



Attention

Introduction

Selective attention is the ability to focus on relevant stimuli and ignore irrelevant stimuli. Sustained attention is the ability to maintain a consistent focus. Selective and sustained attention involve 'alerting' (achieving and maintaining an alert state); 'orienting' (directing attention); and 'executive control' (choosing suitable responses).

Several tasks have been developed to assess attention performance. The most common tasks include the Continuous Performance Test (CPT) that uses both visual and auditory stimuli and requires participants to respond to targets and ignore distractors. The Trail Making Test (TMT), requires participants to connect, in order, letters and/or numbers as quickly as possible. The Stroop Colour Word Test (SCWT), presents colour names printed in an ink congruent to the colour name (e.g. blue), or incongruent to the colour name (e.g. blue). Participants are asked to either read the word or name the ink colour.

Any impairment in attention disrupts other cognitive functions. Information processing, for example, requires selective attention to retrieve relevant information, and dismiss irrelevant information. Working memory requires sustained attention in order to maintain concentration on information temporarily being stored. Therefore, tasks that have been developed to measure attention also measure other cognitive constructs.

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 have been excluded from the library. The PRISMA flow diagram is a suggested way of providing information about studies included and excluded with reasons for exclusion. Where no flow diagram has been presented by individual reviews, but identified studies have been described in the text, reviews have been checked for this item. Note that early reviews may have been guided by less stringent reporting checklists than the PRISMA, and that some reviews may have been limited by journal guidelines.

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



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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 37 systematic reviews that met our inclusion criteria³⁻³⁹.

- Compared to controls, moderate to high quality evidence shows a medium to large effect of poor performance on the SCWT, CPT and TMT-A tests in people with schizophrenia, and poor vigilance in people with first episode schizophrenia. Medication status (medicated or not medicated) may not impact on these results.
- Moderate quality evidence suggests poor visual and verbal attention in people with youth-onset or late-onset schizophrenia.
- Moderate quality evidence suggests people with schizophrenia may show less Inhibition of Return compared to controls, but only in a single cue condition. The evidence suggests that people with schizophrenia showed greater Inhibition of Return as the Stimulus Onset Asynchrony increased in both single cue and cue back conditions.
- Compared to people with bipolar disorder, moderate to high quality evidence shows a small effect of poorer performance on TMT-A, TMT-B, and WCST categories, but not on WCST perseverative errors or the SCWT in people with schizophrenia.
- Moderate to high quality evidence shows a small to medium-sized association between increased disorganised symptoms, negative symptoms or reality distortion and worse attention performance.
- Moderate to high quality evidence suggests no differences on attention tasks between patients receiving first or second-generation antipsychotics, however patients receiving olanzapine or quetiapine show a medium to large improvement pre- to post-treatment, and patients receiving clozapine or risperidone show no improvement. A small effect suggests improved CPT post-treatment with haloperidol.
- Moderate to high quality evidence finds people with schizophrenia who are herpes simplex virus positive are more impaired on attention tasks than people with schizophrenia who are herpes simplex virus negative. There were no differences between smokers and non-smokers with schizophrenia.
- Moderate to high quality evidence shows a small to medium-sized association between better attention and better community functioning, social skills and social problem solving in people with schizophrenia. Moderate quality evidence suggests lower levels of work capacity are associated with poorer attention and vigilance.
- Moderate to high quality evidence suggests a medium to strong association between performance on attention tasks and performance on memory, executive functioning, processing speed, reasoning, abstraction, and flexibility tasks.
- High quality evidence suggests a small effect of better attention in people with a psychotic disorder and a substance use disorder than people with a psychotic disorder without a substance use disorder.
- High quality evidence suggests people at clinical high risk of psychosis and familial high risk of psychosis are similarly impaired on attention tasks when compared to controls, showing small to medium-sized effects. Similar, small improvements in attention over time (1 to 5 years) were found in people at ultra-high risk of psychosis, people with first-episode psychosis, and controls.



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- Moderate to high quality evidence shows a medium-sized effect of better attention in people at clinical high-risk of psychosis than people with first-episode psychosis. People who converted to psychosis were more impaired on attention tasks than people who did not convert to psychosis.
- Moderate to high quality evidence suggests small associations between poor facial recognition, emotion processing, emotion perception, social perception, and Theory of Mind and poor performance on attention tasks.



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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](#)

Comparison	Cognitive functioning in people at clinical high risk (UHR) and familial high risk (FHR) for psychosis.
Summary of evidence	High quality evidence (large sample, consistent, precise, direct) suggests people at clinical high risk of psychosis and familial high risk of psychosis are similarly impaired on attention tasks when compared to controls, showing a small to medium-sized effect.
Attention	
<p><i>Significant, small size effect of poor attention in UHR and FHR groups compared to controls, with no significant differences between groups;</i></p> <p>UHR: 8 studies, N = 1,042, $d = 0.37$, 95%CI 0.25 to 0.50, $p < 0.001$, $I^2 = 0\%$, Q-test $p = 0.59$</p> <p>FHR: 14 studies, N = 1,451, $d = 0.30$, 95%CI 0.16 to 0.44, $p < 0.001$, $I^2 = 0.03\%$, Q-test $p = 0.08$</p> <p style="text-align: center;">$Q_B p > 0.05$</p> <p>Meta-regression of the UHR studies showed that increased deterioration in functioning was associated with more severe deficits in attention.</p> <p style="text-align: center;">Authors report no publication bias.</p>	
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?



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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, consistent, precise, direct) suggests similar, small improvements in attention over time in people at ultra-high risk of psychosis, people with first-episode psychosis, and controls.
Improvement in attention over time (1 to 5 years)	
<p><i>Significant, small improvement in attention over time in UHR, FEP and controls, with no significant differences between groups;</i></p> <p>FEP: 8 studies, N = 620, $d = 0.27$, 95%CI 0.12 to 0.42, $p < 0.001$, $I^2 = 0.02\%$, Q-test $p = 0.14$ UHR: 8 studies, N = 219, $d = 0.33$, 95%CI 0.14 to 0.52, $p < 0.001$, $I^2 = 0\%$, Q-test $p = 0.87$ Controls: 7 studies, N = 155, $d = 0.27$, 95%CI 0.08 to 0.46, $p = 0.006$, $I^2 = 0\%$, Q-test $p = 0.57$ $Q_B p > 0.05$ Authors report no publication bias.</p>	
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	Attention in people with first-episode bipolar disorder vs. people with first-episode schizophrenia.
Summary of evidence	Moderate quality evidence (medium-sized samples, some inconsistencies and imprecision, direct) shows a medium-sized



