Supplementary Online Content

Loughrey DG, Kelly ME, Kelley GA, Brennan S, Lawlor BA. The association of age-related hearing loss with cognitive function, cognitive impairment, and dementia: a systematic review and meta-analysis. *JAMA Otolaryngol*. Published online December 7, 2017. doi:10.1001/jamaoto.2017.2513

This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Search Terms and Results

PubMed		
Terms	**Returns – 26.08.2015**	**New returns – 15.04.2016**
("hearing") AND ("cognition") AND ("older adults" OR "elderly")	282	11
("hearing") AND ("dementia") AND ("older adults" OR "elderly")	156	11
("hearing") AND ("alzheimer's disease") AND ("older adults" OR "elderly")	29	15
Total	467	37/504
Cochrane Library		
Terms	**Returns – 26.08.2015**	**New returns – 15.04.2016**
("hearing") AND ("cognition") AND ("older adults" OR "elderly")	12	6
("hearing") AND ("dementia") AND ("older adults" OR "elderly")	11	2
("hearing") AND ("alzheimer's disease") AND ("older adults" OR "elderly")	1	0
Total	24	8/32
EMBASE – (mapping – limit to terms indexed in article as major focus)		
Terms	**Returns – 26.08.2015**	**New returns – 15.04.2016**
("hearing") AND ("cognition") AND ("older adults" OR "elderly")	13	1
("hearing") AND ("dementia") AND ("older adults" OR "elderly")	0	0
("hearing") AND ("alzheimer's disease") AND ("older adults" OR "elderly")	1	0
Total	14	1/15
SCOPUS		
Terms	**Returns – 26.08.2015**	**New returns – 15.04.2016**
("hearing") AND ("cognition") AND ("older adults" OR "elderly")	714	42
("hearing") AND ("dementia") AND ("older adults" OR "elderly")	418	22
("hearing") AND ("alzheimer's disease") AND ("older adults" OR "elderly")	72	5
Total	1204	69/1273
Results		
Total	1709	115/1824
After removing duplicates	1075	82
Other sources	57	-
After removing articles found in original search/additional records	-	53
Total	1132	1185

eTable 2. Planned Variables for Sensitivity Analyses

Moderator analysis (categorical variables)
1. Study characteristics
Country/region in which the study was conducted (*Australia, Europe, USA, other*)
2. Subject characteristics
Race *(single, mixed or not declared*)
Participants with any of the following risks factors were removed from the sample either at baseline or in analysis (*cognitive impairment, dementia, cardiovascular risk, cerebrovascular risk, & neurological risk*) (*yes or no*)
3. Audiometric factors
Ear used
Hearing loss decibel (dB) criteria (e.g. >25dB);
Frequency range (e.g. > 4kHz)
Sound-treated room or booth used (*yes or no*)
Audiometric criteria followed WHO criteria (*yes or no*)
Hearing aid users were removed (*yes or no*)
4. Cognitive measures
Cognitive test used
Test stimuli were accessible to a hearing loss sample e.g. visual (*yes or no*)
5. Statistical analysis
Type of statistical analysis
Authors reported results as significant (*yes or no*)
Analysis/design controlled or adjusted for covariates (*yes or no*) – age, sex, race, education, occupation, income, vascular factors (stroke, hypertension, diabetes, cardiovascular and cerebrovascular disease), body mass index (BMI), alcohol intake, smoking, depression, hearing aid users, pre-morbid intelligence, and processing speed.
Meta-regression (continuous variables)
1. Study characteristics
Year of publication
Attrition rate (*cohort studies only*)
Time to final follow-up (*cohort studies only*)
Journal impact factor
STROBE score (*0-22*)
2. Subject characteristics
Age (*mean, minimum and maximum age of sample*)
Gender *(% female*)
Race *(% white, black or other*)
Education *(% primary, secondary or tertiary*)
Occupation *(% manual or professional*)
Low income (*%*)
Alcohol intake (*mean unit*)
Smoking *(% current, previous or never*)
3. Audiometric factors
Pure-tone average (PTA) dB of sample
Hearing loss rate (*% of participants diagnosed as having a hearing loss by study authors*)
Hearing aid user (*%*)

eTable 3. Hearing Loss and Cognitive Function: Main Cross-sectional Results

Variable	Studies (*n*)	Outcomes (*n*)*	ES (*n*)	Participants (*n*)	*r*	95% CI	Fisher's Z	Std. Err.	Z(*p*)	Q(*p*)	I^2 (%)
Attention	9	16	11	5,159	-0.156	-0.237, -0.073	-0.157	0.043	**-3.64 (<0.001)**	79.9 (<0.001)	87.5
Delayed recall	6	7	7	3,808	-0.098	-0.157, -0.037	-0.098	0.031	**-3.13 (0.002)**	17.1 (0.01)	64.8
Fluency	7	15	9	4,629	-0.081	-0.121, -0.041	-0.081	0.02	**-3.97 (<0.001)**	11.6 (0.2)	30.8
Global cognition	13	15	15	7,702	-0.146	-0.182, -0.109	-0.147	0.019	**-7.55 (<0.001)**	31.0 (0.01)	54.8
Immediate recall	13	20	15	6,747	-0.143	-0.19, -0.088	-0.144	0.029	**-5.01 (<0.001)**	72.1 (<0.001)	80.6
Processing speed	18	45	20	10,660	-0.128	-0.176, -0.079	-0.128	0.025	**-5.08 (<0.001)**	127.4 (<0.001)	85.1
Reasoning	9	20	12	3,128	-0.178	-0.253, -0.101	-0.18	0.04	**-4.55 (<0.001)**	45.9 (<0.001)	76.0
Semantic memory	8	11	10	2,906	-0.141	-0.204, -0.076	-0.142	0.033	**-4.23 (<0.001)**	26.3 (0.002)	65.8
Visuospatial ability	3	8	5	669	-0.107	-0.185, -0.027	-0.107	0.041	**-2.63 (0.01)**	4.3 (0.4)	7.3
Working memory	7	15	9	4,855	-0.098	-0.148, -0.047	-0.098	0.026	**-3.73 (<0.001)**	18.1 (0.02)	55.9
Overall	26	172	113	15,620	-0.122	-0.139, -0.105	-0.123	0.009	**-13.97 (<0.001)**	482.0 (<0.001)	76.8

Notes: ES, effect size; CI, confidence interval; +, number of effect sizes prior to collapsing them for analysis; Std. Err., standard error;

eTable 4. Hearing Loss and Cognitive Function: Results of Further Analysis for Cross-sectional Studies

Variable	Egger's test of the intercept					One study removed		Cumulative analysis
	β_0	95% CI	t	df	*p* (1-tailed)	Study	Point difference smallest/largest (%)	Significant since
Attention	-3.11	-7.26, 1.04	1.7	9	0.06	ND	0.046 (26.6)	1960
Delayed recall	*NA*	*NA*	*NA*	*NA*	*NA*	ND	0.048 (41.4)	2005
Fluency	*NA*	*NA*	*NA*	*NA*	*NA*	ND	0.036 (37.1)	1986
Global cognition	-0.71	-2.41, 0.999	0.89	13	0.19	ND	0.026 (16.6)	1983
Immediate recall	0.56	-3.7, 4.82	0.29	13	0.39	ND	0.032 (20.8)	1960
Processing speed	-2.09	-5.07, 0.88	1.48	18	0.08	ND	0.023 (16.8)	1960
Reasoning	-2.13	-5.65, 1.4	1.34	10	0.1	ND	0.041 (21.1)	1960
Semantic memory	3.87	0.66, 7.09	2.78	8	**0.01**	ND	0.035 (22.4)	1967
Visuospatial ability	*NA*	*NA*	*NA*	*NA*	*NA*	Clark (1960)	0.064 (44.1)	1960
Working memory	*NA*	*NA*	*NA*	*NA*	*NA*	ND	0.041 (36.0)	1983

Notes: β_0, intercept; CI, confidence interval; df, degrees of freedom; ND (no difference), means results remained statistically significant when each study was deleted from the model once; NA, not applicable.

eTable 5. Hearing Loss and Cognitive Function: Main Cohort Results

Variable	Studies (*n*)	Outcomes (*n*)*	ES (*n*)	Participants (*n*)	*r*	95% CI	Fisher's Z	Std. Err.	Z(*p*)	Q(*p*)	I^2 (%)
Attention	1	2	1	391	-0.1	-0.197, 0.0	-0.1	0.051	**-1.98 (0.048)**	0.0 (>0.99)	0.0
Delayed recall	3	5	4	1,774	-0.101	-0.147, -0.054	-0.101	0.024	**-4.14 (<0.001)**	2.1 (0.55)	0.0
Fluency	3	4	4	1,233	-0.067	-0.139, 0.006	-0.067	0.037	-1.79 (0.07)	7.1 (0.07)	57.5
Global cognition	4	7	6	4,227	-0.139	-0.189, -0.089	-0.14	0.026	**-5.36 (<0.001)**	18.9 (0.002)	73.5
Immediate recall	5	7	6	4,225	-0.061	-0.102, -0.02	-0.061	0.021	**-2.91 (0.004)**	40.7 (<0.001)	87.7
Processing speed	7	15	10	6,462	-0.084	-0.136, -0.031	-0.084	0.027	**-3.12 (0.002)**	285.9 (<0.001)	96.9
Reasoning	1	1	1	1,057	-0.064	-0.124, -0.003	-0.064	0.031	**-2.08 (0.04)**	0.00 (>0.99)	0.00
Semantic memory	1	3	1	707	-0.141	-0.23, -0.05	-0.142	0.047	**-3.01 (0.003)**	0.00 (>0.99)	0.00
Overall	9	44	33	8,233	-0.09	-0.112, -0.068	-0.09	0.01	**-8.74 (<0.001)**	552.8 (<0.001)	94.2

Notes: ES, effect size; CI, confidence interval; +, number of effect sizes prior to collapsing them for analysis; Std. Err., standard error;

eTable 6. Hearing Loss and Cognitive Function: Results of Further Analysis for Cohort Studies

Variable	Egger's test of the intercept					One study removed		Cumulative analysis
	β_0	95% CI	t	df	*p* (1-tailed)	Study	Point difference smallest/largest (%)	Significant since
Attention	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Delayed recall	*NA*	*NA*	*NA*	*NA*	*NA*	ND	0.025 (21.6)	2005
Fluency	*NA*	*NA*	*NA*	*NA*	*NA*	Deal et al. (2015)	0.061 (58.7)	Not sig.
Global cognition	*NA*	*NA*	*NA*	*NA*	*NA*	ND	0.039 (24.5)	2012
Immediate recall	*NA*	*NA*	*NA*	*NA*	*NA*	ND	0.05 (60.2)	2003
Processing speed	-4.03	-9.5, 1.41	1.71	8	0.06	ND	0.029 (31.2)	2003
Reasoning	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
Semantic memory	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

Notes: β_0, intercept; CI, confidence interval; df, degrees of freedom; ND (no difference), means results remained statistically significant when each study was deleted from the model; +, results were non-significant and became significant with this study (mild hearing loss vs normal hearing subgroup) removed;

eTable 7. Hearing Loss and Clinical Outcomes: Main Cross-sectional and Cohort Results

Variable	Studies (*n*)	ES (*n*)	Participants (*n*)	Cases (*n/%*)	Odds Ratio	95% CI	Z(*p*)	Q(*p*)	I^2 (%)
CS/Cognitive impairment	5	5	6,553	797 (12.2)	2.003	1.385 – 2.894	**3.70 (<0.001)**	23.7 (<0.001)	83.1
Co/Cognitive impairment	3	3	6,825	1395 (20.4)	1.215	1.088 – 1.358	**3.45 (<0.001)**	0.11 (0.95)	0.00
CS/Dementia + AD	2	2	679	59 (8.7)	2.421	1.242 – 4.719	**2.60 (0.01)**	0.40 (0.53)	0.00
CS/Dementia	1	1	245	39 (15.9)	2.833	1.242 – 6.464	**2.47 (0.01)**	*NA*	*NA*
CS/AD	1	1	434	20 (4.6)	1.799	0.578 – 5.595	1.01 (0.31)	*NA*	*NA*
Co/Dementia	3	3	3,439	366 (10.6)	1.277	1.024 – 1.594	**2.17 (0.03)**	6.61 (0.04)	69.74
Co/AD	2	2	1,491	78 (5.2)	1.694	0.717 – 4.003	1.20 (0.23)	3.65 (0.06)	72.64
Co/VaD	1	1	870	38 (4.4)	2.4	0.989 – 5.824	1.94 (0.053)	*NA*	*NA*

Notes: Co, Cohort; CS, Cross-sectional; ES, effect size; CI, confidence interval;

eTable 8. Hearing Loss and Cognitive Function: Moderator Analysis for Cross-sectional and Cohort Studies

Moderator	Attention (CS)	Delayed recall (CS)	Fluency (CS)	Global cognition (CS)	Immediate recall (CS)	Processing speed (CS)	Reasoning (CS)	Semantic memory (CS)	Working memory (CS)	Global cognition (Co)	Immediate recall (Co)	Processing speed (Co)
Country/Region	**4.02 (0.045)**	0.06 (0.8)	-	1.15 (0.28)	0.04 (0.85)	**7.88 (0.02)**	-	3.23 (0.2)	**4.33 (0.04)**	-	-	0.44 (0.51)
CI removed (BL)	-	-	-	3.64 (0.06)	-	**5.52 (0.02)**	-	-	-	-	-	**12.6 (<0.001)**
Dementia removed (BL)	-	-	0.06 (0.8)	**5.02 (0.03)**	0.85 (0.36)	2.42 (0.12)	-	-	-	-	-	1.06 (0.3)
CVR removed (BL)	-	-	-	**5.28 (0.02)**	-	-	-	-	-	-	-	-
Race	-	-	-	**5.17 (0.02)**	-	**7.47 (0.01)**	-	-	-	-	-	-
Ear used	2.15 (0.14)	-	0.079 (0.78)	2.82 (0.09)	0.28 (0.59)	**4.32 (0.04)**	1.92 (0.17)	3.29 (0.07)	1.51 (0.22)	-	-	-
Frequencies >4kHz	-	-	0.001 (0.97)	0.05 (0.82)	**4.76 (0.03)**	**4.59 (0.03)**	1.87 (0.17)	0.002 (0.96)	-	-	-	-
Sound-treated booth/room	**7.47 (0.01)**	0.01 (0.94)	0.02 (0.89)	0.48 (0.49)	**4.04 (0.04)**	**8.04 (0.01)**	2.78 (0.1)	3.29 (0.07)	0.01 (0.93)	-	-	0.41 (0.52)
Used WHO criteria	**7.47 (0.01)**	0.01 (0.94)	-	**6.34 (0.01)**	2.15 (0.14)	**10.02 (0.002)**	-	3.29 (0.07)	-	-	-	0.41 (0.52)
Hearing loss criteria (>25dB)	-	-	-	0.26 (0.61)	-	-	-	-	-	-	-	0.44 (0.51)
Hearing aid user removed*	2.87 (0.09)	-	0.03 (0.87)	1.14 (0.29)	**3.99 (0.046)**	3.5 (0.06)	-	**3.88 (0.049)**	-	-	**27.12 (<0.001)**	0.65 (0.42)
Cognitive test accessible	**6.59 (0.01)**	0.06 (0.81)	-	0.5 (0.48)	0.88 (0.35)	-	0.24 (0.62)	-	-	-	-	-
Analysis used	**32.26 (<0.0001)**	-	-	3.82 (0.15)	1.21 (0.27)	**10.67 (0.01)**	-	-	**6.16 (0.01)**	-	-	-
Reported significant	**8.75 (0.003)**	**10.75 (0.001)**	**11.84 (0.001)**	0.004 (0.95)	**13.67 (<0.0001)**	**10.12 (0.001)**	**27.59 (<0.001)**	-	**8.13 (0.004)**	1.89 (0.17)	-	**28.32 (<0.001)**
CI removed*	-	-	-	-	-	-	-	-	-	-	-	**20.9 (<0.001)**
Dementia removed*	-	-	-	-	-	-	-	-	-	-	-	**23.63 (<0.001)**
Age*	**37.96 (<0.0001)**	-	**4.01 (0.045)**	-	1.54 (0.22)	**4.57 (0.03)**	1.92 (0.17)	1.86 (0.17)	0.4 (0.53)	-	-	-
Sex*	**37.96 (<0.0001)**	-	-	**6.34 (0.01)**	2.11 (0.15)	**4.09 (0.04)**	0.69 (0.41)	0.52 (0.47)	-	-	-	-
Race*	2.94 (0.09)	-	-	**8.96 (0.003)**	-	**7.47 (0.01)**	-	3.29 (0.07)	-	-	-	0.41 (0.52)
Education (level/years)*	**4.58 (0.03)**	-	0.69 (0.41)	**7.03 (0.01)**	1.0 (0.32)	**4.06 (0.04)**	-	3.29 (0.07)	-	-	-	-
Education (level)*	-	-	-	1.21 (0.27)	1.85 (0.17)	3.38 (0.07)	-	-	-	-	**27.12 (<0.001)**	0.65 (0.42)
Education (years)*	-	-	-	**6.25 (0.01)**	-	-	-	-	-	-	-	-
Vascular risk factors*	2.94 (0.09)	1.07 (0.3)	-	**8.96 (0.003)**	0.89 (0.35)	**7.45 (0.01)**	-	3.29 (0.07)	-	-	-	0.41 (0.52)
Stroke*	-	-	-	**8.08 (0.004)**	0.89 (0.35)	**7.45 (0.01)**	-	-	-	-	-	0.65 (0.42)
Hypertension*	2.94 (0.09)	-	-	**8.96 (0.003)**	0.94 (0.33)	**7.47 (0.01)**	-	3.29 (0.07)	-	-	-	0.41 (0.52)
Diabetes*	-	-	-	**8.08 (0.004)**	0.94 (0.33)	**7.47 (0.01)**	-	-	-	-	-	0.65 (0.42)
Current smokers*	3.27 (0.07)	-	-	**6.34 (0.01)**	2.15 (0.14)	**8.33 (0.004)**	-	3.29 (0.07)	-	-	-	0.41 (0.52)
Previous smokers*	3.27 (0.07)	-	-	**6.34 (0.01)**	2.15 (0.14)	**8.33 (0.004)**	-	3.29 (0.07)	-	-	-	0.41 (0.52)
Depression*	**7.42 (0.01)**	0.01 (0.94)	-	2.84 (0.09)	-	-	-	-	-	-	-	0.34 (0.56)

Pre-morbid IQ*	1.53 (0.22)	1.25 (0.26)	-	-	-	-	-	-	-	**7.53 (0.006)**	-	0.5 (0.48)
Study site*	-	-	-	-	**5.34 (0.02)**	**6.7 (0.01)**	-	-	-	-	-	0.65 (0.42)

Notes: BL, baseline; Co, cohort study; CI, cognitive impairment; CS, cross-sectional study; CVR, cardiovascular risks; IQ, intelligence quotient; *, adjusted/controlled for in design/analysis;

eTable 9. Hearing Loss and Cognitive Function: Meta-regression Analysis for Cross-sectional and Cohort Studies

Covariate	Attention (CS)	Delayed recall (CS)	Fluency (CS)	Global cognition (CS)	Immediate recall (CS)	Processing speed (CS)	Reasoning (CS)	Semantic memory (CS)	Visuospatial ability (CS)	Working memory (CS)	Delayed recall (Co)	Fluency (Co)	Global cognition (Co)	Immediate recall (Co)	Processing speed (Co)
Year of publication	**5.47 (<0.001)**	-0.52 (0.6)	1.2 (0.23)	0.34 (0.74)	1.57 (0.12)	**4.61 (<0.0001)**	**3.97 (0.0001)**	1.26 (0.21)	1.93 (0.053)	**3.41 (0.001)**	-0.23 (0.82)	1.37 (0.17)	0.55 (0.58)	**6.12 (<0.001)**	0.45 (0.65)
Impact factor	-0.19 (0.85)	-1.04 (0.3)	-0.91 (0.36)	1.6 (0.11)	0.74 (0.46)	0.92 (0.36)	-0.02 (0.98)	0.57 (0.57)	-	-1.12 (0.26)	0.35 (0.73)	**2.12 (0.03)**	**-2.35 (0.02)**	0.86 (0.39)	**-4.94 (<0.0001)**
STROBE	-0.35 (0.73)	-1.08 (0.28)	0.43 (0.67)	0.54 (0.59)	0.39 (0.7)	0.07 (0.95)	-1.32 (0.19)	0.26 (0.8)	1.5 (0.13)	**2.88 (0.004)**	-0.39 (0.7)	1.94 (0.053)	**2.41 (0.02)**	**4.65 (<0.0001)**	0.74 (0.46)
Length to follow-up (yrs)	-	-	-	-	-	-	-	-	-	-	-0.22 (0.82)	1.24 (0.21)	**2.61 (0.009)**	-1.14 (0.25)	0.74 (0.46)
Age (mean BL)	0.42 (0.67)	0.09 (0.93)	-0.71 (0.48)	0.26 (0.8)	0.32 (0.75)	-0.19 (0.85)	0.33 (0.74)	0.01 (0.996)	-	-0.87 (0.38)	-0.05 (0.96)	-1.75 (0.08)	**-2.69 (0.007)**	0.51 (0.61)	-0.62 (0.54)
Age (min BL)	**2.63 (0.01)**	0.49 (0.62)	-1.93 (0.054)	0.24 (0.81)	0.99 (0.32)	1.85 (0.06)	**2.52 (0.01)**	-0.13 (0.9)	0.85 (0.39)	-0.5 (0.62)	0.03 (0.97)	-1.78 (0.08)	**-2.53 (0.01)**	1.37 (0.17)	-0.36 (0.72)
Age (max BL)	0.46 (0.65)	-0.36 (0.72)	0.02 (0.98)	-0.74 (0.46)	-0.46 (0.64)	-0.15 (0.88)	0.26 (0.79)	-0.35 (0.73)	0.39 (0.7)	0.13 (0.9)	-	-1.92 (0.054)	-1.87 (0.06)	-	0.09 (0.92)
Sex (% female BL)	0.8 (0.43)	0.56 (0.58)	0.19 (0.85)	0.33 (0.74)	1.12 (0.26)	0.65 (0.52)	-0.04 (0.97)	-0.29 (0.77)	1.02 (0.31)	1.9 (0.06)	-	-	-	-	-
Sex (% female FU)	-	-	-	-	-	-	-	-	-	-	-0.21 (0.83)	-	-0.11 (0.91)	0.74 (0.46)	-0.15 (0.88)
Race (% white)	0.93 (0.35)	-	-	-0.91 (0.37)	**-2.0 (0.046)**	-0.68 (0.5)	-	-	-	-	-	-	1.01 (0.31)	-	0.05 (0.96)
Race (% black)	-0.86 (0.39)	-	-	0.92 (0.36)	**1.99 (0.047)**	1.55 (0.12)	-	-	-	-	-	-	-1.01 (0.31)	-	-0.05 (0.96)
Race (% other)	-1.18 (0.24)	-	-	-0.86 (0.39)	-1.65 (0.1)	-0.98 (0.33)	-	-	-	-	-	-	-	-	-
Education (mean years)	-	-	-	-0.59 (0.56)	-	0.46 (0.65)	-	-	-	-	-	-	-	-	-
Education (% primary)	-	-	-	0.02 (0.98)	-0.79 (0.43)	**-3.23 (0.001)**	-	-	-	-	-	-	-	-	0.07 (0.94)
Education (% secondary)	-	-	-	-0.12 (0.91)	0.35 (0.73)	0.45 (0.65)	-	-	-	-	-	-	-	-	-0.75 (0.45)
Education (% tertiary)	**5.74 (<0.0001)**	-	-	-0.05 (0.96)	**3.07 (0.002)**	**7.18 (<0.0001)**	-	1.79 (0.07)	-	-	-	-	-1.18 (0.24)	-	-0.16 (0.87)
Current smoker (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6 (0.55)
Previous smoker (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-3.56 (0.0004)**
Never smoked (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2.32 (0.02)**
Sample PTA	**2.93 (0.003)**	0.04 (0.97)	-0.53 (0.6)	-0.28 (0.78)	**2.05 (0.04)**	0.35 (0.72)	1.79 (0.07)	-0.52 (0.6)	0.3 (0.77)	0.35 (0.73)	-0.66 (0.51)	-	0.3 (0.76)	-	0.56 (0.58)
Hearing loss (%)	0.93 (0.35)	0.33 (0.74)	0.93 (0.35)	0.35 (0.73)	**2.74 (0.01)**	0.51 (0.61)	-	-	-	-0.75 (0.45)	-	-	-	-	-
Hearing aid user (%)	0.41 (0.68)	-0.02 (0.99)	-0.47 (0.64)	-0.21 (0.83)	0.57 (0.57)	-0.92 (0.36)	-	-	-	-	-	-	-	-	-0.54 (0.59)

