



Metacognition

Introduction

Metacognition refers to 'thinking about thinking' and involves active control over the cognitive processes engaged in thinking and acquiring knowledge or learning. Metacognition involves the notion of self, ranging from self as own body, to self as own identity or 'agency'. A sense of body ownership occurs regardless of whether an action is generated by the self or others, whereas a sense of agency refers to the sense of being the one who initiates an action. Sense of agency is linked to the ability to maintain the distinction between the individual and the environment.

Intrusive thoughts are generally defined as thoughts that are unwanted or unintended and may be perceived as uncontrollable. It is argued that when intrusive thoughts are experienced, any inconsistency between metacognitive beliefs about one's ability to control thoughts and the experience of uncontrollable intrusive thoughts may lead to cognitive dissonance, a state of negative arousal. From this perspective, hallucination-prone individuals are motivated to attribute their intrusive thoughts to an external source in the attempt to prevent cognitive dissonance from occurring.

Method

We have included only systematic reviews (systematic literature search, detailed methodology with inclusion/exclusion criteria) published in full text, in English, from the year 2000 that report results separately for people with a diagnosis of schizophrenia, schizoaffective disorder, schizophreniform disorder or first episode schizophrenia. Due to the high volume of systematic reviews we have now limited inclusion to systematic meta-analyses. Where no systematic meta-analysis exists for a topic, systematic reviews without meta-analysis are included for that topic. Reviews were identified by searching the

databases MEDLINE, EMBASE, CINAHL, Current Contents, PsycINFO and the Cochrane library. Hand searching reference lists of identified reviews was also conducted. When multiple copies of reviews were found, only the most recent version was included.

Review reporting assessment was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist that describes a preferred way to present a meta-analysis¹. Reviews with less than 50% of items checked have been excluded from the library. The PRISMA flow diagram is a suggested way of providing information about studies included and excluded with reasons for exclusion. Where no flow diagram has been presented by individual reviews, but identified studies have been described in the text, reviews have been checked for this item. Note that early reviews may have been guided by less stringent reporting checklists than the PRISMA, and that some reviews may have been limited by journal guidelines.

Evidence was graded using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group approach where high quality evidence such as that gained from randomised controlled trials (RCTs) may be downgraded to moderate or low if review and study quality is limited, if there is inconsistency in results, indirect comparisons, imprecise or sparse data and high probability of reporting bias. It may also be downgraded if risks associated with the intervention or other matter under review are high. Conversely, low quality evidence such as that gained from observational studies may be upgraded if effect sizes are large or if there is a dose dependent response. We have also taken into account sample size and whether results are consistent, precise and direct with low associated risks (see end of table for an explanation of these terms)². The resulting table represents an



Metacognition

objective summary of the available evidence, although the conclusions are solely the opinion of staff of NeuRA (Neuroscience Research Australia).

Results

We found six reviews that met our inclusion criteria³⁻⁸.

- Compared to controls, moderate to high quality evidence finds large effects of more negative beliefs about thoughts (e.g. uncontrollability and dangerousness) and more cognitive confidence (confidence in one's memory and attentional capabilities) in people with psychotic disorders. There were medium-sized effects of more positive beliefs about worry being able to solve problems and more cognitive self-consciousness (monitoring one's thought processes).
- Compared to people with emotional disorders, a small effect was found for more positive beliefs about worry in people with psychosis, with no differences in negative beliefs, cognitive confidence, or cognitive self-consciousness.
- In people at risk of psychosis, high quality evidence finds large effects of more negative beliefs about thoughts and more cognitive confidence, a medium-sized effect of more cognitive self-consciousness, and a small effect of more positive beliefs about worry when compared to controls. When compared to people with a psychotic disorder, there were no differences on any metacognitive scale.
- Compared to help-seeking individuals who do not meet the 'at-risk for psychosis' criteria, moderate to high quality evidence finds medium-sized effects of more negative beliefs about thoughts and more cognitive confidence in people at risk of psychosis, with no differences in cognitive self-consciousness or positive beliefs about worry.
- In people experiencing hallucinations or those with hallucination proneness, moderate to high quality evidence finds small effects of more negative beliefs, cognitive confidence, and cognitive self-consciousness compared to people not experiencing hallucinations or hallucination proneness.
- Moderate to high quality evidence finds large associations between increased metacognition and decreased symptom severity and increased psychosocial functioning.
- High quality evidence suggests impaired self-awareness, particularly sense of agency, in people with schizophrenia compared to controls.
- Moderate to high quality evidence finds a medium to large effect of poorer self-recognition and new item recognition in people with schizophrenia compared to controls. There is a medium effect of poorer self-recognition, but not new item recognition, in people with schizophrenia who experience auditory hallucinations compared to people with schizophrenia who do not experience auditory hallucinations.



