TECHNICAL COMMENTARY

Language

Introduction

Language may be altered in people with schizophrenia and may present in the form of disorganised speech. Tasks designed to assess language ability include; letter fluency tasks that assess the ability to generate words starting with letter and category fluency tasks that assess the ability to name words within a specified category. Working memory is needed for both letter and category fluency as participants must organise and retrieve relevant information.

Other tests designed to assess language include: Boston Naming task; Wechsler Adult Intelligence Scale (WAIS) comprehension (including the subtest information, similarities and vocabulary), WAIS verbal memory, verbal fluency, National Adult Reading Test (NART)/ Wide Range Achievement Test (WRAT), Controlled Oral Word Association Test (COWA), Category Instance Generation Test (CIGT), Multiple Choice Vocabulary Test (MWT-B), Hopkins Verbal Learning Test (HVLT), California Verbal Learning Test (CVLT), Rey Auditory Verbal Learning Test (AVLT), semantic priming tasks and Lexical Decision Task and the Peabody Individual Achievement reading comprehension (PIAT). Latent Semantic Analysis (LSA) is used to determine the degree of incoherence in language.

Method

We have included only systematic reviews (systematic literature search, detailed methodology with inclusion/exclusion criteria) published in full text, in English, from the year 2000 that report results separately for people with a diagnosis of schizophrenia, schizoaffective disorder, schizophreniform disorder or first episode schizophrenia. Due to the high volume of systematic reviews we have now limited inclusion to systematic meta-analyses. Where no systematic meta-analysis

exists for a topic, systematic reviews without meta-analysis are included for that topic. Reviews were identified by searching the databases MEDLINE, EMBASE, CINAHL, Current Contents, PsycINFO and the Cochrane library. Hand searching reference lists of identified reviews was also conducted. When multiple copies of reviews were found, only the most recent version was included.

Review reporting assessment was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist that describes a preferred way to present a meta-analysis[1]. Reviews with less than 50% of items checked have been excluded from the library. The PRISMA flow diagram is a suggested way of providing information about studies included and excluded with reasons for exclusion. Where no flow diagram has been presented by individual reviews, but identified studies have been described in the text, reviews have been checked for this item. Note that early reviews may have been guided by less stringent reporting checklists than the PRISMA, and that some reviews may have been limited by journal guidelines.

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

precise and direct with low associated risks (see end of table for an explanation of these terms).[2] The resulting table represents an objective summary of the available evidence, although the conclusions are solely the opinion of staff of NeuRA (Neuroscience Research Australia).

Results

We found 33 systematic reviews that met our inclusion criteria[3-35].

Compared to controls

- Moderate to high quality evidence shows a large effect of impaired letter and category fluency, verbal learning and working memory, and semantic priming in people with schizophrenia. People at clinical high risk or familial high risk of psychosis are similarly impaired on language fluency tasks.

- Moderate to high quality evidence suggests a large effect of more incoherent speech in people with schizophrenia or first-episode psychosis.

- Moderate quality evidence suggests poorer performance in vocabulary and word fluency in people with first-episode, youth-onset, or late-onset schizophrenia.

Compared to bipolar disorder

- Moderate to high quality evidence shows a small effect of lower performance in patients with schizophrenia on the Controlled Oral Word Association Test, the California Verbal Learning Test total free recall subscale, but not on the long delayed free recall or recognition hits subscales. Moderate quality evidence also suggests a medium effect of lower WAIS verbal IQ in schizophrenia.

Effects of medication

- Moderate to high quality evidence shows greater improvements in verbal fluency in patients taking second generation antipsychotics compared to first generation antipsychotics.

- Moderate to high quality evidence also shows improvements in verbal learning and delayed verbal recall, but not verbal fluency, after treatment with first generation haloperidol.

- Moderate quality evidence suggests quetiapine, olanzapine, and clozapine but not risperidone, may improve language ability.

Association with symptoms of schizophrenia

- Moderate to high quality evidence shows a medium-sized association of impaired verbal fluency in people with schizophrenia with increased negative or disorganised symptoms.

- Moderate to low quality evidence suggests more impaired language in people with schizophrenia with formal thought disorder compared to people with schizophrenia without thought disorder on verbal fluency and naming tasks, with no differences for semantic associations, categorisation or priming tasks.

Association with social factors

- Moderate to high quality evidence shows that improved performance on verbal learning tasks may be associated with better community functioning, social behaviour, improved social skills, and greater problem-solving ability.

Association with other cognitive factors

- Moderate quality evidence suggests a medium to strong association between verbal learning, and memory, executive functioning, attention, processing speed, reasoning, abstraction, and flexibility.

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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	Verbal fluency in people with psychosis and current cannabis use vs. people with psychosis with no cannabis use.
Summary of evidence	Moderate quality evidence (large sample, inconsistent, imprecise, direct) shows no significant differences in language ability.

Language ability	

There were no significant differences in verbal fluency;

6 studies, N = 736, g = -0.47, 95%CI -1.22 to 0.28, p > 0.05, I^2 = 94%

Consistency[‡]	Inconsistent
Precision[§]	Imprecise
Directness[‖]	Direct

Bokat CE, Goldberg TE

Letter and category fluency in schizophrenia patients: a meta-analysis

Schizophrenia Research 2003; 64: 73-78

View review abstract online

Comparison	Category and letter fluency in people with schizophrenia vs. controls.
Summary of evidence	High quality evidence (large sample, consistent, precise, direct) shows that people with schizophrenia show a large effect of impaired performance on category fluency and letter fluency compared with controls.

