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Acceptance and Efficacy of Metacognitive Training (MCT) on Positive Symptoms and Delusions in Patients With Schizophrenia: A Meta-analysis Taking Into Account Important Moderators

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Metacognitive training (MCT) is a new, widely used intervention for psychosis. The present meta-analysis examines the efficacy of MCT in schizophrenia. Fifteen studies comparing effects of MCT on positive symptoms, delusions or acceptance of MCT with a control group were included in this meta-analysis. These studies comprised a total of 408 patients in the MCT condition and 399 in the control condition. The moderating effects of masking of outcome assessment, randomization, incomplete outcome data, use of an active control intervention, and individual vs group MCT were investigated. Possible effects of sensitivity analyses and publication bias were also examined. The results show a significant overall effect of MCT for positive symptoms (g = −0.34, 95% CI [−0.53, −0.15]), delusions (g = −0.41, 95% CI [−0.74, −0.07]) and acceptance of the intervention (g = −0.84, 95% CI [−1.37, −0.31]). Using only studies being at low risk for bias regarding randomization, masking and incomplete outcome data reduced effect sizes for positive symptoms and delusions (g = −0.28, 95% CI [−0.50, −0.06] and g = −0.18, 95% CI [−0.43, 0.06]), respectively. This meta-analysis demonstrates that MCT exerts a small to moderate effect on delusions and positive symptoms and a large effect on acceptance of the intervention. The effect on delusions is reduced, but remains significant when potential biases are considered.

Key words: metacognitive training/psychosis/schizophrenia/delusions/acceptance/cognitive bias/rehabilitation

Introduction

Delusions are key symptoms of schizophrenia that are often accompanied by distress, and may result in hazardous decisions including assaulting others or suicide.[1] Several studies have shown that delusions arise from cognitive biases[2–7] that consist of distortions in the collection, appraisal and processing of information (eg, jumping to conclusions [JTC], overconfidence in errors). Several psychological interventions have been developed in order to reduce the symptoms of schizophrenia, with recent meta-analyses showing small to moderate effect-sizes for cognitive-behavioral therapy, cognitive remediation, and psychoeducation.[8–12] Metacognitive training (MCT) is a novel intervention for patients with schizophrenia that has been developed by Moritz and colleagues.[13] This program blends elements of psychoeducation, cognitive remediation, and cognitive-behavioral therapy. In contrast to cognitive-behavioral therapy, MCT first addresses cognitive biases before approaching the core symptoms. It aims to "straighten" the cognitive biases associated with delusions, particularly JTC,[14,15] problems with taking the perspective of others and deficits in social cognition.[16] Furthermore, MCT also tries to foster self-esteem, as people diagnosed with schizophrenia have low self-esteem compared to healthy controls.[17]

The initial version of MCT consists of a manualized group training and contains interventions addressing attributional style, JTC, problems taking perspectives of others, change of beliefs, low self-esteem and exercises to improve memory and to foster correction of beliefs.[13] The modules can be downloaded free of charge from via the following website: http://www.uke.de/mct. A summary of the different modules of MCT is presented in supplementary material S1. Individual MCT (MCT+) is a variant of MCT designed for use in a one to one setting. Important add-ons to group MCT are the generation of an individual illness model and

recovery plan and an additional focus on negative symptoms. In addition it is possible to focus more on individual participants' symptoms than in the group MCT. MCT+ may be particularly useful for severely ill patients who have difficulties taking part in group MCT. Finally, all modules of MCT follow the same structure and combine theoretical explanations with practical elements. This provides the program with substantial unity and coherence, making MCT particularly suitable for meta-analytic reviews.

The efficacy of MCT in patients with schizophrenia spectrum disorder was summarized in a narrative review[18] and investigated in 2 meta-analyses.[19,20] Both meta-analyses were however limited either by insufficient statistical power (the meta-analysis by Jiang et al[19] included only 4 studies measuring positive symptoms and delusions) or by statistical flaws, particularly with respect to the selective exclusion of positive studies.[21] The meta-analysis by van Oosterhout et al[20] excluded 3 positive studies as a result of using excessively conservative exclusion criteria, particularly when considering the small number of available studies: 2 studies[22,23] were excluded given that pre- and post-measures were not available, although the pre-post difference was reported in the article and although statistical methods exist to determine effect size in such cases[24]; one study[25] was excluded because scores of partial subscales (and not of the global scale) were reported, although the complete data were available by contacting the authors of the study. Therefore in the meta-analysis presented here, more suitable inclusion criteria were used to investigate the effect of MCT on positive symptoms and delusions. Given that the level of active engagement differs significantly between those patients with schizophrenia who dropout of cognitive-behavioral therapy and those who finish the therapy,[26] acceptance of MCT and of control interventions were compared as higher acceptance of a therapy might foster higher adherence.

It was hypothesized that patients undergoing MCT would display a reduction in positive symptoms and fewer delusions compared to participants in control groups at the end of therapy. Additionally, it was hypothesized that acceptance of MCT was higher than acceptance of control interventions.

