É POSSIBILE ALLENARE IL CERVELLO?

SANTA LUCIA
NEUROSCIENZE
E RIABILITAZIONE

Dr Fabrizio Piras, PhD

FABRIZIO PIRAS

Psicologo, dottore di ricerca in Neuroscienze Cognitive

- **Direttore della linea di ricerca *Neuroscienze Cliniche e Neuroriabilitazione***
- **Responsabile dell'*Ambulatorio di Stimolazione Cognitiva***
- **Ricercatore presso il *Laboratorio di Neuropsichiatria***
- **Coordinatore del Master in *Neuroriabilitazione di Alta Specialità, Metodologie Neurocognitive e Neuromotorie* (Fondazione Santa Lucia-Treccani Accademia)**
- **Docente di *Valutazione Neuropsicologica e Neuroriabilitazione Cognitiva*, Università Telematica Internazionale Uninettuno**
- **Autore di 150 pubblicazioni su riviste scientifiche internazionali, 2 libri, 6 capitoli di libro**

OUTLINE

IL SISTEMA NERVOSO

LA NEUROPLASTICITA’

IL BRAIN TRAINING

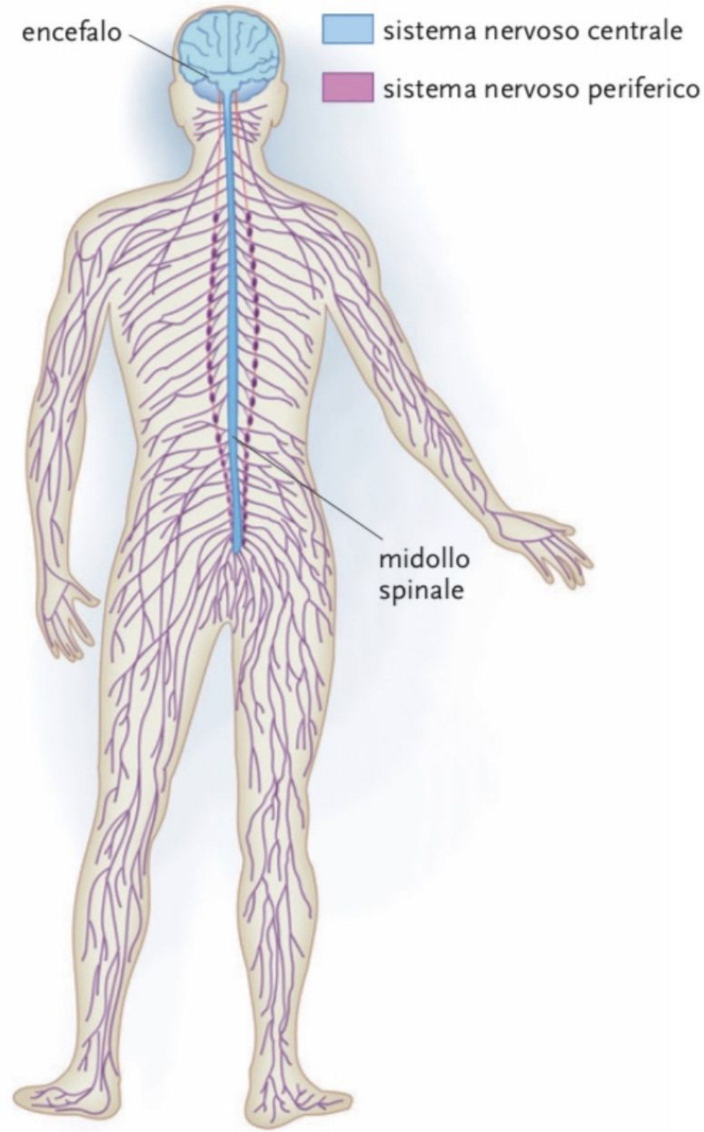
IL SISTEMA NERVOSO

Regolazione di:

- Funzioni vitali involontarie
- Attività volontarie

Formato da:

- Sistema nervoso centrale
- Sistema nervoso periferico



IL SISTEMA NERVOSO

Formato da:

- Sistema nervoso centrale
- Sistema nervoso periferico

  - Encefalo
  - Midollo spinale

IL SISTEMA NERVOSO

Formato da:
- Sistema nervoso centrale
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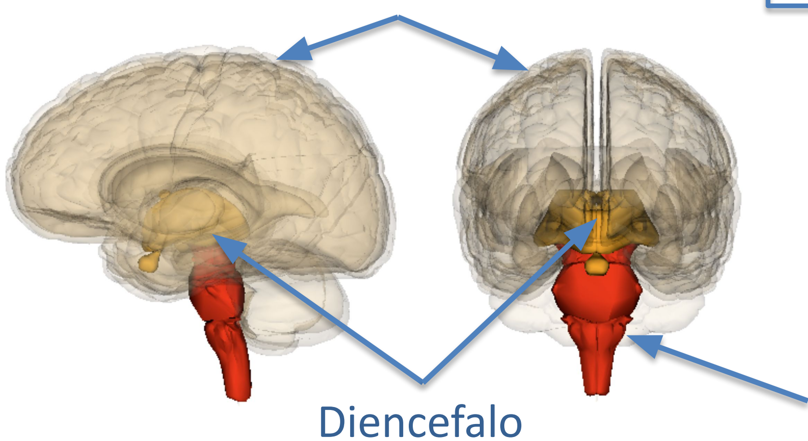
- Encefalo
- Midollo spinale

- Cervello
- Cervelletto
- Tronco encefalico

- Telencefalo
- Diencefalo



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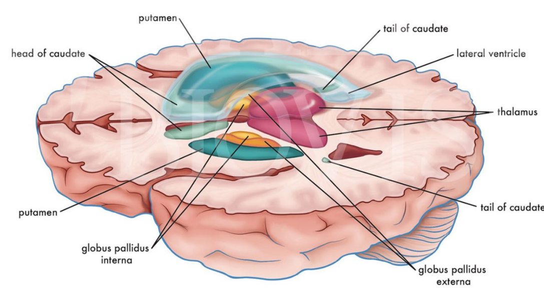
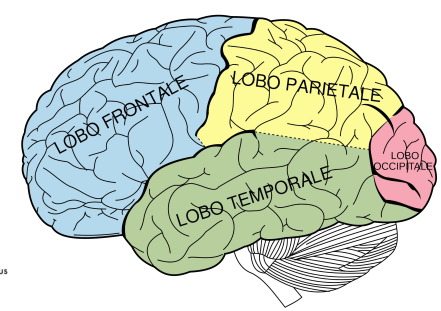
- Cervello
- Cervelletto
- Tronco encefalico

- Telencefalo
- Diencefalo

- Lobi cerebrali
- Nuclei profondi
- Ippocampo





IL SISTEMA NERVOSO

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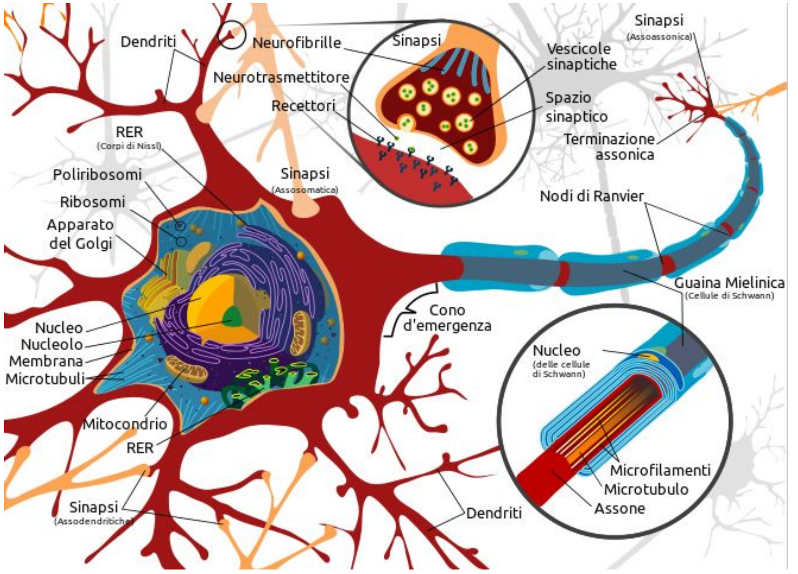
- Cervelletto
- Tronco encefalico

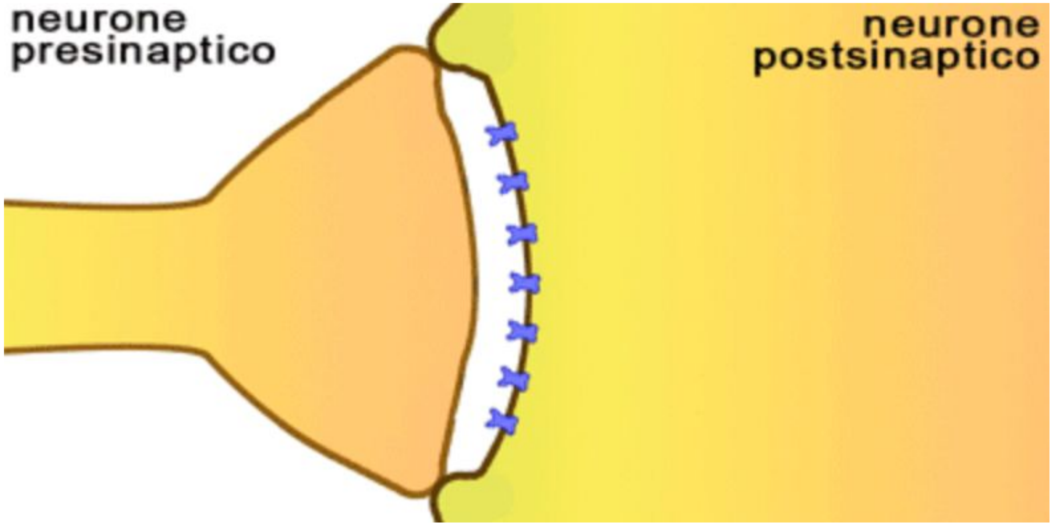
- Telencefalo
- Diencefalo

- Ipotalamo
- Talamo
- Subtalamo
- Epitalamo
- Metatalamo

IL SISTEMA NERVOSO

Il flusso delle informazioni





- 86 miliardi di neuroni
- N sinapsi = N neuroni x 1000
- Il segnale viaggia a 432 km/h