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Category and letter fluency
A large effect size suggests people with schizophrenia showed poorer performance on category and letter fluency compared with controls;
Category fluency: 13 studies, N = 915, *d* = 1.27, 95%CI 1.11 to 1.43, Q_w = 14.4, *p* > 0.10
Letter fluency: 13 studies, N = 915, *d* = 0.99, 95%CI 0.87 to 1.13, Q_w = 5.2, *p* > 0.10

Consistency	Consistent
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

Comparison	**Language fluency in people at clinical high risk (UHR) and familial high risk (FHR) for psychosis.**
Summary of evidence	**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 language fluency tasks when compared with controls, showing small to medium-sized effects.**

Language fluency
Significant, small to medium size effect of poor language fluency in UHR and FHR groups compared with controls, with no significant differences between groups;
UHR: 8 studies, N = 930, *d* = 0.52, 95%CI 0.30 to 0.74, *p* < 0.001, I^2 = 0.06%, Q-test *p* = 0.01
FHR: 10 studies, N = 1,149, *d* = 0.39, 95%CI 0.16 to 0.61, *p* = 0.001, I^2 = 0.08%, Q-test *p* = 0.002
Q_B *p* > 0.05
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 language fluency over time in people at ultra-high risk of psychosis (UHR) compared with people with first-episode psychosis (FEP) or controls.**
Summary of evidence	**Moderate to high quality evidence (medium-sized samples, consistent, precise, direct) suggests small improvements in language fluency over time in people with first-episode psychosis and controls, with no improvement in people at ultra-high risk of psychosis.**

Language fluency over time (1 to 5 years)

Significant, small improvement in language fluency over time in both FEP and controls, with no improvement in UHR, and controls showed most improvement;

FEP: 12 studies, N = 575, d = 0.14, 95%CI 0.01 to 0.27, p = 0.04, I^2 = 0.02%, Q-test p = 0.15

UHR: 10 studies, N = 235, d = 0.03, 95%CI -0.15 to 0.20, p = 0.76, I^2 = 0%, Q-test p = 0.97

Controls: 9 studies, N = 364, d = 0.31, 95%CI 0.14 to 0.49, p < 0.001, I^2 = 0.02%, Q-test p = 0.23

Q_B = 4.9, p = 0.03

Authors report no publication bias and no effects of medication status.

Consistency	Consistent
Precision	Precise
Directness	Direct

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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, consistent, precise, direct) shows a medium-sized effect of poorer verbal fluency in people with first-episode schizophrenia compared to people with first-episode bipolar disorder.

Verbal fluency

A significant, medium-sized effect of poorer fluency in people with first-episode schizophrenia compared with first-episode bipolar disorder;

All fluency tasks: 7 studies, N = 865, d = 0.50, 95%CI 0.33 to 0.66, p < 0.001, I^2 = 22.0%, p = 0.26

Letter: 5 studies, N = 542, d = 0.42, 95%CI 0.24 to 0.60, p < 0.001

Category: 3 studies, N = 328, d = 0.77, 95%CI 0.0 to 1.53, p = 0.05

Authors report no publication bias.

No differences were found for males vs. females or younger vs. older patients.

Consistency in results	Consistent
Precision in results	Imprecise
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	Language ability 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 language ability.
Language ability	
Significant, medium-sized effects of poorer language fluency in people with deficit schizophrenia compared to people with non-deficit schizophrenia; Overall fluency: 9 studies, N = 1,374, d = 0.60, 95%CI 0.42 to 0.77, p < 0.001, I^2 = 47%, p = 0.06 Letter fluency: 9 studies, N = 1,374, d = 0.58, 95%CI 0.40 to 0.77, p < 0.001, I^2 = 51%, p = 0.04 Semantic fluency: 6 studies, N = 1,217, d = 0.54, 95%CI 0.36 to 0.72, p < 0.001, I^2 = 40%, p = 0.14 *Significant, large effects of poorer language fluency in people with deficit schizophrenia compared to controls and in people with non-deficit schizophrenia compared to controls;* Deficit: 6 studies, N = 636, d = 1.53, 95%CI 1.34 to 1.71, p < 0.001, I^2 = 0%, p = 0.69 Non-deficit: 6 studies, N = 738, d = 0.79, 95%CI 0.64 to 0.94, p < 0.001, I^2 = 0%, p = 0.55	
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 verbal learning and language in people with schizophrenia. Note: work capacity is the ability to obtain and maintain competitive work and work behaviours and skills.

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Summary of evidence	Moderate to low quality evidence (medium-sized samples, unable to assess consistency or precision, direct) suggests lower levels of work capacity are associated with poor language skills.
Cognitive performance	
5 studies (N = 348) reported that poor *verbal learning and language* was associated with worse work behaviour improvements, work performance, less hours worked, wages earned and contact with employment specialist.	
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 Boer JN, Voppel AE, Begemann MJH, Schnack HG, Wijnen F, Sommer IEC

Clinical use of semantic space models in psychiatry and neurology: A systematic review and meta-analysis

Neuroscience and Biobehavioral Reviews 2018; 93: 85-92

[View review abstract online](#)

Comparison	Assessment of semantic space scores using LSA in people with schizophrenia vs. people without a clinical diagnosis. Semantic space scores quantify the degree of incoherence in spoken language. Two-thirds of the sample included people with schizophrenia; however some studies included people with first-episode psychosis.
Summary of evidence	Moderate to high quality evidence (large sample, consistent, imprecise, direct) suggests a large effect of increased semantic space scores in people with schizophrenia or first-episode psychosis.
Semantic space	

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A large, significant effect of increased semantic space scores in people with schizophrenia;
4 studies, N = 780, *g* = 0.96, 95%CI 0.32 to 1.60, *p* = 0.003, I² = 0%
Authors report no evidence of publication bias.

