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Autobiographical memory style and clinical outcomes following mindfulness-based cognitive therapy (MBCT): An individual patient data meta-analysis

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ABSTRACT

The ability to retrieve specific, single-incident autobiographical memories has been consistently posited as a predictor of recurrent depression. Elucidating the role of autobiographical memory specificity in patient-response to depressive treatments may improve treatment efficacy and facilitate use of science-driven interventions. We used recent methodological advances in individual patient data meta-analysis to determine a) whether memory specificity is improved following mindfulness-based cognitive therapy (MBCT), relative to control interventions, and b) whether pre-treatment memory specificity moderates treatment response. All bar one study evaluated MBCT for relapse prevention for depression. Our initial analysis therefore focussed on MBCT datasets only($n = 708$), then were repeated including the additional dataset($n = 880$). Memory specificity did not significantly differ from baseline to post-treatment for either MBCT and Control interventions. There was no evidence that baseline memory specificity predicted treatment response in terms of symptom-levels, or risk of relapse. Findings raise important questions regarding the role of memory specificity in depressive treatments.

Tackling recurrent depression is a key global priority. Chronic and remitting depressive presentations are associated with higher mortality and increased severity of physical health conditions (e.g., cardiovascular disease; Hare, Toukhsati, Johansson, & Jaarsma, 2013) and thus increase burden on healthcare systems. We do have effective medications and psychological interventions for chronic depression (National Institute for Health and Care Excellence, 2009). However, symptoms commonly recur when antidepressant medication is ceased (Shelton, 2001). Similarly, over 50% of acutely depressed individuals treated with psychological interventions still experience later relapse (Kessler, Zhao, Blazer, & Swartz, 1997). There is some evidence that both psychological relapse prevention interventions such as Mindfulness-Based Cognitive Therapy (MBCT) and continuation of antidepressants into remission may reduce future recurrence of depression (Breedvelt et al., in press). Identification of patient-level cognitive factors which may promote or interfere with the efficacy of such interventions and modulate treatment responsiveness may help explain why gold-standard interventions do not work for everyone. Here, we use individual-patient data

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meta-analysis to evaluate one patient-level cognitive factor with established links to the course of depression – the specificity versus generality of recollected autobiographical memories – and its interactions with MBCT.

Reduced ability to recall specific, detailed memories for autobiographical events is an established marker of recurrent depression that is prototypically measured using a cognitive paradigm – the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986). On the AMT, depressed individuals tend to recall their personal past in overgeneralized summaries (e.g., '*I never did well at school*'), rather than isolating specific, single-incident events (e.g., '*I failed my final-year maths exam*') (Williams et al., 2007). Reduced specificity in autobiographical memory underlies the overgeneralized, negative self-beliefs which drive depression(Hitchcock, Rees, & Dalgleish, 2017), is associated with increased frequency of depressive episodes and suicide attempts (Kuyken & Brewin, 1995; Williams & Broadbent, 1986), continues to characterize patients in remission (Mackinger, Pachinger, Leibetseder, & Fartacek, 2000) and predicts the course of depression, including relapse (for aggregate data meta-analysis see Sumner, Griffith, & Mineka, 2010; recently updated by Hallford, Rusanov, Yeow, & Barry, 2020).

The role of autobiographical memory specificity in determining outcomes following MBCT for recurrent depression is interesting for several reasons. On the one hand, MBCT intentionally fosters the ability to attend to specific aspects of the internal (e.g., bodily sensations) and external (e.g., auditory) environment, as well as cultivating a sense of 'being in the moment'. This repeated focus on concrete, specific details may therefore train the use of a more specific (as opposed to abstract) processing mode, which experimental studies suggest can increase recall of specific autobiographical memories and other cognitive information (Watkins & Teasdale, 2001). On the other hand, MBCT provides training in decentering – psychologically stepping back (Manjaly & Iglesias, 2020)– from the generalised autobiographical themes that populate the mind in those vulnerable to depression in the form of ruminations or thoughts about the past. The combination of this re-orientation away from the generic past and the focus on enhancing the salience of the specifics of current experience, suggest that MBCT may operate by shifting the cognitive processing style that is indexed by memory specificity. The literature exploring these possibilities is minimal. There is prior published evidence that memory specificity does improve following MBCT (Williams, Teasdale, Segal, & Soulsby, 2000). However, this finding has not been well replicated (Jermann et al., 2013). Similarly mixed findings pertain to other interventions for depression including cognitive behavioural therapy (CBT) and anti-depressant medication (McBride, Segal, Kennedy, & Gemar, 2007).

Individual differences in the pre-treatment ability to retrieve specific memories may also influence clinical outcome following MBCT. Because MBCT trains the ability to narrow in on specific experiences, those individuals with a relatively stronger pre-treatment tendency to focus on specific details of personal experience may develop more efficient MBCT skills, or alternatively, experience ceiling effects of treatment, such that those with lower pre-treatment specificity have more to gain from developing MBCT skills. Furthermore, a large degree of narrative discourse in treatment draws upon specific autobiographical memories. Participants share recent experiences to elicit support from the group, or seek advice from the teacher (e.g., regarding an uncomfortable homework practice). Again, there is little prior research in this area. To date, although there is some evidence showing that memory specificity does predict spontaneous symptom change (Hallford et al., 2020), its relationship to treatment change remains unexamined.

A key reason why the role of memory specificity in predicting or modulating treatment outcome has remained unexplored is the low statistical power of individual clinical trials to examine predictor and moderation effects robustly. Traditional meta-analysis cannot overcome these limitations as only aggregate data are synthesized (Fisher, Copas, Tierney, & Parmar, 2011; Riley et al., 2020). In contrast, individual patient data meta-analysis (IPD-MA) synthesizes participant-level data across multiple studies, providing the statistical capability to explore individual characteristics and how these interact with treatment effects. When considering exploratory hypotheses, secondary analysis of relevant existing data can indicate whether investment in primary data collection is warranted. To date, IPA-MA has focussed almost exclusively on demographic and baseline clinical characteristics which may influence treatment response (Kuyken et al., 2016) and has been vastly under-used for exploring cognitive moderators of clinical outcomes. Here we extend the use of IPD-MA to an experimental cognitive variable – memory specificity as measured with the AMT. To facilitate further IPD-MA consideration of such cognitive variables we include our annotated statistical code as Supplementary Material.

Using state-of-the-art IPD-MA methods (Riley et al., 2020) with data from randomized controlled trials comparing MBCT with a control condition, we therefore evaluated: 1) Does treatment for depression a) induce a change in autobiographical memory specificity on the AMT? And b) is any such change greater following MBCT relative to control interventions? 2) Does the specificity of autobiographical memory at baseline predict treatment response a) for all interventions (a predictor effect)? And b) is this effect different for MBCT relative to control interventions (a moderation effect)?