Notes: Positive values indicate a weaker effect size (Fisher's Z). BL, baseline; Co, cohort study; CI, cognitive impairment; CS, cross-sectional study; FU, follow-up; IQ, intelligence quotient; PTA, pure-tone average;

MODERATOR ANALYSIS

eTable 10. Cognitive Function-Attention Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Europe	4	1341	-0.284 (0.091)	-0.462, -0.107	**4.02 (0.045)**
- USA	5	1669	-0.094 (0.028)	-0.149, -0.04	
Ear used					
- Better	6	3927	-0.095 (0.036)	-0.165, -0.025	2.15 (0.14)
- Both	5	1232	-0.24 (0.092)	-0.421, -0.06	
Sound-treated booth/room					
- No	7	2517	-0.22 (0.062)	-0.341, -0.099	**7.47 (0.01)**
- Yes	4	2642	-0.043 (0.019)	-0.081, -0.005	
Used WHO criteria					
- No	7	2517	-0.22 (0.062)	-0.341, -0.099	**7.47 (0.01)**
- Yes	4	2642	-0.043 (0.019)	-0.081, -0.005	
Hearing aid user removed					
- Not declared	5	1716	-0.249 (0.086)	-0.418, -0.079	2.87 (0.09)
- No	6	3443	-0.088 (0.039)	-0.164, -0.012	
Cognitive test accessible					
- No	3	506	-0.022 (0.042)	-0.105, 0.061	**6.59 (0.01)**
- Yes	9	4833	-0.189 (0.049)	-0.285, -0.092	
Analysis used					
- Correlation	4	1033	-0.347 (0.048)	-0.442, -0.252	**32.26**
- Linear regression	5	3800	-0.057 (0.016)	-0.088. -0.025	**(<0.0001)**
Reported significant					
- No	6	3232	-0.043 (0.017)	-0.077, -0.009	**8.75 (0.003)**
- Yes	5	2172	-0.259 (0.071)	-0.398, -0.12	
Controlled for age					
- No	3	642	-0.395 (0.042)	-0.477, -0.313	**37.96**
- Yes	8	4517	-0.085 (0.028)	-0.14, -0.03	**(<0.0001)**
Controlled for sex					
- No	3	642	-0.395 (0.042)	-0.477, -0.313	**37.96**
- Yes	8	4517	-0.085 (0.028)	-0.14, -0.03	**(<0.0001)**
Controlled for race					
- No	7	3592	-0.21 (0.07)	-0.347, -0.074	2.94 (0.09)
- Yes	4	1567	-0.083 (0.025)	-0.133, -0.034	
Controlled for education (level or years)					
- No	4	822	-0.293 (0.091)	-0.471, -0.116	**4.58 (0.03)**
- Yes	7	4337	-0.089 (0.031)	-0.149, -0.029	
Controlled for vascular risk factors					
- No	7	3592	-0.21 (0.07)	-0.347, -0.074	2.94 (0.09)
- Yes	4	1567	-0.083 (0.025)	-0.133, -0.034	
Controlled for hypertension					
- No	7	3592	-0.21 (0.07)	-0.347, -0.074	2.94 (0.09)
- Yes	4	1567	-0.083 (0.025)	-0.133, -0.034	
Controlled for current smokers					
- No	8	4486	-0.193 (0.056)	-0.302, -0.084	3.27 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Controlled for previous smokers					
- No	8	4486	-0.193 (0.056)	-0.302, -0.084	3.27 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Controlled for depression					
- No	7	1970	-0.225 (0.062)	-0.347, -0.103	**7.42 (0.01)**
- Yes	4	3189	-0.049 (0.018)	-0.083, -0.014	

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Controlled for pre-morbid IQ					
- No	7	2473	-0.198 (0.062)	-0.319, -0.078	1.53 (0.22)
- Yes	4	2686	-0.091 (0.061)	-0.211, 0.029	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences; WHO, World Health Organisation; IQ, intelligence quotient.

eTable 11. Cognitive Function–Delayed Recall Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Europe	3	1254	-0.124 (0.054)	-0.229, -0.019	0.06 (0.8)
- USA	3	585	-0.106 (0.049)	-0.202, -0.01	
Sound-treated booth/room					
- No	4	1513	-0.101 (0.046)	-0.191, -0.011	0.01 (0.94)
- Yes	3	2295	-0.096 (0.051)	-0.195, 0.003	
Used WHO criteria					
- No	4	1513	-0.101 (0.046)	-0.191, -0.011	0.01 (0.94)
- Yes	3	2295	-0.096 (0.051)	-0.195, 0.003	
Cognitive test accessible					
- No	4	1038	-0.108 (0.031)	-0.168, -0.047	0.06 (0.81)
- Yes	3	2770	-0.092 (0.058)	-0.205, 0.021	
Reported significant					
- No	4	2796	-0.038 (0.019)	-0.075, -0.001	**10.75 (0.001)**
- Yes	3	1012	-0.167 (0.035)	-0.236, -0.099	
Controlled for vascular risk factors					
- No	4	3029	-0.076 (0.045)	-0.164, 0.012	1.07 (0.3)
- Yes	3	779	-0.135 (0.035)	-0.202, -0.067	
Controlled for depression					
- No	4	1513	-0.101 (0.046)	-0.191, -0.011	0.01 (0.94)
- Yes	3	2295	-0.096 (0.051)	-0.195, 0.003	
Controlled for pre-morbid IQ					
- No	3	1122	-0.064 (0.03)	-0.122, -0.005	1.25 (0.26)
- Yes	4	2686	-0.135 (0.056)	-0.245, -0.025	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences; WHO, World Health Organisation; IQ, intelligence quotient.

eTable 12. Cognitive Function–Fluency Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Dementia participants removed					
- Not declared	6	3576	-0.084 (0.023)	-0.13, -0.039	0.06 (0.8)
- Yes	3	1053	-0.071 (0.049)	-0.166, 0.025	
Ear used					
- Better	6	3094	-0.075 (0.026)	-0.126, -0.025	0.079 (0.78)
- Both	3	1535	-0.088 (0.037)	-0.16, -0.016	
Frequencies >4kHz included					
- No	7	4135	-0.09 (0.024)	-0.138, -0.043	0.001 (0.97)
- Yes	3	1535	-0.089 (0.04)	-0.167, -0.01	
Sound-treated booth/room					
- No	3	885	-0.086 (0.045)	-0.174, 0.002	0.02 (0.89)
- Yes	6	3744	-0.079 (0.025)	-0.128, -0.03	
Hearing aid user removed					
- Not declared	4	566	-0.088 (0.042)	-0.171, -0.005	0.03 (0.87)
- No	5	4063	-0.079 (0.028)	-0.135, -0.024	
Reported significant					
- No	8	3197	-0.044 (0.018)	-0.079, -0.009	**11.84 (0.001)**
- Yes	4	1700	-0.147 (0.024)	-0.195, -0.1	
Controlled for age					
- No	4	1428	-0.129 (0.027)	-0.181, -0.077	**4.01 (0.045)**
- Yes	5	3201	-0.057 (0.024)	-0.105, -0.009	
Controlled for education (level or years)					
- No	6	1922	-0.105 (0.023)	-0.15, -0.06	0.69 (0.41)
- Yes	3	2707	-0.067 (0.039)	-0.145, -0.01	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences;

eTable 13. Cognitive Function–Global Cognition Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Europe	4	1060	-0.136 (0.031)	-0.197, -0.076	1.15 (0.28)
- USA	8	3857	-0.099 (0.016)	-0.13, -0.068	
Cognitively impaired participants removed					
- Not declared	9	4758	-0.155 (0.025)	-0.203, -0.107	3.64 (0.06)
- Yes	5	2788	-0.096 (0.019)	-0.133, -0.059	
Dementia participants removed					
- Not declared	9	4853	-0.159 (0.024)	-0.205, -0.112	**5.02 (0.03)**
- Yes	5	2693	-0.09 (0.019)	-0128, -0.053	
Cardiovascular risks removed					
- Not declared	10	3407	-0.163 (0.028)	-0.218, -0.108	**5.28 (0.02)**
- No	3	2310	-0.084 (0.02)	-0.124, -0.044	
Race					
- Mixed	4	3484	-0.102 (0.02)	-0.141, -0.062	**5.17 (0.02)**
- Not declared	9	3892	-0.177 (0.027)	-0.229, -0.125	
Ear used					
- Better	7	4656	-0.105 (0.014)	-0.134, -0.077	2.82 (0.09)
- Both	7	1408	-0.185 (0.045)	-0.274, -0.097	
Frequencies >4kHz included					
- No	10	7005	-0.148 (0.023)	-0.193, -0.104	0.05 (0.82)
- Yes	5	697	-0.138 (0.038)	-0.213, -0.063	
Sound-treated booth/room					
- No	9	3106	-0.13 (0.018)	-0.166, -0.095	0.48 (0.49)
- Yes	6	4596	-0.159 (0.038)	-0.233, -0.085	
Used WHO criteria					
- No	11	5045	-0.166 (0.023)	-0.212, -0.121	**6.34 (0.01)**
- Yes	4	2657	-0.091 (0.019)	-0.128, -0.053	
Hearing loss criteria					
- >25dB	3	2453	-0.175 (0.083)	-0.338, -0.012	0.26 (0.61)
- Continuous	10	3453	-0.131 (0.017)	-0.165, -0.098	
Hearing aid user removed					
- Not declared	5	1966	-0.117 (0.023)	-0.162, -0.073	1.14 (0.29)
- No	9	5477	-0.156 (0.028)	-0.211, -0.101	
Cognitive test accessible					
- No	12	7340	-0.15 (0.021)	-0.192, -0.109	0.5 (0.48)
- Yes	3	362	-0.11 (0.053)	-0.214, -0.005	
Analysis used					
- Correlation	6	956	-0.153 (0.033)	-0.217, -0.089	3.82 (0.15)
- Linear mixed models	3	2310	-0.084 (0.02)	-0.124, -0.044	
- Linear regression	4	2497	-0.123 (0.02)	-0.162, -0.084	
Reported significant					
- No	6	2481	-0.158 (0.02)	-0.196, -0.119	0.004 (0.95)
- Yes	9	5221	-0.16 (0.028)	-0.215, -0.105	
Controlled for sex					
- No	6	2848	-0.196 (0.034)	-0.262, -0.13	**6.34 (0.01)**
- Yes	9	4854	-0.104 (0.014)	-0.132, -0.076	
Controlled for race					
- No	10	4151	-0.178 (0.024)	-0.225, -0.132	**8.96 (0.003)**
- Yes	5	3551	-0.092 (0.017)	-0.124, -0.059	
Controlled for education (level or years)					
- No	8	2895	-0.196 (0.032)	-0.258, -0.134	**7.03 (0.01)**
- Yes	7	4807	-0.104 (0.014)	-0.132, -0.076	
Controlled for education (years)					
- No	12	5615	-0.158 (0.026)	-0.209, -0.107	1.21 (0.27)
- Yes	3	2087	-0.12 (0.022)	-0.163, -0.077	

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Controlled for education (level)					
- No	11	4982	-0.167 (0.023)	-0.213, -0.121	**6.25 (0.01)**
- Yes	4	2720	-0.092 (0.019)	-0.128, -0.055	
Controlled for vascular risk factors					
- No	10	4151	-0.178 (0.024)	-0.225, -0.132	**8.96 (0.003)**
- Yes	5	3551	-0.092 (0.017)	-0.124, -0.059	
Controlled for stroke					
- No	12	4477	-0.168 (0.021)	-0.21, -0.126	**8.08 (0.004)**
- Yes	3	3225	-0.09 (0.018)	-0.124, -0.055	
Controlled for hypertension					
- No	10	4151	-0.178 (0.024)	-0.225, -0.132	**8.96 (0.003)**
- Yes	5	3551	-0.092 (0.017)	-0.124, -0.059	
Controlled for diabetes					
- No	12	4477	-0.168 (0.021)	-0.21, -0.126	**8.08 (0.004)**
- Yes	3	3225	-0.09 (0.018)	-0.124, -0.055	
Controlled for current smokers					
- No	11	5045	-0.166 (0.023)	-0.212, -0.121	**6.34 (0.01)**
- Yes	4	2657	-0.091 (0.019)	-0.128, -0.053	
Controlled for previous smokers					
- No	11	5045	-0.166 (0.023)	-0.212, -0.121	**6.34 (0.01)**
- Yes	4	2657	-0.091 (0.019)	-0.128, -0.053	
Controlled for depression					
- No	12	6482	-0.161 (0.024)	-0.207, -0.114	2.84 (0.09)
- Yes	3	1220	-0.099 (0.027)	-0.153, -0.046	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences; WHO, World Health Organisation.

eTable 14. Cognitive Function–Immediate Recall Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Europe	8	3329	-0.128 (0.028)	-0.183, -0.074	0.04 (0.85)
- USA	5	2399	-0.121 (0.027)	-0.174, -0.069	
Dementia participants removed					
- Not declared	9	4185	-0.162 (0.046)	-0.252, -0.072	0.85 (0.36)
- Yes	6	2562	-0.115 (0.022)	-0.158, -0.072	
Ear used					
- Better	6	3141	-0.126 (0.021)	-0.167, -0.085	0.28 (0.59)
- Both	9	3606	-0.155 (0.05)	-0.253, -0.057	
Frequencies >4kHz included					
- No	11	5197	-0.166 (0.036)	-0.237, -0.095	**4.76 (0.03)**
- Yes	5	2591	-0.076 (0.19)	-0.114, -0.038	
Sound-treated booth/room					
- No	11	4303	-0.166 (0.037)	-0.238, -0.094	**4.04 (0.04)**
- Yes	4	2444	-0.082 (0.02)	-0.121, -0.043	
Used WHO criteria					
- No	12	5344	-0.157 (0.035)	-0.225, -0.088	2.15 (0.14)
- Yes	3	1403	-0.091 (0.027)	-0.145, -0.038	
Hearing aid user removed					
- Not declared	7	2734	-0.2 (0.049)	-0.296, -0.104	**3.99 (0.046)**
- No	7	3560	-0.093 (0.021)	-0.134, -0.052	
Cognitive test accessible					
- No	8	4316	-0.176 (0.044)	-0.262, -0.09	0.88 (0.35)
- Yes	9	2971	-0.127 (0.028)	-0.183, -0.072	
Analysis used					
- Correlation	9	3587	-0.176 (0.046)	-0.267, -0.085	1.21 (0.27)
- Linear regression	4	2104	-0.117 (0.027)	-0.17, -0.064	
Reported significant					
- No	6	2668	-0.061 (0.019)	-0.098, -0.023	**13.67**
- Yes	7	3083	-0.159 (0.018)	-0.195, -0.123	**(<0.001)**
Controlled for age					
- No	6	2702	-0.197 (0.066)	-0.327, -0.067	1.54 (0.22)
- Yes	9	4045	-0.111 (0.018)	-0.147, -0.076	
Controlled for sex					
- No	7	2155	-0.19 (0.054)	-0.297, -0.084	2.11 (0.15)
- Yes	8	4592	-0.107 (0.019)	-0.145, -0.068	
Controlled for education (level or years)					
- No	8	3196	-0.172 (0.053)	-0.276, -0.068	1.0 (0.32)
- Yes	7	3551	-0.114 (0.022)	-0.158, -0.071	
Controlled for education (level)					
- No	10	4437	-0.167 (0.04)	-0.245, -0.089	1.85 (0.17)
- Yes	5	2310	-0.1 (0.029)	-0.158, -0.043	
Controlled for vascular risk factors					
- No	10	3997	-0.16 (0.044)	-0.247, -0.073	0.89 (0.35)
- Yes	5	2750	-0.114 (0.019)	-0.153, -0.076	
Controlled for stroke					
- No	10	3997	-0.16 (0.044)	-0.247, -0.073	0.89 (0.35)
- Yes	5	2750	-0.114 (0.019)	-0.153, -0.076	
Controlled for hypertension					
- No	11	4450	-0.157 (0.04)	-0.235, -0.079	0.94 (0.33)
- Yes	4	2297	-0.112 (0.025)	-0.16, -0.064	
Controlled for diabetes					
- No	11	4450	-0.157 (0.04)	-0.235, -0.079	0.94 (0.33)
- Yes	4	2297	-0.112 (0.025)	-0.16, -0.064	

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Controlled for current smokers					
- No	12	5344	-0.157 (0.035)	-0.225, -0.088	2.15 (0.14)
- Yes	3	1403	-0.091 (0.027)	-0.145, -0.038	
Controlled for previous smokers					
- No	12	5344	-0.157 (0.035)	-0.225, -0.088	2.15 (0.14)
- Yes	3	1403	-0.091 (0.027)	-0.145, -0.038	
Controlled for study site					
- No	12	4650	-0.165 (0.034)	-0.231, -0.098	**5.34 (0.02)**
- Yes	3	2097	-0.072 (0.021)	-0.114, -0.03	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences;

eTable 15. Cognitive Function–Processing Speed Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Australia	5	3348	-0.107 (0.08)	-0.263, 0.05	**7.88 (0.02)**
- Europe	8	3329	-0.185 (0.043)	-0.27, -0.099	
- USA	7	4983	-0.058 (0.014)	-0.086, -0.031	
Cognitively impaired participants removed					
- Not declared	16	8466	-0.143 (0.032)	-0.206, -0.081	**5.52 (0.02)**
- Yes	3	2741	-0.056 (0.019)	-0.094, -0.018	
Dementia participants removed					
- Not declared	13	7114	-0.154 (0.037)	-0.225, -0.082	2.42 (0.12)
- Yes	7	4546	-0.083 (0.028)	-0.137, -0.028	
Race					
- Mixed	6	4881	-0.054 (0.014)	-0.082, -0.027	**7.47 (0.01)**
- Not declared	14	6779	-0.162 (0.037)	-0.234, -0.09	
Ear used					
- Better	9	7694	-0.075 (0.019)	-0.112, -0.038	**4.32 (0.04)**
- Both	11	3966	-0.174 (0.043)	-0.259, -0.088	
Frequencies >4kHz included					
- No	14	9750	-0.15 (0.033)	-0.214, -0.086	**4.59 (0.03)**
- Yes	7	2951	-0.07 (0.017)	-0.104, -0.036	
Sound-treated booth/room					
- No	13	4663	-0.171 (0.039)	-0.247, -0.094	**8.04 (0.01)**
- Yes	7	6997	-0.056 (0.012)	-0.078, -0.033	
Used WHO criteria					
- No	14	5704	-0.166 (0.035)	-0.234, -0.097	**10.02 (0.002)**
- Yes	6	5956	-0.047 (0.013)	-0.072, -0.023	
Hearing aid user removed					
- Not declared	9	3094	-0.188 (0.054)	-0.293, -0.083	3.5 (0.06)
- No	10	8113	-0.082 (0.019)	-0.118, -0.045	
Analysis used					
- Correlation	9	3587	-0.205 (0.049)	-0.302, -0.108	**10.67 (0.01)**
- Linear mixed models	3	3040	-0.038 (0.017)	-0.072, -0.005	
- Linear regression	8	5033	-0.071 (0.014)	-0.099, -0.043	

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Reported significant					
- No	14	9133	-0.053 (0.01)	-0.073, -0.032	**10.12 (0.001)**
- Yes	6	3466	-0.213 (0.049)	-0.309, -0.116	
Controlled for age					
- No	6	2702	-0.229 (0.068)	-0.362, -0.095	**4.57 (0.03)**
- Yes	14	8958	-0.079 (0.015)	-0.108, -0.05	
Controlled for sex					
- No	7	2155	-0.211 (0.062)	-0.332, -0.089	**4.09 (0.04)**
- Yes	13	9505	-0.081 (0.015)	-0.111, -0.052	
Controlled for race					
- No	14	6779	-0.162 (0.037)	-0.234, -0.09	**7.47 (0.01)**
- Yes	6	4881	-0.054 (0.014)	-0.082, -0.027	
Controlled for education (level or years)					
- No	10	3556	-0.18 (0.048)	-0.273, -0.087	**4.06 (0.04)**
- Yes	10	8104	-0.077 (0.018)	-0.112, -0.042	
Controlled for education (level)					
- No	12	4797	-0.162 (0.04)	-0.241, -0.084	3.38 (0.07)
- Yes	8	6863	-0.078 (0.022)	-0.121, -0.035	
Controlled for vascular risk factors					
- No	13	6326	-0.169 (0.039)	-0.247, -0.092	**7.45 (0.01)**
- Yes	7	5334	-0.056 (0.013)	-0.082, -0.03	
Controlled for stroke					
- No	13	6326	-0.169 (0.039)	-0.247, -0.092	**7.45 (0.01)**
- Yes	7	5334	-0.056 (0.013)	-0.082, -0.03	
Controlled for hypertension					
- No	14	6779	-0.162 (0.037)	-0.234, -0.09	**7.47 (0.01)**
- Yes	6	4881	-0.054 (0.014)	-0.082, -0.027	
Controlled for diabetes					
- No	14	6779	-0.162 (0.037)	-0.234, -0.09	**7.47 (0.01)**
- Yes	6	4881	-0.054 (0.014)	-0.082, -0.027	
Controlled for current smokers					
- No	15	7673	-0.156 (0.034)	-0.222, -0.09	**8.33 (0.004)**
- Yes	5	3987	-0.049 (0.015)	-0.079, -0.019	
Controlled for previous smokers					
- No	15	7673	-0.156 (0.034)	-0.222, -0.09	**8.33 (0.004)**
- Yes	5	3987	-0.049 (0.015)	-0.079, -0.019	
Controlled for study site					
- No	15	7399	-0.15 (0.033)	-0.214, -0.086	**6.7 (0.01)**
- Yes	4	4081	-0.055 (0.017)	-0.089, -0.021	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences; WHO, World Health Organisation.