Consistency in results	Consistent
Precision in results	Imprecise
Directness of results	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 executive functioning and symptom dimensions in people with non-affective psychosis.**
Summary of evidence	**Moderate to high quality evidence (unclear sample size, direct, precise, consistent) shows a medium-sized association between increased negative symptoms and lower verbal fluency.**

Symptoms and verbal fluency
A significant, medium association between increased negative symptoms and lower verbal fluency;
23 studies, μ_p = -0.291, 95%CI -0.356 to -0.224, *p* = 0.00, I² = 42
No association with positive or disorganised symptoms;
Positive symptoms: 20 studies, μ_p = -0.035, 95%CI -0.101 to 0.031, *p* = 0.29, I² = 17%
Disorganised symptoms: 13 studies, μ_p = -0.092, 95%CI -0.208 to 0.027, *p* = 0.13, I² = 61%

Consistency	Consistent
Precision	Precise
Directness	Direct

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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 between impaired verbal fluency and increased negative or disorganised symptoms.

Verbal fluency

All tasks showed small to medium-sized associations with negative and disorganised symptoms;
Negative symptoms: 40 studies, r = -0.27 95%CI -0.31 to -0.23
Disorganised symptoms: 18 studies, r = -0.11 95%CI -0.17 to -0.05

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	Fluency in people with schizophrenia vs. healthy controls.
Summary of evidence	Moderate to high quality (large samples, direct, consistent or

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	unable to assess, precise) suggests a large effect of poorer performance on fluency tasks, including category fluency and letter fluency compared to controls.
Fluency	
Large effect size suggests people with schizophrenia showed poorer fluency compared with controls on tasks including; Category fluency: 8 studies, N = 698, *g* = -1.41, 95%CI -1.62 to -1.19, Q$_w$ = 10.0, *p* = 0.19 Letter fluency: 22 studies, N = 2,107, *g* = -0.83, 95%CI -0.96 to -0.71	
Consistency	Consistent for category fluency, unable to assess for letter fluency.
Precision	Precise
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 verbal learning 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 verbal learning and increased scores on other Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) domains including memory, executive functioning, attention, processing speed, reasoning, abstraction and flexibility.**
Verbal learning	
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.	

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Weighted effect size of these 9 studies indicated a significant correlation across composite MATRICS cognitive scores; such that increased performance on verbal learning 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 = 40) reported a medium association between increased verbal learning (logical memory, paired associates, CVLT variables) and increased visual learning (visual reproduction variables), working memory and processing speed; $r = 0.35$, 95%CI 0.21 to 0.47.

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

1 study (N = 219) reported a medium association between increased verbal learning (CVLT variables) and increased working memory and executive functioning; $r = 0.34$, 95%CI 0.27 to 0.40.

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

1 study (N = 45) reported a strong association between increased verbal learning (CVLT) and increased visual learning (visual reproduction variables), executive functioning and attention; $r = 0.52$, 95%CI 0.38 to 0.64.

1 study (N = 1,123) reported a strong association between increased verbal learning (HVLT variables) and increased processing speed, reasoning, working memory, vigilance; $r = 0.50$; 95%CI 0.47 to 0.53.

1 study (N = 113) reported a strong association between increased verbal learning (Spanish verbal learning test, verbal fluency variables, Trails B) and increased attention and abstraction and flexibility; $r = 0.45$, 95%CI 0.35 to 0.54.

1 study (N = 118) reported a medium association between increased scores on individual measures of verbal learning (CVLT) and increased scores on Rey complex figure memory, category fluency, Stroop (colour and word) and Gordon's CPT; $r = 0.30$, 95%CI 0.24 to 0.36.

1 study (N = 1,123 to 1,332) reported a strong association between increased scores on individual measures of verbal learning (HVLT) and increased scores on category and letter fluency, digit symbol, WCST, WISC mazes, visuospatial working memory, letter-number sequencing and identical pairs CPT variables; $r = 0.40$, 95%CI 0.37 to 0.44.

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

1 study (N = 32) reported a strong association between increased scores on individual measures of verbal learning (HVLT) and increased scores on WCST (perseverative errors), Penn conditional exclusion test with letter fluency, trails A and B and digit symbol; $r = 0.40$, 95%CI 0.28 to 0.50.

1 study (N = 30) reported a medium association between increased scores on individual measures of verbal learning (Rey AVLT) and increased scores on symbol digit, WCST, identical pairs CPT, letter number sequencing, trials A and B; $r = 0.30$, 95%CI 0.18 to 0.41.

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Consistency	Unable to assess; no measure of consistency is reported.
Precision	Precise
Directness	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 tasks involving language in people with schizophrenia vs. controls.
Summary of evidence	Moderate quality evidence (unclear sample size, direct, inconsistent, mostly precise) 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.
	Moderate to low quality evidence (imprecise) 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 symptoms.

