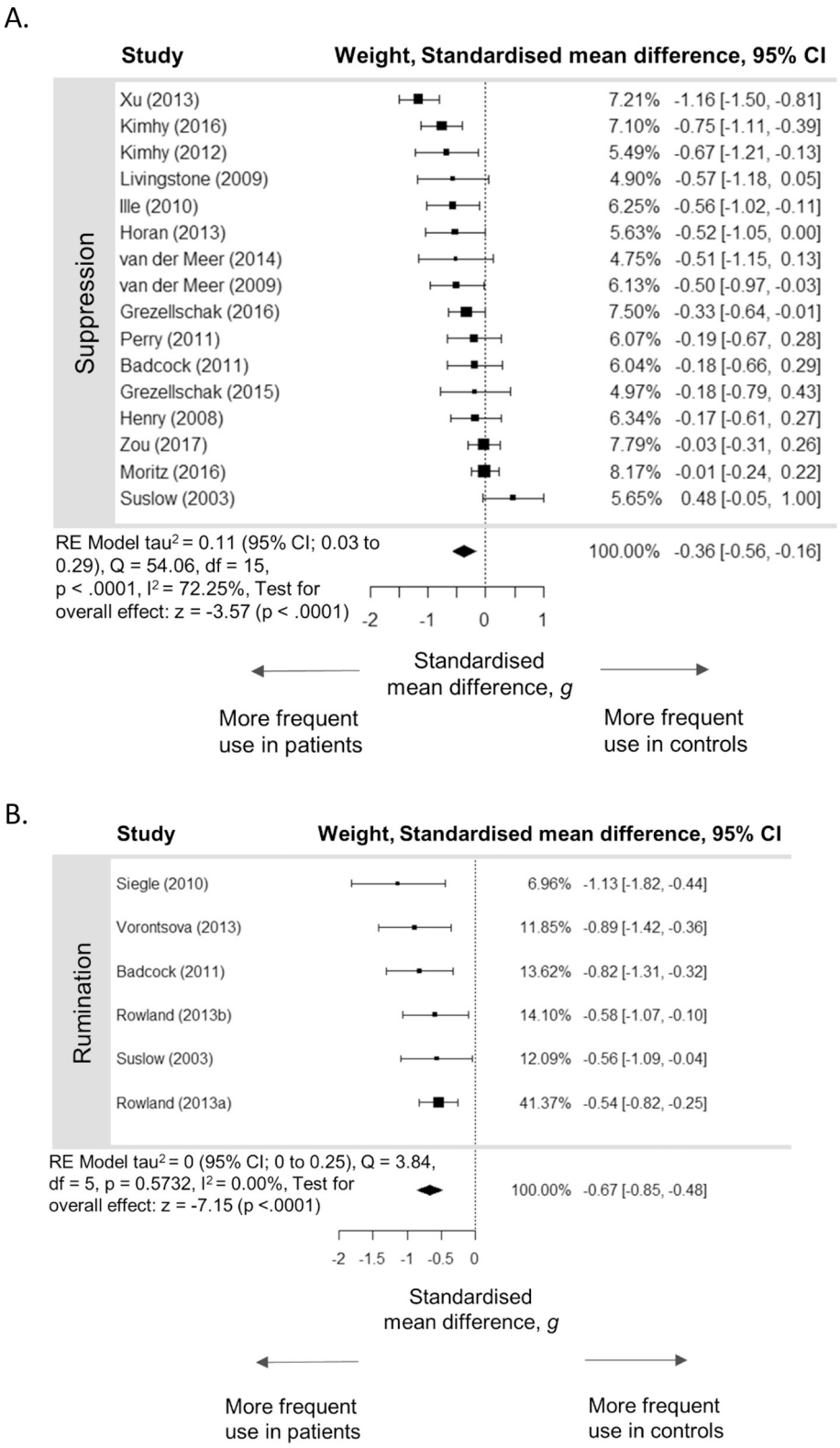

Fig. 2. Forest plots for analyses of habitual use of emotion regulation strategies. (A) Forest plot for comparison of suppression between patients with psychosis and healthy controls. (B) Forest plot for comparison of rumination between patients with psychosis and healthy controls. (C) Forest plot for comparison of self-blaming between patients with psychosis and healthy controls.

(95% CI; -0,33 to 0,13, k = 5), with similar heterogeneity (I^2 = 60,47%). Six studies reported on the association between positive symptoms and the frequency of maladaptive ER strategies (including self-blaming, suppression, rumination and maladaptive coping) (Fig. 4). These yielded a significant mean effect of small to moderate size, with r = 0,34 (95% CI; 0,22 to 0,44), indicating a positive association of

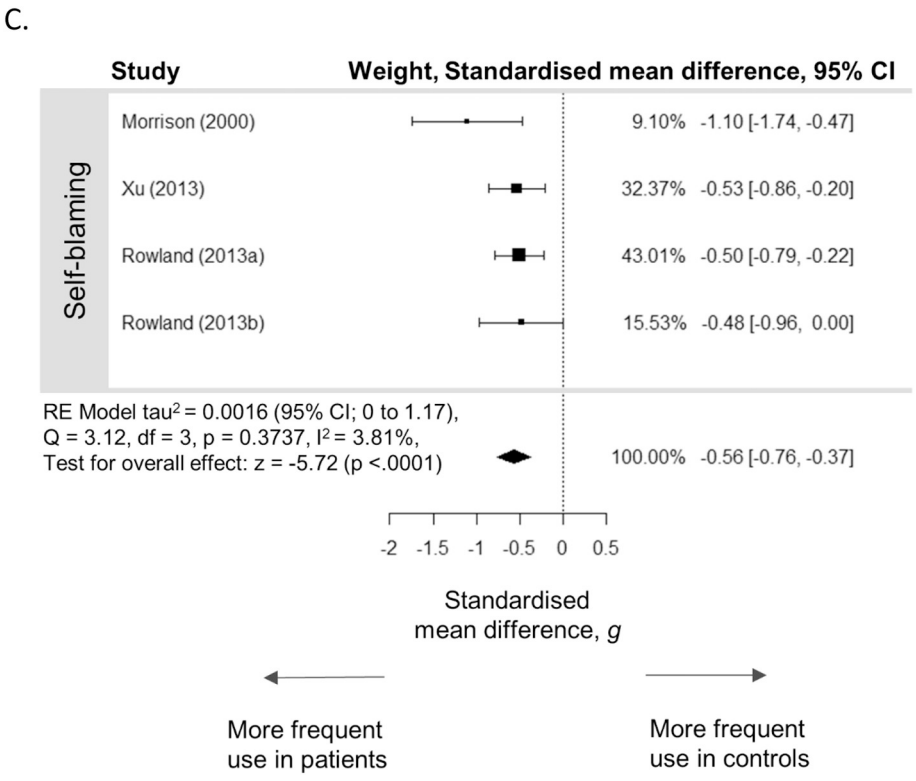

Fig. 2. (*continued*)

maladaptive ER and positive symptoms. Again, the removal of Grezellschak et al. (2016) resulted in a smaller effect of r = 0,30 (95% CI; 0,17 to 0,42, k = 5).

3.5. Experimental self-report data

Two studies used an experimental 2 (group) x 3 (condition) (Grezellschak, Lincoln, & Westermann, 2015; Perry, Henry, Nangle, & Grisham, 2012), and one study used a 3 x 3 (Van der Meer et al., 2014) within-participant paradigm in which participants with psychosis versus healthy controls were instructed to deploy certain ER strategies versus to deploy no strategy (control condition) after the induction of negative affect (Grezellschak et al., 2015; Perry et al., 2012; Van der Meer et al., 2014) (Fig. 4). To induce negative affect these studies either used pictures from the International Affective Pictures System (IAPS) (Grezellschak et al., 2015; Van der Meer et al., 2014) or film clips (Perry et al., 2012). For cognitive reappraisal (k = 3) (Grezellschak et al., 2015; Perry et al., 2012; Van der Meer et al., 2014), the effect size of the difference in standardised mean change was significant with g = 0,23 (95% CI; 0,01 to 0,45; p = 0,04), in favour of a larger reduction of self-reported negative affect in controls than in patients with psychosis (Fig. 4). However, the confidence intervals of the three original studies contained zero throughout. For suppression (k = 2) (Perry et al., 2012; Van der Meer et al., 2014) the effect size of the difference in standardised mean change was non-significant with g = 0,11 (95% CI; -0,26 to 0,48) (Fig. 4). There was moderate heterogeneity (I^2 = 50,31%).