Method

Inclusion and Exclusion Criteria

Studies were included in the meta-analysis, if (1) participants had a diagnosis of a schizophrenia spectrum disorder according to *DSM-IV-TR* criteria[27]; (2) the intervention group received MCT; (3) a control condition was included; and (4) at least one of the relevant outcomes was measured. Studies evaluating group and individual MCT were considered.

Studies that provided other elements of psychological interventions for the experimental group in addition to MCT were excluded, particularly Reasoning Training[28] and combinations of Social Cognition and Interaction Training (SCIT) and MCT,[29] as these studies can not differentiate between effects stemming from MCT and those stemming from the addition of other psychological interventions.

Outcomes

Positive Symptoms. As a measure of positive symptoms the positive subscale of the Positive and Negative Syndrome Scale (PANSS)[30] was used. One study[31] calculating the positive subscale of the PANSS with slightly different items than in the original version was also included. For another study[25] that used multiple algorithms for the positive subscale of the PANSS, one algorithm was chosen by a person not involved in this meta-analysis drawing numbers, with the result being that the algorithm from Knorring[32] was used for this meta-analysis. In contrast, the total score of the Psychotic Symptom Rating Scales (PSYRATS)[33] was not used as a measure of positive symptoms, because some studies showed that the PSYRATS is not strongly correlated with the positive subscale of the PANSS, such that these instruments may tap into different concepts.[34,35]

Delusions. The sum of the delusions subscale of the PSYRATS was used as a measure for delusions. As an alternative, the Peters et al Delusion Inventory (PDI-21)[36] was used in one study. Not used was the Brown Assessment of Beliefs Scale (BABS)[37] because it focuses more on insight in delusions and is therefore not directly comparable to the PSYRATS and PDI-21.[38]

Subjective Acceptance of the Intervention. Subjective acceptance of the intervention was measured with the 10-item acceptance questionnaire[39] or similar shorter versions thereof. Answers could be given on a 5-point Likert scale from 1 (*fully disagree*) to 5 (*fully agree*). The standard deviations of the means in individual studies only reporting means and standard deviations for the individual items were calculated using the formula from Borenstein[40] and imputing the correlations between items in the study by Moritz et al.[41] For all calculations pertaining to acceptance, calculated effect sizes of individual studies were recoded, so the direction of effects was the same as for delusions and positive symptoms with lower values indicating an advantage for the group receiving MCT.

For all outcomes only the post measurements were considered for this meta-analysis. Follow-up measurements were not considered as these were only available for a few studies that also used different interval until follow-up so that results were not comparable.

Identification of Studies

Studies about MCT for schizophrenia were searched by C.E. in the following data bases from 2007 until June 2,

2015: PsycINFO, PUBMED, Embase, and the Cochrane central register of controlled trials. 2007 was chosen as a start date as the first study on MCT was published in this year. The search in these data bases was conducted using the following terms which had to be part of the title or keywords: (delusion* or psychosis or psychotic or schizophren*) and (metacogn* or reason* or cognitive bias*) and (training or therap* or intervention). Studies in any language were considered, although all studies included in this meta-analysis were published in English. Additionally, the reference lists of all identified studies were searched for further studies. Prof. Dr Steffen Moritz, one of the developers of MCT, was also consulted for identifying relevant studies. The systematic review was executed according to the PRISMA standard, including evaluation of bias (confounding, overlapping data, publication bias).[42]

Data Collection and Analysis

Control of Potential Biases. Data from studies was coded independently by the 2 authors of the article using a coding protocol.

Randomized Group Allocation To control for potential effects of nonrandomized group, allocation studies that stated that participants were nonrandomly allocated to experimental groups were considered to be at a high risk for bias. Additionally, studies that did not explicitly state that participants were randomly allocated to groups were considered as being at a high risk for bias. It was assumed that study authors would have mentioned randomized group allocation, if they had employed it. Studies stating that they randomly assigned participants to different groups were considered to be at a low risk for bias with regard to randomized group allocation.

Masking Studies that used interviewers for assessing outcomes, who were not informed about group allocation of the questioned participants, were considered as being at a low risk for bias. Studies using interviewers who knew about group allocation of the tested participants were considered as being at a high risk for bias. Studies making no statement about masking were also considered as having a high risk for bias, as it was assumed that study authors would have provided information about masking if they had employed it. Furthermore, data that was only assessed by self-report of the participants was considered to have a high risk for bias.

Incomplete Outcome Data Similar to the approach used in the meta-analysis about cognitive-behavioral therapy,[8] studies with dropout rates of more than 20% that used no intent-to-treat approach were considered to be at a high risk for bias.

Effect Size Measures. Effect sizes were calculated using the standardized mean difference Hegdes' *g* with Review Manager 5.