2% del peso corporeo, 25% di energia

IL SISTEMA NERVOSO

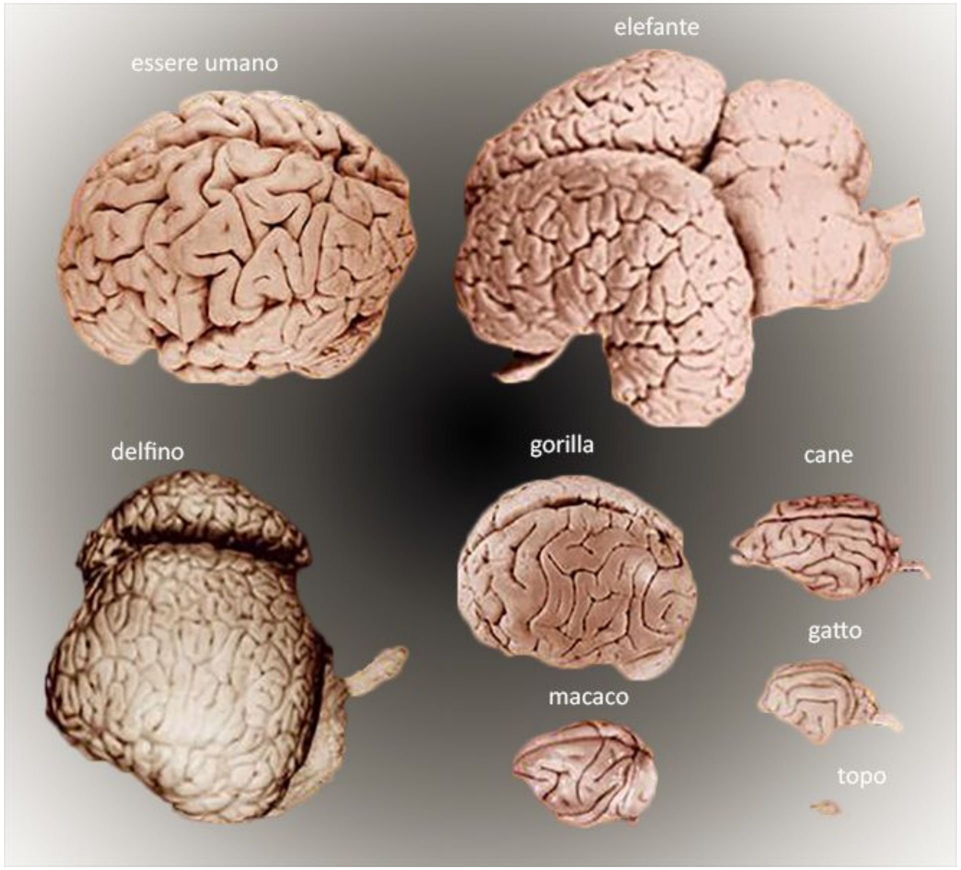
Le dimensioni contano?

Il quoziente di encefalizzazione o QE il rapporto tra la massa del cervello e quella che ci si aspetterebbe di trovare in un tipico animale della stessa taglia.

$$C = \frac{E}{S^r}$$

E=peso del cervello
S=peso del corpo
R= costante (per i mammiferi 0,56 e 0,66)

Uomo=6-8
Delfino=5
Scimmie= 1-3



LA NEUROPLASTICITÁ

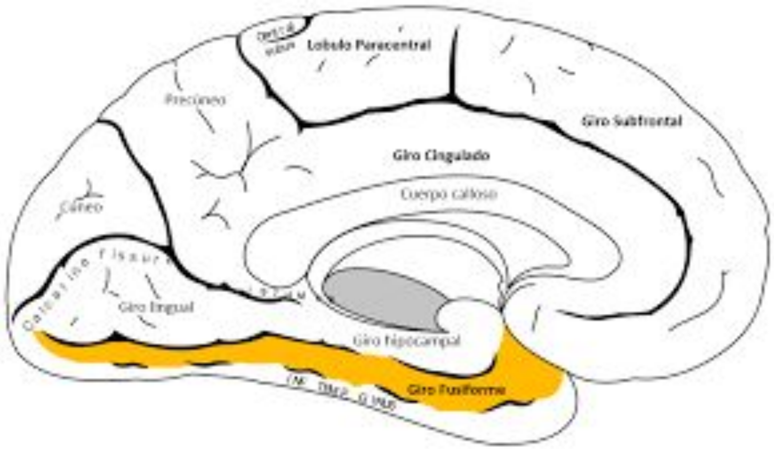
Effetti di una lesione cerebrale

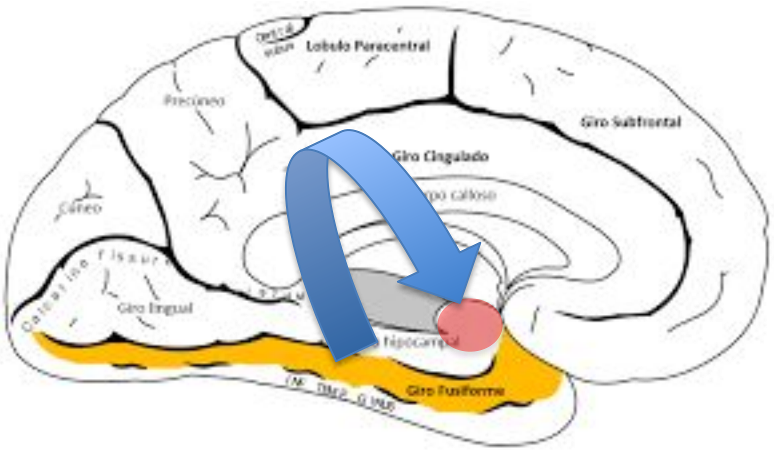
1. Sindrome di Capgras

Madame M sosteneva che il marito ed altre persone a lei note erano state sostitute da sosia

Prima interpretazione: isteria

Anni 90 Ramachandran ipotizza una disconnessione tra la corteccia temporale ed il sistema limbico)



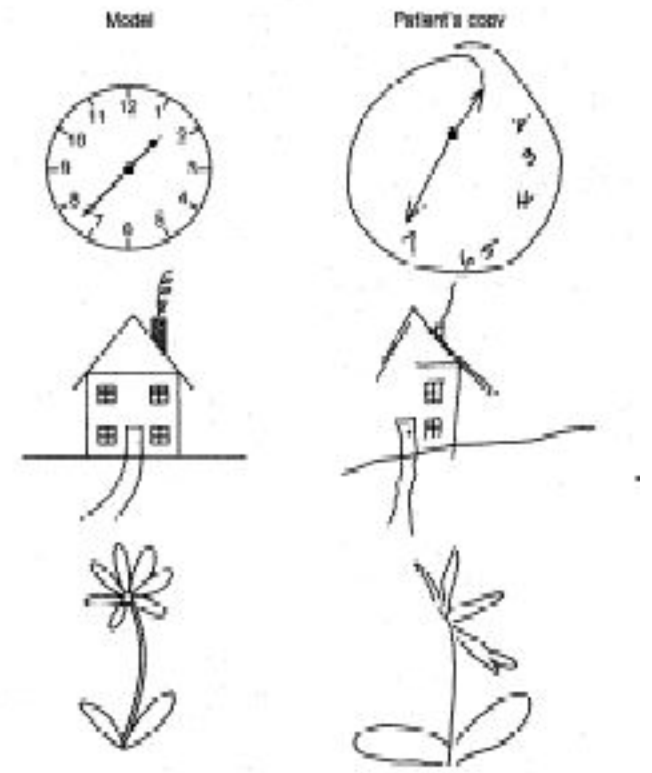


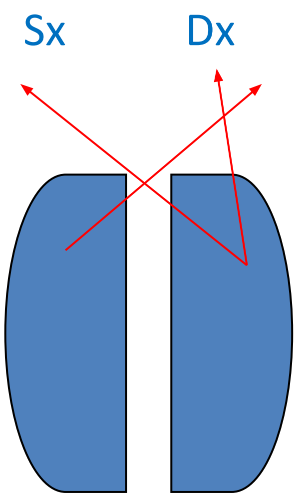
LA NEUROPLASTICITÁ

Effetti di una lesione cerebrale

2. Il neglect

Copying:





LA NEUROPLASTICITÁ

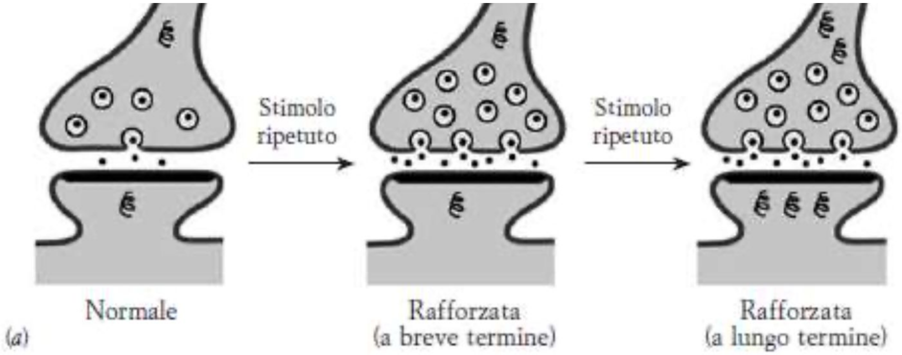
WIKIPEDIA
L'enciclopedia libera

la capacità dell'encefalo di modificare la propria struttura e le proprie funzionalità a seconda dell'attività dei propri neuroni, correlata ad esempio a stimoli ricevuti dall'ambiente esterno, in reazione a lesioni traumatiche o modificazioni patologiche e in relazione al processo di sviluppo dell'individuo.