Language / semantic memory
A significant medium to large effect suggests poorer performance on the following language semantic memory tests in people with schizophrenia compared with controls;
Naming: 15 studies, d = -1.45, 95%CI -1.86 to -1.04, Q_w = 177.69, p < 0.0001
Category fluency: d = -1.33, 95%CI -1.15 to -1.11, Q_w = 248.018, p < 0.001
Word-picture matching: 5 studies, d = -0.58, 95%CI -0.92 to -0.24, Q_w = 14.73, p = 0.04

Priming: 19 studies, $d = -0.02$, 95%CI -0.18 to -0.14, $Q_w = 473.46$, $p < 0.001$
Significant, medium size effect of better performance on associations tasks in people with schizophrenia compared with controls;
Associations: 5 studies, $d = 0.63$, 95%CI 0.003 to 1.28, $Q_w = 30.34$, $p < 0.001$
No difference between performance on categorisation in people with schizophrenia compared with controls;
12 studies, $d = -0.49$, 95%CI -0.86 to 0.12, $Q_w = 125.62$, $p < 0.0001$
Relationship with symptoms
More impairment in people with thought disorder compared with people without thought disorder for;
Verbal fluency: 3 studies reported a difference, $d = -1.12$, 95%CI -1.72 to -0.72, p not reported
Naming: 4 studies reported a difference, $d = -1.195$ vs. -0.73 (CIs not reported), $p = 0.046$
Inconsistent findings for;
Association: 1 study reported a difference, 1 study reported no difference (no statistics)
Categorisation: 1 study reported a difference, 1 study reported no difference (no statistics)
No difference for;
Semantic priming: 1 study reported no difference: $d = 0.126$ vs. $d = 0.202$, $p = 0.12$
More impairment in people with negative symptoms compared with people without negative symptoms in;
Verbal fluency: 2 studies, $d = -1.006$, 95%CI -1.43 to -0.58, p not reported

Consistency	Inconsistent where reported.
Precision	Imprecise for associations, categorisations and symptoms
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

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Comparison	**Relationship between functional outcomes (community**

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	functioning, social behaviour, social problem solving, social skills) and verbal learning in schizophrenia.
Summary of evidence	**Moderate to high quality evidence (mixed samples, direct, mostly consistent, mostly precise) shows improved performance on verbal learning tasks is associated with better community functioning, social behaviour, greater problem-solving ability and a weak association with social skills.**

Community functioning (work performance, social interaction)
Significant medium positive relationship between performance on verbal learning tasks and community functioning;
17 studies, N = 1,125, estimated average correlation = 0.26, 95%CI 0.15 to 0.37, $p < 0.001$, Q_w = 69.54, I² = 71.65%, $p < 0.05$

Social behaviour
Significant medium positive relationship between better performance on verbal learning tasks and improved social behavior;
4 studies, N = 253, estimated average correlation = 0.32, 95%CI 0.15 to 0.47, $p < 0.001$, Q_w = 4.84, I² = 39.22%, $p > 0.05$

Social problem solving
Significant medium positive relationship between better performance on verbal learning tasks and greater social problem solving;
4 studies, N = 117, estimated average correlation = 0.26, 95%CI 0.07 to 0.43, $p = 0.003$, Q_w = 0.44, I² = 0%, $p > 0.05$

Social skills
Significant weak positive relationship between performance on verbal learning task and better social skills;
7 studies, N = 250, estimated average correlation = 0.18, 95%CI 0.06 to 0.31, $p = 0.005$, Q_w = 8.54, I² = 0%, $p > 0.05$

Consistency	Consistent for all except community functioning.
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	**Language functioning in people with schizophrenia vs. controls.**
Summary of evidence	**Moderate to high quality evidence (large sample, inconsistent, precise, direct) suggests people with schizophrenia showed poor language functioning compared to controls.**
Language functioning	

A large effect of poor language functioning n people with schizophrenia compared with controls;

70 studies, N = 6,396, SMD = -0.99, 95%CI -1.10 to -0.87, *p* < 0.0001, I^2 = 74%

Consistency	Inconsistent
Precision	Precise
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	**Verbal learning 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 of poorer performance on verbal learning and working memory in people with schizophrenia.**