Dealing With Missing Data If variables, necessary for effect size calculations, could not be taken directly from studies responsible authors were contacted in keeping with Cochrane guidelines (Chapter 7).[43] In cases where only the standard deviation of posttest scores was missing the standard deviation from the pretest was imputed. In studies that reported mean change scores instead of mean posttest scores, the change scores were used as an estimate for the effect size.[24] Change scores were recoded to ensure that the direction of the effect was similar to studies using the posttest mean for the calculation of effect sizes. The required standard deviations of the change scores were calculated with the formula provided by Lipsey and Wilson.[24] Moritz et al[41] calculated a mean correlation of $r = .768$ between pretest and posttest scores of the PANSS positive subscale in their study investigating the efficacy of MCT. This correlation was imputed for calculations of missing standard deviations of change scores. In one study,[22] only change scores of single items of the delusion subscale of the PSYRATS were reported. The change scores were summed and used as an estimate for the effect size according to the method put forward by Lipsey and Wilson.[24] The sum of change scores of single items was recoded to ensure the direction of the effect was similar to studies using the posttest mean for calculation of effect sizes. In one study,[44] only 2 of 3 items used to assess acceptance were reported. As mean and standard deviation for the missing item could not be estimated, the acceptance scale in this study was calculated considering just the 2 items for which means and standard deviations were reported.

To assess heterogeneity of effects values for I^2 with confidence intervals, τ with confidence intervals and *Q*-statistics with significance tests were calculated using R metafor. Publication bias was examined using funnel plots for all relevant outcomes. Missing studies were imputed using trim and fill procedures as proposed by Duval and Tweedie[45,46] using R metafor. Random effect models were used for the analysis of all outcome measures as the studies included in this meta-analysis were heterogeneous. As differences between groups at baseline can skew the estimate of the posttest effect size, effect sizes for pretest scores were computed for both delusions and positive symptoms.

Subgroup Analysis and Analysis of Heterogeneity. Effect of an Active Control Intervention The aim was to investigate how the use of an active psychological control intervention influenced the effect sizes. Each psychological intervention that exceeds contacts with providers of treatment typically provided in treatment as usual settings was defined as an active control intervention. *Q*-statistics with significance tests were used to test for subgroup differences.

Effect of Group vs Individual Training It was examined whether effects of MCT differed depending on the setting, ie, group or individual therapy. *Q*-statistics with significance tests were used to test for subgroup differences.

Sensitivity Analyses. Sensitivity analyses were performed for all outcomes to determine whether the results were driven mainly by single studies. Heterogeneity of the remaining studies was assessed with I^2 with confidence intervals, τ with confidence intervals and Q-statistics with significance tests. These were calculated using R metafor.

Results

Description of Studies

The search in data bases produced 158 articles, another 6 articles were identified by checking reference lists of considered studies. In addition, one study[47] was considered that had come to the attention of Prof. Steffen Moritz, one of the developers of MCT. After removing duplicates, 89 studies were screened for title or abstract for fulfilling inclusion criteria. Then, 28 studies were screened on full text basis; 13 studies were excluded on the basis of the full text. Finally, 15 studies were included in the meta-analysis (see figure 1 for a flow chart of the selection process).

One study[48] was excluded on the grounds that both groups received MCT. One study[29] was excluded, because the intervention group received social cognition training in addition to MCT. One study[28] was excluded, because delusions were measured by self-rated conviction and no other outcome relevant for this meta-analysis was measured. One study[49] was excluded because acceptance was only assessed for the group receiving MCT and no other relevant outcome was reported. An overview over all included studies is given in table 1.

Effect Sizes

Positive Symptoms. The effect size for 11 studies on positive symptoms was $g = -0.34$, 95% CI [−0.53, −0.15], $P < .01$ (negative sign favors MCT, see figure 2). The studies were homogeneous with $Q = 10.28$, $P = .42$, $I^2 = 2.68$, 95% CI [0.00, 68.70] and $\tau = 0.05$, 95% CI [0.00, 0.48].

Delusions. The effect size for 11 studies on delusions was $g = -0.41$, 95% CI [−0.74, −0.07], $P = .02$ (figure 3). The studies were heterogeneous with $Q = 40.49$, $P < .01$, $I^2 = 75.30$, 95% CI [49.13, 92.85] and $\tau = 0.48$, 95% CI [0.27, 0.99].

Acceptance of MCT. The effect size for 5 studies on acceptance of the intervention was $g = -0.84$, 95% CI [−1.37, −0.31], $P < .01$ (figure 4). The studies were heterogeneous with $Q = 16.50$, $P < .01$, $I^2 = 75.75$, 95% CI [33.36, 97.33] and $\tau = 0.52$, 95% CI [0.21, 1.77].

Analysis of Potential Biases

Risk of Bias. No significant difference in effect sizes were observed between studies with high vs low risk of bias with respect to randomization, masking and completeness of outcome data (supplementary material S2).