Our preregistered ambition (Hitchcock et al., 2019) had been to extend the investigation of memory specificity beyond MBCT to examine CBT more broadly. However, we found only one relevant non-MBCT dataset and so our focus is on MBCT. Nevertheless, we also present analyses including the additional CBT dataset, in line with our protocol.

1. Method

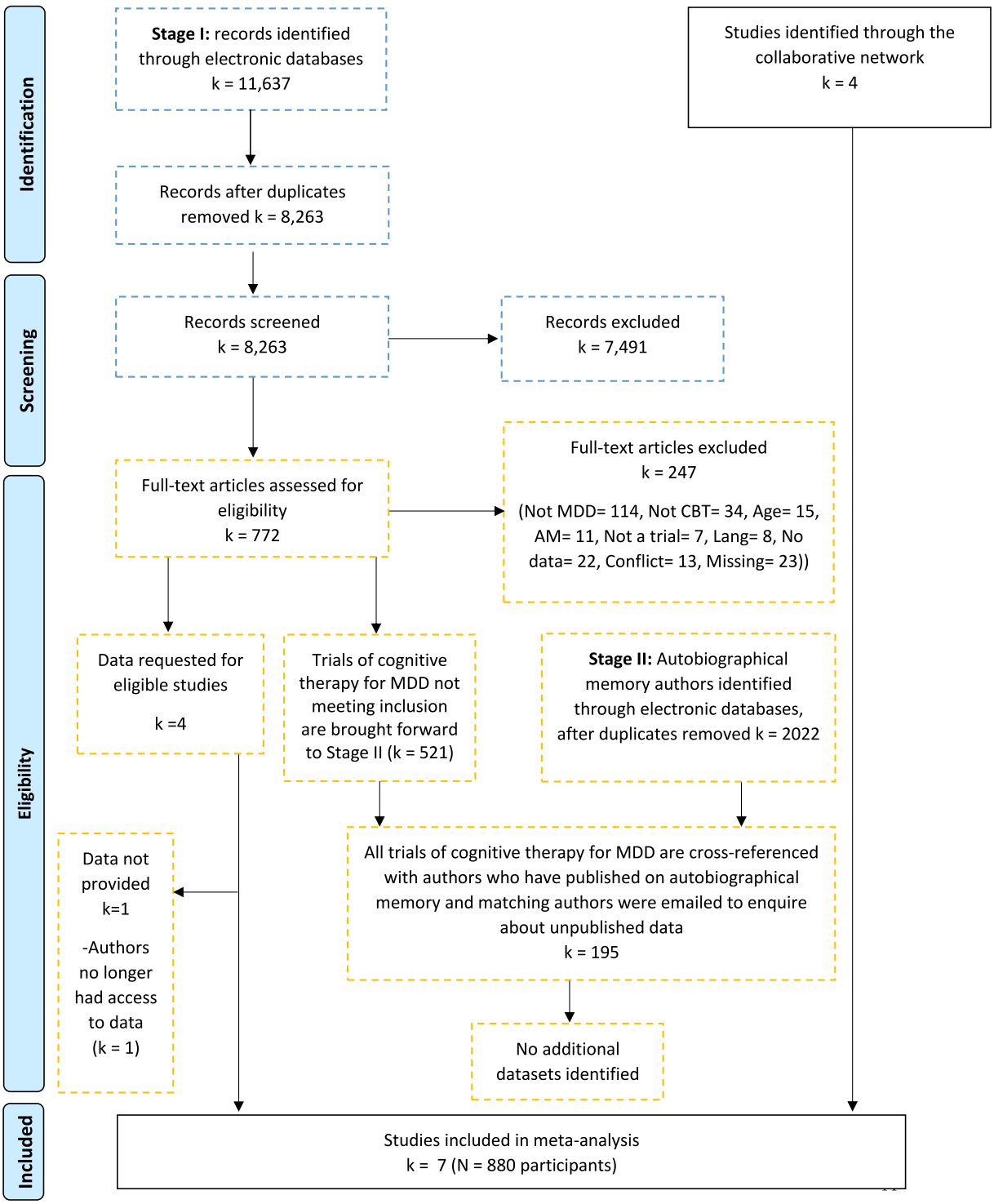
1.1. Preregistration

This meta-analysis accords to PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009) and was preregistered with PROSPERO (CRD42018109673). Methodological details were published in a protocol paper prior to analysis (Hitchcock et al., 2019). Power calculation for meta-analysis is notoriously difficult, as the final *N* is necessarily dependent on existing data, and extra data cannot be collected if sample size is low. Instead of formal power analysis, recent recommendations (Tiernay et al., 2021) advocate for an approach whereby the percentage of available data that is obtained is considered as the most reliable indicator of the merit of completing IPD-MA. We were able to obtain 95.4% of available (including unpublished) data, which in accordance with recommendations, suggests that results are likely to be reliable.

1.2. Identification of included studies

The full search strategy and inclusion criteria are detailed in the published protocol(Hitchcock et al., 2019). Briefly, inclusion criteria were randomized trials measuring autobiographical memory specificity, prior to delivery of a cognitive or cognitive-behavioural therapy (from hereon CBTs) for adults with clinician-diagnosed Major Depressive Disorder (MDD).

A multi-stage search process was used (Fig. 1). First, a collaborative network of experts provided access to four previously unpublished datasets which met inclusion criteria. This was supplemented by a two-stage formal search. In the first stage, searches were completed in PsycINFO, Medline, Web of Science, Cochrane database and WHO trials database from 1986 to February 2019 (search terms in Supplementary Materials). Two researchers completed screening, with high (91%) inter-rater agreement for inclusion. In the second stage, searches in Medline, PsycINFO and Web of Science produced a list of authors who have ever published on autobiographical memory and depression. This list was then cross-referenced with results of the primary search. For studies with an author who also had an autobiographical memory paper, corresponding authors were emailed to enquire about unpublished



Note. MDD = diagnosis of major depressive disorder, Not CBT = no CBT in the study, Age = did not meet age criteria, AM = study aims to improve autobiographical memory, Lang= language other than English; no data = trial protocol/data collection ongoing, conflict = article mutually excluded by both raters, but for different reasons; Missing= unable to locate full text

Fig. 1. *Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) Individual Patient Data Study Selection Proces*
Note: MDD = diagnosis of major depressive disorder, Not CBT = no CBT in the study, Age = did not meet age criteria, AM = study aims to improve autobiographical memory, Lang = language other than English; no data = trial protocol/data collection ongoing, conflict = article mutually excluded by both raters, but for different reasons; Missing = unable to locate full text.

autobiographical memory data. Included studies were rated for risk of bias (Table 1) by two independent researchers using the Revised Cochrane Risk of Bias Tool (Higgins et al., 2016). Inter-rater reliability was good, 71.4%, rising to 100% after discussion.

1.3. Memory specificity measure

Each of the identified studies had used the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986) to measure memory

Table 1
Summary of studies included in the individual patient data meta-analysis.