eTable 16. Cognitive Function–Reasoning Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Ear used					
- Better	4	646	-0.114 (0.041)	-0.195, -0.032	1.92 (0.17)
- Both	8	2482	-0.207 (0.054)	-0.313, -0.102	
Frequencies >4kHz included					
- No	9	2454	-0.194 (0.051)	-0.294, -0.095	1.87 (0.17)
- Yes	4	1715	-0.106 (0.04)	-0.184, -0.027	
Sound-treated booth/room					
- No	8	1700	-0.208 (0.053)	-0.312, -0.104	2.78 (0.1)
- Yes	4	1428	-0.102 (0.035)	-0.171, -0.033	
Cognitive test accessible					
- No	3	387	-0.154 (0.051)	-0.255, -0.053	0.24 (0.62)
- Yes	9	2741	-0.189 (0.049)	-0.285, -0.093	
Reported significant					
- No	7	2169	-0.075 (0.022)	-0.117, -0.033	**27.59 (<0.001)**
- Yes	5	988	-0.304 (0.038)	-0.378, -0.23	
Controlled for age					
- No	8	2195	-0.213 (0.057)	-0.325, -0.1	1.92 (0.17)
- Yes	4	933	-0.115 (0.041)	-0.195, -0.035	
Controlled for sex					
- No	7	1520	-0.202 (0.06)	-0.32, -0.084	0.69 (0.41)
- Yes	5	1608	-0.141 (0.043)	-0.225, -0.056	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences;

eTable 17. Cognitive Function–Semantic Memory Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Australia	3	1199	-0.183 (0.083)	-0.345, -0.02	3.23 (0.2)
- Europe	4	1034	-0.152 (0.031)	-0.213, -0.091	
- USA	3	673	-0.072 (0.037)	-0.145, 0.001	
Ear used					
- Better	3	673	-0.072 (0.037)	-0.145, 0.001	3.29 (0.07)
- Both	7	2233	-0.17 (0.039)	-0.246, -0.094	
Frequencies >4kHz included					
- No	7	2232	-0.138 (0.044)	-0.224, -0.053	0.002 (0.96)
- Yes	3	674	-0.141 (0.049)	-0.237, -0.045	
Sound-treated booth/room					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Used WHO criteria					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Hearing aid user removed					
- Not declared	6	1918	-0.183 (0.042)	-0.265, -0.102	**3.88 (0.049)**
- No	4	988	-0.081 (0.031)	-0.142, -0.02	
Controlled for age					
- No	4	1559	-0.186 (0.054)	-0.291, -0.08	1.86 (0.17)
- Yes	6	1347	-0.104 (0.027)	-0.156, -0.051	
Controlled for sex					
- No	6	2053	-0.157 (0.044)	-0.243, -0.07	0.52 (0.47)
- Yes	4	853	-0.112 (0.043)	-0.197, -0.028	
Controlled for race					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Controlled for education (level or years)					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Controlled for vascular risk factors					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Controlled for hypertension					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Controlled for current smokers					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	
Controlled for previous smokers					
- No	7	2233	-0.17 (0.039)	-0.246, -0.094	3.29 (0.07)
- Yes	3	673	-0.072 (0.037)	-0.145, 0.001	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences; WHO, World Health Organisation.

eTable 18. Cognitive Function–Working Memory Cross-sectional Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Australia	3	2274	-0.032 (0.021)	-0.073, 0.01	**4.33 (0.04)**
- Europe	4	1428	-0.131 (0.043)	-0.215, -0.047	
Ear used					
- Better	6	3509	-0.128 (0.04)	-0.206, -0.05	1.51 (0.22)
- Both	3	1346	-0.069 (0.027)	-0.122, -0.015	
Sound-treated booth/room					
- No	4	1458	-0.101 (0.05)	-0.198, -0.003	0.01 (0.93)
- Yes	5	3397	-0.095 (0.034)	-0.163, -0.028	
Analysis used					
- Correlation	6	1812	-0.148 (0.038)	-0.223, -0.072	**6.16 (0.01)**
- Linear regression	3	3043	-0.042 (0.018)	-0.078, -0.007	
Reported significant					
- No	6	3565	-0.046 (0.017)	-0.079, -0.013	**8.13 (0.004)**
- Yes	6	2581	-0.159 (0.036)	-0.23, -0.088	
Controlled for age					
- No	5	1553	-0.115 (0.033)	-0.179, -0.05	0.4 (0.53)
- Yes	4	3302	-0.082 (0.041)	-0.161, -0.002	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences;

eTable 19. Cognitive Function–Global Cognition Cohort Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Reported significant					
- No	3	1186	-0.087 (0.045)	-0.174, 0.001	1.89 (0.17)
- Yes	3	3041	-0.159 (0.028)	-0.214, -0.104	
Controlled for pre-morbid IQ					
- No	3	2844	-0.183 (0.022)	-0.225, -0.14	**7.53 (0.006)**
- Yes	3	1383	-0.091 (0.025)	-0.141, -0.041	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences;

eTable 20. Cognitive Function–Immediate Recall Cohort Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Hearing aid user removed					
- Not declared	3	3113	-0.116 (0.018)	-0.151, -0.08	**27.12 (<0.001)**
- No	3	1447	-0.008 (0.01)	-0.028, 0.012	
Controlled for education (level)					
- No	3	3113	-0.116 (0.018)	-0.151, -0.08	**27.12 (<0.001)**
- Yes	3	1447	-0.008 (0.01)	-0.028, 0.012	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences;

eTable 21. Cognitive Function–Processing Speed Cohort Studies

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Country/Region					
- Europe	3	1964	-0.064 (0.023)	-0.108, -0.02	0.44 (0.51)
- USA	6	3366	-0.092 (0.036)	-0.162, -0.022	
Cognitively impaired participants removed at baseline					
- Not declared	6	2830	-0.014 (0.008)	-0.03, 0.003	**12.6 (<0.001)**
- Yes	3	3524	-0.161 (0.041)	-0.24, -0.081	
Dementia participants removed at baseline					
- Not declared	3	1383	-0.055 (0.023)	-0.101, -0.009	1.06 (0.3)
- Yes	5	3431	-0.102 (0.039)	-0.178, -0.026	
Sound-treated booth/room					
- No	4	3504	-0.067 (0.017)	-0.1, -0.034	0.41 (0.52)
- Yes	6	3366	-0.092 (0.036)	-0.162, -0.022	
Used WHO criteria					
- No	4	3504	-0.067 (0.017)	-0.1, -0.034	0.41 (0.52)
- Yes	6	3366	-0.092 (0.036)	-0.162, -0.022	
Hearing loss criteria					
- >25dB	4	2750	-0.114 (0.07)	-0.251, 0.023	0.44 (0.51)
- Continuous	4	3504	-0.067 (0.017)	-0.1, -0.034	
Hearing aid user removed					
- Not declared	3	3113	-0.062 (0.018)	-0.098, -0.027	0.65 (0.42)
- No	7	3757	-0.093 (0.033)	-0.159, -0.027	
Reported significant					
- No	7	4728	-0.024 (0.01)	-0.043, -0.004	**28.32 (<0.001)**
- Yes	3	2142	-0.182 (0.028)	-0.237, -0.127	
Cognitively impaired participants removed in analysis					
- Not declared	6	2830	-0.014 (0.008)	-0.03, 0.003	**20.9 (<0.001)**
- No	3	2500	-0.17 (0.033)	-0.234, -0.105	
Dementia participants removed in analysis					
- Not declared	4	1774	-0.063 (0.021)	-0.105, -0.021	**23.63 (<0.001)**
- No	3	2500	-0.17 (0.033)	-0.234, -0.105	
- Yes	3	2596	-0.013 (0.009)	-0.031, 0.006	
Controlled for race					
- No	4	3504	-0.067 (0.017)	-0.1, -0.034	0.41 (0.52)
- Yes	6	3366	-0.092 (0.036)	-0.162, -0.022	
Controlled for education (level)					
- No	3	3113	-0.062 (0.018)	-0.027, -0.098	0.65 (0.42)
- Yes	7	3757	-0.093 (0.033)	-0.027, -0.159	
Controlled for vascular risk factors					
- No	4	3504	-0.067 (0.017)	-0.1, -0.034	0.41 (0.52)
- Yes	6	3366	-0.092 (0.036)	-0.162, -0.022	
Controlled for stroke					
- No	6	3830	-0.066 (0.015)	-0.096, -0.036	0.65 (0.42)
- Yes	4	3040	-0.102 (0.043)	-0.186, -0.019	
Controlled for hypertension					
- No	4	3504	-0.067 (0.017)	-0.1, -0.034	0.41 (0.52)
- Yes	6	3366	-0.092 (0.036)	-0.162, -0.022	
Controlled for diabetes					
- No	6	3830	-0.066 (0.015)	-0.096, -0.036	0.65 (0.42)
- Yes	4	3040	-0.102 (0.043)	-0.186, -0.019	
Controlled for current smokers					
- No	4	3504	-0.067 (0.017)	-0.1, -0.034	0.41 (0.52)
- Yes	6	3366	-0.092 (0.036)	-0.162, -0.022	

Variable	ES (#)	Participants (#)	Fisher's Z (SE)	CI (95%)	$Q_b(p)$
Controlled for previous smokers					
- No	4	3504	-0.067 (0.017)	-0.1, -0.034	0.41 (0.52)
- Yes	6	3366	-0.092 (0.036)	-0.162, -0.022	
Controlled for depression					
- No	7	5004	-0.09 (0.032)	-0.154, -0.027	0.34 (0.56)
- Yes	3	1866	-0.068 (0.021)	-0.109, -0.027	
Controlled for pre-morbid IQ					
- No	6	5096	-0.092 (0.034)	-0.159, -0.024	0.5 (0.48)
- Yes	4	1774	-0.063 (0.021)	-0.105, -0.021	
Controlled for study site					
- No	6	3830	-0.066 (0.015)	-0.096, -0.036	0.65 (0.42)
- Yes	4	3040	-0.102 (0.043)	-0.186, -0.019	

ES, effect sizes; SE, standard error; CI, Confidence Intervals. $Q_b(p)$, Between-group differences and alpha value for between-group differences; WHO, World Health Organisation.

META-REGRESSION ANALYSIS

eTable 22. Cognitive Function–Attention Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	11	5159	0.0065 ±0.0012	0.0042, 0.0088	**5.47 (<0.001)**
Impact factor	8	4517	-0.0046 ±0.024	-0.0516, 0.0425	-0.19 (0.85)
STROBE	11	5159	-0.0048 ±0.0136	-0.0313, 0.0218	-0.35 (0.73)
Age (mean)	8	4517	0.0016 ±0.0037	-0.0058, 0.0089	0.42 (0.67)
Age (min)	9	4833	0.005 ±0.0021	0.0014, 0.0096	**2.63 (0.01)**
Age (max)	8	4486	0.0032 ±0.007	-0.0105, 0.0169	0.46 (0.65)
Sex (% female)	11	5159	0.0013 ±0.0016	-0.0019, 0.0045	0.8 (0.43)
Race (% white)	4	1567	0.005 ±0.0054	-0.0056, 0.0157	0.93 (0.35)
Race (% black)	4	1567	-0.005 ±0.0058	-0.0163, 0.0063	-0.86 (0.39)
Race (% other)	4	1567	-0.062 ±0.0527	-0.1652 , 0.0412	-1.18 (0.24)
Education (% tertiary)	4	866	0.0122 ±0.0021	0.008, 0.0164	**5.74 (<0.001)**
Sample PTA	6	2138	0.0091 ±0.0031	0.003, 0.0152	**2.93 (0.003)**
Hearing loss (%)	7	4337	0.0012 ±0.0013	-0.0013, 0.0038	0.93 (0.35)
Hearing aid user (%)	5	3275	0.0023 ±0.0057	-0.0088, 0.0135	0.41 (0.68)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 23. Cognitive Function–Delayed Recall Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	7	3808	-0.0018 ±0.0034	-0.0084, 0.0048	-0.52 (0.6)
Impact factor	6	3549	-0.0242 ±0.0232	-0.0697, 0.0213	-1.04 (0.3)
STROBE	7	3808	-0.013 ±0.012	-0.0366, 0.0106	-1.08 (0.28)
Age (mean)	7	3808	0.0003 ±0.0031	-0.0057, 0.0063	0.09 (0.93)
Age (min)	5	3482	0.001 ±0.002	-0.003, 0.005	0.49 (0.62)
Age (max)	5	3482	-0.0018 ±0.0051	-0.0118, 0.0082	-0.36 (0.72)
Sex (% female)	7	3808	0.0021 ±0.0038	-0.0054, 0.0096	0.56 (0.58)
Sample PTA	4	1170	0.0001 ±0.0035	-0.0067, 0.0069	0.04 (0.97)
Hearing loss (%)	5	3096	0.0006 ±0.0017	-0.0027, 0.0039	0.33 (0.74)
Hearing aid user (%)	4	2928	-0.0001 ±0.0058	-0.0116, 0.0114	-0.02 (0.99)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 24. Cognitive Function–Fluency Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	9	4629	0.0023 ±0.0019	-0.0015, 0.0061	1.2 (0.23)
Impact factor	6	4242	-0.0286 ±0.0313	-0.09, 0.0327	-0.91 (0.36)
STROBE	9	4629	0.0057 ±0.0133	-0.0204, 0.0318	0.43 (0.67)
Age (mean)	5	4063	-0.003 ±0.0042	-0.0111, 0.0052	-0.71 (0.48)
Age (min)	9	4629	-0.0019 ±0.001	-0.0039, -0.0000	-1.93 (0.054)
Age (max)	8	4282	0.0000 ±0.0014	-0.0028, 0.0028	0.02 (0.98)
Sex (% female)	8	4314	0.0002 ±0.0012	-0.0021, 0.0025	0.19 (0.85)
Sample PTA	7	2345	-0.0005 ±0.0007	-0.0024, 0.0014	-0.53 (0.6)
Hearing loss (%)	6	3094	0.0016 ±0.0017	-0.0017, 0.0048	0.93 (0.35)
Hearing aid user (%)	5	3094	-0.0036 ±0.0077	-0.0188, 0.0115	-0.47 (0.64)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 25. Cognitive Function–Global Cognition Cross-Sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	15	7702	0.0006 ±0.0019	-0.003, 0.0043	0.34 (0.74)
Impact factor	12	7396	0.0081 ±0.005	-0.0018, 0.018	1.6 (0.11)
STROBE	15	7702	0.0048 ±0.0089	-0.0126, 0.0223	0.54 (0.59)
Age (mean)	14	7523	0.0009 ±0.0033	-0.0057, 0.0074	0.26 (0.8)
Age (min)	12	7075	0.0003 ±0.0011	-0.0019, 0.0025	0.24 (0.81)
Age (max)	9	4244	-0.001 ±0.0014	-0.0038, 0.0017	-0.74 (0.46)
Sex (% female)	14	7387	0.0006 ±0.0018	-0.0029, 0.0041	0.33 (0.74)
Race (% white)	5	3551	-0.0012 ±0.0013	-0.0037, 0.0014	-0.91 (0.37)
Race (% black)	5	3551	0.0011 ±0.0013	-0.0013, 0.0036	0.92 (0.36)
Race (% other)	5	3551	-0.0295 ±0.0342	-0.0965 , 0.0375	-0.86 (0.39)
Education (mean years)	4	2388	-0.0149 ±0.0255	-0.0648, 0.035	-0.59 (0.56)
Education (% primary)	5	2700	0.0000 ±0.0018	-0.0034, 0.0035	0.02 (0.98)
Education (% secondary)	4	2290	-0.0005 ±0.004	-0.0082, 0.0073	-0.12 (0.91)
Education (% tertiary)	6	2616	-0.0001 ±0.0027	-0.0055, 0.0052	-0.05 (0.96)
Sample PTA	10	4234	-0.0011 ±0.0039	-0.0087, 0.0066	-0.28 (0.78)
Hearing loss (%)	8	4762	0.0005 ±0.0014	-0.0023, 0.0033	0.35 (0.73)
Hearing aid user (%)	7	3629	0.0006 ±0.0027	-0.0047, 0.0058	-0.21 (0.83)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology

eTable 26. Cognitive Function–Immediate Recall Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	15	6747	0.0026 ±0.0017	-0.0007, 0.0059	1.57 (0.12)
Impact factor	12	6105	0.0158 ±0.0212	-0.0258, 0.0574	0.74 (0.46)
STROBE	15	6747	0.0043 ±0.0112	-0.0176, 0.0262	0.39 (0.7)
Age (mean)	11	5926	0.0013 ±0.0042	-0.0069, 0.0096	0.32 (0.75)
Age (min)	15	6747	0.0013 ±0.0013	-0.0012, 0.0038	0.99 (0.32)
Age (max)	14	6400	-0.0011 ±0.0025	-0.006, 0.0037	-0.46 (0.64)
Sex (% female)	14	6432	0.0017 ±0.0015	-0.0013, 0.0046	1.12 (0.26)
Race (% white)	4	2297	-0.0026 ±0.0013	-0.0051, -0.0000	**-2.0 (0.046)**
Race (% black)	4	2297	0.0025 ±0.0013	0.000, 0.005	**1.99 (0.047)**
Race (% other)	4	2297	-0.0649 ±0.0393	-0.142, 0.0122	-1.65 (0.1)
Education (% primary)	5	2006	-0.0016 ±0.0021	-0.0057, 0.0024	-0.79 (0.43)
Education (% secondary)	4	1596	0.0061 ±0.0175	-0.0282, 0.0404	0.35 (0.73)
Education (% tertiary)	4	1596	0.0041 ±0.0013	0.0015, 0.0066	**3.07 (0.002)**
Sample PTA	7	3430	0.0014 ±0.0007	0.0001, 0.0028	**2.05 (0.04)**
Hearing loss (%)	6	3098	0.0024 ±0.0009	0.0007, 0.0041	**2.74 (0.01)**
Hearing aid user (%)	8	4013	0.0015 ±0.0026	-0.0036, 0.0066	0.57 (0.57)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology

eTable 27. Cognitive Function–Processing Speed Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	20	11660	0.0057 ±0.0012	0.0033, 0.0081	**4.61 (<0.001)**
Impact factor	17	11018	0.0072 ±0.0078	-0.0081, 0.0225	0.92 (0.36)
STROBE	20	11660	0.0006 ±0.0097	-0.0184, 0.0197	0.07 (0.95)
Age (mean)	16	10839	-0.0006 ±0.0029	-0.0063, 0.0052	-0.19 (0.85)
Age (min)	20	11660	0.0023 ±0.0012	-0.0001, 0.0047	1.85 (0.06)
Age (max)	19	11313	-0.0003 ±0.0022	-0.0047, 0.004	-0.15 (0.88)
Sex (% female)	19	11345	0.0008 ±0.0012	-0.0016, 0.0032	0.65 (0.52)
Race (% white)	6	4881	-0.0007 ±0.001	-0.0026, 0.0013	-0.68 (0.5)
Race (% black)	6	4881	0.0017 ±0.0011	-0.0005, 0.0039	1.55 (0.12)
Race (% other)	6	4881	-0.0013 ±0.0014	-0.004, 0.0013	-0.98 (0.33)
Education (mean years)	5	1726	0.0071 ±0.0157	-0.0235, 0.0378	0.46 (0.65)
Education (% primary)	7	4590	-0.0052 ±0.0016	-0.0083, -0.002	**-3.23 (0.001)**
Education (% secondary)	6	4180	0.0056 ±0.0124	-0.0187, 0.0299	0.45 (0.65)
Education (% tertiary)	6	4180	0.0085 ±0.0012	0.0061, 0.0108	**7.18 (<0.001)**
Sample PTA	11	6374	0.0004 ±0.0013	-0.002, 0.0029	0.35 (0.72)
Hearing loss (%)	8	5667	0.0006 ±0.0011	-0.0016, 0.0027	0.51 (0.61)
Hearing aid user (%)	11	8566	-0.0023 ±0.0025	-0.0071, 0.0026	-0.92 (0.36)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology

eTable 28. Cognitive Function–Reasoning Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	12	3128	0.0068 ±0.0017	0.0034, 0.0101	**3.97 (<0.001)**
Impact factor	5	1840	-0.001 ±0.0486	-0.0962, 0.0942	-0.02 (0.98)
STROBE	12	3128	-0.0165 ±0.0125	-0.041, 0.008	-1.32 (0.19)
Age (mean)	5	1920	-0.0026 ±0.008	-0.0129, 0.0182	0.33 (0.74)
Age (min)	12	3128	0.0037 ±0.0015	0.0008, 0.0065	**2.52 (0.01)**
Age (max)	12	3128	0.0006 ±0.0023	-0.0038, 0.005	0.26 (0.79)
Sex (% female)	11	2813	-0.0000 ±0.0012	-0.0025, 0.0024	-0.04 (0.97)
Sample PTA	7	1912	0.0016 ±0.0009	-0.0001, 0.0033	1.79 (0.07)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 29. Cognitive Function–Semantic Memory Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	10	2906	0.0025 ±0.002	-0.0014, 0.0065	1.26 (0.21)
Impact factor	8	2366	0.0149 ±0.0263	-0.0367, 0.0665	0.57 (0.57)
STROBE	10	2906	0.0039 ±0.0151	-0.0257, 0.0335	0.26 (0.8)
Age (mean)	7	2187	0.0001 ±0.0104	-0.0203, 0.0204	0.01 (0.996)
Age (min)	8	2580	-0.0002 ±0.0019	-0.004, 0.0036	-0.13 (0.9)
Age (max)	7	2233	-0.0009 ±0.0026	-0.0061, 0.0042	-0.35 (0.73)
Sex (% female)	9	2591	-0.0004 ±0.0013	-0.0029, 0.0022	-0.29 (0.77)
Education (% tertiary)	4	866	0.0038 ±0.0021	-0.0004, 0.008	1.79 (0.07)
Sample PTA	6	1157	-0.0023 ±0.0044	-0.011, 0.0064	-0.52 (0.6)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 30. Cognitive Function–Visuospatial Ability Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	8	669	0.0062 ±0.0032	-0.0001, 0.0125	1.93 (0.053)
STROBE	8	669	0.0273 ±0.0182	-0.0084, 0.0629	1.5 (0.13)
Age (min)	8	669	0.002 ±0.0024	-0.0026, 0.0067	0.85 (0.39)
Age (max)	8	669	0.0009 ±0.0024	-0.0037, 0.0055	0.39 (0.7)
Sex (% female)	8	669	0.001 ±0.0009	-0.0009, 0.0028	1.02 (0.31)
Sample PTA	7	567	0.0008 ±0.0028	-0.0047, 0.0064	0.3 (0.77)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 31. Cognitive Function–Working Memory Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	9	4855	0.0046 ±0.0013	0.0019, 0.0072	**3.41 (0.001)**
Impact factor	5	4209	-0.0381 ±0.0339	-0.1045, 0.0283	-1.12 (0.26)
STROBE	9	4855	0.0211 ±0.0073	0.0068, 0.0355	**2.88 (0.004)**
Age (mean)	6	4468	-0.0031 ±0.0035	-0.01, 0.0038	-0.87 (0.38)
Age (min)	9	4855	-0.0011 ±0.0023	-0.0056, 0.0033	-0.5 (0.62)
Age (max)	9	4855	0.0002 ±0.0016	-0.003, 0.0034	0.13 (0.9)
Sex (% female)	9	4855	0.0018 ±0.0009	-0.0001, 0.0036	1.9 (0.06)
Sample PTA	7	2627	0.0004 ±0.0012	-0.0019, 0.0027	0.35 (0.73)
Hearing loss (%)	5	3250	-0.0017 ±0.0022	-0.0061, 0.0027	-0.75 (0.45)

ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 32. Cognitive Function–Delayed Recall Cohort Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$SE	CI (95%)	*Z(p)*
Year of publication	4	1774	-0.0017 ±0.0074	-0.0162, 0.0128	-0.23 (0.82)
Impact factor	4	1774	0.0041 ±0.0119	-0.0192, 0.0274	0.35 (0.73)
STROBE	4	1774	-0.0156 ±0.0398	-0.0935, 0.0623	-0.39 (0.7)
Length to FU (years)	4	1774	-0.001 ±0.0044	-0.0095, 0.0076	-0.22 (0.82)
Age (mean BL)	4	1774	-0.0003 ±0.0068	-0.0136, 0.0129	-0.05 (0.96)
Age (min BL)	4	1774	0.0002 ±0.0062	-0.0119, 0.0123	0.03 (0.97)
Sex (% female FU)	4	1774	-0.0002 ±0.001	-0.0021, 0.0017	-0.21 (0.83)
Sample PTA	4	1774	-0.0044 ±0.0067	-0.0175, 0.0087	-0.66 (0.51)