Sensitivity Analyses. Removing individual studies from the meta-analysis of positive symptoms made little difference to the findings (all gs between −0.29 to −0.44 with Ps < .01). Removing the study from Erawati et al[22] in the meta-analysis of delusions considerably reduced the effect size to $g = -0.25$, 95% CI [−0.51, 0.00], $P = .05$, which remained significant. This also considerably reduced heterogeneity in the remaining studies with $Q = 19.07$, $P = .02$, $I^2 = 52.80$, 95% CI [17.74, 87.31] and $\tau = 0.29$, 95% CI [0.01, 0.71]. A similar result was obtained if the So et al[47] study was removed from the meta-analysis of delusions with $g = -0.33$, 95% CI [−0.65, 0.00], $P = .05$. In contrast, if the study by van Oosterhout et al[50] was removed the effect size increased to $g = -0.49$, 95% CI [−0.81, −0.16], $P < .01$ and heterogeneity of the remaining studies dropped to $Q = 26.76$, $P < .01$, $I^2 = 66.37$, 95% CI [31.98, 91.67] and $\tau = 0.42$, 95% CI [0.21, 1.00]. The effect size of acceptance of the intervention changed only slightly if individual studies were removed (all gs between −0.61 to −1.01with Ps ≤ .01).

Analysis of Baseline Differences Between Groups. The effect size of pretest scores for positive symptoms was $g = 0.01$, 95% CI [−0.28, 0.30]. The effect size of pretest scores for delusions was $g = 0.13$, 95% CI [−0.03, 0.29], indicating that participants in the control groups had slightly less delusions than participants in the groups about to get MCT, although this effect was not significant.

Influence of the Use of an Active Control Intervention. Effect sizes did not differ significantly according to the presence or absence of an active control group (supplementary material S3).

Difference Between Group and Individual MCT. Effect sizes were higher in studies using Individual than Group MCT but differences were not significant (all Ps > .09; supplementary material S4).

Publication Bias. Funnel plots for positive symptoms, delusions and acceptance of the intervention are presented in supplementary figures S5, S6 and S7, respectively. Using trim and fill procedures 2 studies were imputed in the meta-analysis of positive symptoms. If the asymmetry is due to publication bias, our analyses suggest that the true effect size on positive symptoms is $g = -0.29$, 95% CI [−0.50, −0.07], $P = .01$. Using trim and fill procedures no studies were imputed in the meta-analysis on delusions or acceptance of the intervention.

Discussion

This meta-analysis showed a significant small to medium effect of MCT on positive symptoms. Studies were somewhat more homogeneous, thus allowing generalization of the findings. Results are thus in accordance with a previous meta-analysis[19] which also found a significant effect of MCT on positive symptoms, but considered fewer studies.