Study reference	Country	Type of CBT	n	Comparison condition	n	AM measure	Depression measure(s)	Follow-up Assessments	Cochrane Risk of Bias
Teasdale et al. (2000)*	UK, Canada	MBCT	76	TAU	69	AMT	BDI-I, Hamilton	12m	No concerns
Ma et al. (2004)*	UK	MBCT	37	TAU	38	AMT	BDI-I, Hamilton	3m	No concerns
Kuyken et al. (2008)*	UK	MBCT	61	ADM	62	AMT	BDI-II, Hamilton	3m, 6m, 9m, 12m, 15m	No concerns
Williams et al. (2014)*	UK	MBCT	108	TAU CPE	56 110	AMT	BDI-II, Hamilton	3m, 6m, 9m, 12m	Some concerns with deviations from intended interventions
Crane et al. (2012)	UK	MBCT	16	TAU	15	AMT	BDI-II	None	No concerns
Jermann et al. (2013)	Switzerland	MBCT	31	TAU	29	AMT	BDI-II	6m, 9m, 12m	No concerns
Spinhoven et al. (2006)	The Netherlands	Cognitive Therapy	88	TAU	84	AMT	BDI-I, Hamilton	12m	Some concerns with deviations from intended interventions

Note. * identified by the collaborative network. Follow-up assessments are in addition to post-intervention assessment and are time since post-intervention. MBCT = Mindfulness-based cognitive therapy; TAU = Treatment as usual which was typically administration of antidepressant medication but may have also included supplemental psychosocial interventions or no tailored intervention for depression; ADM = antidepressant medication; CPE= Cognitive Psycho-Education; AMT = proportion of specific memories on the Autobiographical Memory Test; BDI=Beck Depression Inventory; Hamilton = Hamilton Rating Scale for Depression. The Teasdale et al. (2000) dataset was identified by the collaborative network but the dataset also subsumed data from Williams et al. (2000) which was identified during the electronic search.

specificity. The AMT is a cued-recall task in which individuals are provided with a cue word of positive, negative, or neutral emotional valence, and asked to provide a memory of a specific event that comes to mind in response to that cue. As the number of cue words varied between studies, we calculated the proportion of specific memories for each study by dividing the number of specific memories correctly recalled by the total number of cue words. The AMT is the most widely used measure of memory specificity, and possesses adequate psychometric properties (Griffith et al., 2012).

1.4. Analysis approach

As full analysis code for each model is included in the Supplementary Materials, the key model features are summarised here. Analysis followed recent statistical recommendations(Riley et al., 2020) pertaining to state-of-the-art procedures for examining interactions between treatment effect and participant-level covariates in IPD-MA. Analyses were conducted in R using the *nlme* and *lme4* packages for mixed effects models, and the *coxme* and *survival* packages for survival analysis. As one-stage models yield less biased estimates of effect and maximize power (Riley et al., 2020), we completed one-stage random effects models employing restricted maximum likelihood estimation, in which data from all studies were analysed simultaneously in a single statistical model. Data structure nested individuals within trials. Heterogeneity is indexed via T^2, which we obtained by modelling a random slope for the predictor of interest. By modelling a random slope, heterogeneity is then interpretable as the variance of the random effects distribution on the observed effect of the predictor, such that T^2 reflects the between-study variance in the effect (Cornell et al., 2014), and a value of 0 represents no heterogeneity. When exploring post-treatment outcomes, baseline score for those outcomes were included as a covariate.

Models investigating memory specificity as a moderator included random slopes for the interaction to estimate and account for heterogeneity across trials. We allowed heterogenous variances per trial in line with recent recommendations (de Jong et al., 2020). Each predictor (i.e., specificity, baseline symptoms) was individually investigated for interaction with treatment type. When examining interactions, memory specificity was trial-mean centred to separate within- and across-trial effects. In this context, within-trial interactions provide an estimate of interaction at the participant-level while across-trial interactions estimate the interaction at the trial-level. That is, the within-trial interaction quantifies the degree to which participant-specific variations in memory specificity at baseline interact with the participant-specific effects of intervention. Instead, the across-trial interaction captures the degree to which the overall level of memory specificity at baseline in the RCT is related to the overall effect of the intervention. In analysis, across-trial interactions were covaried to adjust for aggregation bias. All interaction terms reported in the text are for the within-trial interaction, and across-trial interaction terms are presented in figures for information only.

As one-stage models do not give weighted estimates of individual trials as in two-stage (or aggregate) models, forest plots present individual study effect sizes with the pooled estimates from the one-stage models, with marker size reflecting sample size. Intent-to-treat analysis was completed using multilevel multiple imputation at within-study level. Missing outcome data was imputed via a multivariate imputation model using baseline scores on the predictor variables (see Supplementary Materials). As results remained the same, per-protocol analyses using observed data are reported. Because all but one of the returned trials involved MBCT for depression prevention, analyses were first completed on data from these six MBCT trials ($n = 708$), and repeated to include the one preventative cognitive therapy study ($n = 880$). We emphasise analysis involving only the MBCT trials as the preventative cognitive therapy study was substantially different to the other identified studies in terms of both methods and risk of bias.

2. Results

2.1. Overview of included studies

Included studies (Crane, Winder, Hargus, Amarasinghe, & Barnhofer, 2012; Jermann et al., 2013; Kuyken et al., 2008; Ma & Teasdale, 2004; Spinhoven et al., 2006; Teasdale et al., 2000; Williams et al., 2014) are presented in Table 1. Authors of one eligible trial no longer had access to the data (McBride et al., 2007). Data were therefore received from seven studies, $N = 880$. All trials delivered group-based CBTs in eight weekly sessions, however, participants allocated to CBTs were not prohibited from taking psychotropic medication. The published papers reported that treatment-as-usual (TAU) was typically administration of antidepressant medication, but may have also included supplemental psychosocial interventions, or no tailored intervention for depression at all. For Williams et al. (2014) both TAU and Cognitive Psycho-Education arms were included in the control condition. All studies employed the Beck Depression Inventory (BDI; Beck, Steer, Ball, & Ranieri, 1996) for depressive symptoms, and MDD diagnostic status was determined via structured clinician-administered

interviews. There were some concerns regarding bias (Higgins et al., 2016) for two studies, primarily due to our efforts to locate unpublished autobiographical memory data which were not reported in the main trial paper.

2.2. Does memory specificity change following treatment for depression?

Data on memory specificity on the AMT pre- and post-treatment are presented in Supplementary Materials (Table S1).We evaluated whether memory specificity improved from baseline to post-intervention by modelling memory specificity as a function of time. A one-stage model with random intercept for trial suggested that, across all interventions, specificity did not differ between baseline and post-treatment, $b = 0.02$, SE = 0.01, $t(1219) = 1.35$, $p = .18$. There was low between-study heterogeneity in the effect, $T^2 = 0.001$.