Arnon-Ribenfeld N, Hasson-Ohayon I, Lavidor M, Atzil-Slonim D, Lysaker PH

The association between metacognitive abilities and outcome measures among people with schizophrenia: A meta-analysis

European Psychiatry: the Journal of the Association of European Psychiatrists 2017; 46: 33-41

[View review abstract online](#)

Comparison	Relationship between metacognition and symptoms or psychosocial functioning in people with schizophrenia.
Summary of evidence	Moderate to high quality evidence (unclear sample size, consistent, precise, direct) suggests large effects of increased metacognition ability being related to decreased symptoms and increased psychosocial functioning.
<p>Metacognition and symptoms</p> <p>Metacognitive Assessment Scale and the Positive and Negative Syndrome Scale</p>	
<p><i>There were large effects between metacognition scores and symptom scores;</i></p> <p>Overall symptoms: 15 studies, N not reported, $d = -1.07$, 95%CI -1.18 to -0.75, $I^2 = 0\%$</p> <p>Positive symptoms: 3 studies, N not reported, $d = -0.86$, CIs not reported, $I^2 = 9\%$</p> <p>Negative symptoms: 13 studies, N not reported, $d = -0.88$, CIs not reported, $I^2 = 27\%$</p> <p>Disorganised symptoms: 7 studies, N not reported, $d = -1.02$, CIs not reported, $I^2 = 41\%$</p> <p>Emotional discomfort: 2 studies, N not reported, $d = -0.86$, CIs not reported, $I^2 = 21\%$</p> <p><i>There were large effects between metacognition subscale scores and overall symptom scores;</i></p> <p>Self-reflectivity: 11 studies, N not reported, $d = -0.76$, CIs not reported, $I^2 = 0\%$</p> <p>Understanding Other's minds: 10 studies, N not reported, $d = -0.72$, CIs not reported, $I^2 = 68\%$</p> <p>Decentration: 5 studies, N not reported, $d = -0.99$, CIs not reported, $I^2 = 58\%$</p> <p>Mastery: 9 studies, N not reported, $d = -0.86$, CIs not reported, $I^2 = 21\%$</p> <p>Total: 7 studies, N not reported, $d = -0.93$, CIs not reported, $I^2 = 35\%$</p>	
<p>Metacognition and psychosocial factors</p> <p>Metacognitive Assessment Scale and quality of life, work performance, overall functioning and interpersonal relationships</p>	



Metacognition

There were large effects between metacognition scores and psychosocial factor scores;

17 studies, N not reported, $d = 0.94$, 95%CI 0.58 to 1.20, $I^2 = 19\%$

Self-reflectivity: 3 studies, N not reported, $d = 0.86$, CIs not reported, $I^2 = 0\%$

Understanding Other's minds: 4 studies, N not reported, $d = 0.85$, CIs not reported, $I^2 = 9\%$

Mastery: 13 studies, N not reported, $d = 0.92$, CIs not reported, $I^2 = 0\%$

Total: 5 studies, N not reported, $d = 0.90$, CIs not reported, $I^2 = 0\%$

Consistency in results[†]	Consistent
Precision in results[§]	Precise for overall self-awareness and sense of agency.
Directness of results	Direct

Cotter J, Yung AR, Carney R, Drake RJ

Metacognitive beliefs in the at-risk mental state: A systematic review and meta-analysis

Behaviour Research & Therapy 2017; 90: 25-31

[View review abstract online](#)

