GLI ANZIANI: LE RADICI DA PRESERVARE

L'Action Observation Treatment (AOT) nella riabilitazione del paziente con stroke

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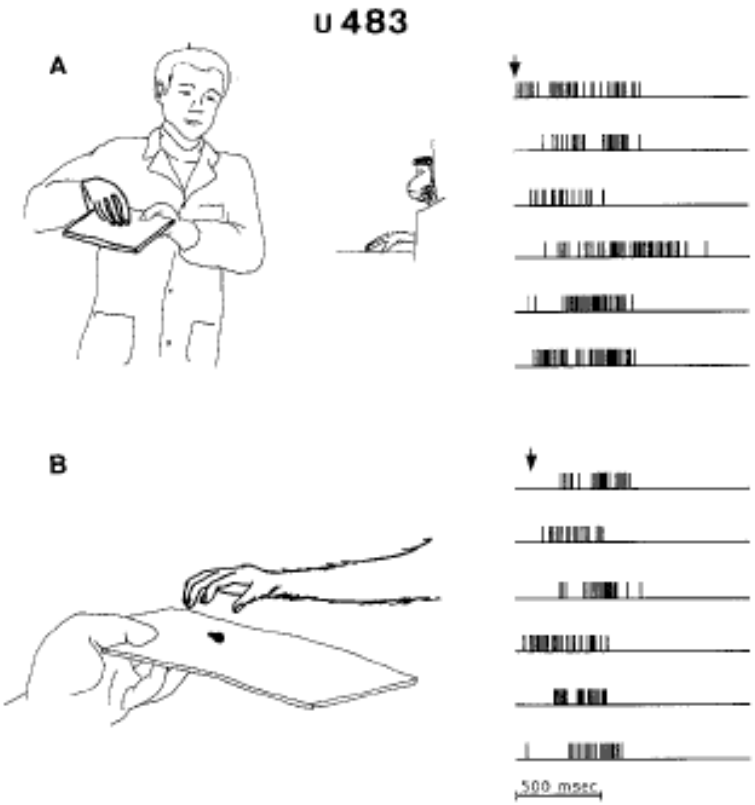
Ospedale Humanitas, Rozzano (MI)

La scoperta dei neuroni mirror

A: lo sperimentatore afferra il cibo

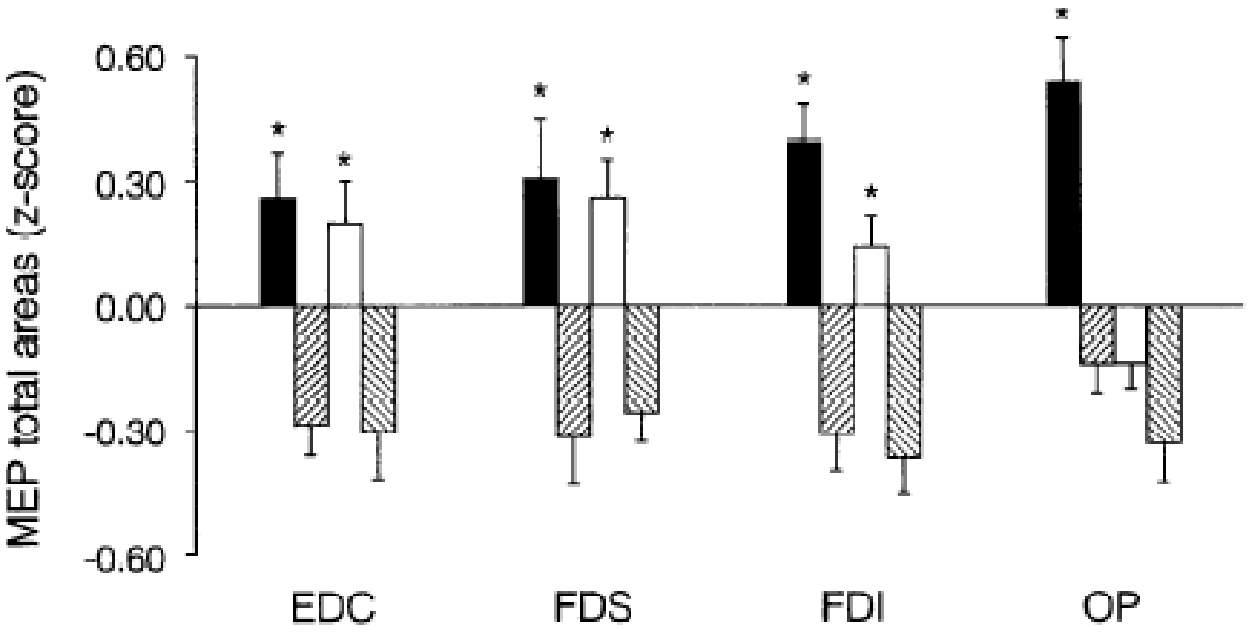
B: la scimmia afferra il cibo

I neuroni mirror rispondono sia quando si esegue che quando si osserva un'azione svolta da altri



Di Pellegrino G, Exp Brain Res 1992

Il sistema mirror nell'uomo



Fadiga L et al. J Neurophysiol 1995

Il mirror neuron system

Il mirror neuron system è implicato nel riconoscimento del significato delle azioni

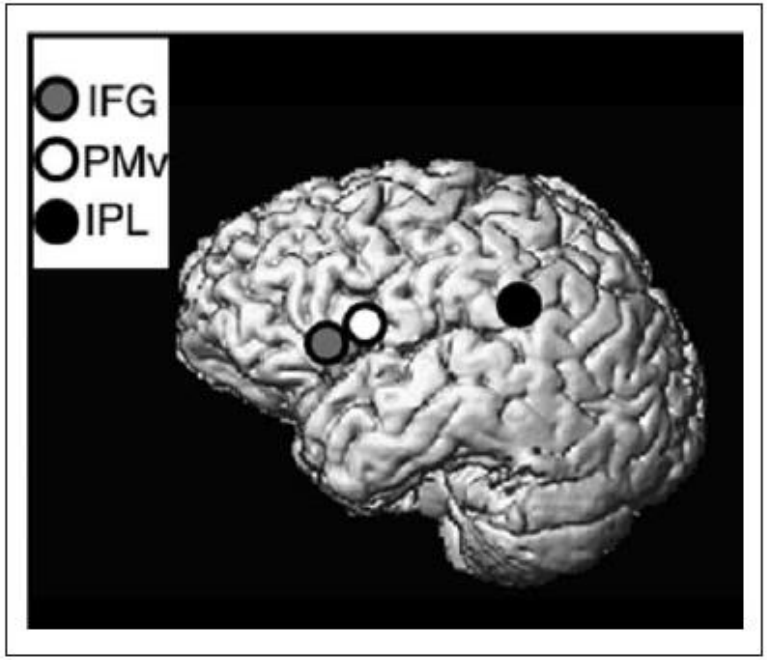


Figure 1. The core mirror neuron system, including the inferior parietal lobule (IPL), ventral premotor cortex (PMv), and inferior frontal gyrus (IFG).

Garrison KA et al, Neurorehab Neur Rep 2010

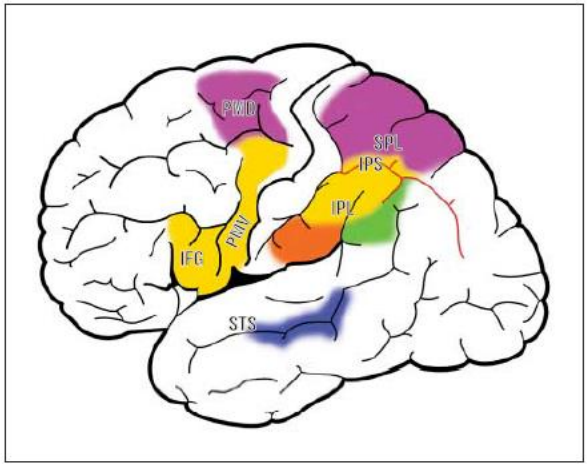
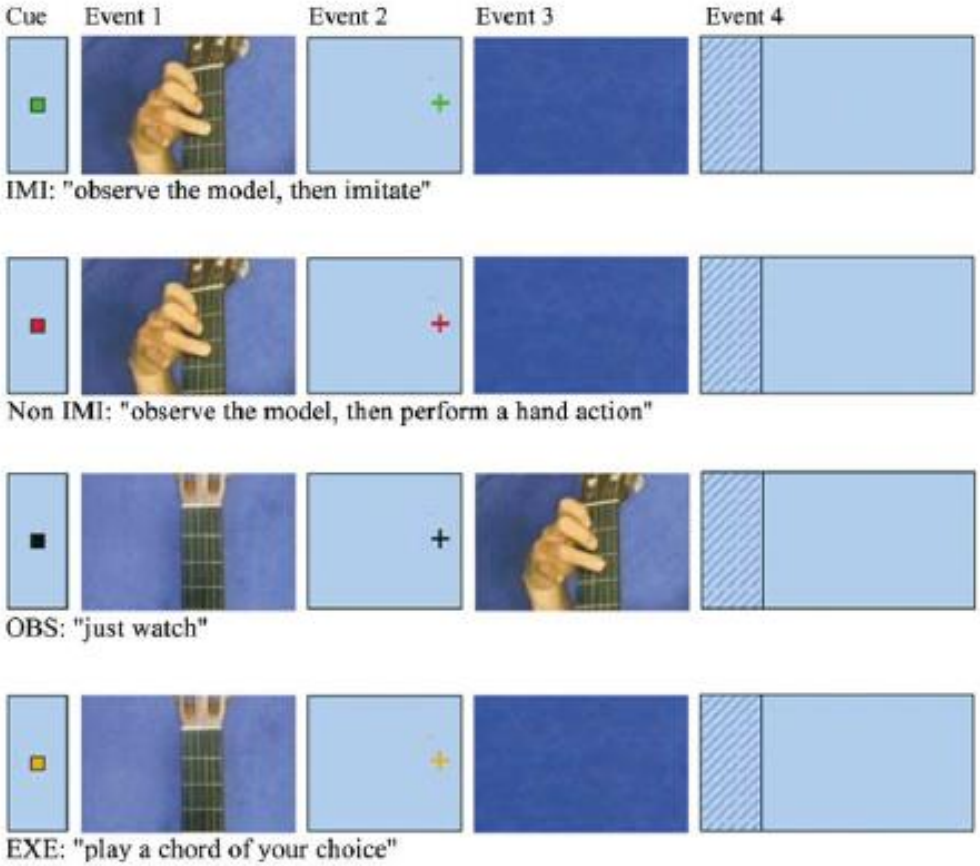


Figure 2. Cortical areas related to the parietofrontal mirror system responding to different types of motor acts.[10-14] Yellow indicates transitive distal movements; purple, reaching movements; orange, tool use; green, intransitive movements; blue, portion of the superior temporal sulcus (STS) responding to observation of upper-limb movements.[4] IFG indicates inferior frontal gyrus; IPL, inferior parietal lobule; IPS, intraparietal sulcus; PMD, dorsal premotor cortex; PMV, ventral premotor cortex; and SPL, superior parietal lobule.