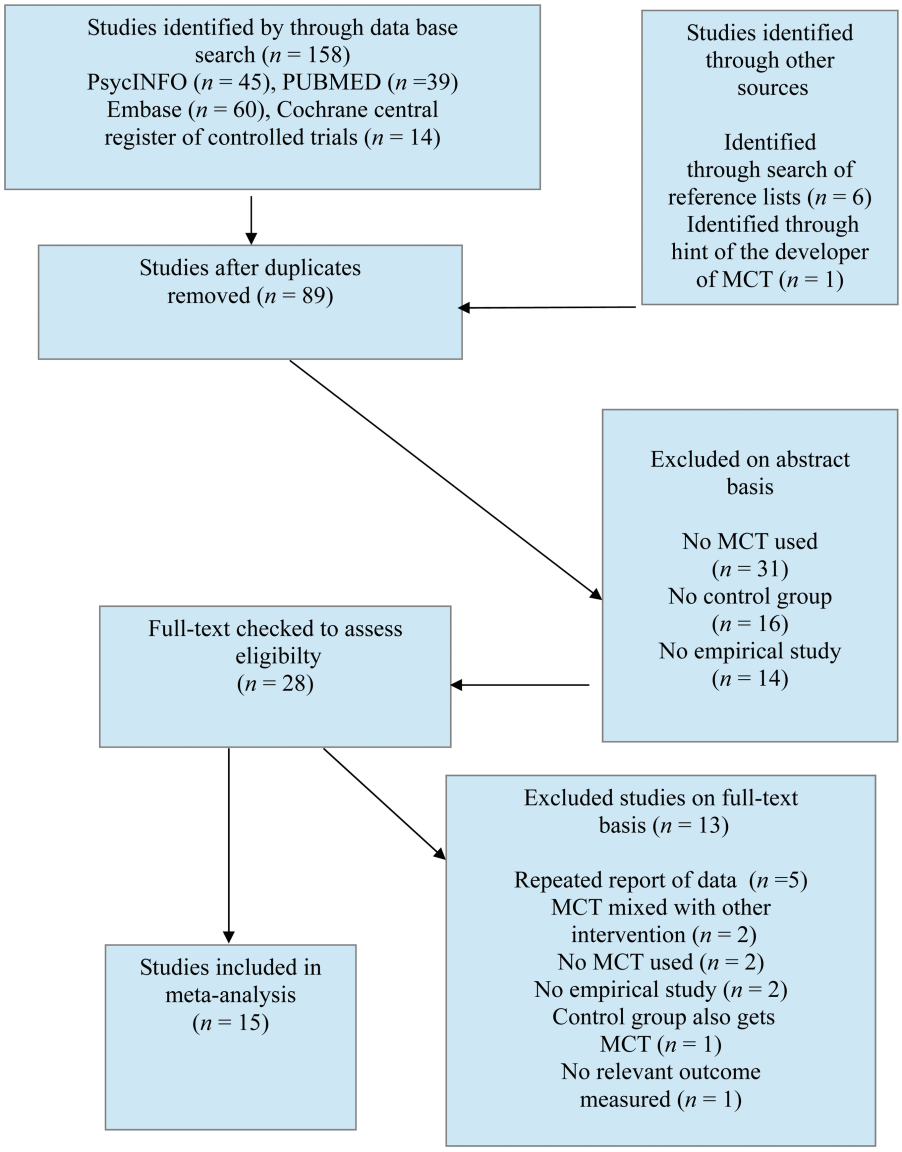

Fig. 1. Flow chart of study selection. Adapted from, Moher et al.[42] *n* = number of studies.

A second meta-analysis[20] showed a slightly smaller and nonsignificant effect of MCT on positive symptoms, but this study had used different inclusion criteria, excluding studies that did not provide complete outcome data for both pretest and posttest. Likewise, there was also a small to medium effect on delusions. The studies were heterogeneous, making it more difficult to generalize the findings. Effects were larger than in the second meta-analysis,[20] again reflecting differences in inclusion criteria. There was a large effect for acceptance of MCT, indicating that acceptance of MCT was considerably better than the acceptance of control interventions. This is noteworthy in view of high rates of nonadherence in patients with schizophrenia for both pharmacological and psychological interventions.[26,51,52] However, as 3 out of the 5 studies used to compare acceptance of the intervention used CogPack[53] as the control intervention, the finding that MCT is better accepted than control interventions seems to be true for the comparison with CogPack, but must still be put to test for other psychological interventions. Heterogeneity of the included studies makes it difficult to generalize the findings.

Influences of Potential Biases

Influences on Effect Sizes for Positive Symptoms. Sensitivity analyses as well as analyses examining a possible publication bias suggest robust findings with applies to both studies using active and passive control interventions. If nonrandomized group allocation, non-masked outcome assessment and incomplete outcome data were accounted for simultaneously, there was a larger effect on positive symptoms for studies being at high risk of bias than for studies being at low risk of bias. Yet, the small to

Table 1. Summary Table of Included Studies and Effect Sizes

Author and Year	Sample[a]	Mesurement[b]	RCT	Masking	Dropout[c]	Effect Sizes [CI]	Significance	Notes
Aghotor et al, 2010	MCT (group): $n = 16$, vs newspaper discussion group: $n = 14$	Baseline, after 4 weeks	yes	yes	13.3	Positive: −0.28 [−1.05, 0.50] Acceptance: −0.57 [−1.41, 0.28]	Positive: $P = .48$ Acceptance: $P = .67$	Low statistical power, change scores are used for effect size calculation
Balzan et al, 2014	MCT (individual single-session training): $n = 14$, vs TAU: $n = 14$	Baseline, 2 weeks after training	no	no	0	Positive: 0.05 [−0.69, 0.80] Delusions: 0.12 [−0.63, 0.86] Acceptance: $M = -3.92$[d], $SD = 0.46$[d]	Positive: $P = .89$ Delusions: $P = .76$	Significant group differences favoring control group at pretest, PDI-21 used to assess delusions
Briki et al, 2014	MCT (group): $n = 35$, vs supportive therapy: $n = 33$	Baseline, after 8 weeks	yes	yes	26.5	Positive: −0.59 [−1.16, −0.02] Delusions: −0.17 [−0.72, 0.39] Acceptance: −0.25 [−0.80, 0.31]	Positive: $P = .04$ Delusions: $P = .55$ Acceptance: $P = .38$	Only 3 items used to assess acceptance, of which only 2 were reported
Erawati et al, 2014	MCT (individual): $n = 26$, vs TAU: $n = 26$	Baseline, after 4 weeks	no	no	0	Delusions: −1.72 [−2.37, −1.08] Acceptance: $M = -3.78$[d], $SD = 0.10$[d]	Delusions: $P < .01$	Change scores are used for effect size calculation, pretest standard deviations are imputed
Favrod et al, 2014	MCT (group): $n = 26$, vs TAU: $n = 26$	Baseline, after 8 weeks	yes	yes	7.7	Positive: −0.49 [−1.06, 0.09] Delusions: −0.54 [−1.12, 0.04]	Positive: $P = .10$ Delusions: $P = .07$	
Gawęda et al, 2015	MCT (group): $n = 26$, vs TAU: $n = 24$	Baseline, after 4 to 5 weeks	yes	yes	12.0	Delusions: −0.35 [−0.94, 0.25]	Delusions: $P = .25$	
Kumar et al, 2010	MCT (group): $n = 8$, vs TAU: $n = 8$	Baseline, after 4 weeks	yes	yes	0	Positive: −0.92 [−1.97, 0.13]	Positive: $P = .09$	Low statistical power
Kuokkanen et al, 2014	MCT (group): $n = 10$, vs TAU: $n = 10$	Baseline, after 4 weeks	yes	yes	0	Positive: −0.16 [−1.03, 0.72] Delusions: −0.25 [−1.13, 0.63]	Positive: $P = .73$ Delusions: $P = .57$	SD were imputed from pretest scores, P1+P6+ G12 used for PANSS positive
Moritz, Kerstan, et al, 2011	MCT (group): $n = 18$, vs wait list control $n = 18$	Baseline, after 8 weeks	yes	yes	0	Positive: −0.03 [−0.68, 0.63] Delusion: −0.09 [−0.74, 0.56] Acceptance: $M = 4.31$[d], $SD = 0.16$[d]	Positive: $P = .93$ Delusion: $P = .79$	Around 50% of the participants were diagnosed with a substance dependence disorder
Moritz et al, 2013	MCT (group): $n = 76$, vs CogPack $n = 74$	Baseline, after 4 weeks	yes	yes	10.0	Positive: −0.10 [−0.44, 0.24] Delusion: −0.22 [−0.56, 0.12] Acceptance: −0.49 [−0.83, −0.14]	Positive: $P = .57$ Delusion: $P = .2$ Acceptance: $P < .01$	
Moritz, Veckenstedt, et al, 2011	MCT (group and individual): $n = 24$, vs CogPack: $n = 24$	Baseline, after 4 weeks	yes	yes	8.3, but ITT approach	Positive: −0.65 [−1.24, −0.07] Delusion: −0.48 [−1.05, 0.09] Acceptance: −1.71 [−2.38, −1.05]	Positive: $P = .03$ Delusion: $P = .10$ Acceptance: $P < .01$	Knorring algorithm for PANSS positive was used
Moritz & Woodward, 2007	MCT (group): $n = 20$, vs CogPack: $n = 20$	Retrospective assessment after 4 weeks	yes	no, subjective assessment	0	Acceptance: −1.34 [−2.03, −0.65]	Acceptance: $P < .01$	