Comparison 1	Metacognition in people at risk of psychosis vs. controls
Summary of evidence	High quality evidence (medium to large samples, consistent, precise, direct) finds large effects of more negative beliefs about uncontrollability, negative beliefs about thoughts, and cognitive confidence, a medium-sized effect of more cognitive self-consciousness, and a small effect of increased positive beliefs about worry in people at risk of psychosis.
Metacognition Metacognitions Questionnaire	
<i>People at risk of psychosis showed large effects of increased;</i>	
Negative beliefs about uncontrollability: 6 studies, N = 680, $g = 1.50$, 95%CI 1.31 to 1.68, $p < 0.001$, $I^2 = 0\%$	
Cognitive confidence: 6 studies, N = 682, $g = 0.92$, 95%CI 0.71 to 1.13, $p < 0.001$, $I^2 = 29\%$	
Negative beliefs about thoughts: 6 studies, N = 682, $g = 1.09$, 95%CI 0.85 to 1.33, $p < 0.001$, $I^2 =$	



Metacognition

44%	
<i>People at risk of psychosis showed a medium-sized effect of increased;</i>	
Cognitive self-consciousness: 6 studies, N = 683, $g = 0.57$, 95%CI 0.34 to 0.80, $p < 0.001$, $I^2 = 43%$	
<i>People at risk of psychosis showed a small trend effect of increased;</i>	
Positive beliefs about worry: 6 studies, N = 681, $g = 0.16$, 95%CI -0.01 to 0.33, $p = 0.053$, $I^2 = 0%$	
Consistency in results	Consistent
Precision in results	Precise
Directness of results	Direct
Comparison 2	Metacognition in people at risk of psychosis vs. people with psychotic disorders.
Summary of evidence	Moderate quality evidence (medium-sized samples, mostly inconsistent, some imprecision, direct) suggests no differences in metacognition ability.
Metacognition	
Metacognitions Questionnaire	
<i>No differences between groups for;</i>	
Positive beliefs about worry: 3 studies, N = 300, $g = -0.24$, 95%CI -0.61 to 0.13, $p = 0.198$, $I^2 = 48%$	
Negative beliefs about uncontrollability: 3 studies, N = 391, $g = 0.12$, 95%CI -0.28 to 0.52, $p = 0.563$, $I^2 = 56%$	
Cognitive confidence: 3 studies, N = 301, $g = -0.16$, 95%CI -0.67 to 0.36, $p = 0.548$, $I^2 = 73%$	
Negative beliefs about thoughts: 3 studies, N = 301, $g = -0.17$, 95%CI -0.51 to 0.18, $p = 0.34$, $I^2 = 41%$	
Cognitive self-consciousness: 3 studies, N = 302, $g = 0.14$, 95%CI -0.24 to 0.52, $p = 0.463$, $I^2 = 51%$	
Consistency in results	Mostly inconsistent
Precision in results	Mostly precise
Directness of results	Direct
Comparison 3	Metacognition in people at risk of psychosis vs. help-seeking individuals deemed not at risk of psychosis.
Summary of evidence	Moderate to high quality evidence (medium-sized samples, consistent, precise, direct) suggests medium-sized effects of



Metacognition

	more negative beliefs about uncontrollability, cognitive confidence and negative beliefs about thoughts in people at risk of psychosis, with no differences in cognitive self-consciousness or positive beliefs about worry.
Metacognition Metacognitions Questionnaire	
<i>People at risk of psychosis showed medium-sized effects of increased;</i>	
Negative beliefs about uncontrollability: 2 studies, N = 309, $g = 0.37$, 95%CI 0.12 to 0.62, $p = 0.004$, $I^2 = 0\%$	
Cognitive confidence: 2 studies, N = 310, $g = 0.39$, 95%CI 0.14 to 0.63, $p = 0.002$, $I^2 = 0\%$	
Negative beliefs about thoughts: 2 studies, N = 310, $g = 0.49$, 95%CI 0.24 to 0.74, $p < 0.001$, $I^2 = 0\%$	
<i>No differences between groups for;</i>	
Positive beliefs about worry: 2 studies, N = 309, $g = 0.18$, 95%CI -0.06 to 0.43, $p = 0.147$, $I^2 = 0\%$	
Cognitive self-consciousness: 2 studies, N = 310, $g = 0.13$, 95%CI -0.12 to 0.38, $p = 0.291$, $I^2 = 0\%$	
Consistency in results	Consistent
Precision in results	Precise
Directness of results	Direct