Cattaneo L, Rizzolati G, Arch Neurol 2009

Razionale per l'uso dell'AOT in neuroriabilitazione

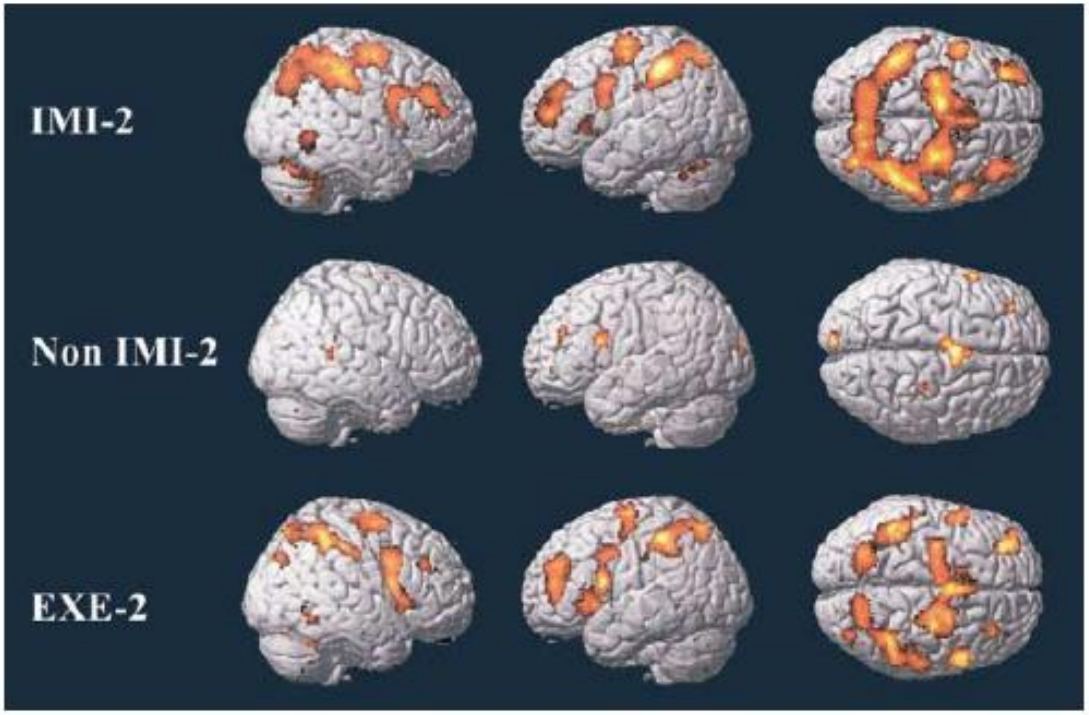
Apprendimento per imitazione



Buccino G et al , Neuron 2004

Razionale per l'uso dell'AOT in neuroriabilitazione

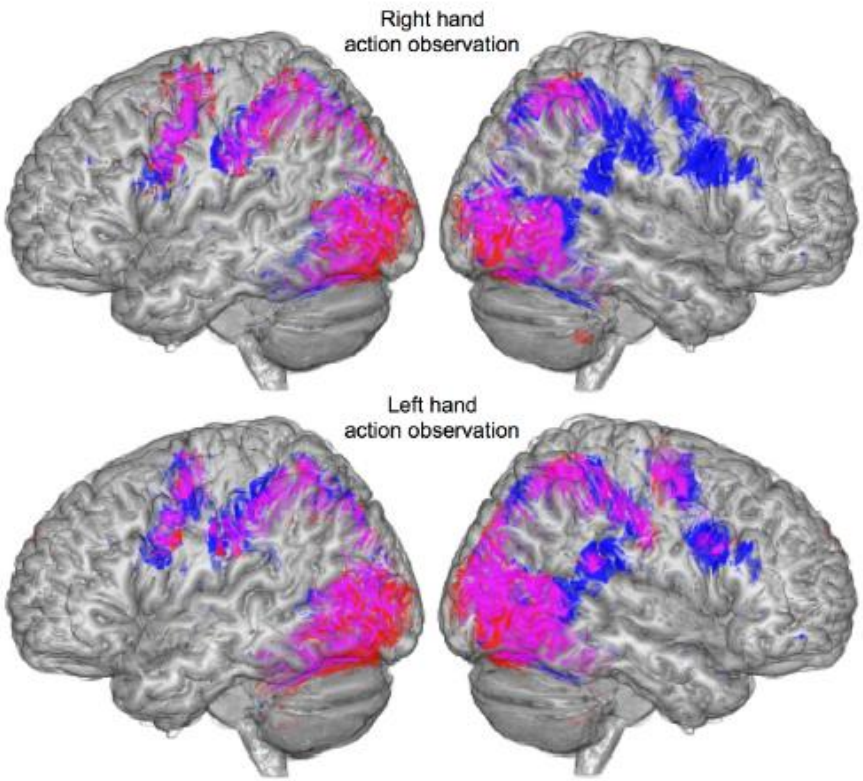
Apprendimento per imitazione



Aree corticali attivate durante l'evento pausa in differenti condizioni sperimentali

Buccino G et al , Neuron 2004

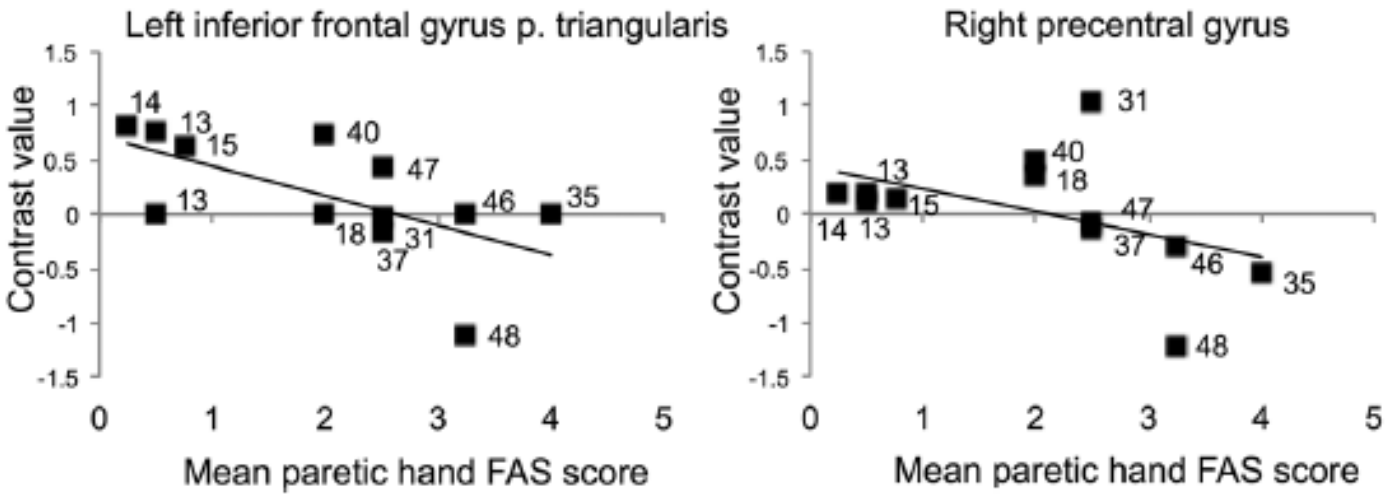
Effetti dell'AO sul sistema motorio dopo stroke



Attivazioni corticali durante action observation della mano destra (in alto) o sinistra (in basso)
Partecipanti con stroke (rosso)
Soggetti sani (blue)
Sovrapposizione tra I gruppi (viola)

Garrison KA, Stroke, 2013

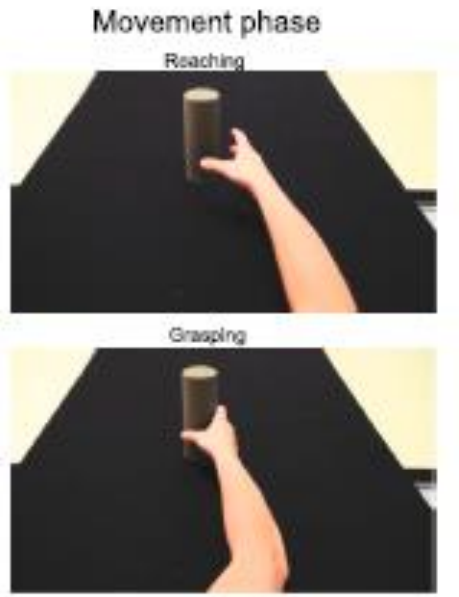
Effetti dell'AO sul sistema motorio dopo stroke



L'estensione delle attivazioni corticali ipsilesionali è risultata più grande nei soggetti con minore punteggio alle scale motorie funzionali

