

Memory

Introduction

Memory involves encoding, storage and retrieval of information. Short-term memory is the ability to remember information after several seconds or minutes; and long-term memory is the ability to remember information over a longer duration. Working memory involves information being temporarily held as well as manipulated. Semantic memory is memory for general facts, episodic memory is memory for personal events, prospective memory is memory for future actions, and retrospective memory is memory for past events. Most memory tasks assess retrospective memory by measuring recall and recognition.

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. 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. Reviews with pooled data are prioritised for inclusion.

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, there is a dose dependent response or if results are reasonably consistent, precise and direct with low associated risks (see end of table for an explanation of these terms)². The resulting table represents an objective summary of the available evidence, although the conclusions are solely the opinion of staff of NeuRA (Neuroscience Research Australia).

Results

We found 57 systematic reviews that met our inclusion criteria³⁻⁵⁹.

- Compared to controls, moderate to high quality evidence finds medium to large effects of poor short-term memory (verbal, nonverbal, recall and recognition), long-term memory (episodic, semantic and delayed recall), working memory (verbal, nonverbal and executive), prospective memory, autographical memory, and memory binding



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in people with schizophrenia. Task difficulty does not appear to moderate these effects.

- Moderate to high quality evidence shows a large effect of poorer memory in people with schizophrenia and violent behaviours compared to controls and a medium-sized effect in people with antisocial personality disorder and violent behaviours.
- Moderate to high quality evidence suggests people with schizophrenia who are herpes simplex virus positive are more impaired on the memory tasks than people with schizophrenia who are herpes simplex virus negative.
- High quality evidence shows a small increase in nonverbal episodic memory ability in males with schizophrenia compared to females with schizophrenia.
- Compared to people with affective psychoses, high quality evidence shows a medium-sized effect of poorer visual delayed memory, verbal immediate memory, and verbal delayed memory in people with schizophrenia. Moderate quality evidence also suggests poorer verbal working memory, but not spatial working memory.
- Moderate to high quality evidence suggests a small reduction in overall memory ability in people with schizophrenia with antisocial traits compared with people with schizophrenia without antisocial traits or compared with people without schizophrenia with antisocial traits.
- Moderate to high quality evidence shows small to medium-sized associations between increased negative or disorganised symptoms and poorer visual and verbal memory, with moderate quality evidence also suggesting a weak association with poor executive working memory. Moderate to high quality evidence suggests no association between reality distortion and verbal, visual or working memory.
- Moderate to high quality evidence shows small to medium-sized associations between poorer prospective memory and increased general psychopathology, medication dose, duration of illness, age, and decreased education, and pre-morbid IQ. A medium-sized association is reported between better memory and higher levels of insight.
- Moderate to high quality evidence shows no differences in working memory, verbal learning and memory, or visual learning and memory between patients taking first or second-generation antipsychotics. Moderate quality evidence suggests people taking olanzapine or risperidone showed improvement on working memory with treatment, however people taking clozapine or quetiapine showed no improvement. People taking olanzapine, clozapine, risperidone or haloperidol showed improvement on delayed recall with treatment, while people taking quetiapine showed no improvement.
- Moderate to high quality evidence shows increased community functioning and greater social problem-solving ability are associated with better working memory.
- Moderate quality evidence finds medium to large associations between increased scores on memory tasks and increased scores on attention, executive functioning, visual learning, verbal learning, processing speed, reasoning, fluency, abstraction and flexibility tasks. There were small associations between poorer performance on emotion perception, social perception, Theory of Mind, facial recognition and emotion processing tasks and poorer performance on verbal, visual and working memory tasks.
- Moderate to high quality evidence suggests better global memory, working memory, visual immediate recall, and visual and verbal recognition in people with schizophrenia with a history of cannabis use



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compared to people with schizophrenia without a history of cannabis use. However, moderate quality evidence finds a medium to large effect of poorer verbal working memory in people with psychosis and current cannabis use compared to people with psychosis and no cannabis use. There was also more impairment on immediate memory in smokers with schizophrenia compared to non-smokers with schizophrenia, with no differences in delayed memory.

- Moderate quality evidence suggests more impaired working memory in people with schizophrenia and alcohol use disorder compared to people with schizophrenia without any substance use disorder.
- High quality evidence finds people at clinical high risk of psychosis or familial high risk of psychosis are similarly impaired on verbal and visual memory, showing small to medium-sized effects compared to controls. However, people at clinical high risk of psychosis were more impaired on visuospatial working memory than those at familial risk of psychosis.
- High quality evidence shows a medium-sized effect of better working memory in people at clinical high-risk of psychosis than in people with first-episode psychosis.
- Moderate to high quality evidence finds a small effect of poorer working memory in people at clinical high risk for psychosis who transitioned to psychosis compared to people at clinical high risk for psychosis who did not transition to psychosis.
- High quality evidence suggests small improvements on memory tasks over time (1-5 years) in people at clinical high risk of psychosis, in people with first-episode psychosis, and in controls.



Achim AM, Lepage M

Is associative recognition more impaired than item recognition memory in schizophrenia? A meta-analysis

Bain and Cognition 2003; 53: 121-124

[View review abstract online](#)

Comparison	Differences in item recognition compared with associative recognition memory in people with schizophrenia.
Summary of evidence	Moderate quality evidence (large sample, unable to assess consistency or precision, direct) suggests people with schizophrenia show greater impairment on associative recognition compared with item recognition tasks.
Item and associative memory	
23 studies, N = 1,305	
People with schizophrenia were significantly more impaired on associative recognition memory (N = 327, $r = 0.48$) compared with item recognition memory (19 studies, N = 978, $r = 0.40$); $p = 0.04$.	
Consistency[‡]	Unable to assess; no measure of consistency is reported.
Precision[§]	Unable to assess; no measure of precision is reported.
Directness	Direct

Achim AM, Weiss AP

No evidence for a differential deficit of reality monitoring in schizophrenia: A meta-analysis of the associative memory literature

Cognitive Neuropsychiatry 2008; 13(5): 369-384

[View review abstract online](#)

Comparison	Recognition memory in people with schizophrenia vs. controls. Note: associative memory can be tested through pair recognition (association between two items) or source recognition (association between an item and an associated
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	characteristic).
Summary of evidence	Moderate quality evidence (unclear sample sizes, mostly consistent, unable to assess precision, direct) suggests more impairment in schizophrenia relative to controls in; pair (vs. source) recognition; recognition tasks with no new items (vs. new items); number of hits (vs. number of errors), with no differences between external, internal or reality monitoring.
Recognition memory	
<p><i>People with schizophrenia were significantly more impaired on pair recognition memory; (p = 0.001)</i></p> <p style="padding-left: 40px;">Pair recognition: 4 studies, r = 0.50, range 0.36 to 0.61, Q_w p = 0.45</p> <p style="padding-left: 40px;">Source recognition: 27 studies, r = 0.29, range 0.07 to 0.62, Q_w p = 0.03</p> <p><i>People with schizophrenia were significantly more impaired on recognition tasks with no new items; (p < 0.001)</i></p> <p style="padding-left: 40px;">With new items: 22 studies, r = 0.26, range 0.07 to 0.56, Q_w p = 0.32</p> <p style="padding-left: 40px;">No new items: 6 studies, r = 0.44, range 0.27 to 0.62, Q_w p = 0.29</p> <p><i>People with schizophrenia were significantly more impaired in studies basing performance on the number of hits rather than the number of errors; (p < 0.001)</i></p> <p style="padding-left: 40px;">Hits: 18 studies, r = 0.36, range 0.07 to 0.62, Q_w p = 0.13</p> <p style="padding-left: 40px;">Errors: 18 studies, r = 0.22, range 0.04 to 0.56, Q_w p = 0.61</p> <p style="padding-left: 40px;"><i>No difference was reported between source recognition (p = 0.09)</i></p> <p style="padding-left: 40px;">External source monitoring: 9 studies, r = 0.32, range -0.02 to 0.62, Q_w p = 0.005</p> <p style="padding-left: 40px;">Internal source monitoring: 8 studies, r = 0.30, range CI 0.18 to 0.42, Q_w p = 0.93</p> <p style="padding-left: 40px;">Reality monitoring: 16 studies, r = 0.22, range 0.07 to 0.56, Q_w p = 0.41</p>	
Consistency	Consistent for all measures except external source recognition
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct

Aleman A, Agrawal N, Morgan KD, David AS

Insight in psychosis and neuropsychological function: Meta-analysis

British Journal of Psychiatry 2006; 189: 204-212



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View review abstract online	
Comparison	Association between memory and insight in people with schizophrenia.
Summary of evidence	Moderate to high quality evidence (small sample, direct, consistent, precise) suggests a medium-sized association between higher levels of memory and higher levels of insight in people with schizophrenia.
Memory	
<i>A medium effect size suggests increased memory ability was associated with increased insight in people with schizophrenia;</i> 3 studies, N = 129, $r = 0.28$, 95%CI 0.11 to 0.43, $p = 0.002$, $Q_w = 1.1$, $p = 0.58$	
Consistency	Consistent
Precision	Precise
Directness	Direct

Berna F, Potheegadoo J, Aouadi I, Ricarte JJ, Alle MC, Coutelle R, Boyer L, Cuervo-Lombard CV, Danion JM

A Meta-Analysis of Autobiographical Memory Studies in Schizophrenia Spectrum Disorder

Schizophrenia Bulletin 2016; 42: 56-66

[View review abstract online](#)

Comparison	Autobiographical memory in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (medium to large samples, inconsistent, precise, direct) finds a large effect of poorer autographical memory in people with schizophrenia.
Autobiographical memory	
<i>Significant, large effects of poorer autobiographical memory in people with schizophrenia;</i>	



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Memory specificity: 14 studies, N = 792, $g = -0.97$, 95%CI -1.45 to -0.48, $p < 0.001$, $I^2 = 90%$, $p < 0.001$

Richness of detail: 9 studies, N = 480, $g = -1.40$, 95%CI -1.82 to -0.98, $p < 0.001$, $I^2 = 76%$, $p < 0.001$

Conscious recollection: 9 studies, N = 354, $g = -0.62$, 95%CI -0.98 to -0.27, $p < 0.01$, $I^2 = 61%$, $p < 0.05$

Effect sizes were not significantly influenced by patients' age, symptoms, duration of illness, sex, IQ, education or differences in tasks used.

Consistency in results	Inconsistent
Precision in results	Precise
Directness of results	Direct

Bogaty SER, Lee RSC, Hickie IB, Hermens DF

Meta-analysis of neurocognition in young psychosis patients with current cannabis use

Journal of Psychiatric Research 2018; 99: 22-32

[View review abstract online](#)

Comparison	Cognition in people with psychosis and current cannabis use vs. people with psychosis with no cannabis use.
Summary of evidence	Moderate quality evidence (large samples, inconsistent, imprecise, direct) finds a medium to large effect of poorer verbal working memory in people with psychosis and current cannabis use compared to people with psychosis with no cannabis use.

Verbal memory

Significant, medium to large effect of poorer verbal working memory in people with psychosis and current cannabis use;

6 studies, N = 927, $g = -0.76$, 95%CI -1.30 to -0.22, $p < 0.01$, $I^2 = 92%$

There were no significant differences in verbal memory;

8 studies, N = 1,153, $g = -0.13$, 95%CI -0.42 to 0.16, $p > 0.05$, $I^2 = 75%$

Consistency in results	Inconsistent
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Precision in results	Imprecise for verbal working memory, precise for verbal memory.
Directness of results	Direct

Bora E, Binnur Akdede B, Alptekin K

Neurocognitive impairment in deficit and non-deficit schizophrenia: a meta-analysis

Psychological Medicine 2017; 47: 2401-13

[View review abstract online](#)

Comparison	Cognitive functioning in people with deficit schizophrenia vs. people with non-deficit schizophrenia. Both groups were also compared to controls.
Summary of evidence	Moderate to high quality evidence (large samples, some inconsistencies, precise, direct) suggests people with deficit schizophrenia are more impaired on verbal, visual and working memory than people with non-deficit schizophrenia.

Memory

Significant, small effects of poorer memory in people with deficit schizophrenia compared to people with non-deficit schizophrenia;

Verbal memory: 12 studies, N = 1,698, $d = 0.34$, 95%CI 0.16 to 0.51, $p < 0.001$, $I^2 = 61%$, $p = 0.004$

Visual memory: 10 studies, N = 789, $d = 0.27$, 95%CI 0.13 to 0.42, $p < 0.001$, $I^2 = 0%$, $p = 0.90$

Working memory: 9 studies, N = 1,428, $d = 0.24$, 95%CI 0.11 to 0.37, $p < 0.001$, $I^2 = 14%$, $p = 0.32$

Significant, large effects of poorer memory in people with deficit schizophrenia compared to controls and in people with non-deficit schizophrenia compared to controls;

Verbal memory

Deficit: 8 studies, N = 962, $d = 1.43$, 95%CI 1.23 to 1.63, $p < 0.001$, $I^2 = 39%$, $p = 0.12$

Non-deficit: 8 studies, N = 1,116, $d = 1.19$, 95%CI 1.03 to 1.35, $p < 0.001$, $I^2 = 38%$, $p = 0.12$

Visual memory

Deficit: 8 studies, N = 962, $d = 1.17$, 95%CI 0.87 to 1.47, $p < 0.001$, $I^2 = 72%$, $p < 0.001$

Non-deficit: 8 studies, N = 1,116, $d = 0.78$, 95%CI 0.66 to 0.91, $p < 0.001$, $I^2 = 0%$, $p = 0.43$

Working memory



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Deficit: 3 studies, N = 328, $d = 1.04$, 95%CI 0.65 to 1.43, $p < 0.001$, $I^2 = 61%$, $p = 0.07$ Non-deficit: 3 studies, N = 343, $d = 1.00$, 95%CI 0.71 to 1.30, $p < 0.001$, $I^2 = 46%$, $p = 0.16$	
Consistency in results	Some inconsistencies.
Precision in results	Precise
Directness of results	Direct

Bora E, Yucel M, Pantelis C

Cognitive functioning in schizophrenia, schizoaffective disorder and affective psychoses: meta-analytic study

The British Journal of Psychiatry 2009; 195: 475-482

[View review abstract online](#)

Comparison	Cognitive functioning in people with schizophrenia vs. people with affective psychosis or schizoaffective disorder. Note: the schizophrenia group had more males, with a younger mean age and with fewer years of education, which may account for any observed effects.
Summary of evidence	Moderate to high quality evidence (unclear sample size, direct, precise, some inconsistencies) shows a small effect of poorer performance on verbal memory tasks in people with schizophrenia compared to people with affective psychosis or schizoaffective disorder. There were no differences in visual memory, spatial working memory or digit span tasks.

Memory

A significant, small effect suggests worse overall memory performance in people with schizophrenia compared with people with affective psychosis or schizoaffective disorder;

13 studies, N = not reported, $d = 0.27$, 95%CI 0.11 to 0.43, $p = 0.001$, Q_w , $p = 0.12$

Subgroup analysis shows that this effect is significant for both comparisons with affective psychosis and with schizoaffective psychosis;

Schizophrenia vs. affective psychosis: 7 studies, $d = 0.30$, 95%CI 0.05 to 0.55, $p = 0.02$, Q_w $p = 0.07$

Schizophrenia vs. schizoaffective disorder: 6 studies, $d = 0.23$, 95%CI 0.04 to 0.43, $p = 0.02$, Q_w p



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= 0.35

Subgroup analysis shows that the effect sizes were non-significant when using only gender-matched studies, and that heterogeneity was substantially reduced (statistics not reported).