We next examined the effect of type of intervention (MBCT vs. control) on memory specificity at post-treatment using a one-stage model with random intercept for trial and random slope for treatment, applying an adjustment for specificity at baseline (Fig. 2a). Results provided no support for an effect of treatment type on change in specificity, $b = 0.02$, SE = 0.01, $t(570) = 1.49$, $p = .14$. There was low between-study heterogeneity in the effect of treatment type, $T^2 = 0.001$. As there was no significant interaction between memory specificity and treatment type, interaction terms were not included in the final models. Thus, findings suggest that autobiographical memory specificity did not improve following either MBCT or control interventions, in trials examining relapse prevention.

Data for memory specificity at follow-up assessments were not available; thus, we were unable to evaluate longer-term effects of treatment on memory specificity. We did repeat the above analyses predicting the proportion of categoric (i.e., non-specific) memories (Williams et al., 2000). Results remained non-significant, *ps* > .10.

2.3. Does baseline autobiographical memory specificity predict treatment response?

Predictor effect. Results (Fig. 3a) provided no support for an effect of baseline memory specificity on post-treatment symptoms (covarying for baseline symptoms), $b = -0.65$, SE = 1.73, $t(565) = 0.38$, $p = .71$. Between-study heterogeneity was low, $T^2 = 0.004$. A significant main effect of treatment type suggested that participants receiving MBCT experienced lower depressive symptoms at post-treatment, relative to control participants, $b = -2.33$, SE = 0.80, $t(565) = -2.92$, $p = .004$.

Three studies measured symptoms at follow-up. Again, there was no support for an effect of baseline memory specificity, adjusting for depressive symptoms at baseline, on depressive symptoms at three-months ($n = 378$), $b = -0.57$, SE = 2.85, $t(372) = -0.20$, $p = .84$, $T^2 = 7.032$, six-months ($n = 364$), $b = 1.78$, SE = 2.41, $t(358) = 0.74$, $p = .46$, $T^2 = 2.213$, or twelve-months ($n = 449$) post-treatment, $b = -2.86$, SE = 3.70, $t(442) = -0.77$, $p = .44$, $T^2 = 30.706$. As before, because the interaction terms between memory specificity and treatment were not significant they were not included in the final models.

All six MBCT datasets indexed time until depressive relapse. Thus, we completed a Cox survival model to determine whether memory specificity at pre-treatment predicted risk-of-relapse, rather than depressive status at post-treatment. A one-stage survival model with separate baseline hazard shape per study provided no support for memory specificity at pre-treatment predicting relapse, Hazard ratio = 1.04, SE = 0.48, $p = .93$, $T^2 = 0.53$.

Moderator effect. To determine whether memory specificity on the AMT at baseline significantly predicted later depression for MBCT relative to other interventions, a one-stage model predicting post-treatment symptoms estimated the interaction between baseline memory specificity and treatment type, applying a baseline symptom adjustment. We modelled a random intercept for trial and random slopes for the interaction terms to obtain T^2.

We found no support for differential predictive effects of baseline memory specificity for MBCT versus control interventions (Fig. 4a) – no significant interaction was observed, $b = 0.04$, SE = 6.12, $t(563) = 0.01$, $p = .99$,. There was a large degree of between-study heterogeneity, $T^2 = 121.60$.

Similarly, no significant interactions were observed when predicting symptoms at: three-months, $b = -4.06$, SE = 5.60, $t(370) = -0.72$, $p = .47$; six-months, $b = 0.31$, SE = 5.99, $t(356) = 0.05$, $p = .96$; or twelve-months follow-up, $b = -3.40$, SE = 5.29, $t(356) = -0.64$, $p = .52$.

Exploratory analyses. As memory specificity has been found to predict spontaneous change in symptoms[12], we explored whether post-treatment memory specificity predicted risk-of-relapse across the follow-up period but found no support for this, Hazard ratio = 0.55, SE = 0.45, $p = .18$, $T^2 = 0.391$.

We did not explore whether change in memory specificity mediated treatment response because: a) the critical criterion that MBCT differentially improves the putative specificity mediator (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001; Lemmens, Müller, Arntz, & Huibers, 2016) was not met; b) there were insufficient follow-up clinical data; and c) robust methods are not yet developed for mediation analysis in IPD.

2.4. Analysis involving all studies

All analyses were repeated to include the cognitive therapy study. Results remained the same (Figs. 2b, 3b and 4b, and Supplementary Materials).