Garrison KA, Stroke, 2013

Percezione tattile durante action observation



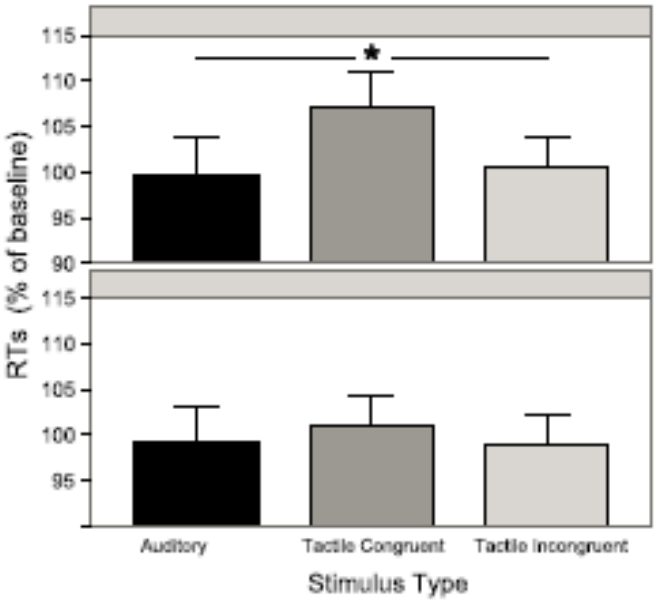


Table 1 Mean and SD (±) of reaction times baseline-corrected (indicated as % of baseline) for stimulus-type movement phase

	Reaching Mean and SD	Grasping Mean and SD
Tactile Congruent—right hand	107 % ± 0.12	100 % ± 0.10
Tactile Incongruent—right leg	100 % ± 0.09	98 % ± 0.10
Auditory	99 % ± 0.13	99 % ± 0.12

Vastano R et al. Exp Brain Res 2016

Di cosa si tratta

1) Osservare dei video con contenuti motori

2) Imitare le azioni appena osservate

Efficacia dell'AOT nei soggetti con esiti di stroke

Stroke

American Heart Association | American Stroke Association

Review

Action observation for upper limb function after stroke: evidence-based review of randomized controlled trials

KyeongMi Kim[1)]

J. Phys. Ther. Sci.
27: 3315–3317, 2015

Article

Clinical feasibility of action observation training for walking function of patients with post-stroke hemiparesis: a randomized controlled trial

Hye-Ryoung Park[1], Jong-Man Kim[2], Moon-Kyu Lee[1] and Duck-Won Oh[3]

CLINICAL REHABILITATION

Clinical Rehabilitation
1–10
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DOI: 10.1177/0269215514523145
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Effects of Mental Practice with Action Observation on Occupational Performance after Stroke

Yu-Jin Cha, OT, PhD,* Eun-Young Yoo, OT, PhD,† Min-Ye Jung, OT, PhD,† Soo-Hyun Park, PhD,‡ Ji-Hyuk Park, OT, PhD,† and Jin Lee, PhD§

Article

The effects of action observational training on walking ability in chronic stroke patients: a double-blind randomized controlled trial

Dae-Hyouk Bang[1], Won-Seob Shin[1,2], Sun-Yeob Kim[1,3] and Jong-Duk Choi[1,2]

CLINICAL REHABILITATION

Clinical Rehabilitation
27(3) 1118–1125
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DOI: 10.1177/0269215513501528
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Effects of Action Observation on Physical Training After Stroke
Pablo Celnik, Brian Webster, Davis M. Glasser and Leonardo G. Cohen

Original Article

Action observation training of community ambulation for improving walking ability of patients with post-stroke hemiparesis: A randomized controlled pilot trial

Hyun-Ju Park[1], Duck-Won Oh[1], Jong-Duk Choi[1], Jong-Man Kim[1], Suhn-Yeop Kim[1], Yong-Jun Cha[1] and Su-Jin Jeon[2]

CLINICAL REHABILITATION

Clinical Rehabilitation
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Topics in Stroke Rehabilitation

ISSN: 1074-9357 (Print) 1945-5119 (Online) Journal homepage: http://www.tandfonline.com/loi/ytsr20

Improving motor imagery practice with synchronous action observation in stroke patients

Yao Sun, Wei Wei, Zhizeng Luo, Haitao Gan & Xiaohua Hu

Drinking Behavior Training for Stroke Patients Using Action Observation and Practice of Upper Limb Function

Daehee Lee, PhD, PT[1)], Hyolyun Roh, PhD, PT[2)*], Jungseo Park, PhD, PT[1)], Sangyoung Lee, PhD, PT[1)], Seulki Han, MS, PT[3)]

J. Phys. Ther. Sci.
25: 611–614, 2013

NeuroRehabilitation 33 (2013) 565–574
DOI: 10.3233/NRE-130991
IOS Press

Action observation training for functional activities after stroke: A pilot randomized controlled trial

Jung-Hee Kim[a] and Byoung-Hee Lee[b,*]

Original Research Articles

Does Action Observation Training With Immediate Physical Practice Improve Hemiparetic Upper-Limb Function in Chronic Stroke?

Neurorehabilitation and Neural Repair
1–11
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DOI: 10.1177/1545968314565512
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Neurorehabilitation and Neural Repair
http://nnr.sagepub.com/

Observation-to-Imitate Plus Practice Could Add Little to Physical Therapy Benefits Within 31 Days of Stroke: Translational Randomized Controlled Trial
Tracy Cowles, Allan Clark, Kathryn Mares, Guy Peryer, Rebecca Stuck and Valerie Pomeroy

Original Article

Effects of purposeful action observation on kinematic patterns of upper extremity in individuals with hemiplegia

Eunjoo Kim[1)], KyeongMi Kim[2)*]

J. Phys. Ther. Sci.
27: 1809–1811, 2015

Neurorehabilitation and Neural Repair
http://nnr.sagepub.com/

Clinical Relevance of Action Observation in Upper-Limb Stroke Rehabilitation : A Possible Role in Recovery of Functional Dexterity. A Randomized Clinical Trial
Marco Franceschini, Maria Gabriella Ceravolo, Maurizio Agosti, Paola Cavallini, Stefano Bonassi, Valentina Dall'Armi, Maurizio Massucci, Francesca Schifini and Patrizio Sale

Original Article

The effects of action observation gait training on the static balance and walking ability of stroke patients

Eun Cho Park, MS, PT[1)], Gak Hwangbo, PhD, PT[1)*]

J. Phys. Ther. Sci.
27: 341–344, 2015

The Mirror Neuron System: A Neural Substrate for Methods in Stroke Rehabilitation

Kathleen A. Garrison, MSc,[1] Carolee J. Winstein, PhD,[2] and Lisa Aziz-Zadeh, PhD[3]

Neurorehabilitation and Neural Repair
24(5) 404–412
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DOI: 10.1177/1545968309354536
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Topics in Stroke Rehabilitation

ISSN: 1074-9357 (Print) 1945-5119 (Online) Journal homepage: http://www.tandfonline.com/loi/ytsr20

informa healthcare

Effects of action observation therapy on hand erity and EEG-based cortical activation erns in patients with post-stroke hemiparesis

Kuk, Jong-Man Kim, Duck-Won Oh & Han-Jeong Hwang

ELSEVIER

NeuroImage

www.elsevier.com/locate/ynimg
NeuroImage 36 (2007) 1164–1173

Action observation has a positive impact on rehabilitation of motor deficits after stroke

Denis Ertelt,[a] Steven Small,[b] Ana Solodkin,[b] Christian Dettmers,[c] Adam McNamara,[a] Ferdinand Binkofski,[a,*,1] and Giovanni Buccino[d,*,1]

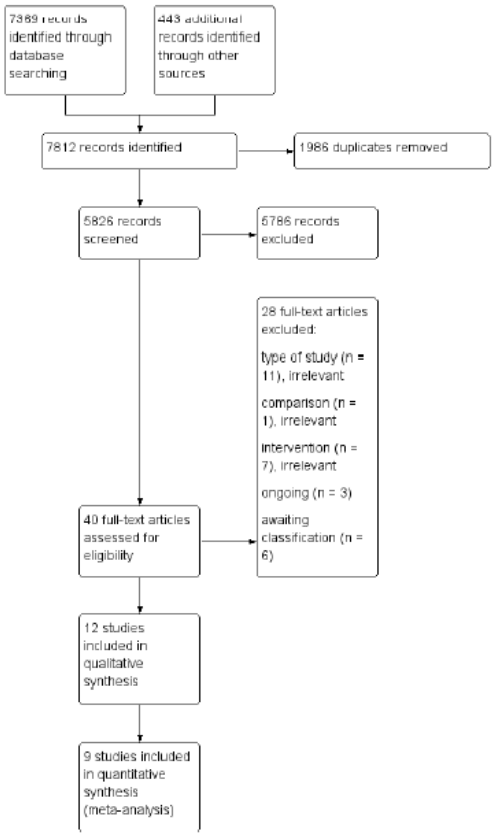
Disability and Rehabilitation, 2010; 32(25): 2097–2106

RESEARCH PAPER

An observation-based intervention for stroke rehabilitation: experiences of eight individuals affected by stroke

LOUISE M. EWAN[1], KATHRYN KINMOND[2] & PAUL S. HOLMES[3]

Efficacia sull'arto superiore



Cochrane Library

Cochrane Database of Systematic Reviews

Action observation for upper limb rehabilitation after stroke (Review)

Borges LRDM, Fernandes ABGS, Melo LP, Guerra RO, Campos TF

Borges LRDM, Fernandes ABGS, Melo LP, Guerra RO, Campos TF.
Action observation for upper limb rehabilitation after stroke.
Cochrane Database of Systematic Reviews 2018, Issue 10. Art. No.: CD011887.
DOI: 10.1002/14651858.CD011887.pub2.

Authors' conclusions

We found evidence that AO is beneficial in improving upper limb motor function and dependence in activities of daily living (ADL) in people with stroke, when compared with any control group; however, we considered the quality of the evidence to be low. We considered the effect of AO on hand function to be large, but it does not appear to be clinically relevant, although we considered the quality of the evidence as moderate. As such, our confidence in the effect estimate is limited because it will likely change with future research.