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Verbal learning
A significant large effect size suggests poorer performance on the following verbal learning tests in people with schizophrenia compared with controls;
Verbal paired associate learning test: 18 studies, d = -0.88, 95%CI -1.07 to -0.69, $p < 0.001$, I² = 64.0, $p < 0.001$
Verbal learning test: List A Trial 1: 11 studies, d = -1.01, 95%CI -1.26 to -0.76, $p < 0.001$, I² = 62.1, $p = 0.36$
Verbal learning test: List A Trial 5: 13 studies, d = -1.25, 95%CI -1.54 to -0.97, $p < 0.001$, I² = 78.8, $p < 0.001$
Verbal learning test: List A Trial 6, cued: 6 studies, d = -0.98, 95%CI -1.32 to -0.65, $p < 0.001$, I² = 59.2, $p = 0.031$
Verbal learning test: List A Trial 6, free recall: 13 studies, d = -1.08, 95%CI -1.35 to -0.80, $p < 0.001$, I² = 76.6, $p < 0.001$
Verbal learning test: Total list A, Trials 1-5: 28 studies, d = -1.32, 95%CI -1.48 to -1.17, $p < 0.001$, I² = 60.4, $p < 0.001$
Verbal learning test: List B: 6 studies, d = -0.92, 95%CI -1.19 to -0.65, $p < 0.001$, I² = 40.4, $p = 0.136$
Verbal recall test: 24 studies, d = -1.21, 95%CI -1.39 to -1.03, $p < 0.001$, I² = 53.3, $p = 0.001$
Verbal span tasks involving manipulation: 9 studies, d = -1.02, 95%CI -1.32 to -0.71, $p < 0.001$, I² = 67.6, $p = 0.002$
A significant medium effect size suggests poorer performance on the following verbal learning tests in people with schizophrenia compared with controls;
Verbal span tasks without manipulation: 7 studies, d = -0.72, 95%CI -0.91 to -0.51, $p < 0.001$, I² = 0, $p = 0.433$
Verbal recognition test: 19 studies, d = -0.63, 95%CI -0.84 to -0.42, $p < 0.001$, I² = 58.9, $p = 0.001$
Meta-regression analysis suggests a significant association between longer duration of illness and poorer performance on verbal learning test cued recall post-distraction (b = -0.037, $p = 0.001$) and verbal learning test free recall post-distraction (b = -0.0339, $p = 0.015$).
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, $p = 0.019$).

Consistency	Inconsistent for all except verbal learning list A trial 1, List B and verbal span task without manipulation.

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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	Language and verbal comprehension performance in people with schizophrenia on second generation antipsychotics vs. first generation antipsychotics.
Summary of evidence	Moderate quality evidence (small sample, direct, precise, unable to assess consistency) suggests greater language and verbal comprehension in people with schizophrenia receiving second-generation antipsychotics compared with those receiving first-generation antipsychotics.

Language and verbal comprehension
A significant small effect size showed greater language and verbal comprehension in people with schizophrenia receiving second-generation antipsychotics compared with those receiving first-generation antipsychotics; 3 RCTs, N = 179, g = 0.38, 95%CI 0.15 to 0.62, $p < 0.01$

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

Irani F, Kalkstein S, Moberg E, Moberg P

Neuropsychological performance in older patients with schizophrenia: A

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meta-analysis of cross-sectional and longitudinal studies	
Schizophrenia Bulletin 2010; Doi: 10.1093/schbul/sbq057 View review abstract online	
Comparison	**Language ability in older people with schizophrenia (mean age 64 years).**
Summary of evidence	**Moderate quality evidence (unclear sample size, direct, inconsistent, precise or unable to assess) suggests older people with schizophrenia have poorer global cognition and language ability than age-matched controls.**
Language	
A large effect suggests global cognition was significantly more impaired in older people with schizophrenia compared with the age-matched control group; 21 observational studies (cross-sectional), d = -1.19, 95%CI -1.29 to -1.11, $p < 0.05$, Q_w = 325.96, $p < 0.01$ A large effect size suggests poorer language in older people with schizophrenia compared with the age-matched control group (d = -1.30). Number of studies, sample sizes, effect size, Q and p-values are not reported. 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.	
Consistency	Inconsistent for overall global cognition, unable to assess for language.
Precision	Precise for overall global cognition. Unable to assess for language.
Directness	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	**Verbal fluency performance in people with schizophrenia vs.**

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	controls.
Summary of evidence	**Moderate to high quality evidence (large samples, direct, inconsistent, precise) suggests impaired verbal fluency in people with schizophrenia compared with controls.**

Verbal fluency
A large effect size suggests impaired performance on verbal fluency in people with schizophrenia compared with controls;
Letter fluency: 25 studies, N = 4,826, g = -0.82, 95%CI -0.94 to -0.70, I^2 = 57.9, Q_w = 57.01, p < 0.0001
Category fluency: 9 studies, N = 1,297, g = -1.31, 95%CI -1.55 to -1.2, I^2 = 52.93, Q_w = 16.10, p < 0.05

Consistency	Inconsistent
Precision	Precise
Directness	Direct

Lee J, Park S

Working memory impairments in schizophrenia: A meta-analysis

Journal of Abnormal Psychology 2005; 114(4): 599-611

[View review abstract online](#)

Comparison	**Verbal working memory in people with schizophrenia vs. controls.**
Summary of evidence	**Moderate quality evidence (unclear sample size, inconsistent, precise, direct) suggests poorer verbal working memory in people with schizophrenia compared with controls.**

Verbal working memory
A large effect of poorer verbal working memory in patients with schizophrenia compared with controls;
70 studies, r = 0.446, 95%CI 0.068 to 0.824, Q_w = 368.77, p < 0.01

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Consistency	Inconsistent
Precision	Precise
Directness	Direct

Mendrek A, Sepehry AA, Stip E

Toward a meta-analytic approach of sex differences in episodic memory of schizophrenia patients: Exploratory findings

Clinical Schizophrenia and Related Psychosis 2008; 271-225

View review abstract online

Comparison	**Sex differences in verbal memory performance in people with schizophrenia.**
Summary of evidence	**Moderate to high quality evidence (large sample, inconsistent, precise, direct) suggests no sex differences on verbal memory tasks.**

Verbal memory	
No sex differences on verbal episodic memory;	

10 studies, N = 833, g = 0.136, 95%CI -0.170 to 0.441, p = 0.383, Q_w = 38.028, $p < 0.05$

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

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

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Neuropsychology 2009; 23(3): 315-335	
View review abstract online	
Comparison	**Language ability 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 language functioning in people with first-episode schizophrenia compared with controls.**

Language
Large effect suggests people with first-episode schizophrenia showed significantly poorer language function than controls;
31 studies, N = 4,069, d = -0.88, 95%CI -0.96 to -0.80, $p < 0.001$, Q_w = 221.14, $p < 0.001$
Large effect size was associated with a higher proportion of first-episode participants on antipsychotic medication, higher education, recency of publication, and studies conducted outside the United States.