4. Discussion

The analysis of the questionnaire-based data shows that patients with psychosis differ in the way they report to habitually regulate and manage emotions. The most prominent differences were found for rumination, self-blaming and distraction, but patients with psychosis also reported to make less use of cognitive reappraisal and more use of suppression. No differences were evident in the use of acceptance. However, distraction, acceptance and self-blaming were only investigated in a small number of studies, warranting a more cautious interpretation. The correlations found between self-reported maladaptive ER and psychotic symptoms largely supported the results obtained in the group-comparisons.

The results on the habitual use of ER strategies thus corroborate our expectations and substantiate the findings reported by O'Driscoll et al. (2014). Several effect sizes were in the moderate to large range, comparable to effects found for other treatment targets, such as the jumping-to-conclusions bias (g = -0,53) (Dudley, Taylor, Wickham, & Hutton, 2016), indicating that ER may also be a promising target of psychological interventions. Indeed, the importance of addressing ER strategies within cognitive behaviour therapy (CBT) for patients with psychosis, for example by promoting the use of reappraisal, acceptance and mindfulness techniques, has already been stressed by several researchers (Khoury & Lecomte, 2012). In line with this, mindfulness- and acceptance-based interventions have been adapted for psychosis. These approaches attempt to equip patients with means to ease distress by responding to inner-experiences (e.g. emotions) in a non-judgemental and accepting way (Chadwick, 2014; Hayes, Strosahl, & Wilson, 1999; O'Donoghue, Morris, Oliver, & Johns, 2018; Wright et al., 2014). The adaptations of mindfulness-based interventions to psychosis involve an explicit normalising approach to positive symptoms. For example, hallucinations are given no superior attention than other sensations (Chadwick, 2014). In symptom specific approaches of acceptance and commitment therapy, the primary aim is to support the patient in disengaging attention from distressing aspects of hallucinations and in accepting the existence of symptoms whilst pursuing committed value-guided action (Thomas, Morris, Shawyer, & Farhall, 2013). The emerging evidence from controlled clinical trials of such approaches is encouraging with meta-analyses demonstrating significant small to moderate effects on overall psychotic symptoms (Cramer, Lauche, Haller, Langhorst, & Dobos, 2016; Louise, Fitzpatrick, Strauss, Rossell, & Thomas, 2018), a moderate treatment effect on depressive symptoms (Louise et al., 2018), as well as on reduced hospitalisation rates (Cramer et al., 2016). In support of the notion that these interventions focus on

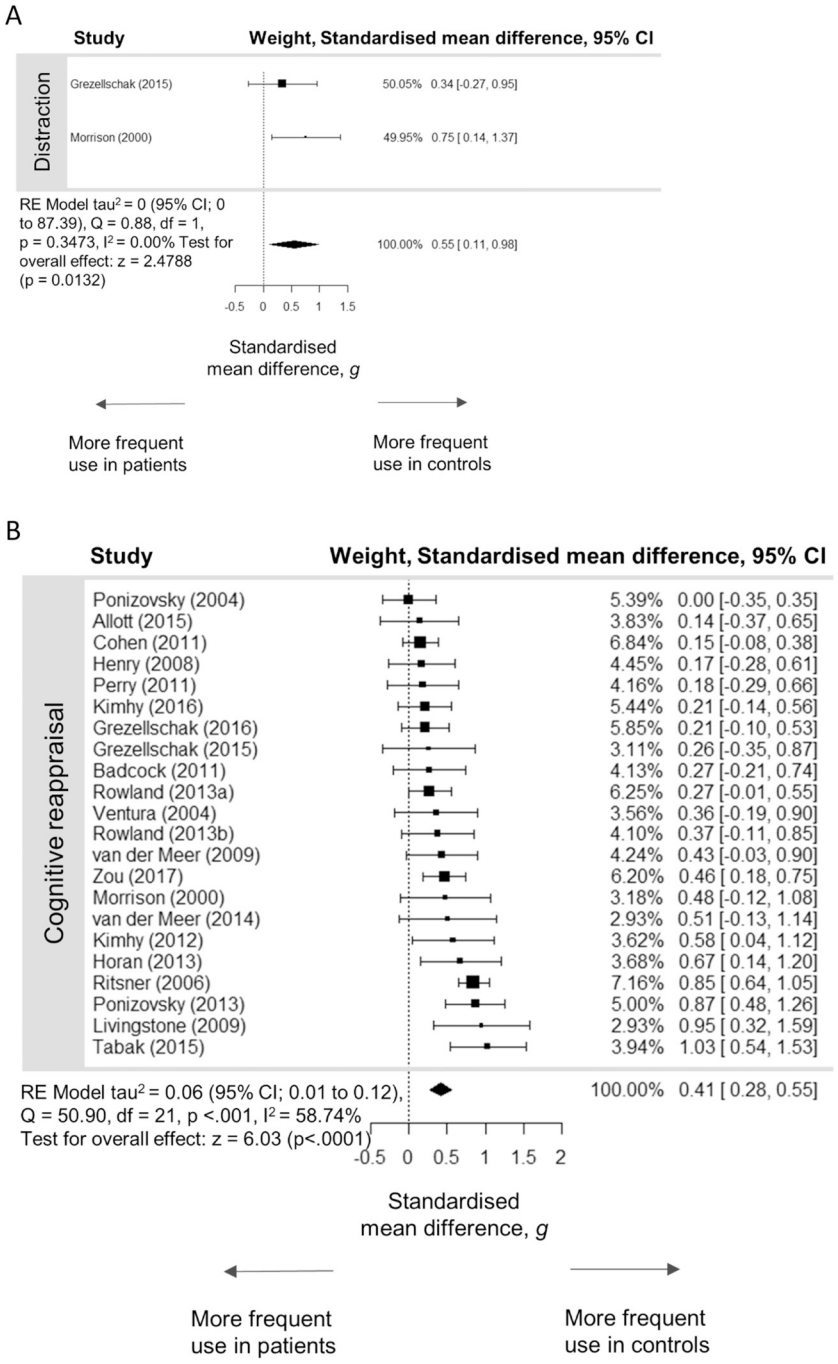

Fig. 3. Forest plots for analyses of habitual use of emotion regulation strategies. (A) Forest plot for comparison of distraction between patients with psychosis and healthy controls. (B) Forest plot for comparison of cognitive reappraisal between patients with psychosis and healthy controls. (C) Forest plot for comparison of acceptance between patients with psychosis and healthy controls. (D) Forest plot for comparison of managing emotions between patients with psychosis and healthy controls.

ER, a recent controlled clinical study also pointed to beneficial effects of acceptance and commitment therapy in ER skills (Spidel, Lecomte, Kealy, & Daigneault, 2018). Several further studies also found that affect-focused interventions (e.g. brief CBT targeting worry, virtual reality CBT involving exposure therapy, and an intervention aiming at emotional processing and meta-cognitive awareness) successfully reduce negative affect and that these reductions seemed to translate into reductions of delusions (Opoka, Ludwig, & Lincoln, 2018). To sum up, these promising results from clinical studies underline that interventions promoting ER skills and those aiming at reducing negative affect show favourable effects in terms of reductions in negative affect as well as positive symptoms and also show that ER skills can be enhanced through training. Above that, the discussion of some aspects of our findings might help to continue tailoring ER trainings better to the specific needs of patients with psychosis.

As a transdiagnostic factor, ER is associated with and contributes to various psychopathologies, and has been most prominently researched in the context of depression (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Understanding whether there is a specific pattern of ER unique to delusion formation or whether difficulties are more transdiagnostic in nature, is important in order to know whether we should develop specifically tailored therapy for delusions or can encourage the use of