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	effect of poorer attention on TMT-A and TMT-B tasks, but not other tasks in people with first-episode schizophrenia compared to people with first-episode bipolar disorder.
Attention	
<p><i>Significant, medium-sized impairment on TMT-A and TMT-B tasks in people with first-episode schizophrenia, with no differences on other tasks of attention;</i></p> <p>TMT-A: 3 studies, N = 328, $d = 0.45$, 95%CI 0.23 to 0.68, $p < 0.001$</p> <p>TMT-B: 3 studies, N = 328, $d = 0.47$, 95%CI 0.14 to 0.80, $p = 0.006$</p> <p>Other tasks: 2 studies, N = 101, $d = 0.05$, 95%CI -0.38 to 0.47, $p = 0.83$, $I^2 = 0\%$, $p = 0.62$</p> <p>Authors report no evidence of publication bias.</p> <p>No differences were found for males vs. females or younger vs. older patients.</p>	
Consistency in results	Inconsistent for TMT A and B, consistent for other tasks.
Precision in results	Precise for TMT A, imprecise for TMT B and other tasks.
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	Attention 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, mostly inconsistent, precise, direct) suggests people with deficit schizophrenia are more impaired than people with non-deficit schizophrenia on measures of attention.
Attention	
<i>Significant, medium-sized effect of poorer attention in people with deficit schizophrenia compared to</i>	



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<i>people with non-deficit schizophrenia;</i>	
Attention: 9 studies, N = 1,271, $d = 0.42$, 95%CI 0.24 to 0.60, $p < 0.001$, $I^2 = 45%$, $p = 0.07$	
<i>Significant, large effect of poorer attention in people with deficit schizophrenia compared to controls and a medium-sized effect in people with non-deficit schizophrenia compared to controls;</i>	
Deficit: 7 studies, N = 869, $d = 1.19$, 95%CI 0.80 to 1.58, $p < 0.001$, $I^2 = 84%$, $p < 0.001$	
Non-deficit: 7 studies, N = 990, $d = 0.68$, 95%CI 0.50 to 0.87, $p < 0.001$, $I^2 = 45%$, $p = 0.09$	
Consistency in results	Mostly inconsistent.
Precision in results	Precise
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 attention in people with schizophrenia. Note: work capacity is the ability to obtain and maintain competitive work, as well as work behaviours and skills.
Summary of evidence	Moderate quality evidence (large sample, unable to assess consistency or precision, direct) suggests lower levels of work capacity are associated with poorer attention or vigilance.
Attention/vigilance	
7 studies (N = 389) reported that poor attention/vigilance was associated with worse employment status, less full-time employment or unemployment, poorer occupational functioning, work behaviour improvement, work performance and work adjustment.	
Consistency	Unable to assess; no measure of consistency is reported.
Precision	Unable to assess; no measure of precision is reported.
Directness	Direct



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de Gracia Domingues M, Viechtbauer W, Simons C, van Os J

Are psychotic psychopathology and neurocognition orthogonal? A systematic review of their associations

Psychological Bulletin 2009; 135(1): 157-171

[View review abstract online](#)

Comparison	Association between attention performance and symptom dimensions people with non-affective psychosis.
Summary of evidence	Moderate to high quality evidence (unclear sample sizes, consistent, precise, direct) shows a medium-sized association between more severe disorganised symptoms and poorer attention, and a small association between more severe negative symptoms and poorer attention.
Attention / vigilance	
<p><i>A significant weak association between increased negative symptoms and worse attention;</i> 15 studies, $\mu_p = -0.134$, 95%CI -0.191 to -0.076, $p = 0.00$, $I^2 = 26\%$</p> <p><i>A significant medium association between increased disorganised symptoms and worse attention;</i> 6 studies, $\mu_p = -0.277$, 95%CI -0.392 to -0.154, $p = 0.00$, $I^2 = 34\%$</p> <p><i>No association with positive symptoms;</i> 11 studies, $\mu_p = -0.012$, 95%CI -0.054 to 0.003, $p = 0.969$, $I^2 = 0\%$</p>	
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



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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.
Summary of evidence	Moderate quality evidence (unclear sample size, inconsistent, precise, direct) suggests no differences in attention.
Attention/vigilance	
<i>No significant differences between groups in attention/vigilance; 5 studies, $g = -0.37$, 95%CI -0.81 to 0.08, $p = 0.107$, Q-test $p = 0.009$</i>	
Consistency	Inconsistent
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 quality evidence (unclear sample size, unable to assess consistency, precise, direct) shows a small to medium-sized association of impaired attention in people with schizophrenia with increased negative or disorganized symptoms.



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Attention and executive impairment	
<p><i>All tasks showed a small to medium size association with negative symptoms;</i></p> <p>Trail-making tasks B: 24 studies, $r = -0.24$, 95%CI -0.29 to -0.18</p> <p>WCST set shifting: 43 studies, $r = -0.16$, 95%CI -0.20 to -0.13</p> <p>Stroop/Hayling: 16 studies, $r = -0.13$, 95%CI -0.21 to -0.05</p> <p><i>And with disorganized symptoms;</i></p> <p>Trail-making task B: 10 studies, $r = -0.31$, 95%CI -0.40 to -0.22</p> <p>Stroop/Hayling: 10 studies, $r = -0.29$, 95%CI -0.38 to -0.21</p> <p>WCST set shifting: 19 studies, $r = -0.19$, 95%CI -0.24 to -0.14</p>	
Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise
Directness	Direct

<p><i>Dickinson D, Ramsey ME, Gold JM</i></p> <p>Overlooking the Obvious: A meta-analytic comparison of digit symbol coding tasks and other cognitive measures in schizophrenia</p> <p>Archives of General Psychiatry 2007; 64: 532-542</p> <p>View review abstract online</p>	
Comparison	Attention in people with schizophrenia vs. controls.
Summary of evidence	<p>Moderate to high quality (medium to large samples, inconsistent or unable to assess, precise, direct) finds a large effect size of poorer performance on CPT identical pairs, and Conners, and a medium effect for poorer performance on the degraded stimulus CPT compared to controls.</p> <p>Moderate quality evidence (imprecise) suggests a large effect size for lower performance on AX CPT.</p>
Sustained attention	
<p><i>Large effect size suggests people with schizophrenia showed poorer sustained attention compared</i></p>	



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to controls on tasks including;