Consistency	Inconsistent
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	
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 poor verbal fluency and verbal learning in EOS.**

	High quality evidence suggests a large effect of poor verbal learning, and a medium effect of poor verbal fluency in PBD.
Verbal fluency	
Large effect in EOS and a medium effect in PBD of poorer verbal fluency vs. controls; EOS: 8 studies, N = 628, g = -0.95, 95%CI -1.31 to -0.59, $p < 0.005$, Q = 5.05, $p = 0.65$ PBD: 9 studies, N = 631, g = -0.54, 95%CI -0.89 to -0.19, $p < 0.005$, Q = 4.36 $p = 0.82$ Verbal fluency was significantly lower in EOS vs. controls than PBD vs. controls ($p < 0.001$). No significant moderators or publication bias.	
Verbal learning and memory	
Large effect of poorer verbal learning and memory in EOS and PBD vs. controls; 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. No publication bias.	
Consistency	Consistent
Precision	Precise
Directness	Direct, apart from EOS vs. PBD

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 language and capacity to consent to treatment and research in people with schizophrenia spectrum disorders, in terms of their *understanding* of the information; *appreciation* of the context; and *reasoning* of the consequences of their decision.

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Summary of evidence	Moderate to low quality evidence (mostly small samples, direct, unable to assess precision or consistency) suggests that impaired understanding and appreciation were associated with poorer language performance (large to medium effect) in people with schizophrenia.
Language and semantic knowledge	

Five studies (N = 1,680) examined the association between an individual's capacity to consent, and their language. Four of five studies reported a significant association between impaired language and semantic knowledge and poorer understanding; two of five for poorer appreciation; and one of five for poorer reasoning.

Understanding: 1 study (N = 70) reporting $p < 0.05$ for WAIS, PIAT, Token, $r = 0.39-0.52$; 1 study (N = 25) reporting $p < 0.05$ for WRAT, RBANS, $r = 0.51-0.54$; 1 study (N = 30) reporting $p < 0.05$ for GORT, $r = 0.30$; 2 studies (N = 178) reporting significant associations for Verbal composite scores, $r = 0.35-0.52$.

Appreciation: 1 study (N = 70) reporting $p < 0.05$ for PIAT, Token, Verbal composite, $r = 0.35-0.56$; 1 study (N = 25) reporting $p < 0.05$ for WAIS, WRAT, RBANS, $r = 0.54-0.58$.

Reasoning: 1 study (N = 108) reporting $p < 0.05$ for Verbal composite score, $r = 0.45$.

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

Pomarol-Clotet E, Oh TM, Laws KR, McKenna PJ	
Semantic priming in schizophrenia: systematic review and meta-analysis	
The British Journal of Psychiatry 2008; 192: 92-97	
View review abstract online	
Comparison	**Semantic priming in people with schizophrenia with or without thought disorder vs. controls.**
Summary of evidence	**Moderate to high quality evidence (unclear sample size, direct, consistent, precise) shows no effect of overall priming and a small to medium size effect of increased indirect semantic priming in patients compared with controls.**
	Moderate quality evidence (inconsistent) suggests a small effect

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	of increased direct semantic priming only in patients with thought disorder compared with controls.
Priming	
No difference in overall priming in people with schizophrenia (with or without thought disorder) compared with controls; 36 studies, d = 0.07, 95%CI -0.02 to 0.16, Q_w = 59.92, p = 0.008 Authors state that excluding two outliers gave similar results but reduced heterogeneity to NS. *A small effect size suggests significantly increased semantic priming in people with schizophrenia with thought disorder compared with controls;* 18 studies, d = 0.16, 95%CI 0.01 to 0.31, Q_w = 52.31, p < 0.001 *No difference in semantic priming in:* *People with schizophrenia without thought disorder vs. controls;* 14 studies, d = 0.00, 95%CI -0.15 to 0.16, Q_w = 21.29, p = 0.07 *People with schizophrenia with thought disorder vs. people with schizophrenia without thought disorder;* 13 studies, d = 0.06, 95%CI -0.12 to 0.24, Q_w = 28.79, p = 0.004 *A small effect size suggests significantly increased indirect semantic priming in people with schizophrenia (with or without thought disorder) compared with controls;* 9 studies, d = 0.19, 95%CI 0.03 to 0.36, Q_w = 4.67, p = 0.80 *A medium effect size suggests significantly increased indirect semantic priming in people with schizophrenia with thought disorder compared with controls;* 6 studies, d = 0.56, 95%CI 0.31 to 0.80, Q_w = 7.74, p = 0.17 A significant difference was reported between patients with thought disorder compared with controls for short Stimulus Onset Asynchronicity (SOA) (10 studies, d = 0.25) and long SOA (7 studies, d = -0.14), Q_B = 6.33, p = 0.01. A trend difference between patients with thought disorder compared with patients without thought disorder for short SOA (8 studies, d = 0.15) and long SOA (6 studies, d = -0.17), Q_B = 3.39, p = 0.06. Age and duration of illness showed no effect.	
Consistency	Consistent for overall priming (without outliers) and indirect semantic priming.
Precision	Precise
Directness	Direct

