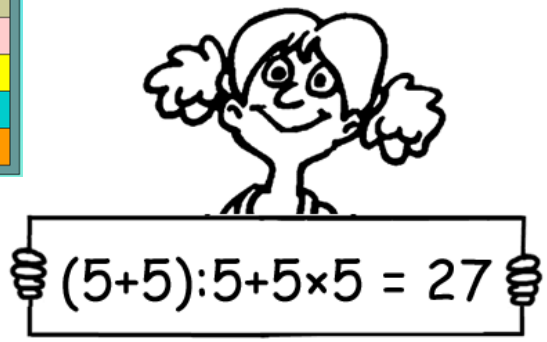
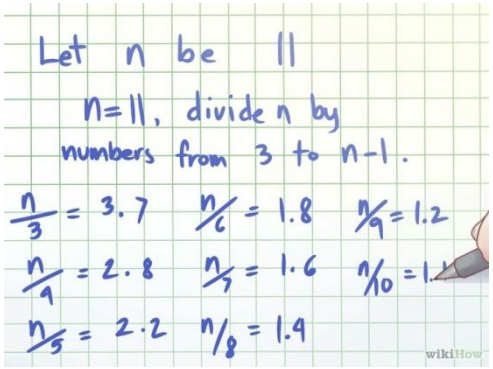
- COGNIZIONE NUMERICA -

COGNIZIONE NUMERICA E EMBODIED COGNITION

Il numero	986
è un numero primo	
è numero composto	✗
è divisibile per 2	✗
è divisibile per 3	
è divisibile per 5	
è divisibile per 7	
è divisibile per 11	



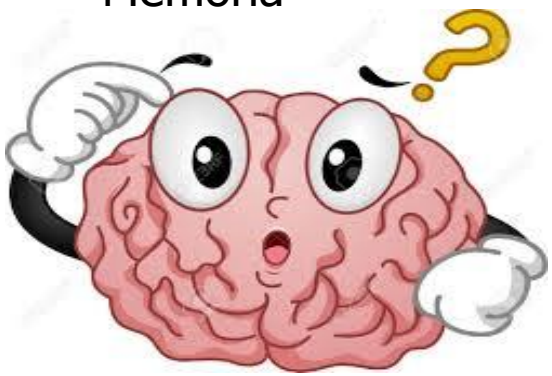


- *Saper leggere e scrivere i numeri*
- *Contare oggetti in un insieme*
- *Calcolare attraverso le quattro operazioni*
- *Applicare queste abilità sul denaro*
- *Dire orari e date*
- *Trovare una certa pagina in un libro*
- *Selezionare il canale televisivo*