Analysis 1.1. Comparison 1 Action observation therapy versus control: effect on arm function, Outcome 1 Arm function.

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 1 Action observation therapy versus control: effect on arm function

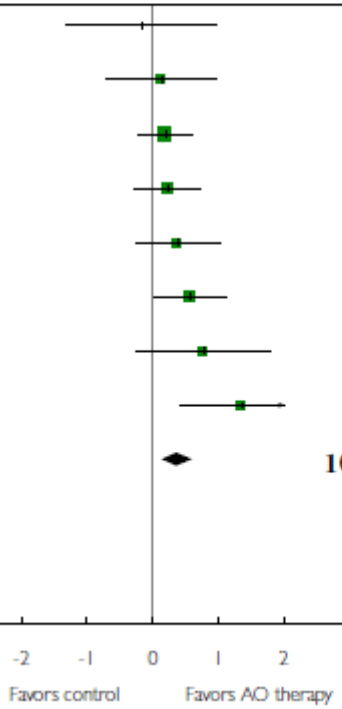
Outcome: 1 Arm function

Study or subgroup	AO Therapy N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Kim 2015	6	39.8 (12.2)	6	42 (11.6)		4.2 %	-0.17 [-1.31, 0.96]
Cowles 2013	9	29.8 (20)	13	27.1 (20.2)		7.4 %	0.13 [-0.72, 0.98]
Franceschini 2012	48	72.7 (31.2)	42	66.9 (28.4)		27.9 %	0.19 [-0.22, 0.61]
Zhu 2015	31	35.5 (12.4)	30	32.8 (11.2)		19.8 %	0.23 [-0.28, 0.73]
Dettmers 2014	19	47.4 (11.8)	19	43.5 (8.3)		12.6 %	0.37 [-0.27, 1.02]
Fu 2017	28	42.32 (12.56)	25	35.08 (12.44)		16.8 %	0.57 [0.02, 1.12]
Ertelt 2007	8	-7 (6.8)	8	-16.9 (15.9)		5.1 %	0.77 [-0.26, 1.79]
Kim 2016a	11	52.7 (3.3)	11	48.4 (2.8)		6.0 %	1.35 [0.41, 2.30]
Total (95% CI)	**160**		**154**			**100.0 %**	**0.36 [0.13, 0.60]**

Heterogeneity: Tau^2 = 0.01; Chi^2 = 7.42, df = 7 (P = 0.39); I^2 =6%

Test for overall effect: Z = 3.04 (P = 0.0024)

Test for subgroup differences: Not applicable



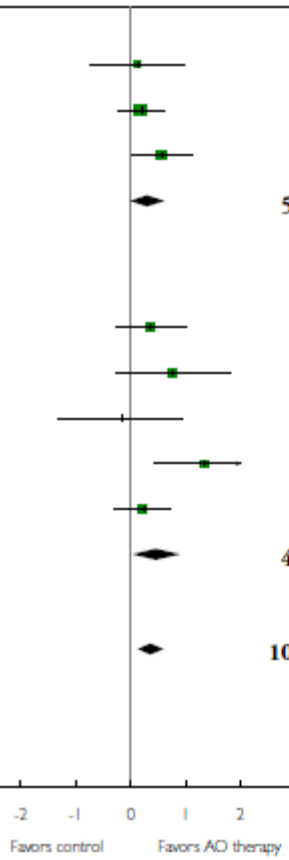
Analysis 1.2. Comparison 1 Action observation therapy versus control: effect on arm function, Outcome 2 Subgroup analysis: age.

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 1 Action observation therapy versus control: effect on arm function

Outcome: 2 Subgroup analysis: age

Study or subgroup	AO Therapy N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Upper 60 years							
Cowles 2013	9	29.8 (20)	13	27.1 (20.2)		7.4 %	0.13 [-0.72, 0.98]
Franceschini 2012	48	72.7 (31.2)	42	66.9 (28.4)		27.9 %	0.19 [-0.22, 0.61]
Fu 2017	28	42.32 (12.56)	25	35.08 (12.44)		16.8 %	0.57 [0.02, 1.12]
Subtotal (95% CI)	**85**		**80**			**52.2 %**	**0.30 [-0.01, 0.61]**
Heterogeneity: Tau^2 = 0.0; Chi^2 = 1.34, df = 2 (P = 0.51); I^2 =0.0%							
Test for overall effect: Z = 1.92 (P = 0.055)							
2 Lower 60 years							
Dettmers 2014	19	47.4 (11.85)	19	43.5 (8.3)		12.6 %	0.37 [-0.27, 1.02]
Ertelt 2007	8	-7 (6.8)	8	-16.9 (15.9)		5.1 %	0.77 [-0.26, 1.79]
Kim 2015	6	39.8 (12.2)	6	42 (11.6)		4.2 %	-0.17 [-1.31, 0.96]
Kim 2016a	11	52.7 (3.3)	11	48.4 (2.8)		6.0 %	1.35 [0.41, 2.30]
Zhu 2015	31	35.5 (12.4)	30	32.8 (11.2)		19.8 %	0.23 [-0.28, 0.73]
Subtotal (95% CI)	**75**		**74**			**47.8 %**	**0.46 [0.04, 0.89]**
Heterogeneity: Tau^2 = 0.07; Chi^2 = 5.80, df = 4 (P = 0.21); I^2 =31%							
Test for overall effect: Z = 2.15 (P = 0.032)							
Total (95% CI)	**160**		**154**			**100.0 %**	**0.36 [0.13, 0.60]**
Heterogeneity: Tau^2 = 0.01; Chi^2 = 7.42, df = 7 (P = 0.39); I^2 =6%							
Test for overall effect: Z = 3.04 (P = 0.0024)							
Test for subgroup differences: Chi^2 = 0.36, df = 1 (P = 0.55), I^2 =0.0%							



Analysis 1.4. Comparison 1 Action observation therapy versus control: effect on arm function, Outcome 4 Subgroup analysis: time post stroke.

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 1 Action observation therapy versus control: effect on arm function

Outcome: 4 Subgroup analysis: time post stroke

Study or subgroup	AO Therapy N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Acute or subacute phase							
Cowles 2013	9	29.8 (20)	13	27.1 (20.2)		7.9 %	0.13 [-0.72, 0.98]
Franceschini 2012	48	72.7 (31.2)	42	66.9 (28.4)		28.7 %	0.19 [-0.22, 0.61]
Fu 2017	28	42.32 (12.56)	25	35.08 (12.44)		17.6 %	0.57 [0.02, 1.12]
Kim 2016a	11	52.7 (3.3)	11	48.4 (2.8)		6.4 %	1.35 [0.41, 2.30]
Zhu 2015	31	35.5 (12.4)	30	32.8 (11.2)		20.6 %	0.23 [-0.28, 0.73]
Subtotal (95% CI)	**127**		**121**			**81.2 %**	**0.39 [0.07, 0.72]**
Heterogeneity: Tau² = 0.04; Chi² = 5.98, df = 4 (P = 0.20); I² =33%							
Test for overall effect: Z = 2.36 (P = 0.018)							
2 Chronic phase							
Ertelt 2007	8	-7 (6.8)	8	-16.9 (15.9)		5.5 %	0.77 [-0.26, 1.79]
Subtotal (95% CI)	**8**		**8**			**5.5 %**	**0.77 [-0.26, 1.79]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.46 (P = 0.14)							
3 Acute, subacute and chronic phase							
Dettmers 2014	19	47.4 (11.85)	19	43.5 (8.3)		13.3 %	0.37 [-0.27, 1.02]
Subtotal (95% CI)	**19**		**19**			**13.3 %**	**0.37 [-0.27, 1.02]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.14 (P = 0.25)							
Total (95% CI)	**154**		**148**			**100.0 %**	**0.39 [0.15, 0.64]**
Heterogeneity: Tau² = 0.01; Chi² = 6.55, df = 6 (P = 0.36); I² =8%							
Test for overall effect: Z = 3.13 (P = 0.0017)							
Test for subgroup differences: Chi² = 0.48, df = 2 (P = 0.79), I² =0.0%							

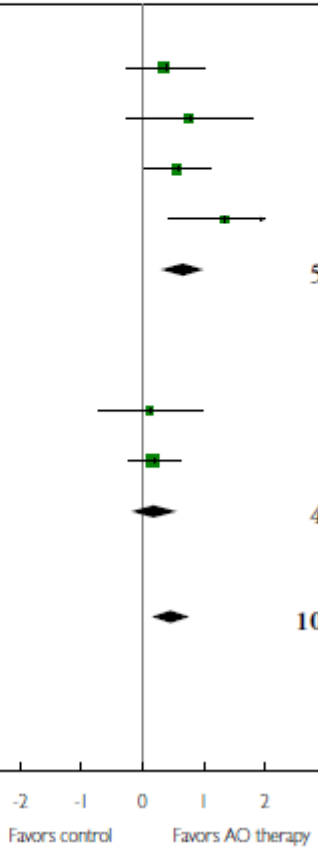
Analysis 1.7. Comparison 1 Action observation therapy versus control: effect on arm function, Outcome 7 Subgroup analysis: duration of observation.