AX CPT: 4 studies, N = 443 (265 schizophrenia, 178 controls), $g = -1.13$, 95%CI -1.83 to -0.42, $p < 0.05$, $Q = 26.5$, $p < 0.001$

Identical pairs CPT: 4 studies, N = 433 (260 schizophrenia, 173 controls), $g = -0.86$, 95%CI -1.13 to -0.58, $p < 0.05$

Conners CPT: 5 studies, N = 516 (218 schizophrenia, 298 controls), $g = -1.02$, 95%CI -1.31 to -0.73, $p < 0.05$

Medium effect size suggests people with schizophrenia showed poorer attention on the degraded stimulus CPT compared to controls;

5 studies, N = 249 (96 schizophrenia, 153 controls), $g = -0.66$, 95%CI -0.98 to -0.35, $p < 0.05$

Consistency	Inconsistent for AX CPT. Unable to assess for other measures.
Precision	Precise for all except AX CPT.
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 attention and other neuropsychological tests on people with schizophrenia.
Summary of evidence	Moderate to high quality evidence (overall large sample, unable to assess consistency, precise, direct) suggests medium to strong associations between increased scores on attention and increased scores on other Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) domains including memory, executive functioning, verbal learning, processing speed, reasoning, abstraction and flexibility.
Attention/vigilance	



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

1 study (N = 62 outpatients), reported strong associations between increased attention/perception (CPT variables, Span of Apprehension) and increased memory and fluency, and executive functioning; $r = 0.54$, 95%CI 0.33 to 0.70.

1 study (N = 45 first-episode) reported strong associations between increased attention (trail making A, digit symbol, digit span, cancellation variables) and increased verbal learning, visual learning and executive functioning; $r = 0.52$, 95%CI 0.38 to 0.64.

1 study (N > 1,123 outpatients) reported strong associations between increased vigilance (identical pairs CPT) and increased verbal learning, processing speed, reasoning and working memory; $r = 0.50$, 95%CI 0.47 to 0.53.

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

1 study (N = 40 patients), reported medium to strong associations between increased sustained attention (identical pairs CPT) and increased verbal memory, executive functioning and visual memory; $r = 0.39$, 95%CI 0.28 to 0.50.

1 study (N = 113 outpatients) reported medium associations between increased attention (CPT variables, Trail making A, digit span, digit symbol) and increased abstraction and flexibility, verbal learning and operative memory; $r = 0.16$, 95%CI 0.08 to 0.23.

1 study (N = 118 first- or second-episode schizophrenia) reported medium associations between increased scores on individual measures of attention (Gordon's CPT) and increased scores on the CVLT (immediate) Rey Complex Figure Memory, category fluency and Stroop (colour and word combinations combined); $r = 0.30$, 95%CI 0.24 to 0.36.

1 study (N = 20 inpatients) reported medium associations between increased scores on individual measures of attention (Identical Pairs CPT) and increased scores on symbol Digit with Rey AVLT, WCST, Letter Number Sequencing, Trails A and B; $r = 0.30$, 95%CI 0.18 to 0.41.

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

Donoghue K, Doody GA



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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 attention in people with a psychotic disorder and a substance use disorder than people with a psychotic disorder without a substance use disorder.
Cognitive functioning in people with a polysubstance use disorder	
<p><i>A significant small effect suggests people with a psychotic disorder and a polysubstance use disorder showed better attention than people with a psychotic disorder without a substance use disorder;</i></p> <p>Attention and psychomotor: 8 studies (N = 513), $g = 0.295$, 95%CI 0.110 to 0.479, $p = 0.002$, $I^2 = 0\%$, $p = 0.780$</p>	
Cognitive functioning in people with a cocaine use disorder	
<p><i>A significant small effect suggests people with a psychotic disorder and a cocaine use disorder showed better attention than people with a psychotic disorder without a substance use disorder;</i></p> <p>Attention and psychomotor: 5 studies (N = 236), $g = 0.326$, 95%CI 0.035 to 0.616, $p = 0.028$, $I^2 = 15\%$, $p = 0.316$</p>	
Cognitive functioning in people with a cannabis use disorder	
<p><i>A significant small effect suggests people with a psychotic disorder and a cannabis use disorder showed better attention than people with a psychotic disorder without a substance use disorder;</i></p> <p>Attention and psychomotor: 3 studies (N = 551), $g = 0.316$, 95%CI 0.144 to 0.488, $p < 0.001$, $I^2 = 0\%$, $p = 0.968$</p>	
Consistency in results	Consistent
Precision in results	Precise
Directness of results	Direct



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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, inconsistent, precise, direct) shows poorer performance on attention tasks in never-medicated people with schizophrenia compared to controls.
Attention	
<p><i>Significant, large effects of poorer attention in never-medicated patients compared with controls;</i> 9 studies, N = 1,095, SMD -0.80, 95%CI -0.95 to -0.65, $p < 0.001$, $I^2 = 44.3%$, $p = 0.02$ Tests used were; CANTAB (mean latency), Continuous Performance tests (omission errors, commission errors, A', d', hit rate).</p>	
Consistency	Inconsistent
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 attention in schizophrenia.
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<p>Summary of evidence</p>	<p>Moderate to high quality evidence (small to medium-sized samples, mostly consistent, mostly precise, direct) showed increased attention may have a weak relationship with better community functioning and a positive medium association with better problem-solving outcomes and social skills.</p>
<p>Community functioning (work performance, social interaction)</p>	
<p><i>Significant weak positive association between increased performance on attention tasks and better community functioning;</i> 9 studies, N = 481 Estimated average correlation in the population = 0.16, 95%CI 0.04 to 0.27, $p = 0.01$, $Q = 13.15$, $I^2 = 38.17\%$, non- significant (p value not reported)</p>	
<p>Social behaviour</p>	
<p><i>No relationship between performance on attention tasks and social behavior;</i> 4 studies, N = 234 Estimated average correlation = 0.19, 95%CI -0.11 to 0.45, $p = 0.21$, $Q = 14.95$, $I^2 = 74.16\%$, significant (p value not reported)</p>	
<p>Social problem solving</p>	
<p><i>Significant medium positive association between increased performance on attention tasks and better social problem solving;</i> 3 studies, N = 100 Estimated average correlation in the population 0.25, 95%CI 0.07 to 0.47, $p = 0.007$, $Q = 1.45$, $I^2 = 0\%$, non- significant (p value not reported)</p>	
<p>Social skills</p>	
<p><i>Significant medium to large positive association between increased performance on attention tasks and better social skills;</i> 3 studies, N = 119 Estimated average correlation = 0.39, 95%CI 0.22 to 0.53, $p = <0.001$, $Q = 0.22$, $I^2 = 0\%$, non- significant (p value not reported)</p>	
<p>Consistency</p>	<p>Consistent for all outcomes except social behaviour</p>
<p>Precision</p>	<p>Precise for all outcomes except social behaviour</p>
<p>Directness</p>	<p>Direct</p>