Hur J, Kwon JS, Lee TY, Park S

The crisis of minimal self-awareness in schizophrenia: A meta-analytic review

Schizophrenia Research 2014; 152: 58-64

[View review abstract online](#)

Comparison	Self-awareness in people with schizophrenia vs. controls.
Summary of evidence	High quality evidence (medium to large samples, consistent, precise, direct,) suggests impaired self-awareness, particularly sense of agency in people with schizophrenia.
Self-awareness	



Metacognition

A significant medium-sized effect of impaired self-awareness, particularly sense of agency;

Overall: 25 studies, $N = 1,669$, $g = 0.51$, 95%CI 0.26 to 0.76, $p < 0.001$, $I^2 = 0\%$, $p = 1.000$

Sense of agency: 15 studies, $N = 753$, $g = 0.49$, 95%CI 0.17 to 0.81, $p = 0.003$, $I^2 = 0\%$, $p = 1.000$

Trend effects for impaired sense of body ownership and sense of self;

Sense of body and ownership: 4 studies, $N = 202$, $g = 0.91$, 95%CI -0.05 to 1.86, $p = 0.062$, $I^2 = 0\%$, $p = 0.994$

Sense of self: 6 studies, $N = 731$, $g = 0.57$, 95%CI -0.05 to 1.19, $p = .072$, $I^2 = 0\%$, $p = 0.923$

Consistency in results	Consistent
Precision in results	Precise for overall self-awareness and sense of agency.
Directness of results	Direct

Sellers R, Varese F, Wells A, Morrison AP

A meta-analysis of metacognitive beliefs as implicated in the self-regulatory executive function model in clinical psychosis

Schizophrenia Research 2017; 179: 75-84

[View review abstract online](#)

Comparison 1	Metacognitive beliefs in people with psychosis vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, precise, direct,) finds large effects of more negative beliefs about uncontrollability, negative beliefs about thoughts, and cognitive confidence, and medium-sized effects of more positive beliefs about worry and cognitive self-consciousness in people with psychotic disorders.
Metacognition Metacognitions Questionnaire	
Overall $N \sim 1,500$ (exact N unclear)	
<i>People with psychosis showed large effects of increased;</i>	
Negative beliefs about uncontrollability: 12 studies, $g = 1.10$, 95%CI 0.78 to 1.42, $p < 0.001$, $I^2 = 84\%$	
Negative beliefs about thoughts: 10 studies, $g = 1.31$, 95%CI 0.96 to 1.66, $p < 0.001$, $I^2 = 84\%$	



Metacognition

<p>Cognitive confidence: 12 studies, $g = 0.83$, 95%CI 0.54 to 1.12, $p < 0.001$, $I^2 = 81\%$ <i>People with psychosis showed medium-sized effects of increased;</i> Positive beliefs about worry: 12 studies, $g = 0.55$, 95%CI 0.34 to 0.76, $p < 0.001$, $I^2 = 66\%$ Cognitive self-consciousness: 11 studies, $g = 0.49$, 95%CI 0.29 to 0.69, $p < 0.001$, $I^2 = 62\%$</p>	
Consistency in results	Inconsistent
Precision in results	Precise
Directness of results	Direct
Comparison 2	Metacognitive beliefs in people with psychosis vs. people with non-psychotic disorders (adjustment disorder, anxiety, depression, dysthymic disorder, generalised anxiety disorder, obsessive-compulsive disorder, panic disorder).
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, precise, direct,) finds a small effect of increased positive beliefs about worry in people with psychotic disorders, with no differences in negative beliefs, cognitive confidence, and cognitive self-consciousness.
<p>Metacognition Metacognitions Questionnaire</p>	
<p>Overall N = 780 <i>People with psychosis showed a small effect of increased;</i> Positive beliefs about worry: 7 studies, $g = 0.38$, 95%CI 0.16 to 0.61, $p = 0.001$, $I^2 = 48\%$ <i>No significant differences for;</i> Negative beliefs about uncontrollability: 7 studies, $g = -0.20$, 95%CI -0.56 to 0.16, $p = 0.281$, $I^2 = 80\%$ Cognitive confidence: 7 studies, $g = 0.14$, 95%CI -0.25 to 0.52, $p = 0.485$, $I^2 = 83\%$ Negative beliefs about thoughts: 6 studies, $g = 0.18$, 95%CI -0.26 to 0.62, $p = 0.415$, $I^2 = 84\%$ Cognitive self-consciousness: 7 studies, $g = 0.10$, 95%CI -0.40 to 0.20, $p = 0.515$, $I^2 = 72\%$</p>	
Consistency in results	Inconsistent
Precision in results	Precise
Directness of results	Direct