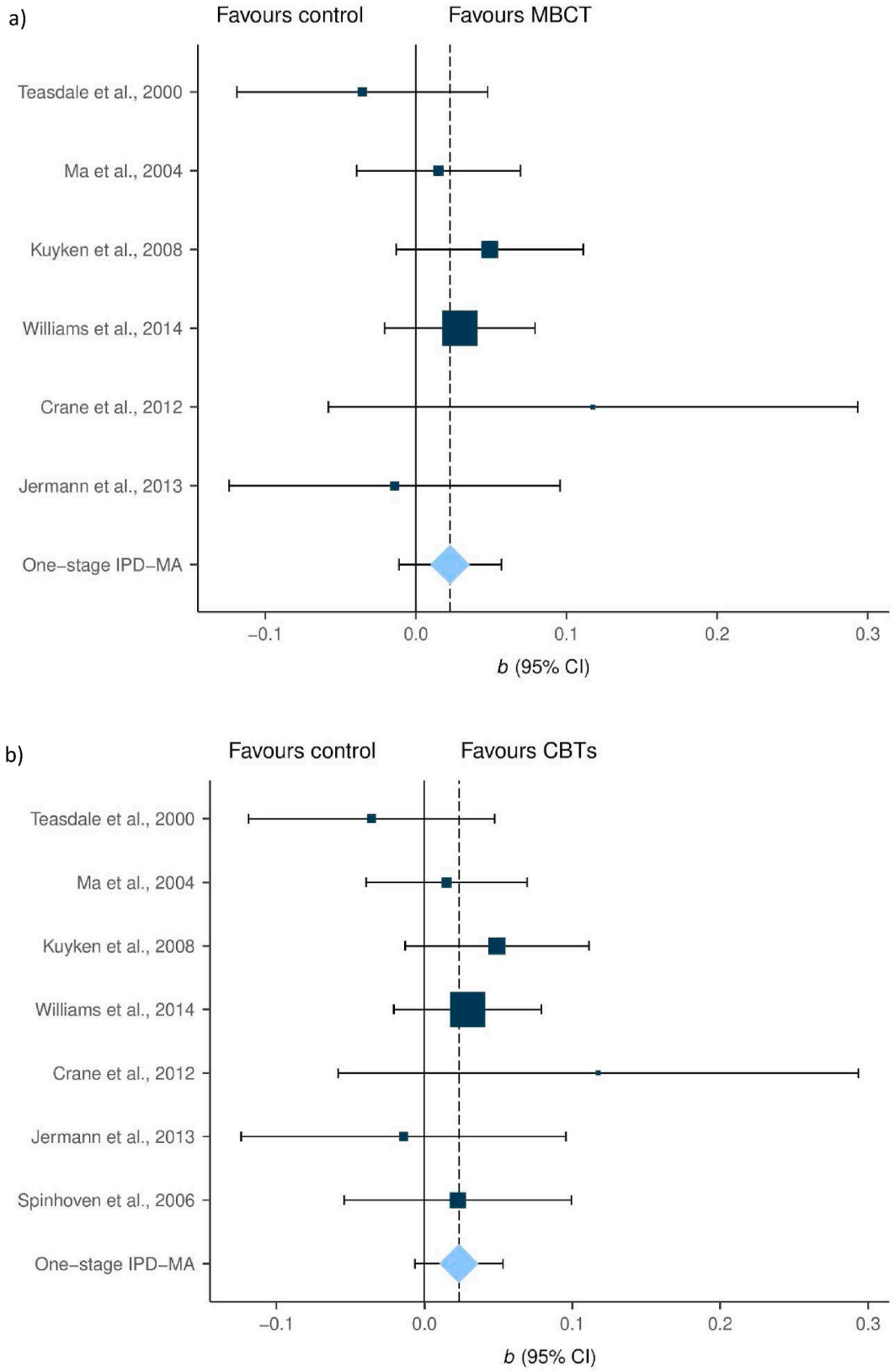
3. Discussion

Using IPD-MA, we explored whether an established depressive cognitive risk factor –reduced autobiographical memory specificity measured using The Autobiographical Memory Test (AMT), improves following treatment for recurrent major depression, and whether any such improvements are greater following MBCT, an evidence-based preventive intervention that involves elements that should enhance cognitive specificity. We also evaluated whether individuals' pre-treatment levels of memory specificity influenced their response to intervention and whether any such relationships are stronger in those receiving MBCT.

We found no support for a general effect of treatment on memory specificity, with a neglible effect size for the difference in specificity between baseline to post-treatment across intervention types. However, we found no support that memory specificity at baseline predicted either future self-report symptoms of depression or risk-of-relapse. There was similarly no support for post-intervention memory specificity predicting later depression, although the effect size was in the anticipated direction, and this analysis had reduced power, relative to other analyses. Analyses synthesising IPD from studies across all cognitive therapies yielded by our literature search, in line with our protocol (Hitchcock et al., 2019), yielded the same results.

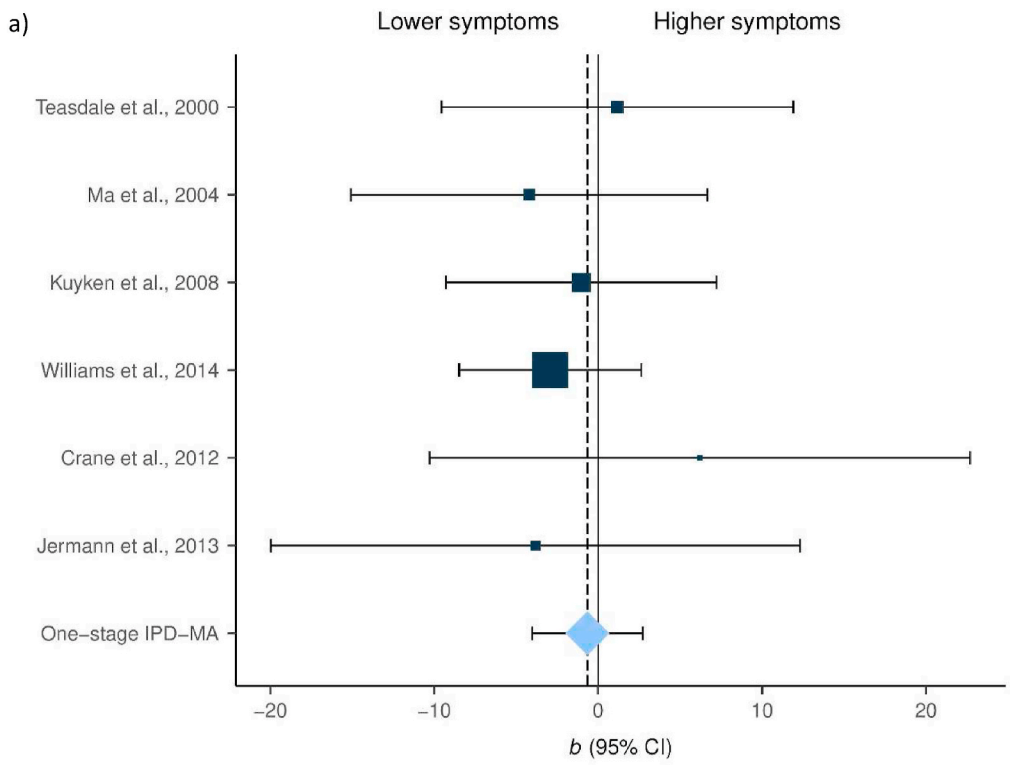
These findings contrast with the seminal and influential prior study which reports differential effects of MBCT on memory specificity (Williams et al., 2000; cited >780 times). Critically, the data from this seminal study were included in our analysis. The majority of our data were previously unpublished which highlights the potential influence of publication bias for prior individual studies on guiding science in this domain. Indeed, publication bias was identified in the recent aggregate meta-analysis (Hallford et al., 2020).

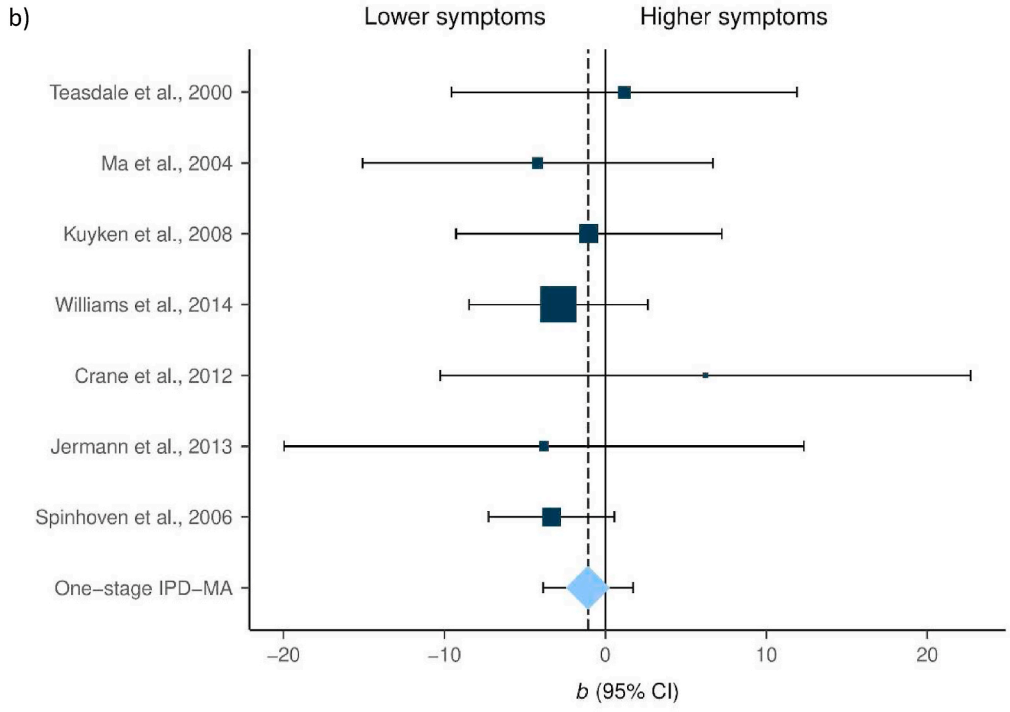
Our finding that post-intervention specificity was not significantly associated with future symptoms also contrasts somewhat with naturalistic studies indicating a small but significant predictive role for specificity in determining depressive course in prior meta-analyses (Hallford et al., 2020; Sumner et al., 2010). A key difference between current and prior results is that here we synthesized treatment trials, while prior meta-analyses used samples who were not engaged in



