

Multi-level meta-analysis of whether fostering creativity during physical activity interventions increases their impact on cognitive and academic outcomes during childhood

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Table S1.

	Lower creativity	Higher creativity	0	1	2
TASK CHARACTERISTICS	Repetitive	Varied	Block training such as learning a set move in ballet or forehand swing in tennis until it is mastered.	A mixture of the two.	A variety of activities to learn. Using different tennis games with different rules to master a forehand.
	1. Individual 2. Parallel 3. No opponent	1. Group 2. Team 3. Opponent	Practicing individually with no interaction with others such as an aerobics class.	A mixture of the two.	Interaction with someone whether that be competitively or not.
	Technical acquisition	Real world activity	Drills to master motor skills.	A mixture of the two.	A sport or holistic movement activity practiced as it is e.g. tennis or martial arts.
	Convergent task	Divergent task	Does not allow for exploration and is prescriptive. For example, copying in ballet.	A mixture of the two.	Allows for exploration such as PA games or creative movement.
ENVIRONMENT	Technical instruction and demonstration	Open-ended instruction	Copying the teacher's movements. For example, in a dance choreography or aerobics class.	A mixture of the two.	Open-ended instructions include " <i>Show me any kind of...</i> ", " <i>Show me any other way to...</i> ", " <i>How would you do that differently?</i> "
	Fixed space	Open space	Court, swim lanes or track.	A mixture of the two.	An indoor or outdoor space with changing boundaries or no boundaries.
	No props	Props	Use of just the body. For example, aerobics class such as cross fit.	A mixture of the two	Music in dance or balls in sports.

Table S2. Search Terms

Intervention	Population	Setting	Design	Outcomes
danc*	child*	class*	train*	acad*
gymnas*	NOT ADHD	school	practice	achiev*
physical* active	NOT autis*		curriculum	attain*
activity	NOT obes*		intervention	math*
PE			teach*	numeracy
sport			instruct*	literacy
fitness			class	reading
exercis*			trial	cognit*
creativity creative				executive function
theat*				attention*
				inhibit*
				flexibility
				switch*
				shift*
				plan*
				working memory
				updating

Table S3. Eligibility Criteria

	Inclusion Criteria	Exclusion Criteria
Population	Participants aged between 5 and 12 years old	Participants with a developmental delay, developmental disorder, obesity, physical or mental illness
Intervention	Physical activities (PA), defined as any activity that encourages children to move PA programs that were manipulated within the study and included a minimum of three sessions over the course of more than one week.	Single bouts of PA PA that is considered elite training An activity that is creative but does not include PA (e.g. painting, drawing, music)
Comparison	Active or passive control group	No comparison group
Outcomes	Direct assessment using objective or standardised measures of cognitive outcomes (working memory, inhibitory control, cognitive flexibility, planning, attention, fluid intelligence, creativity or on-task behaviour) or academic achievement (mathematics or language)	Subjective measures such as surveys, questionnaires, or interviews that are self-report or completed by teachers or parents Objective measures of other aspects of cognition (e.g. IQ)
Study Design	Randomised controlled trials (RCTs), pilot-, cluster-, or quasi-RCTs, controlled before and after studies	Observational studies (e.g., cross-sectional, cohort, case-control), quasi-experimental studies, non-randomised control trials, or case studies
Publication	Peer-reviewed Written in English	Reviews, editorials, policy reviews, statements, or commentaries