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 1 Action observation therapy versus control: effect on arm function

Outcome: 7 Subgroup analysis: duration of observation

Study or subgroup	AO Therapy N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 More than 3 minutes of observation							
Dettmers 2014	19	47.4 (11.8)	19	43.5 (8.3)		17.4 %	0.37 [-0.27, 1.02]
Ertelt 2007	8	-7 (6.8)	8	-16.9 (15.9)		7.7 %	0.77 [-0.26, 1.79]
Fu 2017	28	42.32 (12.56)	25	35.08 (12.44)		22.2 %	0.57 [0.02, 1.12]
Kim 2016a	11	52.7 (3.3)	11	48.4 (2.8)		8.9 %	1.35 [0.41, 2.30]
Subtotal (95% CI)	**66**		**63**			**56.2 %**	**0.65 [0.29, 1.00]**
Heterogeneity: Tau² = 0.0; Chi² = 2.96, df = 3 (P = 0.40); I² =0.0%							
Test for overall effect: Z = 3.53 (P = 0.00041)							
2 Less than 3 minutes of observation							
Cowles 2013	9	29.8 (20)	13	27.1 (20.2)		10.8 %	0.13 [-0.72, 0.98]
Franceschini 2012	48	72.7 (31.2)	42	66.9 (28.4)		33.0 %	0.19 [-0.22, 0.61]
Subtotal (95% CI)	**57**		**55**			**43.8 %**	**0.18 [-0.19, 0.55]**
Heterogeneity: Tau² = 0.0; Chi² = 0.02, df = 1 (P = 0.90); I² =0.0%							
Test for overall effect: Z = 0.95 (P = 0.34)							
Total (95% CI)	**123**		**118**			**100.0 %**	**0.45 [0.15, 0.75]**
Heterogeneity: Tau² = 0.02; Chi² = 6.08, df = 5 (P = 0.30); I² =18%							
Test for overall effect: Z = 2.96 (P = 0.0031)							
Test for subgroup differences: Chi² = 3.11, df = 1 (P = 0.08), I² =68%							



Analysis 1.10. Comparison 1 Action observation therapy versus control: effect on arm function, Outcome 10 Arm function - sensitivity analysis: home-based action observation training (video therapy).

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 1 Action observation therapy versus control: effect on arm function

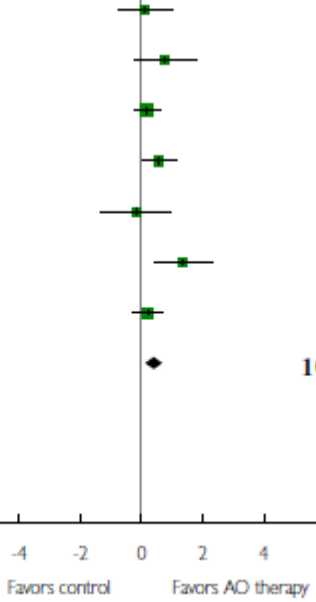
Outcome: 10 Arm function - sensitivity analysis: home-based action observation training (video therapy)

Study or subgroup	AO Therapy N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Cowles 2013	9	29.8 (20)	13	27.1 (20.2)		9.5 %	0.13 [-0.72, 0.98]
Ertelt 2007	8	-7 (6.8)	8	-16.9 (15.9)		6.8 %	0.77 [-0.26, 1.79]
Franceschini 2012	48	72.7 (31.2)	42	66.9 (28.4)		28.6 %	0.19 [-0.22, 0.61]
Fu 2017	28	42.32 (12.56)	25	35.08 (12.44)		19.4 %	0.57 [0.02, 1.12]
Kim 2015	6	39.8 (12.2)	6	42 (11.6)		5.7 %	-0.17 [-1.31, 0.96]
Kim 2016a	11	52.7 (3.3)	11	48.4 (2.8)		7.9 %	1.35 [0.41, 2.30]
Zhu 2015	31	35.5 (12.4)	30	32.8 (11.2)		22.1 %	0.23 [-0.28, 0.73]
Total (95% CI)	**141**		**135**			**100.0 %**	**0.38 [0.10, 0.66]**

Heterogeneity: Tau² = 0.03; Chi² = 7.42, df = 6 (P = 0.28); I² =19%

Test for overall effect: Z = 2.63 (P = 0.0086)

Test for subgroup differences: Not applicable



Analysis 2.1. Comparison 2 Action observation therapy versus control: effect on hand function, Outcome 1 Hand function.

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 2 Action observation therapy versus control: effect on hand function

Outcome: 1 Hand function

Study or subgroup	AO Therapy N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Franceschini 2012	48	20 (19.2)	42	14.5 (15.3)		6.1 %	5.50 [-1.64, 12.64]
Kim 2016a	11	24.6 (2.5)	11	22 (2.1)		83.7 %	2.60 [0.67, 4.53]
Kuk 2016	10	24.4 (5.4)	10	20.6 (7.1)		10.2 %	3.80 [-1.73, 9.33]
Total (95% CI)	**69**		**63**			**100.0 %**	**2.90 [1.13, 4.66]**

Heterogeneity: $Chi^2 = 0.70$, df = 2 (P = 0.70); $I^2 = 0.0\%$

Test for overall effect: Z = 3.22 (P = 0.0013)

Test for subgroup differences: Not applicable

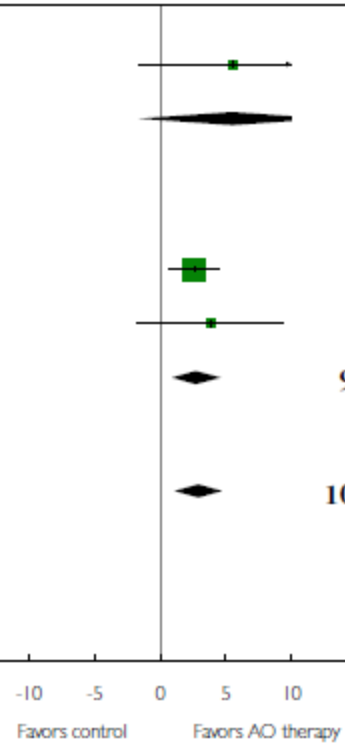
Analysis 2.2. Comparison 2 Action observation therapy versus control: effect on hand function, Outcome 2 Subgroup analysis: age.

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 2 Action observation therapy versus control: effect on hand function

Outcome: 2 Subgroup analysis: age

Study or subgroup	AO Therapy N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Upper 60 years							
Franceschini 2012	48	20 (19.2)	42	14.5 (15.3)		6.1 %	5.50 [-1.64, 12.64]
Subtotal (95% CI)	**48**		**42**			**6.1 %**	**5.50 [-1.64, 12.64]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.51 (P = 0.13)							
2 Lower 60 years							
Kim 2016a	11	24.6 (2.5)	11	22 (2.1)		83.7 %	2.60 [0.67, 4.53]
Kuk 2016	10	24.4 (5.4)	10	20.6 (7.1)		10.2 %	3.80 [-1.73, 9.33]
Subtotal (95% CI)	**21**		**21**			**93.9 %**	**2.73 [0.91, 4.55]**
Heterogeneity: $Chi^2 = 0.16$, df = 1 (P = 0.69); $I^2 = 0.0\%$							
Test for overall effect: Z = 2.94 (P = 0.0033)							
Total (95% CI)	**69**		**63**			**100.0 %**	**2.90 [1.13, 4.66]**
Heterogeneity: $Chi^2 = 0.70$, df = 2 (P = 0.70); $I^2 = 0.0\%$							
Test for overall effect: Z = 3.22 (P = 0.0013)							
Test for subgroup differences: $Chi^2 = 0.54$, df = 1 (P = 0.46), $I^2 = 0.0\%$							



Analysis 3.1. Comparison 3 Action observation therapy versus control: effect on ADL, Outcome 1 Dependence on activities of daily living.

Review: Action observation for upper limb rehabilitation after stroke

Comparison: 3 Action observation therapy versus control: effect on ADL

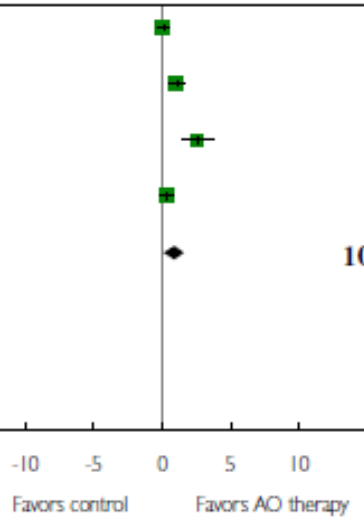
Outcome: 1 Dependence on activities of daily living

Study or subgroup	AO Therapy N	AO Therapy Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Franceschini 2012	48	63.5 (18.3)	42	61.8 (18.4)		28.6 %	0.09 [-0.32, 0.51]
Fu 2017	28	73.5 (10.1)	25	62.2 (11.2)		26.4 %	1.05 [0.47, 1.62]
Kim 2016a	11	78.5 (3.4)	11	70.5 (2.5)		17.5 %	2.58 [1.39, 3.76]
Zhu 2015	31	75.3 (15.5)	30	69.5 (14.3)		27.4 %	0.38 [-0.12, 0.89]
Total (95% CI)	**118**		**108**			**100.0 %**	**0.86 [0.11, 1.61]**

Heterogeneity: $Tau^2 = 0.46$; $Chi^2 = 19.16$, df = 3 (P = 0.00025); $I^2 = 84\%$

Test for overall effect: Z = 2.26 (P = 0.024)

Test for subgroup differences: Not applicable



Efficacia sul cammino e sull'equilibrio

Table 1. The comparison of means for variables between pre- and post-values for the three groups (Unit: score)

	Variables	AOTA		MTA		AOT	
		Pre-value	Post-value	Pre-value	Post-value	Pre-value	Post-value
Balance	OBI	2.3 ± 2.0	1.2 ± 0.8*	1.2 ± 0.5	1.1 ± 0.7	1.4 ± 0.9	1.5 ± 0.9
	ABI	1.3 ± 1.0	0.6 ± 0.5*	0.8 ± 0.5	0.9 ± 0.7	0.8 ± 0.5	0.9 ± 0.5
	MBI	1.4 ± 1.7	0.8 ± 0.6	0.5 ± 0.3	0.5 ± 0.3	1.0 ± 0.7	0.9 ± 0.7
	FR	2.8 ± 1.4	2.3 ± 0.5	2.6 ± 0.6	2.1 ± 1.0	2.5 ± 1.1	2.9 ± 1.0
Gait	mEFAP	102.2 ± 45.5	54.2 ± 41.4*	74.0 ± 35.0	60.0 ± 22.8*	118.1 ± 60.0	101.4 ± 50.5