BL, Baseline; ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; FU, follow-up; PTA, Pure-tone average. STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 33. Cognitive Function–Fluency Cohort Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$SE	CI (95%)	*Z(p)*
Year of publication	4	1233	0.0106 ±0.0077	-0.0046, 0.0258	1.37 (0.17)
Impact factor	4	1233	0.0479 ±0.0226	0.0036, 0.0922	**2.12 (0.03)**
STROBE	4	1233	0.0303 ±0.0156	-0.0003, 0.0608	1.94 (0.053)
Length to FU (years)	4	1233	0.0006 ±0.0049	-0.0035, 0.0155	1.24 (0.21)
Age (mean BL)	4	1233	-0.004 ±0.0023	-0.0085, 0.0005	-1.75 (0.08)
Age (min BL)	4	1233	-0.0047 ±0.0027	-0.0099, 0.0005	-1.78 (0.08)
Age (max BL)	4	1233	-0.0031 ±0.0016	-0.0063, 0.0001	-1.92 (0.054)

BL, baseline; ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; FU, follow-up; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 34. Cognitive Function–Global Cognition Cohort Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$SE	CI (95%)	*Z(p)*
Year of publication	6	4227	0.0135 ±0.0246	-0.0347, 0.0618	0.55 (0.58)
Impact factor	6	4227	-0.0132 ±0.0056	-0.0242, -0.0022	**-2.35 (0.02)**
STROBE	6	4227	0.0567 ±0.0235	0.0107, 0.1027	**2.41 (0.02)**
Length to FU (years)	6	4227	0.0064, ±0.0024	0.0016, 0.0112	**2.61 (0.009)**
Age (mean BL)	5	3367	-0.0045 ±0.0017	-0.0077, -0.0012	**-2.69 (0.007)**
Age (min BL)	6	4227	-0.0036 ±0.0014	-0.0065, -0.0008	**-2.53 (0.01)**
Age (max BL)	4	2310	-0.0067 ±0.0036	-0.0138, 0.0003	-1.87 (0.06)
Sex (% female FU)	5	3367	-0.0001 ±0.0013	-0.0026, 0.0023	-0.11 (0.91)
Race (% white)	4	2310	0.0021 ±0.0021	-0.002, 0.0061	1.01 (0.31)
Race (% black)	4	2310	-0.0021 ±0.0021	-0.0061, 0.002	-1.01 (0.31)
Education (% tertiary)	4	2310	-0.0104 ±0.0087	-0.0275, 0.0068	-1.18 (0.24)
Sample PTA	5	3367	0.0025 ±0.0083	-0.0138, 0.0188	0.3 (0.76)

BL, baseline; ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; FU, follow-up; PTA, Pure-tone average. STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 35. Cognitive Function–Immediate Recall Cohort Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$SE	CI (95%)	*Z(p)*
Year of publication	6	4225	0.0109 ±0.0018	0.0074, 0.0143	**6.12 (<0.001)**
Impact factor	6	4225	0.0097 ±0.0114	-0.0126, 0.032	0.86 (0.39)
STROBE	6	4225	0.0197 ±0.0042	0.0114, 0.028	**4.65 (<0.001)**
Length to FU (years)	6	4225	-0.0051 ±0.0045	-0.0139, 0.0037	-1.14 (0.25)
Age (mean BL)	6	4225	0.0013 ±0.0025	-0.0036, 0.0061	0.51 (0.61)
Age (min BL)	6	4225	0.0026 ±0.0019	-0.0011, 0.0062	1.37 (0.17)
Sex (% female FU)	5	3709	0.0008 ±0.0011	-0.0011, 0.0028	0.74 (0.46)

BL, baseline; ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; FU, follow-up; STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 36. Cognitive Function–Processing Speed Cohort Studies

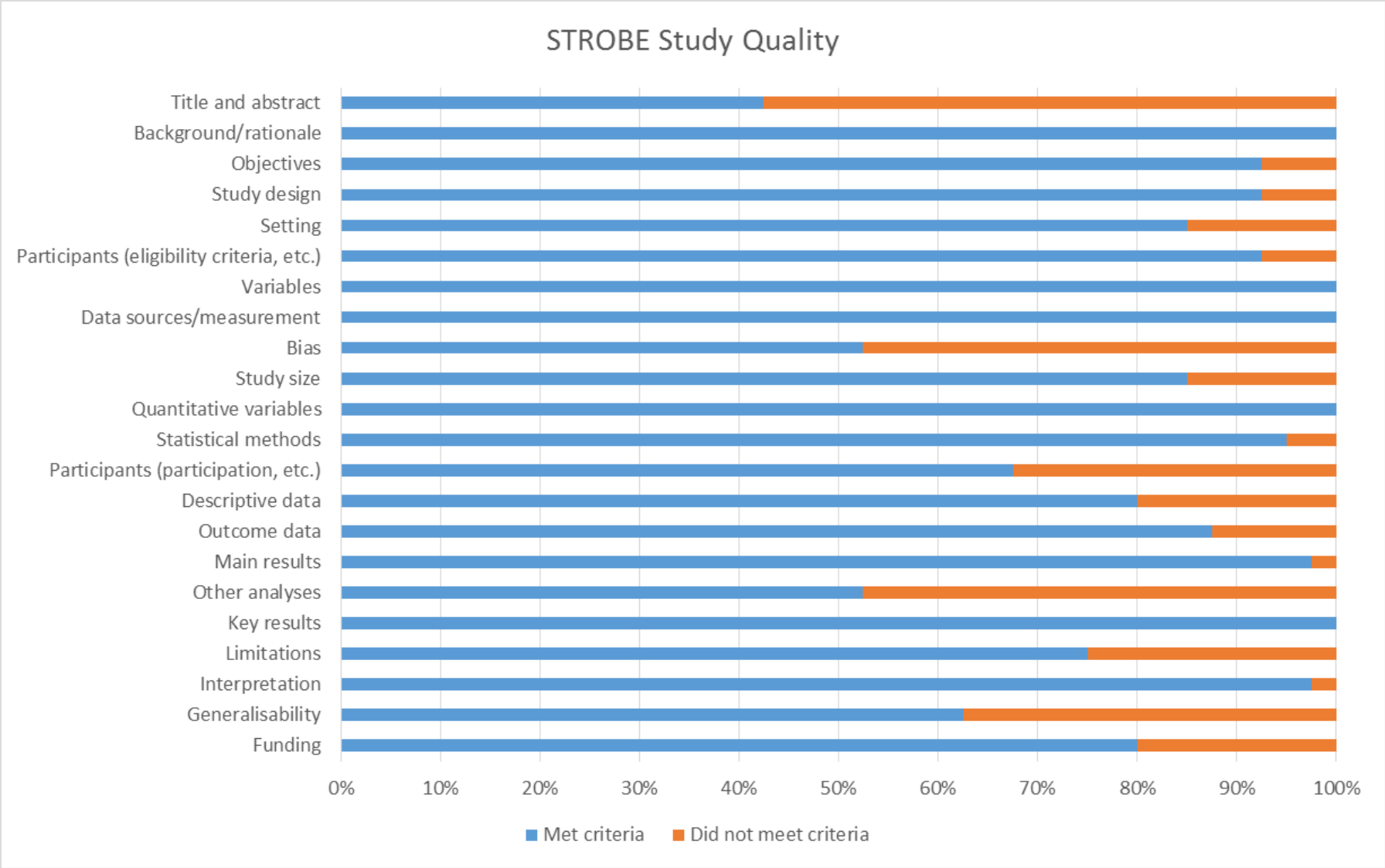
Variable	ES (#)	Participants (#)	$\beta_1 \pm$SE	CI (95%)	*Z(p)*
Year of publication	10	6462	0.0026 ±0.0057	-0.0085, 0.0137	0.45 (0.65)
Impact factor	10	6462	-0.0169 ±0.0034	-0.0236, -0.0102	**-4.94 (<0.001)**
STROBE	10	6462	0.008 ±0.0107	-0.0131, 0.029	0.74 (0.46)
Length to FU (years)	10	6462	0.0031 ±0.0042	-0.0051, 0.0114	0.74 (0.46)
Age (mean BL)	10	6462	-0.0017 ±0.0027	-0.007, 0.0037	-0.62 (0.54)
Age (min BL)	10	6462	-0.0008 ±0.0024	-0.0055, 0.0038	-0.36 (0.72)
Age (max BL)	8	3865	0.0003 ±0.0029	-0.0054, 0.0059	0.09 (0.92)
Sex (% female FU)	9	5946	-0.0002 ±0.0016	-0.0033, 0.0028	-0.15 (0.88)
Race (% white)	6	2958	0.0001 ±0.0025	-0.0048, 0.005	0.05 (0.96)
Race (% black)	6	2958	0.0001 ±0.0025	-0.005, 0.0048	-0.05 (0.96)
Education (% primary)	4	2705	0.0039 ±0.054	-0.1019, 0.1097	0.07 (0.94)
Education (% secondary)	4	2705	-0.0554 ±0.0741	-0.2006, 0.0898	-0.75 (0.45)
Education (% tertiary)	6	2958	-0.0017 ±0.0103	-0.0218, 0.0184	-0.16 (0.87)
Current smoker (%)	5	3762	0.0021 ±0.0034	-0.0047, 0.0088	0.6 (0.55)
Previous smoker (%)	4	2705	-0.022 ±0.0062	-0.0341, -0.0099	**-3.56 (<0.001)**
Never smoked (%)	4	2705	0.0198 ±0.0085	0.0031, 0.0365	**2.32 (0.02)**
Sample PTA	7	5298	0.003 ±0.0054	-0.0076, 0.0136	0.56 (0.58)
Hearing aid user (%)	6	3254	-0.0037 ±0.0069	-0.0172, 0.0098	-0.54 (0.59)

BL, baseline; ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; FU, follow-up; PTA, Pure-tone average. STROBE, Strengthening the Reporting of Observational studies in Epidemiology.

eTable 37. Cognitive Impairment Cross-sectional Studies

Variable	ES (#)	Participants (#)	$\beta_1 \pm$ SE	CI (95%)	*Z(p)*
Year of publication	5	6553	-0.0353 ±0.0937	-0.219, 0.1484	-0.38 (0.71)
Age (mean years)	5	6553	-0.0332 ±0.0428	-0.117, 0.0507	-0.78 (0.44)
Age (min)	4	6252	0.0002 ±0.0207	-0.0402, 0.0407	0.01 (0.99)
Sex (% female)	5	6553	0.0144 ±0.0205	-0.0257, 0.0546	0.7 (0.48)
PTA (mean)	4	6119	-0.0224 ±0.0241	-0.0697, 0.025	-0.93 (0.35)
Hearing loss (%)	4	2332	0.0025 ±0.0048	-0.0068, 0.0119	0.53 (0.59)
Cognitive impairment (%)	4	6118	0.0003 ±0.0131	-0.0254, 0.0259	0.02 (0.98)
Impact factor	5	6553	-0.139 ±0.0784	-0.2926, 0.0146	-1.77 (0.08)
STROBE	5	6553	0.155 ±0.172	-0.1822, 0.4922	0.9 (0.37)

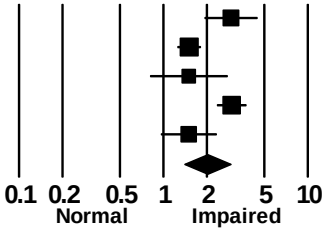
ES, effect size; $\beta_1 \pm$ SE, slope and standard error; CI, confidence interval; PTA, Pure-tone average. STROBE, Strengthening the Reporting of Observational studies in Epidemiology.



eFigure 1. Study Quality: Pooled Results Using the STROBE Instrument

SUPPLEMENTARY FOREST PLOTS

Study name	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Dupuis et al. (2015)	2.939	1.912	4.516
Kiely et al. (2012)	1.507	1.240	1.832
Kurniawan et al. (2012)	1.500	0.802	2.806
Lopez-Torres Hidalgo et al. (2009)	2.971	2.331	3.787
Quaranta et al. (2014)	1.499	0.953	2.358
	2.003	1.385	2.894



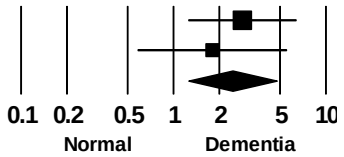
eFigure 2. Forest plot of Odds Ratios for Cognitive Impairment Cross-sectional Outcomes

The black squares represent the OR while the lines represent the corresponding 95% confidence intervals. The middle of the black diamond represents the overall OR while the left and right extremes of the diamond represent the corresponding 95% confidence intervals.

Study name	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Gallacher et al. (2012)	1.240	0.767	2.003
Kiely et al. (2012)	1.194	1.025	1.391
Lin et al. (2013)	1.240	1.044	1.472
	1.215	1.088	1.358

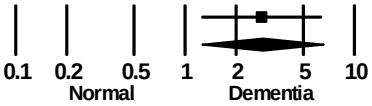
eFigure 3. Forest Plot of Odds Ratios for Cognitive Impairment Cohort Outcomes

Study name	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Herbst & Humphrey (1980)	2.833	1.242	6.464
Quaranta et al. (2014)	1.799	0.578	5.595
	2.421	1.242	4.719



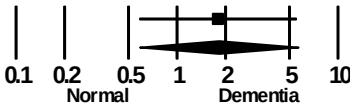
eFigure 4. Forest Plot of Odds Ratios for Dementia+AD Cross-sectional Outcomes

Studyname	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Herbst & Humphrey (1980)	2.833	1.242	6.464
	2.833	1.242	6.464



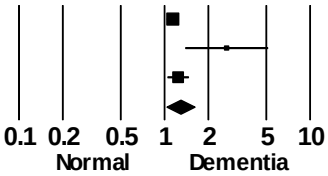
eFigure 5. Dementia Cross-sectional (Forest Plot of Odds Ratios)

Studyname	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Quaranta et al. (2014)	1.799	0.578	5.595
	1.799	0.578	5.595



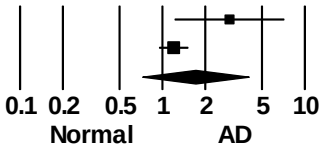
eFigure 6. AD Cross-sectional (Forest Plot of Odds Ratios)

Study name	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Deal et al. (2016)	1.140	1.031	1.261
Gallacher et al. (2012)	2.670	1.378	5.173
Lin et al. (2011c)	1.240	1.039	1.479
	1.277	1.024	1.594



eFigure 7. Forest Plot of Odds Ratios for Dementia Cohort Outcomes

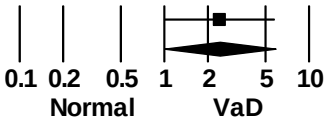
Study name	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Gallacher et al. (2012)	2.960	1.212	7.230
Lin et al. (2011c)	1.200	0.941	1.531
	1.694	0.717	4.003



eFigure 8. Forest Plot of Odds Ratios for AD Cohort Outcomes

Study name	Statistics for each study		
	Odds ratio	Lower limit	Upper limit
Gallacher et al. (2012)	2.400	0.989	5.824
	2.400	0.989	5.824

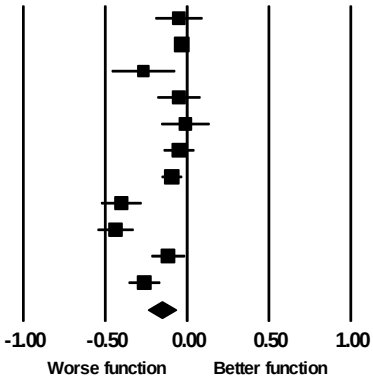
Odds ratio and 95%CI



eFigure 9. VaD Cohort (Forest Plot of Odds Ratios)

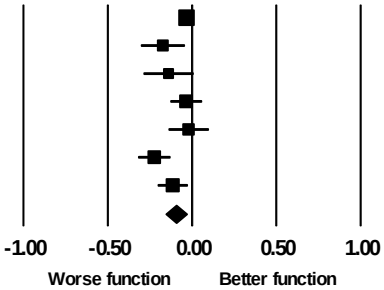
FOREST PLOTS FOR EACH COGNITIVE OUTCOME

Study name	Subgroup within study	Statistics for each study: Fisher's Z	Standard error	Lower limit	Upper limit
Anstey (1999)	None	-0.050	0.075	-0.197	0.097
Bucks et al. (2016)	None	-0.032	0.023	-0.076	0.012
Clark (1960)	None	-0.266	0.101	-0.463	-0.069
Deal et al. (2015)	Mild vs Norm	-0.050	0.069	-0.185	0.086
Deal et al. (2015)	Mod/sev vs Norm	-0.010	0.077	-0.161	0.141
Gussekloo et al. (2005)	None	-0.049	0.050	-0.146	0.048
Harrison Bush et al. (2015)	None	-0.093	0.034	-0.159	-0.027
Heron & Chown (1967)	Female	-0.401	0.065	-0.529	-0.274
Heron & Chown (1967)	Male	-0.437	0.058	-0.551	-0.323
Lin et al. (2011b)	None	-0.116	0.054	-0.222	-0.010
Valentijn et al. (2005)	None	-0.261	0.051	-0.360	-0.161
		-0.157	0.043	-0.242	-0.073



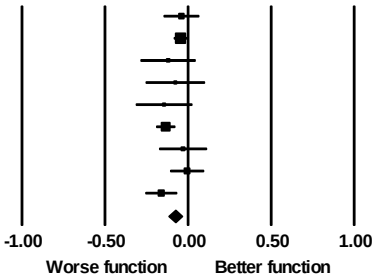
eFigure 10. Attention Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Statistics for each study: Fisher's Z	Standard error	Lower limit	Upper limit
Bucks et al. (2016)	None	-0.032	0.023	-0.076	0.012
Deal et al. (2015)	Mild vs Norm	-0.173	0.068	-0.306	-0.039
Deal et al. (2015)	Mod/sev vs Norm	-0.139	0.077	-0.291	0.013
Gussekloo et al. (2005)	None	-0.035	0.050	-0.132	0.062
Thomas et al. (1983)	None	-0.020	0.063	-0.143	0.102
Valentijn et al. (2005)	None	-0.224	0.051	-0.323	-0.124
van Boxtel et al. (2000)	None	-0.114	0.047	-0.207	-0.022
		-0.098	0.031	-0.160	-0.037



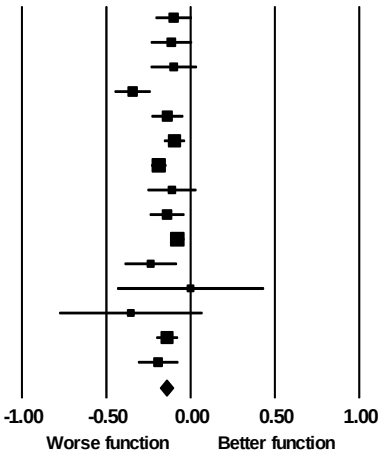
eFigure 11. Delayed Recall Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Statistics for each study: Fisher's Z	Standard error	Lower limit	Upper limit
Baltes & Lindenberger (1997)	None	-0.040	0.057	-0.151	0.071
Bucks et al. (2016)	None	-0.045	0.023	-0.089	-0.001
Era et al. (1986)	Middle	-0.120	0.086	-0.290	0.049
Era et al. (1986)	Old	-0.077	0.093	-0.259	0.105
Era et al. (1986)	Young	-0.144	0.088	-0.318	0.029
Hofer et al. (2003)	None	-0.134	0.031	-0.195	-0.073
Li et al. (1998)	None	-0.030	0.075	-0.178	0.118
Lin et al. (2011b)	None	-0.006	0.054	-0.111	0.100
Valentijn et al. (2005)	None	-0.161	0.051	-0.261	-0.062
		-0.081	0.020	-0.121	-0.041



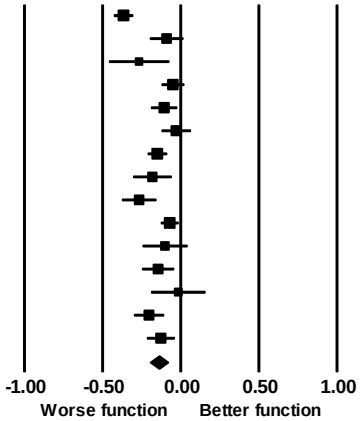
eFigure 12. Fluency Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Baltes & Lindenberger (1997)	None	-0.100	0.057	-0.211	0.011
Deal et al. (2015)	Mld vs Norm	-0.114	0.064	-0.238	0.011
Deal et al. (2015)	Mod/sev vs Norm	-0.100	0.072	-0.240	0.041
Dupuis et al. (2015)	None	-0.344	0.056	-0.453	-0.234
Gussekloo et al. (2005)	None	-0.138	0.050	-0.235	-0.041
Harrison Bush et al. (2015)	None	-0.095	0.034	-0.161	-0.030
Hong et al. (2016)	None	-0.189	0.024	-0.237	-0.141
Li et al. (1998)	None	-0.110	0.075	-0.258	0.037
Lin et al. (2011b)	None	-0.139	0.054	-0.245	-0.033
Lin et al. (2013)	None	-0.079	0.022	-0.122	-0.035
Lindenberger & Baltes (1994)	None	-0.236	0.081	-0.395	-0.078
Schaie et al. (1964)	Female	0.000	0.224	-0.438	0.438
Schaie et al. (1964)	Male	-0.354	0.218	-0.782	0.074
Sugawara et al. (2011)	None	-0.139	0.034	-0.206	-0.071
Thomas et al. (1983)	None	-0.192	0.063	-0.315	-0.070
		-0.147	0.019	-0.185	-0.109



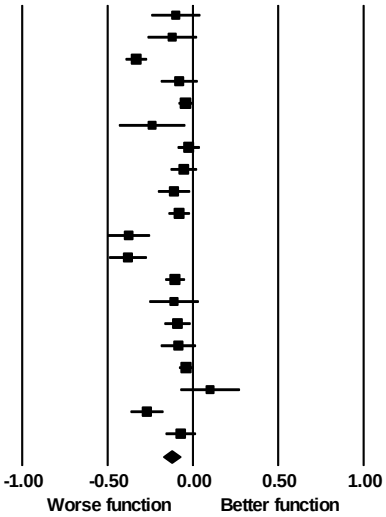
eFigure 13. Global Cognition Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Anstey et al. (2001a)	None	-0.365	0.034	-0.431	-0.300
Baltes & Lindenberger (1997)	None	-0.090	0.057	-0.201	0.021
Clark (1960)	None	-0.266	0.101	-0.463	-0.069
Deal et al. (2016)	Mld vs Norm	-0.050	0.039	-0.126	0.027
Deal et al. (2016)	Mod/sev vs Norm	-0.106	0.045	-0.194	-0.018
Gussekloo et al. (2005)	None	-0.029	0.050	-0.126	0.068
Harrison Bush et al. (2015)	None	-0.149	0.034	-0.215	-0.083
Heron & Chown (1967)	Female	-0.181	0.065	-0.308	-0.054
Heron & Chown (1967)	Male	-0.266	0.058	-0.379	-0.152
Hofer et al. (2003)	None	-0.070	0.031	-0.131	-0.009
Li et al. (1998)	None	-0.100	0.075	-0.248	0.047
Lin et al. (2011b)	None	-0.145	0.054	-0.251	-0.039
MacDonald et al. (2004)	None	-0.015	0.091	-0.192	0.162
Valentijn et al. (2005)	None	-0.203	0.051	-0.302	-0.103
van Boxtel et al. (2000)	None	-0.127	0.047	-0.219	-0.034
		-0.144	0.029	-0.201	-0.088