Table S4. Study Characteristics

Study	n	M age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
Aadland et al. 2019	1202	10.2	-	Active Smarter Kids (PA with academic instruction)	20	3	MVPA	30	Classroom teacher (LQ)	PE	Strong	Language Maths	Standardised national test
Ahamed et al. 2007	287	10.2	50.2%	AS! BC (PA break from academic instruction)	50	5	MPA	15	Classroom teacher (LQ)	PE		AA composite	Canadian Achievement Test (CAT-3)
Barnard et al. 2014	149	7.4	53.0%	Integrated PA (PA with academic instruction)	8	3	LPA	30	Not reported (LQ)	1. Intensive PA 2. Passive	Weak	Language Maths	ESSI Reading ESSI Spelling Vassi Mathematical Skills
Beck et al. 2016	165	7.5	46.7%	Gross Motor Math (PA with academic instruction)	6	3	LMPA	60	Classroom teacher (LQ)	1. Fine Motor Math (not PA) 2. Academic Instruction		Inhibitory control Maths Working memory	Eriksen Flanker Task Standardised test CANTAB: Spatial Span subset
Beckmann et al. 2022	481	8.1	49.0%	KazKidz	12	2	Cannot tell		HQ	Placebo	Strong	Inhibitory control Language Maths	Eriksen Flanker Task School Performance Test
Bugge et al. 2018	1181	8.4	53.3%	PE Boost	234	4	cannot tell	45	PE teachers (HQ)	PE		Language Maths	Danish National Test System
Bunketorp et al. 2015	545	-	46.4%	School-in-Motion: different sports and games with or without use of equipment	8	2	MVPA	30	Experienced exercise instructor (HQ)	PE	Moderate	Language Maths	Standardised national test
Cecchini & Carriedo 2020	46	6.4	58.7%	math-PE integrated teaching	3	5	MVPA	60	PE teachers (HQ)	PE		Maths	Standardised test
Chaddock-Heyman et al. 2013	23	8.9	56.5%	Fitness Improves Thinking in Kids (FIT Kids) (Aerobic)	30	5	MVPA	120	University staff (HQ)	Passive	Weak	Inhibitory control	Eriksen Flanker Task
Chaddock-Heyman et al. 2020	150	8.5	54.3%	Fitness Improves Thinking in Kids (FIT Kids) (Aerobic)	30	5	MVPA	120	University staff (HQ)	Passive		Fluid intelligence Language Maths	Kaufman Test of Educational Achievement WJ III: Concept Formation, Planning, Verbal Comprehension, Visual Auditory Learning

Study	n	Age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
Chaya et al. 2012	193	7.7	49.7%	Yoga	12	6	LPA	45	Experienced yoga teacher (HQ)	PA - passive stretching and aerobic exercises (running and group games)	Strong	Fluid intelligence Language Maths	Malinas Intelligence Scale for Indian Children (MISIC). Indian adaptation of the WISC-II.
Cichy et al. 2020	47	7	44.7%	PE with Eduball	39	2	cannot tell	45	Classroom teacher (LQ)	PE	Moderate	Maths	Standardised national test
Coe et al. 2006	214	11.5	49.0%	PE	20	5	cannot tell	55	Not reported (LQ)	Alternative exploratory class (i.e., arts and computer classes)	Weak	AA composite	Standardised national test
Condello et al. 2021	181	10.7	50.0%	Games-based Multisport		1	Cannot tell		HQ	PE	Moderate	Inhibitory control Working memory	Random Number Generation Task
Crova et al. 2014	70	9.6	50.0%	Tennis skill-based training	21	1	MVPA	120	PE teachers (HQ)	PE	Weak	Inhibitory control Working memory	Random Number Generation Task
D'Souza & Wiseheart 2018	75	7.8	58.7%	Dance: Creative Movement	3	5	MPA	120	Experienced dance teacher (HQ)	1. Music 2. Passive		Cognitive flexibility Fluid intelligence Inhibitory control Language Working memory	Color-shape switch task Digit Span Backward Eriksen Flanker Task K-BIT (Kaufman brief Intelligence Test) matrices PPVT (Peabody Picture Vocabulary Test) Quantity Identity Task Self Ordering Point Task Stroop Colour Test
Dalziell et al. 2015	46	9.5	52.2%	Better Movers and Thinkers (BMT) Enriched PA programme	16	2	cannot tell	60	PE teachers (HQ)	PE	Strong	Fluid intelligence Language Working memory	The Lucid Assessment System for Schools: phonological composite, reading composite, reasoning, spelling, visual spatial memory subtest.
Dalziell et al. 2019	150	10.5	cannot tell	Better Movers and Thinkers (BMT)	16	2	cannot tell	60	PE teachers (HQ)	PE	Moderate Strong	EF composite	Cognitive Assessment System

