S1. Full study criteria for the empirical investigation.

Inclusion criteria	**Exclusion criteria**
Age between 65 and 75 years	Any neurological illness (MMSE[1]<26 excluded)
Available for all parts of the study	Any psychiatric illness (history of mild-moderate depression/anxiety included)
Fluency in the Swedish language	Any head trauma with resulting unconsciousness
Normal/corrected vision	Any brain damage
Normal/corrected hearing	Any medication with effects on the central nervous system
	Cardiovascular disease (high blood pressure included)
	Diabetes Type 2 (dietary treatment included)
	Cancer (successful treatment completed >1 year earlier included)
	Skin disease
	Migraine
	Colour blindness
	Previous study participation involving cognitive testing

[1] MMSE = Mini Mental State Exam (Folstein, Folstein, & McHugh, 1975)

S2. List of tests included in the cognitive test battery used to assess effects of the intervention period.

Domain (latent variable [1])	**Tasks** (observed variable [2])	
Updating Trained	N-back	Task and stimuli trained in WM training
	Running span	Task and stimuli trained in WM training
Switching Trained	Task switching	Task and stimuli trained in WM training
	Rule switching	Task and stimuli trained in WM training
Updating Untrained Stimuli	N-back	Task but not stimuli trained in WM training
	Running span	Task but not stimuli trained in WM training
*Switching Untrained Stimuli**	Task switching	Task but not stimuli trained in WM training
	Rule switching	Task but not stimuli trained in WM training
Updating Untrained Task	Spatial updating	Task not trained in WM or control training
	Numerical updating	Task not trained in WM or control training
*Switching Untrained Task**	Spatial switching	Task not trained in WM or control training
	Numerical switching	Task not trained in WM or control training
Spatial reasoning	Ravens progressive matrices	Task not trained in WM or control training
	WASI-II matrices	Task not trained in WM or control training
	BETA-III matrices	Task not trained in WM or control training
Verbal reasoning	ETS kit verbal inference	Task not trained in WM or control training
	BIS analogies	Task not trained in WM or control training
	Syllogisms	Task not trained in WM or control training
Episodic memory	Spatial memory	Task not trained in WM or control training
	Verbal memory	Task not trained in WM or control training
*Sustained attention**	Temporal expectancy task 1	Task not trained in WM or control training
	Temporal expectancy task 2	Task not trained in WM or control training
Perceptual speed	Perceptual matching	Task and stimuli trained in control training
	Perceptual matching	Task but not stimuli trained in control training

[1] Domains represented latent variables in the LCS models
[2] Tasks represented observed variables in the LCS models
* Cognitive variables that did not meet minimum criteria for analysis

S3. Detailed descriptions of tasks included in the cognitive test battery.

Domain	Task	Task description	Dependent measure	Max score
Updating Trained	N-back, trained stimuli	See task description for N-back in Supplementary Table 6. The test consisted of four runs of single 2-back and four runs of single 3-back. The stimuli set consisted of shapes, which was used during training. 192 stimuli were shown, of which 64 were targets (33%). Completion time was approximately 15 minutes.	(Number hits / total targets) + (number correct rejections/ total foils)	1.0
	Running span, trained stimuli	See task description for Running span in Supplementary Table 6. Responses were required at 10 occasions at the 2-last dual level and at 10 occasions at the 3-last single level with a maximum number of correct per trial of 4 and 3, respectively. The stimuli set consisted of letters and shapes, which was used during training. Completion time was approximately 15 minutes.	Average number correct per trial (reflected log transform)	3.5
Switching Trained	Task switching, trained stimuli	See task description for Task switching in Supplementary Table 6. The test consisted of four runs, which each involved judging 40 stimuli. The rule switched on 64 of the 160 trials (40% switch trials). The stimuli set consisted of a circle/rectangle with horizontal/vertical line and a consonant/vowel presented with an even/uneven number, which was used during training. Completion time was approximately 10 minutes.	Number correct per minute	n/a
	Rule switching, trained stimuli	See task description for Rule switching in Supplementary Table 6. The test consisted of four runs, which each involved sorting 58 stimuli. The rule switched on 64 of the 232 trials. The stimuli set consisted cards that could be sorted on the type/number and colour of the symbols on the cards, which was used during training. Two rules were required: type of symbols, colour of the symbols. Completion time was approximately 10 minutes.	Number correct per minute	n/a
Updating Untrained Stimuli	N-back, untrained stimuli	See task description for N-back in Supplementary Table 6. The test consisted of four runs of single 2-back and four runs of single 3-back. The stimuli set consisted of six photographic images (e.g. clouds, fire), which was not used during training. 192 stimuli were shown, of which 64 were targets (33%). Completion time was approximately 15 minutes.	(Number hits / total targets) + (number correct rejections/ total foils)	1.0
	Running span, untrained stimuli	See task description for Running span in Supplementary Table 6. Responses were required at 10 occasions at the 2-last dual level and at 10 occasions at the 3-last single level with a maximum number of correct per trial of 4 and 3, respectively. The stimuli set consisted of dice presented in different colours showing 1-3 pips, which was not used during training. Completion time was approximately 15 minutes.	Average number correct per trial	3.5
Switching Untrained Stimuli	Task switching, untrained stimuli	See task description for Task switching in Supplementary Table 6. The test consisted of four runs, which each involved judging 40	Number correct per minute	n/a