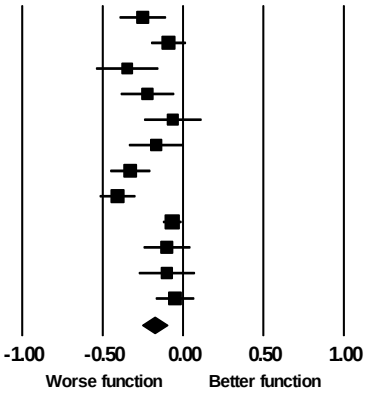
eFigure 14. Immediate Recall Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Statistics for each study			
		Fisher's Z	Standard error	Lower limit	Upper limit
Anstey & Smith (1999)	None	-0.100	0.075	-0.248	0.047
Anstey (1999)	None	-0.121	0.075	-0.268	0.026
Anstey et al. (2001a)	None	-0.332	0.034	-0.397	-0.266
Baltes & Lindenberger (1997)	None	-0.080	0.057	-0.191	0.031
Bucks et al. (2016)	None	-0.044	0.023	-0.088	0.001
Clark (1960)	None	-0.239	0.101	-0.436	-0.042
Deal et al. (2016)	Mild vs Norm	-0.025	0.035	-0.093	0.043
Deal et al. (2016)	Mod/sev vs Norm	-0.053	0.041	-0.134	0.027
Gussekloo et al. (2005)	None	-0.110	0.050	-0.208	-0.013
Harrison Bush et al. (2015)	None	-0.080	0.034	-0.146	-0.014
Heron & Chown (1967)	Female	-0.376	0.065	-0.503	-0.248
Heron & Chown (1967)	Male	-0.380	0.058	-0.494	-0.267
Hofer et al. (2003)	None	-0.105	0.031	-0.166	-0.044
Li et al. (1998)	None	-0.110	0.075	-0.258	0.037
Lin (2011a)	None	-0.090	0.041	-0.170	-0.010
Lin et al. (2011b)	None	-0.085	0.054	-0.191	0.021
Lin et al. (2013)	None	-0.040	0.022	-0.084	0.004
MacDonald et al. (2004)	None	0.100	0.091	-0.077	0.278
Valentijn et al. (2005)	None	-0.269	0.051	-0.369	-0.170
van Boxtel et al. (2000)	None	-0.071	0.047	-0.164	0.021
		-0.128	0.025	-0.178	-0.079



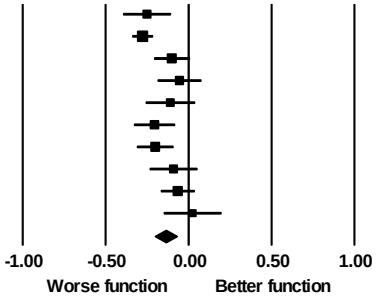
eFigure 15. Processing Speed Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Statistics for each study			
		Fisher's Z	Standard error	Lower limit	Upper limit
Anstey & Smith (1999)	None	-0.250	0.075	-0.397	-0.103
Baltes & Lindenberger (1997)	None	-0.090	0.057	-0.201	0.021
Clark (1960)	None	-0.347	0.101	-0.544	-0.150
Era et al. (1986)	Middle	-0.221	0.086	-0.390	-0.052
Era et al. (1986)	Old	-0.063	0.093	-0.245	0.119
Era et al. (1986)	Young	-0.167	0.088	-0.340	0.007
Heron & Chown (1967)	Female	-0.328	0.065	-0.456	-0.201
Heron & Chown (1967)	Male	-0.407	0.058	-0.521	-0.293
Hofer et al. (2003)	None	-0.067	0.031	-0.128	-0.006
Li et al. (1998)	None	-0.100	0.075	-0.248	0.047
MacDonald et al. (2004)	None	-0.100	0.091	-0.278	0.077
Thomas et al. (1983)	None	-0.050	0.063	-0.173	0.072
		-0.180	0.040	-0.258	-0.103



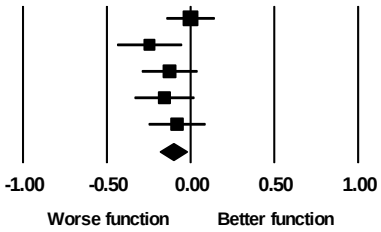
eFigure 16. Reasoning Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Anstey & Smith (1999)	None	-0.250	0.075	-0.397	-0.103
Anstey et al. (2001a)	None	-0.277	0.034	-0.343	-0.211
Baltes & Lindenberger (1997)	None	-0.100	0.057	-0.211	0.011
Deal et al. (2015)	Mld vs Norm	-0.054	0.069	-0.190	0.081
Deal et al. (2015)	Mod/sev vs Norm	-0.109	0.078	-0.262	0.043
Heron & Chown (1967)	Female	-0.205	0.065	-0.332	-0.078
Heron & Chown (1967)	Male	-0.201	0.058	-0.314	-0.087
Li et al. (1998)	None	-0.090	0.075	-0.238	0.057
Lin et al. (2011b)	None	-0.065	0.054	-0.171	0.041
MacDonald et al. (2004)	None	0.025	0.091	-0.152	0.203
		-0.142	0.033	-0.207	-0.076



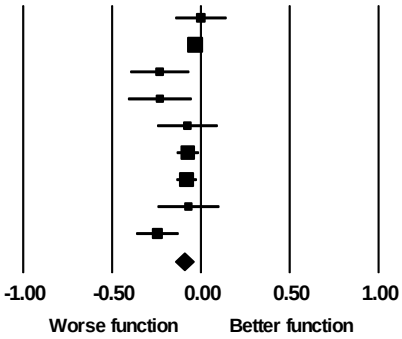
eFigure 17. Semantic Memory Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Anstey & Smith (1999)	None	0.000	0.075	-0.147	0.147
Clark (1960)	None	-0.245	0.101	-0.442	-0.048
Era et al. (1986)	Middle	-0.125	0.086	-0.294	0.044
Era et al. (1986)	Old	-0.156	0.093	-0.338	0.026
Era et al. (1986)	Young	-0.080	0.088	-0.254	0.093
		-0.107	0.041	-0.187	-0.027



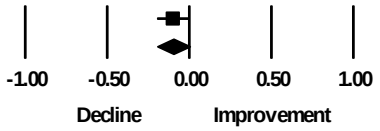
eFigure 18. Visuospatial Ability Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Anstey & Smith (1999)	None	0.000	0.075	-0.147	0.147
Bucks et al. (2016)	None	-0.032	0.023	-0.076	0.012
Era et al. (1986)	Middle	-0.232	0.086	-0.401	-0.062
Era et al. (1986)	Old	-0.231	0.093	-0.413	-0.049
Era et al. (1986)	Young	-0.076	0.088	-0.249	0.097
Harrison Bush et al. (2015)	None	-0.074	0.034	-0.139	-0.008
Hofer et al. (2003)	None	-0.080	0.031	-0.141	-0.019
MacDonald et al. (2004)	None	-0.070	0.091	-0.248	0.107
Thomas et al. (1983)	None	-0.245	0.063	-0.367	-0.122
		-0.098	0.026	-0.149	-0.046



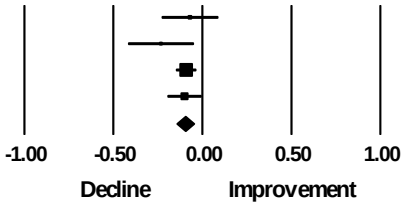
eFigure 19. Working Memory Cross-sectional Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Valentijn et al. (2005)	None	-0.100	0.051	-0.200	-0.001
		-0.100	0.051	-0.200	-0.001



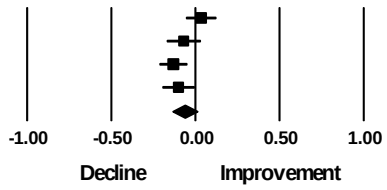
eFigure 20. Attention Cohort Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Deal et al. (2015)	Mld vs Norm	-0.069	0.083	-0.231	0.093
Deal et al. (2015)	Mod/sev vs Norm	-0.232	0.096	-0.420	-0.044
Gallacher et al. (2012)	None	-0.091	0.031	-0.152	-0.031
Valentijn et al. (2005)	None	-0.100	0.051	-0.200	-0.001
		-0.101	0.024	-0.148	-0.053



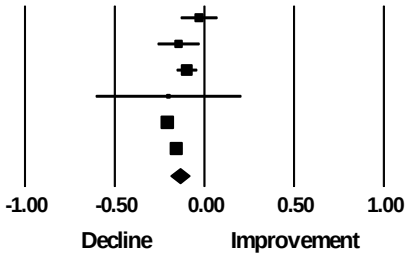
eFigure 21. Delayed Recall Cohort Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Deal et al. (2015)	Mld vs Norm	0.035	0.048	-0.059	0.128
Deal et al. (2015)	Mod/sev vs Norm	-0.070	0.053	-0.173	0.034
Lindenberger & Ghisletta (2009)	None	-0.131	0.044	-0.217	-0.044
Valentijn et al. (2005)	None	-0.100	0.051	-0.200	-0.001
		-0.067	0.037	-0.140	0.006



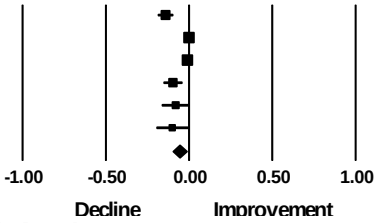
eFigure 22. Fluency Cohort Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Deal et al. (2015)	Mld vs Norm	-0.030	0.054	-0.135	0.076
Deal et al. (2015)	Mod/sev vs Norm	-0.144	0.061	-0.264	-0.024
Gallacher et al. (2012)	None	-0.098	0.031	-0.158	-0.038
Hong et al. (2016)	None	-0.201	0.208	-0.609	0.208
Lin et al. (2013)	Hearing loss	-0.206	0.015	-0.236	-0.177
Lin et al. (2013)	Normal hearing	-0.157	0.018	-0.191	-0.122
		-0.140	0.026	-0.192	-0.089



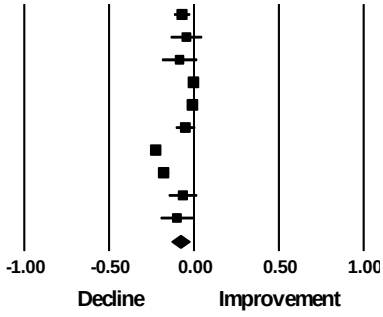
eFigure 23. Global Cognition Cohort Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Anstey et al. (2003)	None	-0.141	0.026	-0.191	-0.091
Deal et al. (2016)	Mld vs Norm	0.000	0.008	-0.015	0.015
Deal et al. (2016)	Mod/sev vs Norm	-0.009	0.009	-0.027	0.009
Gallacher et al. (2012)	None	-0.096	0.031	-0.157	-0.036
Lindenberger & Ghisletta (2009)	None	-0.080	0.044	-0.167	0.006
Valentijn et al. (2005)	None	-0.100	0.051	-0.200	-0.001
		-0.061	0.021	-0.102	-0.020



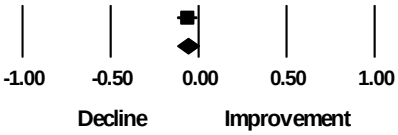
eFigure 24. Immediate Recall Cohort Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Anstey et al. (2003)	None	-0.070	0.026	-0.120	-0.020
Deal et al. (2015)	Mld vs Norm	-0.045	0.049	-0.140	0.051
Deal et al. (2015)	Mod/sev vs Norm	-0.085	0.054	-0.191	0.021
Deal et al. (2016)	Mld vs Norm	-0.002	0.005	-0.012	0.007
Deal et al. (2016)	Mod/sev vs Norm	-0.009	0.007	-0.022	0.004
Gallacher et al. (2012)	None	-0.050	0.031	-0.110	0.010
Lin et al. (2013)	Hearing loss	-0.226	0.015	-0.255	-0.196
Lin et al. (2013)	Normal hearing	-0.179	0.018	-0.213	-0.144
Lindenberger & Ghisletta (2009)	None	-0.065	0.044	-0.152	0.021
Valentijn et al. (2005)	None	-0.100	0.051	-0.200	-0.001
		-0.084	0.027	-0.137	-0.031



eFigure 25. Processing Speed Cohort Forest Plot of Fisher's *z*

Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Gallacher et al. (2012)	None	-0.064	0.031	-0.124	-0.004
		-0.064	0.031	-0.124	-0.004

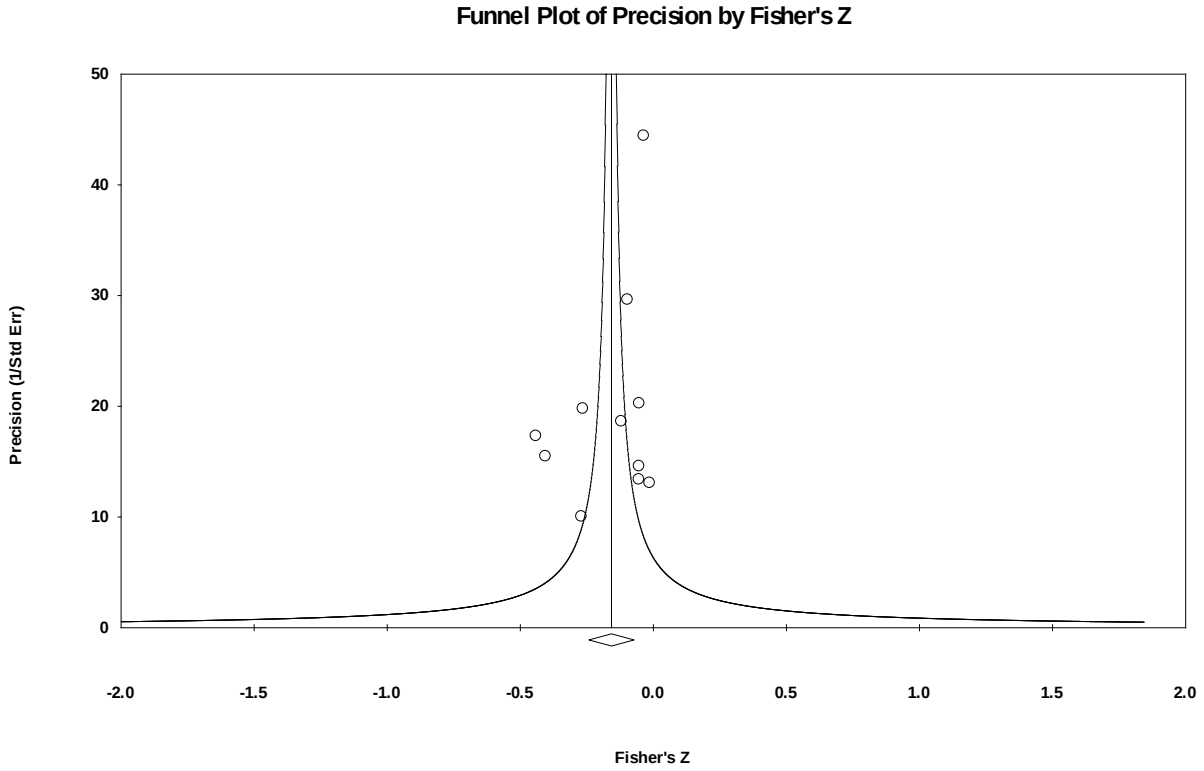


eFigure 26. Reasoning Cohort Forest Plot of Fisher's *z*

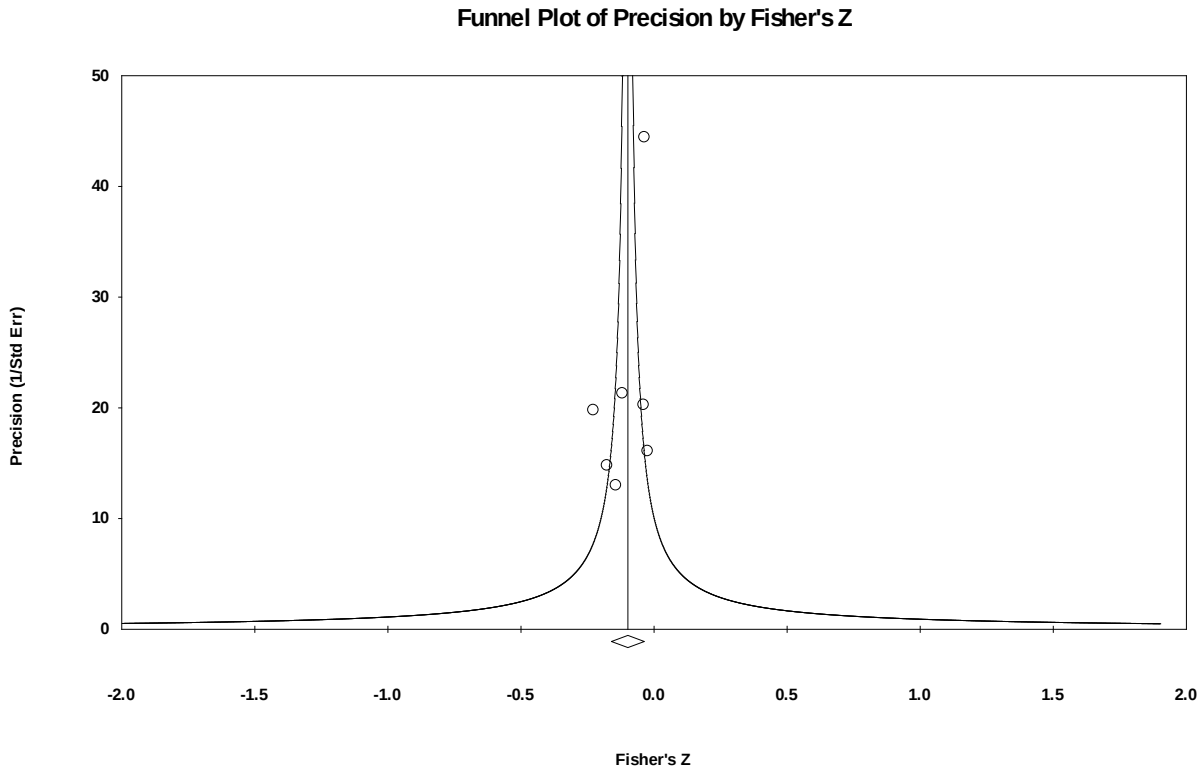
Study name	Subgroup within study	Fisher's Z	Standard error	Lower limit	Upper limit
Anstey et al. (2001b)	None	-0.142	0.047	-0.234	-0.049
		-0.142	0.047	-0.234	-0.049

eFigure 27. Semantic Memory Cohort Forest Plot of Fisher's *z*

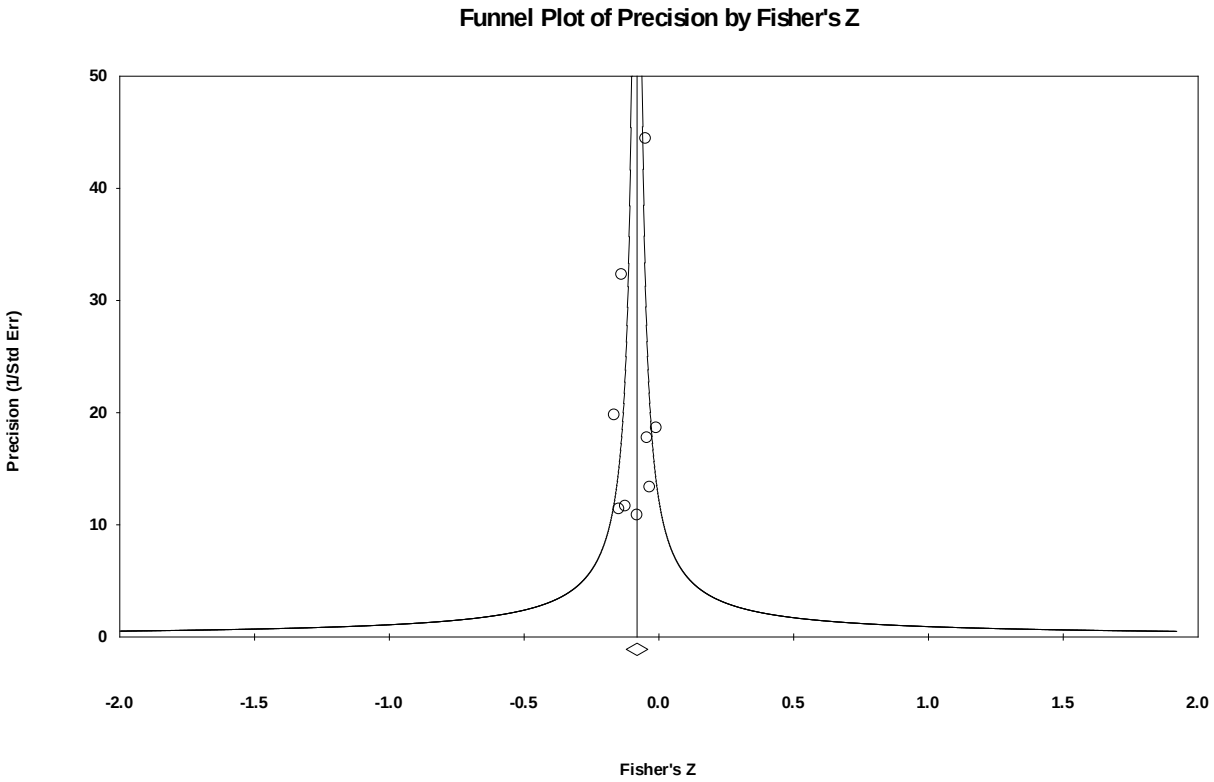
FUNNEL PLOTS



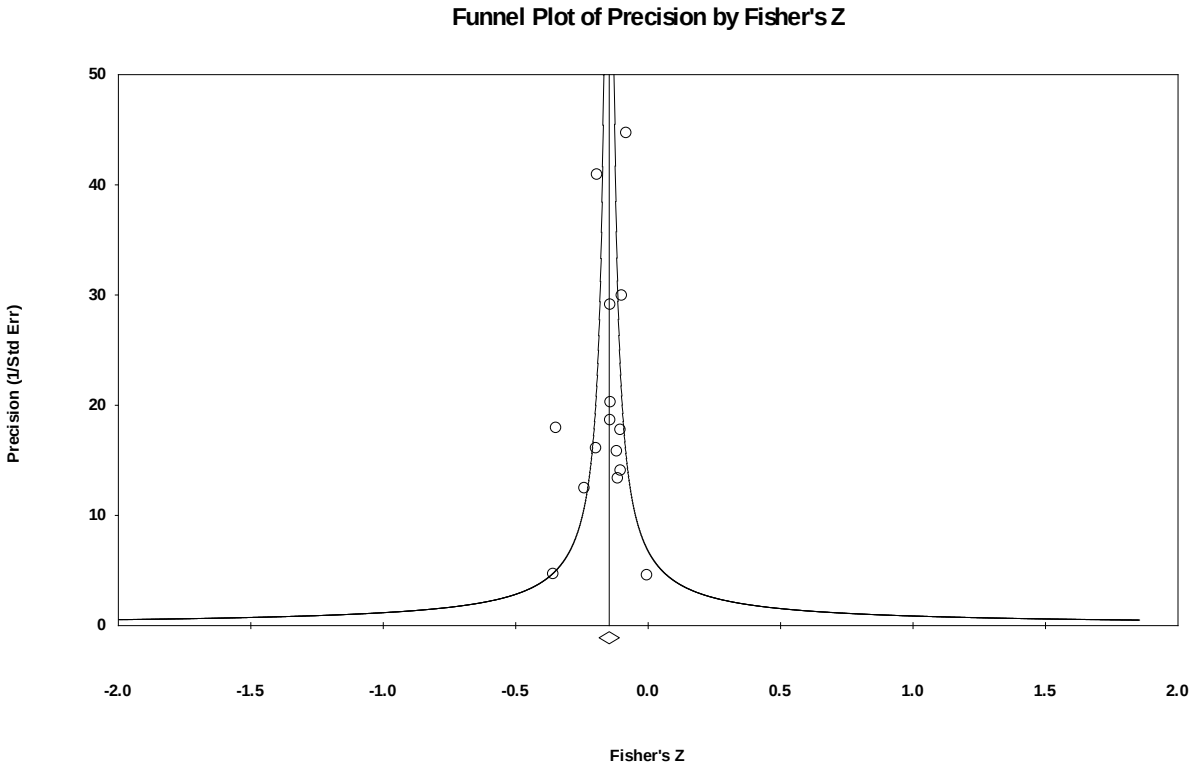
eFigure 28. Attention Cross-sectional Funnel Plot