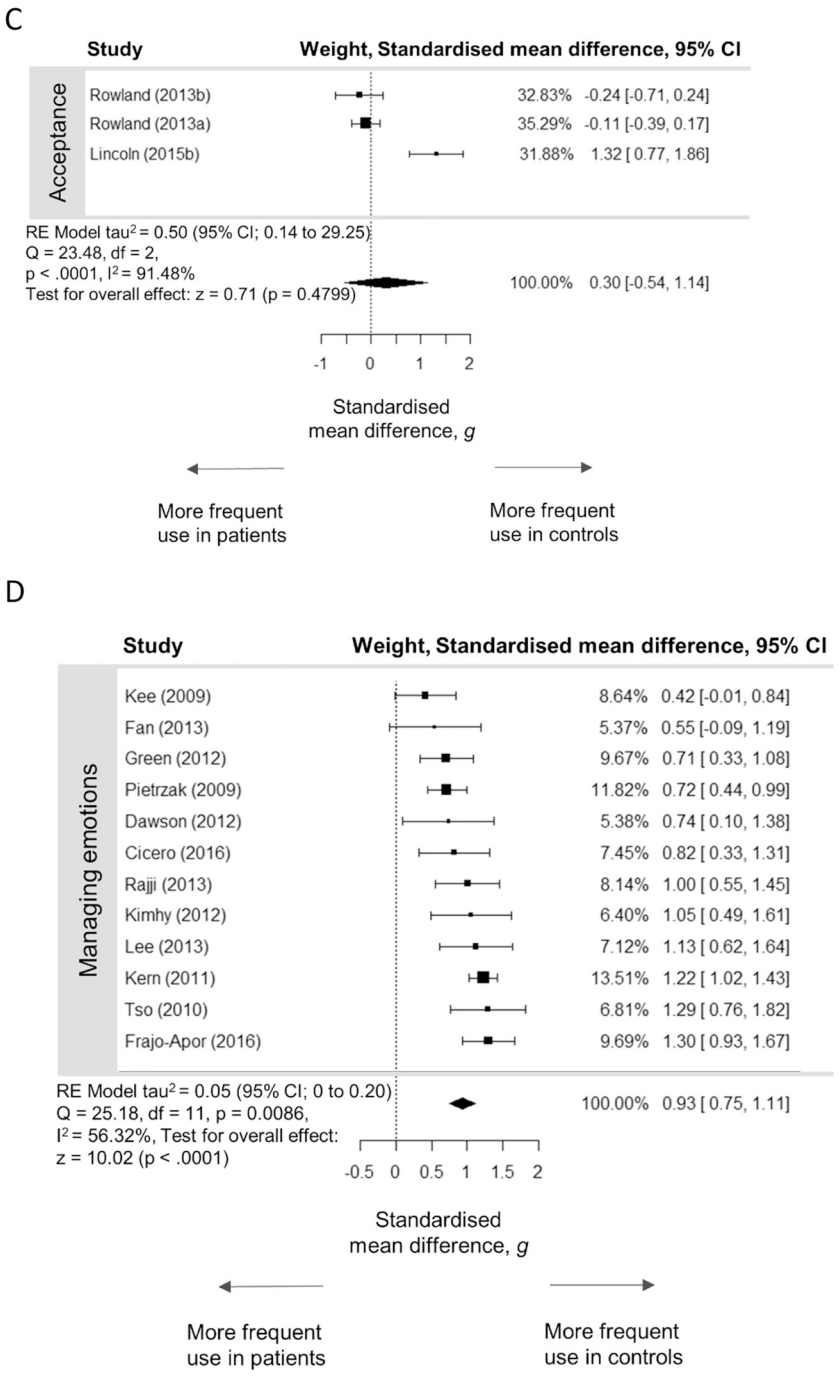

Fig. 3. (*continued*)

non-disorder-specific interventions. However, only a minority of studies included in this meta-analysis explored the specifity of findings. As can be seen in Appendix B these reported heterogeneous results when comparing psychosis with depression or bipolar disorder, with some indicating no differences (acceptance and awareness (Lincoln, Hartmann, Köther, & Moritz, 2015b); reappraisal (Livingstone, Harper, & Gillanders, 2009; Tabak et al., 2015)) and others finding indication of specificity (more suppression in patients with depression (Ille, Schöny, Kapfhammer, & Schienle, 2010); more reappraisal in patients with depression (Ponizovsky, 2013), more self-blaming in patients with bipolar disorder (Rowland, Hamilton, Vella, et al., 2013)). Given the high comorbidity rates of depression in psychotic disorders (Buckley et al., 2009), the strong effects we found for rumination and self-blaming are non-surprising. Clinically, it may be most promising to focus on these strategies specifically, given that depressive thought processes can be key in the formation of psychotic experiences (Freeman & Garety, 2014). In line with this notion, interventions targeting perseverative thinking styles resulted in reductions of paranoia (Foster, Startup, Potts, & Freeman, 2010; Freeman et al., 2015). However, future research would benefit from further multi-sample approaches, in the hope at arriving at a clearer pattern of findings on the question of specificity.

Another question that our results raise relates to the findings from the three experimental studies, in which patients were required to deploy an instructed ER strategy after the induction of negative affect. In contrast to the questionnaire-based studies, the analysis of the experimental data did not point to unequivocal differences between patients and controls. The effect for suppression was non-significant and although the effect size for cognitive reappraisal was significant (p =

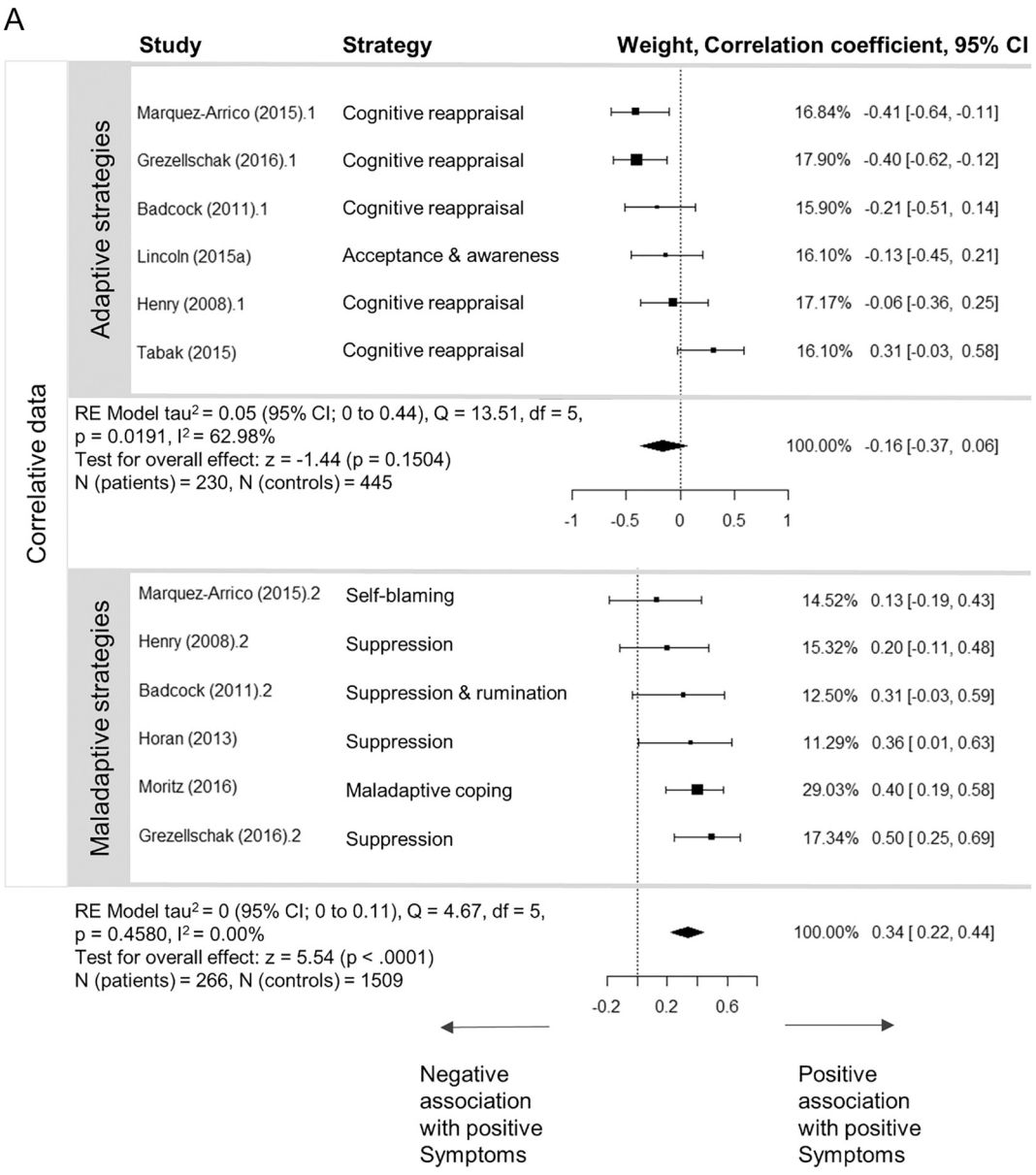

Fig. 4. (A) Forest plots for correlative data of the relationship between (mal)adaptive strategies and positive symptoms in patients with psychosis. (B) Forest plots for experimental data of cognitive reappraisal and suppression in patients with psychosis compared to healthy controls.