Study	n	Age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
				Enriched PA programme									
DeBruijn et al. 2020	891	9.2	51.2%	Aerobic intervention	14	4	MVPA	30	PE teachers (HQ)	1. Cognitively engaging activity	Strong	Language Maths	Standardised tests
DeGreeff et al. 2016	499	8.1	54.7%	F&V (PA with academic instruction)	44	3	MVPA	20	Classroom teacher (LQ)	2. PE Passive		Cognitive flexibility Inhibitory control Working memory	Digit Span Backward Stroop Colour Test Visual Span Backward Wisconsin Card Sorting Test
Donnelly et al. 2017	584	8.1	51.4%	Physical Activity Across the Curriculum (PAAC)	117	10	MVPA	10	Classroom teacher (LQ)	Passive	Strong	Language Maths	Wechsler Individual Achievement Test-Third Edition
Egger et al. 2019	142	7.9	54.9%	PA breaks (high cognitive engagement, high physical exertion) (PA break from academic instruction)	20	10	MVPA	10	Classroom teacher (LQ)	1. Aerobic group 2. Cognitive group (low physical exertion)		cognitive flexibility Inhibitory control Language Maths Working memory	Backwards Colour Recall task Eriksen Flanker Task Hamburger Schreib-Probe: Spelling Heidelberger Rechentest: Maths Salzburger Lesescreening: Reading
Fedewa & Davis, 2015	460	grade 3-5	cannot tell	Classroom-based physical activity breaks	25	20	MPA	5	Classroom teacher (LQ)	Passive	Strong	Fluid intelligence Language Maths	Standard Progressive Matrices National standardised tests
Fedewa et al. 2018	460	grade 3-5	51.0%	Academic-based movement breaks	36	10	LPA	10	Video (HQ)	Aerobic-only movement breaks		PE	Language Maths
Fisher et al. 2011	64	6.1	55.0%	Aerobic PE curriculum	10	2	MVPA	60	Researchers, PE and Classroom teachers (HQ)		Moderate	Attention Fluid intelligence Planning Working memory	CANTAB: attention and working memory subset CAS: planning and simultaneous scale subset
Frischen et al. 2019	76	5.7	60.1%	Yoga	20	3	LPA	20	Researchers (HQ)	1. Rhythm training 2. Pitch training		Cognitive flexibility Inhibitory control Working memory	Corsi Block Test Dimensional Change Card Sort Matrix Span Test NEPSY-II "statue" subtest
											Moderate		