*Significantly different between pre and post ($p<0.05$)
OBI: Overall Balance Index; ABI: Anteroposterior Balance Index; MBI: Mediolateral Balance Index; FR: fall risk; mEFAP: Modified Emory Functional Ambulation Profile

Lee HJ et al. J Phys Ther Sci 2017

Efficacia sull'equilibrio

Park EC et al. J Phys Ther Sci, 2015

Table 1. Comparison of the static balance on standing position between the AOGT group and the GGT group (mean ± SD)

	AOGT		GGT	
	Pretest	Posttest	Pretest	Posttest
SA (mm^2)	437.9±381.2	167.5±166.2*	349.7±407.6	349.7±407.6*
SS (mm/s)	0.8±0.3	0.5±0.2*a	0.7±0.2	0.6±0.2*
LOS (mm^2)	4,235.5±4,644.7	7,064.3±5,014.4*a	2,361.1±2,299.5	3,002.1±2,629.2*

*Significant difference compared with before therapy at <0.05. a significant difference in gains between the two groups at <0.05. AOGT: Action observation gait training group, GGT: General gait training group, SA: Sway Area, SS: Sway Speed, LOS: Limit of stability

Table 2. Comparison of AOGT and GGT groups' gait ability (mean ± SD)

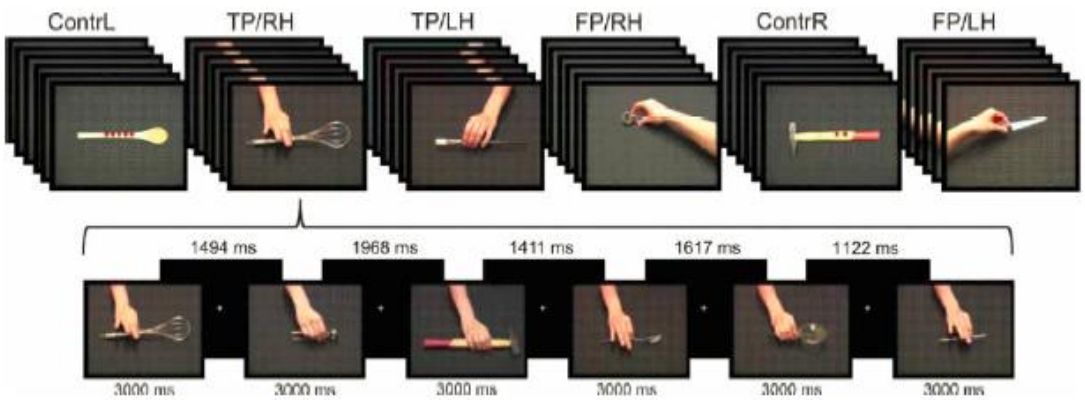
	AOGT		GGT	
	Pretest	Posttest	Pretest	Posttest
TUG (sec)	20.0±3.5	15.7±3.3*a	20.5±3.5	17.7±3.2*
10-M WT (sec)	19.1±1.7	14.6±2.3*a	18.6±2.8	15.5±2.3*

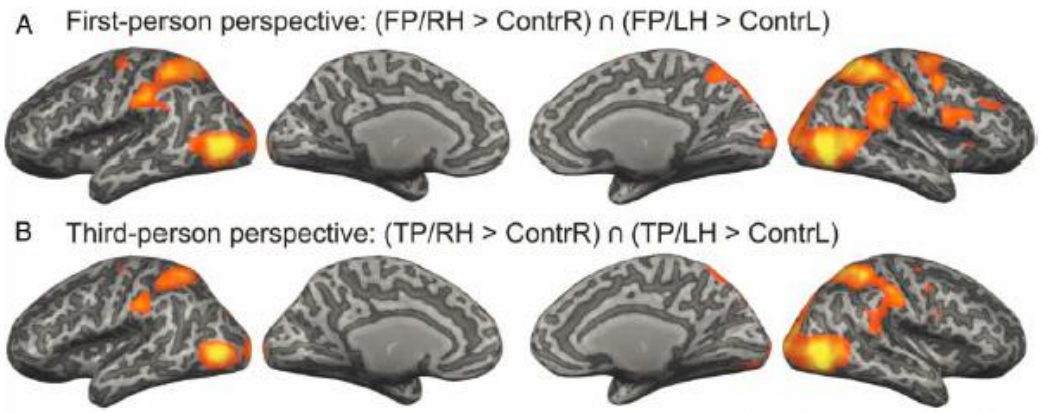
*Significant difference compared with before therapy at <0.05. a significant difference in gains between the two groups at <0.05. AOGT: Action observation gait training group, GGT: General gait training group, TUG: Timed up and go test, 10-MWT: 10-meter walk test

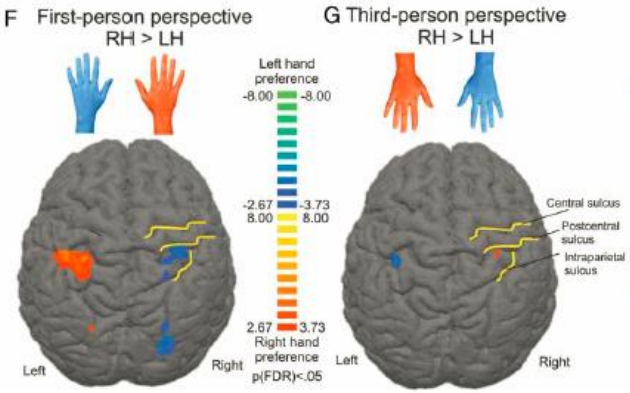
Cosa osservare

Osservazione in prima o terza persona

Vingerhoets, G. Neuropsy rehab, 2012







Cosa osservare

L'esperienza motoria influenza l'attivazione del MNS?

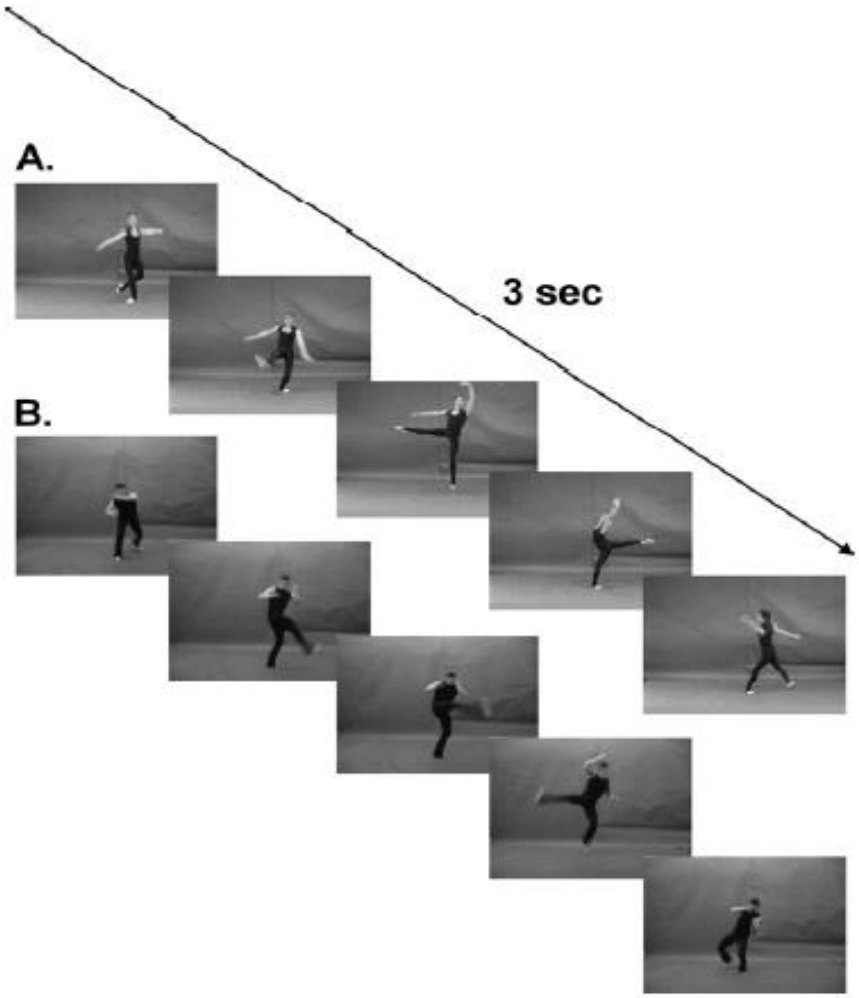
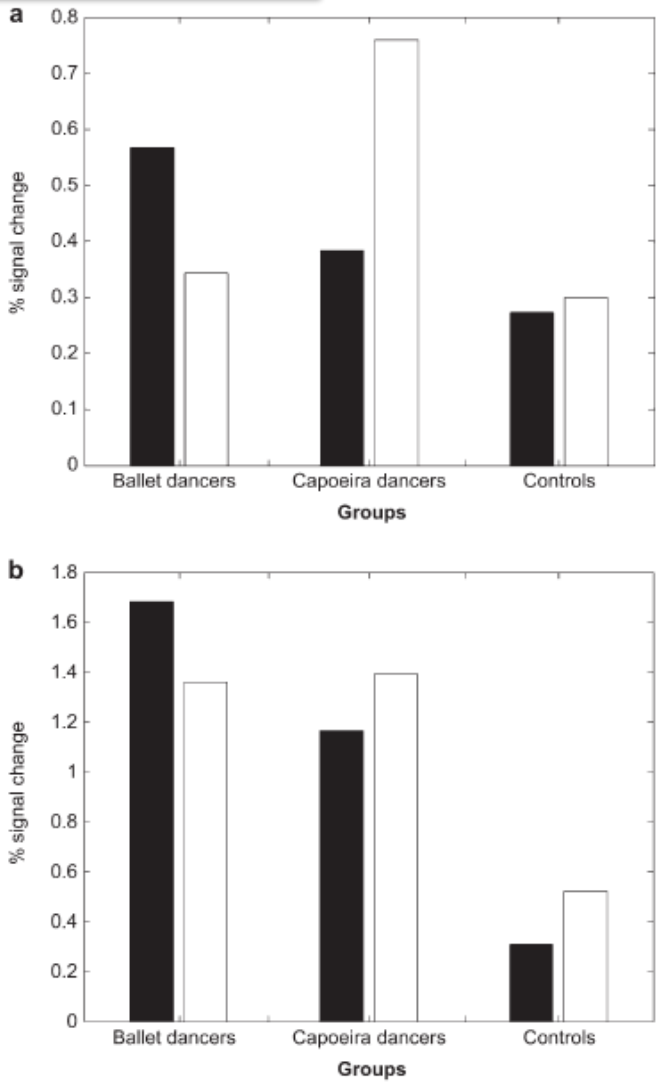


Figure 1. Stimuli: Colour videos of standard classical ballet and capoeira movements were performed by professional dancers. Twelve different moves of each style (*a*, ballet; *b*, capoeira) were matched by a professional choreographer for kinematic features (for examples see videos in the supplementary information online).