		stimuli. The rule switched on 64 of the 160 trials (40% switch trials). The stimuli set consisted of a coloured/black-white object that was edible/non-edible, which was not used during training. Completion time was approximately 10 minutes.		
	Rule switching, untrained stimuli	See task description for Rule switching in Supplementary Table 4. The test consisted of four runs, which each involved sorting 58 stimuli based on two rules. The rule switched on 64 of the 232 trials. The stimuli set comprised moving a ball into one of four locations using different schemas. Two rules were required: placement in the location just below the current location of the ball, placement in the location below-and-diagonal to the current location of the ball. Completion time was approximately 10 minutes.	Number correct per minute	n/a
Updating Untrained Task	Spatial updating	In each block of this task, first a display of three 3x3 was shown for 4000 ms in each of which one blue dot was present in one of the nine locations. Those four locations had to be memorized and updated according to shifting operations, which were indicated by arrows appearing below the corresponding field. Presentation time of the arrows was 3000 ms with an inter-stimulus interval of 250 ms. After six updating operations, the three grids reappeared and the resulting end positions had to be clicked on. Ten trials were included in the test. Completion time was approximately 10 minutes.	Average number correct per trial	3.0
	Numerical updating	Four single digits (ranging from 1 to 9) were presented simultaneously in four cells situated horizontally for 3000 ms. After an inter-stimulus interval of 250 ms, a sequence of eight updating operations were presented in a second row of four cells below the first one. These updating operations were additions and subtractions within a range -9 to +9. Each updating operation was applied to a different cell from the one a step earlier in the sequence, so that no two updating operations had to be applied to one cell in a sequence. Those updating operations had to be applied to the digits memorized from the corresponding cells above and the updated results had to be memorized. Ten trials were included in the test. Completion time was approximately 10 minutes.	Average number correct per trial	4.0
Switching Untrained Task	Spatial switching	One each trial a figure consisting of three circles connected by lines to form an arrow shape (< or >) was presented, with rightward pointing or leftward pointing arrow symbols inside of the circles. If the figure was presented at the bottom half of the screen, the task was to judge the direction of the arrow symbols inside of the circles. If the figure was presented at the top half of the screen, the task was to judge the direction of the arrow formation of the figure itself. The test consisted of four runs, which each involved	Number correct per minute	n/a

		judging 40 stimuli. The rule switched on 64 of the 160 trials (40% switch trials). Completion time was approximately 10 minutes.		
	Numerical switching	One each trial a figure consisting of three circles connected by lines to form an arrow shape (< or >) was presented, moving in a leftward or rightward direction. If a low (1-3) number was present in the circles, the task was to judge the movement of the figure. If a high (7-9) number was presented in the circles, the task was to judge the direction of the arrow formation of the figure itself. The test consisted of four runs, which each involved judging 40 stimuli. The rule switched on 64 of the 160 trials (40% switch trials). Completion time was approximately 10 minutes.	Number correct per minute	n/a
Spatial reasoning	Ravens progressive matrices	The task involved completing as many of the 18 trials within a 12-minute time limit. Each trial consisted of increasingly complex visual geometric designs with a missing piece. The task was to select the missing piece from eight alternatives.	Number correct within time limit	18
	WASI-II matrices	The task involved completing as many of the 30 trials within a 15-minute time limit. Each trial consisted of increasingly complex visuospatial objects with a missing piece. The task was to select the missing piece from five alternatives.	Number correct within time limit	30
	BETA-III matrices	The task involved completing as many of the 25 trials within a 10-minute time limit. Each trial consisted of increasingly complex visual geometric designs with a missing piece. The task was to select the missing piece from five alternatives.	Number correct within time limit	25
Verbal reasoning	ETS kit verbal inference	The task involved completing as many of the 20 verbal inference trials as possible within a 12-minute time limit. The task involved selecting the valid conclusion given the information given in a verbal statement. Example trial: One year a particular farmer's stand of wheat yielded 40 bushels per acre. 1) The farmer's land is extremely fertile 2) The farmer has raised wheat on his land 3) The weather that year was unfavourable for growing wheat 4) Forty bushels per acre is a high yield 5) The field would be more suitable for some other crop	Number correct within time limit	20
	BIS analogies	The task involved completing as many of the twelve analogies within a 5-minute time limit. The task involved finding completing analogies. Example trial: Newspaper is to text as speaker is to 1) sound 2) song 3) news 4) listening 5) stereo	Number correct within time limit	12
	Syllogisms	The task involved completing as many of the 30 syllogism trials within a 20-minute time limit. The task on each trial was to decide whether the conclusion that followed the premises was valid or not. Example trial: All trees are fish. All fish are horses. Therefore all trees are horses. 1) valid conclusion 2) invalid conclusion		30
Episodic memory	Spatial memory	Sequences of 12 colored photographs of real-world objects were displayed at different locations in a 6x6 grid. Each photograph was	Number correct	24

		presented for 8000ms with an inter-stimulus interval of 1000ms. After presentation, objects appeared at the right side of the screen and had to be moved in the correct order to the correct locations by clicking on the objects and the locations with the computer mouse. Two trials were included in the test.		
	Verbal memory	Sequences of 16 nouns were presented in the middle of the screen. Each noun was presented for 6000ms with an inter-stimulus interval of 1000ms.After presentation, the nouns had to be recalled by typing in the word into a blank field. Two trials were included in the test.	Number correct	32
Sustained attention	Temporal expectancy task version 1	The task involved a black-and-white pattern of small triangles, which shifted direction after a standard presentation time of 800ms. The task was to detect when the presentation time had been extended to 1070ms. The task comprised five 4-minute blocks. Each block had 286 trials, of which 24 were targets (8%). Number of hits were expected to decrease linearly for each sequential block. Completion time was approximately 25 minutes.	Individual slope coefficient	n/a
	Temporal expectancy task version 2	The task involved a blue-and-yellow pattern of waves, which shifted direction after a standard presentation time of 800ms. The task was to detect when the presentation time had been extended to 1070ms. The task comprised five 4-minute blocks. Each block had 286 trials, of which 24 were targets (8%). Number of hits was expected to decrease linearly for each sequential block. Completion time was approximately 25 minutes.	Individual slope coefficient	n/a
Perceptual speed	Perceptual matching, trained stimuli	See task description for Perceptual matching in Supplementary Table 6. The test consisted of four runs with 50 trials in each run. 50% of the 4-item stimuli strings were identical and 50% were different. For different string pairs, one item in the string differed. The stimuli set comprised letters, which was included in the control training. Completion time was approximately 10 minutes.	Number correct per minute	n/a
	Perceptual matching, untrained stimuli	See task description for Perceptual matching in Supplementary Table 6. The test consisted of four runs with 50 trials in each run. 50% of the 4-item stimuli strings were identical and 50% were different. For different string pairs, one item in the string differed. The stimuli set comprised a set of 3d figures, which was not included in the control training. Completion time was approximately 10 minutes.	Number correct per minute	n/a

S4. Detailed descriptions of training tasks.