Table 1. *Continued*

Author and Year	Sample[a]	Mesurement[b]	RCT	Masking	Dropout[c]	Effect Sizes [CI]	Significance	Notes
Naughton et al, 2012	MCT (group): $n = 11$, vs wait list control: $n = 8$	Baseline, after 6 months	no	no	0	Positive: −0.36 [−1.28, 0.56]	Positive: $P = .45$	
So et al, 2015	MCT (short version, modules 2,3,5, and 7 in individual setting): $n = 23$, vs TAU: $n = 21$	Baseline, after 4 weeks	yes	yes	29.6	Positive: −0.98 [−1.74, −0.23] Delusion: −1.33 [−2.12, −0.54] Acceptance: $M = -4.06$[d], $SD = 0.06$[d]	Positive: $P = .01$ Delusion: $P = .01$	
Van Oosterhout et al, 2014	MCT (group): $n = 75$, vs TAU: $n = 79$	Baseline, after 8 weeks	yes	yes	16.9 but ITT approach	Delusion: 0.25 [−0.06, 0.57]	Delusion: $P = .12$	Study included only moderately to severely deluded patients

Note: n, number of participants; TAU, treatment as usual; RCT, randomized controlled trial; ITT, intention to treat; MCT, metacognitive training; PANSS, Positive and Negative Syndrome Scale; PDI-21, Peters et al Delusion Inventory.
[a]Given values are the number of participants at the start of the study.
[b]Only measurements relevant for this meta-analysis are stated.
[c]Values are given in percent.
[d]Descriptive results of acceptance for MCT group.

medium effect on positive symptoms remained significant even for those studies being at low risk of bias, indicating that differences in methodological rigor were responsible for some, but not all of the effects.

Influences on Effect Sizes for Delusions. When randomized group allocation, masked assessment of outcomes and missing outcome data were considered simultaneously, the effect on delusions differed considerably between studies being at low risk for bias and studies being at high risk for bias, indicating that differences in methodological rigor were partly responsible for the effect. Yet, there was still a nonsignificant effect on delusions when only studies being at low risk for bias were considered. The nonsignificant findings for studies being at low risk of bias were mainly driven by one study.[50] It remains unclear if the nonsignificant findings for studies being at low risk for bias indicate that there was no effect above chance or if the results just remained insignificant due to low power, often a problem in subgroup analyses when there are few studies per subgroup.

There was considerable difference between studies using an active control intervention and studies using treatment as usual or a waiting group, indicating that some of the effects on delusions were due to lack of appropriate control interventions. However, even for the subgroup using active control interventions, there was a significant small effect on delusions, so some, but not all of the effect size on delusions can be attributed to differences regarding the control interventions used.