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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	Attention in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, precise, direct, suggests people with schizophrenia showed poor attention compared to controls.
Attention	
<p><i>Authors reported a large effect of poor attention (longer reaction time) in people with schizophrenia compared to controls;</i></p> <p>Reaction time: 76 studies, N = 5333, SMD = 0.99, 95%CI 0.86 to 1.12, $p < 0.0001$, $I^2 = 77\%$</p> <p><i>Subgroup analyses showed a larger effect for inpatients vs. controls than outpatients vs. controls;</i></p> <p>Inpatients: 19 studies, N = 1319, SMD = 1.34, 95%CI 0.93 to 1.76, $p < 0.00001$, $I^2 = 91\%$</p> <p>Outpatients: 21 studies, N = 1417, SMD = 1.02, 95%CI 0.70 to 1.34, $p < 0.00001$, $I^2 = 86\%$</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

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Comparison	Attention in people with schizophrenia on second generation antipsychotics vs. first generation antipsychotics.
Summary of evidence	Moderate to high quality evidence (large sample, unable to assess consistency, precise, direct) suggests no difference in attention/vigilance scores in people with schizophrenia receiving second generation antipsychotics compared to those receiving first generation antipsychotics.
Attention/vigilance scores	
<i>No significant difference in attention/vigilance scores in people with schizophrenia receiving second-generation antipsychotics compared to first-generation antipsychotics;</i> 12 RCT, N = 1,574, $g = 0.06$, 95%CI -0.04 to 0.15, $p = 0.23$	
Consistency	Unable to assess
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	Attention 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 attention in people at clinical high-risk for psychosis.
Attention	
<i>Significant, small effect of poorer attention in people at clinical high-risk;</i>	



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<p>14 studies, N = 2,038, $g = -0.17$, 95%CI -0.30 to -0.04, $p = 0.009$, $I^2 = 46\%$</p> <p>This effect was larger in longitudinal studies (follow-up 10.4 months, $g = -0.34$). The effect was significant in studies using the Continuous Performance Test and digits forward, but not STROOP or digit span.</p>	
Consistency in results	Inconsistent
Precision in results	Precise
Directness of results	Direct
Comparison 2	Attention in individuals at clinical high-risk for psychosis vs. people with first-episode psychosis.
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, precise, direct) shows a medium-sized effect of better attention in people at clinical high-risk of psychosis.
Attention	
<p><i>Significant, medium-sized effect of better attention in people at clinical high-risk;</i></p> <p>7 studies, N = 906, $g = 0.40$, 95%CI 0.14 to 0.66, $p = 0.003$, $I^2 = 71\%$</p>	
Consistency in results	Inconsistent
Precision in results	Precise
Directness of results	Direct
Comparison 3	Attention 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 small effect of poorer attention in non-converters and a medium-sized effect of poorer attention in converters.
Attention	
<p><i>Significant, small effect of poorer attention in non-converters vs. controls;</i></p> <p>8 studies, N = 611, $g = -0.21$, 95%CI -0.37 to -0.05, $p = 0.01$, $I^2 = 0\%$</p> <p>This effect was significant in studies using the Continuous Performance Test, but not digit span.</p> <p><i>Significant, medium-sized effect of poorer attention in converters vs. controls;</i></p> <p>8 studies, N = 483, $g = -0.41$, 95%CI -0.71 to -0.12, $p = 0.006$, $I^2 = 58\%$</p>	



Attention

This effect was significant in studies using the Continuous Performance Test and digit span.	
Consistency in results	Consistent in non-converters, inconsistent in converters.
Precision in results	Precise
Directness of results	Direct

Knowles E, David A, Reichenberg A

Processing speed deficits in schizophrenia: Reexamining the evidence

American Journal of Psychiatry 2010; 167: 828-835

[View review abstract online](#)

Comparison	Trail making A performance in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large sample, inconsistent, precise, direct) suggests a large effect of impaired performance on TMT-A in people with schizophrenia compared to controls.

Attention

A large effect size suggests impaired performance on TMT-A in people with schizophrenia;
24 studies, N = 3,224, $g = 0.85$, 95%CI 0.74 to 0.97, $I^2 = 49.92$, $Q = 45.92$, $p < 0.001$

Consistency	Inconsistent
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](#)



Attention

<p>Comparison</p>	<p>Attention in people with first-episode schizophrenia vs. healthy controls.</p> <p>Note: participants defined as ‘first-episode’ had either a first presentation of psychosis, initial psychiatric hospitalisation, or a minimal duration of illness/treatment.</p>
<p>Summary of evidence</p>	<p>Moderate to high quality evidence (large sample, inconsistent, precise, direct) suggests poorer overall attention in people with first-episode schizophrenia compared to controls, including a large effect size showing poorer processing speed, and a medium effect size showing poorer working memory and vigilance.</p>
<p>Attention</p>	
<p><i>People with first-episode schizophrenia showed significantly poorer attention than controls:</i></p> <p>Large effect for processing speed: 25 studies, N = 3,017, $d = -0.96$, 95%CI -1.05 to -0.86, $p < 0.001$ $Q = 313.72$, $p < 0.001$</p> <p>Smaller effect sizes were associated with higher proportions of right-handed and male patients, and more recent publications ($p < 0.05$).</p> <p>Medium effect for working memory: 21 studies, N = 2,751, $d = -0.79$, 95%CI -0.93 to -0.65, $p < 0.001$, $Q = 92.96$, $p < 0.001$</p> <p>Smaller effect sizes were associated with higher proportions of right-handed controls, and with fewer right-handed patients ($p < 0.05$).</p> <p>Medium effect for vigilance: 15 studies, N = 2,417, $d = -0.71$, 95%CI -0.87 to -0.55, $p < 0.001$, $Q = 164.57$, $p < 0.001$</p> <p>Smaller effect sizes were associated with higher proportions of right-handed patients, and fewer right-handed controls, $p < 0.05$.</p>	
<p>Consistency</p>	<p>Inconsistent</p>
<p>Precision</p>	<p>Precise</p>
<p>Directness</p>	<p>Direct</p>