COGNIZIONE NUMERICA E EMBODIED COGNITION

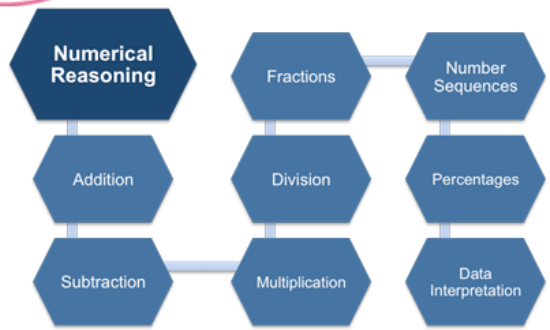
Memoria

Attenzione

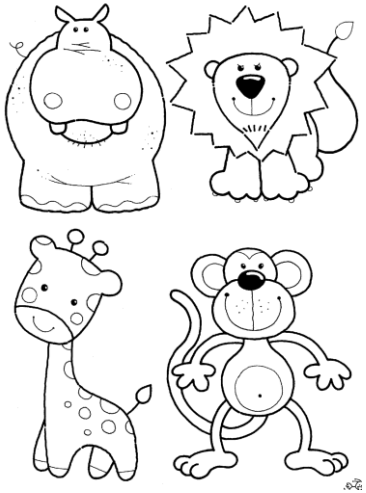


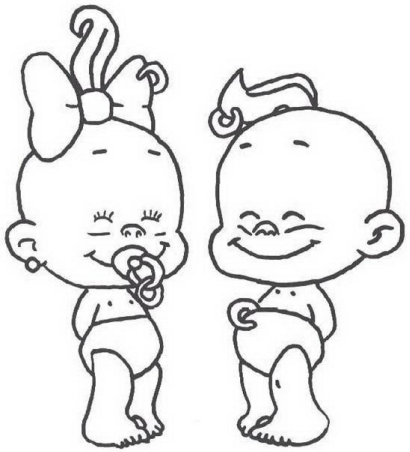
Pensiero e ragionamento

Apprendimento

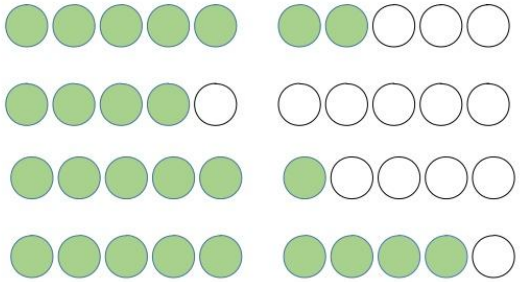


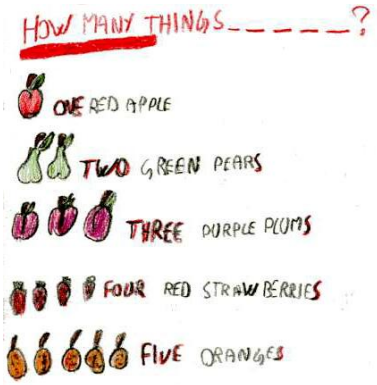
COGNIZIONE NUMERICA E EMBODIED COGNITION



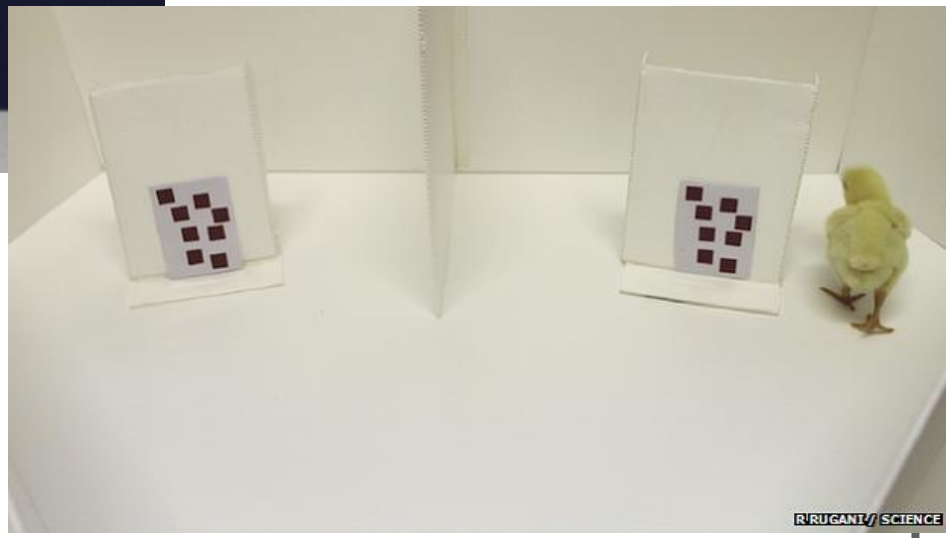


Indovinare la quantità senza contare





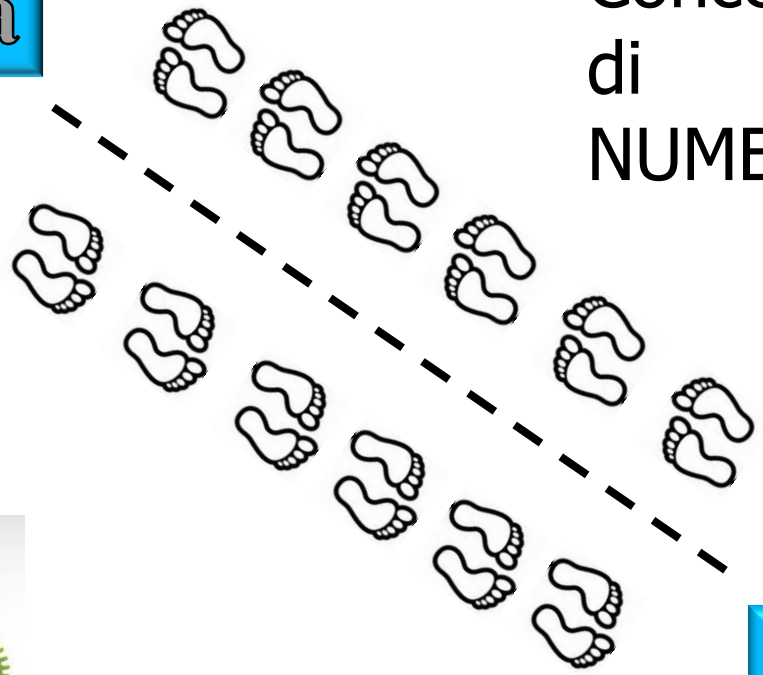
COGNIZIONE NUMERICA E EMBODIED COGNITION