Note. CBTs= cognitive behavioral therapies. Marker indicates the effect size (*b*) for treatment type and associated 95% confidence interval. Trial marker size reflects trial sample size.

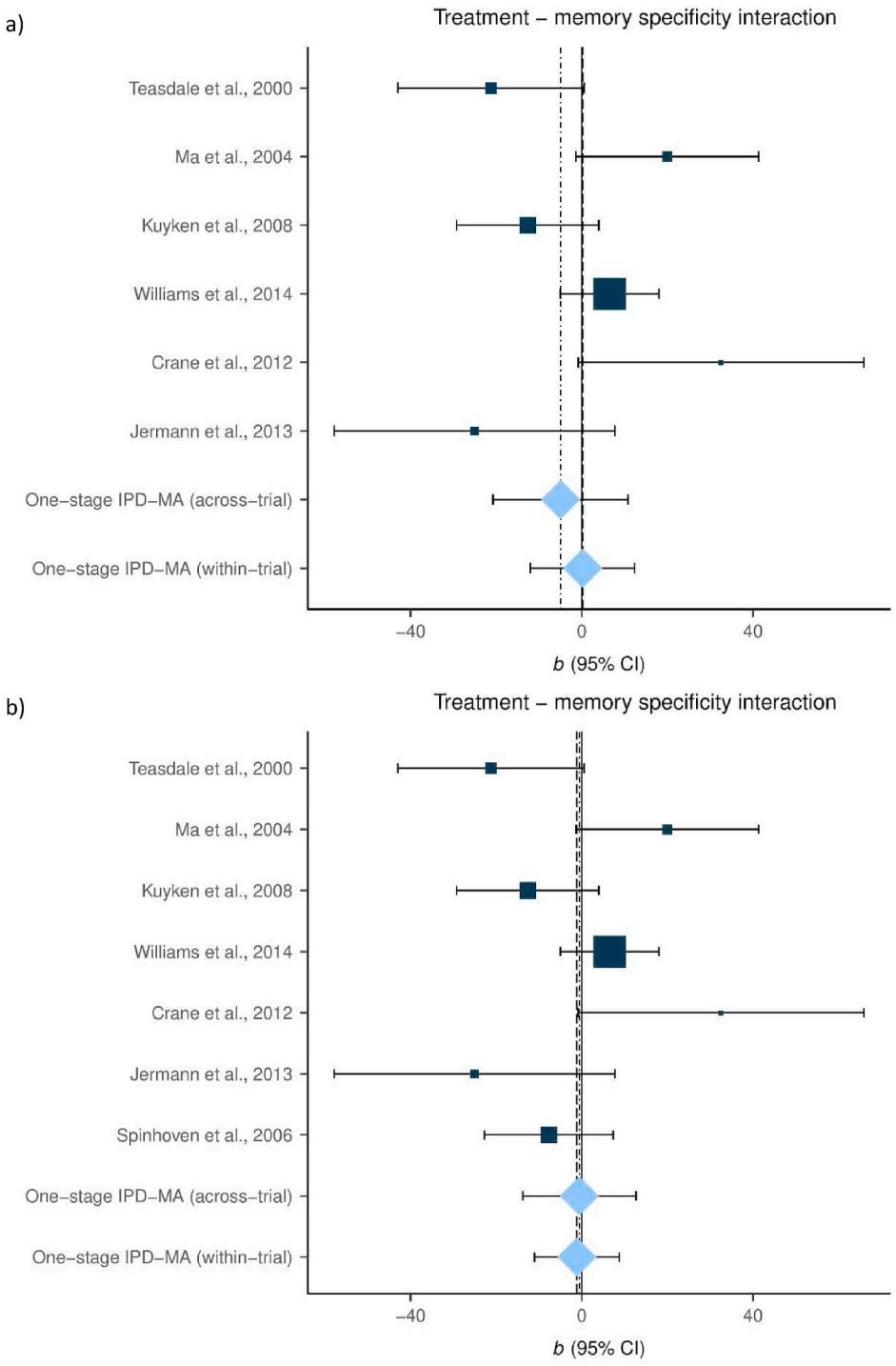
Fig. 2. *Forest plot for the effect of treatment versus control on memory specificity for: a) MBCT studies only; and b) all studiesNote.* CBTs = cognitive behavioural therapies. Marker indicates the effect size (*b*) for treatment type and associated 95% confidence interval. Trial marker size reflects trial sample size.





Note. The models were statistically non-significant but the pattern of effects was in the direction of higher memory specificity predicting lower depressive symptoms at post-treatment. Marker indicates the effect size (*b*) and associated 95% confidence interval. Trial marker size reflects trial sample size

Fig. 3. *Forest plot of the effects of baseline memory specificity on post-treatment depressive symptoms for: a) MBCT studies only; and b) all studiesNote.* The models were statistically non-significant but the pattern of effects was in the direction of higher memory specificity predicting lower depressive symptoms at post-treatment. Marker indicates the effect size (*b*) and associated 95% confidence interval. Trial marker size reflects trial sample size.



Note. Models were statistically non-significant. The interaction effects between treatment (control vs. MBCT/CBTs) and memory specificity at baseline pertain to the mean difference in depressive symptoms at post-treatment on the within- and the across-trial levels, respectively, controlling for baseline depressive symptoms. Individual study markers are within-trial interactions. The marker size of the individual trials reflects their sample size.A negative *b* value indicates that those with higher specificity at baseline would do better in MBCT/CBTs. A positive *b* value indicates that those with higher specificity would do better in comparison conditions.