Results for individual memory tasks

Verbal memory – worse performance in schizophrenia for all comparisons;

Schizophrenia vs. affective psychosis: 6 studies, $d = 0.36$, 95%CI 0.03 to 0.69, $p = 0.003$, $Q_W p = 0.001$

Schizophrenia vs. schizoaffective disorder: 4 studies, $d = 0.23$, 95%CI 0.02 to 0.44, $p = 0.03$, $Q_W p = 0.55$

Immediate verbal memory: 8 studies, $d = 0.42$, 95%CI 0.20 to 0.65, $p < 0.05$, $Q_W p = 0.02$

Verbal working memory: 7 studies, $d = 0.31$, 95%CI 0.02 to 0.57, $p < 0.05$, $Q_W p = 0.06$

Verbal memory delay: 9 studies, $d = 0.29$, 95%CI 0.09 to 0.49, $p < 0.05$, $Q_W p = 0.07$

Visual memory – no differences for any comparison;

Schizophrenia vs. affective psychosis: 5 studies, $d = 0.10$, 95%CI -0.27 to 0.46, $p = 0.60$, $Q_W p = 0.01$

Schizophrenia vs. schizoaffective disorder: 4 studies, $d = 0.08$, 95%CI -0.35 to 0.51, $p = 0.72$, $Q_W p = 0.02$

Immediate visual memory: 4 studies, $d = 0.14$, 95%CI -0.21 to 0.50, $p = 0.43$, $Q_W p = 0.03$

Visual memory delay: 8 studies, $d = 0.09$, 95%CI -0.24 to 0.40, $p = 0.63$, $Q_W p < 0.001$

No differences for spatial working memory or digit span;

Spatial working memory: 4 studies, $d = -0.09$, 95%CI -0.55 to 0.38, $p = 0.71$, $Q_W p = 0.09$

Digit span: 12 studies, $d = 0.02$, 95%CI -0.14 to 0.18, $p = 0.78$, $Q_W p = 0.17$

Meta-regression of the overall analysis showed that schizophrenia samples with more severe negative symptoms showed the greatest impairments compared with people with schizoaffective/affective psychosis;

5 studies, $B = 0.23$, $SE = 10$, $p = 0.02$

Consistency	Consistent for overall memory, schizoaffective subgroup analysis for verbal memory, spatial working memory and digit span only.
Precision	Precise
Directness	Direct

Bora E, Lin A, Wood SJ, Yung AR, McGorry PD, Pantelis C



Cognitive deficits in youth with familial and clinical high risk to psychosis: A systematic review and meta-analysis

Acta Psychiatrica Scandinavica 2014; 130(1): 1-15

[View review abstract online](#)

<p>Comparison</p>	<p>Cognitive functioning in people at clinical high risk (UHR) and familial high risk (FHR) for psychosis.</p>
<p>Summary of evidence</p>	<p>High quality evidence (large samples, consistent, precise, direct) suggests people at clinical high risk of psychosis and familial high risk of psychosis are similarly impaired on verbal and visual memory, showing small to medium sized effects. People at clinical high risk of psychosis were more impaired on visuospatial working memory than those at familial risk of psychosis.</p>

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Significant, medium-sized effect of poor verbal memory in UHR and FHR groups compared with controls, with no significant differences between groups;

UHR: 10 studies, N = 1,205, $d = 0.50$, 95%CI 0.32 to 0.68, $p < 0.001$, $I^2 = 0.04\%$, Q-test $p = 0.03$

FHR: 12 studies, N = 1,547, $d = 0.45$, 95%CI 0.29 to 0.61, $p < 0.001$, $I^2 = 0.03\%$, Q-test $p = 0.06$

$Q_B p > 0.05$

Significant, small to medium-sized effect of poor verbal working memory in UHR and FHR groups compared with controls, with no significant differences between groups;

UHR: 9 studies, N = 1,136, $d = 0.41$, 95%CI 0.20 to 0.61, $p < 0.001$, $I^2 = 0.06\%$, Q-test $p = 0.007$

FHR: 10 studies, N = 1,206, $d = 0.32$, 95%CI 0.12 to 0.51, $p = 0.001$, $I^2 = 0.05\%$, Q-test $p = 0.02$

$Q_B p > 0.05$

Significant, medium-sized effect of poor visual memory in UHR and FHR groups compared with controls, with no significant differences between groups;

UHR: 8 studies, N = 955, $d = 0.50$, 95%CI 0.23 to 0.77, $p = 0.0002$, $I^2 = 0.10\%$, Q-test $p = 0.001$

FHR: 8 studies, N = 985, $d = 0.51$, 95%CI 0.30 to 0.72, $p < 0.001$, $I^2 = 0.04\%$, Q-test $p = 0.08$

$Q_B p > 0.05$

Significant, small to medium-sized effect of poor visuospatial working memory in UHR and FHR groups compared with controls, with the UHR group showing the greatest deficit;

UHR: 9 studies, N = 802, $d = 0.71$, 95%CI 0.39 to 1.04, $p < 0.001$, $I^2 = 0.18\%$, Q-test $p < 0.001$

FHR: 4 studies, N = 426, $d = 0.35$, 95%CI 0.01 to 0.71, $p = 0.04$, $I^2 = 0.09\%$, Q-test $p = 0.02$



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$Q_B = 4.6, p = 0.03$

Meta-regression of the UHR studies showed that increased deterioration in functioning was associated with more severe deficits in verbal memory. In FHR studies, symptomatic subjects were significantly more impaired than asymptomatic subjects on verbal memory.

Authors report no publication bias.

Consistency	Consistent
Precision	Precise
Directness	Direct

Bora E, Murray RM

Meta-analysis of cognitive deficits in ultra-high risk to psychosis and first-episode psychosis: Do the cognitive deficits progress over, or after, the onset of psychosis?

Schizophrenia Bulletin 2014; 40(43): 744-755

[View review abstract online](#)

Comparison	Changes in cognitive functioning over time in people at ultra-high risk of psychosis (UHR) compared with people with first-episode psychosis (FEP) or controls.
Summary of evidence	High quality evidence (medium to large samples, precise, direct, consistent) suggests small improvements on memory tasks over time in people at ultra-high risk of psychosis, people with first-episode psychosis and controls. Controls showed superior performance on verbal working memory tasks.

Memory improvement over time (1 to 5 years)

Significant, small improvement in verbal working memory over time in UHR and controls, with no improvement in FEP, and controls showed the most improvement;

FEP: 10 studies, N = 503, $d = 0.13$, 95%CI -0.03 to 0.28, $p = 0.10$, $I^2 = 0.02\%$, Q-test $p = 0.20$

UHR: 8 studies, N = 224, $d = 0.20$, 95%CI 0.01 to 0.39, $p = 0.04$, $I^2 = 0\%$, Q-test $p = 0.97$

Controls: 7 studies, N = 268, $d = 0.34$, 95%CI 0.16 to 0.51, $p < 0.001$, $I^2 = 0\%$, Q-test $p = 0.79$

$Q_B = 4.10, p = 0.04$

Significant, small improvement in verbal memory over time in UHR, FEP and controls, with no



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significant differences between groups;

FEP: 11 studies, N = 702, $d = 0.33$, 95%CI 0.19 to 0.47, $p < 0.001$, $I^2 = 0.02\%$, Q-test $p = 0.14$

UHR: 12 studies, N = 532, $d = 0.31$, 95%CI 0.12 to 0.51, $p = 0.002$, $I^2 = 0.06\%$, Q-test $p = 0.02$

Controls: 10 studies, N = 338, $d = 0.38$, 95%CI 0.17 to 0.53, $p < 0.001$, $I^2 = 0.02\%$, Q-test $p = 0.26$

$Q_B p > 0.05$

Significant, small to medium size improvement in visual memory over time in FEP and controls, and a trend improvement for UHR groups, with no significant differences between groups;

FEP: 10 studies, N = 574, $d = 0.27$, 95%CI 0.06 to 0.48, $p = 0.01$, $I^2 = 0.07\%$, Q-test $p = 0.001$

UHR: 5 studies, N = 92, $d = 0.34$, 95%CI -0.02 to 0.70, $p = 0.06$, $I^2 = 0.04\%$, Q-test $p = 0.25$

Controls: 6 studies, N = 228, $d = 0.45$, 95%CI 0.17 to 0.53, $p = 0.002$, $I^2 = 0.06\%$, Q-test $p = 0.06$

$Q_B p > 0.05$

In FEP studies, a decrease in negative symptoms was significantly associated with greater improvement in verbal working memory, and a decrease in positive symptoms was associated with improvement of visual memory performance at follow-up.

Authors report no publication bias, and no effect of medication status.

Consistency	Consistent
Precision	Precise
Directness	Direct

Bora E, Pantelis C

Meta-analysis of Cognitive Impairment in First-Episode Bipolar Disorder: Comparison with First-Episode Schizophrenia and Healthy Controls

Schizophrenia Bulletin 2015; 41(5): 1095-1104

[View review abstract online](#)

Comparison	Cognitive functioning in people with first-episode schizophrenia vs. people with first-episode bipolar disorder.
Summary of evidence	High quality evidence (large samples, direct, precise, consistent) shows medium-sized effects of poorer verbal memory in people with first-episode schizophrenia compared to people with first-episode bipolar disorder. Moderate quality evidence (inconsistent) also shows a small effect of poorer working memory, and moderate to low quality evidence



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	(imprecise and inconsistent) shows a small effect of poorer visual memory in people with first-episode schizophrenia.
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<p><i>A significant, small to medium-sized effect of poorer verbal memory and verbal working memory in people with first-episode schizophrenia compared with first-episode bipolar disorder;</i></p> <p>All verbal memory tasks: 7 studies, N = 832, $d = 0.47$, 95%CI 0.28 to 0.65, $p < 0.001$, $I^2 = 39.5%$, $p = 0.13$</p> <p style="padding-left: 40px;">Learning: 5 studies, N = 638, $d = 0.59$, 95%CI 0.40 to 0.78, $p < 0.001$</p> <p style="padding-left: 40px;">Recall: 5 studies, N = 638, $d = 0.38$, 95%CI 0.20 to 0.55, $p < 0.001$</p> <p>Working memory: 8 studies, N = 774, $d = 0.35$, 95%CI 0.11 to 0.59, $p = 0.005$, $I^2 = 59.2$, $p = 0.02$</p> <p style="padding-left: 40px;">Verbal working memory: 8 studies, N = 774, $d = 0.33$, 95%CI 0.08 to 0.57, $p = 0.009$</p> <p style="padding-left: 40px;">Digit span forwards: 4 studies, N = 435, $d = 0.18$, 95%CI -0.03 to 0.38, $p = 0.09$</p> <p style="padding-left: 40px;">Digit span backwards: 6 studies, N = 536, $d = 0.13$, 95%CI -0.04 to 0.31, $p = 0.14$</p> <p>Visual memory: 4 studies, N = 406, $d = 0.28$, 95%CI -0.05 to 0.60, $p = 0.09$, $I^2 = 66.2%$, $p = 0.05$</p> <p style="text-align: center;">Authors report no publication bias.</p> <p style="text-align: center;">Meta-regression analysis revealed between-group differences in working memory were more significant in studies that included younger people with first-episode schizophrenia. No differences were found for males vs. females.</p>	
Consistency in results	Consistent for verbal memory, inconsistent for working memory and visual memory.
Precision in results	Precise for all verbal memory tasks and all working memory tasks, imprecise for visual memory.
Directness of results	Direct

Christensen T

The influence of neurocognitive dysfunctions on work capacity in schizophrenia patients: a systematic review of the literature

International Journal of Psychiatry in Clinical Practice 2007; 11(2): 89-101

[View review abstract online](#)

Comparison	Association between work capacity and cognitive performance
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	<p>in people with schizophrenia.</p> <p>Note: work capacity is the ability to obtain and maintain competitive work and work behaviours and skills.</p>
Summary of evidence	<p>Moderate to low quality evidence (small to medium-sized sample, direct, unable to assess consistency or precision) suggests lower work capacity is associated with poorer memory.</p>
Memory	
<p>5 studies (N = 365) reported that poor <i>verbal memory</i> was associated with worse work habits, occupational functioning, work performance, work behaviour, integrated employment status, fewer hours worked and wages earned. No association between <i>verbal memory</i> and personal presentation, social work skills and cooperativeness.</p> <p>1 study (N = 77) reported that poor <i>immediate and delayed memory</i> was associated with worse employment status. Poor <i>working memory</i> (1 study, N = 30) was associated with unemployment.</p>	
Consistency	Unable to assess; no measure of consistency is reported.
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct

Daban C, Martinez-Aran A, Torrent C, Tabarés-Seisdedos R, Balanzá-Martínez V, Salazar-Fraile J, Selva-Vera G, Vieta E

Specificity of cognitive deficits in bipolar disorder versus schizophrenia: A systematic review

Psychotherapy and Psychosomatics 2006; 75: 72-84

[View review abstract online](#)

Comparison	Cognitive performance in people with schizophrenia vs. people with bipolar disorder.
Summary of evidence	<p>Moderate quality evidence (medium to large samples, unable to assess consistency or precision, direct) suggests people with schizophrenia may show impaired immediate story recall compared with people with bipolar disorder.</p>



Memory

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Memory	
<p>6 studies (N = 831) reported worse <i>immediate story recall</i> in people with schizophrenia compared with people with bipolar disorder. 1 study (N = 446) reported that both groups were impaired compared with controls.</p> <p>Only 1 study, (N = 102) reported worse <i>verbal memory</i> (WMS-R logical memory and paired associates) in people with schizophrenia compared with people to people with unipolar or depressive bipolar. 8 studies (N = 721) reported no difference in verbal memory (CVLT, AVLT, WMS-R logical memory and paired associates, Babcock story recall) in people with schizophrenia compared with bipolar disorder. 3 studies, (N = 246) reported both groups showed impaired performance compared with controls. 1 study, (N = 223) reported worse verbal memory in people with first-admission schizophrenia than in people with first-admission psychotic affective disorder.</p> <p>5 studies (N = 466) reported no difference in <i>working memory</i> (Visual Backward Masking task) in people with schizophrenia and bipolar disorder.</p>	
Consistency	Unable to assess; no measure of consistency is reported.
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct

<p><i>de Gracia Domingues M, Viechtbauer W, Simons C, van Os J</i></p> <p>Are psychotic psychopathology and neurocognition orthogonal? A systematic review of their associations</p> <p>Psychological Bulletin 2009; 135(1): 157-171</p> <p>View review abstract online</p>	
Comparison	Association between memory and symptom dimensions in people with non-affective psychosis.
Summary of evidence	Moderate to high quality evidence (unclear sample size, direct, precise, consistent) suggests a small to medium association between increased negative or disorganised symptoms and lower visual and verbal memory, but not lower working memory.
Memory	



Memory

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A significant small to medium association between increased negative symptoms and lower;
 Verbal learning and memory: 20 studies, $\mu_p = -0.214$, 95%CI -0.279 to -0.146, $p = 0.00$, $I^2 = 54\%$
 Visual learning and memory: 13 studies, $\mu_p = -0.126$, 95%CI -0.202 to -0.047, $p = 0.001$, $I^2 = 29\%$
No association with verbal working memory;
 10 studies, $\mu_p = -0.07$, 95%CI -0.174 to 0.036, $p = 0.194$, $I^2 = 19\%$
A significant small to medium association between increased disorganised symptoms and lower;
 Visual learning and memory: 6 studies, $\mu_p = -0.206$, 95%CI -0.331 to -0.074, $p = 0.002$, $I^2 = 42\%$
 Verbal learning and memory: 13 studies, $\mu_p = -0.169$, 95%CI -0.27 to -0.064, $p = 0.001$, $I^2 = 59\%$
No association with verbal working memory;
 5 studies, $\mu_p = -0.177$, 95%CI -0.247 to 0.018, $p = 0.09$, $I^2 = 0\%$
No association with positive symptoms;
 Verbal working memory: 9 studies, $\mu_p = -0.013$, 95%CI -0.144 to 0.118, $p = 0.843$, $I^2 = 37\%$
 Verbal learning and memory: 17 studies, $\mu_p = -0.021$, 95%CI -0.096 to 0.054, $p = 0.578$, $I^2 = 47\%$
 Visual learning and memory: 9 studies, $\mu_p = -0.005$, 95%CI -0.089 to 0.079, $p = 0.91$, $I^2 = 0\%$

Consistency	Consistent
Precision	Precise
Directness	Direct

De Herdt A, Wampers M, Vancampfort D, De Hert M, Vanhees L, Demunter H, Van Bouwel L, Brunner E, Probst M

Neurocognition in clinical high risk young adults who did or did not convert to a first schizophrenic psychosis: a meta-analysis

Schizophrenia Research 2013; 149(1-2): 48-55

[View review abstract online](#)

Comparison	Baseline cognitive functioning in people at clinical high risk for psychosis who transitioned to psychosis at follow-up compared with those who did not transition to psychosis at follow-up (period not reported).
Summary of evidence	Moderate to high quality evidence (unclear sample size, consistent, precise, direct) suggests a small effect of poorer



Memory

	working memory in people at clinical high risk for psychosis who transitioned to psychosis compared with people at clinical high risk for psychosis who did not transition to psychosis.
Working memory	
<i>A trend, small effect of poorer working memory in people at clinical high risk for psychosis who transitioned to psychosis compared with those who did not transition to psychosis;</i> 7 studies, $g = -0.27$, 95%CI -0.56 to 0.02, $p = 0.069$, Q-test $p = 0.232$	
Consistency	Consistent
Precision	Precise
Directness	Direct

Dibben CR, Rice C, Laws K, McKenna PJ

Is executive impairment associated with schizophrenic syndromes? A meta-analysis

Psychological Medicine 2009; 39(3): 381-392

[View review abstract online](#)

Comparison	Association between executive impairment and symptom dimensions in people with schizophrenia.
Summary of evidence	Moderate to low quality evidence (unclear sample size, unable to assess consistency, precise, direct) shows a weak association of impaired executive working memory in people with schizophrenia with increased negative or disorganised symptoms.
Working memory	
<i>All tasks showed a weak association with negative symptoms;</i> 13 studies, $r = -0.14$, 95%CI -0.22 to -0.07 <i>And with disorganised symptoms;</i> 6 studies, $r = -0.12$, 95%CI -0.23 to 0.00	



Memory

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Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise
Directness	Direct

Dickinson D, Ramsey ME, Gold JM

Overlooking the Obvious: A meta-analytic comparison of digit symbol coding tasks and other cognitive measures in schizophrenia

Archives of General Psychiatry 2007; 64: 532-542

[View review abstract online](#)

Comparison	Memory in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, direct, mostly precise, unable to assess consistency) suggests large effects of poorer performance on episodic memory tasks and working memory tasks in people with schizophrenia compared to controls.