Study	n	Mean age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
Fernandes et al. 2022	47	10.5	50.0%	Capoeira		3	Cannot tell	60	HQ	Passive		Working memory Inhibitory control Maths	WISC IV Digit span backward WISC IV Letter number sequencing
Gall et al. 2018	663	9.2	51.0%	Moving to Music	20	1	MPA	45	Classroom teacher and Researchers (HQ)	PE	Strong	Language Attention AA composite	d2 Test of Attention End of year results
Gallotta et al. 2015	230	9.5	cannot tell	Coordinative PA	20	2	MVPA	60	Classroom teacher (LQ)	1. Traditional PA 2. Passive	Moderate	Attention	d2 Test of Attention
Garcia-a-Hermoso et al. 2020	170	10.1	43.5%	Active Start (PE boost)	8	5	MVPA	30	Sport Science Graduate (LQ)	PE	Strong	Attention Language Maths	d2 Test of Attention End of year results
Giordano & Alesi 2022	75	5.7	48.0%	Enriched programme		3	Cannot tell	10	HQ	Free play Passive	Moderate	Inhibitory control	Stroop Test Head Shoulders Knees Toes
Have et al. 2018	505	7.2	50.5%	Active Math (PA with academic instruction)	30	6	MVPA	45	Classroom teacher (LQ)	Academic instruction	Moderate	Inhibitory control Maths	Eriksen Flanker Task Standardised test
Hillman et al. 2014	221	8.8	46.2%	Fitness Improves Thinking in Kids (FIT Kids) (Aerobic)	30	5	MVPA	120	University staff (HQ)	Passive	Strong	Cognitive flexibility Inhibitory control	Color-shape switch task Eriksen Flanker Task
Hraste et al. 2018	36	10.4	cannot tell	Integrated lessons of mathematics/geometry and PA	4	4	LMPA	45	Classroom teacher (LQ)	Academic instruction	Moderate	AA composite	National standardised test
Hsieh et al. 2017	44	8.6	47.7%	Gymnastics	8	2	MPA	90	PE teachers (HQ)	Passive	Weak	Working memory	Delayed matching-to-sample test
Jia et al. 2021	40	6.1	50.0%	Diverse exercise		3	MPA		HQ	Aerobic	Moderate	Language Maths	Wechsler Individual Achievement Test-Third Edition
Kamijo et al. 2011	36	9.0	52.8%	After-School PA Intervention (aerobic)	30	5	MVPA	120	University staff (HQ)	Passive	Moderate	Working memory	Sternberg task
Koutsandreou et al. 2015	71	9.4	54.9%	Cardiovascular Fitness Training	10	3	MVPA	45	Experienced exercise instructor (HQ)	1. Motor skills training 2. Academic instruction	Strong	Working memory	Letter Digit Span

Study	n	M age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
Kvalo et al. 2017	449	9.5	48.7%	Active School (PA with academic instruction)	38	2	MPA	45	Classroom teacher (LQ)	PE		Inhibitory control Working memory	Backward digit span task Stroop Golden interference effect
Lakes & Hoyt 2004	193	cannot tell	51.3%	Taekwondo	12	2	MVPA	45	Experienced martial arts instructor (HQ)	PE	Strong	Maths On-task behaviour Working memory	Cognitive subscale of Response to Challenge Scale WISC III-FD Arithmetic and Digit Span
Lakes et al. 2013	59	12.2	52.0%	Taekwondo	36	2	VPA	45	Experienced martial arts instructor (HQ)	PE	Strong	EF composite Inhibitory control	The Hearts & Flowers test
Leandro et al. 2018	117	7.5	43.6%	Creative dance & mathematics (PA with academic instruction)	5	1	MPA	60	Classroom teacher (LQ)	Academic instruction	Moderate	Maths	Standardised test
Lin et al. 2021	50	8.6	48.0%	Gymnastics	8	2	MPA	90	PE teachers (HQ)	Passive	Strong	Working memory	Spatial working memory delayed-matching test
Lind et al. 2018	931	11.9	51.0%	Football	11	2	MVPA	45	Classroom teacher (LQ)	PE	Strong	Working memory	Cogstate® Brief Battery: one back (OBK)
Marson et al. 2021	30	8.5	30.0%	Quadrato Motor Training (QMT)		4	Cannot tell		HQ	One Minute Meditation	Weak	Creativity	Alternative Uses Test
Mavilidi et al. 2018	55	10.3	47.3%	Thinking While Moving in English (TWM-E) (PA with academic instruction)	4	3	MPA	40	Researchers, PE teacher (HQ)	Passive		Inhibitory control Language On-task behaviour Working memory	Eriksen Flanker Task Grammar and Punctuation test Momentary time sampling n-back task National standardised test
Mavilidi et al. 2020	283	9.8	48.4%	Thinking While Moving in English (TWM-E) (PA with academic instruction)	6	3	MPA	40	Classroom teacher (LQ)	Passive	Weak	Language On-task behaviour	National standardised test Momentary time sampling
Mavilidi & Vazou 2021	560	10	51.0%	Move for thought		3	Cannot tell		HQ	Academic	Strong	Maths	Academic Achievement Test
Mazzoli et al. 2021	141	7.7	46.1%	Cognitively engaging Active Breaks		4	Cannot tell		HQ	Academic instruction	Moderate	Attention Inhibitory control Working memory	Go No/Go List sorting working memory test (NIH Toolbox)