0.04), all confidence intervals of the original studies contained zero. Thus, patients with psychosis do not seem to differ much from healthy controls in the effectiveness of their use of strategies once they have been instructed to employ them. Interestingly, indication of a discrepancy between self-reported use of cognitive reappraisal in questionnaires and self-reported success of its use in the lab was also found in a recent systematic review of numerous studies across various disorders (Zilverstand, Parvaz, & Goldstein, 2017), indicating that this "discrepancy" seems to be robust and not specific to psychosis. One possible explanation is the artificial laboratory setting: While a participant may be able to apply a strategy when confronted with IAPS pictures, the actual success of this strategy employed in everyday life, where emotions are elicited through personally relevant stimuli might require a more proficient usage of skills. Moreover, it may be easier applying a strategy following an instruction than generating it from one's own account as is necessary in every-day life settings. Furthermore, the experimental manipulation of ER strategies remains artificial as it creates two distinct conditions of either applying a certain strategy or not (McRae, 2013). The possibility that one instructed strategy facilitates the use of another in the sense of a natural continuous variation and interaction of ER, remains unexplored. Another problem is social desirability, as the typical design of these experiments is transparent and might lead participants to rate their negative affect in favour of a reduction after the deployment of the instructed strategy. This interpretation is corroborated by the interesting finding from an experimental study by Strauss et al., 2013, who reported no differences between self-reported negative affect ratings in both patients with psychosis and healthy controls, but nevertheless found differences in the late positive potential, which was interpreted as an indicator of (abnormal) ER. Similarly, the review on experimental studies of cognitive reappraisal mentioned above found a reduced activation in the ventrolateral prefrontal cortex as well as in the dorsolateral prefrontal cortex despite the absence of differences in self-reported success of strategy use (Zilverstand et al., 2017). Thus, it appears important to continue to apply multi-method approaches in accordance with the various facets of emotional responses (Joormann & Stanton, 2016).

The question of causality in the relationship between ER and psychotic symptoms also requires further consideration. In order to assume

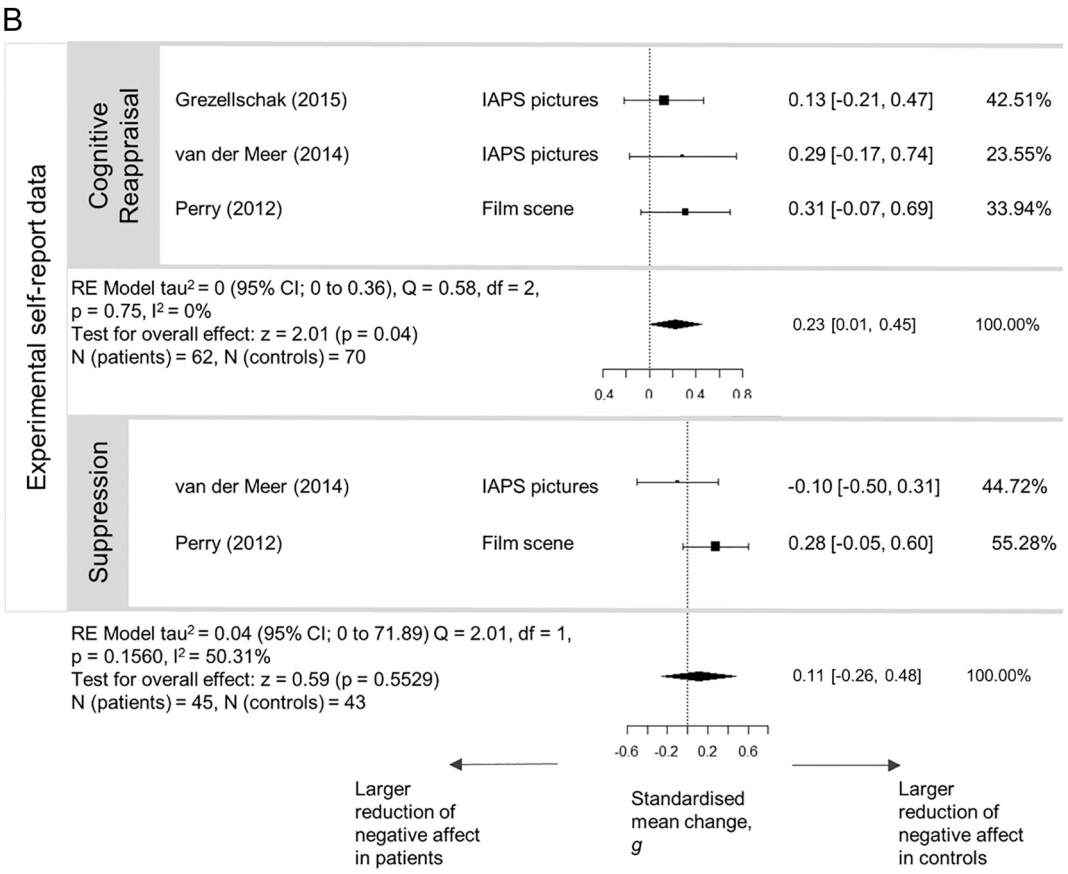

Fig. 4. (*continued*)

causality, the putative causal mechanism (ER) should not only be associated with the outcome variable (psychotic symptoms), as shown in our data, but it should also be tested whether ER precedes psychotic symptoms and whether change in ER leads to change in psychotic symptoms (see Schwartz & Susser, 2006). As the questionnaire-based studies generally did not control for baseline negative affect, which tends to be high in patients with psychosis (Braga et al., 2013; Buckley et al., 2009), we cannot exclude the possibility that the self-reported difficulties in ER are – at least in part – a consequence rather than a cause of the higher levels of negative affect. Thus, cleverly designed experience sampling and experimental studies are required to tease out the temporal order and causal relation of strategy use and symptoms. First attempts in this direction have recently been made, with one study finding that from a range of ER strategies used in daily life suppression significantly predicted subsequent paranoia (Nittel et al., 2018). Another study found that, compared to healthy controls, patients with psychosis deployed a comparable or even higher number of ER strategies, but did so less effectively (Visser, Esfahlani, Sayama, & Strauss, 2018).

If a causal role of ER strategies can be further established for psychosis, the question arises by which mechanisms these difficulties lead to psychotic symptoms. One assumption is that the failure to employ adaptive ER strategies increases or even amplifies the affective stress response, resulting in increasingly unbearable negative affect which increases the likelihood of beliefs that are congruent with the emotion (e.g. threat beliefs in the presence of extreme anxiety (Freeman, Garety, & Kuipers, 2001)). Another is that the use of maladaptive strategies triggers symptoms, for example the use of suppression could result in misinterpreting own affective states which eventually increase the likelihood of a paranoid interpretation.

This also promotes the discussion of how known indicators of vulnerability (e.g. neurocognitive or biological vulnerability) or genetic and social risk factors are linked to impaired ER. For example, executive functions, which are known to be impaired in people with psychosis (Orellana & Slachevsky, 2013), may be associated with the difficulty to deploy certain strategies, such as cognitive reappraisal (McRae, Jacobs, Ray, John, & Gross, 2012). Also, heart rate variability, which is an indicator of physical adaptability of the organism and is reduced in people with psychosis (Clamor, Lincoln, Thayer, & Koenig, 2016), has also been found to be linked to impaired ER in this group (Clamor et al., 2015). Furthermore, early adverse experiences tend to be associated with impaired ER skills (Laloyaux, Dessart, Van der Linden, Lemaire, & Larøi, 2016) and a recent study in a large community sample found ER to mediate the link between childhood trauma and psychotic experiences (Lincoln et al., 2017). Here too, however, questions related to the specificity need to be addressed.

Several limitations warrant discussion. One is that the quality of studies varied considerably, with matching of controls as a main weakness. Also, it became apparent that some strategies were measured through a myriad of inventories, leading to a potential variance in the construct being assessed. Despite efforts to precisely formulate our inclusion criteria in a first step and then transparently describe the definitions used in the questionnaires included, a potential confounding due to this variance cannot be ruled out. Moreover, some of our research questions were based on a small number of primary studies. Thus, and in line with Aldao et al., 2010, we caution that these results can only be regarded as an approximation. In order to synthesise correlative data, we grouped strategies into the categories of maladaptive

and adaptive strategies. This comes with the tradeoff of reduced precision in terms of which specific strategies are linked to specific symptoms. Furthermore, despite the common agreement on what constitutes a more or less adaptive strategy (see reviews in Gross, 1998; Nolen-Hoeksema & Watkins, 2011), whether a strategy is adaptive or maladaptive also depends on the context and the goal (Aldao & Nolen-Hoeksema, 2012) and these aspects were not controlled for or assessed in the questionnaire-based studies.

To sum up, our meta-analysis further substantiates the assumption that difficulties in ER are closely linked to psychotic symptoms, emphasising the potential relevance of ER as a treatment target. However, more studies using multi-method approaches and including different clinical control groups are needed to gain a more complete understanding of the distinct difficulties in this group of patients and the interplay of negative affect, ER strategies and subsequent positive symptoms. Advancing our understanding of underlying mechanisms and risk factors as well as identifying those strategies which are important to target in treatment will be a necessary and promising endeavour of future research.

