

Supplemental Material

Supplemental Table S1. Characteristics of the included studies

Study	Sample size	Demographic and clinical features of participants						Intervention				
		Total (EG/CG)	Ages in years, mean (SD)	Time since stroke onset in days/ [weeks]/"months" mean (SD)		Paretic side (n: right/left)		Experimental group	Control group	Treatment dosage	Outcome measures	Video types
				EG	CG	EG	CG					
Bang DH 2013 ¹⁹	30 (15/15)	64.1 (6.35)	58.9 (7.03)	"14.1" (3.78)	"12.6" (3.86)	8/7	6/9	Action observation therapy (watching videos for 9 minutes + Treadmill training for 30 minutes)	Sham action observation	40 min/day, 5 day/week, for 4 weeks	TUG; 10MWT; 6MWT; KASW	Treadmill training
Cowles T 2013 ⁵	22 (9/13)	78.8 (8.1)	75.6 (12.4)	19.5 (7.0)	17.8 (5.1)	1/8	6/7	Conventional rehabilitation + action observation therapy (watching the therapist performing the actions for 2 minutes and then practicing the actions for 4 to 6 minutes)	Conventional rehabilitation	30 min/session, 2 sessions/day, for 15 working days	MI; ARAT	Functional tasks (e.g., bring telephone to ear)
Dettmers C 2014 ²⁷	56 (19/19/18)	62.79 (N/A)	58.83 (11.25)	"37.91" (69.96)	"26.74" (61.69)	11/8	12/6	Conventional rehabilitation + action observation	Conventional rehabilitation	1 hour/day, for 6 weeks	WMFT; NHPT;	Functional tasks (e.g.,

								therapy (watching each video clip for 5 minutes and then practice the same actions)			MAL; SIS	grasping and lifting a glass)
Ertelt D 2007 ²	16 (8/8)	57.16 (8.73)	55.40 (10.77)	1472.9 (1258.8)	724.8 (360.9)	2/6	2/6	Action observation therapy (watching the videos for 6 minutes, and then performing the actions for 6 minutes; each action was presented twice)	Sham action observation	90 min/day, for 18 working days	FAT; WMFT; SIS	Functional tasks (e.g., the use of a ball or a cup)
Franceschini M 2012 ⁶	90 (48/42)	65.7 (11.9)	67.0 (12.4)	29.5 (4.2)	31.0 (4.6)	22/26	18/24	Conventional rehabilitation + action observation therapy (watching the videos for 3 minutes and then performing the actions for 2 minutes, for 3 motor sequences)	Conventional rehabilitation + sham action observation	15 min/session, 2 sessions/day, 5 day/week, for 4 weeks	BBT; FAT; FMA; MAS; FIM	Functional tasks (e.g., drinking from a glass)
Fu J 2017 ⁷	53 (28/25)	62.04 (9.93)	59.76 (10.57)	39.49 (18.45)	41.12 (18.79)	12/16	13/12	Conventional rehabilitation + action observation therapy (watching the videos for 10 minutes and then practicing the actions for 10 minutes)	Conventional rehabilitation + sham action observation	20 min/day, 6 day/week, for 8 weeks	FMA; WMFT; MBI; Motor evoked potential	Upper-limb movements