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Rabin RA, Zakzanis KK, George TP

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

Schizophrenia Research 2011; 128: 111-116

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Comparison	**Relationship between current cannabis use and language ability in people with schizophrenia.**
Summary of evidence	**Moderate to low quality evidence (unclear sample size, unable to assess consistency or precision, direct) suggests no differences between groups.**

Language ability	
No differences in language ability; 4 studies, $d = 0.06$, SD = 0.30, $p < 0.05$	
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	**Verbal fluency in people with schizophrenia aged over 50 years.**
Summary of evidence	**Moderate to low quality evidence (medium-sized samples, direct, unable to assess consistency or precision) suggests people with late-life schizophrenia have impaired verbal fluency compared to controls. No differences were found in verbal**

	fluency in people with late-life schizophrenia compared tp people with early-onset schizophrenia.
Verbal fluency	
Thirteen studies (N = 1,828) reported deficits in verbal fluency in people with late-life schizophrenia compared with controls, including those which combined verbal fluency with executive functioning (N = 266) or naming (N = 166). Compared with controls, verbal fluency deficits were reported in people with schizophrenia who were institutionalised (2 studies, N = 414), had late-onset schizophrenia (2 studies, N = 169), and who were ambulatory (1 study, N = 255). Three studies (N = 412) reported no significant difference in the severity of verbal fluency deficit in people with early-onset schizophrenia compared with late onset-schizophrenia, despite illness duration.	
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

View review abstract online

Comparison	**Language in people with schizophrenia with different age of onset (first-episode schizophrenia, youth-onset schizophrenia and late-onset schizophrenia) vs. controls.** **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.**
Summary of evidence	**Moderate quality evidence (large sample, direct, unable to assess consistency or precision) suggests poorer performance in vocabulary and word fluency in people with first-episode, youth-onset and late-onset schizophrenia compared to controls.**
Language	

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N = 5,010 (4057 first-episode schizophrenia, 692 youth-onset schizophrenia, 261 late-onset schizophrenia). *All three groups showed considerable impaired vocabulary, with significant between group variability;* First-episode schizophrenia: 16 studies, d = 1.02, SE 0.05, p < 0.05 Youth-onset schizophrenia: 8 studies, d = 1.18, SE 0.11, p < 0.05 Late-onset schizophrenia: 2 studies, d = 0.42, SE 0.19, p < 0.05	
All three groups showed considerable word fluency impairment, with significant between group variability; First-episode schizophrenia: 32 studies, d = 0.87, SE 0.03, p < 0.05 Youth-onset schizophrenia: 6 studies, d = 0.96, SE 0.10, p < 0.05 Late-onset schizophrenia: 4 studies, d = 1.47, SE 0.14, 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

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

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

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Comparison	**Language performance in people with schizophrenia vs. bipolar disorder vs. controls.**
Summary of evidence	**Moderate to high quality evidence (unclear sample size, direct, consistent, precise) 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 compared with bipolar disorder. A small effect was also reported for poorer language performance on the Controlled Oral Word Association Test.** **Moderate quality evidence (inconsistent) suggests a medium**

	effect of lower verbal IQ in schizophrenia compared with bipolar disorder.
Language	
A significant, medium effect suggests that people with schizophrenia had lower verbal IQ scores than people with bipolar disorder; WAIS verbal IQ: SMD = 0.56, 95%CI 0.14 to 0.99, *p* = 0.009, I² = 71%, *p* = 0.004 *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;* Total free recall: (number of studies not reported) SMD = 0.39, 95%CI 0.06 to 0.72, *p* = 0.02, Q-test *p* = 0.71 Long delayed free recall: SMD = 0.16, 95%CI -0.16 to 0.48, *p* = 0.33, Q-test *p* = 0.73 Recognition hits: SMD = 0.07, 95%CI -0.31 to 0.47, *p* = 0.69, Q-test *p* = 0.50 *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;* SMD = 0.35, 95%CI 0.14 to 0.55, *p* = 0.001, Q-test *p* = 0.06	
Consistency	Consistent for all except WAIS verbal IQ for bipolar disorder
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	**Language performance in people with schizophrenia tested on two 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 that people with schizophrenia may show improved performance on the similarities task (verbal conception formation).**

Language
Significant small effect size suggests that people with schizophrenia showed improved performance on the similarities task (verbal conception formation) at retest compared with baseline;   4 studies, N = 152, *g* = 0.36, 95%CI 0.13 to 0.59, *p* < 0.05   *No significant difference was reported for;*   Vocabulary skills: 4 studies, N = 73, *g* = 0.10, 95%CI -0.23 to 0.42, *p* > 0.05   Boston Naming Test: 4 studies, N = 437, *g* = -0.02, 95%CI -0.17 to 0.11, *p* > 0.05

Consistency	Consistent
Precision	Precise
Directness	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	**Language in people with schizophrenia who smoke vs. people with schizophrenia who don't smoke.**
Summary of evidence	**Moderate to high quality evidence (large sample, inconsistent, precise, direct) suggests no differences in language ability.**

Language
Repeatable Battery for Neuropsychological Status (RBANS) test
No significant difference between groups;   2 studies, N = 739, SMD = -0.13, 95%CI -0.30 to 0.36, *p* = 0.86, I^2 = 69%

Consistency	Inconsistent
Precision	Precise

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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	Verbal fluency 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 (medium-sized samples, consistent, precise, direct) shows greater improvements in verbal fluency in patients receiving second generation antipsychotics compared with first generation antipsychotics. Moderate quality evidence (unable to assess precision) suggests patients receiving quetiapine, olanzapine, or clozapine may show improvements post treatment, however patients receiving risperidone may show no improvement.