Working Memory Training		
Trained domain	Task	Task description
Updating	N-back	Stimuli were presented on the screen, one by one, and the task was to press a button whenever the currently shown stimulus was the same as the one presented N steps back in the series. Difficulty was varied by the number of steps (2-back, 3-back) and whether the stimuli were evaluated based on one or two aspects of the stimuli (single, dual). For example, a dual 2-back task required participants to base their decision on the word *and* the colour of the stimulus (targets marked with *): sofa, football, chest, football*, tree*, sofa, football, sofa*. The four stimuli sets included words and colours, shape and patterns, shape and position in a 3x3 grid, and, number and position in a 3x3 grid. With the exception of position, which included 9 items, stimuli sets consisted of six items. Each stimulus was presented for 2250ms with an interstimulus interval of 250ms. 24 stimuli were presented for each of the eight 1-minute runs with an average of 30% of the stimuli in a run representing targets. Level criteria were expressed as number correct for each run, with both hits and correct rejections contributing to the score.
Updating	Running span	Stimuli were presented on the screen, one by one, and the task was to remember the N last stimuli. The difficulty was varied by how many stimuli that had to be remembered (2 last, 3 last) and by presenting one or two series of stimuli simultaneously (single, dual). For example, a 2-last dual task required participants to indicate the two last pairs of stimuli whenever the stimuli stream stopped (targets marked with *): money-chair, money-car, ball-chair, elephant*-plane*, elephant*-car* (stimuli presented as images). The four stimuli sets included two image sets like in the example, letter and shape, word and colour, and, number and position in a 3x3 grid. With the exception of position, which included 9 items, stimuli sets consisted of three items. Each stimulus was presented for 2000 ms with an inter-stimulus interval of 250 ms. For each of the three runs, a response was required 8 times. At response, all stimuli items were presented and participants responded by clicking the items in the correct order within 8 seconds. Level criteria were expressed as number correctly identified stimuli items for each run.
Switching	Task switching	Stimuli were presented on the screen, one by one, underneath one-word questions present on the screen. The questions specified which aspect of the stimulus to attend to and on which criteria to make a judgment. For example, the question "vowel?" required attention to the letter in the stimuli item "E4" and to make a judgment according to whether the letter

		was a vowel or not. If the next stimulus was presented underneath a different question, participants were required to switch their attention. Difficulty level was varied by number of stimuli types per set (one, two), number of questions per stimuli type (one, two) and the frequency at which the stimuli was presented underneath a different question (every 3-4 trial, every 2-3 trials, every 1-2 trials). Each of the four stimuli sets included two stimuli types with two aspects each: a circle/rectangle with horizontal/vertical line and a consonant/vowel presented with an even/uneven number, a triangle/pentagon with dots/stripes and a word representing an animal/transport with more/less than six letters, small triangles/squares making up a larger triangle/square and a number lower/higher than seven written in capital/lowercase letters, and, two ellipses of the same/different size presented vertically/horizontally and a word/non-word presented in italic/non-italic font. Once a response was made the next stimulus was presented. Level criteria were expressed as number correctly answered questions within the eight 1-minute runs.
Switching	Rule switching	Stimuli were presented on the screen, one by one, and the task was to sort the stimuli into four categories presented at the bottom of the screen according to different rules given to participants before each run. For example, cards were required to be sorted based on the number or colour of the symbols on the card. Participants received feedback on each trial on whether the correct rule had been selected or not, requiring a switch to a different rule when given an error. Difficulty level was varied by the number of rules (2, 3) and how often the rule changed (every 4-5 trials, every 3-4 trials). The four stimuli sets included objects that could be sorted by object/colour/ownership, cards that could be sorted on the type/number and colour of the symbols on the cards, cards that could be sorted on the pattern of the background/circle/triangle shapes on the cards and words that could be sorted on the word/colour/category of the word. Once a response was made the next stimulus was presented. Level criteria were expressed as number of correctly sorted stimuli within the eight 1-minute runs, allowing for one error after a rule switch.
Perceptual speed (control) training		
Perceptual speed	Perceptual matching	Pairs of 4-item stimuli strings were presented and the task was to decide whether they were identical or not as quickly as possible. Difficulty was varied by the number of items in the stimuli string that differed (1, 2, 3, 4) and an increased requirement for speed (more correct trials required per run). Once a response was made the next stimulus was presented. Level criteria were expressed as number of correct trials within the 1-minute runs. There were four different task versions, designed to give an equivalent impression to the four tasks used for the working memory training, that differed in regards to the

		stimuli presented: numbers, letters, colours and 3D figures. There were eight 1-minute runs per task version per training session.

S5. Details regarding difficult levels in the training tasks.

N-back level	Level description	Criterion (max)	**Task switching level**	Level description		Criterion
1	single, 2-back	20 (24)	1	2 stim type, 1 question/stim type	SF every 3-4 trials	40
2	single, 2-back	20 (24)	2	1 stim type, 1 question/stim type	SF every 3-4 trials	40
3	single, 2-back	20 (24)	3	2 stim type, 2 questions/stim type	SF every 3-4 trials	40
4	single, 2-back	20 (24)	4	1 stim type, 2 question/stim type	SF every 3-4 trials	40
5	single, 3-back	20 (24)	5	2 stim type, 1 question/stim type	SF every 2-3 trials	40
6	single, 3-back	20 (24)	6	1 stim type, 1 question/stim type	SF every 2-3 trials	40
7	single, 3-back	20 (24)	7	2 stim type, 2 questions/stim type	SF every 2-3 trials	40
8	single, 3-back	20 (24)	8	1 stim type, 2 question/stim type	SF every 2-3 trials	40
9	dual, 2-back	40 (48)	9	2 stim type, 1 question/stim type	SF every 1-2 trials	40
10	dual, 2-back	40 (48)	10	1 stim type, 1 question/stim type	SF every 1-2 trials	40
11	dual, 2-back	40 (48)	11	2 stim type, 2 questions/stim type	SF every 1-2 trials	40
12	dual, 2-back	40 (48)	12	1 stim type, 2 question/stim type	SF every 1-2 trials	40
13	dual, 3-back	40 (48)	13	1 stim type, 2 question/stim type	SF every 1-2 trials	40
14	dual, 3-back	40 (48)	14	1 stim type, 2 question/stim type	SF every 1-2 trials	40
15	dual, 3-back	40 (48)	15	1 stim type, 2 question/stim type	SF every 1-2 trials	40
16	dual, 3-back	40 (48)	16	1 stim type, 2 question/stim type	SF every 1-2 trials	40