- La capacità del cervello e quindi dei suoi circuiti nervosi di rispondere a degli stimoli provenienti dall'ambiente
- Adatta la funzione dei circuiti nervosi sulla base delle esperienze
- Ottimizza le risposte del cervello agli stimoli dell'ambiente

LA NEUROPLASTICITÁ

Plasticità sinaptica molecolare



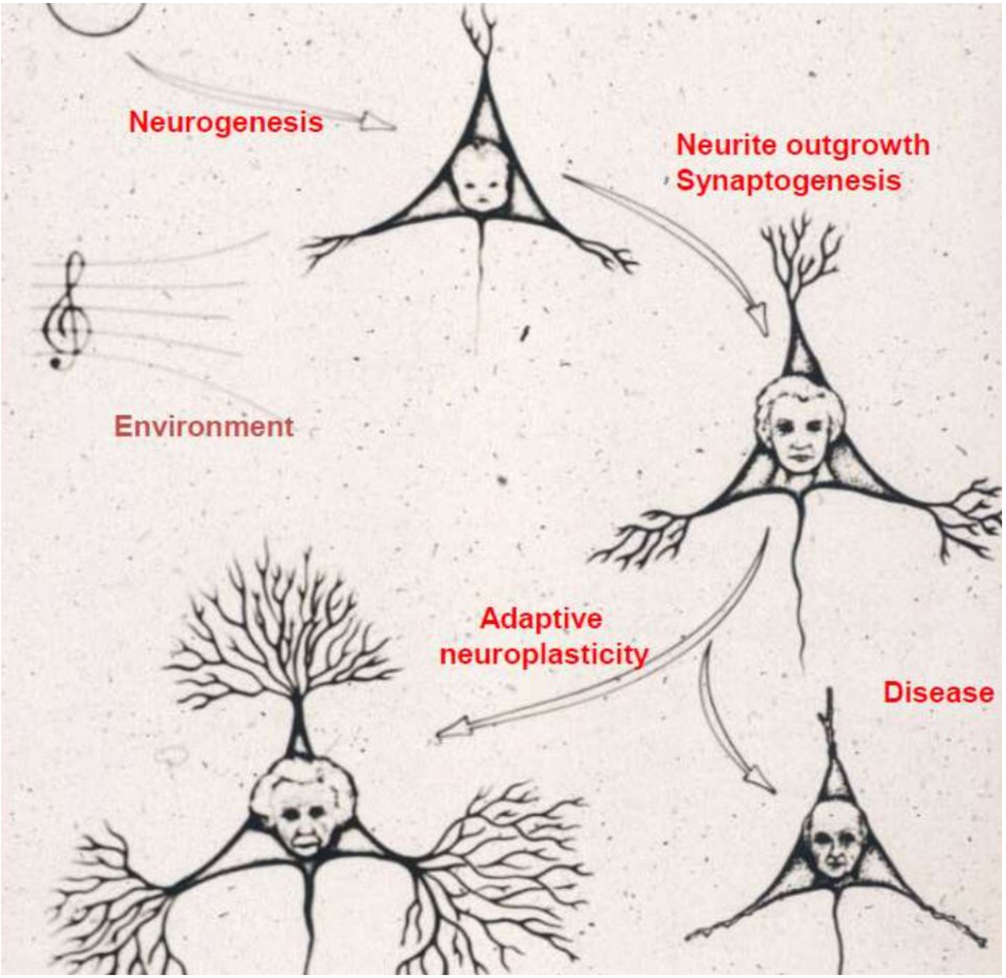
Plasticità sinaptica strutturale

Tempo 0 5 ore dopo

Tempo 0 **1 ora dopo**

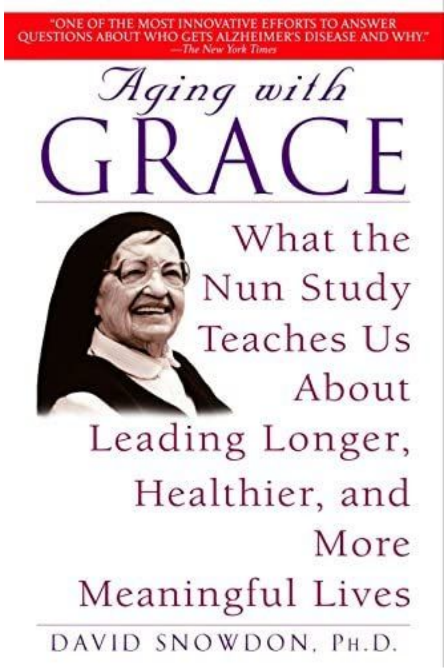
LA NEUROPLASTICITÁ

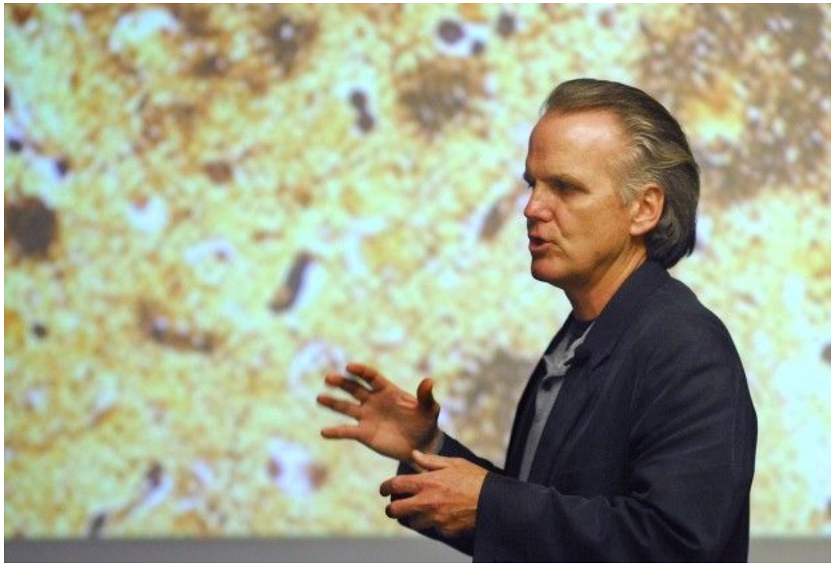
Periodo critico



LA NEUROPLASTICITÁ

La riserva





The Nun Study – David Snowdon 1986-2020

LA NEUROPLASTICITÁ

La riserva

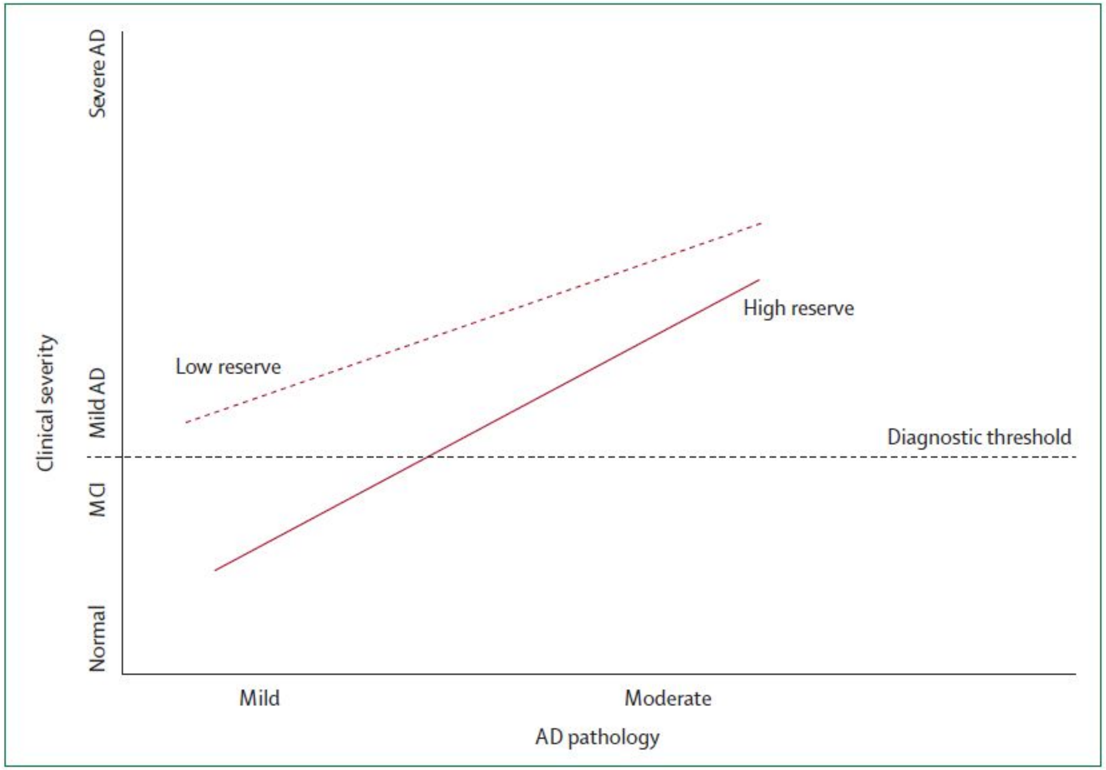
Resilienza del cervello rispetto al danno cerebrale

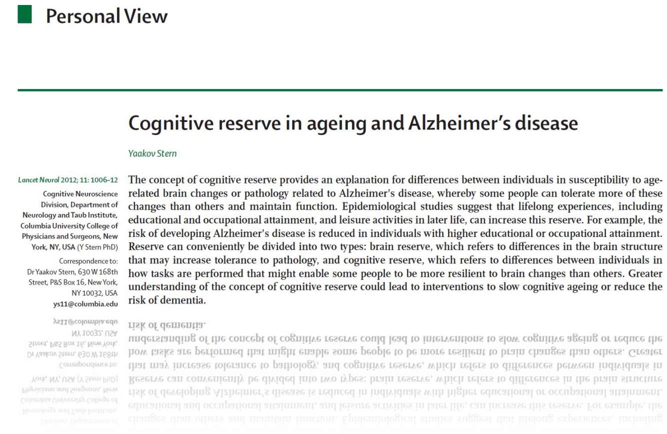
Riserva cerebrale

Riserva cognitiva

LA NEUROPLASTICITÁ

La riserva





Personal View

Cognitive reserve in ageing and Alzheimer's disease

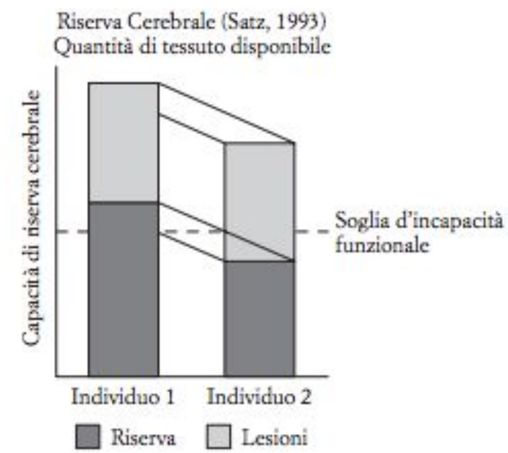
Yaakov Stern

Lancet Neurol 2012; 11: 1006–12

Cognitive Neuroscience Division, Department of Neurology and Taub Institute, Columbia University College of Physicians and Surgeons, New York, NY, USA (Y Stern PhD)

Correspondence to: Dr Yaakov Stern, 630 W 168th Street, P&S Box 16, New York, NY 10032, USA ys11@columbia.edu

The concept of cognitive reserve provides an explanation for differences between individuals in susceptibility to age-related brain changes or pathology related to Alzheimer's disease, whereby some people can tolerate more of these changes than others and maintain function. Epidemiological studies suggest that lifelong experiences, including educational and occupational attainment, and leisure activities in later life, can increase this reserve. For example, the risk of developing Alzheimer's disease is reduced in individuals with higher educational or occupational attainment. Reserve can conveniently be divided into two types: brain reserve, which refers to differences in the brain structure that may increase tolerance to pathology, and cognitive reserve, which refers to differences between individuals in how tasks are performed that might enable some people to be more resilient to brain changes than others. Greater understanding of the concept of cognitive reserve could lead to interventions to slow cognitive ageing or reduce the risk of dementia.