Varese F, Bentall RP

The metacognitive beliefs account of hallucinatory experiences: A literature review and meta-analysis

Clinical Psychology Review 2011; 31: 850–864

[View review abstract online](#)

<p>Comparison</p>	<p>Metacognitive beliefs in hallucinating people vs. non-hallucinating people, and in hallucination prone people vs. non-hallucination prone people.</p>
<p>Summary of evidence</p>	<p>Moderate to high quality evidence (large samples, inconsistent, precise, direct) suggests small effects of people experiencing hallucinations or hallucination proneness having increased thoughts of uncontrollability and danger, cognitive confidence, and cognitive self-consciousness (after controlling for other symptoms) compared to people not experiencing hallucinations or hallucination proneness.</p>
<p style="text-align: center;">Metacognition</p>	
<p style="text-align: center;">25 studies, N = 3,222</p> <p style="text-align: center;"><i>When both clinical and non-clinical studies are pooled, metacognitive factors are significantly associated with hallucinations or hallucination proneness;</i></p> <p>Uncontrollability/danger (medium to large effect): $g = 0.71$, 95%CI 0.50 to 0.93, $p < 0.001$, $I^2 = 83\%$ Cognitive confidence (medium effect): $g = 0.54$, 95%CI 0.37 to 0.70, $p < 0.001$, $I^2 = 69\%$ Negative beliefs about thought (medium effect): $g = 0.45$, 95%CI 0.29 to 0.61, $p < 0.001$, $I^2 = 69\%$ Cognitive self-consciousness (medium effect): $g = 0.54$, 95%CI 0.40 to 0.7, $p < 0.001$, $I^2 = 57\%$ Positive beliefs (small to medium effect): $g = 0.31$, 95%CI 0.20 to 0.43, $p < 0.001$, $I^2 = 39\%$</p> <p>Authors report that after controlling for comorbid symptoms, the effects of positive beliefs about worry and general negative beliefs were no longer statistically significant and the magnitude of the effect for uncontrollability and danger, cognitive confidence and cognitive self-consciousness reduced to small.</p> <p>Subgroup analysis of clinical samples vs. non-clinical samples showed non-clinical samples had effect sizes of similar magnitude to those reported above, however, clinical samples showed the only significant factors were cognitive self-consciousness and positive beliefs about worry, both showing small effects.</p>	
<p>Consistency in results</p>	<p>Inconsistent</p>



Metacognition

Precision in results	Precise
Directness of results	Direct

Waters F, Woodward T, Allen P, Aleman A, Sommer I

Self-recognition deficits in schizophrenia patients with auditory hallucinations: a meta-analysis of the literature

Schizophrenia Bulletin 2012; 38(4): 741-750

[View review abstract online](#)

Comparison	Self-recognition in people with schizophrenia vs. controls and people with auditory hallucinations in the week prior to testing vs. those without auditory hallucinations in the week prior to testing.
Summary of evidence	Moderate to high quality evidence (medium to large samples, consistent, unable to assess precision, direct) suggests a medium to large effect of poorer self-recognition and new item recognition in people with schizophrenia compared with controls. There was a medium effect of poorer self-recognition, but not new item recognition, in people with schizophrenia with auditory hallucinations compared with people with schizophrenia without auditory hallucinations.