COGNIZIONE NUMERICA E EMBODIED COGNITION

Concretezza

Concetto di NUMERO



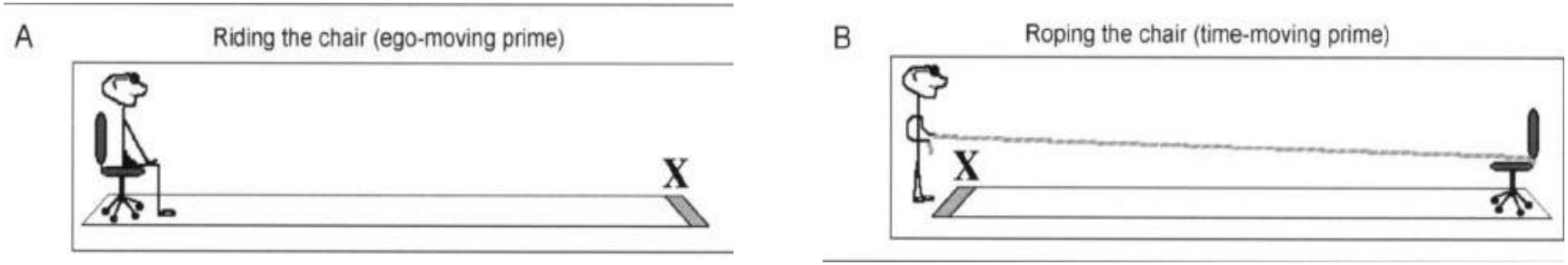
Concetto di TEMPO

Astrattezza

COGNIZIONE NUMERICA E EMBODIED COGNITION

CONCETTO di TEMPO: Boroditsky & Ramscar (2002)

Compito: rispondere a domande ambigue, es. "Il prossimo incontro di mercoledì è stato spostato di due giorni. In che giorno si svolge?"



• con un priming di auto-locomozione (effettivo o indotto, fig. A) i partecipanti interpretano lo spostamento come POSTICIPO, rispondendo VENERDÌ (Ego-moving perspective);

•con un priming di immobilità (effettivo o indotto, fig. B) i partecipanti interpretano lo spostamento come ANTICIPO, rispondendo LUNEDÌ (Time-moving perspective)

COGNIZIONE NUMERICA E EMBODIED COGNITION

COGNIZIONE NUMERICA: lavoro in corso→ esperimento stima frasi e movimenti

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PLOS | ONE

Counting Is Easier while Experiencing a Congruent Motion

Luisa Lugli[1,2]*, Giulia Baroni[1], Filomena Anelli[1,3], Anna M. Borghi[4,5], Roberto Nicoletti[1]

1 Department of Philosophy and Communication Studies, University of Bologna, Bologna, Italy, **2** Department of Communication and Economics, University of Modena and Reggio Emilia, Reggio Emilia, Italy, **3** Department of Education Sciences, University of Bologna, Bologna, Italy, **4** Department of Psychology, University of Bologna, Bologna, Italy, **5** Institute of Cognitive Sciences and Technologies, National Research Council, Roma, Italy

Abstract

Several studies suggest that numerical and spatial representations are intrinsically linked. Recent findings demonstrate that also motor actions interact with number magnitude processing, showing a motor-to-semantic effect. The current study assesses whether calculation processes can be modulated by motions performed with the whole body. Participants were required to make additions or subtractions while performing (on-line condition) or after having experienced (off-line condition) an ascending or descending motion through a passive (i.e., taking the elevator) or an active (i.e., taking the stairs) mode. Results show a congruency effect between the type of calculation and the direction of the motion depending on: a) the off-line or on-line condition, b) the passive or active mode and c) the real or imagined task. Implications of the results for an embodied and grounded perspective view will be discussed.

Citation: Lugli L, Baroni G, Anelli F, Borghi AM, Nicoletti R (2013) Counting Is Easier while Experiencing a Congruent Motion. PLoS ONE 8(5): e64500. doi:10.1371/journal.pone.0064500

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Competing Interests: The authors have declared that no competing interests exist.