Sensitivity analyses showed that omitting individual studies changed the results considerably in some cases. If the study by Erawati et al[22] was removed the effect size decreased. This study showed a very large effect of MCT on delusions. But effect size calculations could not be carried out using the original data, so change scores for individual items of the PSYRATS delusion subscale were summed up and used as the mean score of the posttest. Furthermore, neither standard deviations of change scores nor standard deviations of posttest scores were provided, so standard deviations from pretest scores had to be imputed. This might have led to an overestimation of the actual effect in this study. Removing the study by So et al[47] also reduced the effect size considerably.

On the other hand, removing the study by van Oosterhout et al[50] increased the effect size on delusions. It was one of 2 studies reporting lower posttest values of delusions for patients in the control condition than for patients in the condition receiving MCT. It was a high-quality study. However, patients with severe delusions were included, whereas the other studies in this meta-analysis tended to exclude severely deluded patients for the group intervention. It is possible that patients in this study[50] were too disorganized or not attentive enough due to concurrent positive symptoms, which might explain the negative effect on delusions in this study. In addition, an earlier version of MCT was used, which failed to stress the importance of

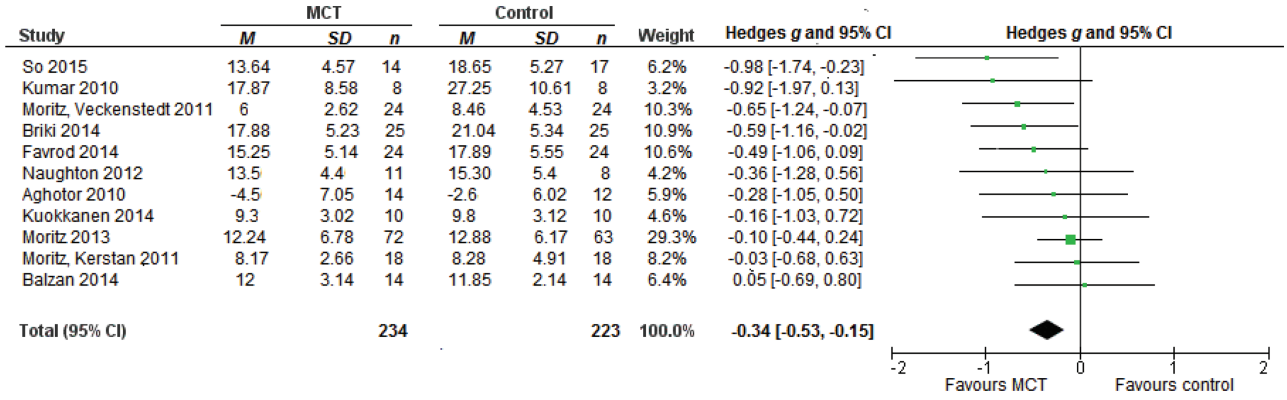

Fig. 2. Forest plot of studies in the meta-analysis of positive symptoms. Effect sizes of metacognitive training (MCT) on positive symptoms.

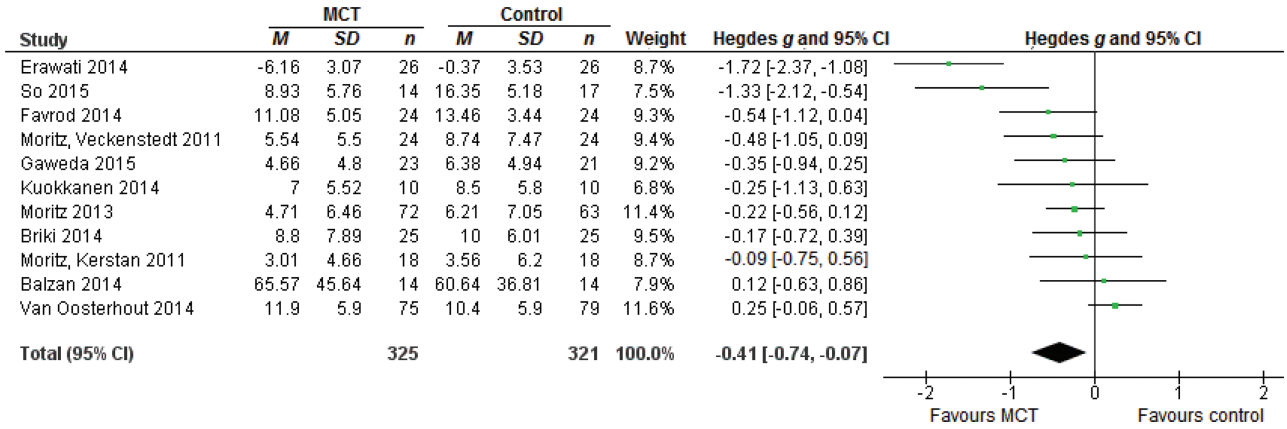

Fig. 3. Forest plot of studies in the meta-analysis of delusions. Effect sizes of metacognitive training (MCT) on delusions.