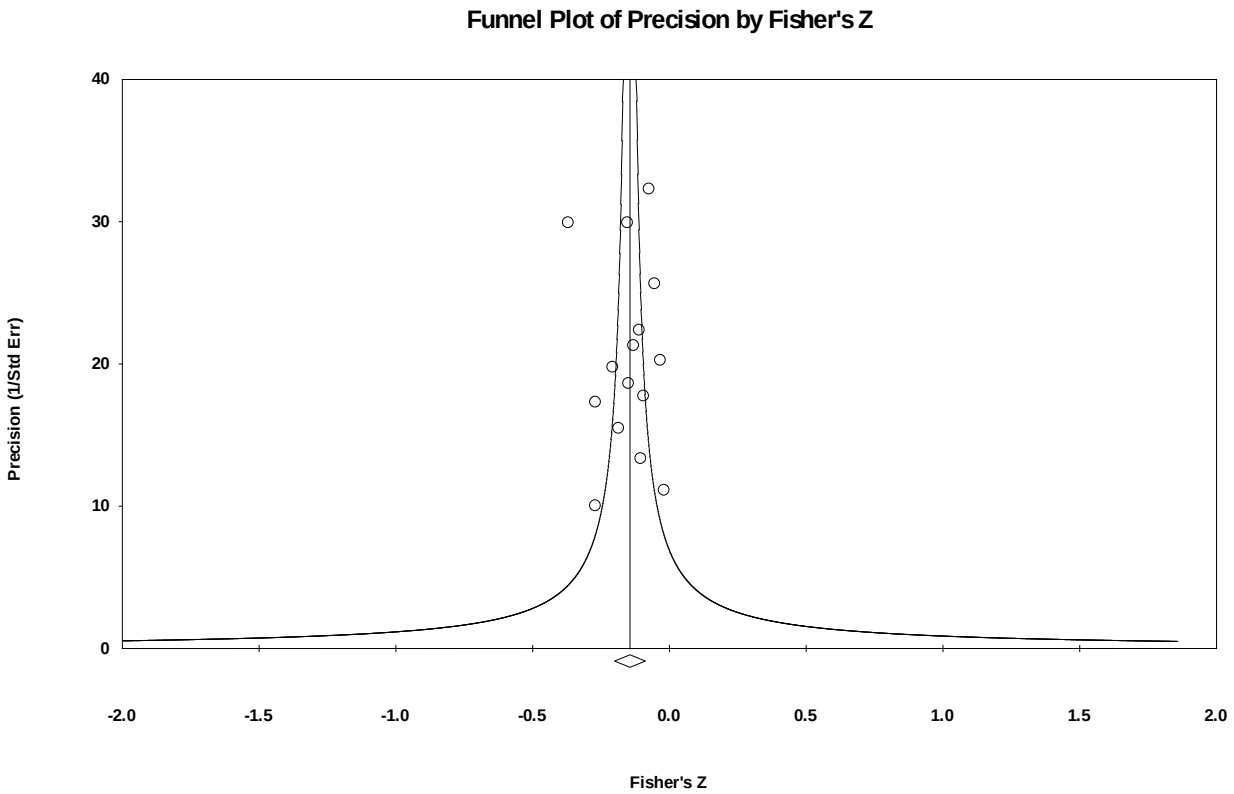
eFigure 29. Delayed Recall Cross-sectional Funnel Plot



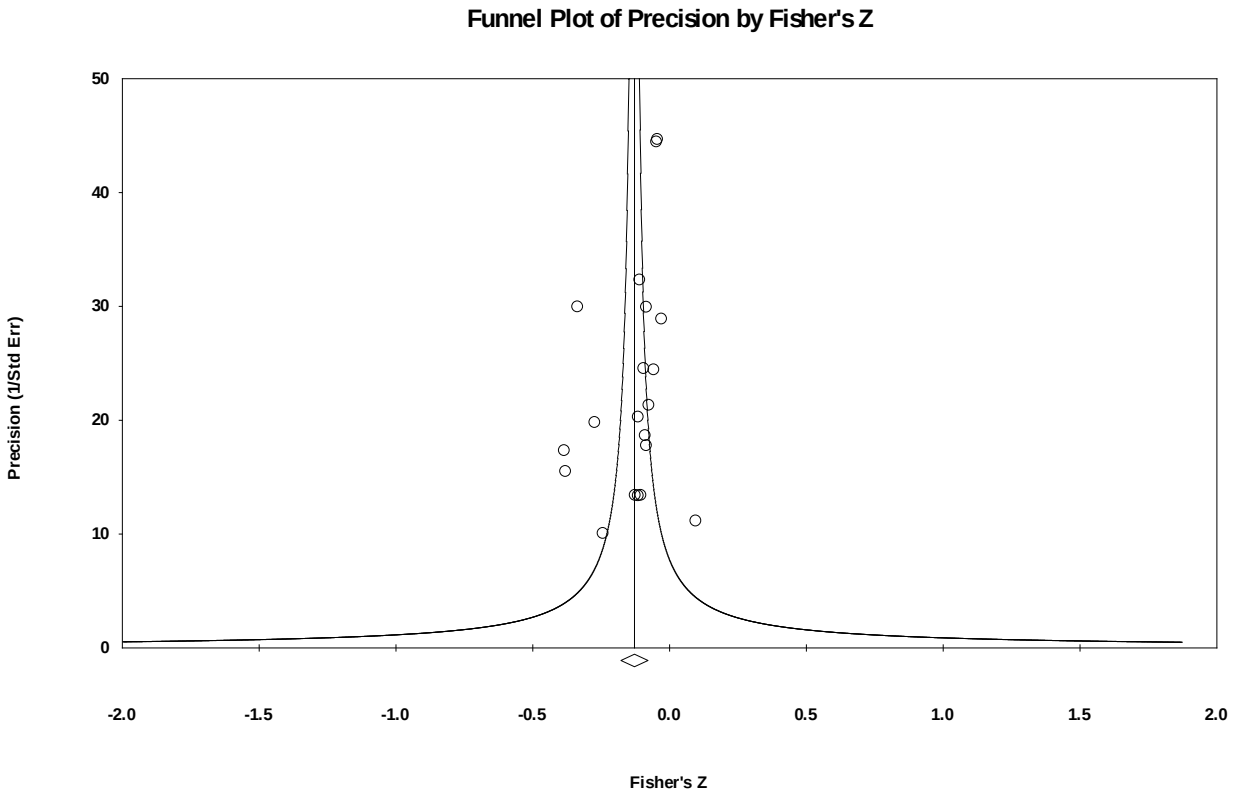
eFigure 30. Fluency Cross-sectional Funnel Plot



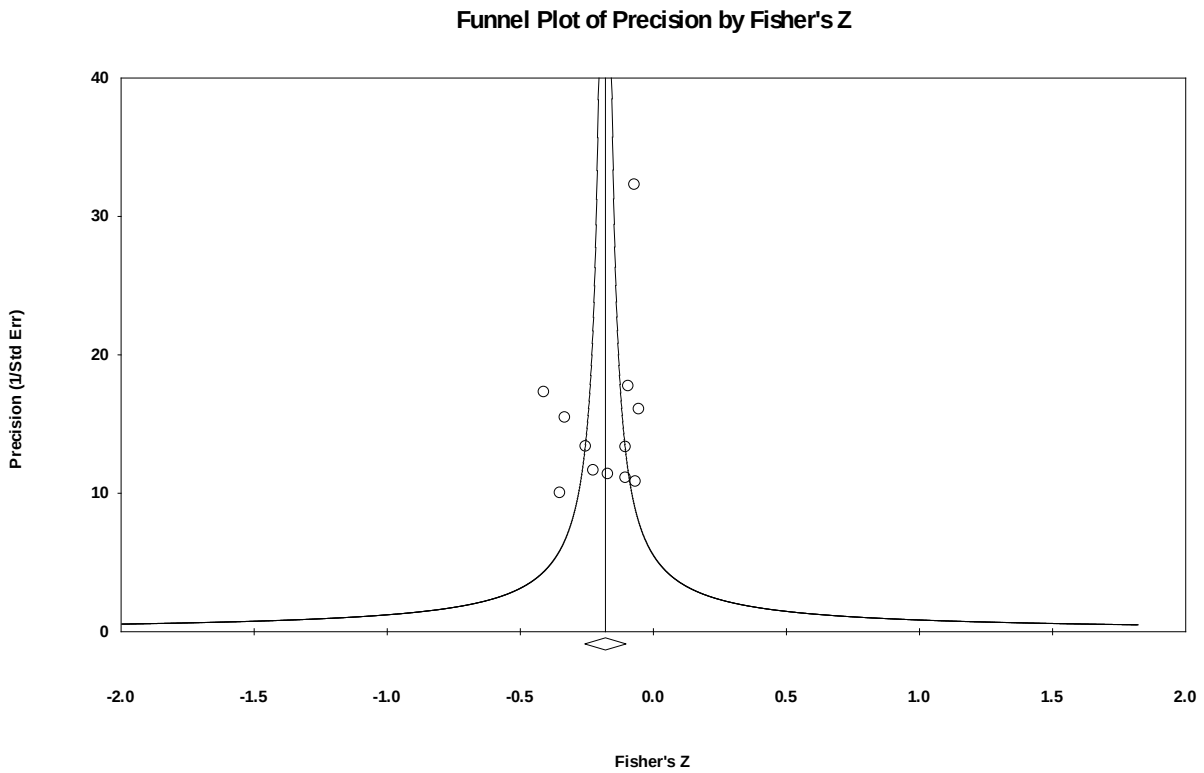
eFigure 31. Global Cognition Cross-sectional Funnel Plot



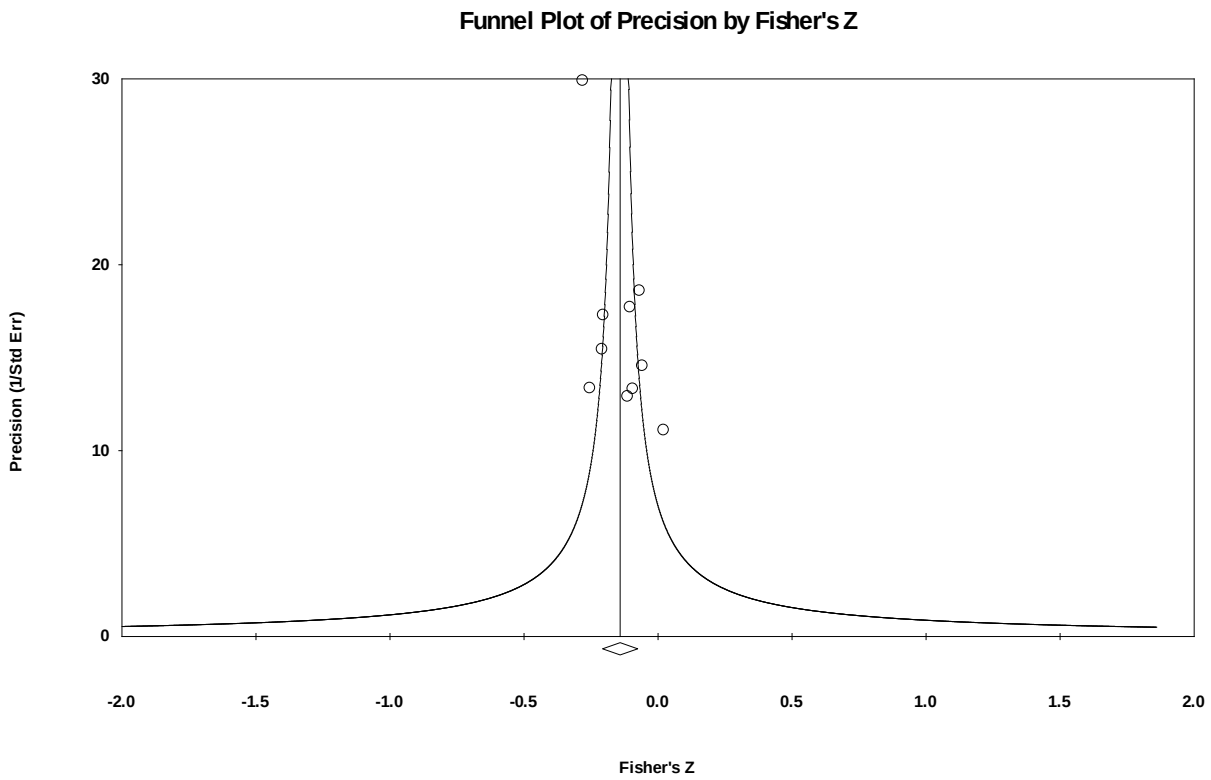
eFigure 32. Immediate Recall Cross-sectional Funnel Plot



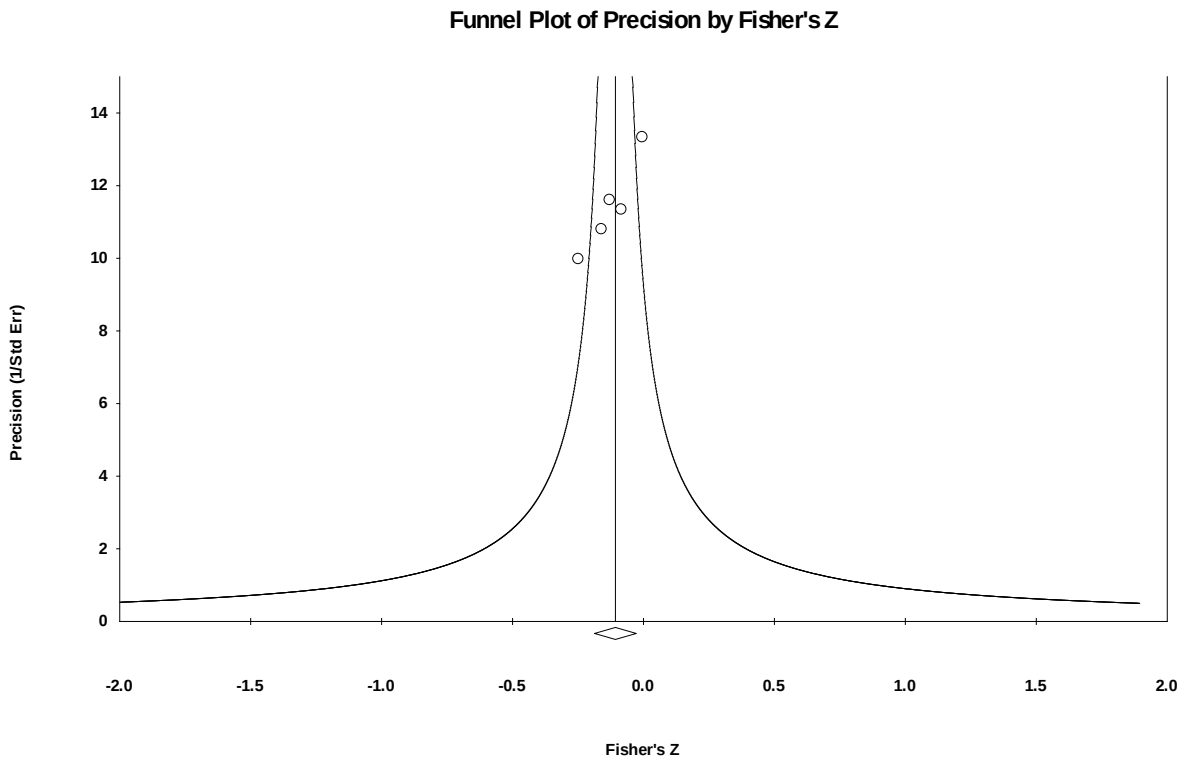
eFigure 33. Processing Speed Cross-sectional Funnel Plot



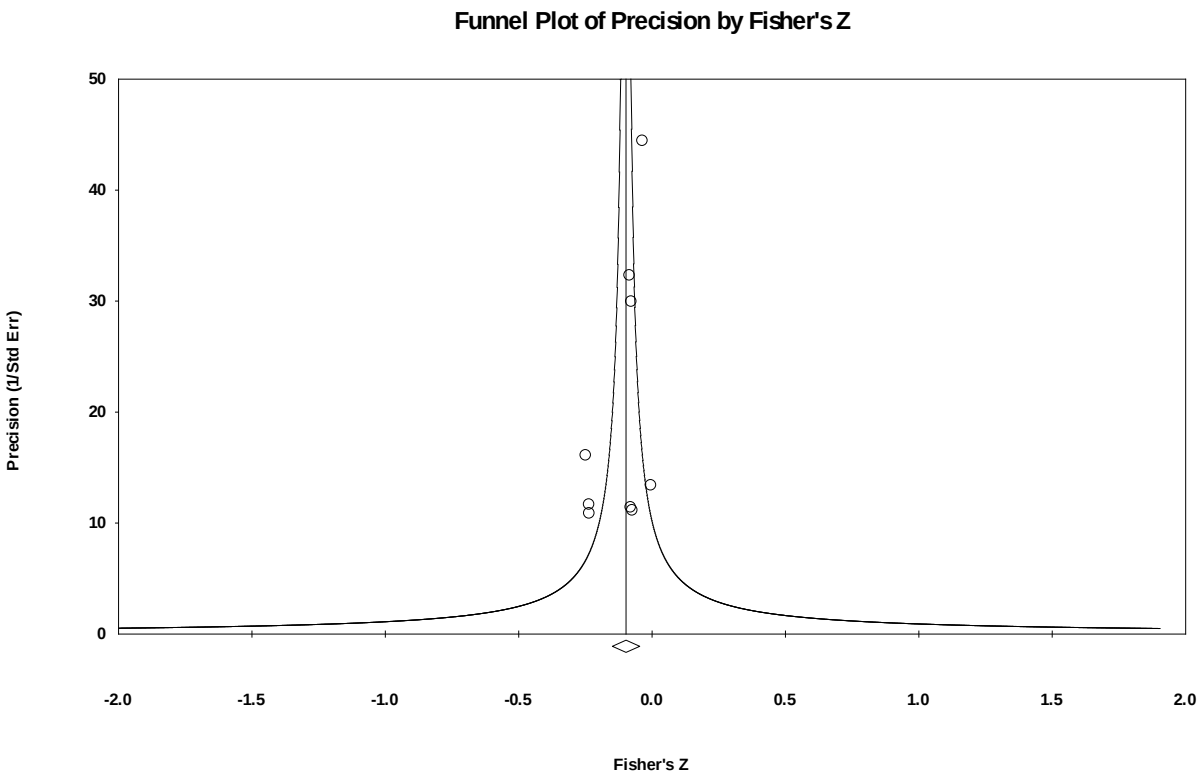
eFigure 34. Reasoning Cross-sectional Funnel Plot



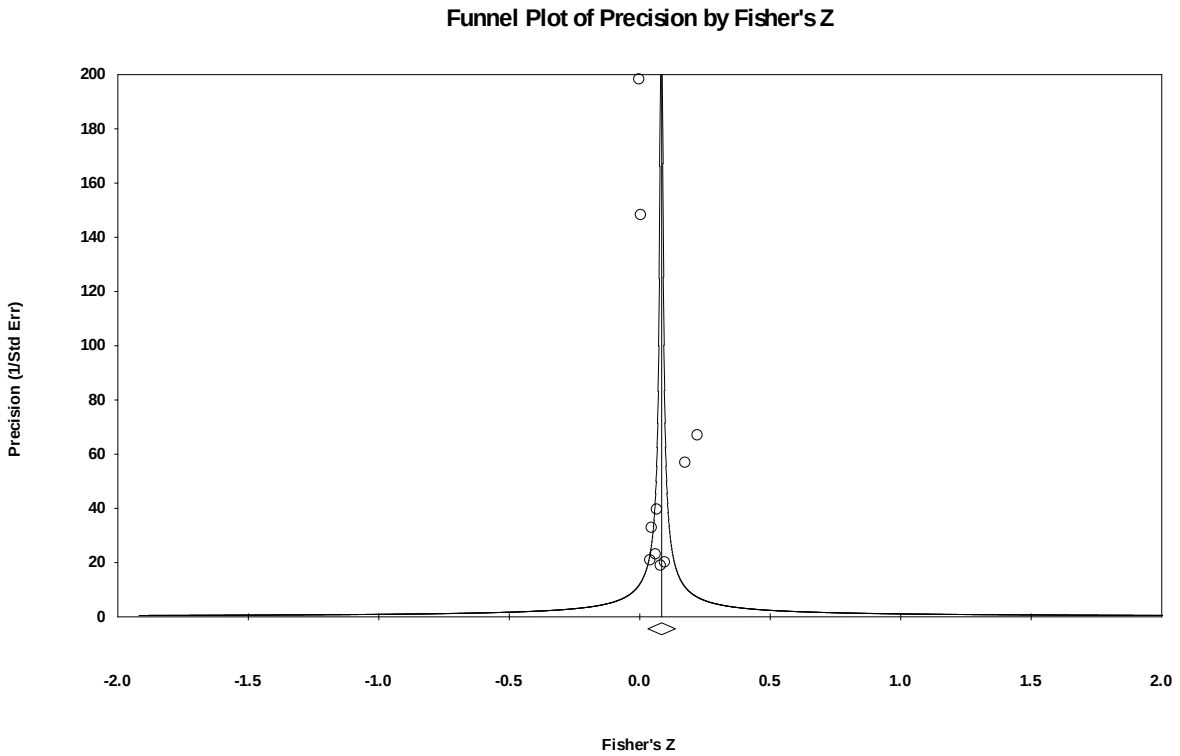
eFigure 35. Semantic Memory Cross-sectional Funnel Plot



eFigure 36. Visuospatial Ability Cross-sectional Funnel Plot



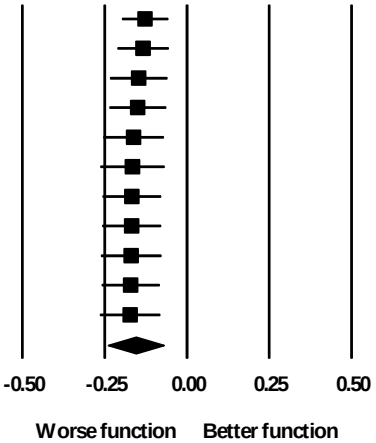
eFigure 37. Working Memory Cross-sectional Funnel Plot



eFigure 38. Processing Speed Cohort Funnel Plot

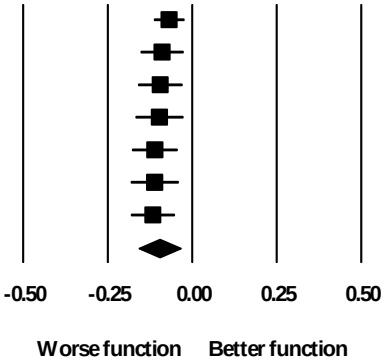
INFLUENCE ANALYSIS

Studyname	Subgroup within study	Statistics with studyremoved			
		Point	Standard error	Lower limit	Upper limit
Heron & Chown (1967)	Male	-0.127	0.037	-0.199	-0.055
Heron & Chown (1967)	Female	-0.133	0.041	-0.213	-0.053
Valentijn et al. (2005)	None	-0.146	0.045	-0.235	-0.058
Clark (1960)	None	-0.149	0.045	-0.238	-0.061
Lin et al. (2011b)	None	-0.162	0.048	-0.255	-0.069
Harrison Bush et al. (2015)	None	-0.165	0.051	-0.265	-0.066
Anstey (1999)	None	-0.167	0.046	-0.258	-0.077
Deal et al. (2015)	Mild vs Norm	-0.168	0.046	-0.259	-0.077
Gussekloo et al. (2005)	None	-0.169	0.048	-0.263	-0.076
Deal et al. (2015)	Mod/sev vs Norm	-0.171	0.046	-0.261	-0.081
Bucks et al. (2016)	None	-0.173	0.047	-0.266	-0.080
		-0.157	0.043	-0.242	-0.073