Fig. 4. *Forest plot for baseline memory specificity as a moderator of the effect of treatment on post-treatment depressive symptoms for: a) MBCT studies only; and b) all studiesNote.* Models were statistically non-significant. The interaction effects between treatment (control vs. MBCT/CBTs) and memory specificity at baseline pertain to the mean difference in depressive symptoms at post-treatment on the within- and the across-trial levels, respectively, controlling for baseline depressive symptoms. Individual study markers are within-trial interactions. The marker size of the individual trials reflects their sample size.A negative *b* value indicates that those with higher specificity at baseline would do better in MBCT/CBTs. A positive *b* value indicates that those with higher specificity would do better in comparison conditions.

treatment. It may be that the overall effect of treatment wipes out any predictive effect of individual differences in specificity identified in naturalistic studies. Another possibility is that in the prior naturalistic studies, reduced memory specificity was related to later relapse simply because worse depression severity correlates with both reduced memory specificity and worse later depression severity/relapse. However, the prior aggregate meta-analyses (Hallford et al., 2020) did control for baseline depressive symptoms, suggesting this is unlikely to be the case. Future research is therefore needed to clarify the conditions in which memory specificity predicts depressive prognosis.

We also completed the first examination of memory specificity as a moderator of treatment response. Again, we found no evidence that pre-treatment memory specificity influenced symptoms at post-treatment differentially for individuals who received MBCT. This result remained the same when synthesising across MBCT and a cognitive therapy study. One possibility is that the role of memory specificity in treatment response and later relapse may be minimal, contrary to theoretical speculations. Alternatively, because the AMT indexes retrieval of specific events, and does not capture sensory-perceptual and contextual detail, it may be a relatively blunt tool to assay the finer, specific detail which is arguably important during therapy.

There are limits on how widely we can generalise our findings. Overall, the number and quality of identified studies was low, and all studies were conducted in the UK or Europe. We are able to conclude that there is no support for memory specificity moderating the effects of MBCT, or being differentially reduced by MBCT. However we cannot generalise our conclusions to CBTs more broadly due to the absence of available data. Similarly, all MBCT studies were aimed at relapse prevention and effects may be evident in treatment programmes which seek to reduce current symptoms. In making use of individual participant data, we were able to overcome any potential issues with the individual studies having relatively mild mean levels of impairment in memory specificity (due to participants being remitted from depression), as use of individual data points meant we were able to examine effects across the spectrum of specificity. However, findings may differ in samples selected on the basis of low memory specificity. Finally, some studies did not prohibit medication-use within the MBCT arm, making it difficult to draw conclusions about the effect of MBCT alone. Future primary research on the role of memory specificity in response to other CBT approaches which draw more heavily upon autobiographical memory (e.g., cognitive therapy for depression or trauma-focussed CBT) may be warranted.

In sum, our findings provide no support for any differential impact of MBCT on memory specificity nor for any moderating role of specificity on MBCT outcomes. Specificity did not improve overall following intervention but there was no support for post-intervention specificity predicting depression prognosis. These results raise important questions regarding the role of memory specificity in treatments for depression. Future research on memory specificity will need to explore a potentially mediating role in broader CBT outcomes, to ensure the most effective use of basic science to enhance clinical practice.

Author statement

CH and TD conceived the study. EW contributed to study design. IK completed the literature search. JR and SP completed study screening, data extraction and risk of bias rating. AS completed study screening and data extraction. FJ, SM, WK, JW, CB, and CC provided datasets and advised on data harmonisation. CH, JR, and CHaag completed data analysis. DF provided supervision of data analysis. CH, JR, and TD wrote the first draft of the manuscript and all authors provided critical revisions.

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.brat.2022.104048.

References

Beck, A. T., Steer, R. A., Ball, R., & Ranieri, W. F. (1996). Comparison of Beck depression inventories-IA and-II in psychiatric outpatients. *Journal of Personality Assessment, 67*. https://doi.org/10.1207/s15327752jpa6703_13

Breedvelt, J., Brouwer, M., Harrer, M., Semkovska, M., Ebert, D., Cuijpers, P., et al (in press). To taper or top-up? Preventative psychological interventions as alternative and add-on to antidepressant medication to prevent depressive relapse: A systematic review and meta-analysis. British Journal of Psychiatry.

Cornell, J. E., Mulrow, C. D., Localio, R., Stack, C. B., Meibohm, A. R., Guallar, E., et al. (2014). Random-effects meta-analysis of inconsistent effects: A time for change. *Annals of Internal Medicine, 160*(4), 267–270.

Crane, C., Winder, R., Hargus, E., Amarasinghe, M., & Barnhofer, T. (2012). Effects of mindfulness-based cognitive therapy on specificity of life goals. *Cognitive Therapy and Research, 36*(3), 182–189. https://doi.org/10.1007/s10608-010-9349-4

Fisher, D., Copas, A., Tierney, J., & Parmar, M. (2011). A critical review of methods for the assessment of patient-level interactions in individual participant data meta-analysis of randomized trials, and guidance for practitioners. *Journal of Clinical Epidemiology, 64*(9), 949–967. https://doi.org/10.1016/j.jclinepi.2010.11.016

Griffith, J. W., Sumner, J. A., Raes, F., Barnhofer, T., Debeer, E., & Hermans, D. (2012). Current psychometric and methodological issues in the measurement of overgeneral autobiographical memory. *Journal of Behavior Therapy and Experimental Psychiatry, 43*, S21–S31.

Hallford, D. J., Rusanov, D., Yeow, J., & Barry, T. (2020). Overgeneral and specific autobiographical memory predict the course of depression: An updated meta-analysis. https://psyarxiv.com/gjwsb/.

Hare, D. L., Toukhsati, S. R., Johansson, P., & Jaarsma, T. (2013). Depression and cardiovascular disease: A clinical review. *European Heart Journal, 35*(21), 1365–1372. https://doi.org/10.1093/eurheartj/eht462

Higgins, J. P., Sterne, J. A., Savovic, J., Page, M. J., Hróbjartsson, A., Boutron, I., & Eldridge, S. (2016). A revised tool for assessing risk of bias in randomized trials. *Cochrane Database of Systematic Reviews, 10*(Suppl 1), 29–31.