LA NEUROPLASTICITÁ

La riserva

BRAIN RESEARCH REVIEWS 61 (2009) 221–239

available at www.sciencedirect.com
ScienceDirect
www.elsevier.com/locate/brainresrev

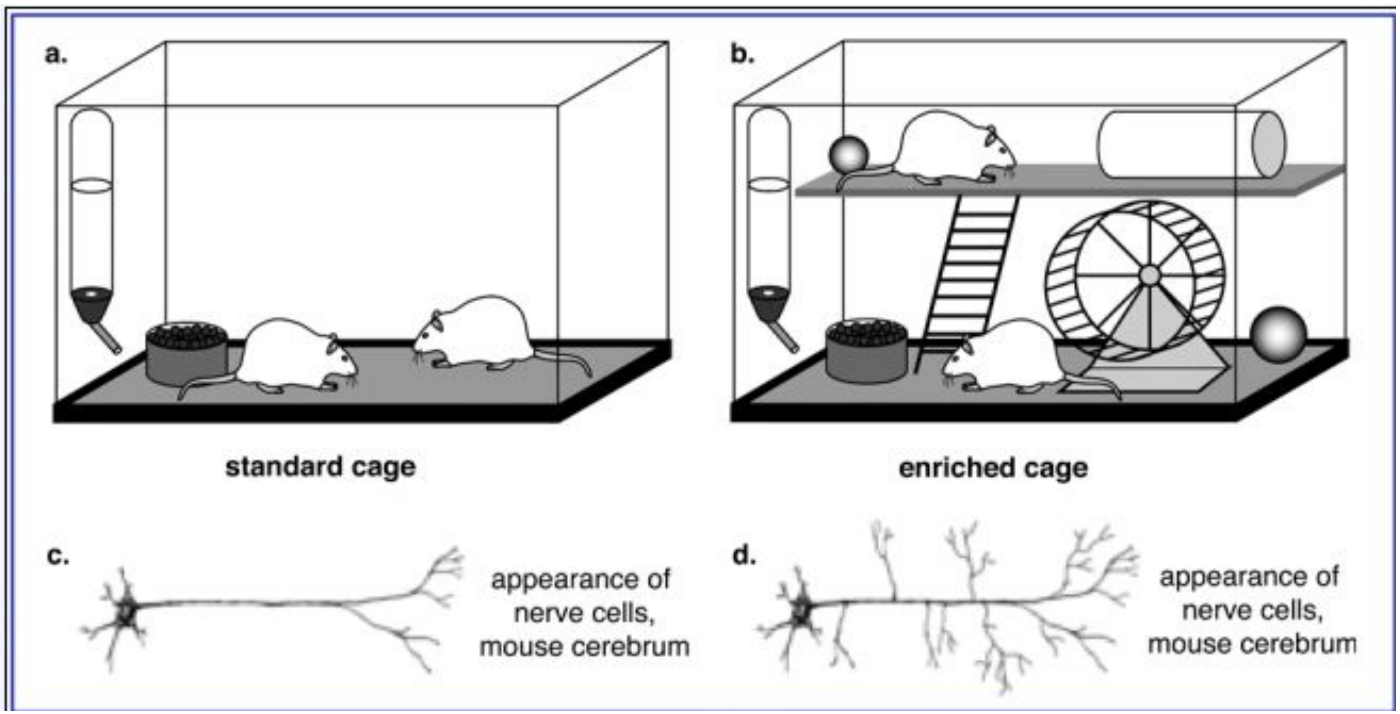
ELSEVIER

BRAIN RESEARCH REVIEWS

Review

On whether the environmental enrichment may provide cognitive and brain reserves

Laura Petrosini[a,b,], Paola De Bartolo[a,b], Francesca Foti[a,b], Francesca Gelfo[c,b], Debora Cutuli[a,b], Maria Giuseppa Leggio[a,b], Laura Mandolesi[c,b]*



LA NEUROPLASTICITÁ

La riserva

L. Serra et al. / Novel Ideas on Reserve in Humans and Animals 1069

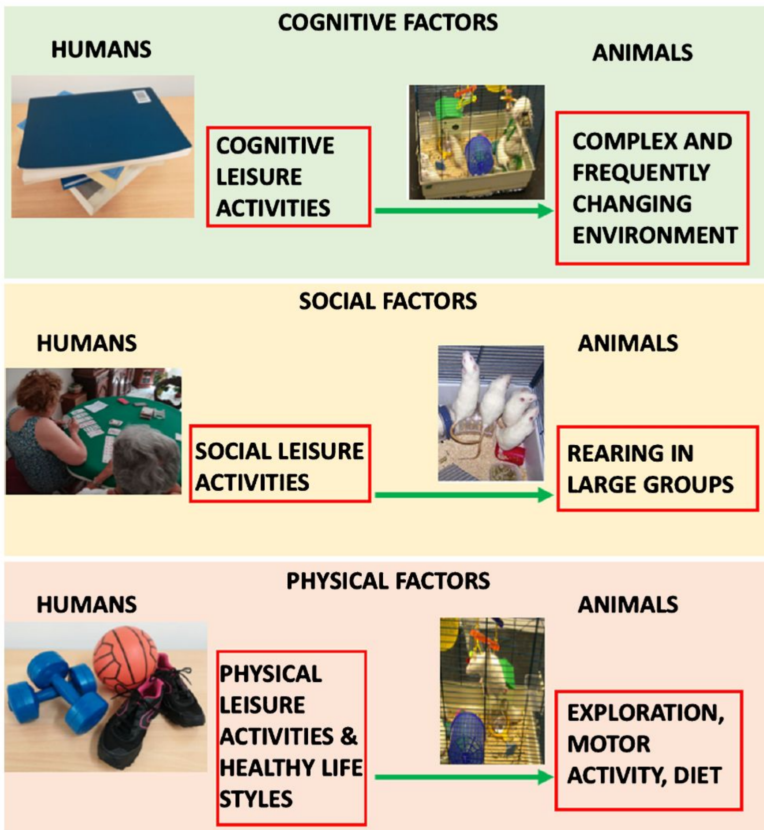


Fig. 1. Lifestyle enrichment indexes in humans and in animals. The panel represents the parallelism between the lifestyle enrichment indexes that are classically considered in humans (on the left) and the environmental enrichment variables that are manipulated in animal models (on the right).

Journal of Alzheimer's Disease 65 (2018) 1065–1078 1065
DOI 10.3233/JAD-180609
IOS Press

Review

Rethinking the Reserve with a Translational Approach: Novel Ideas on the Construct and the Interventions

Laura Serra[a,1], Francesca Gelfo[b,c,1,*], Laura Petrosini[d,e], Carlotta Di Domenico[a], Marco Bozzali[a,f] and Carlo Caltagirone[b,g]

LA NEUROPLASTICITÁ

La riserva

Journal of Alzheimer's Disease 28 (2012) 223–230
DOI 10.3233/JAD-2011-110377
IOS Press

Active Cognitive Lifestyle Associates with Cognitive Recovery and a Reduced Risk of Cognitive Decline

Riccardo E. Marioni[a,*], Ardo van den Hout[b], Michael J. Valenzuela[c,d,e], Carol Brayne[a], Fiona E. Matthews[b] and MRC Cognitive Function and Ageing Study

Psychiatry Research 196 (2012) 90–95

Contents lists available at SciVerse ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

ELSEVIER

Cognitive activity, education and socioeconomic status as preventive factors for mild cognitive impairment and Alzheimer's disease

Christine Sattler, Pablo Toro, Peter Schönknecht, Johannes Schröder *

Section of Geriatric Psychiatry, University of Heidelberg, Heidelberg, Germany

Journal of Alzheimer's Disease 39 (2014) 833–839
DOI 10.3233/JAD-131808
IOS Press

Physical Activity Reduces the Risk of Dementia in Mild Cognitive Impairment Subjects: A Cohort Study

Giulia Grande[a,b], Nicola Vanacore[c], Laura Maggiore[a], Valentina Cucumo[a], Roberta Ghiretti[a], Daniela Galimberti[d], Elio Scarpini[d], Claudio Mariani[a,b] and Francesca Clerici[a,b,*]

AJE

American Journal of Epidemiology

Vol. 173, No. 9
DOI: 10.1093/aje/kwq476
Advance Access publication:
March 4, 2011

Original Contribution

Cognitive Lifestyle and Long-Term Risk of Dementia and Survival After Diagnosis in a Multicenter Population-based Cohort

Michael Valenzuela*, Carol Brayne, Perminder Sachdev, Gordon Wilcock , and Fiona Matthews on Behalf of the Medical Research Council Cognitive Function and Ageing Study