Memory

Large effect size suggests people with schizophrenia showed poorer episodic memory performance compared with controls on tasks including;

- Word list learning: 21 studies, N = 2,107, $g = -1.25$, SE = 0.10, 95%CI -1.44 to -1.05
- Word list learning delay: 16 studies, N = 1,516, $g = -1.09$, SE = 0.08, 95%CI -1.25 to -0.93
- Story memory: 12 studies, N = 1,519, $g = -1.19$, SE = 0.11, 95%CI -1.40 to -0.98
- Story memory delay: 10 studies, N = 1,201, $g = -1.29$, SE = 0.11, 95%CI -1.51 to -1.07
- Verbal paired associates: 6 studies, N = 634, $g = -1.12$, SE = 0.26, 95%CI -1.62 to -0.61
- Visual reproduction: 9 studies, N = 841, $g = -0.82$, SE = 0.10, 95%CI -1.02 to -0.62
- Visual reproduction delayed: 8 studies, N = 758, $g = -0.78$, SE = 0.09, 95%CI -0.95 to -0.61
- Figure recall: 5 studies, N = 629, $g = -1.03$, SE = 0.13, 95%CI -1.28 to -0.77

Large effect size suggests people with schizophrenia showed poorer working memory performance compared with controls on tasks including;

- Letter-number sequencing: 4 studies, N = 419, $g = -0.85$, SE = 0.11, 95%CI -1.06 to -0.63



Memory

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<p>Digit span forward: 4 studies, N = 295, $g = -0.73$, SE = 0.18, 95%CI -1.08 to -0.38 Digit span backward: 4 studies, N = 188, $g = -0.86$, SE = 0.14, 95%CI -1.14 to -0.59 Digit span total: 17 studies, N = 1602, $g = -0.71$, SE = 0.06, 95%CI -0.82 to -0.59 Arithmetic: 9 studies, N = 947, $g = -1.18$, SE = 0.10, 95%CI -1.38 to -0.98</p>	
Consistency	Inconsistent for verbal paired associates. Unable to assess for other measures
Precision	Precise for all measures except verbal paired associated
Directness	Direct

Dickinson D, Gold, JM

Less unique variance than meets the eye: Overlap among traditional neuropsychological dimensions in schizophrenia

Schizophrenia Bulletin 2008; 34(3): 423-434

[View review abstract online](#)

Comparison	Association between individual and composite measures of working memory and other neuropsychological tests in people with schizophrenia.
Summary of evidence	Moderate quality evidence (mixed samples, direct, unable to assess consistency, precise) suggests a medium to strong association between increased scores on memory (verbal, visual and working memory) and increased scores on other Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) domains including attention, executive functioning, visual learning, verbal learning, processing speed, reasoning, fluency, abstraction and flexibility.

Memory

9 studies (N = 1,860) Meta-analysis combined multiple correlations within each study into a single study-level effect size, and then calculated an overall weighted effect size between studies.

Weighted effect size of these 9 studies indicated a significant correlation across composite MATRICS cognitive scores; such that increased performance on attentions tasks was associated



Memory

with increased performance on other cognitive tests, $r = 0.45$, 95%CI 0.35 to 0.54, $p < 0.001$.

1 study (N = 148 outpatients) reported a large association between increased verbal learning (including logical memory) and increased visual learning, processing speed and executive functioning; $r = 0.61$, 95%CI 0.56 to 0.66.

1 study (N = 62 outpatients) reported a large association between increased memory and fluency (digit span distractibility variables, CVLT and fluency) and increased attention and executive functioning; $r = 0.54$, 95%CI 0.33 to 0.70.

1 study (N = 53 outpatients) reported a large association between increased verbal learning (including logical memory, Penn working memory and CVLT) and increased executive functioning (including working memory); $r = 0.54$, 95%CI 0.40 to 0.66.

1 study (N > 1,123 outpatients) reported a large association between increased working memory (visuospatial working memory and letter number sequencing) and increased verbal learning, processing speed, reasoning and vigilance; $r = 0.50$, 95%CI 0.47 to 0.53.

1 study (N = 40 first episode) reported a medium association between increased working memory (digit span and reading span) and increased verbal learning, visual learning and processing speed; $r = 0.35$, 95%CI 0.21 to 0.47.

1 study (N = 219 first episode) reported a medium association between increased working memory (letter fluency, digit span distractibility variables, CPT hits) and increased verbal learning and executive functioning; $r = 0.34$, 95%CI 0.27 to 0.40.

1 study (N = 40 patients) reported a medium association between increased verbal memory (HVL variables and digit span), visual memory (Rey complex figure memory) and increased executive functioning and attention; $r = 0.39$, 95%CI 0.28 to 0.50.

1 study (N = 113 outpatients) reported a small association between verbal learning (including "operative memory) and increased attention, abstraction and flexibility; $r = 0.16$, 95%CI 0.08 to 0.23.

1 study (N = 36 inpatients) reported a large association between increased scores on individual measures of memory (letter-number span and digit span) and increased scores on WCST perseverative errors, trails B, Gordon's CPT and letter fluency; $r = 0.44$, 95%CI 0.33 to 0.54.

1 study (N > 1,123 outpatients) reported a large association between increased scores on individual measures of memory (visuospatial working memory) and increased scores on letter fluency, digit symbol, WCST, WISC mazes, HVL, letter number sequencing and identical pairs CPT; $r = 0.40$, 95%CI 0.37 to 0.44.

1 study (N = 53 inpatients) reported a large association between increased scores on individual measures of memory (digit span) and increased score on letter fluency, verbal series CPT, trails B, symbol digit, HVL, WCST and Stroop; $r = 0.43$, 95%CI 0.38 to 0.47.

1 study (N = 27 inpatients) reported a large association between increased scores on individual measures of memory (working memory tasks, dot working memory test and digit span backwards) and increased scores on Penn CPT, Benton visual retention test, visual object learning test, Penn face memory, Penn abstraction and inhibition; $r = 0.46$, 95%CI 0.29 to 0.61.

1 study (169 inpatients) reported a medium association between increased scores on individual measures of memory (digit span) and increased scored on arithmetic, block design and digit



Memory

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symbol; $r = 0.32$, 95%CI 0.25 to 0.39.

1 study (N = ~140 inpatients and outpatients) reported a medium association between increased scores on individual measures of memory (digit sequencing) and increased scores on verbal list learning, category and letter fluency, digit symbol coding and Tower of London; $r = 0.33$, 95%CI 0.24 to 0.41.

1 study (N = 204 inpatients) reported a small association between increased scores on individual measures of memory (logical memory and digit span) and increased scores on category fluency, visual reproduction and WCST perseverative errors; $r = 0.24$, 95%CI 0.18 to 0.30.

1 study (N = 30 inpatients) reported a small association between increased scores on individual measures of memory (dot working memory test, spatial working memory) and increased scores on letter-number sequencing, WCST perseverative errors and HVLT; $r = 0.27$, 95%CI 0.12 to 0.40.

Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise
Directness	Direct

Donoghue K, Doody GA

Effect of Illegal Substance Use on Cognitive Function in Individuals With a Psychotic Disorder, A Review and Meta-Analysis

Neuropsychology 2012; 26(6): 785–801

[View review abstract online](#)

Comparison	Cognitive functioning in people with a psychotic disorder and a substance use disorder vs. people with a psychotic disorder without a substance use disorder.
Summary of evidence	High quality evidence (medium to large samples, consistent, precise, direct) suggests a small effect of better verbal learning and memory in people with a psychotic disorder and a substance use disorder than people with a psychotic disorder without a substance use disorder.

Verbal learning and memory in people with a polysubstance use disorder

A significant small effect suggests people with a psychotic disorder and a polysubstance use disorder showed better verbal learning and memory than people with a psychotic disorder without a substance use disorder;



Memory

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Verbal learning and memory: 5 studies, N = 296, $g = 0.257$, 95%CI 0.011 to 0.503, $p = 0.040$, $I^2 = 0\%$, $p = 0.780$	
Verbal learning and memory in people with a cannabis use disorder	
<i>A significant small effect suggests people with a psychotic disorder and a cannabis use disorder showed better verbal learning and memory than people with a psychotic disorder without a substance use disorder;</i>	
Verbal learning and memory: 3 studies, N = 551, $g = 0.351$, 95%CI 0.179 to 0.523, $p < 0.001$, $I^2 = 0\%$, $p = 0.910$	
Consistency in results	Consistent
Precision in results	Precise
Directness of results	Direct

Doughty OJ, Done DJ

Is semantic memory impaired in schizophrenia? A systematic review and meta-analysis of 91 studies

Cognitive Neuropsychiatry 2009; 14(6): 473-509

[View review abstract online](#)

Comparison	Semantic memory in people with schizophrenia vs. controls.
Summary of evidence	<p>Moderate quality evidence (unclear sample size, direct, inconsistent, some imprecision) suggests a medium to large effect of poorer performance in people with schizophrenia compared with controls on naming, category fluency, word-picture matching, and priming. Patients with schizophrenia may show better performance on association tasks.</p> <p>Moderate to low quality evidence (unable to assess consistency) suggests more impaired performance in people with schizophrenia with formal thought disorder compared with people with schizophrenia without thought disorder on verbal fluency and naming tasks, with no consistent differences for semantic associations, categorisation or priming tasks. The evidence also suggests more impaired performance in verbal fluency in people with schizophrenia with negative symptoms compared with people with schizophrenia without negative</p>



Memory

	symptoms.
Semantic memory	
<p><i>A significant medium to large effect suggests poorer performance on the following language semantic memory tests in people with schizophrenia compared with controls;</i></p> <p>Naming: 15 studies, $d = -1.45$, 95%CI -1.86 to -1.04, $Q = 177.69$, $p < 0.0001$</p> <p>Category fluency: $d = -1.33$, 95%CI -1.15 to -1.11, $Q = 248.018$, $p < 0.001$</p> <p>Word-picture matching: 5 studies, $d = -0.58$, 95%CI -0.92 to -0.24, $Q = 14.73$, $p = 0.04$</p> <p>Priming: 19 studies, $d = -0.02$, 95%CI -0.18 to -0.14, $Q = 473.46$, $p < 0.001$</p> <p><i>Significant, medium size effect of better performance on associations tasks in people with schizophrenia compared with controls;</i></p> <p>Associations: 5 studies, $d = 0.63$, 95%CI 0.003 to 1.28, $Q = 30.34$, $p < 0.001$</p> <p><i>No difference between performance on categorisation in people with schizophrenia compared with controls;</i></p> <p>12 studies, $d = -0.49$, 95%CI -0.86 to 0.12, $Q = 125.62$, $p < 0.0001$</p>	
Relationship with symptoms	
<p><i>More impairment in people with thought disorder compared with people without thought disorder for;</i></p> <p>Verbal fluency: 3 studies reported a difference, $d = -1.12$, 95%CI -1.72 to -0.72, $p < 0.05$</p> <p>Naming: 4 studies reported a difference, $d = -1.195$ vs. -0.73 (CIs not reported), $p = 0.046$</p> <p style="text-align: center;"><i>Inconsistent findings for;</i></p> <p>Association: 1 study reported a difference, 1 study reported no difference (no statistics)</p> <p>Categorisation: 1 study reported a difference, 1 study reported no difference (no statistics)</p> <p style="text-align: center;"><i>No difference for:</i></p> <p>Semantic priming: 1 study reported no difference: $d = 0.126$ vs. $d = 0.202$, $p = 0.12$</p> <p><i>More impairment in people with negative symptoms compared with people without negative symptoms in;</i></p> <p>Verbal fluency: 2 studies, $d = -1.006$, 95%CI -1.43 to -0.58, p not reported</p>	
Consistency	Inconsistent where reported.
Precision	Imprecise for associations, categorisations and symptoms.
Directness	Direct



Memory

Fatouros-Bergman H, Cervenka S, Flyckt L, Edman G, Farde L

Meta-analysis of cognitive performance in drug-naïve patients with schizophrenia

Schizophrenia Research 2014; 158: 156-162

[View review abstract online](#)

Comparison	Cognitive performance in people with schizophrenia who have never been medicated vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, direct, inconsistent, precise) shows poorer performance on verbal, visual and working memory tasks in never-medicated people with schizophrenia compared to controls.
Memory	
<p><i>Significant, large effects of poorer verbal, visual, and working memory in never-medicated patients;</i> Verbal memory: 7 studies, N = 1,019, SMD -1.03, 95%CI -1.44 to -0.63, $p < 0.001$, $I^2 = 88.4%$, $p < 0.001$</p> <p>Tests used were; the Buschke Selective Reminding Test (total recall), the Serial Verbal Learning Task (total recall), the Hopkins Verbal Learning Test Revised (total recall), the Immediate Memory from Repeatable Battery for the Assessment of Neuropsychological Status (total recall), the Logical Memory Test from Wechsler Memory Scale (immediate recall), and the California Verbal Learning Test (total recall trials 1–5, list A).</p> <p>Visual memory: 6 studies, N = 650, SMD -0.78, 95%CI -1.21 to -0.34, $p < 0.001$, $I^2 = 85.3%$, $p < 0.0001$</p> <p>Tests used were; the Rey–Osterrieth Complex Figure (immediate recall), the Figure Recall Test from Repeatable Battery for the Assessment of Neuropsychological Status (immediate recall), the Pattern Recognition Memory test (immediate recall % of correction), the Brief Visuospatial Memory Test Revised (total recall), Visual Reproduction Wechsler Memory Scale 3rd (total recall).</p> <p>Working memory: 10 studies, N = 786, SMD -0.97, 95%CI -1.25 to -0.69, $p < 0.001$, $I^2 = 83.8%$, $p < 0.0001$</p> <p>Tests used were; the Letter Number Span (digits and letters recalled), Digit Span from Wechsler Memory or Intelligence Scales (digits recalled), the Spatial Span from Wechsler Memory Scale 3rd (length), Spatial Span (length), Continuous Performance Test –AX (long delay), the Paced Auditory Serial Addition Test (correct responses), CANTAB (strategy, total errors), N-back task (sensitivity measure, % correct responses), Sternberg working memory task (accuracy %).</p>	
Consistency	Inconsistent



Memory

Precision	Precise
Directness	Direct

Fett AK, Viechtbauer W, Dominguez M, Penn D, van Os J, Krabbendam L

The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: A meta-analysis

Neuroscience and Biobehavioural Reviews 2011; 35: 573-588

[View review abstract online](#)

Comparison	Association between functional outcomes (community function, social behaviour, social problem solving, social skills) and performance on various cognitive domains in patients with schizophrenia.
Summary of evidence	Moderate to high quality evidence (medium-sized samples, direct, mostly consistent, precise) shows increased community functioning and greater social problem-solving ability are associated with better working memory.
Community functioning (work performance, social interaction)	
<i>Significant weak to medium positive association between increased performance on working memory tasks and greater community functioning;</i> 7 studies, N = 495, $r = 0.22$, 95%CI 0.05 to 0.38, $p = 0.01$, $Q = 18.89$, $I^2 = 69.30\%$, $p < 0.05$	
Social problem solving	
<i>Significant medium positive association between increased performance on WM task and greater social problem solving;</i> 4 studies, N = 127, $r = 0.25$, 95%CI 0.07 to 0.41, $p = 0.007$, $Q = 0.29$, $I^2 = 0\%$, $p > 0.05$	
Consistency	Consistent for all outcomes except community functioning - working memory.
Precision	Precise
Directness	Direct