Running span level	Level description	Criterion (max)	**Rule switching level**	Level description		Criterion
1	single, 2-last	12 (14)	1	2 rules	SF every 4-5 trials	36
2	single, 2-last	12 (14)	2	2 rules	SF every 4-5 trials	36
3	single, 2-last	12 (14)	3	2 rules	SF every 4-5 trials	36
4	single, 2-last	12 (14)	4	2 rules	SF every 4-5 trials	36
5	single, 3-last	18 (21)	5	2 rules	SF every 3-4 trials	36
6	single, 3-last	18 (21)	6	2 rules	SF every 3-4 trials	36
7	single, 3-last	18 (21)	7	2 rules	SF every 3-4 trials	36
8	single, 3-last	18 (21)	8	2 rules	SF every 3-4 trials	36
9	dual, 2-last	25 (28)	9	3 rules	SF every 4-5 trials	36
10	dual, 2-last	25 (28)	10	3 rules	SF every 4-5 trials	36
11	dual, 2-last	25 (28)	11	3 rules	SF every 4-5 trials	36
12	dual, 2-last	25 (28)	12	3 rules	SF every 4-5 trials	36
13	dual, 3-last	35 (42)	13	3 rules	SF every 3-4 trials	36
14	dual, 3-last	35 (42)	14	3 rules	SF every 3-4 trials	36
15	dual, 3-last	35 (42)	15	3 rules	SF every 3-4 trials	36
16	dual, 3-last	35 (42)	16	3 rules	SF every 3-4 trials	36

Perceptual matching level	Level description	Criterion
1	4 items differ	35 (no max)
2	4 items differ	ind score +2
3	4 items differ	ind score +2
4	4 items differ	ind score +2
5	3 items differ	35 (no max)
6	3 items differ	ind score +2
7	3 items differ	ind score +2
8	3 items differ	ind score +2
9	2 items differ	35 (no max)
10	2 items differ	ind score +2
11	2 items differ	ind score +2

12	2 items differ	ind score +2
13	1 item differs	35 (no max)
14	1 item differs	ind score +2
15	1 item differs	ind score +2
16	1 item differs	ind score +2

Note that the working memory training (N-back, Task Switching, Running Span, Rule Switching) alternated between four stimuli sets before difficulty was increased . Four versions of the Perceptual Matching task, implementing different stimuli sets, constituted the control training. The criterion for each difficulty for the control training (4-1 items differ) was fixed for the first level and then based on the individual score. SF = switching frequency.

S6. Descriptive statistics for the cognitive test battery measures used for evaluating the effects of the intervention period, at pretest and posttest, separately for the four experimental groups.