LA NEUROPLASTICITÁ

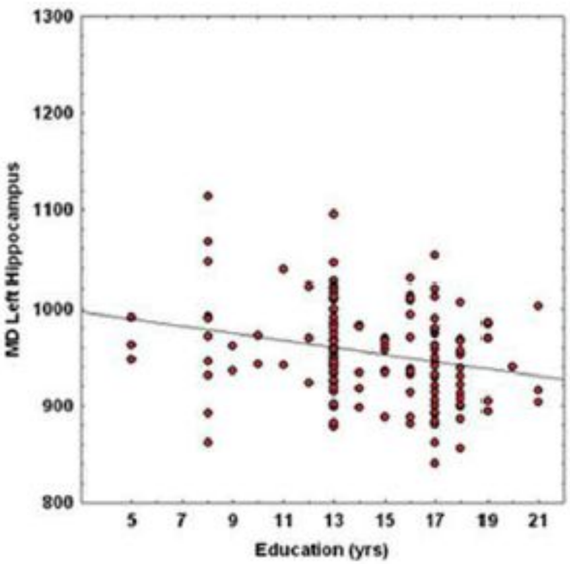
◆ Human Brain Mapping 32:282–289 (2011) ◆

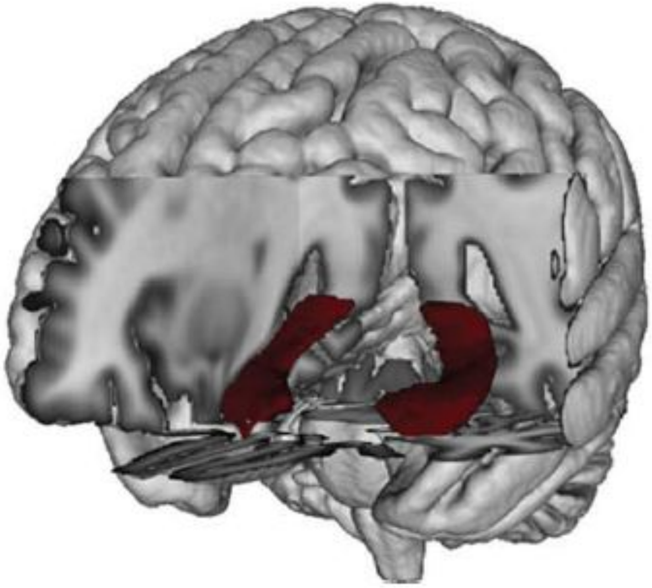
Education Mediates Microstructural Changes in Bilateral Hippocampus

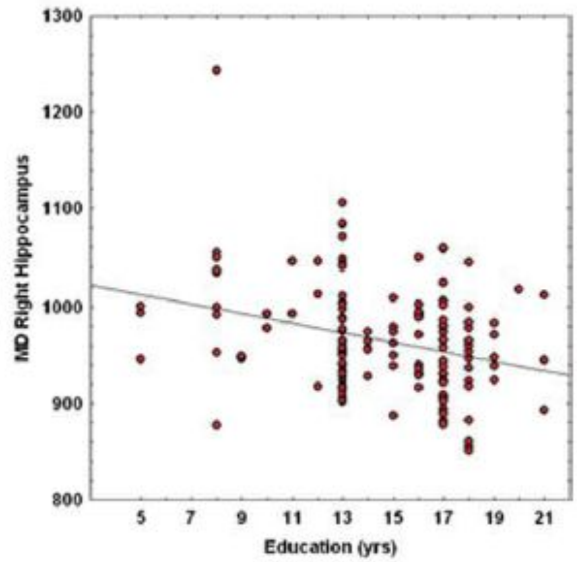
Fabrizio Piras,[1]* Andrea Cherubini,[1] Carlo Caltagirone,[1,2] and Gianfranco Spalletta[1]

[1]Fondazione Santa Lucia, Rome, Italy
[2]Dipartimento di Neuroscienze, Università Tor Vergata, Rome, Italy

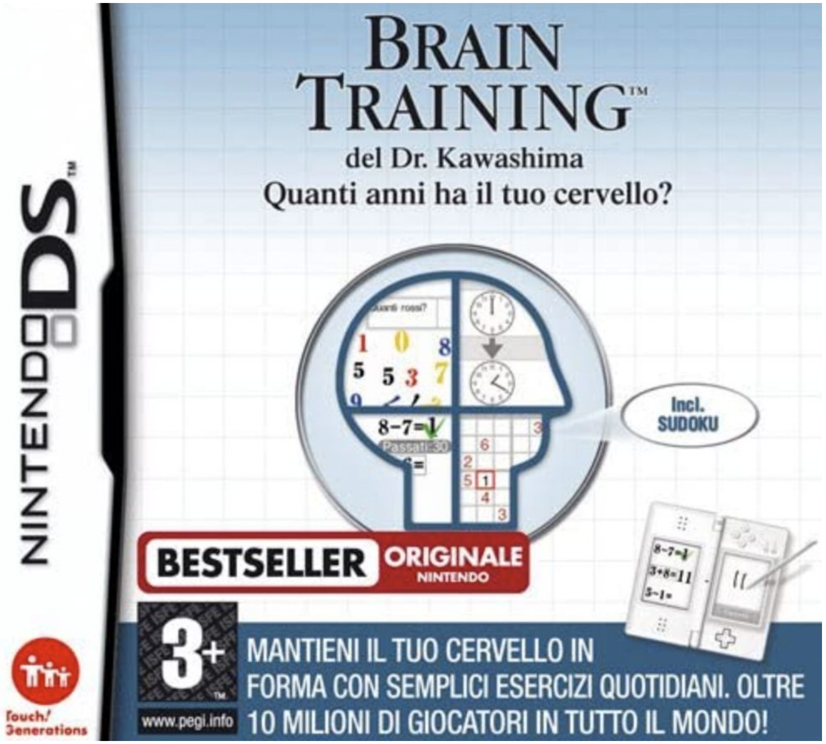
La riserva







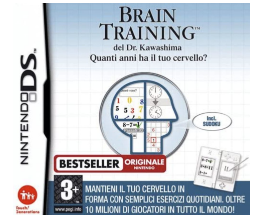
IL BRAIN TRAINING



Ryuta Kawashima

2005: Nintendo rilascia Brain Training

IL BRAIN TRAINING



Calcolo 20 e Calcolo 100
operazioni (addizioni, sottrazioni e moltiplicazioni e divisioni)

Lettura opere
testi celebri da leggere nel minor tempo possibile.

Memoria lampo
Caselle con numeri che scompaiono

Contasillabe
fornire il numero di sillabe che compongono frasi

Contagente
quantificare le persone all'interno di un edificio contando ingressi e uscite

Calcolo plurimo
catena di operazioni da risolvere nel minor tempo possibile.

Calcolo del tempo
differenza temporale tra i quadranti di due orologi analogici

IL BRAIN TRAINING

Gamification:

utilizzo di elementi mutuati dai giochi e delle tecniche di creazione di giochi in contesti non ludici:

- Punti da accumulare;
- Livelli da raggiungere;
- Ricompense o doni da ottenere;
- Distintivi da esibire;

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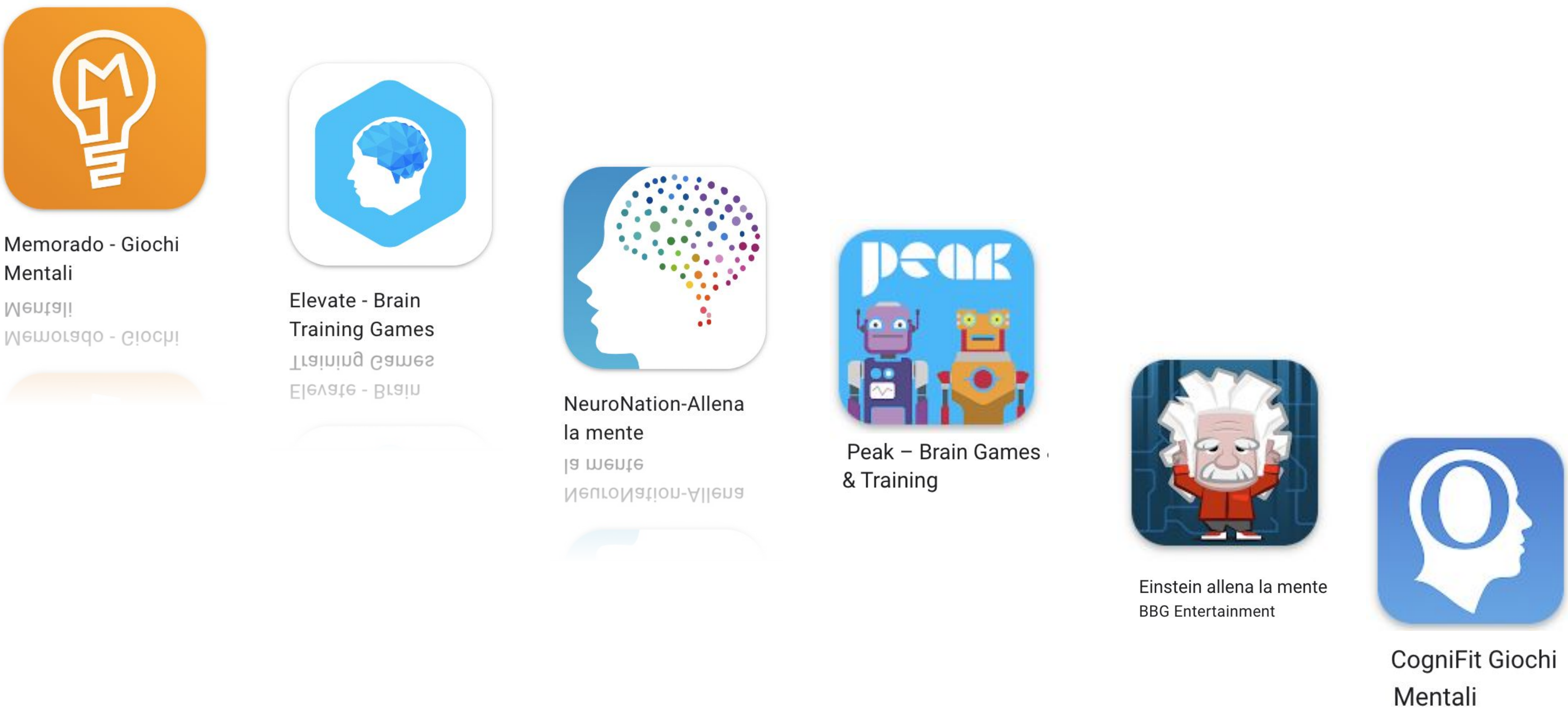
Gamification:



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Cochrane Library

Cochrane Database of Systematic Reviews

Evidenze:

Computerised cognitive training for 12 or more weeks for maintaining cognitive function in cognitively healthy people in late life (Review)

Gates NJ, Rutjes AWS, Di Nisio M, Karim S, Chong LY, March E, Martínez G, Vernooij RWM

Outcomes	Difference between CCT and control (95% CI)[a*]	No. of participants (studies)	Quality of the evidence (GRADE)	Comments
Global cognitive function measured at the end of the intervention period	Not reported using a validated measure			
Cognitive subdomain: episodic memory measured at the end of the intervention period (6 months)	MD 0.90 lower (1.73 lower to 0.07 lower)	150 participants (1 study)	⊕⊕⊝⊝ **low[b]**	CCT may improve slightly episodic memory when compared to inactive control
Cognitive subdomain: speed of processing measured at the end of the intervention period (12 to 16 weeks)	SMD 0.28 lower (0.82 lower to 0.26 higher)	204 participants (2 studies)	⊕⊝⊝⊝ **very low[c]**	It is uncertain whether CCT maintains speed of processing better than inactive control
Cognitive subdomain: executive functioning measured at the end of the intervention period (12 weeks to 6 months)	SMD 0.08 lower (0.31 lower to 0.15 higher)	292 participants (2 studies)	⊕⊕⊝⊝ **low[b]**	CCT may lead to little or no improvement in executive functioning when compared to inactive control
Cognitive subdomain: working memory measured at the end of the intervention period (16 weeks)	MD 0.08 lower (0.43 lower to 0.27 higher)	60 participants (1 study)	⊕⊕⊝⊝ **low[b]**	CCT may lead to little or no improvement in working memory when compared to inactive control
Cognitive subdomain: verbal fluency measured at the end of the intervention period (6 months)	MD 0.11 lower (1.58 lower to 1.36 higher)	150 participants (1 study)	⊕⊕⊝⊝ **low[b]**	CCT may lead to little or no improvement in verbal fluency when compared to inactive control

IL BRAIN TRAINING

OPEN ACCESS Freely available online

PLOS | ONE

Brain Training Game Boosts Executive Functions, Working Memory and Processing Speed in the Young Adults: A Randomized Controlled Trial

Rui Nouchi[1,2]*, Yasuyuki Taki[3], Hikaru Takeuchi[1], Hiroshi Hashizume[3], Takayuki Nozawa[1], Toshimune Kambara[2,4,5], Atsushi Sekiguchi[4], Carlos Makoto Miyauchi[4], Yuka Kotozaki[1], Haruka Nouchi[1], Ryuta Kawashima[1,3,4]

Evidenze:

	Brain Age Group		*Tetris* Group		Results of ANCOVAs	
	Mean	**SD**	**Mean**	**SD**	**Effect size (η^2)**	***P*-value**
Fluid intelligence						
RAPMT (score)	3.44	(1.93)	2.53	(1.86)	0.08	0.126
Executive functions						
WCST (percentage of error response)	−2.38	(2.53)	−0.33	(1.62)	0.23	0.000
rST (score)	6.38	(8.24)	0.53	(5.10)	0.20	0.007
ST (score)	3.81	(3.41)	0.80	(1.76)	0.25	0.002
Working memory						
OpS (percentage of correct response)	0.15	(0.18)	0.06	(0.14)	0.15	0.003
LNS (score)	2.31	(2.24)	0.53	(1.82)	0.14	0.005
Ari (score)	1.75	(1.29)	0.47	(1.50)	0.21	0.008
Short-term memory						
DS-F (score)	0.63	(1.45)	1.00	(1.93)	0.00	0.626
DS-B (score)	0.25	(1.65)	0.13	(1.67)	0.00	0.923
SpS-F (score)	0.31	(2.39)	0.20	(1.87)	0.00	0.554
SpS-B (score)	0.31	(1.58)	0.27	(1.34)	0.00	0.863
Attention						
D-CAT (number)	2.00	(4.83)	1.33	(4.70)	0.00	0.690
SRT (ms)	−2.94	(18.42)	−16.56	(15.30)	0.10	0.012
Processing speed						
Cd (number)	8.63	(5.44)	2.40	(6.24)	0.23	0.006
SS (number)	3.81	(3.67)	0.67	(3.03)	0.24	0.004
Reading ability						
JART (score)	0.25	(1.00)	0.60	(1.50)	0.00	0.961
Visuo-spatial ability						
MR (ms)	−66.95	(243.82)	−339.39	(271.25)	0.18	0.003

IL BRAIN TRAINING

Evidenze:

Neuropsychol Rev (2017) 27:62–80
DOI 10.1007/s11065-016-9338-9

REVIEW

Enhancing Cognitive Functioning in Healthly Older Adults: a Systematic Review of the Clinical Significance of Commercially Available Computerized Cognitive Training in Preventing Cognitive Decline

Tejal M. Shah [1,2,3] · Michael Weinborn [1,2,4] · Giuseppe Verdile [1,2,3,5] · Hamid R. Sohrabi [1,2,3] · Ralph N. Martins [1,2,3]

Abstract Successfully assisting older adults to maintain or improve cognitive function, particularly when they are dealing with neurodegenerative disorders such as Alzheimer's disease (AD), remains a major challenge. Cognitive training may stimulate neuroplasticity thereby increasing cognitive and brain reserve. Commercial brain training programs are computerized, readily-available, easy-to-administer and adaptive but often lack supportive data and their clinical validation literature has not been previously reviewed. Therefore, in this review, we report the characteristics of commercially available brain training programs, critically assess the number and quality of studies evaluating the empirical evidence of these programs for promoting brain health in healthy older adults, and discuss underlying causal mechanisms. We searched PubMed, Google Scholar and each program's website for relevant studies reporting the effects of computerized cognitive training on cognitively healthy older adults. The evidence for each program was assessed via the number and quality (PEDro score) of studies, including Randomized Control Trials (RCTs). Programs with clinical studies were subsequently classified as possessing Level I, II or III evidence. Out of 18 identified programs, 7 programs were investigated in 26 studies including follow-ups. Two programs were identified as possessing Level I evidence, three programs demonstrated Level II evidence and an additional two programs demonstrated Level III evidence. Overall, studies showed generally high methodological quality (average PEDro score = 7.05). Although caution must be taken regarding any potential bias due to selective reporting, current evidence supports that at least some commercially available computerized brain training products can assist in promoting healthy brain aging.

Keywords Computerized cognitive training · Brain training · Cognition · Dementia · Alzheimer's disease

Introduction

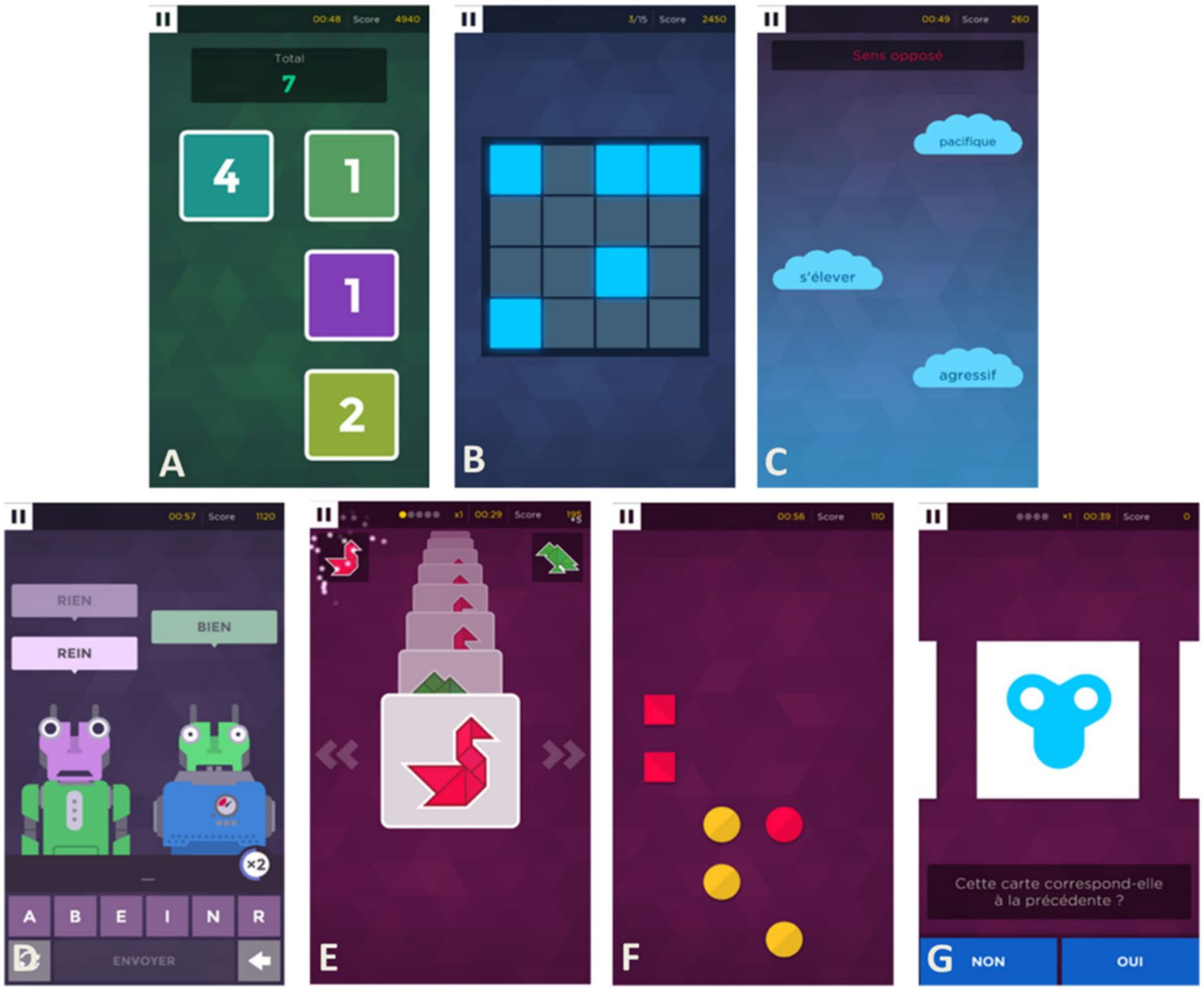
IL BRAIN TRAINING

scientific reports

OPEN **Brain training using cognitive apps can improve cognitive performance and processing speed in older adults**