Study	n	Age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
McMahon et al. 2003	721	6.5	cannot tell	Basic Reading Through Dance (PA with academic instruction)	10	2	MPA	40	Experienced dance teacher (HQ)	Passive	Strong	Language	PhonoGraphix Standardised Tests
Mead et al. 2016	81	11.5	51.9%	Activity breaks from academic instruction	40	5	MVPA	10	Classroom teacher (LQ)	1. Stability Balls 2. Passive		Maths	National standardised test Measure of academic progress test
Meijer et al. 2021	650	9.17	50.6%	Cognitively engaging	14	4	MVPA		HQ	Passive	Weak	Attention Working memory Inhibitory control	Attention Network Task WISC III-FD Digit span Stop and Signal Task
Meloni & Fanari 2019	85	9.3	51.8%	Basketball	30	1	MVPA	60	Not reported (LQ)	Chess		Language Maths	Standard Progressive Battery Studying test
Morris et al. 2022	97	9.6	52.6%	Maths on the move		1	MVPA		HQ	Academic	Moderate	Maths	
Moreau et al. 2017	318	9.9	61.3%	HIT (High Intensity Training)	6	5	VPA	10	Video (HQ)	Sedentary Games		Inhibitory control Working memory	Backward digit span task Stroop Test Eriksen Flanker Task
Mullender-Wijnsma et al. 2015	228	8.1	46.5%	F&V (PA with academic instruction)	21	3	MVPA	10	Classroom teacher (LQ)	Passive	Strong	Language Maths	One-Minute Test - Reading Speed Test Arithmetic
Mullender-Wijnsma et al. 2016	499	8.1	45.2%	F&V (PA with academic instruction)	44	3	MVPA	20	Classroom teacher (LQ)	Passive		Language Maths	One-Minute Test - Reading Speed Test Arithmetic Child Academic Monitoring System - Maths & Spelling
Mullender-Wijnsma et al. 2019	499	8.1	54.7%	F&V (PA with academic instruction)	44	3	MVPA	20	Classroom teacher (LQ)	Passive	Strong	Language Maths	One-Minute Test - Reading Speed Test Arithmetic Child Academic Monitoring System - Maths & Spelling
Nobre et al. 2022	211		50.0%	Mastery climate		3	Cannot tell		HQ	Traditional PA		Maths Language	
Neville & Makopoulou 2021	40	7.4	50.0%	Dance-based PE	6	1	MPA	50	PE Graduate (LQ)	PE	Moderate	Creativity	Guilford's (1967) Alternative Uses task
Norris et al. 2018	219	8.6	49.3%	Virtual Traveller	6	3	MVPA	10	Classroom teacher (LQ)	Passive		On-task behaviour	Observing Teachers and Pupils in Classrooms (OPTIC) tool
Oppici et al. 2020	80	8.8	61.0%	Dance (high cognitive)	7	2	MPA	60	Experienced dance teacher (HQ)	1. Dance (low cognitive) 2. PE	Strong	Cognitive flexibility Inhibitory control Working memory	Dimensional Change Card Sort Eriksen Flanker Task List sorting working memory test (NIH Toolbox)