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Uno degli articoli da studiare a scelta

COGNIZIONE NUMERICA E EMBODIED COGNITION

EFFETTO SNARC

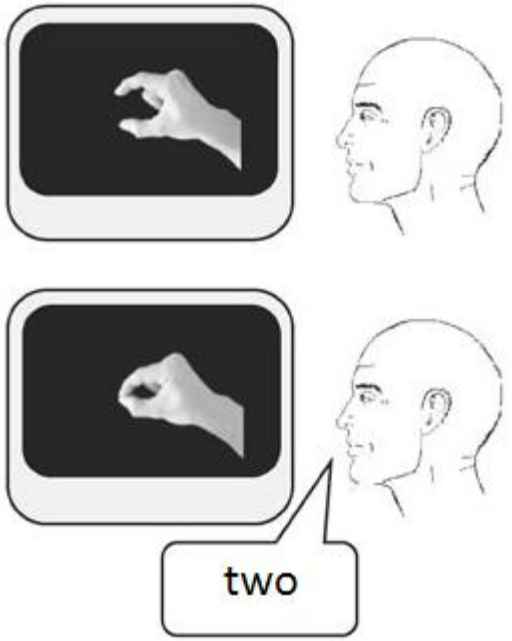
(Spatial Numerical Association of Response Codes, vedi ad esempio: Bonato et al., 2012; Dehaene et al., 1993; Fischer & Brugger, 2011; Walsh, 2003; Hubbard et al., 2005; Zorzi et al., 2002)

1 2 3 4 5 6 7 8 9 …

Mental number line

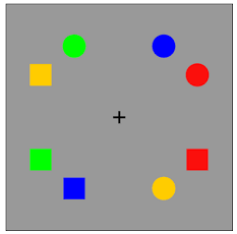
MOTOR-to-SEMANTIC EFFECT

(Badets et al., 2012; Badets & Pesenti, 2010; 2011)



COGNIZIONE NUMERICA E EMBODIED COGNITION

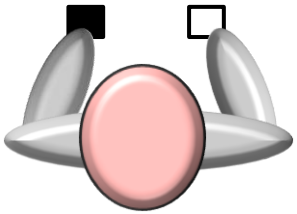
EFFETTO SNARC

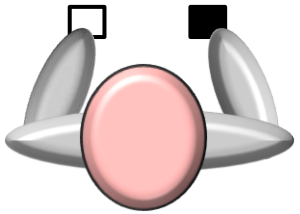


"Premi il tasto di sinistra se il numero è dispari, premi il tasto di destra se il numero è pari"