Bruno Bonnechère[1,2], Malgorzata Klass[3], Christelle Langley[2] & Barbara Jacquelyn Sahakian[2]

Evidenze:



IL BRAIN TRAINING

scientific reports

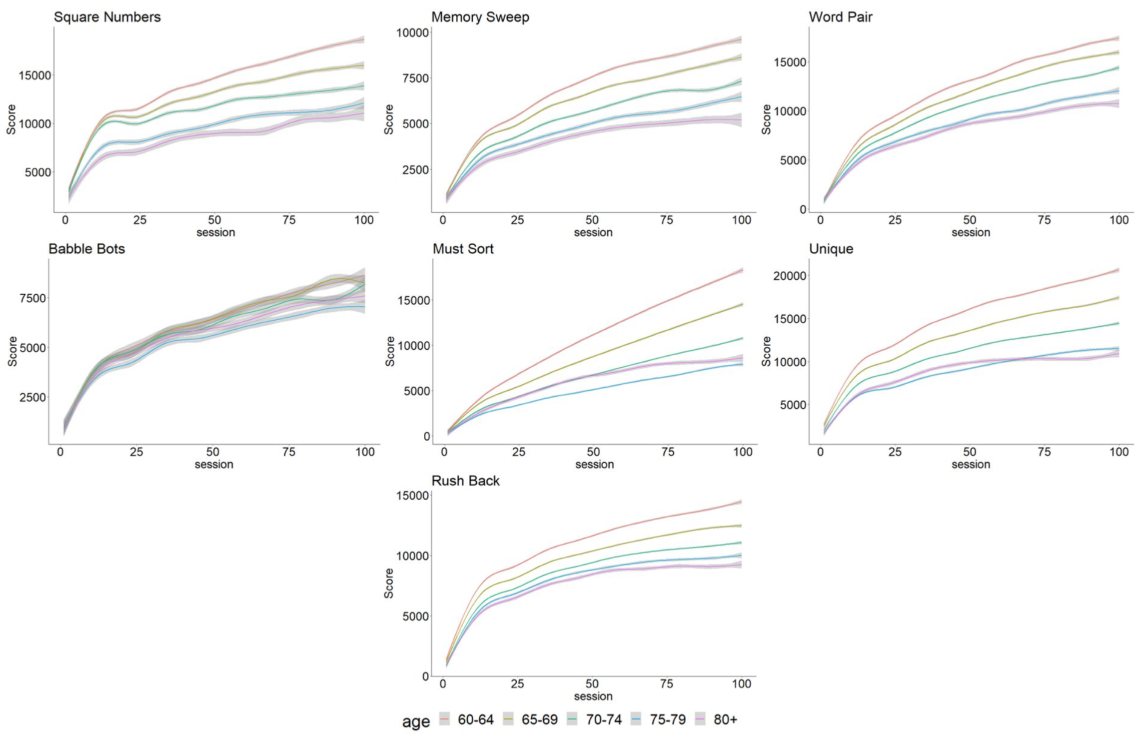
OPEN

Brain training using cognitive apps can improve cognitive performance and processing speed in older adults

Bruno Bonnechère[1,2✉], Malgorzata Klass[3], Christelle Langley[2] & Barbara Jacquelyn Sahakian[2]

Evidenze:

	Cognitive Mobile Games													
	Square Numbers		Memory Sweep		Word Pair		Babble Bots		Must Sort		Unique		Rush Back	
Age	n	Score	n	Score	n	Score	n	Score	n	Score	n	Score	n	Score
60–64	4863	16,735 [13,910]	3157	31,687 (6260)	3543	2460 [2310]	1006	4530 [7600]	3538	3392 [2019]	3558	3330 [3010]	3553	11,350 [10,550]
65–69	3591	16,600 [13,975]	2833	30,872 (6101)	3559	2460 [2095]	1015	4110 [8170]	3543	3205 [2160]	3569	3240 [3560]	3556	10,750 [11,200]
70–74	3312	14,485 [11,730]	1885	29,931 (5439)	3537	2460 [2360]	1012	3695 [6738]	3565	3005 [2280]	3048	2930 [3890]	3549	10,300 [11,050]
75–79	1034	14,442 [10,968]	726	29,246 (5408)	1345	1960 [2480]	1004	3020 [5772]	1421	2865 [2445]	1449	2910 [4740]	1330	9850 [10,600]
≥ 80	527	13,340 [12,205]	368	28,576 (5880)	723	1960 [2680]	1005	3530 [6010]	848	2758 [2742]	802	2610 [4150]	734	10,300 [10,738]



IL BRAIN TRAINING

Quali funzioni cognitive?

Quali funzioni cognitive?

Attenzione: funzione cognitiva che regola l'attività dei processi mentali, filtrando ed organizzando le informazioni provenienti dall'ambiente allo scopo di emettere una risposta adeguata

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Quali funzioni cognitive?

Attenzione

Attenzione selettiva: capacità di concentrare l'attenzione su un'informazione in presenza di un stimoli interferenti

IL BRAIN TRAINING

Quali funzioni cognitive?

Attenzione

Attenzione selettiva: capacità di concentrare l'attenzione su un’informazione in presenza di un stimoli interferenti

Attenzione divisa: capacità di prestare attenzione a più stimoli simultaneamente (doppio compito)

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Quali funzioni cognitive?

Attenzione

Attenzione selettiva: capacità di concentrare l'attenzione su un'informazione in presenza di un stimoli interferenti
Attenzione divisa: capacità di prestare attenzione a più stimoli simultaneamente (doppio compito)
Attenzione sostenuta: prestare attenzione ad un'unica fonte di informazioni per un tempo prolungato.

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Quali funzioni cognitive?

Velocità di elaborazione: la velocità alla quale un individuo riesce a compiere semplici task mentali automatici o minimamente controllati

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Quali funzioni cognitive?

Funzioni esecutive: complesso sistema di moduli funzionali della mente, che regolano i processi di pianificazione, controllo e coordinazione del sistema cognitivo, e che governano l'attivazione e la modulazione di schemi e processi cognitivi

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Quali funzioni cognitive?

Funzioni esecutive

Inibizione: la capacità di ignorare gli stimoli distrattori, le informazioni irrilevanti o le risposte prepotenti ma errate, mantenendo lo scopo

IL BRAIN TRAINING

Quali funzioni cognitive?

Funzioni esecutive

Inibizione: la capacità di ignorare gli stimoli distrattori, le informazioni irrilevanti o le risposte prepotenti ma errate, mantenendo lo scopo

Flessibilità: la capacità di modificare il proprio comportamento in relazione ad un cambiamento delle richieste ambientali

IL BRAIN TRAINING

Quali funzioni cognitive?

Funzioni esecutive

Inibizione: la capacità di ignorare gli stimoli distrattori, le informazioni irrilevanti o le risposte prepotenti ma errate, mantenendo lo scopo
Flessibilità: la capacità di modificare il proprio comportamento in relazione ad un cambiamento delle richieste ambientali
Memoria di lavoro: sistema di immagazzinamento temporaneo, che mantiene una quantità limitata di informazioni in un tempo limitato, per consentirne l'utilizzo nell'immediato.

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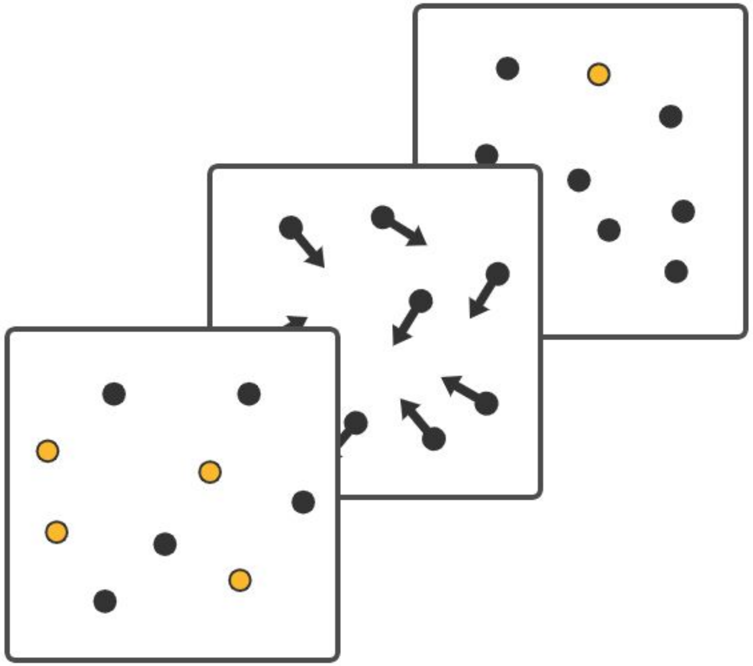
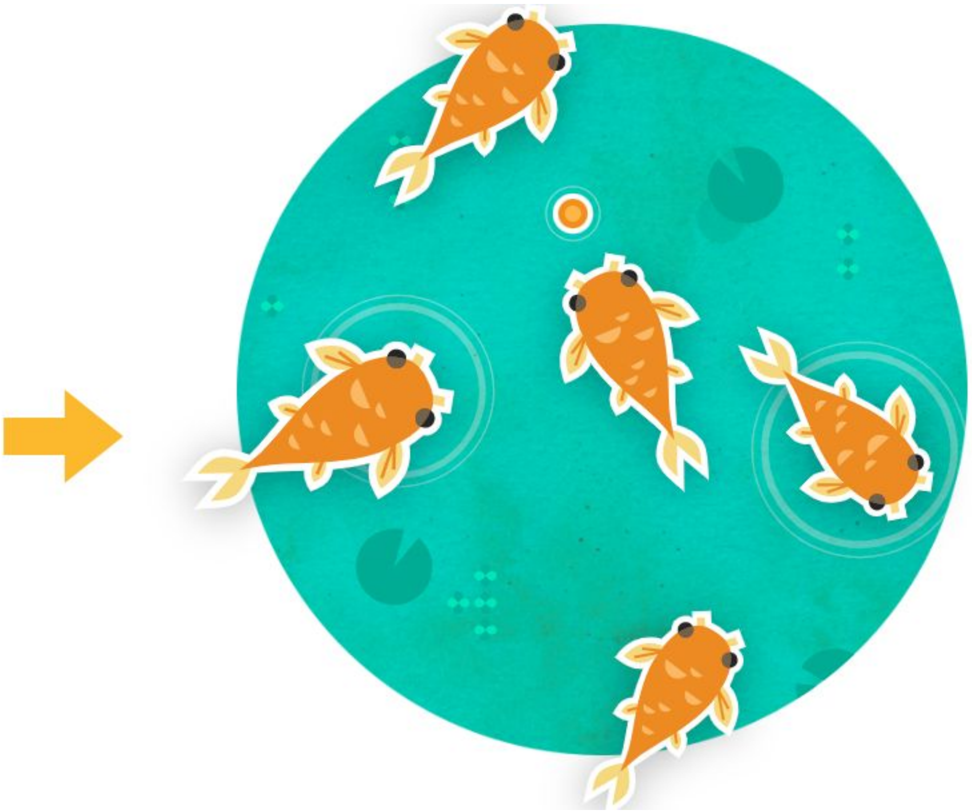
LUMOSITY