Study	n	Age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
Pesce et al. 2013	250	6.9	49.2%	Cognitively Enriched Specialist Led PA	20	1	Cannot tell	60	PE teachers (HQ)	1. Specialist Led PE	Strong	Attention Planning	CAS: attention and planning sub-scale
Pesce et al. 2016	460	7.5	50.0%	Enriched PE (high cognitive)	24	1	Cannot tell	60	PE teachers (HQ)	2. PE PE		Attention Inhibitory control Working memory	CAS: attention sub-scale Random Number Generation Task
Pesce et al. 2021	116	8.8	53.0%	Self control programme		1	Cannot tell		PE teachers (HQ)	PE	Moderate	Inhibitory control	
Reed et al. 2010	155	10	43.2%	PA fundamental skills in Core Curriculum (PA with academic instruction)	12	3	MPA	30	Researchers and Classroom teachers (HQ)	Academic instruction	Moderate	Attention Fluid intelligence	Standard Progressive Matrices
Resaland et al. 2016	1202	10.2	cannot tell	Active Smarter Kids (PA with academic instruction)	28	3	MVPA	30	Classroom teacher (LQ)	PE	Strong	Language Maths	National standardised tests
Richard et al. 2018	173	9.6	cannot tell	Creative Exercise Program	10	1	MPA	30	PE teachers (HQ)	Conventional Exercise Program		Creativity	Bertsch test motor creativity Runco Creative Assessment Battery
Riley et al. 2015	54	10.5	48.2%	EASY Minds (PA with academic instruction)	6	3	MVPA	60	Classroom teacher (LQ)	Academic instruction	Strong	On-task behaviour	Momentary time sampling
Riley et al. 2016	240	11.1	40.7%	EASY Minds (PA with academic instruction)	6	3	MPA	60	Classroom teacher (LQ)	Passive		Maths On-task behaviour	Momentary time sampling Standardised test
Rudd et al. 2021	55	6.6	47.0%	Creative dance	10	2	Cannot tell	60	HQ	Choreography dance	Strong	Cognitive flexibility Inhibitory control Working memory	Dimensional Change Card Sort Eriksen Flanker Task List sorting working memory test (NIH Toolbox)
Sanchez-Lopez et al. 2019	1608	5.8	56.3%	MOVI-KIDS (recreational non-competitive physical activity)	26	3	MVPA	60	Experienced exercise instructor (HQ)	PE		Fluid intelligence Maths	Battery of general and Differential Aptitudes - logic reasoning and numerical factor subsets
Santos et al. 2017	50	9.2	cannot tell	Skills4Genius	20	3	MVPA	60	PE teachers (HQ)	PE (Additional)	Moderate	Creativity	Creativity Behavior Assessment in Team Sports Torrance Test of Creative Thinking
Schmidt et al. 2015	181	11.4	54.9%	Team Games	6	2	MVPA	45	PE teachers (HQ)	1. Aerobic Exercise	Moderate	Cognitive flexibility	Eriksen Flanker task n-back task with pictures of fruits

Study	n	Age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
Sjowall 2017	470	9.5	48.5%	PE Boost	78	5	VPA	60	Activity leader (LQ)	PE		Inhibitory control Working memory Maths	Arithmetic test Follow instructions task Odd One Out task
Tanir & Erkut 2018	56	9.2	50.0%	Rhythmic Basketball	6	2	MVPA	60	PE teachers (HQ)	Basketball	Weak	Working memory Inhibitory control	Stroop Colour Test
Telford et al. 2012	620	7.5	48.8%	Specialist Taught PA	75	2	MVPA	45	PE teachers (HQ)	PE	Weak	Language Maths	National standardised tests
Telles et al. 2013	98	10.5	38.7%	Yoga	12	5	LPA	45	Experienced yoga teacher (HQ)	PA (Additional)	Moderate	Inhibitory control	Stroop Colour Test
Tocci et al. 2022	95	7.7	50.0%	Specialist led enriched programme		1	Cannot tell		Specialist teacher (HQ)		Strong	Creativity Inhibitory control Working memory	Bertsch test motor creativity Random Number Generation Task
Tottori 2019	58	10.2	42.3%	HIT (High Intensity Training)	4	3	MVPA	10	University staff (HQ)	Passive	Moderate	Planning Working memory	Digit Span Backward (WISC) Tower of Hanoi (5 disk) time
Tseng et al. 2021	55	11.3	51.0%	FIFA11		5	Cannot tell		HQ	Passive	Moderate	Attention	Attention Scale
Van den Berg et al. 2019	512	10.9	46.5%	Just Dance	9	5	MVPA	10	Video (HQ)	Academic instruction	Strong	Attention Inhibitory control	Attention Network d2 Test of Attention Stroop Colour test
Van den Berg et al. 2019b	323	11	48.0%	Juggling with Maths	5	4	LPA	5	Video (HQ)	Academic instruction	Strong	Maths	Multiplication tables test
Van der Niet et al. 2016	112	8.8	50.0%	PA Boost (aerobic and cognitive enriched)	22	2	MVPA	30	PE teachers (HQ)	Passive	Strong	Cognitive flexibility Inhibitory control Working memory	Digit Span Test from Weschler Memory Scale Golden Stroop Colour Test Tower of London Trail-Making Test Visual Memory Span test from Wechler Memory Scale
Van Klaveren & De Witte 2015	178	10.5	36.0%	Football	10	1	MVPA	180	Experienced exercise instructor (HQ)	Passive	Moderate	Language Maths	Test construction by CITO National standardised test
Vazou & Skrade 2017	284	10.0	46.5%	Move for Thought (PA with academic instruction)	8	3	MPA	10	Classroom teacher (LQ)	Academic instruction	Moderate	Maths	National standardised test