Hitchcock, C., Rees, C., & Dalgleish, T. (2017). The devil's in the detail: Accessibility of specific personal memories supports rose-tinted self-generalizations in mental health and toxic self-generalizations in clinical depression. *Journal of Experimental Psychology: General, 146*(9), 1286–1295. https://doi.org/10.1037/xge0000343

Hitchcock, C., Rudokaite, J., Patel, S., Smith, A., Kuhn, I., Watkins, E., et al. (2019). Role of autobiographical memory in patient response to cognitive behavioural therapies for depression: Protocol of an individual patient data meta-analysis. *BMJ Open, 9*(6), Article e031110. https://doi.org/10.1136/bmjopen-2019-031110

Jermann, F., Van der Linden, M., Gex-Fabry, M., Guarin, A., Kosel, M., Bertschy, G., & Bondolfi, G. (2013). Cognitive functioning in patients remitted from recurrent depression: Comparison with acutely depressed patients and controls and follow-up of a mindfulness-based cognitive therapy trial. *Cognitive Therapy and Research, 37*(5), 1004–1014. https://doi.org/10.1007/s10608-013-9544-1

de Jong, V. M. T., Moons, K. G. M., Riley, R. D., Tudur Smith, C., Marson, A. G., Eijkemans, M. J. C., et al. (2020). Individual participant data meta-analysis of intervention studies with time-to-event outcomes: A review of the methodology and an applied example. *Research Synthesis Methods, 11*(2), 148–168. https://doi.org/10.1002/jrsm.1384

Kessler, R. C., Zhao, S., Blazer, D. G., & Swartz, M. (1997). Prevalence, correlates, and course of minor depression and major depression in the national comorbidity survey. *Journal of Affective Disorders, 45*(1–2), 19–30. https://doi.org/10.1016/S0165-0327(97)00056-6

Kraemer, H. C., Stice, E., Kazdin, A., Offord, D., & Kupfer, D. (2001). How do risk factors work together? Mediators, moderators, and independent, overlapping, and proxy risk factors. *American Journal of Psychiatry, 158*(6), 848–856. https://doi.org/10.1176/appi.ajp.158.6.848

Kuyken, W., & Brewin, C. R. (1995). Autobiographical memory functioning in depression and reports of early abuse. *Journal of Abnormal Psychology, 104*(4), 585. https://doi.org/10.1037/0021-843X.104.4.585

Kuyken, W., Byford, S., Taylor, R. S., Watkins, E., Holden, E., White, K., … Mullan, E. (2008). Mindfulness-based cognitive therapy to prevent relapse in recurrent depression. *Journal of Consulting and Clinical Psychology, 76*(6), 966. https://doi.org/10.1037/a0013786

Kuyken, W., Warren, F. C., Taylor, R. S., et al. (2016). Efficacy of mindfulness-based cognitive therapy in prevention of depressive relapse: An individual patient data meta-analysis from randomized trials. *JAMA Psychiatry, 73*(6), 565–574. https://doi.org/10.1001/jamapsychiatry.2016.0076

Lemmens, L. H. J. M., Müller, V. N. L. S., Arntz, A., & Huibers, M. J. H. (2016). Mechanisms of change in psychotherapy for depression: An empirical update and evaluation of research aimed at identifying psychological mediators. *Clinical Psychology Review, 50*, 95–107. https://doi.org/10.1016/j.cpr.2016.09.004

Mackinger, H. F., Pachinger, M. M., Leibetseder, M. M., & Fartacek, R. R. (2000). Autobiographical memories in women remitted from major depression. *Journal of Abnormal Psychology, 109*(2), 331–334. https://doi.org/10.1037/0021-843X.109.2.331

Manjaly, Z.-M., & Iglesias, S. (2020). A computational theory of mindfulness based cognitive therapy from the "Bayesian Brain" perspective. *Frontiers in Psychiatry, 11* (404). https://doi.org/10.3389/fpsyt.2020.00404

Ma, S. H., & Teasdale, J. D. (2004). Mindfulness-based cognitive therapy for depression: Replication and exploration of differential relapse prevention effects. *Journal of Consulting and Clinical Psychology, 72*(1), 31–40. https://doi.org/10.1037/0022-006X.72.1.31

McBride, C., Segal, Z., Kennedy, S., & Gemar, M. (2007). Changes in autobiographical memory specificity following cognitive behavior therapy and pharmacotherapy for major depression. *Psychopathology, 40*(3), 147–152. https://doi.org/10.1159/000100003

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting Items for systematic Reviews and meta-analyses: The PRISMA statement. *PLoS Medicine, 6*(7), Article e1000097. https://doi.org/10.1371/journal.pmed.1000097

National Institute for Health and Care Excellence. (2009). Depression in adults: The treatment and management of depression in adults. Retrieved from https://www.nice.org.uk/guidance/CG90.

Riley, R. D., Debray, T. P. A., Fisher, D., Hattle, M., Marlin, N., Hoogland, J., … Ensor, J. (2020). Individual participant data meta-analysis to examine interactions between treatment effect and participant-level covariates: Statistical recommendations for conduct and planning. *Statistics in Medicine, 39*(15), 2115–2137. https://doi.org/10.1002/sim.8516

Shelton, R. C. (2001). Steps following attainment of remission: Discontinuation of antidepressant therapy. *Primary Care Companion to the Journal of Clinical Psychiatry, 3*(4), 168–174. https://doi.org/10.4088/pcc.v03n0404

Spinhoven, P., Bockting, C. L. H., Schene, A. H., Koeter, M. W. J., Wekking, E. M., & Williams, J. M. G. (2006). Autobiographical memory in the euthymic phase of recurrent depression. *Journal of Abnormal Psychology, 115*(3), 590–600. https://doi.org/10.1037/0021-843X.115.3.590

Sumner, J. A., Griffith, J. W., & Mineka, S. (2010). Overgeneral autobiographical memory as a predictor of the course of depression: A meta-analysis. *Behaviour Research and Therapy, 48*(7), 614–625. https://doi.org/10.1016/j.brat.2010.03.013

Teasdale, J. D., Segal, Z. V., Williams, J. M. G., Ridgeway, V. A., Soulsby, J. M., & Lau, M. A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology, 68* (4), 615. https://doi.org/10.1037/0022-006X.68.4.615

Watkins, E., & Teasdale, J. D. (2001). Rumination and overgeneral memory in depression: Effects of self-focus and analytic thinking. *Journal of Abnormal Psychology, 110*. https://doi.org/10.1037/0021-843x.110.2.333

Williams, J. M. G., Barnhofer, T., Crane, C., Herman, D., Raes, F., Watkins, E. R., et al. (2007). Autobiographical memory specificity and emotional disorder. *Psychological Bulletin, 133*, 122–148. https://doi.org/10.1037/0033-2909.133.1.122

Williams, J. M., & Broadbent, K. (1986). Autobiographical memory in suicide attempters. *Journal of Abnormal Psychology, 95*(2), 5. https://doi.org/10.1037/0021-843X.95.2.144

Williams, J. M. G., Crane, C., Barnhofer, T., Brennan, K., Duggan, D. S., Fennell, M. J. V., … Russell, I. T. (2014). Mindfulness-based cognitive therapy for preventing relapse in recurrent depression: A randomized dismantling trial. *Journal of Consulting and Clinical Psychology, 82*(2), 275–286. https://doi.org/10.1037/a0035036

Williams, J. M. G., Teasdale, J. D., Segal, Z. V., & Soulsby, J. (2000). Mindfulness-based cognitive therapy reduces overgeneral autobiographical memory in formerly depressed patients. *Journal of Abnormal Psychology, 109*(1), 150–155. https://doi.org/10.1037/0021-843X.109.1.150