Fioravanti M, Bianchi V, Cinti ME

Cognitive deficits in schizophrenia: an updated meta-analysis of the scientific evidence

BMC Psychiatry 2012; 12: 64

[View review abstract online](#)

Comparison	Memory functioning in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, mostly precise, direct) suggests people with schizophrenia showed lower memory functioning than healthy controls, with a larger effect in outpatients and on long-term memory tasks.
Memory	
<p><i>Authors reported a large effect of lower memory functioning in people with schizophrenia;</i> 47 studies, N = 3,432, SMD = -1.22, 95%CI -1.44 to -1.01, $p < 0.0001$, $I^2 = 86\%$ <i>Subgroup analysis showed a larger effect for outpatients vs. controls than inpatients vs. controls;</i> Inpatients: 17 studies, N = 1,183, SMD = -1.21, 95%CI -1.63 to -0.80, $p < 0.00001$, $I^2 = 90\%$ Outpatients: 16 studies, N = 1,162, SMD = -1.83, 95%CI -2.35 to -1.31, $p < 0.00001$, $I^2 = 92\%$ <i>Subgroup analysis showed a larger effect for long term memory than short term memory;</i> Long term: 45 studies, N = 5,045, SMD = -1.14, 95%CI -1.32 to -0.96, $p < 0.00001$, $I^2 = 87\%$ Short term: 56 studies, N = 5,405, SMD = -1.05, 95%CI -1.18 to -0.92, $p < 0.00001$, $I^2 = 77\%$ Digit span: 31 studies, N = 2,092, SMD = -0.67, 95%CI -0.81 to -0.53, $p < 0.00001$, $I^2 = 51\%$</p>	
Consistency	Inconsistent
Precision	Precise, apart from the outpatients' analysis.
Directness	Direct

Forbes NF, Carrick LA, McIntosh AM, Lawrie SM

Working memory in schizophrenia: a meta-analysis

Psychological Medicine 2009; 39: 889-905



[View review abstract online](#)

Comparison	Working memory performance in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (unclear sample size, direct, mostly consistent and precise) suggests a medium to large effect showing poorer performance in people with schizophrenia compared with controls on verbal working memory, visual working memory and executive working memory tasks.
Working memory	
<p><i>A significant large effect size suggests poorer performance on the following verbal working memory tests in people with schizophrenia compared with controls;</i></p> <p>Verbal paired associate learning test: 18 studies, $d = -0.88$, 95%CI -1.07 to -0.69, $p < 0.001$, $I^2 = 64.0$, $p < 0.001$</p> <p>Verbal learning test: List A Trial 1: 11 studies, $d = -1.01$, 95%CI -1.26 to -0.76, $p < 0.001$, $I^2 = 62.1$, $p = 0.36$</p> <p>Verbal learning test: List A Trial 5: 13 studies, $d = -1.25$, 95%CI -1.54 to -0.97, $p < 0.001$, $I^2 = 78.8$, $p < 0.001$</p> <p>Verbal learning test: List A Trial 6, cued: 6 studies, $d = -0.98$, 95%CI -1.32 to -0.65, $p < 0.001$, $I^2 = 59.2$, $p = 0.031$</p> <p>Verbal learning test: List A Trial 6, free recall: 13 studies, $d = -1.08$, 95%CI -1.35 to -0.80, $p < 0.001$, $I^2 = 76.6$, $p < 0.001$</p> <p>Verbal learning test: Total list A, Trials 1-5: 28 studies, $d = -1.32$, 95%CI -1.48 to -1.17, $p < 0.001$, $I^2 = 60.4$, $p < 0.001$</p> <p>Verbal learning test: List B: 6 studies, $d = -0.92$, 95%CI -1.19 to -0.65, $p < 0.001$, $I^2 = 40.4$, $p = 0.136$</p> <p>Long DSDT: distraction condition: 3 studies, $d = -1.41$, 95%CI -2.12 to -0.70, $p < 0.001$, $I^2 = 65.3$, $p = 0.056$</p> <p>Long DSDT: non-distraction condition: 3 studies, $d = -1.07$, 95%CI -1.54 to -0.59, $p < 0.001$, $I^2 = 29.5$, $p = 0.242$</p> <p>Short DSDT: distraction condition: 6 studies, $d = -1.30$, 95%CI -1.73 to -0.87, $p < 0.001$, $I^2 = 64.9$, $p = 0.014$</p> <p>Short DSDT: non-distraction condition: 6 studies, $d = -1.0$, 95%CI -1.25 to -0.76, $p < 0.001$, $I^2 = 0.0$, $p = 0.544$</p> <p>Digit span backwards: 31 studies, $d = -0.87$, 95%CI -0.96 to -0.77, $p < 0.001$, $I^2 = 6.7$, $p = 0.36$</p> <p>Digit span forwards and backwards: 17 studies, $d = -0.92$, 95%CI -0.69 to -1.16, $p < 0.001$, $I^2 = 68.0$, $p < 0.001$</p>	



Memory

Letter number span: 12 studies, $d = -1.36$, 95%CI -1.63 to -1.09, $p < 0.001$, $I^2 = 69.4$, $p < 0.001$

Tests of passage recall: 37 studies, $d = -1.35$, 95%CI -1.50 to -1.20, $p < 0.001$, $I^2 = 67.0$, $p < 0.001$

Verbal recall test: 24 studies, $d = -1.21$, 95%CI -1.39 to -1.03, $p < 0.001$, $I^2 = 53.3$, $p = 0.001$

Verbal span tasks involving manipulation: 9 studies, $d = -1.02$, 95%CI -1.32 to -0.71, $p < 0.001$, $I^2 = 67.6$, $p = 0.002$

A significant medium effect size suggests poorer performance on the following verbal working memory tests in people with schizophrenia compared with controls;

Verbal span tasks not involving manipulation: 7 studies, $d = -0.72$, 95%CI -0.91 to -0.51, $p < 0.001$
 $I^2 = 0$, $p = 0.433$

Consonant trigram test: 7 studies, $d = -0.77$, 95%CI -1.09 to -0.44, $p < 0.001$, $I^2 = 54.0$, $p = 0.042$

Digit span forwards: 38 studies, $d = -0.55$, 95%CI -0.7 to -0.4, $p < 0.001$, $I^2 = 65.7$, $p < 0.001$

Verbal recognition test: 19 studies, $d = -0.63$, 95%CI -0.84 to -0.42, $p < 0.001$, $I^2 = 58.9$, $p = 0.001$

A significant medium effect size suggests poorer performance on the following visual working memory tests in people with schizophrenia compared with controls;

Visual paired associate learning test: 6 studies, $d = -0.91$, 95%CI -1.24 to -0.57, $p < 0.001$, $I^2 = 51.5$,
 $p = 0.067$

Benton visual retention test: 9 studies, $d = -1.29$, 95%CI -1.73 to -0.85, $p < 0.001$, $I^2 = 83$, $p < 0.001$

Complex figure reproduction (errors): 3 studies, $d = 0.95$, 95%CI 0.49 to 1.41, $p < 0.001$, $I^2 = 18.1$,
 $p = 0.295$

Tests of immediate facial recognition: 15 studies, $d = -0.82$, 95%CI -1.02 to -0.61, $p < 0.001$, $I^2 = 44.1$,
 $p = 0.034$

Tests of pattern recognition: 9 studies, $d = -0.84$, 95%CI -1.04 to -0.64, $p < 0.001$, $I^2 = 42.5$, $p = 0.85$

Spatial delayed response task (error distance): 3 studies, $d = 0.85$, 95%CI 0.5 to 1.19, $p < 0.001$, $I^2 = 0$,
 $p = 0.955$

Test of spatial recognition: 5 studies, $d = -0.76$, 95%CI -0.96 to -0.56, $p < 0.001$, $I^2 = 0$, $p = 0.41$

Spatial span backwards: 6 studies, $d = -0.99$, 95%CI -1.27 to -0.72, $p < 0.001$, $I^2 = 27.6$, $p = 0.227$

Spatial span forward: 19 studies, $d = -0.94$, 95%CI -1.08 to -0.79, $p < 0.001$, $I^2 = 39.1$, $p = 0.042$

Immediate visual recall tests: 33 studies, $d = -0.87$, 95%CI -1.01 to -0.72, $p < 0.001$, $I^2 = 63.2$, $p < 0.001$

Visuospatial span - forwards and backwards: 3 studies, $d = -0.51$, 95%CI -0.88 to -0.16, $p < 0.001$,
 $I^2 = 53.4$, $p = 0.117$

A significant medium to large effect size suggests poorer performance on the following executive working memory tests in people with schizophrenia compared with controls;

CANTAB SWM strategy score: 6 studies, $d = 0.92$, 95%CI 0.69 to 1.16, $p < 0.001$, $I^2 = 44.1$, $p = 0.111$

Random letter/number generation: 3 studies, $d = 0.81$, 95%CI 0.28 to 1.34, $p = 0.003$, $I^2 = 49.3$, $p =$



Memory

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0.139

Executive golf task: 4 studies, $d = 0.73$, 95%CI 0.50 to 0.96, $p < 0.001$, $I^2 = 0.0$, $p = 0.488$

Self-ordered pointing: 3 studies, $d = 0.75$, 95%CI 0.3 to 1.2, $p = 0.001$, $I^2 = 47.8$, $p = 0.147$

Meta-regression analysis suggests a significant association between longer duration of illness and poorer performance on spatial working memory strategy task ($b = 0.027$, $p = 0.021$), verbal learning test cued recall post-distraction ($b = -0.037$, $p = 0.001$), verbal learning test free recall post-distraction ($b = -0.0339$, $p = 0.015$), visual paired associate learning test ($b = -0.15$, $p = 0.017$), and immediate visual recall test ($b = -0.062$, $p = 0.005$).

A significant association between higher IQ and better performance on the memory test passage recall ($b = -0.074$, $p = 0.001$) in people with schizophrenia. Dose of chlorpromazine was associated with performance on verbal list learning list 1 ($b = -0.0026$, $p < 0.001$), verbal list learning list 5 ($b = -0.0027$, $p < 0.001$), total recall on verbal learning tests recall trials ($b = -0.0013$, $p < 0.001$) and verbal learning test, short delay, free recall ($b = -0.002$, $p = 0.01$).

Verbal list learning list 1 was associated with increased positive symptoms ($b = 0.09$, $p = 0.35$) and negative symptoms ($b = 0.13$, $p = 0.019$). Digit span forwards and backwards was also associated with increased positive symptoms ($b = 0.154$, $p < 0.01$) and negative symptoms ($b = 0.139$, $p < 0.001$).

Consistency	Consistent for verbal working memory (list A trial 1, trial 6 cued, list B), visual paired associate test and executive working memory.
Precision	Precise for all except random letter/number generation.
Directness	Direct

Grimes KM, Zanjani A, Zakzanis KK

Memory impairment and the mediating role of task difficulty in patients with schizophrenia

Psychiatry & Clinical Neurosciences 2017; 71: 600-11

[View review abstract online](#)

Comparison	The effect of task difficulty on memory performance in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, direct, precise, mostly inconsistent) suggests similar large effects of poor visual and verbal memory in people with schizophrenia, regardless of task difficulty.



Memory

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Verbal memory	
<i>Similar, large effects of poorer verbal memory in people with schizophrenia;</i>	
California Verbal Learning Test: 19 studies, N = 1,923, $d = 1.51$, 95%CI 1.22 to 1.80, $I^2 = 86\%$	
Rey Auditory Verbal Learning Test: 11 studies, N = 1,119, $d = 1.52$, 95%CI 1.11 to 1.91, $I^2 = 86\%$	
Hopkins Verbal Learning Test delayed recall: 5 studies, N = 347, $d = 1.47$, 95%CI 1.23 to 1.72, $I^2 = 0\%$	
Visual memory	
<i>Similar, large effects of poorer visual memory in people with schizophrenia;</i>	
Benton Visual Retention Test: 12 studies, N = 1,477, $d = 1.31$, 95%CI 1.02 to 1.59, $I^2 = 78\%$	
Wechsler Memory Scale Visual Reproduction II: 18 studies, N = 1,434, $d = 1.13$, 95%CI 0.86 to 1.39, $I^2 = 80\%$	
Wechsler Memory Scale Visual Reproduction I: 17 studies, N = 1,323, $d = 0.99$, 95%CI 0.70 to 1.27, $I^2 = 82\%$	
Rey-Osterrieth Complex Figure Test delayed recall: 13 studies, N = 1,812, $d = 1.05$, 95%CI 0.82 to 1.26, $I^2 = 71\%$	
Rey-Osterrieth Complex Figure Test immediate recall: 8 studies, N = 1,503, $d = 0.99$, 95%CI 0.70 to 1.26, $I^2 = 79\%$	
Consistency	Inconsistent apart from the Hopkins Verbal Learning Test.
Precision	Precise
Directness	Direct

Grot S, Potvin S, Luck D

Is there a binding deficit in working memory in patients with schizophrenia? A meta-analysis

Schizophrenia Research 2014; 158: 142-145

[View review abstract online](#)

Comparison	Memory binding (memorize and recognize at least two bound information) and working memory performance (memorize and recognize isolated information) in people with schizophrenia vs. controls.
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Memory

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Summary of evidence	Moderate to high quality evidence (medium to large samples, direct, precise, inconsistent) suggests similarly large effects of poor memory binding and poor working memory in people with schizophrenia compared to controls.
Memory binding and working memory	
<p><i>Large, significant effects of poor memory binding and working memory performance in people with schizophrenia compared with controls;</i></p> <p>Binding: 10 studies, N = 538, $d = 1.07$, 95%CI 0.74 to 1.40, $p < 0.001$, $I^2 = 76.14%$, $p < 0.001$ Performance: 10 studies, N = 538, $d = 0.82$, 95%CI 0.59 to 1.05, $p < 0.001$, $I^2 = 78.28%$, $p < 0.001$ Between-condition heterogeneity was not significant ($Q = 1.49$; $p = 0.22$). There was no publication bias, and no effect of moderators.</p>	
Consistency	Inconsistent
Precision	Precise
Directness	Direct

Guilera G, Pino O, Gomez-Benito J, Rojo JE

Antipsychotic effects on cognition in schizophrenia: A meta-analysis of randomised control trials

The European Journal of Psychiatry 2009; 23(2): 77-89

[View review abstract online](#)

Comparison	Memory performance in people with schizophrenia on second generation antipsychotics vs. first generation antipsychotics.
Summary of evidence	Moderate to high quality evidence (large sample, direct, precise, unable to assess consistency) suggests no difference in verbal learning and memory, visual learning and memory or working memory scores in people with schizophrenia receiving second-generation antipsychotics compared with those receiving first-generation antipsychotics.
Memory	



Memory

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No significant difference in scores in people with schizophrenia receiving second-generation antipsychotics compared with first-generation antipsychotics for;

Verbal learning and memory: 11 RCT, N = 1,615, $g = 0.19$, 95%CI -0.01 to 0.39, $p = 0.07$

Visual learning and memory: 6 RCT, N = 725, $g = 0.16$, 95%CI -0.05 to 0.38, $p = 0.12$

Working memory: 8 RCT, N = 1,167, $g = 0.02$, 95%CI -0.10 to 0.15, $p = 0.74$

Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise
Directness	Direct

Hauser M, Zhang JP, Sheridan EM, Burdick KE, Mogil R, Kane JM, Auther A, Carrion RE, Cornblatt BA, Correll CU

Neuropsychological Test Performance to Enhance Identification of Subjects at Clinical High Risk for Psychosis and to Be Most Promising for Predictive Algorithms for Conversion to Psychosis: A Meta-Analysis

Journal of Clinical Psychiatry 2017; 78: e28-e40

[View review abstract online](#)

Comparison 1	Working memory in individuals at clinical high-risk of psychosis vs. controls.
Summary of evidence	Moderate to high quality evidence (large sample, inconsistent, precise, direct) shows a small effect of poorer working memory in people at clinical high-risk for psychosis.
Working memory	
<p><i>Significant, small effect of poorer working memory in people at clinical high-risk;</i></p> <p>10 studies, N = 1,512, $g = -0.24$, 95%CI -0.49 to 0.005, $p = 0.05$, $I^2 = 80\%$</p> <p>This effect was larger in longitudinal studies (follow-up 10.4 months, $g = -0.60$). The effect was significant in studies using the Letter Number Sequencing Test, but not digits backward or Subject Ordered Pointing Task.</p>	
Consistency in results	Inconsistent