3

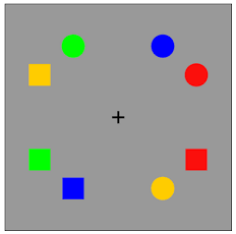
8





COGNIZIONE NUMERICA E EMBODIED COGNITION

EFFETTO SNARC



Tempi di reazione più veloci e risposte più accurate

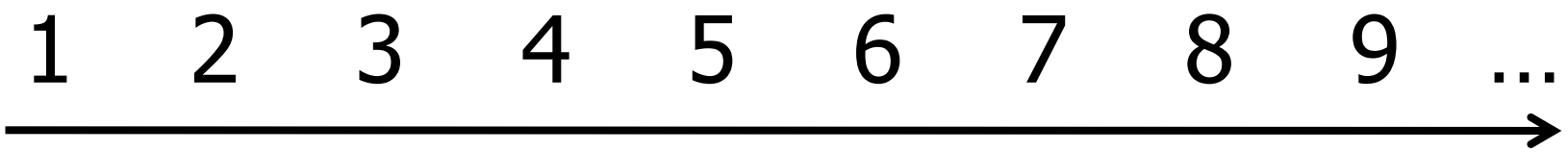
3 8

Tempi di reazione più lenti e risposte meno accurate

3 8

COGNIZIONE NUMERICA E EMBODIED COGNITION

EFFETTO SNARC

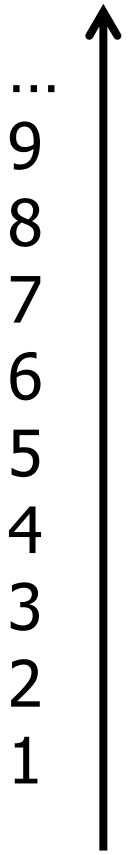


Horizontal Mental number line

COGNIZIONE NUMERICA E EMBODIED COGNITION

EFFETTO SNARC

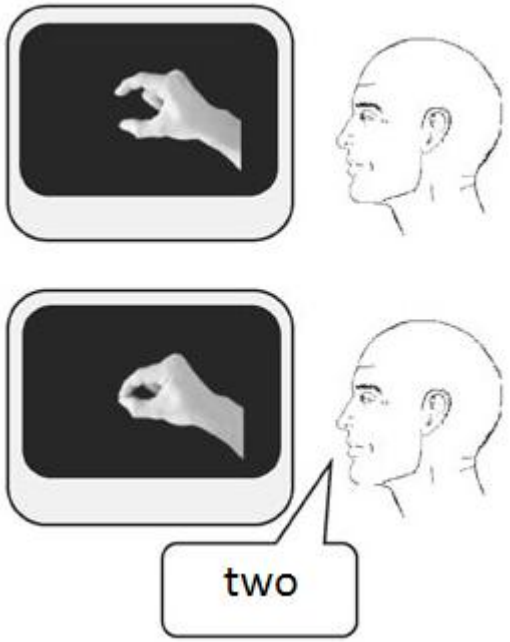
Vertical Mental number line???



COGNIZIONE NUMERICA E EMBODIED COGNITION

MOTOR-to-SEMANTIC EFFECT

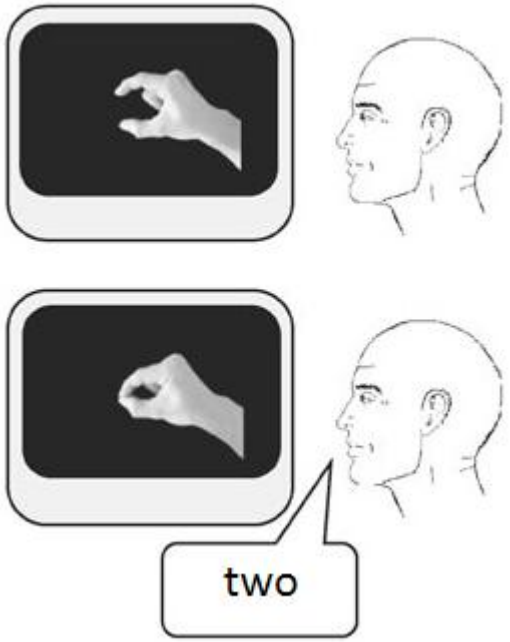
(Badets et al., 2012; Badets & Pesenti, 2010; 2011)



COGNIZIONE NUMERICA E EMBODIED COGNITION

MOTOR-to-SEMANTIC EFFECT

(Badets et al., 2012; Badets & Pesenti, 2010; 2011)



COGNIZIONE NUMERICA E EMBODIED COGNITION

HARTMANN et al. 2011

Journal of Experimental Psychology:
Human Perception and Performance

0096-1523/11/$12.00 DOI: 10.1037/a0026706

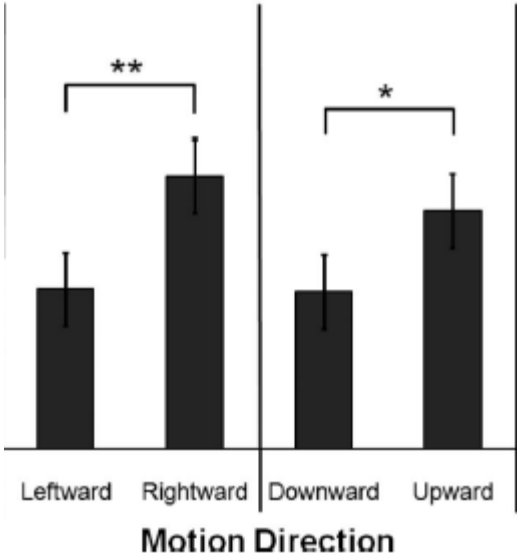
Moving Along the Mental Number Line: Interactions Between Whole-Body Motion and Numerical Cognition

Matthias Hartmann, Luzia Grabherr, and Fred W. Mast
University of Bern

Active head turns to the left and right have recently been shown to influence numerical cognition by shifting attention along the mental number line. In the present study, we found that *passive* whole-body motion influences numerical cognition. In a random-number generation task (Experiment 1), leftward and downward displacement of participants facilitated small number generation, whereas rightward and upward displacement facilitated the generation of large numbers. Influences of leftward and rightward motion were also found for the processing of auditorily presented numbers in a magnitude-judgment task (Experiment 2). Additionally, we investigated the reverse effect of the number-space association (Experiment 3). Participants were displaced leftward or rightward and asked to detect motion direction as fast as possible while small or large numbers were auditorily presented. When motion detection was difficult, leftward motion was detected faster when hearing small number and rightward motion when hearing large number. We provide new evidence that bottom-up vestibular activation is sufficient to interact with the higher-order spatial representation underlying numerical cognition. The results show that action planning or motor activity is not necessary to influence spatial attention. Moreover, our results suggest that self-motion perception and numerical cognition can mutually influence each other.