Self-recognition and new item recognition

Significant medium to large effect of poorer self-recognition accuracy and new item recognition in people with schizophrenia compared with controls;

Self-recognition accuracy: 23 studies, N = 1,370, $g = -0.73$, CI not reported, $p < 0.00001$, $I^2 = 52\%$

Omitting 1 study reduced I^2 to 41%, and increased g to -0.71

No evidence of publication bias.

New item recognition: 23 studies, N = 1,370, $g = -0.39$, CI not reported, $p < 0.00001$, $I^2 = 45\%$

Possible publication bias.

Significant medium effect of poorer self-recognition, but not new item recognition, in people with schizophrenia with auditory hallucinations compared with people with schizophrenia without auditory hallucinations;

Self-recognition accuracy: 9 studies, N = 315, $g = -0.58$, CI not reported, $p < 0.00001$, $I^2 = 17\%$



Metacognition

New item recognition: 5 studies, N = 214, $g = -0.13$, CI not reported, $p = 0.352$, $I^2 = 71\%$

No evidence of publication bias.

Consistency in results	Consistent for both control comparisons, and for self-recognition in patients with hallucinations vs. patients without hallucinations.
Precision in results	Unable to assess
Directness of results	Direct

Explanation of acronyms

CI = confidence interval, g = Hedges' g = standardised mean differences (see below for interpretation of effect size), I^2 = the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance), N = number of participants, p = statistical probability of obtaining that result ($p < 0.05$ generally regarded as significant), vs. = versus



Metacognition

Explanation of technical terms

* Bias has the potential to affect reviews of both RCT and observational studies. Forms of bias include; reporting bias – selective reporting of results; publication bias - trials that are not formally published tend to show less effect than published trials, further if there are statistically significant differences between groups in a trial, these trial results tend to get published before those of trials without significant differences; language bias – only including English language reports; funding bias - source of funding for the primary research with selective reporting of results within primary studies; outcome variable selection bias; database bias - including reports from some databases and not others; citation bias - preferential citation of authors. Trials can also be subject to bias when evaluators are not blind to treatment condition and selection bias of participants if trial samples are small⁹.

† Different effect measures are reported by different reviews.

Prevalence refers to how many existing cases there are at a particular point in time. Incidence refers to how many new cases there are per population in a specified time period. Incidence is usually reported as the number of new cases per 100,000 people per year. Alternatively some studies present the number of new cases that have accumulated over several years against a person-years denominator. This denominator is the sum of individual units of time that the persons in the population are at risk of becoming a case. It takes into account the size of the underlying population sample and its age structure over the duration of observation.

Reliability and validity refers to how accurate the instrument is. Sensitivity is the proportion of actual positives that are correctly identified (100% sensitivity = correct identification of all actual positives) and specificity is the proportion of negatives that are correctly identified (100% specificity = not identifying anyone as positive if they are truly not).

Mean difference scores refer to mean differences between treatment and comparison groups after treatment (or occasionally pre- to post-treatment) and in a randomised trial there is an assumption that both groups are comparable on this measure prior to treatment. Standardised mean differences are divided by the pooled standard deviation (or the standard deviation of one group when groups are homogenous) that allows results from different scales to be combined and compared. Each study's mean difference is then given a weighting depending on the size of the sample and the variability in the data. Less than 0.4 represents a small effect, around 0.5 a medium effect, and over 0.8 represents a large effect⁹.

Relative risk (RR) refers to the probability of a reduction (< 1) or an increase (> 1) in a particular outcome in a treatment group, or a group exposed to a risk factor, relative to the comparison group. For example, a RR of 0.75 translates to a reduction in risk of an outcome of 25% relative to those not receiving the treatment or not exposed to the risk factor. Conversely, a RR of 1.25 translates to an increased risk of 25% relative to those not receiving treatment or not having been exposed to a risk factor. A RR of 1.00 means there is no difference between groups. A medium effect is considered if $RR > 2$ or < 0.5 and a large effect if $RR > 5$ or < 0.2 ¹⁰. Odds ratios (ORs) are similar to RRs, but they are based on the probability of an event occurring divided by the probability of that event not



Metacognition

occurring. ORs and RRs are similar in size when the event is rare, such as with schizophrenia. InOR stands for logarithmic OR where a InOR of 0 shows no difference between groups. Hazard ratios (HRs) measure the effect of an explanatory variable on the hazard or risk of an event.