Memory

Precision in results	Precise
Directness of results	Direct
Comparison 2	Working memory in individuals at clinical high-risk for psychosis vs. people with first-episode psychosis.
Summary of evidence	High quality evidence (medium to large sample, consistent, precise, direct) shows a medium-sized effect of better working memory in people at clinical high-risk of psychosis.
Working memory	
<i>Significant, medium-sized effect of better working memory in people at clinical high-risk;</i> 3 studies, N = 418, $g = 0.41$, 95%CI 0.18 to 0.64, $p < 0.0001$, $I^2 = 19\%$	
Consistency in results	Consistent
Precision in results	Precise
Directness of results	Direct
Comparison 3	Working memory in individuals at clinical high-risk of psychosis that converted or did not convert to psychosis vs. controls.
Summary of evidence	Moderate to high quality evidence (medium to large samples, some inconsistency, precise, direct) found a medium to large effect of poorer working memory in converters, with no differences in non-converters.
Working memory	
<i>Significant, medium to large effect of poorer working memory in converters vs. controls;</i> 6 studies, N = 344, $g = -0.63$, 95%CI -0.89 to -0.37, $p < 0.0001$, $I^2 = 24\%$ <i>No significant differences in working memory in non-converters vs. controls;</i> 6 studies, N = 427, $g = -0.31$, 95%CI -0.65 to 0.03, $p = 0.07$, $I^2 = 65\%$	
Consistency in results	Inconsistent for non-converters, consistent for converters.
Precision in results	Precise
Directness of results	Direct



Memory

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Irani F, Kalkstein S, Moberg E, Moberg P

Neuropsychological performance in older patients with schizophrenia: A meta-analysis of cross-sectional and longitudinal studies

Schizophrenia Bulletin 2010. Doi: 10.1093/schbul/sbq057

[View review abstract online](#)

Comparison	Memory (immediate, delayed and recognition) in older people with schizophrenia (mean age 64 years) compared with controls.
Summary of evidence	Moderate quality evidence (unclear sample size, direct, inconsistent, precise or unable to assess) suggests older people with schizophrenia may have poorer global cognition and immediate memory than age-matched controls.
Memory	
<p><i>A large effect suggests global cognition was significantly more impaired in older people with schizophrenia compared with the age-matched control group;</i> 21 studies, $d = -1.19$, 95%CI -1.29 to -1.11, $p < 0.05$, $Q = 325.96$, $p < 0.01$</p> <p><i>A large effect size suggesting poorer immediate memory in older people with schizophrenia compared with the age-matched control group;</i> $d = -1.25$, CIs, Q and p-values are not reported</p> <p>Subgroup analysis suggests global cognition may be associated with age, sex, education, ethnicity, diagnosis, living status, age of onset/duration of illness and clinical symptoms.</p>	
Consistency	Inconsistent for overall global cognition, unable to assess for immediate memory.
Precision	Precise for overall global cognition. Unable to assess for immediate memory.
Directness	Direct

Krabbendam L, Arts B, van Os J, Aleman A

Cognitive functioning in patients with schizophrenia and bipolar disorder:



Memory

A quantitative review

Schizophrenia Research 2005; 80: 137-149

[View review abstract online](#)

Comparison	Cognitive performance in people with schizophrenia vs. people with bipolar disorder.
Summary of evidence	High quality evidence (large samples, direct, consistent, precise) shows a medium-sized effect of lower performance on verbal immediate, verbal delayed and visual delayed memory in people with schizophrenia. Moderate quality evidence (inconsistent) suggests this finding may also be applicable to verbal working memory but not visual immediate memory.
Memory	
<p><i>A significant, medium-sized effects of more impaired memory in people with schizophrenia;</i></p> <p>Verbal working memory: 8 studies, N = 532, $d = 0.60$, 95%CI 0.12 to 1.07, $p = 0.01$, $Q_w = 38.0$, $p < 0.001$</p> <p>Verbal immediate memory: 9 studies, N = 697, $d = 0.43$, 95%CI 0.23 to 0.63, $p < 0.0001$, $Q_w = 11.6$, $p = 0.17$</p> <p>Verbal delayed memory: 7 studies, N = 523, $d = 0.34$, 95%CI 0.16 to 0.53, $p = 0.0003$, $Q_w = 3.6$, $p = 0.73$</p> <p>Visual delayed memory: 4 studies, N = 360, $d = 0.51$, 95%CI 0.25 to 0.76, $p = 0.0009$, $Q_w = 3.8$, $p = 0.28$</p> <p><i>No differences in visual immediate memory;</i></p> <p>5 studies, N = 431, $d = 0.26$, 95%CI -0.12 to 0.64, $p = 0.17$, $Q_w = 11.9$, $p = 0.02$</p>	
Consistency	Consistent apart from verbal working memory and visual immediate memory.
Precision	Precise
Directness	Direct

Lee J, Park S

Working memory impairments in schizophrenia: A meta-analysis



Memory

<p>Journal of Abnormal Psychology 2005; 114(4): 599-611 View review abstract online</p>	
<p>Comparison</p>	<p>Working memory in people with schizophrenia vs. controls.</p>
<p>Summary of evidence</p>	<p>Moderate quality evidence (unclear sample size, inconsistent, precise, direct) suggests poorer verbal and visual working memory in people with schizophrenia.</p>
<p>Working memory</p>	
<p><i>A large effect suggests significantly poorer working memory in patients with schizophrenia;</i> Visuospatial working memory: 59 studies, $r = 0.459$, 95%CI 0.152 to 0.766, $Q = 121.25$, $p < 0.01$ Verbal working memory: 70 studies, $r = 0.446$, 95%CI 0.068 to 0.824, $Q = 368.77$, $p < 0.01$</p>	
<p>Consistency</p>	<p>Inconsistent</p>
<p>Precision</p>	<p>Precise</p>
<p>Directness</p>	<p>Direct</p>

<p>Mendrek A, Sepehry A, Stip E Toward a meta-analytic approach of sex differences in episodic memory of schizophrenia patients: Exploratory findings</p>	
<p>Clinical Schizophrenia & Related Psychosis 2008; 2(3): 217-225 View review abstract online</p>	
<p>Comparison</p>	<p>Sex differences in memory performance in people with schizophrenia.</p>
<p>Summary of evidence</p>	<p>High quality evidence (large samples, consistent, precise, direct) shows a small effect of better performance on nonverbal episodic memory tasks in males than females. Moderate quality evidence (inconsistent) suggests no sex differences on verbal memory tasks.</p>
<p>Memory</p>	



Memory

Significant small effect shows males performed better than females on nonverbal episodic memory tasks;

Nonverbal episodic memory: 8 studies, N = 699, $g = 0.244$, 95%CI 0.073 to 0.415, $p = 0.005$

$Q = 8.213$, $p > 0.05$

No differences for:

Verbal episodic memory tasks: 10 studies, N = 833, $g = 0.136$, 95%CI -0.170 to 0.441, $p = 0.383$

$Q = 38.028$, $p < 0.05$

Meta-regression revealed significant relationships between decreased differences in verbal episodic memory tasks between males and females and increased study sample size ($p = 0.025$), and increased age of onset for males ($p = 0.040$).

Consistency	Inconsistent for verbal memory
Precision	Precise
Directness	Direct

Mesholam-Gately R, Giuliano A, Goff K, Faraone S, Seidman L

Neurocognition in first-episode schizophrenia: a meta analytic review

Neuropsychology 2009, 23(3): 315-335

[View review abstract online](#)

Comparison	Memory in people with first-episode schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large sample, direct, inconsistent, precise) suggests a large effect of poorer immediate verbal memory, delayed verbal recall and learning strategies and nonverbal memory; and a medium effect showing poorer working memory in people with first-episode schizophrenia.

Memory

Large effect sizes suggest people with first-episode schizophrenia showed significantly poorer memory compared with controls;

Immediate verbal memory: 21 studies, N = 2,837, $d = -1.20$, 95%CI -1.35 to -1.05, $p < 0.001$, $Q = 207.21$, $p < 0.001$



Memory

Smaller effect sizes were associated with higher proportion of people diagnosed with schizophrenia, and fewer males.

Delayed verbal recall and learning strategies: 16 studies, N = 2,196, $d = -0.85$, 95%CI -0.99 to -0.71, $p < 0.001$, $Q = 232.95$, $p < 0.001$

Smaller effect sizes were associated with recency of publication.

Nonverbal memory: 12 studies, N = 1,894, $d = -0.91$, 95%CI -1.03 to -0.79, $p < 0.001$, $Q = 58.90$, $p < 0.001$

Smaller effect sizes were associated with recency of publication, a higher proportion of first-episode participants on medication, and studies conducted outside the US.

Medium effect size suggests people with first-episode schizophrenia showed significantly poorer working memory compared with controls (Note: the working memory domain was a subcategory of attention);

21 studies, N = 2,751, $d = -0.79$, 95%CI -0.93 to -0.65, $p < 0.001$, $Q = 92.96$, $p < 0.001$

Smaller effect sizes were associated with a higher proportion of right-handed controls, and fewer right handed first-episode participants.

Consistency	Inconsistent
Precision	Precise
Directness	Direct

Nair A, Palmer EC, Aleman A, David AS

Relationship between cognition, clinical and cognitive insight in psychotic disorders: A review and meta-analysis

Schizophrenia Research 2014; 152: 191-200

[View review abstract online](#)

Comparison	Associations between clinical and cognitive insight and cognitive functioning in people with schizophrenia.
Summary of evidence	High quality evidence (medium to large samples, precise, consistent, direct) suggests small associations between increased clinical insight and increased memory, and between increased composite cognitive insight, reduced self-certainty, and increased memory.



Memory

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Associations between clinical insight (ability to identify symptoms as being a mental disorder) and memory

Significant, small associations between increased clinical insight and increased overall memory and verbal memory, and no associations with working memory or non-verbal memory;

Overall memory: 14 studies, N = 707, $r = 0.15$, 95%CI 0.05 to 0.25, $p < 0.001$, $Q_w = 22.05$, $p = 0.05$, $I^2 = 41.05\%$

Verbal memory: 5 studies, N = 296, $r = 0.15$, 95%CI 0.01 to 0.28, $p = 0.03$, $Q_w = 5.12$, $p = 0.28$, $I^2 = 21.9\%$

Working memory: 6 studies, N = 291, $r = 0.20$, 95%CI -0.06 to 0.44, $p = 0.13$, $Q_w = 21.44$, $p = 0.13$, $I^2 = 76.68\%$

Non-verbal memory: 5 studies, N = 236, $r = 0.12$, 95%CI -0.16 to 0.38, $p = 0.42$, $Q_w = 14.71$, $p < 0.01$, $I^2 = 72.8\%$

Relationship between cognitive insight (ability to evaluate symptoms as measured by the Beck Cognitive Insight Scale) and cognitive functioning

Significant, small associations between increased composite cognitive insight, reduced self-certainty and memory, and no associations were found with self-reflectiveness;

Cognitive insight: 5 studies, N = 299, $r = 0.21$, 95%CI 0.09 to 0.32, $p < 0.001$, $Q_w = 3.64$, $p = 0.46$, $I^2 = 0\%$

Self-certainty: 6 studies, N = 430, $r = -0.23$, 95%CI -0.32 to -0.13, $p < 0.001$, $Q_w = 4.70$, $p = 0.45$, $I^2 = 0\%$

Self-reflectiveness: 6 studies, N = 430, $r = 0.06$, 95%CI -0.04 to 0.16, $p = 0.23$, $Q_w = 2.67$, $p = 0.75$, $I^2 = 0\%$

Consistency Consistent

Precision Precise

Directness Direct

Nieto R, Castellanos F

A Meta-Analysis of Neuropsychological Functioning in Patients with Early Onset Schizophrenia and Paediatric Bipolar Disorder

Journal of Clinical Child & Adolescent Psychology 2012; 40:2, 266-280

[View review abstract online](#)



Memory

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Comparison	Cognitive performance in patients with early onset schizophrenia (EOS: mean age 15.8 years) and in paediatric bipolar disorder (PBD: mean age 13.6 years) vs. controls.
Summary of evidence	High quality evidence (medium to large samples, consistent, precise, direct) suggests a large effect of poor working memory, verbal learning, and visual memory in EOS. There was a large effect of poor verbal learning, and a medium-sized effect of poor working memory and visual memory in PBD.
Working memory	
<p><i>Large effect in EOS and a medium-sized effect in PBD of poor working memory vs. controls;</i> EOS: 6 studies, N = 464, $g = -0.99$, 95%CI -1.33 to -0.65, $p < 0.005$, $Q = 6.18$, $p = 0.29$ PBD: 7 studies, N = 525, $g = -0.68$, 95%CI -0.99 to -0.37, $p < 0.005$, $Q = 9.04$ $p = 0.17$ Working memory was significantly lower in EOS vs. controls than PBD vs. controls ($p < 0.001$). Moderator analyses revealed significantly smaller effect sizes in PBD studies with a lower percentage of patients taking mood stabilizers, and in EOS studies with a higher percentage of patients taking antipsychotics. Smaller effect sizes were reported in studies with a lower percentage of patients with acute psychotic symptoms or a lower percentage of manic patients.</p>	
Verbal learning and memory	
<p><i>Large effect of poor verbal learning and memory in EOS and PBD vs. controls;</i> EOS: 9 studies, N = 627, $g = -0.86$, 95%CI -1.15 to -0.57, $p < 0.005$, $Q = 4.41$, $p = 0.82$ PBD: 9 studies, N = 631, $g = -0.83$, 95%CI -1.18 to -0.48, $p < 0.005$, $Q = 11.26$ $p = 0.19$ No significant difference between EOS vs. controls and PBD vs. controls ($p \geq 0.05$). Moderator analyses revealed significantly smaller effect sizes in studies with a lower percentage of males in both diagnostic groups.</p>	
Visual memory	
<p><i>Large effect in EOS and a medium effect in PBD of poor visual memory vs. controls;</i> EOS: 4 studies, N = 213, $g = -0.82$, 95%CI -1.32 to -0.32, $p < 0.005$, $Q = 2.58$, $p = 0.46$ PBD: 5 studies, N = 283, $g = -0.44$, 95%CI -0.93 to -0.05, $p = 0.03$, $Q = 4.36$ $p = 0.96$ Visual memory was significantly lower in EOS vs. controls than PBD vs. controls ($p < 0.001$).</p>	
Consistency	Consistent



Memory

Precision	Precise
Directness	Direct, apart from EOS vs. PBD

Palmer BW, and Savla GN

The association of specific neuropsychological deficits with capacity to consent to research or treatment

Journal of the International Neuropsychological Society 2007; 13: 1047-1059

[View review abstract online](#)

Comparison	Association between memory and capacity to consent to treatment and research in people with schizophrenia spectrum disorders, in terms of their <i>understanding</i> of the information; <i>appreciation</i> of the context; and <i>reasoning</i> of the consequences of their decision.
Summary of evidence	Moderate to low quality evidence (mixed samples, direct, unable to assess precision or consistency) suggests impaired understanding and appreciation are associated with poorer attention/ working memory and episodic memory (medium to large effects). Reasoning had fewer associations overall but may be associated with poor attention/ working memory (medium effect) and episodic memory (medium to large effect).

Memory

Five studies (N = 1,680) examined the association between an individual's capacity to consent, and their memory performance. 4 of 5 studies reported a significant association between impaired understanding with poorer attention, working memory and episodic learning/memory; 5 of 5 studies for impaired appreciation and poorer attention and working memory; 4 of 5 for impaired appreciation and poorer episodic learning/memory; 2 of 5 for impaired reasoning and poorer attention and working memory; and 3 of 5 for impaired reasoning and poorer episodic learning/ memory.

Understanding with attention and working memory: 1 study (N = 25) reporting $p < 0.05$ for RBANS, WAIS, $r = 0.44-0.56$; 1 study (N = 1,447) reporting $p < 0.01$ for CPT, $r = 0.15$; 3 studies (N = 1,625) reporting $p < 0.05$ for Working memory composite, $r = 0.22$ to 0.40 .