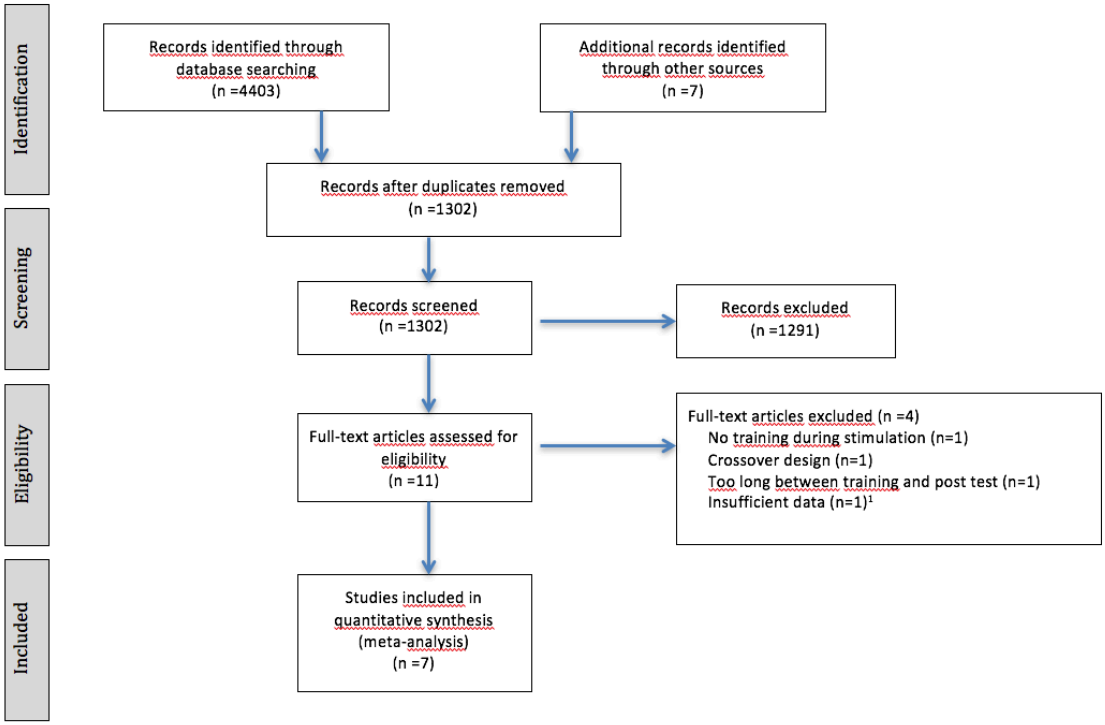
		tDCS + working memory						sham + working memory						tDCS + control						sham + control					
		Pre			Post			Pre			Post			Pre			Post			Pre			Post		
Domain	**Task**	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*	*Mean*	*SD*	*n*
Trained Updating	Running span	1,272	0,181	32	1,371	0,138	31	1,289	0,140	33	1,391	0,116	33	1,294	0,161	30	1,309	0,158	30	1,262	0,122	28	1,308	0,134	28
	N-back	0,713	0,083	32	0,795	0,081	31	0,741	0,071	32	0,822	0,059	32	0,727	0,079	30	0,744	0,082	30	0,706	0,086	28	0,753	0,080	28
Trained Switching	Task switching	30,785	8,562	32	51,981	11,841	31	32,786	7,318	33	53,997	10,774	33	29,694	8,414	30	37,298	8,655	30	28,981	8,312	28	39,141	6,613	28
	Rule switching	22,404	9,258	32	44,212	11,851	31	22,588	7,184	33	44,960	11,540	33	22,075	8,054	30	26,645	8,837	30	21,276	7,829	28	27,356	8,054	28
Updating Untrained Stimuli	Running span	1,295	0,162	32	1,451	0,158	31	1,291	0,154	33	1,479	0,115	33	1,310	0,163	30	1,352	0,173	30	1,276	0,119	28	1,310	0,124	28
	N-back	0,715	0,092	32	0,792	0,093	31	0,714	0,084	33	0,840	0,041	31	0,699	0,090	30	0,723	0,098	30	0,683	0,101	27	0,743	0,096	27
Switching Untrained Stimuli	Task switching	24,717	8,203	32	43,800	12,345	31	25,570	7,143	33	43,963	9,936	33	23,812	8,413	30	30,592	8,512	30	23,354	7,309	28	31,134	8,508	28
	Rule switching	38,799	15,529	32	58,328	14,552	31	38,603	11,573	33	59,104	10,997	33	34,356	12,611	30	45,610	14,189	30	36,679	10,939	28	46,658	12,070	28
Updating Untrained Task	Spatial updating	1,166	0,495	32	1,306	0,621	32	1,172	0,537	32	1,278	0,503	32	0,997	0,452	30	1,243	0,561	30	1,111	0,563	28	1,204	0,587	28
	Numerical updating	1,878	0,833	32	2,203	0,905	32	1,933	0,840	33	2,318	0,948	33	1,893	0,989	30	2,167	0,973	30	1,782	0,773	28	2,086	0,697	28
Switching Untrained Task	Spatial Switching	30,160	12,323	32	42,621	13,622	32	29,775	10,748	33	44,540	11,566	33	29,300	11,501	30	39,101	11,852	30	28,234	9,954	28	39,904	10,744	28
	Numerical Switching	36,562	14,190	32	45,628	13,649	32	37,357	11,099	33	46,666	13,107	33	33,313	9,960	30	41,379	11,541	30	32,950	10,836	28	42,367	12,921	28
Spatial Reasoning	Ravens Progressive Matrices	7,060	2,723	32	7,880	2,860	32	6,880	2,355	33	8,090	2,754	33	6,970	3,023	30	8,000	2,393	30	6,930	2,260	28	7,540	2,617	28
	WASI-II Matrices	21,220	3,405	32	21,340	3,442	32	21,840	2,343	32	21,660	2,280	32	20,700	3,515	30	21,170	3,395	30	21,460	2,442	28	21,180	3,056	28
	BETA-III Matrices	17,750	3,877	32	17,910	3,675	32	17,520	3,607	33	19,090	2,708	33	17,600	3,692	30	17,900	3,881	30	18,180	2,868	28	18,210	3,213	28
Verbal Reasoning	BIS Analogies	5,620	2,268	32	5,840	2,424	32	5,150	2,224	33	5,560	2,422	32	4,970	2,428	30	5,630	2,526	30	5,290	2,123	28	5,960	2,516	28
	Syllogisms	18,160	3,993	32	17,690	3,450	32	17,760	4,528	33	18,360	3,723	33	16,830	4,997	30	17,970	4,165	30	16,750	4,351	28	18,040	3,930	28
	ETS Kit Verbal Inference	10,440	4,056	32	11,970	3,641	32	10,700	4,027	33	11,270	4,025	33	9,700	4,625	30	11,470	4,015	30	10,070	3,925	28	11,360	3,456	28
Episodic Memory	Verbal Memory	16,560	4,508	32	16,970	5,294	32	17,090	4,489	33	16,120	5,331	33	17,330	4,113	30	17,100	5,827	30	16,390	5,600	28	17,320	6,159	28
	Spatial Memory	12,690	3,921	32	13,840	3,638	32	13,030	3,828	33	13,520	3,743	33	13,370	2,895	30	13,630	3,146	30	12,180	3,255	28	13,180	3,732	28
Sustained Attention	Temporal Expectancy Task 1	0,224	0,149	31	0,217	0,114	31	0,190	0,137	33	0,162	0,131	33	0,184	0,132	30	0,184	0,126	30	0,177	0,139	28	0,215	0,116	28
	Temporal Expectancy Task 2	0,244	0,135	32	0,201	0,129	31	0,177	0,124	33	0,142	0,119	31	0,194	0,119	30	0,200	0,144	30	0,116	0,128	27	0,239	0,147	28
Perceptual Speed	Perceptual matching trained	25,798	4,355	32	28,513	5,635	31	26,535	5,108	33	29,676	6,834	33	25,152	6,523	30	28,676	8,849	30	25,725	6,318	28	29,308	8,821	28
	Perceptual matching untrained	20,355	6,090	32	25,239	7,697	31	19,327	5,507	33	24,488	6,574	33	18,185	6,678	30	22,772	9,657	30	19,927	6,193	28	23,350	8,483	28

S7. Model fit for the eight considered latent change score models.

	χ^2 difference test			
Variable	χ^2 (df,n)	p	RMSEA	CFI
Updating Trained [1]	10.59 (10,123)	0.390	0.022	0.998
Switching Trained [3]	5.665 (6,123)	0.462	0.001	1.000
Updating Untrained Stimuli [1]	12.052 (9,123)	0.210	0.053	0.987
Updating Untrained Task [1]	6.736 (9,123)	0.665	0.001	1.000
Spatial reasoning [3]	24.961 (19,123)	0.162	0.051	0.970
Verbal reasoning [2]	24.04 (21,123)	0.291	0.034	0.992
Episodic memory [3]	5.337 (6,123)	0.501	0.001	1.000
Perceptual speed [3]	4.494 (6,123)	0.610	0.001	1.000

Fit indices are reported at the strict [1], strong [2] or weak [3] level of measurement invariance. RMSEA=root mean square error of approximation. CFI=comparative fit index. A non-significant χ^2 difference test, an RMSEA of less than 0.06 and a CFI of more than 0.95 indicates good fit of the model.

S8. Literature search flow.



[1]The study excluded due to insufficient data (Park, Seo, Kim, & Ko, 2014) met other inclusion criteria, but reported a very low standard deviation (a suspected typo) for one of the tasks at baseline (Table 2, digit span forward, sham group), which would, with our way of calculating net effect sizes, bias the effect size from this study towards a large negative effect of anodal stimulation. Because uncertainty on the accuracy of this data and with data on several other administered tasks also not being reported in the article, we decided to not include this study in the meta-analysis (despite repeated attempts, the authors also did not respond to our questions).