Correlation coefficients (eg, r) indicate the strength of association or relationship between variables. They can provide an indirect indication of prediction, but do not confirm causality due to possible and often unforeseen confounding variables. An r of 0.10 represents a weak association, 0.25 a medium association and 0.40 and over represents a strong association. Unstandardised (b) regression coefficients indicate the average change in the dependent variable associated with a one unit change in the independent variable, statistically controlling for the other independent variables. Standardised regression coefficients represent the change being in units of standard deviations to allow comparison across different scales.

‡ Inconsistency refers to differing estimates of effect across studies (i.e. heterogeneity or variability in results) that is not explained by subgroup analyses and therefore reduces confidence in the effect estimate. I^2 is the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance) - 0% to 40%: heterogeneity might not be important, 30% to 60%: may represent moderate heterogeneity, 50% to 90%: may represent considerable heterogeneity and over this is considerable heterogeneity. I^2 can be calculated from Q (chi-square) for the test of heterogeneity with the following formula:⁹

$$I^2 = \left(\frac{Q - df}{Q} \right) \times 100\%$$

§ Imprecision refers to wide confidence intervals indicating a lack of confidence in the effect estimate. Based on GRADE recommendations, a result for continuous data (standardised mean differences, not weighted mean differences) is considered imprecise if the upper or lower confidence limit crosses an effect size of 0.5 in either direction, and for binary and correlation data, an effect size of 0.25. GRADE also recommends downgrading the evidence when sample size is smaller than 300 (for binary data) and 400 (for continuous data), although for some topics, these criteria should be relaxed.¹¹

|| Indirectness of comparison occurs when a comparison of intervention A versus B is not available but A was compared with C and B was compared with C that allows indirect comparisons of the magnitude of effect of A versus B. Indirectness of population, comparator and/or outcome can also occur when the available evidence regarding a particular population, intervention, comparator, or outcome is not available and is therefore inferred from available evidence. These inferred treatment effect sizes are of lower quality than those gained from head-to-head comparisons of A and B.



Metacognition

References

1. Moher D, Liberati A, Tetzlaff J, Altman DG, PRISMA Group (2009): Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *British Medical Journal* 151: 264-9.
2. GRADE Working Group (2004): Grading quality of evidence and strength of recommendations. *British Medical Journal* 328: 1490.
3. Hur JW, Kwon JS, Lee TY, Park S (2014): The crisis of minimal self-awareness in schizophrenia: A meta-analytic review. *Schizophrenia Research* 152: 58-64.
4. Varese F, Bentall RP (2011): The metacognitive beliefs account of hallucinatory experiences: A literature review and meta-analysis. *Clinical Psychology Review* 31: 850-64.
5. Waters F, Woodward T, Allen P, Aleman A, Sommer I (2012): Self-recognition deficits in schizophrenia patients with auditory hallucinations: a meta-analysis of the literature. *Schizophrenia Bulletin* 38: 741-50.
6. Arnon-Ribenfeld N, Hasson-Ohayon I, Lavidor M, Atzil-Slonim D, Lysaker PH (2017): The association between metacognitive abilities and outcome measures among people with schizophrenia: A meta-analysis. *European Psychiatry: the Journal of the Association of European Psychiatrists* 46: 33-41.
7. Cotter J, Yung AR, Carney R, Drake RJ (2017): Metacognitive beliefs in the at-risk mental state: A systematic review and meta-analysis. *Behaviour Research & Therapy* 90: 25-31.
8. Sellers R, Varese F, Wells A, Morrison AP (2017): A meta-analysis of metacognitive beliefs as implicated in the self-regulatory executive function model in clinical psychosis. *Schizophrenia Research* 179: 75-84.
9. Cochrane Collaboration (2008): Cochrane Handbook for Systematic Reviews of Interventions. Accessed 24/06/2011.
10. Rosenthal JA (1996): Qualitative Descriptors of Strength of Association and Effect Size. *Journal of Social Service Research* 21: 37-59.
11. GRADEpro (2008): [Computer program]. Jan Brozek, Andrew Oxman, Holger Schünemann. Version 3.2 for Windows