Understanding with episodic learning/memory: 1 study (N = 25) reporting $p < 0.05$ for RBANS-immediate ($r = 0.63$) and delayed ($r = 0.41$); 1 study (N = 70) reporting $p < 0.05$ for auditory ($r = 0.50$) and visual learning composites ($r = 0.40$); 1 study (N = 1,447) reporting on Hopkins verbal learning test ($r = 0.16$, $p < 0.01$); and 1 study (N = 108) reporting $p < 0.05$ for DRS memory ($r =$



Memory

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0.54) and learning composite score ($r = 0.47$).

Appreciation with attention and working memory: 1 study ($N = 25$) reporting $p < 0.05$ for RBANS, $r = 0.51$; 1 study ($N = 1,447$) reporting $p < 0.05$ for CPT, $r = 0.15$; 2 studies ($N = 55$) reporting $p < 0.05$ for WAIS-LNS, $r = 0.59-0.81$; 3 studies ($N = 1625$) reporting $p < 0.05$ for Working memory composite, $r = 0.23$ to 0.37 .

Appreciation and episodic learning/ memory: 1 study ($N = 25$) reporting $p < 0.05$ for RBANS-immediate ($r = 0.57$) and delayed ($r = 0.47$); 1 study ($N = 70$) reporting $p < 0.05$ for auditory learning composite ($r = 0.29$); 1 study ($N = 1,447$) reporting on Hopkins verbal learning test ($r = 0.20$, $p < 0.01$); and 1 study ($N = 108$) reporting $p < 0.05$ for DRS memory ($r = 0.27$) and learning composite score ($r = 0.34$).

Reasoning and attention and working memory: 2 studies ($N = 1,555$) reporting $p < 0.05$ for working memory composite ($r = 0.26-0.54$); 1 study ($N = 1,447$) reporting $p < 0.01$ for CPT ($r = 0.12$); and 1 study ($N = 108$) reporting $p < 0.05$ for DRS-Attention ($r = 0.33$).

Reasoning and episodic learning/ memory: 1 study ($N = 30$) reporting $p < 0.05$ for RBANS-immediate ($r = 0.30$); 1 study ($N = 1,447$) reporting on Hopkins verbal learning test ($r = 0.24$, $p < 0.01$); and 1 study ($N = 108$) reporting $p < 0.05$ for DRS memory ($r = 0.46$) and learning composite score ($r = 0.45$).

Consistency	Authors report inconsistency.
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct

Pelletier M, Achim AM, Montoya A, Lal S, Lepage M

Cognitive and clinical moderators of recognition memory in schizophrenia: a meta-analysis

Schizophrenia Research 2005; 74: 233-252

[View review abstract online](#)

Comparison	Recognition memory in people with schizophrenia vs. controls.
Summary of evidence	<p>Moderate to high quality evidence (large samples, inconsistent, precise, direct) suggests a large effect of poor recognition memory in schizophrenia vs. controls.</p> <p>Moderate quality evidence (unable to assess consistency or precision) suggests no association between performance on recognition tasks and symptoms.</p>



Recognition memory

A significant large effect suggests poorer overall recognition in people with schizophrenia compared with controls;

70 studies, N = 4,164, $d = 0.76$, 95%CI 0.68 to 0.84, $Q = 183.6$, $p < 0.001$

A medium to large effect suggests increased verbal recognition memory and better performance on the following subtests;

Source: 11 studies, $d = 0.48$, 95%CI 0.41 to 0.55

Pair: 1 study, $d = 1.29$, 95%CI 0.64 to 2.05

Recency: 4 studies, $d = 0.75$, 95%CI 0.50 to 1.01

Frequency: 1 study, $d = 0.62$, 95%CI 0.03 to 1.27

A large effect suggests increased figural recognition memory and better performance on the following subtests;

Source: 4 studies, $d = 1.09$, 95%CI 0.78 to 1.42

Pair: 3 studies, $d = 1.15$, 95%CI 0.80 to 1.52

Recency: 1 study, $d = 0.56$, 95%CI 0.14 to 1.00

Frequency: 2 studies, $d = 1.43$, 95%CI 0.94 to 1.99

No differences in results with regards to varying medication, illness duration and patient status;

Medication free: 8 studies, N = 811, weighted $d = 0.78$, 95%CI 0.63 to 0.93

First generation antipsychotics: 41 studies, N = 2,108, weighted $d = 0.75$, 95%CI 0.66 to 0.85

Second generation antipsychotics: 14 studies, N = 689, weighted $d = 0.85$, 95%CI 0.68 to 1.02

Anticholinergics: 35 studies, N = 1,974, weighted $d = 0.77$, 95%CI 0.67 to 0.87

Duration of illness (≤ 10 years): 21 studies, N = 1,198, weighted $d = 0.76$, 95%CI 0.64 to 0.89

Duration of illness (> 10 years): 22 studies, N = 1,483, weighted $d = 0.96$, 95%CI 0.81 to 1.04

Status of patient – Inpatient: 20 studies, N = 1,003, weighted $d = 0.67$, 95% 0.51 to 0.78

Status of patient – Outpatient: 15 studies, N = 1,310, weighted $d = 0.64$, 95%CI 0.51 to 0.74

Recognition memory and symptoms



Memory

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No association between symptoms and effect sizes of recognition memory performance by schizophrenia vs. controls;

Positive symptoms:

SAPS global ratings: 10 studies, N = 918, $p = 0.12$

SAPS total items: 7 studies, N = 370, $p = 0.44$

PANSS positive scale: 6 studies, N = 395, $p = 0.052$

Negative symptoms:

SANS global ratings: 10 studies, N = 918, $p = 0.07$

SANS total items: 8 studies, N = 374, $p = 0.34$

PANSS negative scale: 6 studies, N = 395, $p = 0.17$

Overall symptoms:

BRPS: 16 studies, N = 1,158, $p = 0.13$

PANSS overall: 8 studies, N = 549, $p = 0.06$

Consistency	Inconsistent for overall effect. Unable to assess for remaining variables.
Precision	Mostly precise
Directness	Direct

Piskulic D, Olver JS, Norman TR, Maruff P

Behavioural studies of spatial working memory dysfunction in schizophrenia: A quantitative literature review

Psychiatry Research 2007; 150: 111-121

[View review abstract online](#)

Comparison	Spatial working memory in people with schizophrenia vs. controls. Note: 9% of the sample was a mixed group of chronic and unmedicated people with schizophrenia; 6% were acutely ill.
Summary of evidence	Moderate to high quality evidence (large sample, direct, unable to assess consistency, precise) suggests impaired overall



	spatial working memory, including impaired spatial working memory (various tasks) in people with schizophrenia.
Spatial working memory	
<p><i>A large effect suggests impaired overall spatial working memory in people with schizophrenia compared with controls;</i></p> <p>33 studies, N = 2,353, $d = -1.00$, 95%CI -0.93 to -1.07, SE = 0.03</p> <p><i>Specific spatial working memory tasks;</i></p> <p>SOSP BSE: 7 studies, $d = -1.18$, 95%CI -1.62 to -1.33, SE = 0.07</p> <p>SOSP Strategy: 4 studies, $d = -1.10$, 95%CI -1.28 to -0.93, SE = 0.09</p> <p>SOSP Spatial span: 5 studies, $d = -1.20$, 95%CI -1.40 to -1.00, SE = 0.10</p> <p>n-back task (% accuracy): 3 studies, $d = -0.83$, 95%CI -1.34 to -0.33, SE = 0.25</p> <p>DRT (% accuracy): 16 studies, $d = -0.86$, 95%CI -1.01 to -0.72, SE = 0.07</p> <p>Authors report a moderate correlation between lower patient IQ and increased effect sizes.</p>	
Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise for all measures except the n-back task
Directness	Direct

Potvin S, Joyal CC, Pelletier J, Stip E

Contradictory cognitive capacities among substance-abusing patients with schizophrenia: a meta-analysis

Schizophrenia Research 2008; 100: 242-251

[View review abstract online](#)

Comparison	Cognitive functioning in people with schizophrenia with a substance use disorder (SUD) vs. people with schizophrenia without a SUD.
Summary of evidence	Moderate quality evidence (small to medium-sized samples, direct, precise, unable to assess consistency) suggests better visual memory in people with schizophrenia with cannabis use disorder, and more impaired working memory in people with schizophrenia with alcohol use disorder compared with people



Memory

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	with schizophrenia without any SUD.
Memory	
<p>Visual memory composite (based on MATRICS groupings)</p> <p><i>A significant medium effect suggests better visual memory in people with schizophrenia with cannabis SUD compared with people with schizophrenia without any SUD;</i></p> <p>Cannabis SUD: 2 studies, N = 145, $g = 0.446$, 95%CI 0.100 to 0.791, $p = 0.011$</p> <p>Working memory composite (based on MATRICS groupings)</p> <p><i>A significant small to medium effect suggests impaired working memory in people with schizophrenia with alcohol SUD compared with people with schizophrenia without any SUD;</i></p> <p>Alcohol SUD: 3 studies, N = 324, $g = -0.415$, 95%CI -0.799 to -0.031, $p = 0.034$</p>	
Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise
Directness	Direct

<p><i>Rabin RA, Zakzanis KK, George TP</i></p> <p>The effects of cannabis use on neurocognition in schizophrenia: a meta-analysis</p> <p>Schizophrenia Research 2011; 128: 111-116</p> <p>View review abstract online</p>	
Comparison	Relationship between current cannabis use and cognitive ability in people with schizophrenia.
Summary of evidence	Moderate to low quality evidence (unclear samples size, unable to assess consistency or precision, direct) suggests no differences between groups in memory tasks.
Cognitive ability	
<p><i>No differences in memory;</i></p> <p>Working memory: 5 studies, $d = 0.07$, SD = 0.40, $p > 0.05$</p> <p>Retrieval: 6 studies, $d = 0.12$, SD = 0.50, $p > 0.05$</p>	



Memory

Consistency in results	Unable to assess; no measure of consistency is reported.
Precision in results	Unable to assess; no measure of precision is reported.
Directness of results	Direct

Rajji TK, Mulsant BH

Nature and course of cognitive function in late-life schizophrenia: a systematic review

Schizophrenia Research 2008; 102: 122-140

[View review abstract online](#)

Comparison	Memory performance in people with schizophrenia aged over 50 years (late-life schizophrenia, LLS).
Summary of evidence	Moderate to low quality evidence (mixed samples, direct, unable to assess consistency or precision) suggests people with late-life schizophrenia are impaired on memory and working memory.
Memory	
Memory impairment was reported in eleven studies in LLS (N = 1,505), including verbal and visual memory measures, in both hospitalised and ambulatory patients. No difference was reported between early and late onset LLS.	
Attention and Working memory	
Six studies (N = 792) reported impairments in working memory and attention tasks in LLS (both hospitalised and ambulatory) compared with controls. However, three studies reported no difference in LLS compared with healthy controls (N = 225). The separation between working memory and executive function was not adequately delineated in most of these studies and so pure attentional deficits are unclear.	
Consistency	Unable to assess; no measure of consistency is reported.
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct



Memory

Raji TK, Ismail Z, Mulsant BH

Age at onset and cognition in schizophrenia: meta-analysis

The British Journal of Psychiatry 2009; 195: 286-293

[View review abstract online](#)

<p>Comparison</p>	<p>Memory in people with schizophrenia with different age of onset (first-episode schizophrenia, youth-onset schizophrenia and late-onset schizophrenia) vs. controls.</p> <p>Note: maximum age for youth-onset was 19 years; minimum age for late-onset was 40 years; people with any other age at onset were classified as first-episode schizophrenia.</p>
<p>Summary of evidence</p>	<p>Moderate quality evidence (large samples, direct, unable to assess consistency or precision) suggests poorer performance in verbal and visual memory in people with first-episode, youth-onset and late-onset schizophrenia compared with controls.</p>

Memory

N = 5,010 (4,057 first episode schizophrenia, 692 youth-onset schizophrenia, 261 late-onset schizophrenia)

All three groups showed considerable visual memory impairment, with significant between group variability;

First-episode schizophrenia: 55 studies, $d = 0.85$, SE 0.03, $p < 0.05$

Youth-onset schizophrenia: 8 studies, $d = 0.95$, SE 0.10, $p < 0.05$

Late-onset schizophrenia: 9 studies, $d = 1.12$, SE 0.09, $p < 0.05$

All three groups showed considerable verbal general memory impairment, with significant between group variability;

First-episode schizophrenia: 42 studies, $d = 1.03$, SE 0.03, $p < 0.05$

Youth-onset schizophrenia: 12 studies, $d = 0.98$, SE 0.07, $p < 0.05$

Late-onset schizophrenia: 4 studies, $d = 1.11$, SE 0.013, $p < 0.05$

All three groups showed considerable verbal special memory impairment, with significant between group variability;

First-episode schizophrenia: 54 studies, $d = 0.94$, SE 0.03, $p < 0.05$

Youth-onset schizophrenia: 15 studies, $d = 1.18$, SE 0.06, $p < 0.05$

Late-onset schizophrenia: 5 studies, $d = 1.20$, SE 0.12, $p < 0.05$



Memory

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All three groups showed considerable poorer digit span impairment, with significant between group variability

First-episode schizophrenia: 24 studies, $d = 0.64$, SE 0.04, $p < 0.05$

Youth-onset schizophrenia: 7 studies, $d = 0.85$, SE 0.10, $p < 0.05$

Late-onset schizophrenia: 5 studies, $d = 0.87$, SE 0.12, $p < 0.05$

Consistency	Unable to assess; no measure of consistency is reported.
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct

Schoeler T, Kambeitz J, Behlke I, Murray R, Bhattacharyya S

The effects of cannabis on memory function in users with and without a psychotic disorder: findings from a combined meta-analysis

Psychological Medicine 2016; 46: 177-188

[View review abstract online](#)

Comparison	<p>People with psychosis who are cannabis users vs. people with psychosis who are non-users.</p> <p>People without psychosis who are cannabis users vs. healthy non-users.</p>
Summary of evidence	<p>Moderate to high quality evidence (large samples, inconsistent, precise, direct) suggests small to medium-sized effects of better global memory, working memory, visual immediate recall, and visual and verbal recognition in people with psychosis who use cannabis compared with people with psychosis who don't use cannabis. Conversely, in people without psychosis, there is poorer global memory, prospective memory, working memory, verbal immediate recall, verbal learning, verbal delayed recall and verbal recognition in cannabis users compared with non-users.</p>

Memory

In the analysis comparing people with psychosis who use cannabis to people with psychosis who don't use cannabis, cannabis use was associated with small to medium-sized effects of better;

Global memory: 63 samples, $N = 4,428$, $d = -0.11$, 95%CI -0.22 to 0.003, $p = 0.05$, $I^2 = 76\%$

Working memory: $N = 2,468$, $d = -0.20$, 95%CI -0.34 to -0.05, $p < 0.05$



Memory

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Visual immediate recall: $N = 89$, $d = -0.73$, 95%CI, -1.17 to -0.30, $p < 0.05$

Visual recognition: $N = 119$, $d = -0.42$, 95%CI -0.80 to -0.05, $p < 0.05$

Verbal recognition: $N = 283$, $d = -0.34$, 95%CI -0.71 to 0.00, $p = 0.05$

No differences were found for visual working memory, verbal immediate recall, verbal learning, visual learning, or verbal delayed recall.

In the analysis comparing healthy cannabis users to healthy non-users, cannabis use was associated with small to medium-sized effects of poorer;

Global memory: 240 samples, $N = 20,586$, $d = 0.27$, 95%CI 0.22 to 0.32, $p < 0.0001$, $I^2 = 61\%$

Prospective memory: $N = 294$, $d = 0.61$, 95%CI 0.38 to 0.85, $p < 0.05$

Working memory: $N = 4,277$, $d = 0.11$, 95%CI 0.04 to 0.17, $p < 0.05$

Verbal immediate recall: $N = 3,168$, $d = 0.40$, 95%CI 0.27 to 0.53, $p < 0.05$

Verbal learning: $N = 2,710$, $d = 0.36$, 95%CI, 0.24 to 0.48, $p < 0.05$

Verbal delayed recall: $N = 3,365$, $d = 0.36$, 95%CI, 0.22 to 0.49, $p < 0.05$

Visual recognition: $N = 483$, $d = 0.41$, 95%CI, 0.10 to 0.72, $p < 0.05$

No differences were found for visual working memory, visual immediate recall, visual learning, or visual delayed recall.

Authors report that in cannabis-using patients, better global memory was associated with younger age. In healthy cannabis-users, poorer global memory was associated with increased cannabis use, higher depression scores, lower functioning, lower IQ and studies published after vs. before the year 2000. Longer duration of abstinence from cannabis reduced its effects on memory in both healthy and patient users.