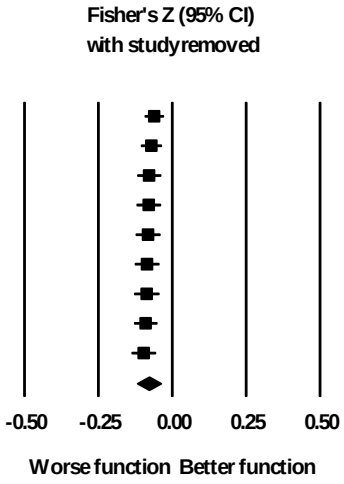
eFigure 39. Attention Cross-sectional Influence Analysis for Changes in Fisher's *z*

Studyname	Subgroup within study	Statistics with studyremoved			
		Point	Standard error	Lower limit	Upper limit
Valentijn et al. (2005)	None	-0.068	0.024	-0.115	-0.022
Deal et al. (2015)	Mild vs Norm	-0.089	0.033	-0.154	-0.024
Deal et al. (2015)	Mod/sev vs Norm	-0.094	0.034	-0.162	-0.027
van Boxtel et al. (2000)	None	-0.097	0.037	-0.169	-0.024
Thomas et al. (1983)	None	-0.110	0.035	-0.180	-0.041
Gussekloo et al. (2005)	None	-0.111	0.037	-0.183	-0.039
Bucks et al. (2016)	None	-0.116	0.034	-0.183	-0.050
		-0.098	0.031	-0.160	-0.037



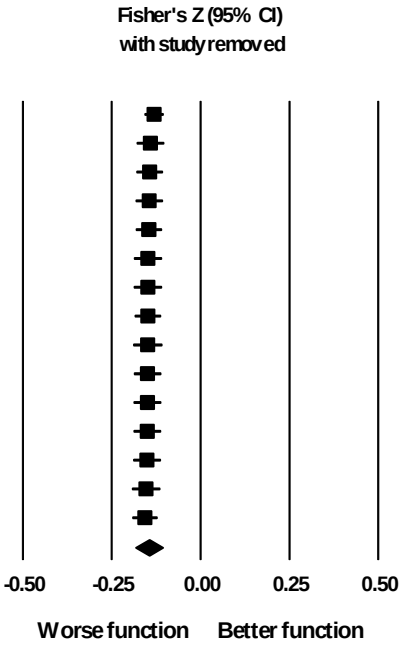
eFigure 40. Delayed Recall Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Hofer et al. (2003)	None	-0.061	0.017	-0.095	-0.027
Valentijn et al. (2005)	None	-0.071	0.019	-0.108	-0.033
Era et al. (1986)	Young	-0.078	0.022	-0.121	-0.036
Era et al. (1986)	Middle	-0.079	0.022	-0.123	-0.036
Era et al. (1986)	Old	-0.082	0.022	-0.125	-0.038
Li et al. (1998)	None	-0.085	0.022	-0.128	-0.042
Baltes & Lindenberger (1997)	None	-0.086	0.023	-0.131	-0.042
Lin et al. (2011b)	None	-0.090	0.021	-0.131	-0.049
Bucks et al. (2016)	None	-0.097	0.022	-0.140	-0.053
		-0.081	0.020	-0.121	-0.041



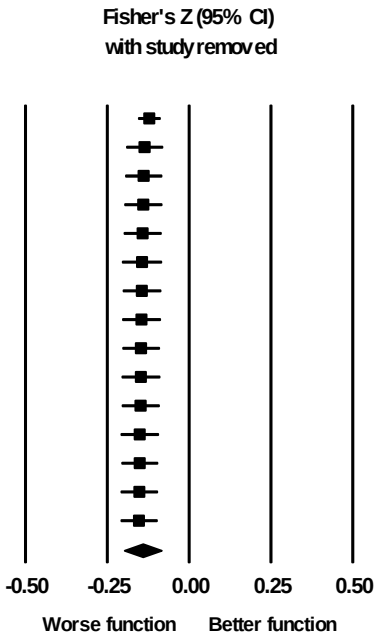
eFigure 41. Fluency Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Dupuis et al. (2015)	None	-0.131	0.015	-0.159	-0.102
Hong et al. (2016)	None	-0.141	0.020	-0.181	-0.101
Lindenberger & Baltes (1994)	None	-0.143	0.020	-0.182	-0.104
Thomas et al. (1983)	None	-0.144	0.020	-0.184	-0.104
Schaie et al. (1964)	Male	-0.145	0.020	-0.184	-0.107
Lin et al. (2011b)	None	-0.148	0.021	-0.189	-0.107
Gussekloo et al. (2005)	None	-0.148	0.021	-0.189	-0.107
Schaie et al. (1964)	Female	-0.148	0.020	-0.187	-0.110
Sugawara et al. (2011)	None	-0.149	0.022	-0.191	-0.106
Li et al. (1998)	None	-0.149	0.020	-0.189	-0.109
Deal et al. (2015)	Mld vs Norm	-0.149	0.021	-0.190	-0.109
Deal et al. (2015)	Mod/sev vs Norm	-0.150	0.020	-0.190	-0.110
Baltes & Lindenberger (1997)	None	-0.151	0.021	-0.191	-0.110
Harrison Bush et al. (2015)	None	-0.153	0.021	-0.195	-0.112
Lin et al. (2013)	None	-0.157	0.019	-0.194	-0.119
		-0.147	0.019	-0.185	-0.109



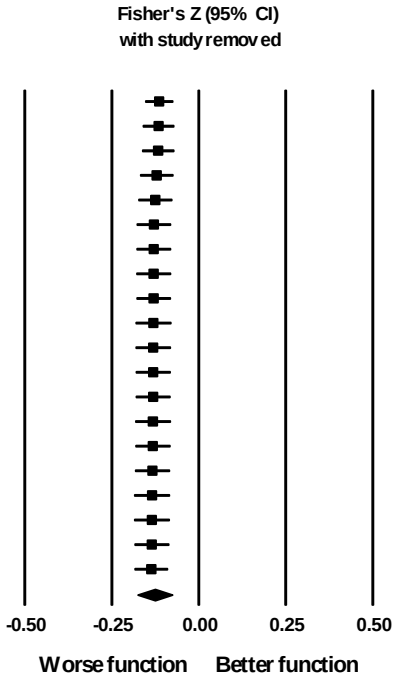
eFigure 42. Global Cognition Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Anstey et al. (2001a)	None	-0.121	0.019	-0.158	-0.085
Heron & Chown (1967)	Male	-0.136	0.030	-0.194	-0.078
Clark (1960)	None	-0.139	0.030	-0.197	-0.081
Valentijn et al. (2005)	None	-0.140	0.031	-0.200	-0.080
Heron & Chown (1967)	Female	-0.142	0.030	-0.201	-0.082
Harrison Bush et al. (2015)	None	-0.144	0.032	-0.206	-0.081
Lin et al. (2011b)	None	-0.144	0.031	-0.204	-0.084
van Boxtel et al. (2000)	None	-0.146	0.031	-0.206	-0.085
Li et al. (1998)	None	-0.147	0.030	-0.206	-0.088
Deal et al. (2016)	Mod/sev vs Norm	-0.147	0.031	-0.208	-0.087
Baltes & Lindenberger (1997)	None	-0.148	0.030	-0.208	-0.088
Hofer et al. (2003)	None	-0.151	0.031	-0.211	-0.091
MacDonald et al. (2004)	None	-0.151	0.030	-0.208	-0.093
Deal et al. (2016)	Mld vs Norm	-0.152	0.030	-0.211	-0.093
Gussekloo et al. (2005)	None	-0.153	0.030	-0.211	-0.095
		-0.144	0.029	-0.201	-0.088



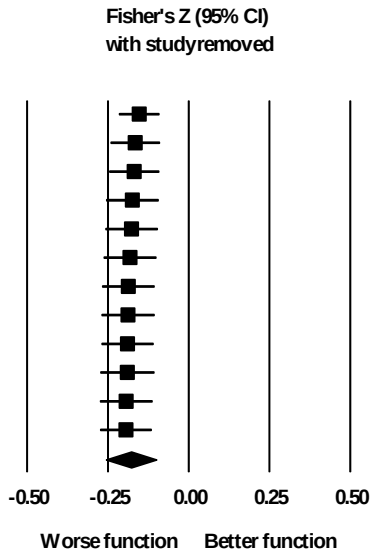
eFigure 43. Immediate Recall Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Anstey et al. (2001a)	None	-0.114	0.021	-0.156	-0.072
Heron & Chown (1967)	Male	-0.115	0.024	-0.162	-0.068
Heron & Chown (1967)	Female	-0.117	0.024	-0.164	-0.069
Valentijn et al. (2005)	None	-0.121	0.025	-0.170	-0.071
Clark (1960)	None	-0.125	0.026	-0.175	-0.074
Anstey (1999)	None	-0.129	0.026	-0.180	-0.078
Li et al. (1998)	None	-0.129	0.026	-0.180	-0.078
Gussekloo et al. (2005)	None	-0.130	0.026	-0.181	-0.078
Anstey & Smith (1999)	None	-0.130	0.026	-0.181	-0.079
Hofer et al. (2003)	None	-0.130	0.027	-0.184	-0.077
Lin (2011a)	None	-0.131	0.027	-0.183	-0.078
Lin et al. (2011b)	None	-0.131	0.026	-0.183	-0.079
Baltes & Lindenberger (1997)	None	-0.131	0.026	-0.183	-0.079
Harrison Bush et al. (2015)	None	-0.132	0.027	-0.185	-0.079
van Boxtel et al. (2000)	None	-0.132	0.026	-0.184	-0.080
Deal et al. (2016)	Mod/sev vs Norm	-0.133	0.027	-0.185	-0.081
Bucks et al. (2016)	None	-0.134	0.027	-0.187	-0.081
Lin et al. (2013)	None	-0.134	0.027	-0.187	-0.081
Deal et al. (2016)	Mld vs Norm	-0.135	0.026	-0.187	-0.083
MacDonald et al. (2004)	None	-0.137	0.025	-0.187	-0.087
		-0.128	0.025	-0.178	-0.079



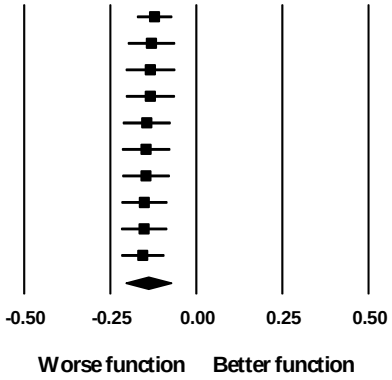
eFigure 44. Processing Speed Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Heron & Chown (1967)	Male	-0.153	0.033	-0.217	-0.089
Heron & Chown (1967)	Female	-0.165	0.040	-0.244	-0.087
Clark (1960)	None	-0.168	0.040	-0.247	-0.089
Anstey & Smith (1999)	None	-0.174	0.042	-0.257	-0.091
Era et al. (1986)	Middle	-0.177	0.042	-0.260	-0.094
Era et al. (1986)	Young	-0.181	0.042	-0.265	-0.098
MacDonald et al. (2004)	None	-0.187	0.042	-0.269	-0.104
Li et al. (1998)	None	-0.188	0.043	-0.271	-0.104
Era et al. (1986)	Old	-0.189	0.042	-0.271	-0.107
Baltes & Lindenberger (1997)	None	-0.190	0.044	-0.275	-0.104
Thomas et al. (1983)	None	-0.193	0.042	-0.276	-0.110
Hofer et al. (2003)	None	-0.194	0.042	-0.276	-0.113
		-0.180	0.040	-0.258	-0.103



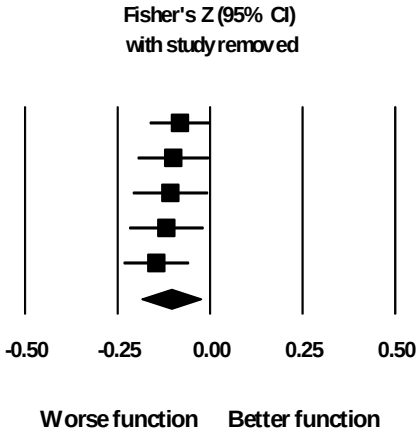
eFigure 45. Reasoning Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Anstey et al. (2001a)	None	-0.121	0.027	-0.174	-0.069
Anstey & Smith (1999)	None	-0.130	0.036	-0.201	-0.060
Heron & Chown (1967)	Male	-0.133	0.037	-0.207	-0.060
Heron & Chown (1967)	Female	-0.134	0.037	-0.206	-0.061
Deal et al. (2015)	Mod/sev vs Norm	-0.144	0.036	-0.215	-0.073
Baltes & Lindenberger (1997)	None	-0.146	0.037	-0.218	-0.074
Li et al. (1998)	None	-0.146	0.036	-0.216	-0.076
Deal et al. (2015)	Mld vs Norm	-0.151	0.035	-0.219	-0.082
Lin et al. (2011b)	None	-0.152	0.035	-0.220	-0.083
MacDonald et al. (2004)	None	-0.156	0.033	-0.220	-0.091
		-0.142	0.033	-0.207	-0.076



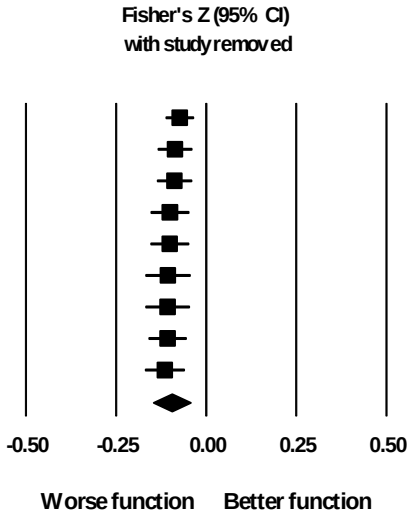
eFigure 46. Semantic Memory Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Clark (1960)	None	-0.081	0.042	-0.164	0.002
Era et al. (1986)	Old	-0.099	0.050	-0.197	-0.002
Era et al. (1986)	Middle	-0.107	0.053	-0.210	-0.004
Era et al. (1986)	Young	-0.118	0.052	-0.220	-0.016
Anstey & Smith (1999)	None	-0.145	0.046	-0.235	-0.056
		-0.107	0.041	-0.187	-0.027



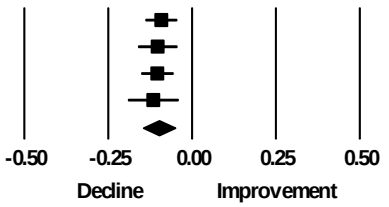
eFigure 47. Visuospatial Ability Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Thomas et al. (1983)	None	-0.073	0.021	-0.114	-0.032
Era et al. (1986)	Middle	-0.086	0.025	-0.136	-0.037
Era et al. (1986)	Old	-0.088	0.026	-0.138	-0.038
Era et al. (1986)	Young	-0.101	0.028	-0.156	-0.045
MacDonald et al. (2004)	None	-0.101	0.028	-0.156	-0.046
Hofer et al. (2003)	None	-0.106	0.033	-0.170	-0.042
Harrison Bush et al. (2015)	None	-0.107	0.032	-0.170	-0.043
Anstey & Smith (1999)	None	-0.107	0.028	-0.162	-0.053
Bucks et al. (2016)	None	-0.114	0.029	-0.171	-0.058
		-0.098	0.026	-0.149	-0.046



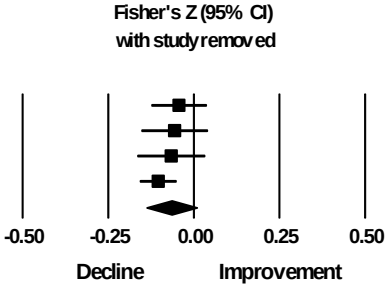
eFigure 48. Working Memory Cross-sectional Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Deal et al. (2015)	Mod/sev vs Norm	-0.091	0.025	-0.141	-0.042
Valentijn et al. (2005)	None	-0.102	0.031	-0.163	-0.042
Deal et al. (2015)	Mild vs Norm	-0.103	0.025	-0.153	-0.054
Gallacher et al. (2012)	None	-0.116	0.039	-0.193	-0.038
		-0.101	0.024	-0.148	-0.053



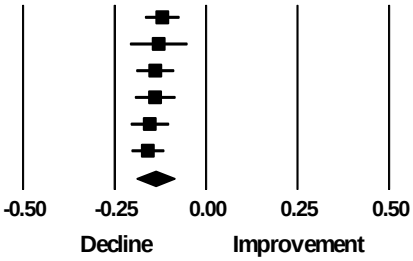
eFigure 49. Delayed Recall Cohort Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Lindenberger & Ghisletta (2009)	None	-0.043	0.042	-0.126	0.039
Valentijn et al. (2005)	None	-0.056	0.050	-0.155	0.042
Deal et al. (2015)	Mod/sev vs Norm	-0.066	0.052	-0.167	0.035
Deal et al. (2015)	Mld vs Norm	-0.104	0.028	-0.159	-0.049
		-0.067	0.037	-0.140	0.006



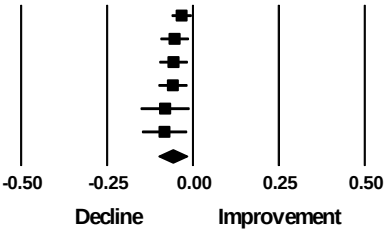
eFigure 50. Fluency Cohort Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Lin et al. (2013)	Hearing loss	-0.120	0.025	-0.168	-0.071
Lin et al. (2013)	Normal hearing	-0.129	0.041	-0.209	-0.049
Hong et al. (2016)	None	-0.139	0.027	-0.192	-0.086
Deal et al. (2015)	Mod/sev vs Norm	-0.139	0.029	-0.196	-0.082
Gallacher et al. (2012)	None	-0.153	0.028	-0.207	-0.100
Deal et al. (2015)	Mld vs Norm	-0.159	0.024	-0.205	-0.113
		-0.140	0.026	-0.192	-0.089



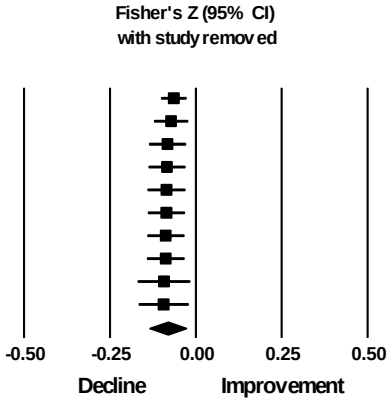
eFigure 51. Global Cognition Cohort Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Anstey et al. (2003)	None	-0.033	0.016	-0.063	-0.002
Gallacher et al. (2012)	None	-0.053	0.022	-0.096	-0.011
Valentijn et al. (2005)	None	-0.056	0.022	-0.099	-0.014
Lindenberger & Ghisletta (2009)	None	-0.058	0.022	-0.102	-0.015
Deal et al. (2016)	Mod/sev vs Norm	-0.081	0.037	-0.154	-0.008
Deal et al. (2016)	Mld vs Norm	-0.083	0.034	-0.150	-0.016
		-0.061	0.021	-0.102	-0.020



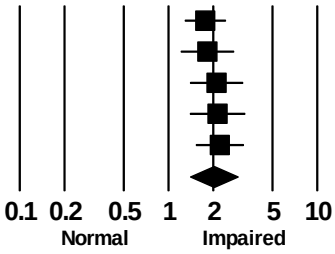
eFigure 52. Immediate Recall Cohort Influence Analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Statistics with study removed			
		Point	Standard error	Lower limit	Upper limit
Lin et al. (2013)	Hearing loss	-0.064	0.020	-0.103	-0.025
Lin et al. (2013)	Normal hearing	-0.072	0.026	-0.123	-0.021
Valentijn et al. (2005)	None	-0.082	0.028	-0.138	-0.027
Deal et al. (2015)	Mod/sev vs Norm	-0.084	0.028	-0.139	-0.029
Anstey et al. (2003)	None	-0.085	0.029	-0.142	-0.029
Lindenberger & Ghisletta (2009)	None	-0.086	0.028	-0.141	-0.030
Deal et al. (2015)	Mild vs Norm	-0.087	0.028	-0.143	-0.032
Gallacher et al. (2012)	None	-0.088	0.029	-0.144	-0.031
Deal et al. (2016)	Mod/sev vs Norm	-0.093	0.040	-0.171	-0.014
Deal et al. (2016)	Mild vs Norm	-0.093	0.038	-0.168	-0.019
		-0.084	0.027	-0.137	-0.031



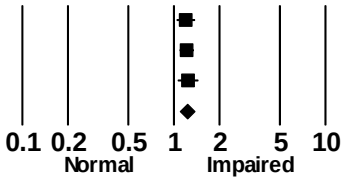
eFigure 53. Processing Speed Cohort Influence Analysis for Changes in Fisher's *z*

Study name	Statistics with study removed		
	Point	Lower limit	Upper limit
Lopez-Torres Hidalgo et al. (2009)	1.768	1.277	2.446
Dupuis et al. (2015)	1.827	1.202	2.777
Kurniawan et al. (2012)	2.106	1.388	3.195
Quaranta et al. (2014)	2.138	1.384	3.301
Kiely et al. (2012)	2.214	1.518	3.228
	2.003	1.385	2.894



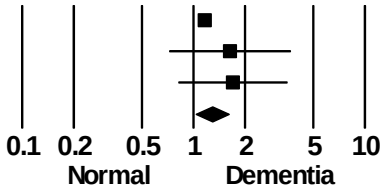
eFigure 54. Cognitive Impairment Cross-sectional Influence Analysis for Changes in Odds Ratio

Study name	Statistics with study removed		
	Point	Lower limit	Upper limit
Lin et al. (2013)	1.198	1.036	1.386
Gallacher et al. (2012)	1.214	1.083	1.361
Kiely et al. (2012)	1.240	1.055	1.457
	1.215	1.088	1.358



eFigure 55. Cognitive Impairment Cohort Influence Analysis for Changes in Odds Ratio

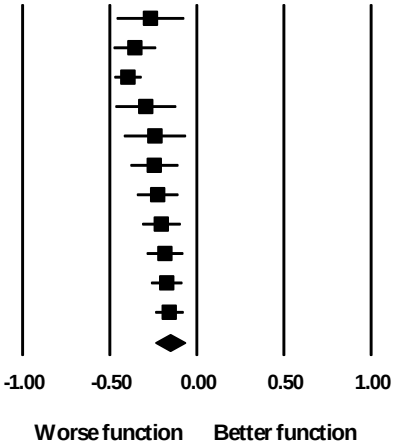
Study name	Statistics with study removed		
	Point	Lower limit	Upper limit
Gallacher et al. (2012)	1.164	1.066	1.270
Lin et al. (2011c)	1.634	0.717	3.726
Deal et al. (2016)	1.698	0.811	3.557
	1.277	1.024	1.594



eFigure 56. Dementia Cohort Influence Analysis for Changes in Odds Ratio[a]

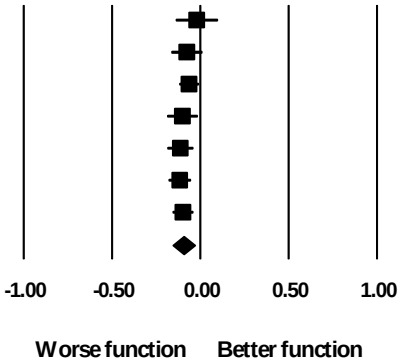
CUMULATIVE META-ANALYSIS

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Clark (1960)	None	-0.266	0.101	-0.463	-0.069
Heron & Chown (1967)	Female	-0.355	0.064	-0.481	-0.230
Heron & Chown (1967)	Male	-0.395	0.042	-0.477	-0.313
Anstey (1999)	None	-0.293	0.091	-0.471	-0.116
Gussekloo et al. (2005)	None	-0.240	0.092	-0.421	-0.060
Valentijn et al. (2005)	None	-0.244	0.072	-0.385	-0.103
Lin et al. (2011b)	None	-0.225	0.062	-0.347	-0.103
Deal et al. (2015)	Mld vs Norm	-0.203	0.058	-0.317	-0.090
Deal et al. (2015)	Mod/sev vs Norm	-0.183	0.055	-0.291	-0.075
Harrison Bush et al. (2015)	None	-0.173	0.047	-0.266	-0.080
Bucks et al. (2016)	None	-0.157	0.043	-0.242	-0.073
		-0.157	0.043	-0.242	-0.073