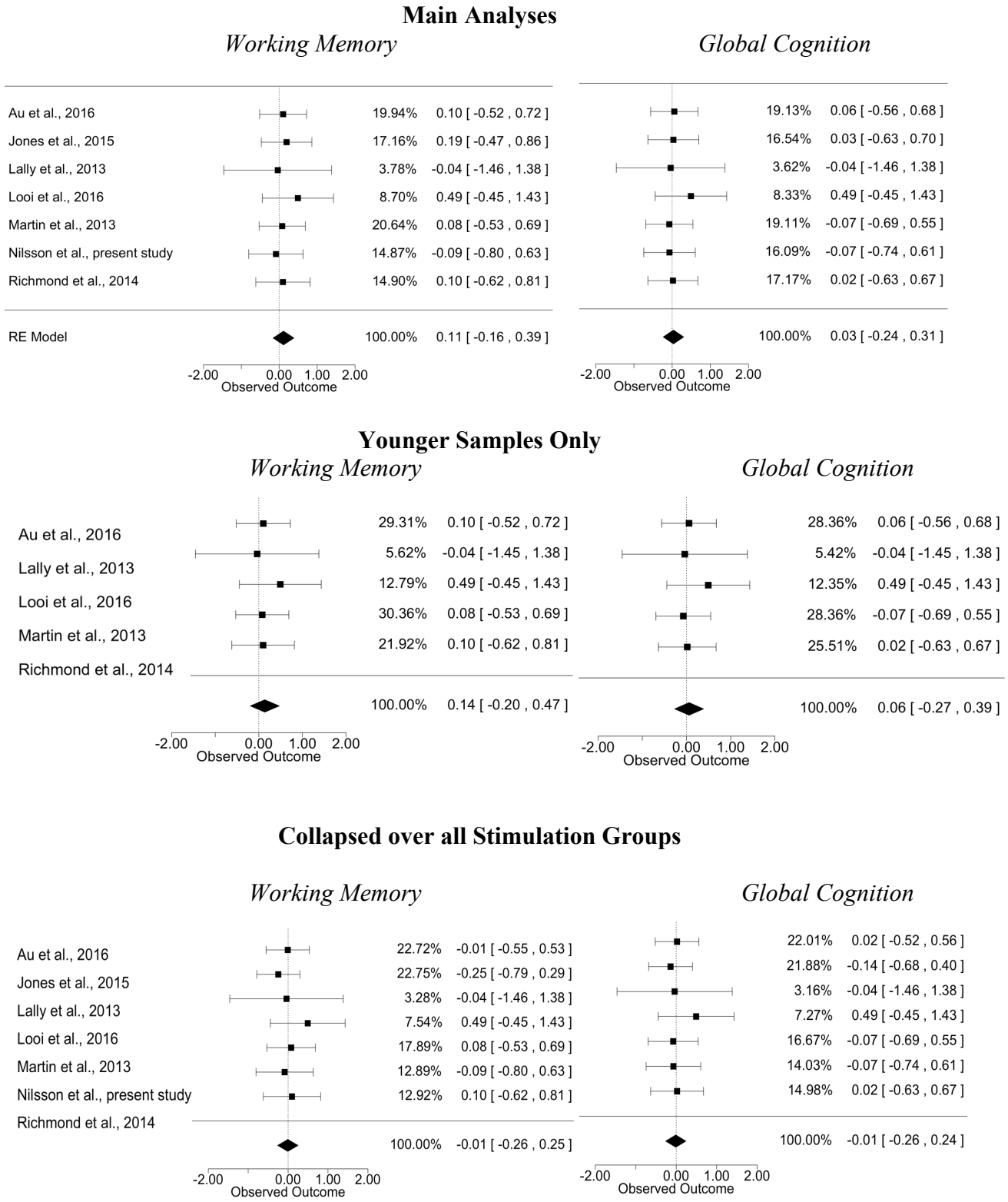
S9. Outcome measures selected for calculation of effect sizes for meta-analysis.

Study	***Outcome task***	***Selected outcome measure***
Au et al., (2016)	N-back* Digit span* Block-tapping task* AX-Continuous Performance Task	Hit rate minus false alarm rate Total number of trials correctly repeated in forward and backwards versions Total number of trials correctly reproduced in forward and backwards versions Percentage accuracy during "AY" trials
Jones et al., (2015)	Digit span* N-back* Stroop	Maximum numbers rememberd Correct hits and correct false alarm Reaction times
Lally et al., (2013)	N-back*	d´value[1]
Looi et al., (2016)	Digit span* Corsi blocks*	Maximum numbers correct in forward and backwards versions Maxmium blocks correct in forward and backwards versions
Martin et al., (2013)	Digit span* Serial sevens* Letter number sequencing* Trail Making Test A&B Controlled Oral Word Association Test Simple and choice Reaction Times	Maximum numbers correct, forward and backwards together Time in seconds to complete the task Maximum length of sequences correct Total time for completion Numbers of words produced Average response time in milliseconds
Nilsson et al., (2016)	BIS Analogies Ravens Advanced Matrices Syllogisms Beta-III matrices Wasi-II matrices ETS kit Verbal inference Spatial memory Verbal memory Spatial updating* Numerical updating* Spatial switching* Numerical switching* Temporal expectancy task version 1 Temporal expectancy task version 2 N-back trained* N-back untrained* Taskswitching trained* Taskswitching untrained* Rule switching trained* Rule switching untrained* Running span trained* Running span untrained* Perceptual matching trained Perceptual matching untraind	Number correct within time limit Number correct within time limit Number correct within time limit Number correct within time limit Number correct within time limit Number correct within time limit Number correct Number correct Average number correct per trial Average number correct per trial Number correct per minute Number correct per minute Individual slope coefficient Individual slope coefficient (Number hits / total targets) + (number correct rejections/ total foils) (Number hits / total targets) + (number correct rejections/ total foils) Number correct per minute Number correct per minute Number correct per minute Number correct per minute Average number correct per trial (reflected log transform) Average number correct per trial (reflected log transform) Number correct per minute Number correct per minute
Richmond et al ., (2014)	Automated Operation Span* Automated Symmetry Span* Stroop Antisaccade Psychomotor Vigilance Task Sustained Attention Response Task Ravens California Verbal Learning Test Nelson-Denny Reading Test	The sum of all perfectly recalled sets The sum of all perfectly recalled sets ACC cost accuracy ACC cost accuracy Response time for correct trials Response time for correct trials Total correct answers Number of correct answers Number of correct answers