Publication bias was present in the healthy sample but not in the patient sample for global memory.

Consistency in results	Inconsistent
Precision in results	Precise
Directness of results	Direct

Schug R, Raine A

Comparative meta-analyses of neuropsychological functioning in antisocial schizophrenic persons

Clinical Psychological Review 2009; 29: 230-242

[View review abstract online](#)



Memory

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Comparison	Memory in people with schizophrenia and antisocial traits vs. people with schizophrenia and no antisocial traits. Note: antisocial behaviour was broadly defined as assaultive, criminal, psychopathic, or violent behaviours and included individuals who had committed specific crimes (e.g. homicide, assault) or who had specific mental disorder diagnoses (e.g. antisocial personality disorder, psychopathy).
Summary of evidence	Moderate to high quality evidence (unclear sample size, direct, consistent, precise) suggests a small effect of poorer memory performance in people with schizophrenia and antisocial traits.
Memory	
<i>Significant, small effect size suggests people with schizophrenia and antisocial traits perform worse on memory tasks;</i> 11 studies, $g = -0.212$, $p < 0.05$, 95%CI -0.403 to -0.021, $Q = 11.290$, $p > 0.05$	
Consistency	Consistent
Precision	Precise
Directness	Direct
Comparison 2	Memory in people with schizophrenia and antisocial traits vs. people without schizophrenia who have antisocial traits.
Summary of evidence	Moderate to high quality evidence (unclear sample size, direct, consistent, precise) suggests a small effect size for poorer memory in people with schizophrenia and antisocial traits.
Memory	
<i>Significant small effect size suggests people with schizophrenia and antisocial traits have perform worse on memory tasks.</i> 7 studies, $g = -0.284$, $p < 0.05$, 95%CI -0.518 to -0.051, $Q = 11.861$, $p > 0.05$	
Consistency	Consistent
Precision	Precise
Directness	Direct



Sedgwick O, Young S, Baumeister D, Greer B, Das M, Kumari V

Neuropsychology and emotion processing in violent individuals with antisocial personality disorder or schizophrenia: The same or different? A systematic review and meta-analysis

Australian and New Zealand Journal of Psychiatry 2017; 51: 1178-97

[View review abstract online](#)

Comparison	Memory in people with schizophrenia or antisocial personality disorder and violent behaviours vs. controls.
Summary of evidence	Moderate to high quality evidence (unclear sample size, consistent, precise, direct) shows a large effect of poorer memory in people with schizophrenia and a medium-sized effect in people with antisocial personality disorder.
Memory	
<p><i>A large effect of poorer memory in people with schizophrenia than controls;</i> 5 studies, $g = -1.16$, 95%CI -1.47 to -0.86, $p < 0.001$, $I^2 = 45%$, $p = 0.119$</p> <p><i>A medium-sized effect of poorer memory in people with antisocial personality disorder than controls;</i> 3 studies, $g = -0.47$, 95%CI -0.83 to -0.10, $p = 0.01$, $I^2 = 0%$, $p = 0.50$</p>	
Consistency in results	Consistent
Precision in results	Precise
Directness of results	Direct

Stefanopoulou E, Manoharan A, Landau S, Geddes J, Goodwin G, Frangou S

Cognitive functioning in patients with affective disorders and schizophrenia: A meta-analysis

International Review of Psychiatry 2009; 21(4): 336-356

[View review abstract online](#)



Memory

Comparison	Verbal memory performance in people with schizophrenia vs. bipolar disorder.
Summary of evidence	Moderate to high quality (unclear sample size, direct, consistent, precise) evidence shows a small effect of lower performance on the California Verbal Learning Test total free recall subscale, but not on the long delayed free recall or recognition hits subscales in patients with schizophrenia vs. bipolar disorder. A small effect was also reported for poorer language performance on the Controlled Oral Word Association Test.
Verbal memory & learning	
<p><i>A significant, small effect suggests that people with schizophrenia had lower performance on the California Verbal Learning Test total free recall subscale compared with people with bipolar disorder. However, no differences were reported on the long delayed free recall and recognition hits subscales;</i></p> <p>Total free recall: (number of studies not reported) SMD = 0.39, 95%CI 0.06 to 0.72, $p = 0.02$, $I^2 =$ not reported, $p = 0.71$</p> <p>Long delayed free recall: SMD = 0.16, 95%CI -0.16 to 0.48, $p = 0.33$, $I^2 =$ not reported, $p = 0.73$</p> <p>Recognition hits: SMD = 0.07, 95%CI -0.31 to 0.47, $p = 0.69$, $I^2 =$ not reported, $p = 0.50$</p> <p><i>A significant, small effect suggests that people with schizophrenia produced fewer words on the Controlled Oral Word Association Test compared with people with bipolar disorder;</i></p> <p>SMD = 0.35, 95%CI 0.14 to 0.55, $p = 0.001$, $I^2 =$ not reported, $p = 0.06$</p>	
Consistency	Consistent
Precision	Precise
Directness	Direct

Szöke A, Tranfafir A, Dunpont ME, Méary A, Schürhoff, F

Longitudinal studies of cognition in schizophrenia: meta-analysis

The British Journal of Psychiatry 2008; 192: 248-257

[View review abstract online](#)

Comparison	Memory testing in people with schizophrenia tested on two
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Memory

	separate occasions more than 1 month apart.
Summary of evidence	Moderate quality evidence (small to medium-sized samples, precise, direct, unable to assess consistency) suggests a small to medium effect of improved performance on the ROCFT, RAVL, CVLT, Wechsler Memory Scale and HVLТ (recognition only) California Verbal Learning Test (immediate recall only).
Visual memory	
<p><i>Significant small to medium effect size suggests that people with schizophrenia showed improved memory performance between baseline and retest on;</i></p> <p>ROCFT (recall, immediate): 5 studies, N = 161: $g = 0.53$, 95%CI 0.31 to 0.76, $p < 0.05$</p> <p>Wechsler Memory Scale – visual reproduction (delayed): 10 studies, N = 450, $g = 0.30$, 95%CI 0.16 to 0.43, $p < 0.05$</p> <p>Wechsler Memory Scale – visual reproduction (immediate): 11 studies, N = 400, $g = 0.20$, 95%CI 0.06 to 0.34, $p < 0.05$</p> <p><i>Compared with controls, there were no differences in improvement levels on;</i></p> <p>Wechsler Memory Scale – visual reproduction (immediate): 5 studies, N = 126, $g = -0.28$, 95%CI -0.87 to 0.32, $p > 0.05$</p> <p>Wechsler Memory Scale – visual reproduction (delayed): 5 studies, N = 126, $g = 0.37$, 95%CI -0.43 to 1.16, $p > 0.05$</p>	
Verbal memory	
<p><i>Significant small effect size suggests that people with schizophrenia showed improved performance on memory tasks when retested after 1 month;</i></p> <p>RAVL: (recall immediate): 5 studies, N = 377, $g = 0.31$, 95%CI 0.16 to 0.45, $p < 0.05$</p> <p>HVLТ (recognition, immediate): 5 studies, N = 252, $g = 0.33$, 95%CI 0.10 to 0.55, $p < 0.05$</p> <p>CVLT (recall, immediate): 4 studies, N = 159: $g = 0.32$, 95%CI 0.10 to 0.54, $p < 0.05$</p> <p>Wechsler Memory Scale – logical memory (recall, immediate): 10 studies, N = 380, $g = 0.30$, 95%CI 0.15 to 0.44, $p < 0.05$</p> <p>Wechsler Memory Scale – logical memory (recall, delayed): 9 studies, N = 360, $g = 0.30$, 95%CI 0.16 to 0.45, $p < 0.05$</p> <p><i>No difference was reported on;</i></p> <p>HVLТ (recall, delayed): 3 studies, N = 167, $g = 0.33$, 95%CI -0.05 to 0.70, $p > 0.05$</p> <p><i>Compared with controls, improvement was significantly greater in controls compared with people with schizophrenia on;</i></p> <p>Wechsler Memory Scale – logical memory (recall, immediate): 4 studies, N = 93, $g = 0.54$, 95%CI -</p>	



Memory

0.31 to 1.38, $p < 0.05$

Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise for all measures except control comparisons
Directness	Direct

Tucker JD, Bertke AS

Assessment of cognitive impairment in HSV-1 positive schizophrenia and bipolar patients: Systematic review and meta-analysis

Schizophrenia Research 209: 40-7

[View review abstract online](#)

Comparison	Memory in people with schizophrenia who are herpes simplex virus positive vs. people with schizophrenia who are herpes simplex virus negative.
Summary of evidence	Moderate to high quality evidence (large sample, consistent, unable to assess precision, direct) suggests that people with schizophrenia who are HSV-1 positive are more impaired on the RBANS memory tasks than people with schizophrenia who are HSV-1 negative.

Memory

Repeatable Battery for Neuropsychological Status (RBANS) test

Poorer performance on the RBANS memory subscales in people with schizophrenia who are HSV-1 positive;

Immediate memory: 2 studies, N = 609, MD = -8.57, 95%CI -12.75 to -4.40, $p < 0.0001$, $I^2 = 54%$

Delayed memory: 2 studies, N = 609, MD = -4.36, 95%CI -7.83 to -0.90, $p = 0.01$, $I^2 = 23%$

Consistency	Consistent
Precision	Unable to assess; MD not standardised.
Directness	Direct



Ventura J, Helleman GS, Thames AD, Koellner V, Nuechterlein KH

Symptoms as mediators of the relationship between neurocognition and functional outcome in schizophrenia: a meta-analysis

Schizophrenia Research, 2009; 113(2-3): 189-99

[View review abstract online](#)

<p>Comparison</p>	<p>Association between memory, positive symptoms and negative symptoms in people with schizophrenia.</p>
<p>Summary of evidence</p>	<p>Moderate quality evidence (medium to large samples, direct, inconsistent, unable to assess precision) suggests increased negative symptoms but not positive symptoms are associated with poorer working memory, verbal learning and memory, and visual learning and memory. Symptom severity may act as a mediator between memory and functional impairment.</p>
<p style="text-align: center;">Positive symptoms</p>	
<p style="text-align: center;"><i>No significant association was reported between positive symptom severity and memory;</i></p> <p style="text-align: center;">Working memory: 8 studies, N = 357, $r = -0.03$, $p = 0.54$</p> <p style="text-align: center;">Verbal learning and memory: 10 studies, N = 531, $r = 0.00$, $p = 0.93$</p> <p style="text-align: center;">Visual learning and memory: 4 studies, N = 197, $r = -0.10$, $p = 0.20$</p>	
<p style="text-align: center;">Negative symptoms</p>	



Memory

Small effect size suggests a significant association between increased negative symptom severity and poorer neurocognitive performance in;

Working memory: 17 studies, N = 2,230, $r = -0.21$, $p < 0.01$

Verbal learning and memory: 23 studies, N = 2,978, $r = -0.21$, $p < 0.01$

Visual learning and memory: 8 studies, N = 454, $r = -0.16$, $p < 0.01$

Subgroup analysis examined the potential for negative symptom severity to mediate the effect of neurocognitive performance on functional outcomes;

The relationship between working memory, verbal learning and memory, and visual learning and memory with community function appears to be at least partially mediated by negative symptom severity, $p < 0.01$.

The relationship between working memory, verbal learning and memory, and visual learning and memory with skills assessment also appears to be mediated by negative symptom severity, $p < 0.01$.

Consistency	Authors report all results are inconsistent.
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct for symptom relationships, indirect subgroup analysis.

Ventura J, Thames AD, Wood RC, Guzik LH, Helleman G

Disorganisation and reality distortion in schizophrenia: a meta-analysis of the relationship between positive symptoms and neurocognitive deficits

Schizophrenia Bulletin 2010; 121(1-3): 1-14

[View review abstract online](#)

Comparison	Association between memory, disorganised symptoms and reality distortion in people with schizophrenia.
Summary of evidence	Moderate to high quality evidence (large samples, direct, inconsistent, precise) suggests a small effect of impaired memory (verbal, working and visual memory) being associated with increased disorganised symptoms. No significant relationship was reported between reality distortion and memory (verbal, working and visual memory).
Disorganised symptoms	



Memory

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Small effect size suggests a significant association between increased disorganised symptoms and poorer memory;

Verbal memory: 22 studies, N = 1,532, $r = -0.20$, 95%CI -0.24 to -0.15, $p < 0.01$

Working memory: 20 studies, N = 945, $r = -0.20$, 95%CI -0.26 to -0.13, $p < 0.01$

Visual memory: 14 studies, N = 978, $r = -0.20$, 95%CI -0.27 to -0.14, $p < 0.01$

Reality distortion

No significant association between reality distortion and verbal memory, working memory and visual memory;

Verbal memory: 16 studies, N = 927, $r = 0.01$, 95%CI -0.07 to 0.06, $p > 0.05$

Working memory: 18 studies, N = 855, $r = -0.00$, 95%CI -0.07 to 0.07, $p > 0.05$

Visual memory: 10 studies, N = 630, $r = 0.01$, 95%CI -0.07 to 0.09, $p > 0.05$

Consistency

Authors report results are inconsistent.

Precision

Precise

Directness

Direct

Ventura J, Wood RC, Helleman GS

Symptom Domains and Neurocognitive Functioning Can Help Differentiate Social Cognitive Processes in Schizophrenia: A Meta-Analysis

Schizophrenia Bulletin 2013; 39(1): 102-111

[View review abstract online](#)

Comparison

Association between social cognition, symptom domains and cognitive functioning in people with schizophrenia.

Summary of evidence

Moderate to high quality evidence (medium to large samples, consistent, direct, unable to assess precision) suggests small associations between poor performance on emotion perception, social perception and Theory of Mind tasks and decreased performance on verbal, visual and working memory tasks.

Associations between social cognition and memory functioning



Memory

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Small size associations between poor emotion perception and poor;
 Verbal memory: 14 studies, N = 915, $r = 0.28$, $Q_w = 28.10$, $p = 0.01$
 Omitting 1 study gave homogenous results and $r = 0.24$
 Visual memory: 10 studies, N = 469, $r = 0.30$, $Q_w = 2.61$, $p = 0.99$
 Working memory: 7 studies, N = 424, $r = 0.22$, $Q_w = 12.20$, $p = 0.09$
Small size associations between poor social perception and poor;
 Verbal memory: 12 studies, N = 867, $r = 0.37$, $Q_w = 25.87$, $p = 0.01$
 Omitting 1 study gave homogenous results and $r = 0.31$
 Visual memory: 2 studies, N = 181, $r = 0.30$, $Q_w = 1.68$, $p = 0.43$
 Working memory: 4 studies, N = 323, $r = 0.17$, $Q_w = 16.15$, $p < 0.001$
 Omitting 1 study gave homogenous results and $r = 0.22$
Small size associations between poor Theory of Mind and poor;
 Verbal memory: 9 studies, N = 572, $r = 0.31$, $Q_w = 15.46$, $p = 0.08$
 Visual memory: 3 studies, N = 198, $r = 0.22$, $Q_w = 0.22$, $p = 0.97$
 Working memory: 6 studies, N = 352, $r = 0.33$, $Q_w = 5.04$, $p = 0.54$

Consistency in results	Consistent
Precision in results	Unable to assess; no measure of precision is reported.
Directness of results	Direct

Ventura J, Wood RC, Jimenez AM, Helleman GS

Neurocognition and symptoms identify links between facial recognition and emotion processing in schizophrenia: Meta-analytic findings

Schizophrenia Research 2013; 151: 78-84

[View review abstract online](#)