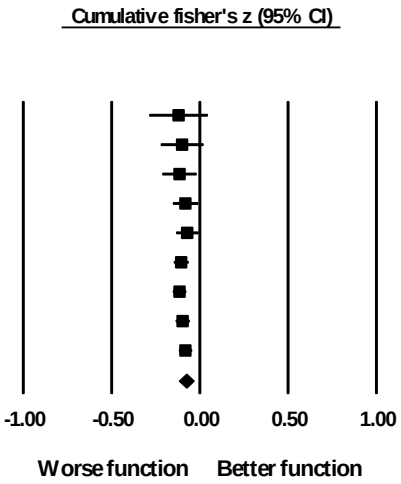
eFigure 57. Attention Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Thomas et al. (1983)	None	-0.020	0.063	-0.143	0.102
van Boxtel et al. (2000)	None	-0.076	0.046	-0.167	0.015
Gussekloo et al. (2005)	None	-0.064	0.030	-0.122	-0.005
Valentijn et al. (2005)	None	-0.101	0.046	-0.191	-0.011
Deal et al. (2015)	Mld vs Norm	-0.113	0.039	-0.190	-0.037
Deal et al. (2015)	Mod/sev vs Norm	-0.116	0.034	-0.183	-0.050
Bucks et al. (2016)	None	-0.098	0.031	-0.160	-0.037
		-0.098	0.031	-0.160	-0.037



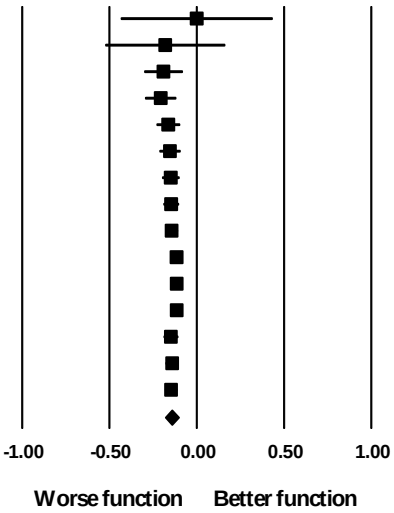
eFigure 58. Delayed Recall Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Era et al. (1986)	Middle	-0.120	0.086	-0.290	0.049
Era et al. (1986)	Old	-0.100	0.063	-0.224	0.024
Era et al. (1986)	Young	-0.115	0.051	-0.216	-0.014
Baltes & Lindenberger (1997)	None	-0.081	0.038	-0.156	-0.007
Li et al. (1998)	None	-0.071	0.034	-0.137	-0.004
Hofer et al. (2003)	None	-0.105	0.023	-0.150	-0.060
Valentijn et al. (2005)	None	-0.115	0.021	-0.156	-0.074
Lin et al. (2011b)	None	-0.097	0.022	-0.140	-0.053
Bucks et al. (2016)	None	-0.081	0.020	-0.121	-0.041
		-0.081	0.020	-0.121	-0.041



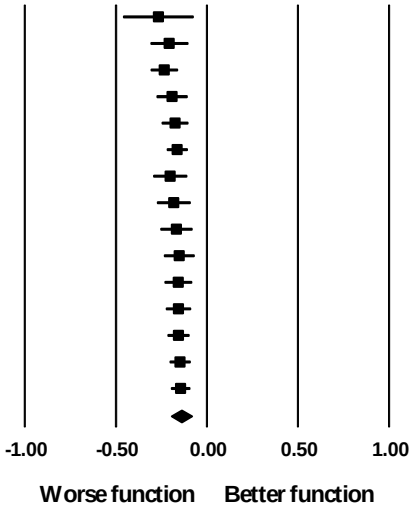
eFigure 59. Fluency Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Schaie et al. (1964)	Female	0.000	0.224	-0.438	0.438
Schaie et al. (1964)	Male	-0.180	0.177	-0.527	0.167
Thomas et al. (1983)	None	-0.191	0.058	-0.305	-0.077
Lindenberger & Baltes (1994)	None	-0.206	0.047	-0.299	-0.114
Baltes & Lindenberger (1997)	None	-0.163	0.036	-0.234	-0.092
Li et al. (1998)	None	-0.153	0.033	-0.217	-0.089
Gussekloo et al. (2005)	None	-0.148	0.027	-0.202	-0.095
Lin et al. (2011b)	None	-0.147	0.024	-0.194	-0.099
Sugawara et al. (2011)	None	-0.144	0.020	-0.183	-0.105
Lin et al. (2013)	None	-0.115	0.015	-0.144	-0.086
Deal et al. (2015)	Mld vs Norm	-0.115	0.014	-0.143	-0.087
Deal et al. (2015)	Mod/sev vs Norm	-0.114	0.014	-0.142	-0.087
Dupuis et al. (2015)	None	-0.148	0.023	-0.193	-0.103
Harrison Bush et al. (2015)	None	-0.141	0.020	-0.181	-0.101
Hong et al. (2016)	None	-0.147	0.019	-0.185	-0.109
		-0.147	0.019	-0.185	-0.109



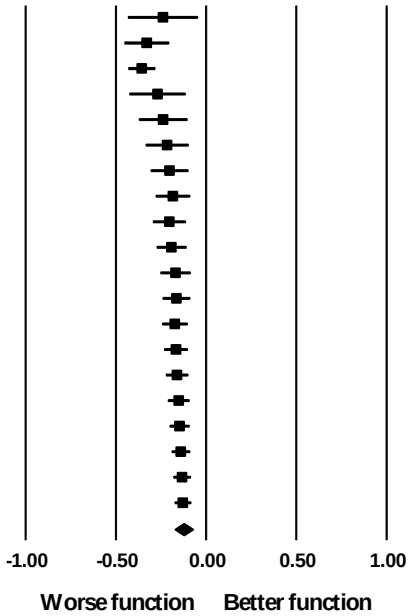
eFigure 60. Global Cognition Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Clark (1960)	None	-0.266	0.101	-0.463	-0.069
Heron & Chown (1967)	Female	-0.206	0.055	-0.313	-0.099
Heron & Chown (1967)	Male	-0.234	0.040	-0.312	-0.156
Baltes & Lindenberger (1997)	None	-0.191	0.045	-0.279	-0.103
Li et al. (1998)	None	-0.175	0.039	-0.251	-0.098
van Boxtel et al. (2000)	None	-0.163	0.031	-0.223	-0.102
Anstey et al. (2001a)	None	-0.201	0.049	-0.298	-0.105
Hofer et al. (2003)	None	-0.182	0.049	-0.278	-0.086
MacDonald et al. (2004)	None	-0.167	0.047	-0.258	-0.075
Gussekloo et al. (2005)	None	-0.152	0.044	-0.239	-0.065
Valentijn et al. (2005)	None	-0.157	0.040	-0.235	-0.079
Lin et al. (2011b)	None	-0.156	0.037	-0.228	-0.084
Harrison Bush et al. (2015)	None	-0.156	0.032	-0.219	-0.092
Deal et al. (2016)	Mld vs Norm	-0.147	0.031	-0.208	-0.087
Deal et al. (2016)	Mod/sev vs Norm	-0.144	0.029	-0.201	-0.088
		-0.144	0.029	-0.201	-0.088



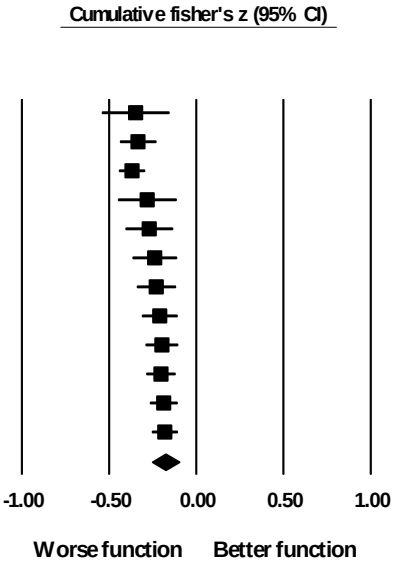
eFigure 61. Immediate Recall Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Clark (1960)	None	-0.239	0.101	-0.436	-0.042
Heron & Chown (1967)	Female	-0.329	0.065	-0.456	-0.201
Heron & Chown (1967)	Male	-0.356	0.040	-0.434	-0.279
Baltes & Lindenberger (1997)	None	-0.269	0.081	-0.429	-0.110
Li et al. (1998)	None	-0.238	0.070	-0.376	-0.100
Anstey & Smith (1999)	None	-0.216	0.062	-0.338	-0.094
Anstey (1999)	None	-0.203	0.055	-0.310	-0.095
van Boxtel et al. (2000)	None	-0.184	0.050	-0.282	-0.085
Anstey et al. (2001a)	None	-0.203	0.048	-0.298	-0.109
Hofer et al. (2003)	None	-0.192	0.044	-0.277	-0.106
MacDonald et al. (2004)	None	-0.169	0.044	-0.256	-0.082
Gussekloo et al. (2005)	None	-0.164	0.041	-0.244	-0.085
Valentijn et al. (2005)	None	-0.173	0.038	-0.247	-0.099
Lin (2011a)	None	-0.167	0.035	-0.236	-0.098
Lin et al. (2011b)	None	-0.161	0.033	-0.226	-0.096
Lin et al. (2013)	None	-0.152	0.032	-0.215	-0.088
Harrison Bush et al. (2015)	None	-0.147	0.030	-0.206	-0.088
Bucks et al. (2016)	None	-0.140	0.028	-0.194	-0.085
Deal et al. (2016)	Mld vs Norm	-0.133	0.027	-0.185	-0.081
Deal et al. (2016)	Mod/sev vs Norm	-0.128	0.025	-0.178	-0.079
		-0.128	0.025	-0.178	-0.079



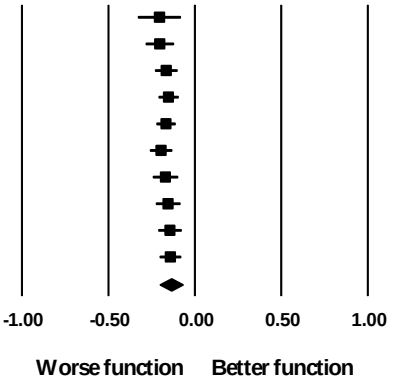
eFigure 62. Processing Speed Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Clark (1960)	None	-0.347	0.101	-0.544	-0.150
Heron & Chown (1967)	Female	-0.334	0.055	-0.441	-0.227
Heron & Chown (1967)	Male	-0.368	0.040	-0.446	-0.290
Thomas et al. (1983)	None	-0.281	0.087	-0.452	-0.109
Era et al. (1986)	Middle	-0.269	0.071	-0.409	-0.130
Era et al. (1986)	Old	-0.238	0.067	-0.369	-0.107
Era et al. (1986)	Young	-0.229	0.059	-0.344	-0.114
Baltes & Lindenberger (1997)	None	-0.209	0.054	-0.315	-0.103
Li et al. (1998)	None	-0.197	0.049	-0.293	-0.101
Anstey & Smith (1999)	None	-0.202	0.044	-0.289	-0.115
Hofer et al. (2003)	None	-0.187	0.042	-0.269	-0.104
MacDonald et al. (2004)	None	-0.180	0.040	-0.258	-0.103
		-0.180	0.040	-0.258	-0.103



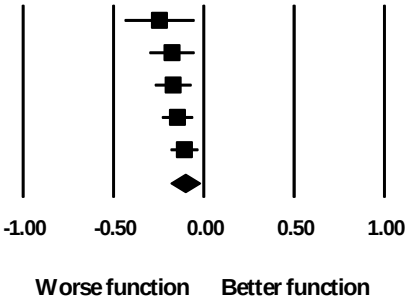
eFigure 63. Reasoning Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Heron & Chown (1967)	Female	-0.205	0.065	-0.332	-0.078
Heron & Chown (1967)	Male	-0.202	0.043	-0.287	-0.118
Baltes & Lindenberger (1997)	None	-0.165	0.035	-0.233	-0.097
Li et al. (1998)	None	-0.152	0.031	-0.213	-0.091
Anstey & Smith (1999)	None	-0.167	0.030	-0.226	-0.108
Anstey et al. (2001a)	None	-0.195	0.034	-0.262	-0.128
MacDonald et al. (2004)	None	-0.170	0.039	-0.246	-0.094
Lin et al. (2011b)	None	-0.155	0.038	-0.229	-0.080
Deal et al. (2015)	Mld vs Norm	-0.144	0.036	-0.215	-0.073
Deal et al. (2015)	Mod/sev vs Norm	-0.142	0.033	-0.207	-0.076
		-0.142	0.033	-0.207	-0.076



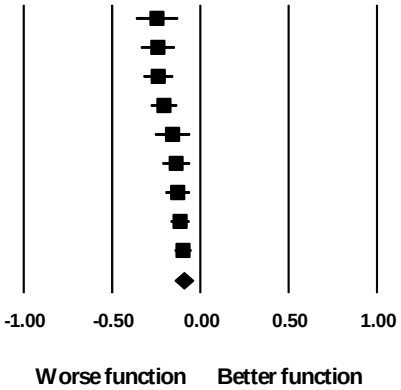
eFigure 64. Semantic Memory Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Clark (1960)	None	-0.245	0.101	-0.442	-0.048
Era et al. (1986)	Middle	-0.176	0.066	-0.304	-0.047
Era et al. (1986)	Old	-0.169	0.054	-0.274	-0.064
Era et al. (1986)	Young	-0.145	0.046	-0.235	-0.056
Anstey & Smith (1999)	None	-0.107	0.041	-0.187	-0.027
		-0.107	0.041	-0.187	-0.027



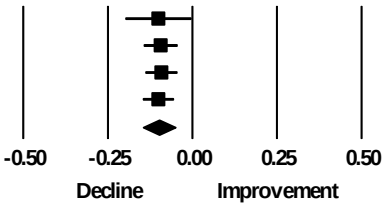
eFigure 65. Visuospatial Ability Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Thomas et al. (1983)	None	-0.245	0.063	-0.367	-0.122
Era et al. (1986)	Middle	-0.240	0.051	-0.340	-0.141
Era et al. (1986)	Old	-0.238	0.044	-0.325	-0.151
Era et al. (1986)	Young	-0.205	0.040	-0.283	-0.128
Anstey & Smith (1999)	None	-0.157	0.052	-0.260	-0.055
Hofer et al. (2003)	None	-0.137	0.042	-0.218	-0.055
MacDonald et al. (2004)	None	-0.128	0.037	-0.200	-0.056
Harrison Bush et al. (2015)	None	-0.114	0.029	-0.171	-0.058
Bucks et al. (2016)	None	-0.098	0.026	-0.149	-0.046
		-0.098	0.026	-0.149	-0.046



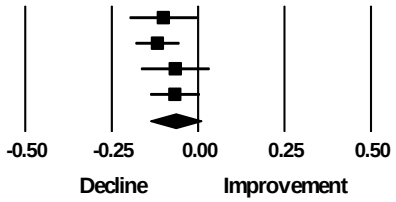
eFigure 66. Working Memory Cross-sectional Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Valentijn et al. (2005)	None	-0.100	0.051	-0.200	-0.001
Gallacher et al. (2012)	None	-0.094	0.026	-0.145	-0.042
Deal et al. (2015)	Mild vs Norm	-0.091	0.025	-0.141	-0.042
Deal et al. (2015)	Mod/sev vs Norm	-0.101	0.024	-0.148	-0.053
		-0.101	0.024	-0.148	-0.053



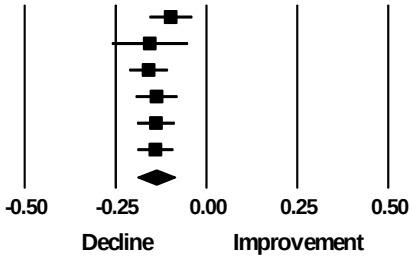
eFigure 67. Delayed Recall Cohort Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Valentijn et al. (2005)	None	-0.100	0.051	-0.200	-0.001
Lindenberger & Ghisletta (2009)	None	-0.118	0.033	-0.183	-0.052
Deal et al. (2015)	Mld vs Norm	-0.066	0.052	-0.167	0.035
Deal et al. (2015)	Mod/sev vs Norm	-0.067	0.037	-0.140	0.006
		-0.067	0.037	-0.140	0.006



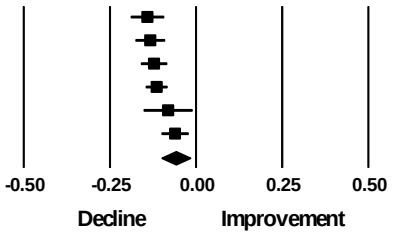
eFigure 68. Fluency Cohort Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Gallacher et al. (2012)	None	-0.098	0.031	-0.158	-0.038
Lin et al. (2013)	Hearing loss	-0.156	0.054	-0.262	-0.049
Lin et al. (2013)	Normal hearing	-0.159	0.028	-0.214	-0.104
Deal et al. (2015)	Mld vs Norm	-0.137	0.030	-0.196	-0.078
Deal et al. (2015)	Mod/sev vs Norm	-0.139	0.027	-0.192	-0.086
Hong et al. (2016)	None	-0.140	0.026	-0.192	-0.089
		-0.140	0.026	-0.192	-0.089



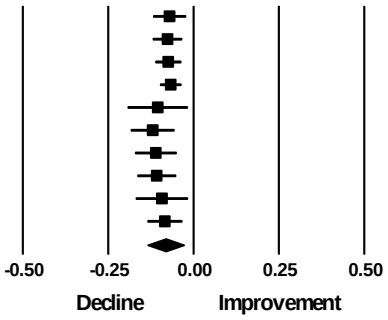
eFigure 69. Global Cognition Cohort Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Anstey et al. (2003)	None	-0.141	0.026	-0.191	-0.091
Valentijn et al. (2005)	None	-0.133	0.023	-0.177	-0.088
Lindenberger & Ghisletta (2009)	None	-0.122	0.020	-0.161	-0.082
Gallacher et al. (2012)	None	-0.114	0.017	-0.147	-0.081
Deal et al. (2016)	Mld vs Norm	-0.081	0.037	-0.154	-0.008
Deal et al. (2016)	Mod/sev vs Norm	-0.061	0.021	-0.102	-0.020
		-0.061	0.021	-0.102	-0.020



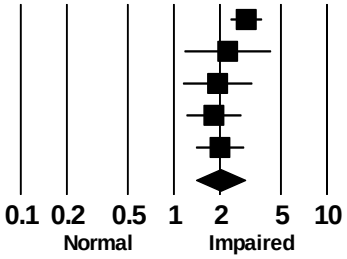
eFigure 70. Immediate Recall Cohort Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Subgroup within study	Cumulative statistics			
		Point	Standard error	Lower limit	Upper limit
Anstey et al. (2003)	None	-0.070	0.026	-0.120	-0.020
Valentijn et al. (2005)	None	-0.076	0.023	-0.121	-0.032
Lindenberger & Ghisletta (2009)	None	-0.074	0.020	-0.114	-0.034
Gallacher et al. (2012)	None	-0.067	0.017	-0.100	-0.034
Lin et al. (2013)	Hearing loss	-0.105	0.046	-0.194	-0.015
Lin et al. (2013)	Normal hearing	-0.120	0.034	-0.185	-0.054
Deal et al. (2015)	Mld vs Norm	-0.110	0.032	-0.173	-0.048
Deal et al. (2015)	Mod/sev vs Norm	-0.108	0.030	-0.166	-0.050
Deal et al. (2016)	Mld vs Norm	-0.093	0.040	-0.171	-0.014
Deal et al. (2016)	Mod/sev vs Norm	-0.084	0.027	-0.137	-0.031
		-0.084	0.027	-0.137	-0.031



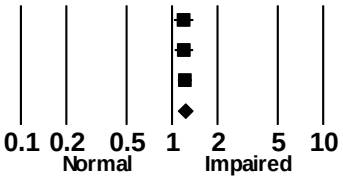
eFigure 71. Processing Speed Cohort Cumulative Meta-analysis for Changes in Fisher's *z*

Study name	Cumulative statistics		
	Point	Lower limit	Upper limit
Lopez-Torres Hidalgo et al. (2009)	2.971	2.331	3.787
Kurniawan et al. (2012)	2.249	1.165	4.343
Kiely et al. (2012)	1.932	1.141	3.271
Quaranta et al. (2014)	1.827	1.202	2.777
Dupuis et al. (2015)	2.003	1.385	2.894
	2.003	1.385	2.894



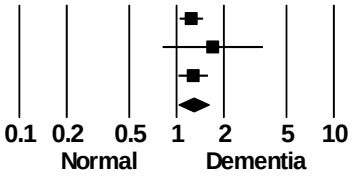
eFigure 72. Cognitive Impairment Cross-sectional Cumulative Meta-analysis for Changes in Odds Ratio

Study name	Cumulative statistics		
	Point	Lower limit	Upper limit
Kiely et al. (2012)	1.194	1.025	1.391
Gallacher et al. (2012)	1.198	1.036	1.386
Lin et al. (2013)	1.215	1.088	1.358
	1.215	1.088	1.358



eFigure 73. Cognitive Impairment Cohort Cumulative Meta-analysis for Changes in Odds Ratio

Study name	Cumulative statistics		
	Point	Lower limit	Upper limit
Lin et al. (2011c)	1.240	1.039	1.479
Gallacher et al. (2012)	1.698	0.811	3.557
Deal et al. (2016)	1.277	1.024	1.594
	1.277	1.024	1.594



eFigure 74. Dementia Cohort Cumulative Meta-analysis for Changes in Odds Ratio)

eResults. Sensitivity Analyses

Hearing loss & cognitive function

Qualitative analysis of small-study effects demonstrated moderate to no asymmetry across studies (eFigures 28-38). Quantitative analysis with Egger's Test of the Intercept found statistically significant small-study effects for cross-sectional sematic memory (eTables 4, 6). With each included study deleted from the model once, results remained statistically significant across all deletions for all domains with one exception (eFigures 39-53, & eTables 4, 6). The difference between the largest and smallest values, having deleted each group once, ranged from 16.6% to 60.2%. Cumulative meta-analysis demonstrated that ARHL has been significantly related to cognitive function since between 1960 and 2012 (eFigures 57-71 & eTables 4, 6).

Hearing loss & cognitive impairment

Small-study effects were not examined because there were less than 10 effect sizes. With each group deleted from the model once, results remained statistically significant across all deletions (eFigures 54-55). The difference between the largest and smallest values with each group deleted was 0.45 (20.1%) for cross-sectional studies and 0.04 (3.4%) for cohort studies. Cumulative meta-analysis demonstrated that ARHL has been significantly related to cognitive impairment since the completion of the first cross-sectional study in 2009 and cohort study in 2012 (eFigures 72, 73).

Hearing loss & dementia

No sensitivity analyses were conducted for cross-sectional dementia studies. Among cohort dementia studies, small-study effects were not examined. With each group was deleted from the model once, results remained statistically significant only with the study by Gallacher et al (2012) deleted (eFigure 56). This study did not control for any vascular risk factors (VRFs) which may have contributed to the larger effect size and confidence intervals. The difference between the largest and smallest values with each group deleted was 0.53 (31.4%). Cumulative meta-analysis demonstrated that results were statistically significant since 2011 (eFigure 74).