Mushquash AR, Fawcett JM, Klein RM

Inhibition of return and schizophrenia: A meta-analysis



Attention

<p>Schizophrenia Research 2012; 135: 55-61 View review abstract online</p>	
Comparison	Inhibition of Return (IOR) in people with schizophrenia vs. controls.
Summary of evidence	Moderate quality evidence (direct, unable to assess consistency or precision, large sample) suggests people with schizophrenia may show less Inhibition of Return compared to controls, but only in a single cue condition. The evidence suggests that people with schizophrenia showed greater Inhibition of Return as the Stimulus Onset Asynchrony increased in both single cue and cue back conditions.
Inhibition of Return (IOR)	
<p><i>A significant effect of group suggests less IOR in people with schizophrenia compared to controls;</i> $N = 583, b = 16.57, 95\%CI 9.40 \text{ to } 23.73$</p> <p><i>A significant effect of Stimulus Onset Asynchrony (SOA), suggests people with schizophrenia showed increased IOR as SOA increased;</i> $b = -0.06, 95\%CI -0.07 \text{ to } -0.05$</p> <p><i>A significant effect of cue type suggesting people with schizophrenia showed more IOR in experiments containing a cue back compared to those receiving a single cue;</i> $b = 14.36, 95\%CI 7.11 \text{ to } 21.61$</p> <p><i>The evidence suggests a significant interaction of group by cue type;</i> $b = 15.13, 95\%CI 0.63 \text{ to } 29.64$</p>	
<u>Single cue condition</u>	
<p><i>A significant effect suggests less IOR in people with schizophrenia compared to controls;</i> $b = 23.10, 95\%CI 14.40 \text{ to } 31.79$</p> <p><i>A significant effect suggests increased IOR as SOA increased;</i> $b = -0.06, 95\%CI -0.07 \text{ to } -0.05$</p> <p><i>No group by SOA interaction;</i> $b = 0.00, 95\%CI -0.02 \text{ to } 0.02$</p> <p>Authors report a later crossover (greater SOA) from facilitation to inhibition in people with schizophrenia (758ms, 95%CI 536 to 1290) compared to controls (293ms, 95%CI 238 to 350) in a single cue condition.</p>	
<u>Cue back condition</u>	



Attention

No effect of group people with schizophrenia compared to controls;

b = 8.09, 95%CI -3.62 to 19.79

A significant effect of SOA suggests IOR increased as SOA increased;

b = -0.05, 95%CI -0.07 to -0.04

No group by SOA interaction;

b = -0.01, 95%CI -0.04 to 0.02

Authors report no difference in the time it takes to crossover from facilitation to inhibition in people with schizophrenia (313 ms, 95%CI 256 to 373) compared to controls (241 ms, 95%CI 184 to 297) in a cue back condition.

Consistency	Unable to assess; no measure of consistency is reported.
Precision	Unable to assess; no measure of precision is reported.
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](#)

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 (large samples, consistent, precise, direct) suggests a large effect of poorer attention in EOS and a medium effect of poorer attention in PBD.

Attention

Large effect in EOS and a medium effect in PBD of poor attention vs. controls;

*EOS: 11 studies, N = 758, g = -1.01, 95%CI -1.37 to -0.65, p < 0.005, Q = 9.17, p = 0.52
publication bias p = 0.15*

*PBD: 8 studies, N = 538, g = -0.62, 95%CI -0.93 to -0.31, p < 0.005, Q = 5.07 p = 0.65
publication bias p = 0.56*



Attention

Attention 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 medications, and in EOS studies with a higher percentage of patients taking antipsychotics.

In PBD studies, there were smaller effect sizes in studies with lower rates of comorbid ADHD.

Consistency	Consistent
Precision	Precise
Directness	Direct, apart from EOS vs. PBD

Nieuwenstein M, Aleman A, de Haan E

Relationship between symptom dimensions and neurocognitive functioning in schizophrenia: a meta-analysis of WCST and CPT studies

Journal of Psychiatric Research 2001; 35: 119-125

[View review abstract online](#)

Comparison	Association between sustained attention and symptom dimensions in people with schizophrenia.
Summary of evidence	Moderate to high quality evidence (small to medium-sized samples, consistent, precise, direct) shows a medium-sized association between increased negative symptoms and impaired attention. No significant association is reported with positive symptoms, disorganised symptoms or reality distortion.
Negative symptoms	
<i>A medium negative association suggests that as negative symptoms increase in patients with schizophrenia, they may demonstrate worse performance on the CPT-d';</i> 6 studies, N = 250, $r = -0.31$, 95%CI -0.41 to 0.21, $p < 0.01$, $Q = 6.8$, $p > 0.10$	
Positive symptoms	
<i>No association was reported between positive symptoms and attention on the CPT-d';</i> 4 studies, N = 188, $r = -0.01$, 95%CI -0.10 to 0.09, $p > 0.05$, $Q = 4.5$, $p > 0.10$	



Attention

Disorganised symptoms	
<i>No significant association was reported between disorganised symptoms and attention on CPT-d';</i> 2 studies, N = 98, $r = -0.06$, 95%CI -0.04 to 0.08, $p > 0.05$, $Q = 1.1$, $p > 0.10$	
Reality distortion	
<i>No significant association was reported between reality distortion and attention on the CPT -d';</i> 2 studies, N = 98, $r = 0.04$, 95%CI 0.02 to 0.06, $p > 0.05$, $Q = 0.0$, $p > 0.10$	
Consistency	Consistent
Precision	Precise
Directness	Direct

Palmer BW, 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 attention 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 quality evidence (overall large sample, inconsistent, unable to assess precision, direct) finds impaired understanding and appreciation are associated with poorer attention/working memory in people with schizophrenia. Reasoning showed weaker associations with poor attention/working memory.

Attention

Five studies (N = 1,630) examined the association between an individual's capacity to consent, and their attentional performance. 4 of 5 studies reported a significant association between impaired attention and poorer understanding; 5 of 5 studies reported a significant association between



Attention

impaired attention and poorer appreciation; 2 of 5 studies reported a significant association between impaired attention and poorer reasoning.

Understanding: 1 study (N = 25) reporting $p < 0.05$ for RBANS and 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, $r = 0.22- 0.40$.

Appreciation: 1 study (N = 25) reporting $p < 0.05$ for RBANS, $r = 0.51$; 1 study (N = 1447) 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 .

Reasoning: 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, $r = 0.33$.