* Tasks selected for the analysis focusing on working memory performance

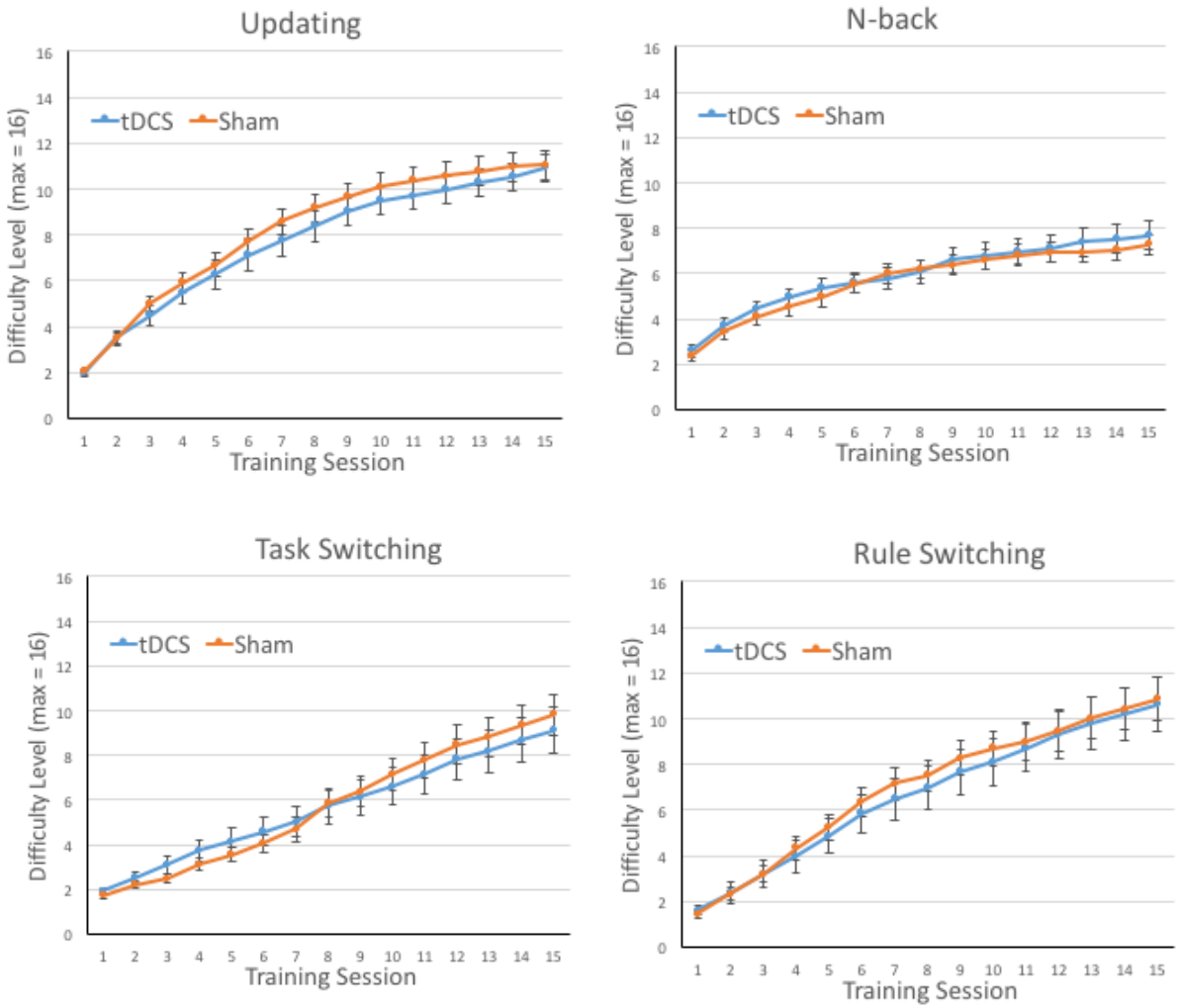
[1] Data was not available in tables, authors did not respond upon request for this data. Values were estimated from plot in the article (page 6) using software Plot Digitizer (version 2.6.8; Huwaldt, 2015)

S10. Results of main meta-analyses using pooled standard deviations at pretest (d_{ppc2} in Morris, 2008) for standardizing the effects.

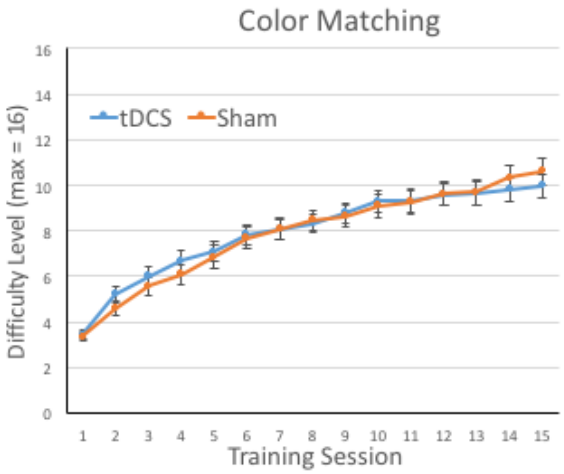


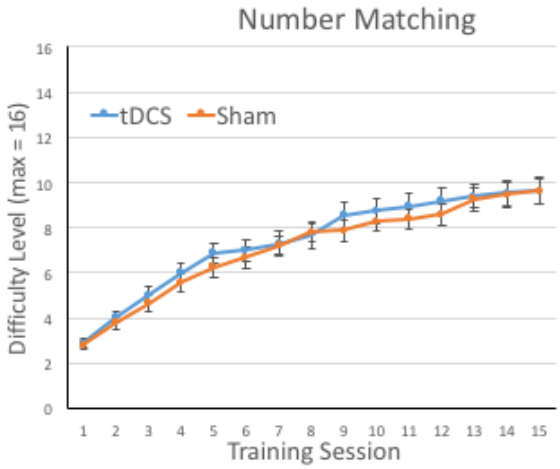
SOM11. Average (+-SEM) maximum level of difficulty reached in each training task as a function of training session and stimulation group (tDCS vs. Sham) for the groups training working memory (A) and perceptual matching (B). Although average number of completed session were 19, the subject with the fewest sessions had 15 session completed, which is the reason for displaying the first 15 sessions only (where data is complete). Statistical analyses with a mixed 2 (stimulation group; tDCS vs. Sham) by 15 (training; training session 1-15) ANOVA (with linear and quadratic contrasts for training), revealed statistically significant main effects of training for all measures (all *ps* < .001), but no statistically significant effects of stimulation (all *ps* > *.261)* and no stimulation x training interaction (all *ps* > *.088)*. Comparisons between stimulation groups run separately for each training session showed no statistically significant effects (all *ps* > .055).