Keywords: numerical cognition, mental number line, body motion, self-motion perception, vestibular stimulation

Small numbers



COGNIZIONE NUMERICA E EMBODIED COGNITION

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PLOS | ONE

Counting Is Easier while Experiencing a Congruent Motion

Luisa Lugli[1,2]*, Giulia Baroni[1], Filomena Anelli[1,3], Anna M. Borghi[4,5], Roberto Nicoletti[1]

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Uno degli articoli da studiare a scelta

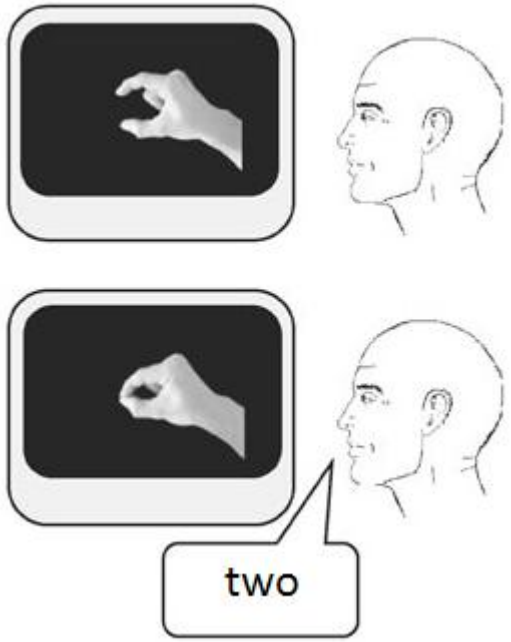
COGNIZIONE NUMERICA E EMBODIED COGNITION

1 2 3 4 5 6 7 8 9 …

Mental number line

Vertical Mental number line???

…
9
8
7
6
5
4
3
2
1



COGNIZIONE NUMERICA E EMBODIED COGNITION

Il **compito**: processo che genera la rappresentazione della grandezza numerica con un orientamento verso l'alto o verso il basso, e cioè il calcolo aritmetico di addizioni e sottrazioni.

COGNIZIONE NUMERICA E EMBODIED COGNITION

Il **tipo di movimento**: passivo (prendere l'ascensore) *vs*. attivo (fare le scale).

Differenza anche in termini di valenza del movimento:

ascensore = movimento veloce e chiaramente verticale

scale = movimento più progressivo e meno verticale.

COGNIZIONE NUMERICA E EMBODIED COGNITION

L'**esperienza del movimento**: condizione "movimento reale" in cui ai partecipanti viene chiesto di fare i calcoli durante l'esperienza del movimento (Esperimento 1) *vs*. condizione "movimento immaginato" in cui i partecipanti procedono con i calcoli mentre si immaginano il movimento (Esperimento 2).

COGNIZIONE NUMERICA E EMBODIED COGNITION

Variabili indipendenti:

- Tipo di movimento: attivo vs. passivo
- Tipo di operazione: addizioni vs. sottrazioni
- Tipo di compito: reale vs. immaginato

Variabile dipendente:

Numero di operazioni eseguite correttamente

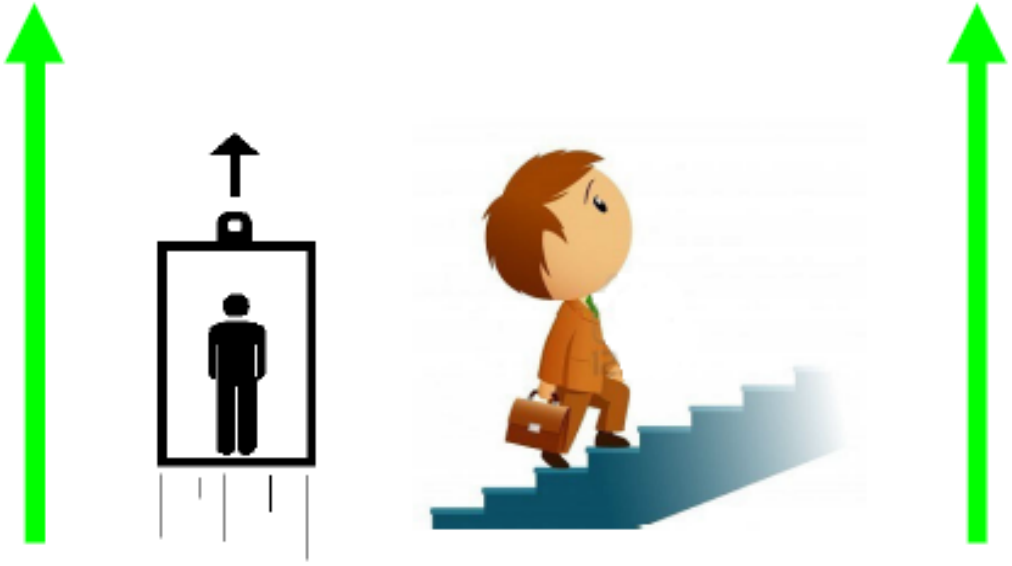
Ipotesi:

- Influenza del tipo di movimento sul numero di operazioni eseguite correttamente

COGNIZIONE NUMERICA E EMBODIED COGNITION

CONDIZIONI CONGRUENTI: MAGGIORE NUMERO DI OPERAZIONI

DIREZIONE DEL MOVIMENTO = **SU**



TIPO DI OPERAZIONE:
ADDIZIONI

523

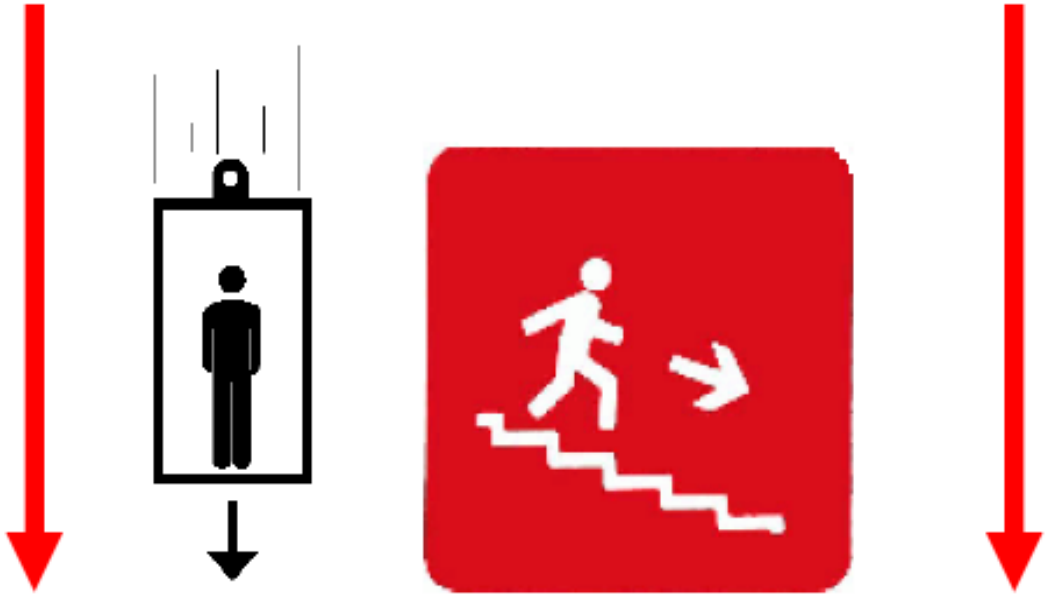
+ 3

526

COGNIZIONE NUMERICA E EMBODIED COGNITION

CONDIZIONI CONGRUENTI: MAGGIORE NUMERO DI OPERAZIONI

DIREZIONE DEL MOVIMENTO = **GIU'**



TIPO DI OPERAZIONE:
SOTTRAZIONI

523

- 3

520

COGNIZIONE NUMERICA E EMBODIED COGNITION

CONDIZIONI INCONGRUENTI
MINOR NUMERO DI OPERAZIONI

DIREZIONE DEL MOVIMENTO = **SU**

TIPO DI OPERAZIONE:
SOTTRAZIONI

523

- 3

520

COGNIZIONE NUMERICA E EMBODIED COGNITION

CONDIZIONI INCONGRUENTI: MINOR NUMERO DI OPERAZIONI

DIREZIONE DEL MOVIMENTO = GIU'