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

Rabin RA, Zakzanis KK, George TP

The effects of cannabis use on neurocognition in schizophrenia: a meta-analysis

Schizophrenia Research 2011; 128: 111-116

[View review abstract online](#)

Comparison	Relationship between current cannabis use and cognitive ability in people with schizophrenia.
Summary of evidence	Moderate to low quality evidence (unclear sample size, unable to assess consistency or precision, direct) suggests patients using cannabis have a small increased effect of better attention than patients who do not use cannabis.
Cognitive ability	
<i>A small to medium-sized effect of better attention in patients using cannabis; 6 studies, $d = 0.35$, $SD = 0.23$, $p < 0.05$</i>	
Consistency in results	Unable to assess; no measure of consistency is reported.



Attention

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	Attention and working memory performance in people with schizophrenia aged over 50 years (late-life schizophrenia, LLS).
Summary of evidence	Moderate to low quality evidence (medium to large samples, unable to assess consistency or precision, direct) is unclear about deficits in attention and working memory in people with late-life schizophrenia.
Attention and Working memory	
Six studies (N = 792) reported impairments in working memory and attention tasks in LLS (both hospitalised and ambulatory) compared to controls. However, three studies reported no difference in LLS compared to 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

Rajji TK, Ismail Z, Mulsant BH

Age at onset and cognition in schizophrenia: meta-analysis

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



Attention

[View review abstract online](#)

<p>Comparison</p>	<p>Attention 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 overall sample, unable to assess consistency or precision, direct) suggests a medium to large effect of poorer performance in visual and auditory attention in people with first-episode, youth-onset and late-onset schizophrenia compared to controls.</p>
<p>Attention</p>	
<p><i>A medium to large effect of impaired attention in all groups compared to controls;</i> N = 5,010 (4057 first-episode schizophrenia, 692 youth-onset, 261 late-onset)</p> <p style="text-align: center;"><i>Visual attention</i></p> <p>First-episode schizophrenia: 52 studies, $d = 0.72$, SE 0.03 Youth-onset schizophrenia: 11 studies, $d = 0.66$, SE 0.08 Late-onset schizophrenia: 3 studies, $d = 1.51$, SE 0.15</p> <p style="text-align: center;"><i>Auditory attention</i></p> <p>First-episode schizophrenia: 7 studies, $d = 0.61$, SE 0.08 Youth-onset schizophrenia: 6 studies, $d = 0.53$, SE 0.12 Late-onset schizophrenia: 1 study, $d = 1.95$, SE 0.27</p> <p style="text-align: center;"><i>CPT</i></p> <p>First-episode schizophrenia: 28 studies, N = 4057, $d = 0.83$, SE 0.04 Youth-onset schizophrenia: 10 studies, N = 692, $d = 0.73$, SE 0.08</p>	
<p>Consistency</p>	<p>Unable to assess; no measure of consistency is reported.</p>
<p>Precision</p>	<p>Unable to assess; no measure of precision is reported.</p>
<p>Directness</p>	<p>Direct</p>

Schug R, Raine A



Attention

Comparative meta-analyses of neuropsychological functioning in antisocial schizophrenic persons

Clinical Psychological Review 2009; 29: 230-242

[View review abstract online](#)

Comparison 1	<p>Attention in people with schizophrenia and antisocial traits vs. people with schizophrenia without antisocial traits.</p> <p>Note: Authors state that antisocial behaviour was broadly defined as assaultive, criminal, psychopathic, or violent behaviours and included individuals who had committed specific crimes (i.e. homicide, assault) or who had specific mental disorder diagnoses (i.e. antisocial personality disorder, psychopathy).</p>
Summary of evidence	<p>Moderate to high quality evidence (unclear sample size, consistent, precise, direct) suggests no difference in attention performance between people with schizophrenia and antisocial traits vs. people with schizophrenia without antisocial traits.</p>
Attention	
<p><i>No significant difference in attention;</i></p> <p>12 studies, $g = -0.063$, 95%CI -0.253 to 0.128, $p > 0.05$, $Q = 17.754$, $p > 0.05$</p>	
Consistency	Consistent
Precision	Precise
Directness	Direct
Comparison 2	<p>Attention in people with schizophrenia and antisocial traits vs. people without schizophrenia who have antisocial traits.</p>
Summary of evidence	<p>Moderate quality evidence (unclear sample size, inconsistent, precise, direct) suggests a small effect of poorer attention in people with schizophrenia and antisocial traits compared to people without schizophrenia who have antisocial traits.</p>
Attention	



Attention

Small effect suggests people with schizophrenia and antisocial traits have significantly poorer attention than people without schizophrenia who have antisocial traits;

8 studies, $g = -0.353$, $p < 0.01$, 95%CI -0.588 to -0.117, $Q = 15.712$, $p < 0.05$

Consistency	Inconsistent
Precision	Precise
Directness	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](#)

Comparison	Attention performance in people with schizophrenia vs. bipolar disorder.
Summary of evidence	Moderate to high quality evidence (unclear sample size, consistent, precise, direct) shows a small effect of lower performance on TMT-A, TMT-B, and WCST categories, but not on WCST perseverative errors or the STROOP test in patients with schizophrenia compared to patients with bipolar disorder.

Attention & executive functioning

A significant, small effect suggests people with schizophrenia were more impaired on the following attention and executive functioning tests than people with bipolar disorder;

TMT-A: (number of studies not reported) SMD = -0.23, 95%CI -0.44 to 0.03, $p = 0.02$, $I^2 =$ not reported, $p = 0.06$

TMT-B: SMD = -0.42, 95%CI -0.63 to 0.21, $p < 0.0001$, $I^2 =$ not reported, $p = 0.08$

WCST Categories achieved: SMD = 0.37, 95%CI 0.22 to 0.51, $p < 0.0001$, $I^2 =$ not reported, $p = 0.30$

No differences were reported for the following tests;

WCST perseverative errors: SMD = -0.14, 95%CI -0.33 to 0.03, $p = 0.10$, $I^2 =$ not reported, $p = 0.14$

Stroop Colour Word Test: SMD = 0.18, 95%CI -0.16 to 0.58, $p = 0.34$, $I^2 =$ not reported, $p = 0.21$



Attention

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	Attention testing in people with schizophrenia on two separate occasions more than 1 month apart, with no training in between.
Summary of evidence	Moderate to high quality evidence (large samples, unable to assess consistency, precise, direct) suggests that people with schizophrenia may show a small, improved performance on the TMT-A timed task from initial test to re-test at one month, with no improvement on other tasks of attention including digit span, Stroop or TMT-A (number of errors). Controls show greater improvement on TMT-A (timed).