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Contributors

LL, TL and DW contributed to the study conception and design. LL did the systematic literature research and selected studies for inclusion. LL extracted data and assessed the quality of the studies. LL and DW did statistical analyses. DW critically reviewed the methodology. LL wrote the first draft of the manuscript and TL revised the manuscript for important intellectual content. All authors critically revised the manuscript, and contributed and approved the final draft.

Declaration of Competing Interest

The authors declare no competing interests.

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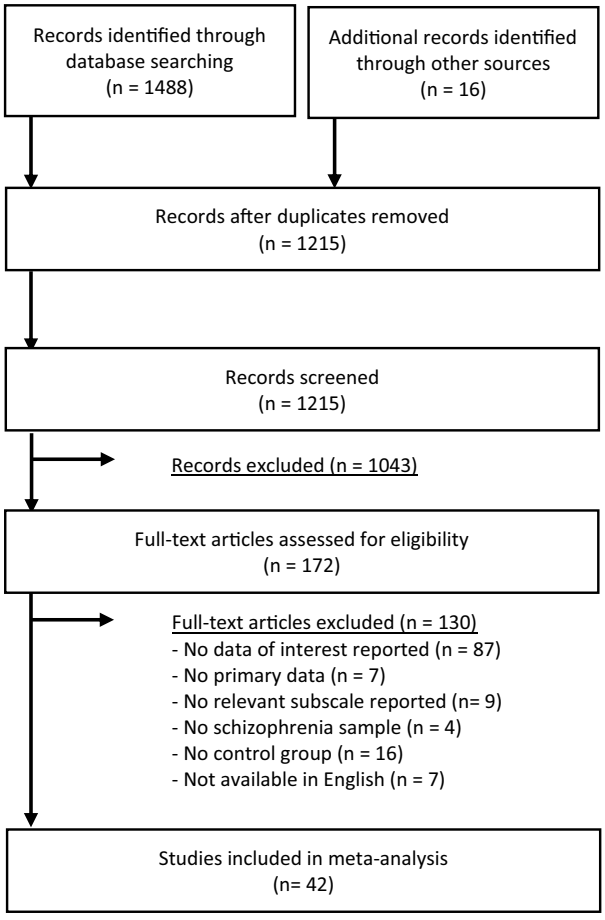
Declarations of Competing Interest

None.

Appendix A. Flow chart



Appendix B. Main Table (Individual study characteristics, individual ratings of quality)

Table 1
Cross-sectional and correlative questionnaire-based studies on habitual use of emotion regulation.

Author name	Sample details	Age M (SD)	Psychopath-ology measures	ER measures	Results	Quality	Risk of bias
(Allott et al., 2015)	34 individuals with first-episode psychosis (FEP); 26 healthy controls	SZ: 20.03 (2.56) HC: 21.85 (2.01)	DSM-IV (SCID) BPRS, SANS	CISS	An independent-samples t-test revealed no significant group difference regarding the use of task-oriented coping ($p = .58$). Pearson Correlation indicated a significant negative correlation between task-oriented coping and perceived stress in FEP patients ($r = -.429$, $p = .014$) but not in HC ($r = -.066$, $p = .747$)	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: fair	Selection bias: low Confounding bias: unclear Measurement bias: low
(Badcock et al., 2011)	34 individuals with schizophrenia and current auditory hallucinations; 34 healthy controls	SZ: 37.91 (9.40) HC: 41.35 (11.85)	DSM-IV (DIP) PSYRATS	ERQ, RRS	An independent-samples t-test revealed no significant group difference regarding the use of reappraisal ($t = 1.10$, $p = .276$) and suppression ($t = 0.77$, $p = .445$). Rumination was significantly higher in SZ ($t = 3.38$, $p = .001$) compared to HC Pearson Correlation indicated a significant positive correlation between the use of expressive suppression and severity of hallucinatory experience ($r = .405$, $p < .05$) as well as disruption to life[a] ($r = .479$, $p = .005$) in SZ Scores on the rumination scale were significantly correlated with levels of depression ($r = .398$, $p < .05$) and distress related to hallucinations ($r = .378$, $p < .05$) in SZ. When controlling for levels of depression, the correlation between suppression and severity of hallucinatory experience remained significant ($p = .022$), but the correlation between rumination and distress related to hallucinations did not remain significant ($p > .1$)	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: fair	Selection bias: low Confounding bias: unclear Measurement bias: low
(Cicero et al., 2016)	45 individuals with schizophrenia or schizoaffective disorder; 28 healthy controls	SZ: 49.49 (10.67) HC: 44.31 (14.14)	DSM-IV (SCID) PANSS	MSCEIT	An independent-samples t-test revealed a significantly lower score on managing emotions in SZ compared to HC ($t = 2.84$, $p < .01$). Spearman Correlation indicated a significant negative correlation between positive symptoms and managing emotions ($\rho = -.51$, $p < .05$). Negative symptoms were not associated with managing emotions ($\rho = -.17$, $p > .05$).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Cohen, Hassamal, & Begum, 2011)	198 individuals with schizophrenia; 113 healthy controls	SZ: 61.5 (5.6) HC: 63.0 (5.4)	DSM-IV PANSS	Own list of 22 strategies (derived from (Pearlin, Mullan, Semple, & Skaff, 1990); Cognitive Coping subscale = cognitive reappraisal	An independent-samples t-test revealed no significant difference in the use of a cognitive coping style between SZ and HC ($t = 1.24$, $p = .22$).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: poor Matching: poor	Selection bias: low Confounding bias: unclear Measurement bias: unclear
(Dawson et al., 2012)	20 individuals with schizophrenia; 20 healthy controls	SZ: 43.25 (9.15) HC: 38.60 (10.86)	DSM-IV-TR	MSCEIT	An independent-samples t-test showed significantly lower scores for managing emotions in SZ compared to HC ($t = -2.39$, $p = .02$, $d = 0.76$).	Case definition: fair Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: unclear Confounding bias: unclear Measurement bias: low
(Fan et al., 2013)	27 individuals with schizophrenia (inpatients); 15 healthy controls	SZ: 39.7 (7.2) HC: 41.4 (6.3)	DSM-IV-TR (SCID) PANSS	MSCEIT	An independent-samples t-test revealed no significant difference in managing emotion scores between SZ and HC ($t = 1.71$, $p = .096$).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: fair Matching: fair	Selection bias: low Confounding bias: low Measurement bias: low

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Table 1 (*continued*)

Author name	Sample details	Age M (SD)	Psychopath-ology measures	ER measures	Results	Quality	Risk of bias
(Frajo-Apor et al., 2016	56 individuals with schizophrenia (out-patients); 84 healthy controls	SZ: 45.3 (10.2) HC: 44.8 (9.3)	M.I.N.I PANSS	MSCEIT	A Mann-Whitney U-test showed significantly lower managing emotions scores in SZ compared to HC ($z = -6{,}225$, $p < .001$, $d = 1.31$). An analysis of covariance showed that the group difference in managing emotions remained significant after adjusting for non-social cognition and education ($F = 14.82$, $p < .001$).	Case definition: fair Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: fair	Selection bias: low Confounding bias: unclear Measurement bias: low
(Green et al., 2012)	50 prodromal participants; 34 healthy controls 81 first episode schizophrenia patients[b] 46 healthy controls 53 chronic schizophrenia patients 47 healthy controls	SZ(prodr.): 18.25 (3.12) HC: 18.95 (2.91) SZ(firstep.): 22.02 (4.18) HC: 22.20 (3.51) SZ(chronic): 34.77 (7.89) HC: 33.02 (5.32)	DSM-IV (SCID) SAPS	MSCEIT	An ANOVA revealed no significant difference in the use of managing emotions between prodromal participants, first episode SZ and chronic SZ ($F = 1.41$, $p = .245$), but a significant difference in the use of managing emotions between the patient groups and HC ($F = 21.07$, $p < .001$). A Pearson correlation analysis indicated no significant correlation between MSCEIT total scores and positive symptoms in prodromal participants ($r = -.278$, $p > .05$) and first episode SZ ($r = -.120$, $p > .05$), but a significant negative correlation in chronic SZ ($r = -.295$, $p < .05$).	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Grezellschak et al., 2016)	46 individuals with psychosis; 23 relatives of individuals with psychosis; 267 healthy controls	SZ: 36.16 (11.58) Relat.: 26.65 (9.59) HC: 28.27 (9.26)	PCL	ERQ	Independent-samples t-tests showed no significant difference regarding the use of reappraisal in SZ compared to HC ($t = 1.49$, $p = .14$), but a significantly higher use of expressive suppression in SZ compared to HC ($t = -2.05$ $p = .04$). Correlation analyses revealed a significant negative correlation between reappraisal and paranoid ideation in the total sample ($r = -.21$, $p < .01$) as well as in the SZ group only ($r = -.40$, $p < .01$). Expressive suppression was significantly correlated to paranoid ideation in the total sample ($r = .38$, $p < .01$) as well as in the SZ group only ($r = .50$, $p < .01$).	Case definition: fair Appropriate sample: good Selection of controls: good Definition of controls: fair Matching: fair	Selection bias: unclear Confounding bias: unclear Measurement bias: low
(Henry et al., 2008)	41 individuals with schizophrenia or schizoaffective Disorder; 38 healthy controls	SZ: 37.5 (10.67) HC: 36.1 (11.99)	DSM-IV SAPS	ERQ	Independent-samples t-tests showed no significant difference regarding the use of suppression ($t = 1.03$, $p = .308$, $d = 0.24$) and reappraisal ($t = 0.82$, $p = .415$, $d = 0.19$) between SZ and HC. Exploratory analyses revealed no group differences in the use of these emotion regulation strategies across three classes of emotional valence: positive ($t = 0.06$, $p = .955$), negative ($t = 0.39$, $p = .700$), or nonvalenced ($t = 0.11$, $p = .911$) emotional states. Correlation analyses revealed that there were no significant associations between the use of reappraisal and hallucinations ($r = -.10$, $p > .05$) or delusions ($r = -.06$, $p > .05$) within SZ. No significant correlation between the use of suppression and hallucinations ($r = .03$, $p > .05$) or delusions ($r = .20$, $p > .05$) was found.	Case definition: fair Appropriate sample: good Selection of controls: good Definition of controls: fair Matching: good	Selection bias: unclear Confounding bias: low Measurement bias: low
(Horan et al., 2013)	31 individuals with schizophrenia (out-patients); 27 healthy controls	SZ: 47.8 (9.8) HC: 45.5 (6.7)	DSM-IV (SCID) BPRS	ERQ	An independent-samples t-test indicated a significantly higher use of reappraisal ($t56 = -2.45$, $p < .05$) and lower use of suppression by SZ compared to HC ($t56 = 2.27$, $p < .05$).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low