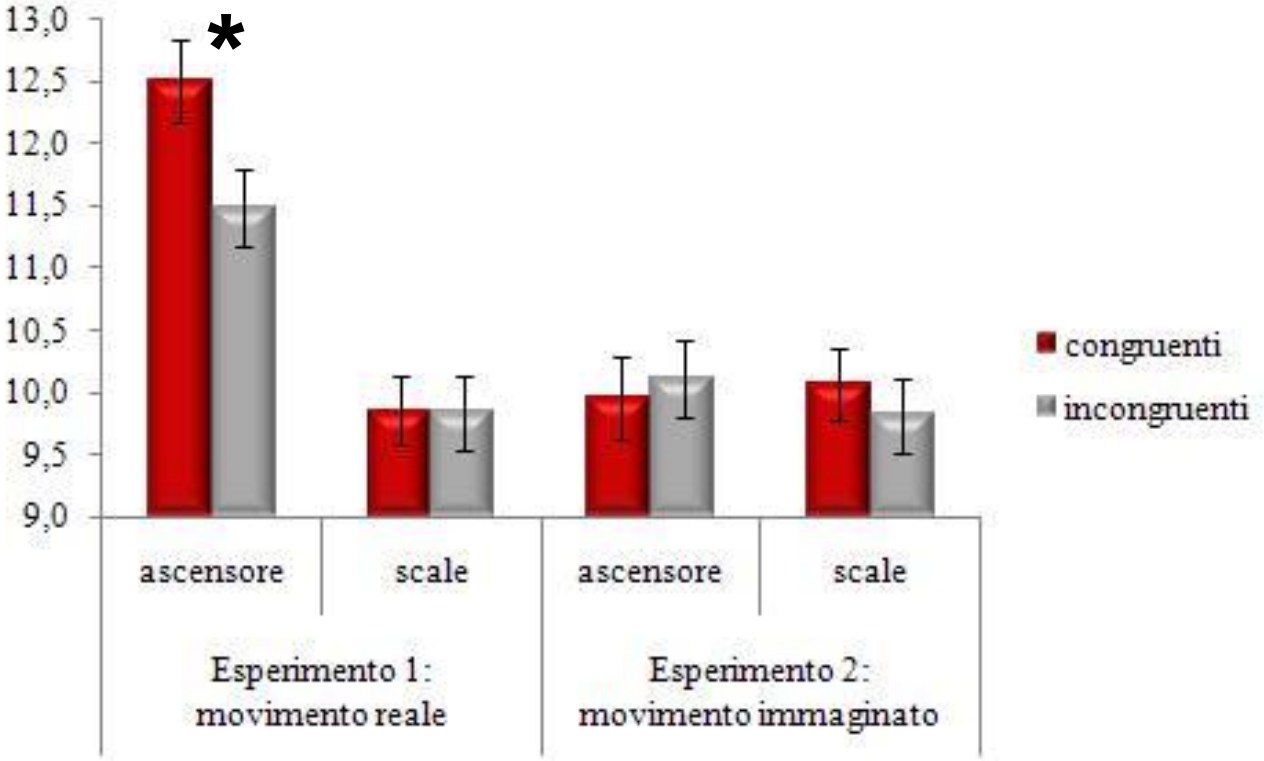
TIPO DI OPERAZIONE: ADDIZIONI

523

+ 3

526

COGNIZIONE NUMERICA E EMBODIED COGNITION



COGNIZIONE NUMERICA E EMBODIED COGNITION

I movimenti di salita e discesa di tutto il corpo influenzano il calcolo aritmetico delle addizioni e delle sottrazioni.

COGNIZIONE NUMERICA E EMBODIED COGNITION

Questo suggerisce che non solo l'informazione numerica assoluta (cioè il numero 2 o il numero 9, per esempio), ma anche il processo alla base della grandezza numerica sono strettamente connessi con l'elaborazione dell'informazione spaziale.

COGNIZIONE NUMERICA E EMBODIED COGNITION

La rappresentazione spaziale dei numeri: meccanismo di orientamento dell'attenzione o processo di simulazione? I risultati di questo studio forniscono ulteriori evidenze a favore di una natura *grounded* ed *embodied* dell'elaborazione numerica (in linea con la recente proposta di Fischer e Brugger 2012 che spiega l'origine dell'Spatial-Numerical Association dal *finger counting*).

COGNIZIONE NUMERICA E EMBODIED COGNITION