Kim CH 2016 ²⁰	22 (11/11)	60.77 (7.03)	59.11 (7.05)	[12.89] (2.93)	[11.33] (2.96)	5/6	5/6	Conventional rehabilitation + action observation therapy (watching videos for 9 minutes, a break for 1 minute, and practicing the tasks for 30 minutes)	Conventional rehabilitation + task-oriented training	40 min/day, 5 time/week, for 4 weeks	FMA; BBT; MBI; MAS	Functional tasks (e.g., folding up a towel)
Kim E 2015 ⁸	12 (6/6)	N/A	N/A	N/A	N/A	N/A	N/A	Conventional rehabilitation + action observation therapy (no report on detailed observation time)	Conventional rehabilitation + performing the actions without watching videos	30 min/day, 5 day/week, for 6 weeks	WMFT	Functional tasks (e.g., feeding)
Kim JC 2018 ²¹	21 (11/10)	57.08 (7.29)	52.92 (8.21)	“37.08” (32.45)	“38.92” (31.92)	4/7	3/7	Action observation therapy (watching videos for 2.5 minutes and practicing the action for 12.5 minutes)	Sham action observation	15 min/session, 2 sessions/day, 3 time/week, for 6 weeks	WDI; LOS; TUG; DGI	Balance training, walking
Kim JH 2013 ²²	27 (9/9/9)	55.3 (12.1)	59.8 (8.9)	“8.3” (3.3)	“8.5” (3.6)	6/3	3/6	Neurodevelopmental therapy + action observation therapy (watching video for 20 minutes and practicing for 10 minutes)	Neurodevelopmental therapy	30 min/day, 5 time/week, for 4 weeks	TUG; FRT; WAQ; FAC; gait parameters	Balance training, walking (e.g., stepping over obstacles)

Kim JS 2012 ²³	30 (15/15)	64.1 (8.3)	65.5 (7.7)	“4.6” (1.3)	“4.1” (1.0)	8/7	8/7	Conventional rehabilitation + action observation therapy (watching 5 different kinds of video clips in walking for 10 minutes and practicing for 10 minutes)	Conventional rehabilitation + watching a video in which they were taken through a progressive relaxation program	20 min/day	Gait parameters	Sit-to- stand, balance training, walking
Oh SJ 2019 ²⁸	35 (17/18)	58.85 (7.60)	59.35 (9.39)	“5.81” (0.87)	“5.66” (0.94)	12/5	N/A	Functional action observation therapy (watching videos for 15 minutes and practicing for 15 minutes)	General action observation therapy (watching videos for 15 minutes, e.g., looking at the front while walking, and practicing for 15 minutes)	30 min/day	Gait parameters , FGA	Walking (e.g., walking around the hospital)

Park EC 2015 ²⁴	40 (20/20)	51.15 (14.81)	48.65 (12.81)	“14.91” (6.1)	“13.4” (8.2)	11/9	9/11	Conventional rehabilitation + action observation therapy (each training set including watching videos for 3 minutes, taking 1 minute break, and walking training for 5 minutes. The walking training took a total of 20 minutes per session)	Conventional rehabilitation + shame action observation	30 min/day, 5 day/week, for 8 weeks	Static standing balance; TUG; 10MWT	Walking (e.g., walking on a flat land)
Park HJ 2016 ²⁵	25 (12/13)	57.33 (6.89)	55.08 (8.12)	“33.58” (24.67)	“21.15” (12.44)	5/7	9/4	Conventional rehabilitation + action observation therapy (no report on detailed observation time)	Conventional rehabilitation + shame action observation	30 min/day, 3 day/week, for 4 weeks	10MWT; CWT; ABC; Gait parameters	Community-based ambulation (e.g., walking in a parking lot)
Park HR 2014 ²⁶	21 (11/10)	55.91 (9.1)	54.80 (12.22)	“21.09” (16.66)	“25.60” (19.67)	4/7	4/6	Conventional rehabilitation + action observation therapy (watching video clips demonstrating 4 tasks for functional walking for 10 minutes)	Conventional rehabilitation + shame action observation	30 min/day, 3 day/week, for 4 weeks	10MWT; F8WT; DGI; Gait symmetry scores	Weight shifting, walking (e.g., walking on straight paths)

Sale P 2014 ⁹	67 (33/34)	66.5 (12.7)		29.6 (4.5)		30/37	Conventional rehabilitation + action observation therapy (watching the videos for 3 minutes and then performing the actions for 2 minutes, for 3 motor sequences)	Conventional rehabilitation + sham action observation	15 min/session, 2 sessions/day, 5 day/week, for 4 weeks	FMA; BBT	Functional tasks (e.g., drinking a cup of coffee)
Zhu MH 2015 ¹¹	61 (31/30)	57.75 (15.57)	56.89 (14.93)	30.67 (17.85)	31.54 (18.79)	17/14 17/13	Conventional rehabilitation + action observation therapy (watching each video for 50 seconds and then practicing the actions)	Conventional rehabilitation	30 min/day, 6 day/week, for 8 weeks	FMA; BI; MAS	Range of motion exercises, functional tasks (e.g., handling of a pen)