Study	n	Age	% Female	Physical activity intervention	Duration (weeks)	Freq. (per week)	Intensity	Session duration (min)	Teacher qualification	Control group(s)	Quality	Outcomes	Instrument
Vetter et al. 2020	170	8.4	52.0%	Playground	6	3	MVPA	30	Classroom teacher (LQ)	Academic instruction	Strong	Maths	NAPLAN test Teacher-designed multiplication-tables test
Watson et al. 2019	341	9.1	52.8%	ACTI-BREAK: a variety of elements including: drama, games, following instructions, and technology	6	15	MPA	5	Classroom teacher (LQ)	Academic instruction		Language Maths On-task behaviour	Wheldall Assessment of Reading Passages Test Westwood One Minute Tests of Basic Number Facts Adaptation from the Direct Behaviour Rating Scale
Zinelabidine et al. 2022	44	10.3	49.0%	Aerobic dance		2	MVPA		HQ	Passive	Strong	Cognitive flexibility Inhibitory control Working memory	Trail-making test Stroop Test Digit Recall Test

Table S5. Results of analyses comparing higher and lower creativity physical intervention groups' effect on executive function measures

Outcome measure	Creativity rating group	Sample size	<i>k</i>	ES	Creativity grouping				Heterogeneity			
					Summary effect size <i>g</i>	95% CI	<i>p</i> _{subgroup}	<i>p</i> _{comparison}	<i>I</i> ² level 3	<i>I</i> ² level 2	95% CI	<i>Q</i>
Executive function		8448	45	127				0.19	25.7%	47.1%	67.0% - 72.8%	320.7
	Lower	5660	29	88	0.08	-0.02 – 0.19	0.12					
	Higher	2788	16	39	0.12	-0.25 – 0.49	0.53					
<i>Infl. cases removed</i>		7886	45	125				0.97	81.6%	10.6%	57.2% - 92.2%	775.5
	Lower ¹	5250	29	87	0.08	-0.02 – 0.19	0.11					
	Higher ²	2636	16	38	0.05	-0.31 – 0.41	0.78					
Attention		2999	11	19				<0.01	89.7%	1.9%	77.0% - 91.6%	73.0
	Lower	2212	7	13	0.03	-0.03 – 0.10	0.28					
	Higher	787	4	6	0.25	-0.36 – 0.86	0.34					
<i>Infl. cases removed</i>		2847	10	18				0.30	0.0%	18.6%	0.0% - 18.6%	20.1
	Lower	2212	7	13	0.03	-0.03 – 0.10	0.28					
	Higher ²	635	3	5	0.01	-0.30 – 0.31	0.10					
Cognitive flexibility		1278	11	16				0.03	38.9%	0.0%	0.0% - 38.9%	22.4
	Lower	1173	8	10	0.13	-0.10 – 0.35	0.21					
	Higher	105	3	6	-0.27	-0.54 – -0.01	0.04					
<i>Infl. cases removed</i>		1057	10	15				0.04	26.8%	0.0%	0.0% - 26.8%	5.3
	Lower ³	952	7	9	0.08	-0.14 – 0.31	0.42					
	Higher	105	3	6	-0.27	-0.54 – -0.01	0.04					
Inhibitory control		5441	30	41				0.66	92.9%	0.0%	50.4% - 92.9%	548.7
	Lower	3829	20	29	-0.02	-0.16 – 0.11	0.71					
	Higher	1612	10	12	-0.12	-0.72 – 0.46	0.64					
<i>Infl. cases removed</i>		4981	29	40				0.42	92.0%	0.0%	11.9% - 92.0%	386.8
	Lower	3829	20	29	-0.02	-0.15 – 0.10	0.71					
	Higher ⁴	1152	9	11	-0.23	-0.85 – 0.39	0.43					
Working memory		5287	30	46				0.59	0.1%	78.9%	60.7% - 79.6%	145.4
	Lower	3241	18	31	0.16	0.02 – 0.29	0.02					
	Higher	2046	12	15	0.22	-0.01 – 0.44	0.05					
<i>Infl. cases removed</i>		5243	29	45				0.98	5.6%	66.0%	52.9% - 71.6%	122.8
	Lower	3241	18	31	0.16	0.02 – 0.29	0.02					
	Higher ⁵	2002	11	14	0.13	-0.01 – 0.34	0.28					