Comparison	Association between social cognition, symptom domains and cognitive functioning in people with schizophrenia.
Summary of evidence	Moderate quality evidence (mixed samples, consistent, unable to assess precision, direct) suggests small to medium-sized associations between poor facial recognition and emotion processing and decreased performance on verbal, visual and



	working memory tasks.
Associations between social cognition and memory functioning	
<p><i>Small to medium size associations between poor facial recognition and poor;</i></p> <p>Verbal memory: 4 studies, N = 194, $r = 0.21$, $Q_w = 1.31$, $p = 0.86$</p> <p>Visual memory: 5 studies, N = 156, $r = 0.41$, $Q_w = 2.86$, $p = 0.75$</p> <p>Working memory: 2 studies, N = 62, $r = 0.28$, $Q_w = 0.00$, $p = 1.00$</p> <p><i>Small to medium size associations between poor emotion processing (facial stimuli) and poor;</i></p> <p>Verbal memory: 15 studies, N = ,1046, $r = 0.27$, $Q_w = 28.44$, $p = 0.02$</p> <p>Omitting 1 study gave homogenous results and $r = 0.23$</p> <p>Visual memory: 12 studies, N = 620, $r = 0.30$, $Q_w = 3.01$, $p = 1.00$</p> <p>Working memory: 9 studies, N = 575, $r = 0.28$, $Q_w = 22.22$, $p = 0.01$</p> <p>Omitting 1 study gave homogenous results and $r = 0.36$</p> <p><i>Small to medium size associations between poor emotion processing (voice prosody) and poor;</i></p> <p>Verbal memory: 4 studies, N = 194, $r = 0.30$, $Q_w = 4.08$, $p = 0.40$</p> <p>Visual memory: 5 studies, N = 156, $r = 0.43$, Q_w not reported</p> <p>Working memory: 2 studies, N = 62, $r = 0.31$, $Q_w = 1.40$, $p = 0.71$</p>	
Consistency in results	Consistent
Precision in results	Unable to assess; no measure of precision is reported.
Directness of results	Direct

Wang YY, Wang S, Zheng W, Zhong B-L, Ng CH, Ungvari GS, Wang CX, Xiang YT, Li XH

Cognitive functions in smoking and non-smoking patients with schizophrenia: A systematic review and meta-analysis of comparative studies

Psychiatry Research 2019; 272: 155-63

[View review abstract online](#)

Comparison	Memory in people with schizophrenia who smoke vs. people with schizophrenia who don't smoke.
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Memory

Summary of evidence	High quality evidence (large sample, consistent, precise, direct) suggests more impairment on immediate memory in smokers, and no differences in delayed memory.
Memory	
Repeatable Battery for Neuropsychological Status (RBANS) test	
<p><i>Smokers were more impaired than non-smokers on immediate, but not delayed memory;</i> Immediate memory: 2 studies, N = 739, SMD = -0.22, 95%CI -0.39 to -0.05, $p = 0.01$, $I^2 = 0\%$ Delayed memory: 2 studies, N = 739, SMD = -0.02, 95%CI -0.19 to 0.15, $p = 0.80$, $I^2 = 0\%$</p>	
Consistency	Consistent
Precision	Precise
Directness	Direct

Wang Y, Cui J, Chan R, Deng Y, Shi H, Hong X, Li Z, Yu X, Gong QY, Shum D,
Meta-analysis of prospective memory in schizophrenia: Nature, extend, and correlates

Schizophrenia Research 2009; 114: 64-70

[View review abstract online](#)

Comparison	<p>Prospective memory (time-based, event-based and activity-based PM) in people with schizophrenia vs. controls.</p> <p>Note: Prospective memory (PM) is the ability to remember to carry out an intended action in the future.</p>
Summary of evidence	<p>Moderate to high quality evidence (mixed samples, consistent, precise, direct) suggests a large effect of impaired prospective memory in people with schizophrenia compared to controls, covering time-based, event-based and activity-based measures. There were small to medium-size associations between prospective memory and increased general psychopathology, medication dose, duration of the illness and age, and decreased education, and premorbid IQ. No association was reported with positive symptom severity.</p> <p>Moderate quality evidence (inconsistent) also suggests a small</p>



Memory

	to medium-sized relationship between negative symptom severity and reduced current IQ.
Prospective memory	
<p><i>Significant large effect size suggests people with schizophrenia showed impaired prospective memory compared with controls on;</i></p> <p>Summary PM scores: 7 studies, $d = -1.353$, 95%CI -1.545 to -1.161, $p < 0.001$, $Q = 2.708$, $p = 0.844$</p> <p>Time-based PM: 6 studies, $d = -1.33$, 95%CI -1.515 to -1.145, $p < 0.001$, $Q = 2.083$, $p = 0.838$</p> <p>Event-based PM: 7 studies, $N = 639$, $d = -0.827$, 95%CI -0.989 to -0.665, $p < 0.001$, $Q = 6.66$, $p = 0.353$</p> <p>Activity-based PM: 4 studies, $N = 291$, $d = -0.729$, 95%CI -0.968 to -0.491, $p < 0.001$, $Q = 2.092$, $p = 0.554$</p> <p>Note: authors report that the effect size of time-based PM was significantly larger than that of event-based PM ($Q = 16.052$, $p < 0.001$).</p> <p><i>A significant association between poorer prospective memory scores and increased negative symptoms, general psychopathology, medication dose, duration of the illness and age, and lower education, IQ and premorbid IQ;</i></p> <p>Negative symptoms: 8 studies, $N = 400$, $r = -0.18$, 95%CI -0.276 to -0.081, $p < 0.001$, $Q = 21.32$, $p = 0.003$</p> <p>General psychopathology: 4 studies, $N = 146$, $r = -0.168$, 95%CI -0.326 to 0, $p = 0.05$, $Q = 2.268$, $p = 0.519$</p> <p>Medication dose: 7 studies, $N = 358$, $r = -0.119$, 95%CI -0.222 to -0.013, $p = 0.028$, $Q = 6.204$, $p = 0.401$</p> <p>Duration of the illness: 9 studies, $N = 423$, $r = -0.113$, 95%CI -0.226 to -0.033, $p = 0.009$, $Q = 12.439$, $p = 0.133$</p> <p>Age: 9 studies, $N = 423$, $r = -0.23$, 95%CI -0.321 to -0.135, $p < 0.001$, $Q = 11.036$, $p = 0.20$</p> <p>Education: 7 studies, $N = 358$, $r = 0.249$, 95%CI 0.147 to 0.346, $p < 0.001$, $Q = 5.712$, $p = 0.456$</p> <p>Current IQ: 5 studies, $N = 176$, $r = 0.439$, 95%CI 0.306 to 0.555, $p < 0.001$, $Q = 12.179$, $p = 0.016$</p> <p>Premorbid IQ: 3 studies, $N = 125$, $r = 0.356$, 95%CI 0.188 to 0.504, $p < 0.001$, $Q = 0.94$, $p = 0.625$</p> <p><i>No significant association between summary PM scores and positive symptoms or age at onset;</i></p> <p>Positive symptoms: 8 studies, $N = 400$, $r = -0.094$, 95%CI -0.193 to 0.007, $p = 0.067$, $Q = 7.512$, $p = 0.378$</p> <p>Age at onset: 7 studies, $N = 290$, $r = 0.035$, 95%CI -0.153 to 0.084, $p = 0.564$, $Q = 30.548$, $p < 0.001$</p>	
Consistency	Consistent apart from negative symptoms, IQ and age at onset.



Memory

Precision	Precise
Directness	Direct

Woodward ND, Purdon SE, Meltzer HY, Zald DH

A meta-analysis of neuropsychological change to clozapine, olanzapine, quetiapine, and risperidone in schizophrenia

International Journal of Neuropsychopharmacology 2005; 8: 457-472

[View review abstract online](#)

Comparison	Memory in people with schizophrenia receiving second generation antipsychotics (clozapine, olanzapine, risperidone and quetiapine) vs. first generation antipsychotics (various) or pre- to post-treatment comparison with second generation antipsychotics.
Summary of evidence	Moderate to high quality evidence (small to medium-sized samples, consistent, precise, direct) shows no differences in working memory or delayed recall between patients receiving first or second-generation antipsychotics. Patients receiving olanzapine, clozapine or risperidone show improvement pre- to post-treatment, however patients receiving quetiapine showed no improvement. Moderate quality evidence (unable to assess precision) suggests patients receiving olanzapine or risperidone showed improvement pre- to post-treatment, however patients receiving clozapine or quetiapine showed no improvement.

Working memory

No difference in working memory was reported between patients receiving second generation antipsychotics compared with patients receiving first generation antipsychotics;

10 studies, N= 286, $g = 0.05$, 95%CI -0.12 to 0.22, $p = 0.546$, $Q p > 0.05$

Post-treatment, patients receiving olanzapine or risperidone showed improved performance;

Olanzapine: 8 studies, N = 406, $g = 0.24$, (CI not reported), $p < 0.006$, $Q p > 0.05$

Risperidone: 9 studies, N = 281, $g = 0.24$, (CI not reported), $p < 0.006$, $Q p > 0.05$

Patients receiving clozapine or quetiapine showed no significant improvement post medication;

Quetiapine: 2 studies, N = 27, $g = 0.41$ (CI not reported), $p > 0.05$, $Q p > 0.05$



Memory

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Clozapine: 8 studies, N = 160, $g = 0.25$, (CI not reported), $p > 0.05$, $Q p > 0.05$

Delayed recall

No difference in delayed recall was reported between patients receiving second generation antipsychotics compared with patients receiving first generation antipsychotics;

10 studies, N= 374, $g = 0.13$, 95%CI - 0.02 to 0.28, $p = 0.091$, $Q p > 0.05$

Post-treatment, patients receiving clozapine, olanzapine, or risperidone showed improved performance;

Clozapine: 13 studies, N = 280, $g = 0.25$, (CI not reported), $p < 0.006$, $Q p > 0.05$

Olanzapine: 7 studies, N = 460, $g = 0.53$, (CI not reported), $p < 0.006$, $Q p > 0.05$

Risperidone: 5 studies, N = 211, $g = 0.46$, (CI not reported), $p < 0.006$, $Q p > 0.05$

Patients receiving quetiapine showed no significant improvement post medication;

Quetiapine: 3 studies, N = 58, $g = 0.30$, (CI not reported), $p > 0.05$, $Q p < 0.05$

Consistency

Consistent apart from quetiapine pre-post comparison.

Precision

Precise for all first vs. second generation comparisons, unable to assess pre-post comparisons.

Directness

Direct

Woodward ND, Purdon SE, Meltzer HY, Zald DH

A meta-analysis of cognitive changes with haloperidol in clinical trials of atypical antipsychotics: Dose effects and comparison to practice effects

Schizophrenia Research 2007; 89: 211-224

[View review abstract online](#)

Comparison

Delayed verbal recall in people with schizophrenia receiving haloperidol to assess pre-post treatment effects.

Summary of evidence

Moderate to high quality evidence (small to medium-sized samples, consistent, precise, direct) shows improvements on delayed verbal recall post treatment with haloperidol.



Memory

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Delayed verbal recall	
<p><i>Significant, small effect size of improved delayed verbal recall performance post-treatment;</i> All studies: 7 studies, N = 420, $g = 0.27$, 95%CI 0.14 to 0.40, $p < 0.05$ Low dose: 3 studies, N = 252, $g = 0.22$, 95%CI 0.05 to 0.39, $p < 0.05$ High dose: 3 studies, N = 141, $g = 0.28$, 95%CI 0.06 to 0.50, $p < 0.05$</p>	
Consistency	Authors report all results are consistent (using fixed effects model).
Precision	Precise
Directness	Direct

Yücel M, Bora E, Lubman DI, Solowij N, Brewer WJ, Cotton SM, Conus P, Takagi MJ, Fornito A, Wood SJ, McGorry PD, Pantelis C

The impact of cannabis use on cognitive functioning in patients with schizophrenia: a meta-analysis of existing findings and new data in first-episode sample

Schizophrenia Bulletin 2012; 38(2):316-330

[View review abstract online](#)

Comparison	Cognition in people with schizophrenia with a history of cannabis use vs. people with schizophrenia without a history of cannabis use.
Summary of evidence	Moderate to high quality evidence (small samples, direct, consistent, precise) suggests better visual and working memory in people with schizophrenia with a history of cannabis use.

Memory

People with schizophrenia and a history of cannabis use showed better visual and working memory;

Visual memory: 3 studies, N = 178, $d = 0.45$, 95%CI 0.13 to 0.77, $p = 0.006$, $Q = 2.24$, $p > 0.05$

Working memory: 2 studies, N = 96, $d = 0.64$, 95%CI 0.22 to 1.05, $p = 0.003$, $Q = 0.16$, $p > 0.05$

Consistency	Consistent
Precision	Precise



Memory

Directness	Direct
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Zhou FC, Zheng W, Lu L, Wang YY, Ng CH, Ungvari GS, Li J, Xiang YT

Prospective memory in schizophrenia: A meta-analysis of comparative studies

Schizophrenia Research 2019; 212: 62-71

[View review abstract online](#)

Comparison	Prospective memory in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, precise, direct) suggests poorer prospective memory in people with schizophrenia compared to controls. This effect was found for time-based, event-based, and activity-based prospective memory and was generally worse in older samples.

Prospective memory

People with schizophrenia showed large effects of poorer prospective memory in;

Overall prospective memory

22 studies, N = 1,044, SMD = -1.13, 95%CI -1.46 to -0.79, $p < 0.001$, $I^2 = 83\%$

Subgroup analyses showed larger effect sizes with older samples, male samples, lower education, chronic patients, and eco-valid than dual-task measurements. Meta-regression analysis showed higher negative symptom score was associated with more severe overall prospective memory impairment.

Time-based prospective memory

20 studies, N = 1,632, SMD = -1.16, 95%CI -1.33 to -0.98, $p < 0.001$, $I^2 = 60\%$

Subgroup analyses showed larger effect sizes in chronic patient samples. Meta-regression analyses showed that lower study quality was associated with poorer time-based prospective memory.

Event-based prospective memory

27 studies, N = 2,042, SMD = -1.07, 95%CI -1.35 to -0.79, $p < 0.001$, $I^2 = 88\%$

Subgroup analyses showed larger effect sizes in older samples, male samples, samples with fewer years of education, and in studies using eco-valid rather than dual-task measurements. Meta-regression analyses showed that lower study quality and more severe overall symptoms was



Memory

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significantly associated with poorer event-based prospective memory.

Activity-based prospective memory

5 studies, N = 401, SMD = -0.563, 95%CI -0.849 to -0.278, $p = 0.0001$, $I^2 = 50%$

Subgroup analyses showed larger effect sizes in male samples, chronic samples, and older publications.

Consistency	Inconsistent
Precision	Precise
Directness	Direct

Explanation of acronyms

B = estimated regression coefficient, BPRS = Brief Psychiatric Rating Scale, BVRT = Benton Visual Retention Test, CANTAB SWM = Cambridge Neuropsychological Test Automated Battery, Spatial Working Memory, CERAD = Consortium to Establish Registry for Alzheimer’s Disease, CI = Confidence Interval, CPT = Continuous Performance Test, CPT-X = Continuous Performance Test-Simple version, CPT-AX = Continuous Performance Test, “X” is target only following “A” or equivalent, CPT-IP = Continuous Performance Test- Identical Pairs Version, target consists of 2 identical consecutive stimuli, CVLT = California Verbal Learning Test, d = Cohen’s d and g = Hedges’ g = standardized mean differences (see below for interpretation of effect size), DRS = Mattis Dementia Rating Scale, DSDT = digit span distraction test, DTR = delayed recall task, ES = effect size, HVL = Hopkins Verbal Learning Test, I^2 = the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance), IQ = intelligence quotient, LLS = late life schizophrenia, N = number of participants, NART = National Adult Reading Test, p = statistical probability of obtaining that result ($p < 0.05$ generally regarded as significant), PM = prospective memory, PANSS = Positive and Negative Symptoms Scale, r = correlation coefficient, Q = Q statistic (chi-square) for the test of heterogeneity, Q_B = test for between group differences (heterogeneity between groups of studies for an outcome of interest), Q_w = test for within group differences (heterogeneity in study results within a group of studies – measure of study consistency), RBANS = Repeatable Battery for the Assessment of Neuropsychological Status, RCT = randomized controlled trial, RAVLT = Rey Auditory Verbal Learning Test, ROCFT = Rey Osterrieth Complex Figure Test, SANS = Scale for the Assessment of Negative Symptoms, SAPS = Scale for the Assessment of Positive Symptoms, SE = standard error, SOSP = Self Ordered Search Paradigm, SMD = standardised mean difference, vs = versus, WAIS-R = Wechsler Adult Intelligence Scale- Revised, WCST = Wisconsin Card Sorting Test, WISC = Wechsler Intelligence Scale for Children, WM = working memory, WMS-R = Wechsler Memory Scale- Revised, χ^2 = chi-squared, Z = z-transformation of effect size, μ_p = estimated average correlation in the population



Memory

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 small⁶⁰.

† 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).

Weighted 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. 0.2 represents a small effect, 0.5 a medium effect, and 0.8 and over represents a large effect⁶⁰.

Odds ratio (OR) or 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 or OR 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 ⁶¹. InOR stands for logarithmic OR where a InOR of 0 shows no difference between groups. Hazard ratios



Memory

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 are an 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 1 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 formula⁶⁰;

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

§ 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.⁶²

|| 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.



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