Verbal fluency

Greater improvements in verbal fluency were reported for patients receiving second generation antipsychotics compared with patients receiving first generation antipsychotics;

15 studies, N= 449, g = 0.16, 95%CI 0.02 to 0.30, p = 0.024, Q-test p > 0.05

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

Quetiapine: 6 studies, N = 107, g = 0.63, (CI not reported), p < 0.006, Q-test p > 0.05

Clozapine: 15 studies, N = 319, g = 0.44, (CI not reported), p < 0.006, Q-test p > 0.05

Olanzapine: 11 studies, N = 651, g = 0.25, (CI not reported), p < 0.006, Q-test p > 0.05

Patients receiving risperidone showed no significant improvement post medication;

Risperidone: 5 studies, N = 207, g = 0.06, (CI not reported), p > 0.05, Q-test p > 0.05

Language

Consistency	Consistent
Precision	Precise for first vs. second generation antipsychotics, unable to assess pre-post comparison.
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	**Language 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, mostly precise, direct) shows improvements on verbal learning and delayed verbal recall post treatment with haloperidol, but no improvements in verbal fluency.**

Verbal learning
Significant, small effect size of improved verbal learning performance post-treatment;
All studies: 11 studies, N = 538, g = 0.32, 95%CI 0.19 to 0.43, $p < 0.05$
Low dose: 6 studies, N = 371, g = 0.37, 95%CI 0.23 to 0.51, $p < 0.05$
High dose: 5 studies, n = 167, g = 0.20, 95%CI 0.00 to 0.40, $p < 0.05$

Delayed verbal recall
Significant, small effect size of improved delayed verbal recall performance post-treatment;
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, $p < 0.05$

Verbal fluency

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No improvements on COWA or CIGT post treatment; COWA All studies: 12 studies, N = 553, *g* = 0.05, 95%CI -0.07 to 0.17, *p* < 0.05 Low dose: 6 studies, N = 372, *g* = 0.04, 95%CI -0.10 to 0.18, *p* < 0.05 High dose: 5 studies, N = 154, *g* = 0.00, 95%CI -0.21 to 0.21, *p* < 0.05 CIGT All studies: 5 studies, N = 349, *g* = -0.09, 95%CI -0.24 to 0.06, *p* < 0.05 Low dose: 4 studies, N = 330, *g* = -0.06, 95%CI -0.21 to 0.09, *p* < 0.05 High dose: 1 study, N = 19, *g* = -0.68, 95%CI -1.33 to 0.05, *p* < 0.05	
Consistency	Authors report all results are consistent (using fixed effects model).
Precision	Imprecise for CIGT high dose only.
Directness	Direct

Explanation of acronyms

AVLT = Auditory Verbal Learning Test, BPRS = Brief Psychotic Rating Scale, CI = Confidence Interval, COWA = Controlled Oral Word Association Test, CIGT = Category Instance Generation Test, CPT = Continuous Performance Task, CVLT = California Verbal Learning Test, *d* = Cohen's *d* and *g* = Hedges' *g* = standardised mean differences (see below for interpretation of effect size), ES = effect size, GORT = Grey Oral Reading Test, HVLT = Hopkins Verbal Learning Test, I² = 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, MATRICS = Measurement and Treatment Research to Improve Cognition in Schizophrenia, MWT-B = Multiple Choice Vocabulary Test, N = number of participants, NART = National Adult Reading Test, *p* = statistical probability of obtaining that result (*p* < 0.05 generally regarded as significant), PIAT = Peabody Individual Achievement Test Reading and Comprehension, 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), , Q_w = test for within group differences (heterogeneity in study results within a group of studies – measure of study consistency), *r* = correlation coefficient, RBANS = Repeatable Battery for the Assessment of Neuropsychological Status, RCT = Randomised Controlled Trial, SANS = Scale for Assessment of Negative Symptoms, SAPS = Scale for Assessment of Positive Symptoms, SE = standard error, SMD = Standardised Mean Difference, SOA = Stimulus Onset Asynchrony, vs. = versus, WAIS-R = Wechsler Adult Intelligence Scale – Revised, WCST = Wisconsin Card Sorting Task, WISC = Wechsler Intelligence Scale for Children, WRAT = Wide Range Achievement Test, μ_p = estimated average correlation in the population

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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 small[36].

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† 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 effect.[36]

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[37]. lnOR stands for logarithmic OR where a lnOR of 0 shows no difference between groups. Hazard ratios

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 unforseen 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. I² 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. I² can be calculated from Q (chi-square) for the test of heterogeneity with the following formula;[36]

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

§ 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.[38]

‖ 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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