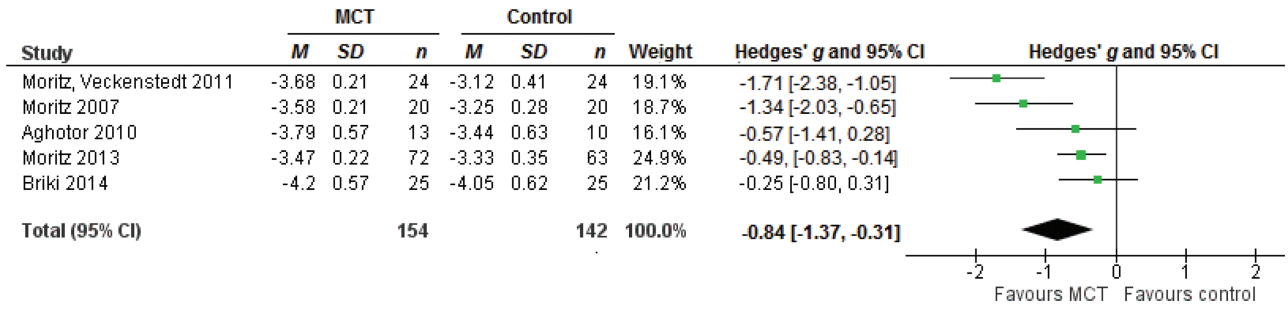

Fig. 4. Forest plot of studies in the meta-analysis of acceptance of the intervention. Effect sizes of acceptance of the intervention.

attenuating one's level of confidence in the light of incomplete or ambiguous evidence. Newer versions of the MCT have added this feature as a core element of MCT. No publication bias was evident for the meta-analysis of delusions.

Influences on Effect Sizes for Acceptance of the Intervention. The findings were robust to sensitivity analyses. One study[44] that was considered to be at high risk of bias considering randomized group allocation and missing outcome data showed a considerably smaller effect on acceptance than the studies being classified as being at low risk of bias. The reason for this might be that this study used a different scale than the other studies for assessing acceptance and only 2 items (originally 3 items, but only 2 items were reported), whereas the other studies used 10 items. The items used were also formulated differently than in the other studies. Thus it may be difficult to compare the value for acceptance in this study with the other studies. No publication bias was evident for the meta-analysis of acceptance of the intervention.

Special Issues of Individual Studies. One study[54] included in this meta-analysis reported lower posttest

scores on positive symptoms for the control group than for the MCT group. It also reported lower posttest scores of delusions for the control group. This was due to significant pretest group differences favoring the control group with regard to both positive symptoms and delusions.

Differences Between Individual and Group MCT

Effect sizes for individual MCT were considerably larger than effect sizes for group MCT for all outcome measures. Still it needs to be considered that except for one study[55] that investigated a version of MCT that combined group and individual sessions, all studies investigating individual MCT either used nonrandomized group allocation and non-masked assessment of outcomes, or were at high risk for bias regarding incomplete outcome data. So one cannot be sure whether the larger effects of individual MCT really indicate an advantage of individual MCT over group MCT or were simply due to lower study quality of studies investigating individual MCT.

Limitations

One limitation of this meta-analysis is that it sometimes used different types of outcome data for calculating effect sizes. While most studies reported means and standard deviations for posttest values, one study[23] reported only change scores from pretest to posttest with the corresponding standard deviations. One study[22] also reported change scores only and failed to report standard deviations of change scores, making it necessary to impute pretest standard deviations. Pretest standard deviations had also to be imputed in another study.[31] These inconsistent outcome measures might have influenced the effect size calculations. As studies investigating individual MCT were of lower methodological quality (except one study[55]), it cannot be determined if larger effects for individual MCT were the result of a decreased of methodological rigor. Therefore more high-quality studies investigating individual MCT should be conducted. Significance tests for subgroup analyses and tests for differences between subgroups had low power because the number of studies was relatively small and so the number of studies in subgroups was even smaller. Therefore it is hard to interpret tests of significance for subgroups.

In addition to these methodological limitations, these results are limited by few investigations into long-term effects of MCT. Due to the small number of studies reporting follow-up assessments, a meta-analysis of these data was not possible, but these 2 studies found significant positive results for both delusions and positive symptoms in patients reassessed 6 to 36 months after the end of MCT.[56,57] Finally, over and above the significant effect of MCT on positive symptoms, its clinical relevance in terms of both daily life and social functioning has not been assessed to date, and future studies should include measures of global functioning and social cognition to better document these points.

Conclusions

The present meta-analysis showed small to moderate effect sizes for MCT on delusions and positive symptoms of schizophrenia. These were in similar range as those reported with cognitive-behavioral therapy of positive symptoms for schizophrenia.[8,9,12] Acceptance of MCT was also high, and altogether, this evidence supports the dissemination of MCT in routine care. Clinicians should however be aware that individual MCT may be more effective than group MCT for patients with severe delusions, given the results of one study[50] that did not found significant effects of group MCT on samples including severely delusional patients. Cognitive-behavioral therapy also represents a validated therapeutic option for patients with medication-resistant psychotic symptoms.[12]

Supplementary Material

Supplementary material is available at http://schizophreniabulletin.oxfordjournals.org.

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