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Table 1 (*continued*)

Author name	Sample details	Age M (SD)	Psychopath-ology measures	ER measures	Results	Quality	Risk of bias
(Ille et al., 2010)	38 individuals with schizophrenia (inpatients); 40 healthy controls	SZ: 39.7 (12.9) HC: 35.5 (14.1)	ICD-10 (M.I.N.I.)	STAXI	Pairwise comparisons revealed significantly more anger suppression in SZ compared to HC (mean difference = 2.56, p = .046).	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: fair	Selection bias: unclear Confounding bias: low Measurement bias: low
(Kee et al., 2009)	50 individuals with schizophrenia (outpatients); 39 healthy controls	SZ: 34.37(7.69) HC: 32.97 (5.17)	DSM-IV (SCID) SAPS	MSCEIT	Independent-samples t-test revealed significantly lower emotion management in the SZ compared to HC (t = -1.96, p < .05, d = 0.42). Correlation analyses showed no significant association between managing emotions scores and hallucinations (r = -.21, p > .05), delusions (r = -.03, p > .05) or the SAPS total score (r = -.23, p > .05).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Kern et al., 2011)	176 persons with schizophrenia or schizoaffective disorder; 300 healthy controls	SZ: 44.0 (11.2) HC: 42.6 (11.6)	DSM-IV (SCID)	MSCEIT	A MANOVA revealed significantly lower managing emotions scores in SZ compared to HC (p < .001). Classification and regression trees showed managing emotions scores to be an important factor for discriminating SZ from HC (importance = 0.372, normalized importance = 82.6%).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: fair Matching: fair	Selection bias: unclear Confounding bias: unclear Measurement bias: low
(Kimhy et al., 2012)	44 individuals with schizophrenia (inpatients and outpatients); 20 healthy controls	SZ: 30.33 (8.08) HC: 24.20 (4.62)	SAPS	MSCEIT + ERQ	An ANCOVA controlling for age revealed significantly lower managing emotion scores (F = 8.29, p < .01, d = 1.06), use of reappraisal (F = 5.27, p = .02, d = 0.60) and significantly higher use of suppression (F = 5.42, p = .02, d = 0.68) in SZ compared to HC.	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: fair Matching: poor	Selection bias: unclear Confounding bias: low Measurement bias: low
(Kimhy et al., 2016)	87 individuals with schizophrenia; 54 clinical high risk for psychosis (CHR); 50 healthy controls	SZ: 33.45 (9.47) CHR: 20.18 (3.41) HC: 23.04 (4.10)	DSM-IV SAPS	ERQ	An ANCOVA controlling for age revealed significant differences in reappraisal (F = 5.57, p = .004, d = 0.73) and suppression (F = 15.42, p < .001, d = 1.10) between CHR, SZ and HC. Pairwise comparisons showed reappraisal scores to be significantly lower in SZ and CHR compared to HC and suppression scores to be significantly higher in SZ and CHR compared to HC.	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: fair Matching: poor	Selection bias: unclear Confounding bias: low Measurement bias: low
(Lee et al., 2013)	38 individuals with schizophrenia (outpatients); 68 individuals with bipolar disorder (BD, outpatients); 36 healthy controls	SZ: 44.7 (9.1) BD: 43.9 (10.6) HC: 41.4 (9.9)	BPRS	DSM-IV (SCID) MSCEIT	An ANOVA revealed a significant difference in managing emotions scores in SZ, BD and HC (F = 12.73, p < .001). Pairwise comparisons revealed no difference in managing emotions between BD and HC, but significantly lower managing emotion scores in SZ patients compared to both other groups (effect size = 1.13).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Lincoln et al., 2015a), (Lincoln et al., 2015b)	37 individuals with schizophrenia and schizoaffective disorder; 30 individuals with depression (D); 28 healthy controls	SZ: 40.3 (12.3) D: 41.7 (11.1) HC: 35.6 (14.5)	DSM-IV (M.I.N.I) PANSS PCL	ERSQ-ES	A MANOVA revealed significant group effects for awareness (F = 8.54, p < .001) and acceptance (F = 17.00, p < .001) of emotion, with both scores being lower in SZ and D than in HC. Awareness did not remain significantly impaired in SZ when controlling for depression (F = 3.34, p = .72, η_p^2 = .05), while acceptance did (F = 5.84, p = .001, η_p^2 = .16). Correlation analyses revealed no significant association between awareness and PANSS positive scores (-.10), acceptance and PANSS positive scores (-.17) and modification and PANSS positive scores (.03) but significant negative correlations between awareness and Paranoia Checklist scores (-.36, p < .05), acceptance and Paranoia Checklist scores (-.48, p < .01) and modification and Paranoia Checklist scores (-.35, p < .05)	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low

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Table 1 (*continued*)