Attention

Significant, small effect size shows improvement in performance on the TMT- A (time) at retest;

17 studies, N = 840, $g = 0.27$, 95%CI 0.18 to 0.37, $p < 0.05$

No differences were reported between test and retest for;

Digit span: 11 studies, N = 330, $g = 0.13$, 95%CI -0.03 to 0.28, $p > 0.05$

Digit span distractibility task: 5 studies, N = 251, $g = 0.11$, 95%CI -0.06 to 0.28, $p > 0.05$

Stroop (coloured dots): 3 studies, N = 153, $g = 0.15$, 95%CI -0.08 to 0.37, $p > 0.05$

Stroop (words): 3 studies, N = 153, $g = 0.13$, 95%CI -0.10 to 0.35, $p > 0.05$

TMT-A (errors): 3 studies, N = 73, $g = 0.08$, 95%CI -0.25 to 0.41, $p > 0.05$

Compared to controls, there was a significant difference in the level of improvement on the TMT- A (time) between test and retest, with controls showing greater improvement;

4 studies, N = 64, $g = 0.44$, 95%CI 0.13 to 0.76, $p < 0.05$



Attention

Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise
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	Attention 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 attention task than people with schizophrenia who are HSV-1 negative.
Attention	
Repeatable Battery for Neuropsychological Status (RBANS) test	
<i>Poorer performance on the RBANS attention subscale in people with schizophrenia who are HSV-1 positive;</i>	
2 studies, N = 609, MD = -6.12, 95%CI -9.09 to -3.15, $p < 0.0001$, $I^2 = 17\%$	
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



Attention

functional outcome in schizophrenia: a meta-analysis

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

[View review abstract online](#)

Comparison	Association between attention, positive symptoms and negative symptoms in people with schizophrenia.
Summary of evidence	Moderate quality evidence (large sample, inconsistent, unable to assess precision, direct) suggests a small effect of increased negative symptoms but not positive symptoms with poorer attention/ vigilance. Symptom severity may act as a mediator between attention/ vigilance and functional impairment.
Negative Symptoms	
<p><i>Small effect size suggests a significant association between increased negative symptom severity and poorer attention/ vigilance;</i></p> <p style="text-align: center;">10 studies, N = 2,138, $r = -0.17$, $p < 0.01$</p> <p style="text-align: center;"><i>Subgroup analysis examined the potential for negative symptoms to mediate the effect of neurocognitive performance on functional outcomes;</i></p> <p>The relationship between attention/ vigilance and community function appears to be at least partially mediated by negative symptom severity, $p < 0.01$.</p> <p>The relationship between attention/ vigilance and skills assessment also appears to be mediated by negative symptom severity, $p < 0.01$.</p>	
Positive Symptoms	
<p><i>No significant association was reported between positive symptom severity and attention/ vigilance;</i></p> <p style="text-align: center;">4 studies, N = 199, $r = -0.10$, $p = 0.15$</p>	
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



Attention

the relationship between positive symptoms and neurocognitive deficits

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

[View review abstract online](#)

Comparison	Association between attention and reality distortion and disorganised symptom dimensions in people with schizophrenia.
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, precise, direc,) suggests a medium effect of impaired attention/vigilance with disorganised symptoms and a small effect for reality distortion.
Disorganised symptoms	
<i>Medium-sized effect of a significant association between increased disorganised symptoms and reduced attention/ vigilance;</i> 19 studies, N = 1,404, $r = -0.25$, 95%CI -0.31 to -0.20, $p < 0.01$	
Reality distortion	
<i>Small effect of a significant association between increased reality distortion and reduced attention/vigilance.</i> 10 studies, N = 743, $r = -0.12$, 95%CI -0.19 to -0.05, $p < 0.01$	
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
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Attention

	cognitive functioning in people with schizophrenia.
Summary of evidence	Moderate to high quality evidence (large samples, consistent, unable to assess precision, direct) suggests a small association between poor performance on emotion perception, social perception and Theory of Mind tasks and decreased performance on attention tasks.
Associations between social cognition and attention	
<p><i>Small association between poor emotion perception and poor attention/vigilance;</i> 16 studies, N = 828, $r = 0.26$, $Q_w = 20.00$, $p = 0.22$</p> <p><i>Small association between poor social perception and poor attention/vigilance;</i> 7 studies, N = 424, $r = 0.17$, $Q_w = 12.18$, $p = 0.09$</p> <p><i>Small association between poor Theory of Mind and poor attention/vigilance;</i> 5 studies, N = 279, $r = 0.24$, $Q_w = 6.48$, $p = 0.26$</p>	
Consistency in results	Consistent
Precision in results	Unable to assess (no CIs reported)
Directness of results	Direct

<p><i>Ventura J, Wood RC, Jimenez AM, Helleman GS</i></p> <p>Neurocognition and symptoms identify links between facial recognition and emotion processing in schizophrenia: Meta-analytic findings</p> <p>Schizophrenia Research 2013; 151: 78-84</p> <p>View review abstract online</p>	
Comparison	Association between social cognition, symptom domains and cognitive functioning in people with schizophrenia.
Summary of evidence	Moderate quality evidence (small to large studies, consistent, unable to assess precision, direct) suggests a small association between poor facial recognition and emotion processing and decreased performance on attention tasks.
Associations between social cognition and attention	



Attention

Small association between poor facial recognition and poor attention/vigilance;

3 studies, N = 108, $r = 0.28$, $Q_w = 1.19$, $p = 0.76$

Small association between poor emotion processing (facial stimuli) and poor attention/vigilance;

17 studies, N = 922, $r = 0.29$, $Q_w = 31.06$, $p = 0.02$

Omitting 1 study gave homogenous results and $r = 0.25$

Small association between poor emotion processing (voice prosody) and poor attention/vigilance;

3 studies, N = 108, $r = 0.29$, $Q_w = 2.43$, $p = 0.66$

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

Wang Y-Y, 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	Attention in people with schizophrenia who smoke vs. people with schizophrenia who don't smoke.
Summary of evidence	High quality evidence (large sample, consistent, precise, direct) suggests no differences in attention between people with schizophrenia who smoke or don't smoke.
Attention	
Repeatable Battery for Neuropsychological Status (RBANS) test	
<i>No significant differences in attention;</i> 2 studies, N = 739, SMD = -0.13, 95%CI -0.30 to 0.04, $p = 0.13$, $I^2 = 0\%$	
Consistency	Consistent
Precision	Precise