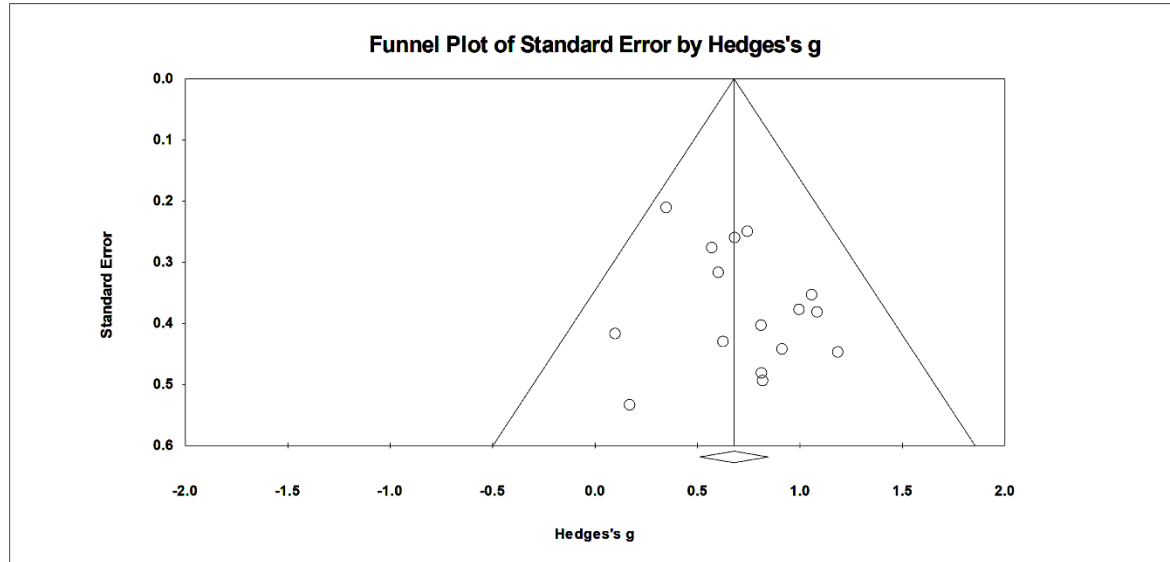
Abbreviations: 6MWT, 6-Minute Walk Test; 10MWT, 10-Meter Walk Test; ABC, Activities-specific Balance Confidence scale; ARAT, Action Research Arm Test; BBT, Box and Block Test; BI, Barthel Index; CG, Control group; CWT, Community Walk Test; DGI, Dynamic Gait Index; EG, Experimental group; FAC, Functional Ambulation Category; FAT, Frenchay Arm Test; FGA, Functional Gait Assessment; FIM, Functional Independence Measure; FMA, Fugl-Meyer Assessment; FRT, Functional Reaching Test; KASW, knee angle in swing phase during walking; MAS, Modified Ashworth scale; MBI, modified Barthel Index; MI, Motricity Index; min, minutes; NHPT, Nine Hole Peg Test; SIS, Stroke Impact Scale; TUG, the Timed Up and Go test; WAQ, Walking Ability Questionnaire; WDI, Weight Distribution Index; WMFT, Wolf Motor Function Test.

Note. N/A indicates not available.