Author name	Sample details	Age M (SD)	Psychopath-ology measures	ER measures	Results	Quality	Risk of bias
					Regression analyses showed awareness, acceptance and modification of emotion to significantly predict the increase in state paranoia from no stress to noise stress condition in SZ (β=-0.20, p<.05; β=-0.18, p<.05; β=-0.25, p<.01, respectively)		
(Livingstone et al., 2009)	21 individuals with schizophrenia; 21 individuals with anxiety disorder (AD) or depression; 21 healthy controls	SZ: 39.26 (11.30) AD/D: 40.52 (10.67) HC: 40.00 (11.88)	-	ERQ	An ANOVA revealed a significant main effect of group regarding the use of cognitive reappraisal (F=5.161, p<.05). Posthoc comparisons, using between-groups t-tests, found a significant difference when comparing the two clinical groups together with HC (t=−4.003, p<.025), with no significant difference when comparing the two clinical groups with each other (t=0.000, p>.025). An ANOVA revealed no significant main effect of group on the expressive suppression subscale (F=2.158, p>.05)	Case definition: poor Appropriate sample: fair Selection of controls: fair Definition of controls: fair Matching: fair	Selection bias: unclear Confounding bias: unclear Measurement bias: low
(Marquez-Arrico et al., 2015)	39 male individuals with Substance Use Disorder (SUD) and SZ (SZ+) 43 male individuals with SUD	SUD: 35.35 (8.42) SZ+: 37.49 (8.18)	DSM-IV- R (SCID) PANSS;	CSI	An ANOVA indicated no significant difference in the use of cognitive restructuring between SUD and SZ+ (F<0.006; p>.939), but SZ+ had lower scores in self-criticism than SUD (F=4.190; p=.044; η^2=.50). Bivariate correlations showed a significant negative correlation between cognitive restructuring and PANSS positive scores for SZ+ (r=-.408, p<.01). No significant association between self-criticism and PANSS positive scores was found (r=.134, p>.05).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: NA Matching: NA	Selection bias: low Confounding bias: low Measurement bias: low
(Moritz, Lüdtke, et al., 2016)	75 individuals with psychosis; 100 individuals with depression; 1100 healthy controls	SZ: 40.89 (9.41) D: 42,59 (10,47) HC: 41,96 (11,35)	CAPE	MAX	Group comparisons (F=18.39, p<.001) revealed significantly more avoidance in both SZ (p=.046) and depression patients (p<.001) than in HC; comparing the two clinical groups, depression patients showed more avoidance than SZ (p=.015). Adaptive coping was correlated with lower (r=-.312), maladaptive coping with higher (r=.402) positive symptoms. Avoidance and suppression coping were also associated with positive symptoms (r=.447, r=.459). Suppression was significantly correlated with CAPE paranoia scores (r=.431, p<.001).[c]	Case definition: fair Appropriate sample: fair Selection of controls: good Definition of controls: fair Matching: good	Selection bias: unclear Confounding bias: low Measurement bias: low
(Morrison & Wells, 2000)	22 individuals with schizophrenia; 22 healthy controls	SZ: 44,1 (14,35) HC: 39,8 (8,81)	-	TCQ	Univariate analysis indicated a significantly higher use of punishment- (F=11.40, p=.002) and worry (F=15.40, p=.001) and a less frequent use of distraction in SZ compared to HC (F=6.42, p=.015). No group difference was found regarding reappraisal (F=2.57, p>.05).	Case definition: fair Appropriate sample: fair Selection of controls: fair Definition of controls: poor Matching: fair	Selection bias: unclear Confounding bias: unclear Measurement bias: unclear
(Perry et al., 2011)	33 individuals with schizophrenia or schizoaffective disorder; 36 healthy controls	SZ: 43.7 (9.89) HC: 40.8 (11.49)	SAPS	ERQ	Independent-samples t-tests revealed no between-group differences in the use of suppression (t=0.83, p=.412, d=0.20) and reappraisal (t=0.78, p=.441, d=0.19). For SZ, Pearson's correlations indicated, that a greater use of suppression was associated with poorer social functioning (r=-.40, p=.022), greater use of reappraisal was related to decreased levels of depression (r=-.40, p=.021) and lower negative symptoms (r=-.48, p=.005).	Case definition: fair Appropriate sample: good Selection of controls: good Definition of controls: fair Matching: good	Selection bias: low Confounding bias: low Measurement bias: low

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Table 1 (*continued*)

Author name	Sample details	Age M (SD)	Psychopath-ology measures	ER measures	Results	Quality	Risk of bias
(Pietrzak et al., 2009)	121 individuals with schizophrenia or Schizoaffective dis-order; 120 healthy controls	SZ: 40.4 (11.1) HC: 39.2 (11.0)	DSM-IV PANSS BPRS	MSCEIT	A group comparison indicated a difference in MSCEIT performance scores in favor of HC ($M = 96.2$, $SD = 9.5$) compared to SZ ($M = 87.9$, $SD = 13.1$, $p < .001$) with a moderate effect size ($d \approx -0.73$).	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Ponizovsky et al., 2004)	70 individuals with schizophrenia; 55 healthy controls	SZ: 38.6 (9.4) HC: 40.6 (10.0)	ICD-10	CISS	An independent-samples t-test indicated no signif-icant difference in task-oriented coping ($t = 0.006$, $p > .05$).	Case definition: fair Appropriate sample: fair Selection of controls: good Definition of controls: fair Matching: good	Selection bias: unclear Confounding bias: low Measurement bias: low
(Ponizovsky, 2013)	51 individuals with schizophrenia; 70 individuals with de-pression; 61 healthy controls	SZ: 33.8 (10.5) D: 37.4 (13.4) HC: 35.7 (11.3)	DSM-IV (SCID) PANSS	CISS	Task-oriented coping scores were significantly lower in SZ compared to the depression group and HC ($F = 7.45$, $p = .001$). In a regression model (coping in SZ), task- and emotion-oriented coping styles predicted PANSS general psychopathology scores, accounting for 8.8% and 7.2%, respectively, of the total variance ($R^2 = 0.45$; adjusted $R^2 = 0.34$; $F = 3.3$, $p < .001$)	Case definition: good Appropriate sample: good Selection of controls: fair Definition of controls: fair Matching: fair	Selection bias: unclear Confounding bias: unclear Measurement bias: low
(Rajji et al., 2013)	59 individuals with schizophrenia or schizoaffective dis-order; 33 healthy controls	SZ: 63.5 (6.8) HC: 63.4 (7.7)	DSM-IV (SCID) PANSS	MSCEIT	Independent-samples t-tests revealed lower scores in managing emotions in SZ compared to HC ($t = -4.61$, $df = 90$, $p < .0001$, $d = 1.0$).	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: fair	Selection bias: low Confounding bias: low Measurement bias: low
(Ritsner et al., 2006)	237 individuals with schizophrenia; 175 healthy controls	SZ: 37.9 (9.9) HC: 38.4 (10.0)	PANSS	CISS	A two-way ANCOVA revealed a significantly lower use of task-oriented coping in SZ compared to HC ($F = 39.6$, $p = .001$). Task-oriented coping style scores were independent from covariates tested.	Case definition: fair Appropriate sample: good Selection of controls: fair Definition of controls: good Matching: poor	Selection bias: unclear Confounding bias: low Measurement bias: low
(Rowland, Hamilt-on, Vella, et al., 2013)	126 individuals with schizophrenia; 97 individuals with bi-polar disorder; 81 healthy controls	SZ: 45.46 (10.96) BD: 51.26 (12.10) HC: 44.65 (12.86)	DIP	CERQ	ANCOVAs, controlling for age and gender, revealed a significantly more frequent use of rumination (SZ: $F = 8.05$, $p < .0005$, $\eta_p^2 = .106$) and self-blame (SZ: $F = 5.12$, $p = .002$, $\eta_p^2 = .070$) in SZ and bipolar patients compared to HC. They showed less putting into perspective (SZ: $F = 4.65$, $p = .004$, $\eta_p^2 = .064$). No differences in positive reappraisal and accep-tance. There were no significant associations between levels of positive or negative symptomatology and frequency of use of CERQ strategies in SZ	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: poor Matching: poor	Selection bias: unclear Confounding bias: low Measurement bias: unclear
(Rowland, Hamilt-on, Vella, et al., 2013)	32 individuals with schizophrenia; 24 individuals with bi-polar I disorder; 36 healthy controls	SZ: 44.57 (10.37) BD: 40.67 (11.27) HC: 33.91 (12.24)	PANSS	CERQ	A MANOVA revealed a significantly more frequent use of rumination in SZ compared to HC ($F = 3.53$, $p = .034$, $\eta^2 = .073$). SZ scored higher in the use of self-blaming than HC ($F = 3.19$, $p = .046$, $\eta^2 = .067$), patients with bipolar scored higher than SZ. No differences were found regarding positive reappraisal and acceptance between SZ and HC.	Case definition: fair Appropriate sample: good Selection of controls: good Definition of controls: poor Matching: poor	Selection bias: unclear Confounding bias: unclear Measurement bias: unclear
(Siegle et al., 2010)	15 individuals with schizophrenia; 14 with major de-pression; 24 healthy controls	SZ: 41.5 (5.6) D: 43.1 (14.2) HC: 30.2 (11.4)	SCID	RSQ	Higher scores of rumination on RRS scale in SZ compared to HC.[d]	Case definition: good Appropriate sample: good Selection of controls: fair Definition of controls: fair Matching: poor	Selection bias: unclear Confounding bias: unclear Measurement bias: low
(Suslow et al., 2003)	28 individuals with schizophrenia; 30 healthy controls	SZ: 35.7 (9.4) HC: 35.5 (8.6)	SAPS	ECQ	No significant difference was found regarding suppression and rumination between SZ and HC.	Case definition: good Appropriate sample: fair Selection of controls: fair Definition of controls: fair Matching: fair	Selection bias: unclear Confounding bias: unclear Measurement bias: unclear

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Table 1 (*continued*)