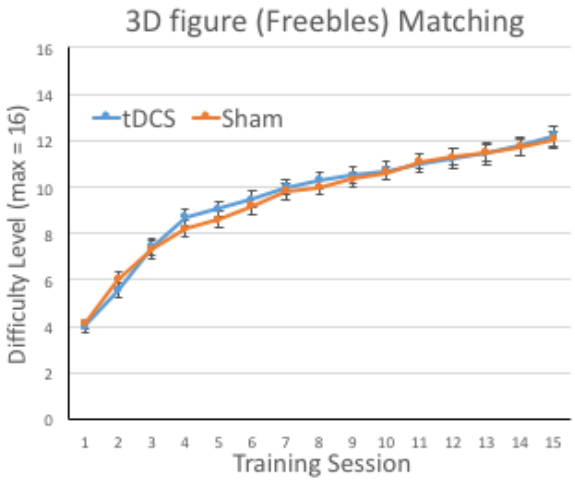
A. Working Memory Training

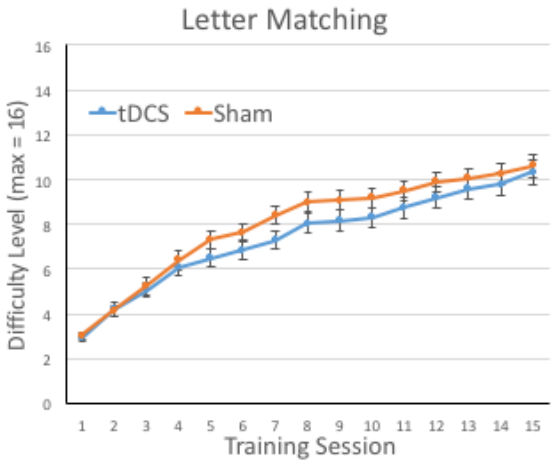


B. Perceptual-Matching Training









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SOM12. Description of studies included in meta-analysis, including a reference list.

Study	*Sample size tDCS (m/f)*	*Sample size sham (m/f)*	*Mean age tDCS (SD)*	*Mean age sham (SD)*	*Anode*	Cathode	*Current intensity (mA)*	*Current density (mA/cm2)*	*Duration*	*Training type (adaptive)*	*Training duration*	*Online/ Oflline*[1]	*Blinding*[2]	*No of session*
Au et al., (2016)	20 (9/11)	22 (8/14)	21.55 (2.86)*	20.52 (1.93)	F3	Contralateral supraorbital	2	0.057	25 min,	Working memory (adaptive)	20-25 min	Online	Single, assessed	7 over 2 weeks
Jones et al., (2015)	18	18	63.94 (4.30)	64.33 (5.24)	F4	Contralateral cheek	1.5	0.043	10 min	Working memory (non-adaptive)	60 min	Offline	Single, assessed	10 over 2 weeks
Lally et al., (2013)	10	11	23.09 (3.85)*		F3	Contralateral cheek	1	0.029	10 min	Working memory (non-adaptive)	20 min	Online	Double, not assessed	2 over 2 days
Looi et al., (2016)	10 (4/6)	10 (2/8)	24.6 (3.8)*	23.9 (2.5)	F4	F3	1	0.04	30 min	Mathematical (adaptive)	30 min	Online	No info	2 within 3 days
Martin et al., (2013)	21 (12/9)	21 (13/8)	23.1 (2.78)*	23.2 (6.80)	F3	Right deltoid muscle	2	0.057	30 min	Working memory (adaptive)	25 min	Online	Single, assessed	10 over 2 weeks
Nilsson et al., (2016)	32 (16/16)	33 (11/22)	69.31 (2.73)	69.64 (2.97)	F3	Contralateral supraorbital	2	0.057	25 min	Working memory (adaptive)	45 min	Online	Double, assessed	20 over 4 weeks
Richmond et al., (2014)	20 (7/13)	20 (7/13)	20.7*	20.7	F3	F4	1.5	0.043	15 min	Working memory (adaptive)	30 min	Online	Single, not assessed	10 over 2 weeks

[1] Online = stimulation administered in direct conjunction with training, Offline = stimulation administered before training.
[2] Single = participants blinded to stimulation, Double = participants and experimenters blinded to stimulation
* Studies included in the subanalysis focusing on young test samples only
Age descriptives in the Lally et al., (2013) study were only available for the full sample.

Studies included in meta-analysis

Au J, Katz B, Buschkuehl M, Bunarjo K, Senger T, Zabel C, Jaeggi SM, Jonides J. 2016. Enhancing Working Memory Training with Transcranial Direct Current Stimulation. J Cogn Neurosci 28:1419-1432.

Jones KT, Stephens JA, Alam M, Bikson M, Berryhill ME. 2015. Longitudinal neurostimulation in older adults improves working memory. Plos One 10:e0121904.

Lally N, Nord CL, Walsh V, Roiser JP. 2013. Does excitatory fronto-extracerebral tDCS lead to improved working memory performance? F1000Res 2:219.

Looi CY, Duta M, Brem AK, Huber S, Nuerk HC, Cohen Kadosh R. 2016. Combining brain stimulation and video game to promote long-term transfer of learning and cognitive enhancement. Scientific reports 6:22003.

Martin DM, Liu R, Alonzo A, Green M, Player MJ, Sachdev P, Loo CK. 2013. Can transcranial direct current stimulation enhance outcomes from cognitive training? A randomized controlled trial in healthy participants. Int J Neuropsychopharmacol 16:1927-1936.

Richmond L, Wolk D, Chein J, Olson IR. 2014. Transcranial Direct Current Stimulation Enhances Verbal Working Memory Training Performance over Time and Near-transfer Outcomes. J Cogn Neurosci.