Note: significant associations are highlighted in bold, *k* = number of studies, *I*² at study level, ES = effect size. Removed as influential studies: ¹ Kvalo et al., 2017; ² Gallotta et al., 2015, one ES); ³ Hillman et al., 2014; ⁴ Pesce et al., 2016; ⁵ Hsieh et al., 2017.

Table S6. Results of analyses comparing higher and lower creativity physical intervention groups' effect academic achievement measures

Outcome measure	Creativity rating group	Sample size	<i>k</i>	ES	Creativity grouping				Heterogeneity			
					Summary effect size <i>g</i>	95% CI	<i>p</i> _{subgroup}	<i>p</i> _{comparison}	<i>I</i> ² level 3	<i>I</i> ² level 2	95% CI	Q
Academic achievement		14386	47	114				0.65	78.4%	18.6%	74.0% - 97.0%	1900.2
	Lower	8565	28	75	0.10	0.02 – 0.18	0.01					
	Higher	5821	19	39	0.20	-0.29 – 0.69	0.41					
<i>Infl. cases removed</i>		13641	46	113				0.91	78.2%	18.8%	64.3% - 97.0%	1878.7
	Lower	8565	28	75	0.10	0.02 – 0.18	0.01					
	Higher ¹	5076	18	38	0.15	-0.51 – 0.81	0.65					
Language		11320	32	60				0.96	56.9%	40.8%	73.0% - 97.7%	1066.2
	Lower	6035	18	38	0.07	-0.04 – 0.17	0.20					
	Higher	5285	14	22	0.10	-0.46 – 0.67	0.71					
<i>Infl. cases removed</i>		11162	31	59				0.55	57.2%	40.4%	62.1% - 97.7%	1041.3
	Lower	6035	18	38	0.07	-0.04 – 0.17	0.20					
	Higher ²	5127	13	21	0.04	-0.57 – 0.65	0.89					
Maths		13366	42	54				0.48	84.1%	12.41%	71.2% - 96.5%	834.7
	Lower	7603	25	37	0.10	0.01 – 0.18	0.03					
	Higher	5733	17	17	0.25	-0.30 – 0.80	0.34					
<i>Infl. cases removed</i>		13264	42	53				0.42	0.0%	96.7%	64.3% - 96.7%	825.8
	Lower ³	7531	25	36	0.08	-0.02 – 0.18	0.11					
	Higher	5733	17	17	0.25	-0.30 – 0.80	0.34					

Note: Significant associations are highlighted in bold, *k* = number of studies, *I*² at study level, ES = effect size. Removed as influential studies: ¹ Leandro et al., 2018; ² Garcia-a-Hermoso et al., 2020; ³ Mullender-Wijnsma et al., 2015, one effect size.

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