Author name	Sample details	Age M (SD)	Psychopath-ology measures	ER measures	Results	Quality	Risk of bias
(Tabak, Horan, & Green, 2015)	35 individuals with schizophrenia (out-patients); 38 indivi-duals with bipolar disorder (outpati-ents); 35 healthy controls	SZ: 47.06 (9.79) BP: 43.47 (11.38) HC: 47.17 (6.53)	DSM-IV (SCID) BPRS	TMMS	Post-hoc analysis revealed that the use of cognitive reappraisal was significantly higher in SZ than in HC ($t=4.38$, $p<.01$, $d=1.05$). There was no difference between SZ and patients with bipolar disorder. Correlation analysis showed no signifi-cant correlation between cognitive reappraisal and BPRS positive scores ($r=.31$, $p>.05$).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Tso et al., 2010)	33 individuals with schizophrenia or schizoaffective dis-order; 33 healthy controls	SZ: 38.5 (11.3) HC: 38.2 (9.6)	DSM-IV (SCID) BPRS	MSCEIT	Independent-samples t-test revealed significantly lower managing emotion scores in SZ compared to HC ($t=-5.27$, $p<.005$).	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Van der Meer, & Aleman, 2009)	31 individuals with schizophrenia; 44 healthy controls	SZ: 32.2 (8.0) HC: 29.2 (8.6)	DSM-IV (CASH) PANSS	ERQ	Two separate ANOVAs revealed a significant effect for group for suppression ($F=4.638$, $p=.035$) and no significant effect for group for reappraisal ($F=3.490$, $p=.066$).	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Ventura et al., 2004)	29 individuals with schizophrenia (out-patients); 24 healthy controls	SZ: 25.8 (6.3) HC: 26.9 (5.9)	DSM-IV (SCID) BPRS	CRI	Independent-samples t-test indicated no significant difference between SZ and controls regarding cog-nitive reappraisal ($t=1.32$, $p<.20$)	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Vorontsova et al., 2013)	30 individuals with schizophrenia 30 individuals with depression 30 healthy controls	SZ: 40.1 (10.7) D: 42.5 (13.1) HC: 40.4 (13.1)	SCAN v2.1 PSYRATS	RRS	A group comparison revealed a higher usage of rumination in SZ compared to HC ($t=3.286$, $p=.0017$, $d=-0.899$)	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: fair Matching: fair	Selection bias: low Confounding bias: unclear Measurement bias: low
(Xu et al., 2013)	133 individuals with schizophrenia; 50 healthy controls	SZ: 34.6 (11.4) HC: 31.8 (11.9)	PANSS	CSQ	Independent-samples t-test revealed that self-blaming ($t=3.3$, $p=.001$) and avoidance ($t=7.1$, $p<.001$) were used significantly more frequently in SZ	Case definition: fair Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: fair	Selection bias: low Confounding bias: low Measurement bias: unclear
(Zou, Y. min, Ni, K., Yang, Z. ya, Li, Y., Cai, X. lu, Xie, D. jie, … Chan, R. C. K., 2017)	146 individuals with schizophrenia 73 healthy controls	SZ: 36,3 (10.3) HC: 35.95 (10.6)	PANSS	ERQ	Independent-samples t-test indicated that HC used significantly more often reappraisal strategies ($t=3.248$, $p<.001$, $d=-0.5$). No significant differ-ence in the use of suppression strategies ($d=0.025$).	Case definition: fair Appropriate sample: fair Selection of controls: good Definition of controls: fair Matching: good	Selection bias: low Confounding bias: low Measurement bias: low

AD: Anixiety Disorder; BD: Bipolar Disorder; BPRS: Brief Psychiatric Rating Scale; CAPE: Community Assessment of Psychic Experiences; CASH: Comprehensive Assessment of Symptoms and History; CERQ: Cognitive Emotion Regulation Questionnaire; CHR: Clinical High Risk; CISS: Coping Inventory for Stressful Situations; CRI: Coping Response Inventory; CSI: Coping Strategies Inventory; CSQ: Coping Style Questionnaire; D: Depression; DIP: The Diagnostic Interview for Psychosis; DSM IV: Diagnostic and Statistical Manual of Mental Disorders 4th edition; ECQ: Emotional Control Questionnaire; ERP: Event Related Potential; ERQ: Emotion Regulation Questionnaire; ERSQ-ES: emotion specific Emotion Regulation Skill Questionnaire; FEP: First Episode Psychosis; HC: Healthy Controls; ICD- 10: International Statistical Classification of Diseases and Related Health Problems 10th edition; MAX: Maladaptive and Adaptive Coping Styles questionnaire; M.I.N.I.: Mini Mental Neuropsychiatric Interview; MSCEIT: Mayer-Salovey-Caruso Emotion Intelligence Test; PANSS: Positive and Negative Symptom Scale; PCL: Paranoia Checklist; RRS: Ruminative Response Scale; RSQ: Response Style Questionnaire; SANS: Scale for the Assessment of Negative Symptoms; SAPS: Scale for the Assessment of Positive Symptoms; SCAN v2.1: Schedules for Clinical Assessment in Neuropsychiatry version 2.1; SCID: Structured Clinical Interview for DMS Disorders; STAXI: State-Trait-Anger Expression Inventory; SZ: Schizophrenia Patients; TCQ: Thought Control Questionnaire; TMMS: Trait Meta Mood Scale.

[a] PSYRATS Item.

[b] Data from first episode participants were included in the meta-analysis.

[c] Authors were contacted in order to receive means and SDs for the suppression subscale.

[d] Authors were contacted in order to receive means and SDs on RRS scale for the meta-analysis.

Table 2
Experimental studies on emotion regulation

Author name	Sample details	Age M (SD)	Psychopathology measures	Induced Emotions	Emotion regulation strategies tested	Experimental design/manipulation	Results	Quality	Risk of bias
(Grezellschak et al., 2015)	17 individuals with schizophrenia; 27 healthy controls	SZ: 40.41 (11.52) HC: 37.89 (10.93)	CAPE	Negative affect (anxiety)	Reappraisal, distraction	Induction of anxiety through IAPS pictures and IADS-2 sounds; all participants were instructed to down-regulate their feelings through either reappraisal or distraction. Control condition = watching the pictures without deploying a strategy. State anxiety rated on visual analogue scale	A repeated measure ANOVA revealed a significant main effect for emotion regulation ($F = 12.27$, $p < .001$, $\eta_p^2 = .23$), with simple contrasts showing a significant difference between control condition and reappraisal ($p = .001$) and between control condition and distraction ($p < .001$). No significant main effect for group ($F = 2.51$, $p = .12$) and no significant interaction between group and strategy ($F = 0.20$, $p = .82$) were found. Habitual questionnaire-based data (ERQ): No significant group difference was found regarding the use of both reappraisal and suppression.	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Perry et al., 2012)	25 individuals with schizophrenia (16) or schizoaffective disorder (9); 24 healthy controls	SZ: 42.2 (9.53) HC: 42.8 (12.54)	SAPS	Negative affect (sadness)	Suppression, reappraisal, acceptance	Watching a film scene, inducing negative affect. Participants are asked to use emotion regulation strategies; rating of ability to implement strategies and willingness to watch another similar film clip; measurement of behavioral expression (surface electromyography) and subjective experience of emotion	Repeated measures ANOVAs revealed no group differences in reported levels of negative affect Increased ability to deploy acceptance, relative to suppression ($p = .17$), independent of group. No group or interaction effects of implementation of emotion regulation instructions SZ were less willing than HC to experience sadness again, regardless of the regulatory strategy that was implemented, ($F = 6.04$, $p = .018$, $\eta_p^2 = .12$) A mixed model ANOVA revealed lower levels of self-reported sadness for the implementation of reappraisal compared to expression ($p = .042$) or acceptance ($p = .032$) in both groups. No significant comparisons were obtained for suppression and any of the other conditions (all ps > .05)[a]	Case definition: good Appropriate sample: good Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low
(Van der Meer et al., 2014)	20 individuals with schizophrenia; 20 non-psychotic siblings; 20 healthy controls	SZ: 35.2 (10.8) HC: 35.5 (11.7)	PANSS	Negative affect	Suppression, reappraisal	fMRI scan; viewing IAPS pictures, inducing negative affect, four conditions (attend neutral, attend negative, reappraisal, suppression), rating of negative emotions	An ANOVA indicated no group difference for regulating negative affect with both reappraisal and the suppression strategy. Reappraising negative stimuli activated previously reported brain areas in all groups. SZ and siblings showed decreased activation of the left VLPFC compared to HC during reappraisal. Habitual questionnaire-based data (ERQ): An ANOVA indicated no group difference regarding the use of both reappraisal and suppression.	Case definition: good Appropriate sample: fair Selection of controls: good Definition of controls: good Matching: good	Selection bias: low Confounding bias: low Measurement bias: low

CAPE: Community Assessment of Psychic Experiences; ERQ: Emotion Regulation Questionnaire; fMRI: functional Magnetic Resonance Imaging; HC: Healthy Controls; IADS-2: International Affective Digitized Sounds System; IAPS: International Affective Pictures System; PANSS: Positive and Negative Symptom Scale; SZ: Schizophrenia Patients; SAPS: Scale for the Assessment of Positive Symptoms; VLPFC: Ventrolateral Prefrontal Cortex.

[a] Authors were contacted in order to receive data for means and SDs.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cpr.2019.101746.

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