Calvo-Merino et al, Cerebral Cortex 2005

Cosa osservare



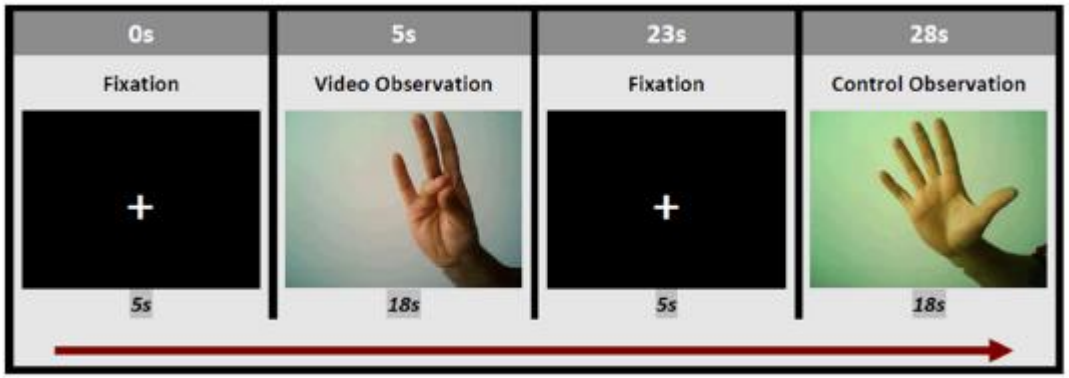
Il MNS è più attivato quando l'osservazione riguarda azioni che appartengono all'esperienza motoria

Figure 3. Parameter estimates for the influence of motor expertise on action observation in the central voxels of areas classically identified with the human mirror system: (*A*) left precentral gyrus/dorsal premotor cortex (−24 −6 72), (*B*) left intraparietal sulcus (−33 −45 54), (*C*) left posterior superior temporal sulcus (−39 −66 36). In all three areas, parameter estimates show that the effect of expertise is driven by a crossover interaction between the two groups of expert dancers and the two stimulus types. Stimulus type has minimal effects in control subjects. Black bars reflect parameter estimates for ballet stimulus and white bars reflect capoeira stimulus.

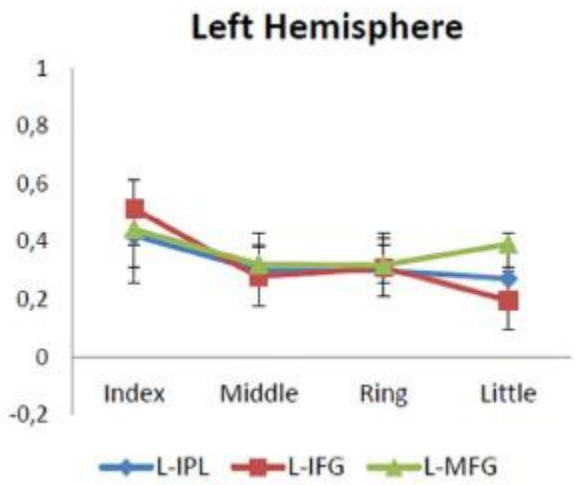
Calvo-Merino et al, Cerebral Cortex 2005

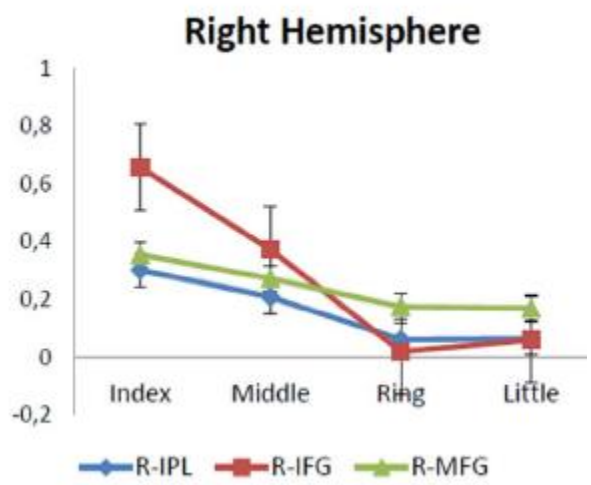
Cosa osservare

MNS e la familiarità con le azioni osservate



L'osservazione di movimenti intransitivi semplici produce meno attivazione delle aree parietali e premotorie rispetto all'osservazione di movimenti familiari





Plata Bello J et al, PlosOne 2013

Cosa osservare

Brain Imaging and Behavior
DOI 10.1007/s11682-016-9536-3

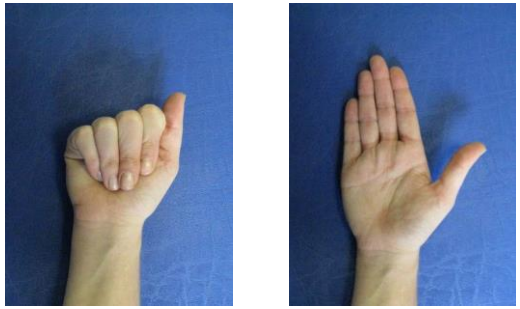
ORIGINAL RESEARCH

The effect of action observation/execution on mirror neuron system recruitment: an fMRI study in healthy individuals

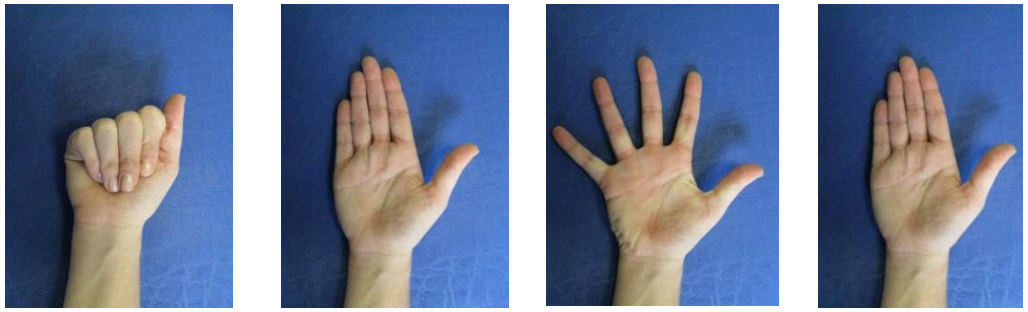
Roberto Gatti[1] · Maria A. Rocca[2] · Silvia Fumagalli[1,2] · Erik Cattrysse[3] · Eric Kerckhofs[3] · Andrea Falini[4] · Massimo Filippi[2]

Analizzare tramite risonanza magnetica funzionale (fMRI) l'attivazione del MNS durante l'osservazione e la simultanea osservazione ed esecuzione di movimenti intransitivi semplici, intransitivi complessi e transitivi eseguiti con la mano dominante

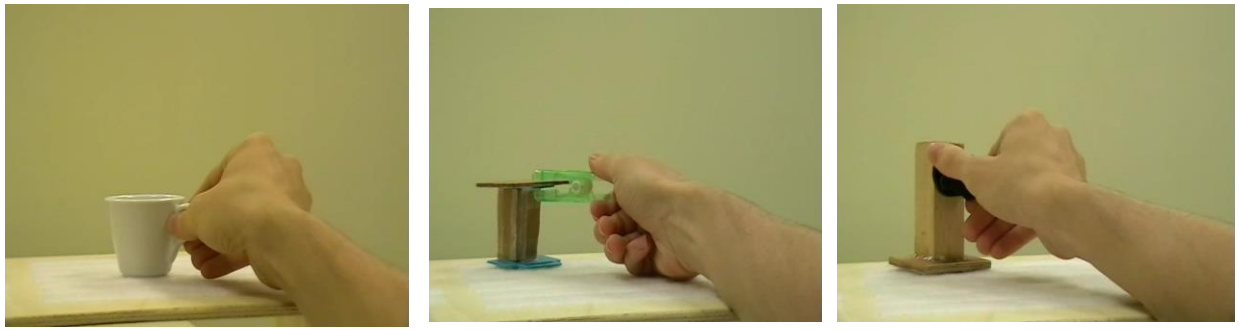
Compiti eseguiti a 1 Hz di frequenza



Movimento intransitivo semplice flessione estensione delle ultime 4 dita della mano destra