IL BRAIN TRAINING

LUMOSITY





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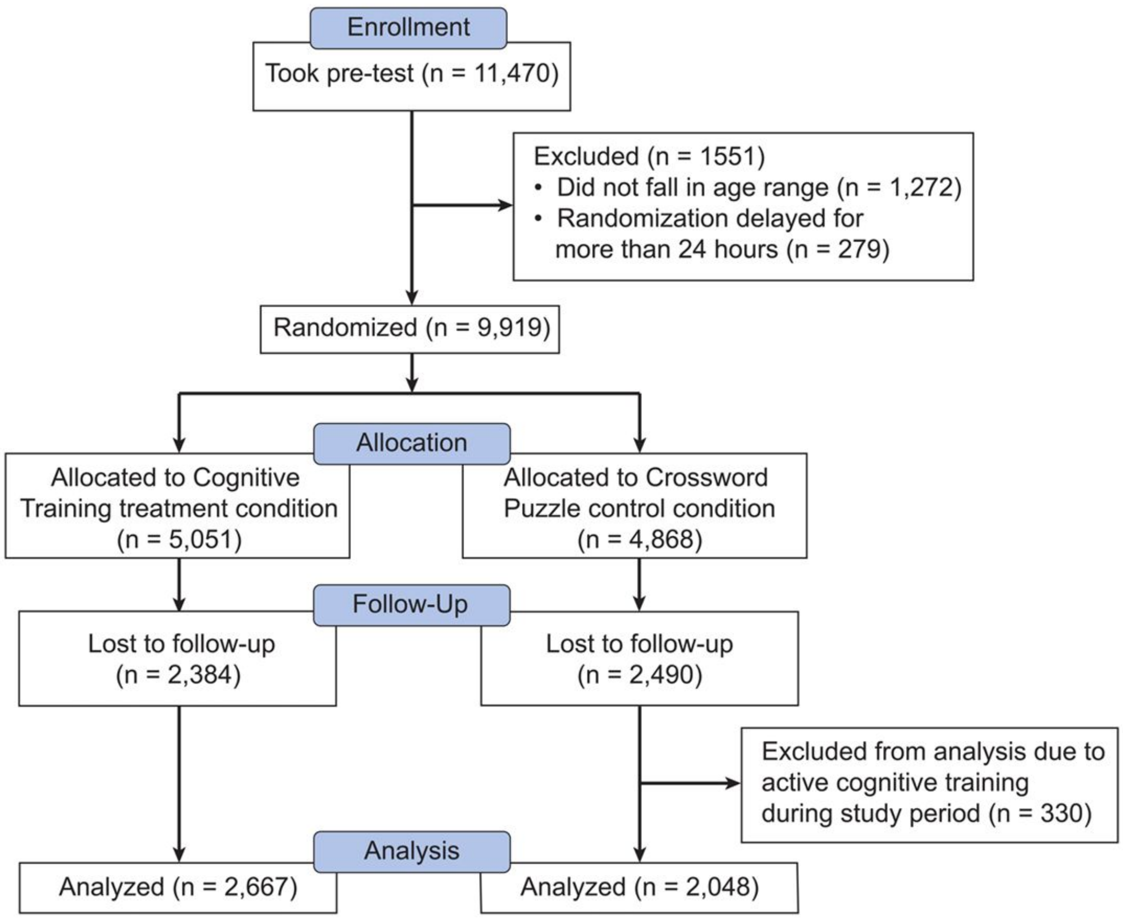
LUMOSITY

RESEARCH ARTICLE

Enhancing Cognitive Abilities with Comprehensive Training: A Large, Online, Randomized, Active-Controlled Trial

Joseph L. Hardy[1], Rolf A. Nelson[2], Moriah E. Thomason[3,4], Daniel A. Sternberg*[1], Kiefer Katovich[1], Faraz Farzin[1], Michael Scanlon[1]

1 Department of Research and Development, Lumos Labs, San Francisco, California, United States of America, 2 Department of Psychology, Wheaton College, Norton, Massachusetts, United States of America, 3 Merrill Palmer Skillman Institute for Child and Family Development, Wayne State University, Detroit, Michigan, United States of America, 4 Department of Pediatrics, Wayne State University School of Medicine, Detroit, Michigan, United States of America



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RESEARCH ARTICLE

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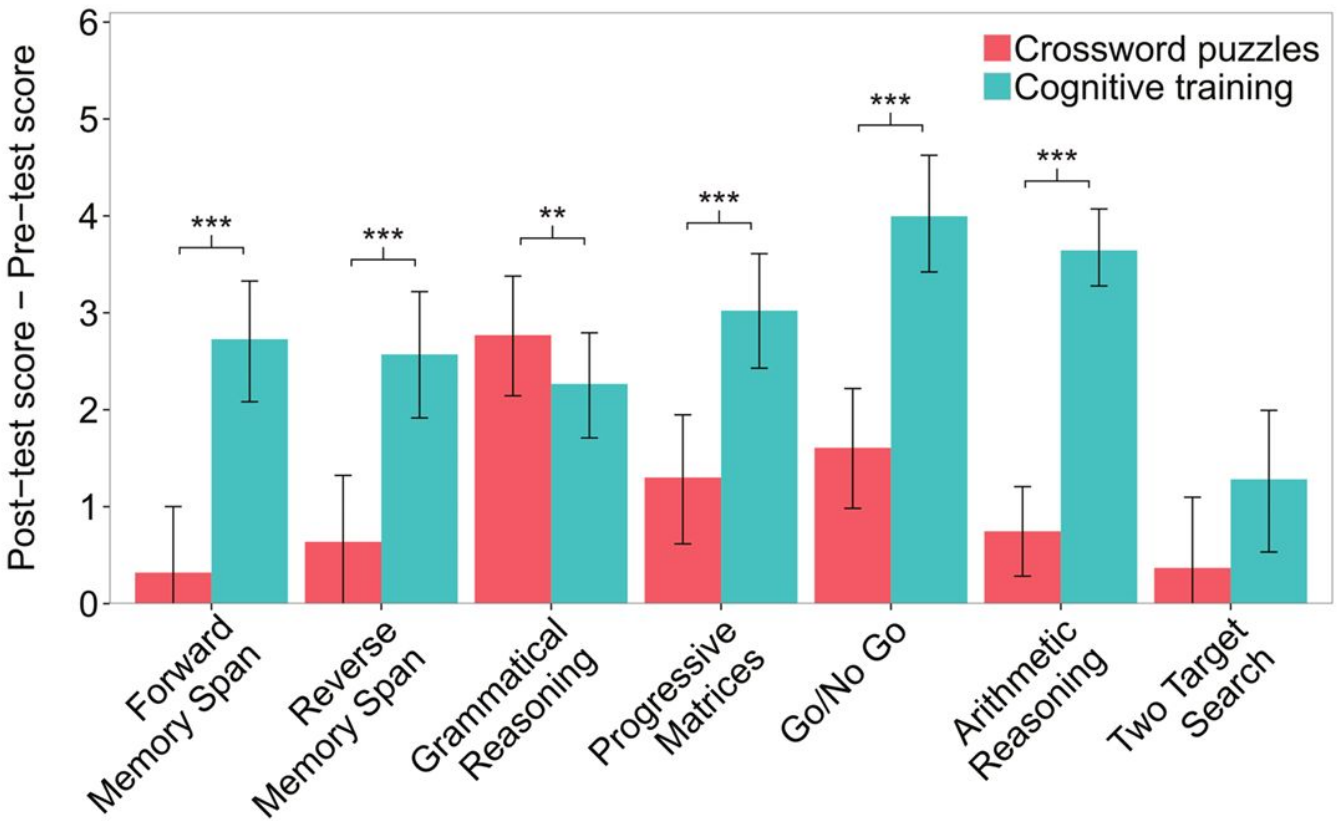
LUMOSITY



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THE HUMAN COGNITION PROJECT

OVERVIEW FOR RESEARCHERS

PUBLISHED RESEARCH

LUMOSITY

Cleland, S. E., Wyatt, L. H., Wei, L., Paul, N., Serre, M. L., West, J. J., ... & Rappold, A. G. (2022). Short-Term Exposure to Wildfire Smoke and PM 2.5 and Cognitive Performance in a Brain-Training Game: A Longitudinal Study of US Adults. Environmental Health Perspectives, 130(6), 067005. doi:10.1289/EHP10498.

Han, Y. M., Chan, M. M., Shea, C. K., Lai, O. L. H., Krishnamurthy, K., Cheung, M. C., & Chan, A. S. (2022). Neurophysiological and behavioral effects of multisession prefrontal tDCS and concurrent cognitive remediation training in patients with autism spectrum disorder (ASD): A double-blind, randomized controlled fNIRS study. Brain Stimulation, 15(2), 414-425. doi: 10.1016/j.brs.2022.02.004.

Ho, H. Y., Chen, M. D., Tsai, C. C., & Chen, H. M. (2022). Effects of computerized cognitive training on cognitive function, activity, and participation in individuals with stroke: A randomized controlled trial. NeuroRehabilitation, 2022;51(1):79-89. doi: 10.3233/NRE-210271.

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GRAZIE


MI STA AUMENTANDO L'AUTOSTIMA, LUISA.
STAI PERDENDO LA MEMORIA.
ALTAN.