Attention

Directness	Direct
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Westerhausen R, Kompus K, Hugdahl K

Impaired cognitive inhibition in schizophrenia: A meta-analysis of the Stroop interference effect

Schizophrenia Research 2011; 133: 172-181

[View review abstract online](#)

Comparison	Attention measured by the Stroop test in people with schizophrenia vs. controls.
Summary of evidence	Moderate to high quality evidence (large samples, inconsistent, precise, direct) suggests a medium effect of lower reaction time and increased errors on the Stroop test in patients with schizophrenia.
Attention	
<p><i>A medium effect of increased reaction time in patients with schizophrenia;</i> 36 studies, N = 2,107, $g = 0.43$. 95%CI 0.35 to 0.52, $p < 0.0001$, $I^2 = 70.5\%$, $p < 0.0001$ Authors report publication bias is unlikely.</p> <p>Meta-regression analysis revealed a larger effect in the card vs. computerized version ($b = -0.44$, $p = 0.007$). Heterogeneity remained high in the card version, but not the computerized version (78.4% vs. 33.8%).</p> <p><i>A medium effect of increased errors in patients with schizophrenia;</i> 12 studies, N = 767, $g = 0.62$. 95%CI 0.47 to 0.77, $p < 0.0001$, $I^2 = 39.6\%$, $p = 0.139$ Authors report publication bias is likely.</p>	
Consistency	Inconsistent for reaction time, consistent for reaction time in computerized studies only and for error rate.
Precision	Precise
Directness	Direct



Attention

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](#)

<p>Comparison</p>	<p>Attention 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.</p>
<p>Summary of evidence</p>	<p>Moderate to high quality evidence (medium-sized samples, consistent, precise or unable to assess, direct) suggests no differences in attention performance between patients receiving first or second-generation antipsychotics. Patients receiving olanzapine or quetiapine show a medium to large effect of improvement pre- to post-treatment, however patients receiving clozapine or risperidone show no improvement.</p>
<p style="text-align: center;">Attention and vigilance</p>	
<p><i>No difference in attention was reported between patients receiving second generation antipsychotics compared to patients receiving first generation antipsychotics;</i> 12 studies, N= 316, $g = 0.12$, 95%CI - 0.04 to 0.28, $p = 0.152$, $Q p > 0.05$</p> <p><i>Post-treatment, patients receiving olanzapine or quetiapine showed a medium to large effect of improved performance;</i></p> <p>Olanzapine: 9 studies, N = 512, $g = 0.47$, (CI not reported), $p < 0.006$, $Q p > 0.05$ Quetiapine: 5 studies, N = 91, $g = 0.82$, (CI not reported), $p < 0.006$, $Q p > 0.05$</p> <p><i>Patients receiving clozapine or risperidone showed no significant improvement post medication;</i></p> <p>Clozapine: 8 studies, N = 152, $g = 0.17$, (CI not reported), $p > 0.05$, $Q p > 0.05$ Risperidone: 9 studies, N = 289, $g = 0.12$, (CI not reported), $p > 0.05$, $Q p > 0.05$</p>	
<p>Consistency</p>	<p>Consistent</p>
<p>Precision</p>	<p>Precise for first vs. second generation antipsychotics, unable to assess pre-post comparison.</p>
<p>Directness</p>	<p>Direct</p>



Attention

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	Attention 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) suggests a small effect of improved CPT performance post treatment, but no improvement on TMT-A post-treatment with haloperidol.
Attention	
<p><i>Significant, small effect size of improved CPT performance post-treatment;</i> High (>10mg) or low (<10mg) dose: 5 studies, N = 313, $g = 0.20$, 95%CI 0.05 to 0.35, $p < 0.05$ Low dose: 4 studies, N = 294, $g = 0.22$, 95%CI 0.06 to 0.38, $p < 0.05$ <i>No improvement on TMT-A post treatment;</i> All studies: 6 studies, N = 231, $g = 0.15$, 95%CI -0.03 to 0.33, $p > 0.05$ Low dose: 2 studies, N = 151, $g = 0.07$, 95%CI -0.15 to 0.29, $p > 0.05$ High dose: 3 studies, N = 53, $g = 0.22$, 95%CI -0.16 to 0.60, $p > 0.05$</p>	
Consistency	Authors report all results are consistent (using fixed effects model)
Precision	Precise
Directness	Direct



Attention

Explanation of acronyms

AVLT = Auditory Verbal Learning Test, 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, d = Cohen's d and g = Hedges' g = standardised mean differences (see below for interpretation of effect size), DRS = Mattis Dementia Rating Scale, ERP = Event Related Potential, ES = effect size, FE = First-Episode, I^2 = the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance), LLS = Late-life Schizophrenia, MATRICS = Measurement and Treatment Research to Improve Cognition in Schizophrenia, N = number of participants, p = statistical probability of obtaining that result ($p < 0.05$ generally regarded as significant), Q = Q statistic for the test of heterogeneity, Q_B = test for between group differences (heterogeneity between groups of studies for an outcome of interest), r = correlation coefficient, RCT = randomised controlled trial, RBANS = Repeatable Battery for the Assessment of Neuropsychological Status, RCT = randomised control trial, SCWT = Stroop Colour and Word Test, SE = standard error, SMD = standard mean difference, SPAN = Span of Apprehension Test, TMT = Trail Making Test, μ_p = estimated average correlation in the population, μ_p = estimated average correlation in the population, vs. = versus, WAIS = Wechsler Adult Intelligence Scale, WAIS-LNS = Wechsler Adult Intelligence Scale- Letter Number Sequencing, WAIS-R = Wechsler Adult Intelligence Scale Revised, WCST = Wisconsin Card Sorting Task, WMS = Wechsler Memory Scale



Attention

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 small⁴⁰.

† 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. Less than 0.4 represents a small effect, around 0.5 a medium effect, and over 0.8 represents a large effect⁴⁰.

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 ⁴¹. InOR stands for logarithmic OR where a InOR of 0 shows no difference between groups. Hazard ratios



Attention

measure the effect of an explanatory variable on the hazard or risk of an event.

Correlation coefficients (eg, r) indicate the strength of association or relationship between variables. They can provide an indirect indication of prediction, but do not confirm causality due to possible and often unforeseen confounding variables. An r of 0.10 represents a weak association, 0.25 a medium association and 0.40 and over represents a strong association. Unstandardised (b) regression coefficients indicate the average change in the dependent variable associated with a 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.

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

§ 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 relaxed⁴².

‡ 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 formula⁴⁰;

|| 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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