Supplemental Table S2. Quality assessment of the included studies using the PEDro scale

	Eligibility criteria	Random allocation	concealed allocation	Baseline comparability	Blind subjects	Blind therapists	Blind assessors	Adequate follow-up	Intention-to- treat analysis	Between group comparisons	Point estimates and variability	Total score
Bang DH 2013 ¹⁹	Y	1	1	1	1	0	1	1	1	1	1	9
Cowles T 2013 ⁵	Y	1	1	0	0	0	1	0	0	1	1	5
Dettmers C 2014 ²⁷	Y	1	0	1	0	0	1	1	0	1	0	5
Ertelt D 2007 ²	Y	1	0	1	0	0	0	1	1	1	1	6
Franceschini M 2012 ⁶	Y	1	1	1	0	0	1	1	0	1	1	7
Fu J 2017 ⁷	Y	1	0	1	0	0	0	0	0	1	1	4
Kim CH 2016 ²⁰	Y	1	1	1	0	0	1	1	1	1	1	8
Kim E 2015 ⁸	N	1	0	0	0	0	0	1	1	1	1	5
Kim JC 2018 ²¹	Y	1	0	1	0	0	0	0	0	1	1	4
Kim JH 2013 ²²	Y	1	1	1	0	0	0	1	0	1	1	6
Kim JS 2012 ²³	N	1	1	1	0	0	0	1	1	1	1	7
Oh SJ 2019 ²⁸	Y	1	0	1	0	0	0	1	0	1	1	5
Park EC 2015 ²⁴	Y	1	0	0	0	0	0	1	1	1	1	5
Park HJ 2016 ²⁵	Y	1	0	1	0	0	1	1	0	1	1	6
Park HR 2014 ²⁶	Y	1	1	1	0	0	1	0	0	1	1	6
Sale P 2014 ⁹	Y	1	1	1	0	0	1	1	1	1	1	8
Zhu MH 2015 ¹¹	Y	1	0	1	0	0	1	1	1	1	1	7

Supplemental Figure 1. Funnel plot for all included studies of meta-analyses



Supplemental Appendix 1. Example of a searching strategy

Recent queries in PubMed		
Search	Query	Items found
#7	Search #5 AND #6	601
#6	Search #3 AND #4	11049
#5	Search #1 OR #2	448862
#4	Search therapy OR treatment OR training OR physical training OR rehabilitation OR neurorehabilitation	11454061
#3	Search action observation OR action observation-execution OR motor observation OR movement observation OR action imitation	24817
#2	Search hemipleg* OR hemipar* OR paresis OR paretic	42058
#1	Search stroke OR poststroke OR cerebrovasc* OR cva* OR “cerebrovascular disease” OR “cerebrovascular accident” OR brain infarct* OR brain ischemi* OR brain hemorrhag*	420135

Supplemental Appendix 2. Excluded studies due to not written in English or Chinese.

Publication	Language
1. Dettmers C, Braun N, Büsching I, Hassa T, Debener S, Liepert J. Neurofeedback-based motor imagery training for rehabilitation after stroke. <i>Nervenarzt</i> . 2016;87:1074-108.	German
2. Dettmers C, Nedelko V, Schoenfeld MA. New therapeutic approaches for stroke rehabilitation based on the concept of the mirror system. <i>Journal für Neurologie, Neurochirurgie und Psychiatrie</i> . 2012;13:5-10.	German
3. Ghanja A, Torkaman G, Ghabaee M, Ebrahimi E, Motaqhey M. Effect of action observation and imitation on improving the functional activities indices in hemiplegic patients based on mirror neurons theory. <i>Journal of Mazandaran University of Medical Sciences</i> . 2014;24:136-150.	Persian
4. Ghanjal A, Torkaman G, Ghabaee M, Ebrahimi E, Motaqhey M. The effect of action observation on weight distribution and dynamic balance index improvement in hemiparetic patients based on mirror neuron theory. <i>Journal of Zanjan University of Medical Sciences and Health Services</i> . 2015;23:77-88.	Persian
5. Kolářová B, Krobot A, Habermannová P, Kolář P, Bastlová P. Use of motion imagination and observation in cognitive and motion rehabilitation. <i>Rehabilitacia</i> . 2015;52:131-139.	Czech