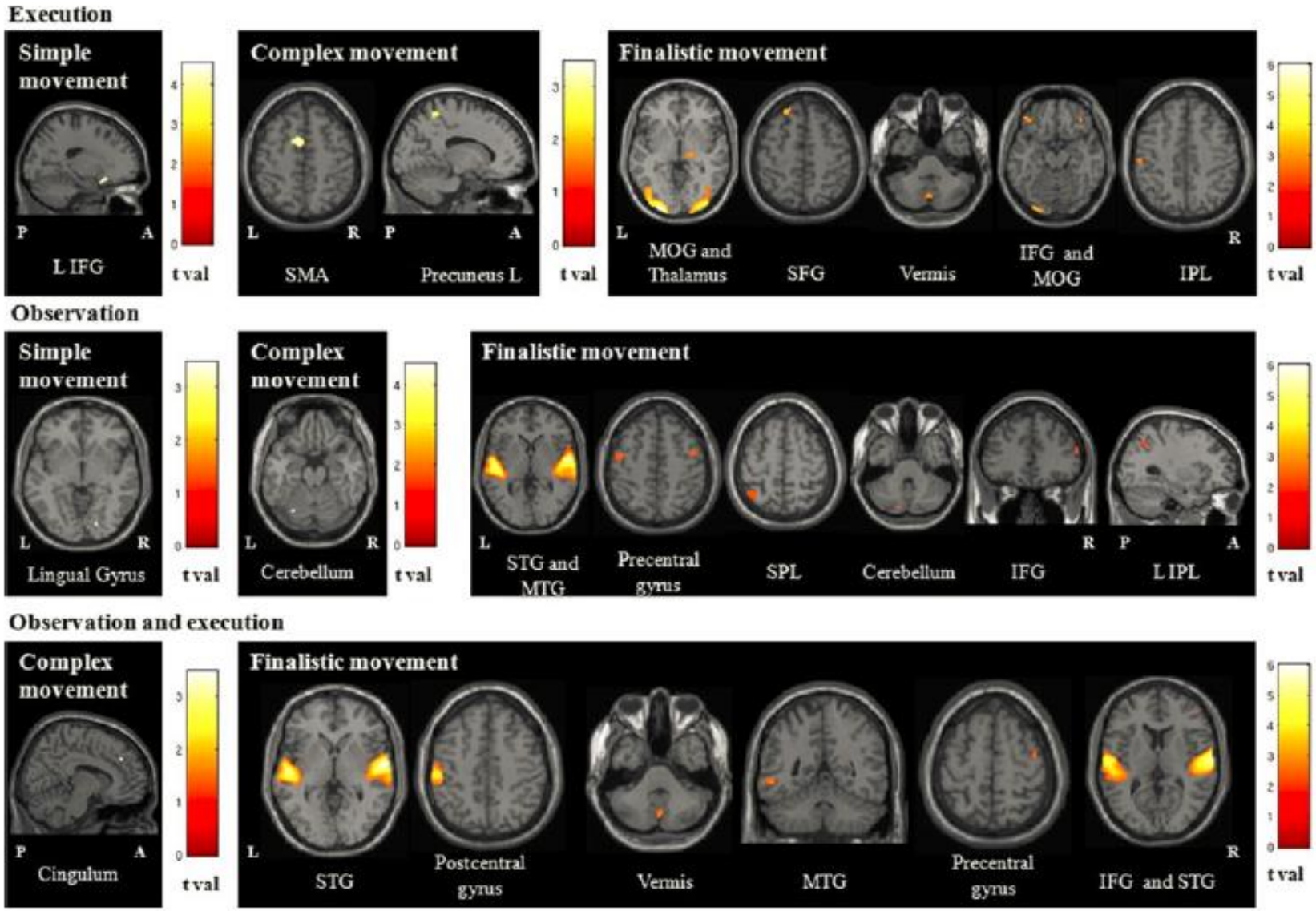


Movimento intransitivo complesso: flessione estensione alternata con adduzione abduzione delle ultime 4 dita della mano destra



Movimento transitivo: sollevare una tazzina e rilasciarla su una tavola di legno, aprire e chiudere una molletta per i panni e girare una manopola in senso orario

Risultati


Execution
Simple movement
P
A
L IFG
t val
Complex movement
L
R
P
A
SMA
Precuneus L
t val
Finalistic movement
L
R
MOG and Thalamus
SFG
Vermis
IFG and MOG
IPL
t val
Observation
Simple movement
L
R
Lingual Gyrus
t val
Complex movement
L
R
Cerebellum
t val
Finalistic movement
L
R
P
A
STG and MTG
Precentral gyrus
SPL
Cerebellum
IFG
L IPL
t val
Observation and execution
Complex movement
P
A
Cingulum
t val
Finalistic movement
L
R
STG
Postcentral gyrus
Vermis
MTG
Precentral gyrus
IFG and STG
t val

Cosa osservare

Il piano di movimento osservato modifica il motor learning?

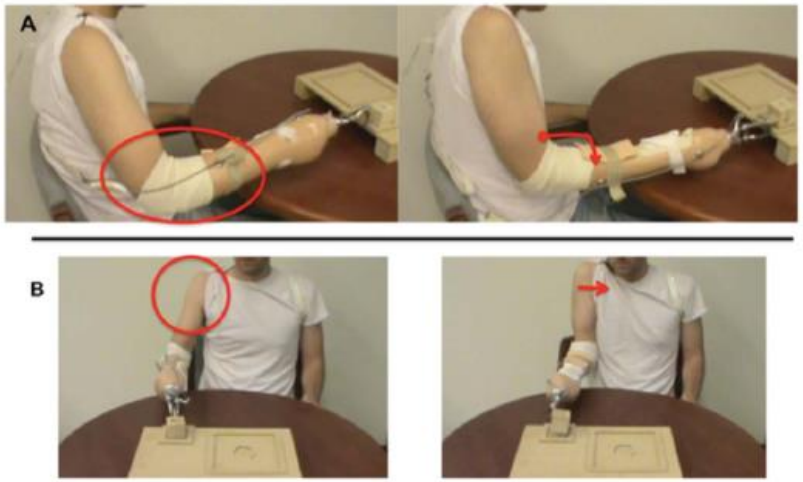


FIGURE 1. Perspectives captured from screenshots of the videos used in this study (circles and arrows were not a part of the video). (A) sagittal view with elbow extension highlighted and (B) coronal view with shoulder adduction highlighted.

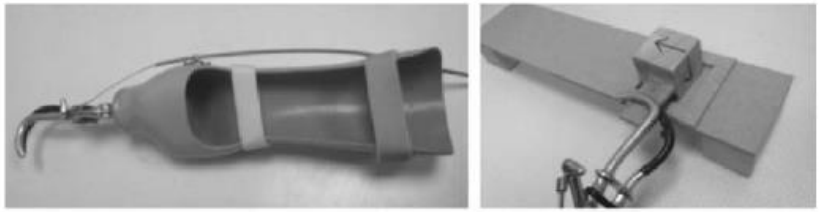


FIGURE 2. Prosthesis (left) and motor task board (right) used in this study (based on Cusack, et al, 2014, and relevant text).

Lawson D et al. J Mot Behav, 2016

Risultati

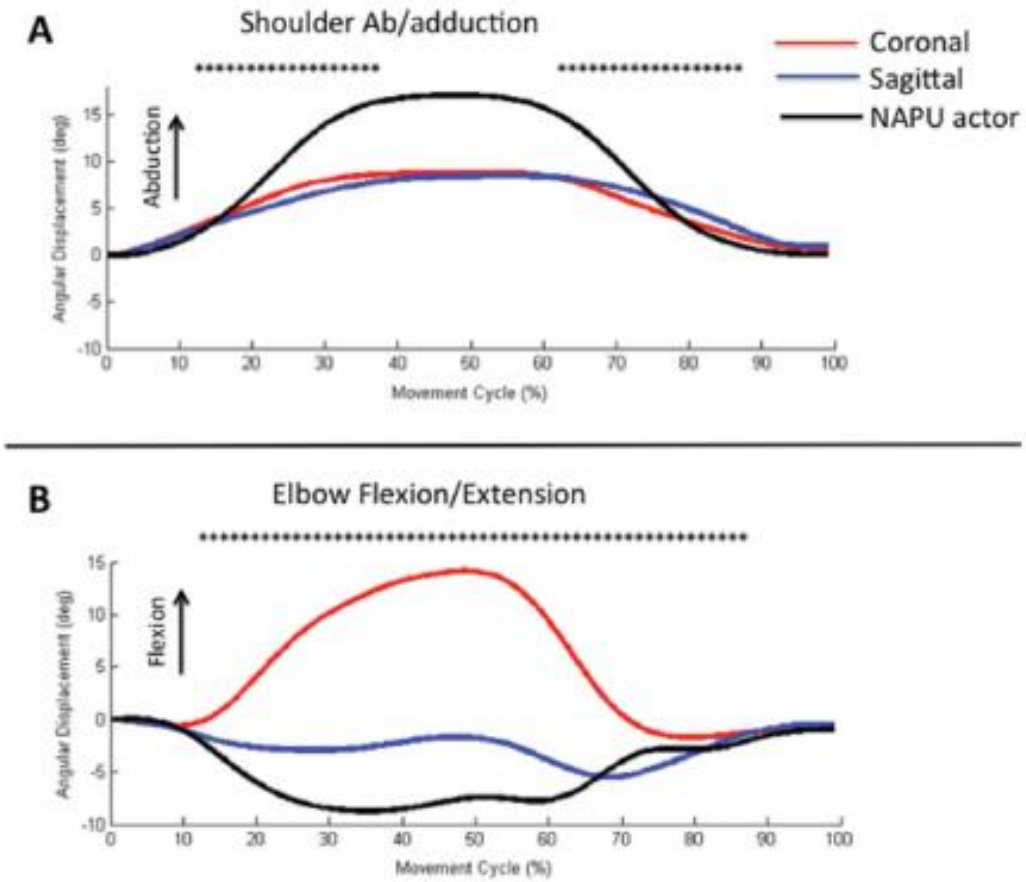


FIGURE 3. (A) Shoulder abduction/adduction and (B) elbow flexion/extension angular displacement effects over the duration of the movement cycle (%). Asterisks indicate time windows where there was a significant difference ($p < .05$) between perspective groups. The nonamputated prosthesis user (NAPU) actor trace is provided for visual comparison purposes.

Conclusioni

- L'aggiunta di action observation therapy nei soggetti con esiti di stroke migliora il recupero motorio e funzionale

- I soggetti meno anziani sembrerebbero essere più responder

- I video che si propongono ai pazienti devono:
  1) durare più di tre minuti; 2) proporre azioni task oriented; 3) considerare l'esperienza motoria dei pazienti; 4) permettere di osservare i dettagli cinematici delle azioni

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Grazie per l’attenzione