

Γνωστικό Αποθεματικό

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ΕΚΠΑ, 2023

Γνωστικό αποθεματικό



- Γνωστικό αποθεματικό (cognitive reserve – CR) είναι το **νοητικό απόθεμα**, η ικανότητα δηλαδή του εγκεφάλου να αντιμετωπίσει την υποβάθμισή του που προκαλείται από φυσιολογικό γήρας ή κάποια νευροεκφυλιστική νόσο
- *The concept of reserve has been proposed to account for the **disjunction between the degree of brain damage or pathology and its clinical manifestations.***

For example, a head injury of the same magnitude can result in different levels of cognitive impairment, and that impairment can vary in its rate of recovery. Similarly, several prospective studies of aging have reported that up to 25% of elders whose neuropsychological testing is unimpaired prior to death meet full pathologic criteria for Alzheimer's disease (Ince, 2001), suggesting that this degree of pathology does not invariably result in clinical dementia. Stern, 2009

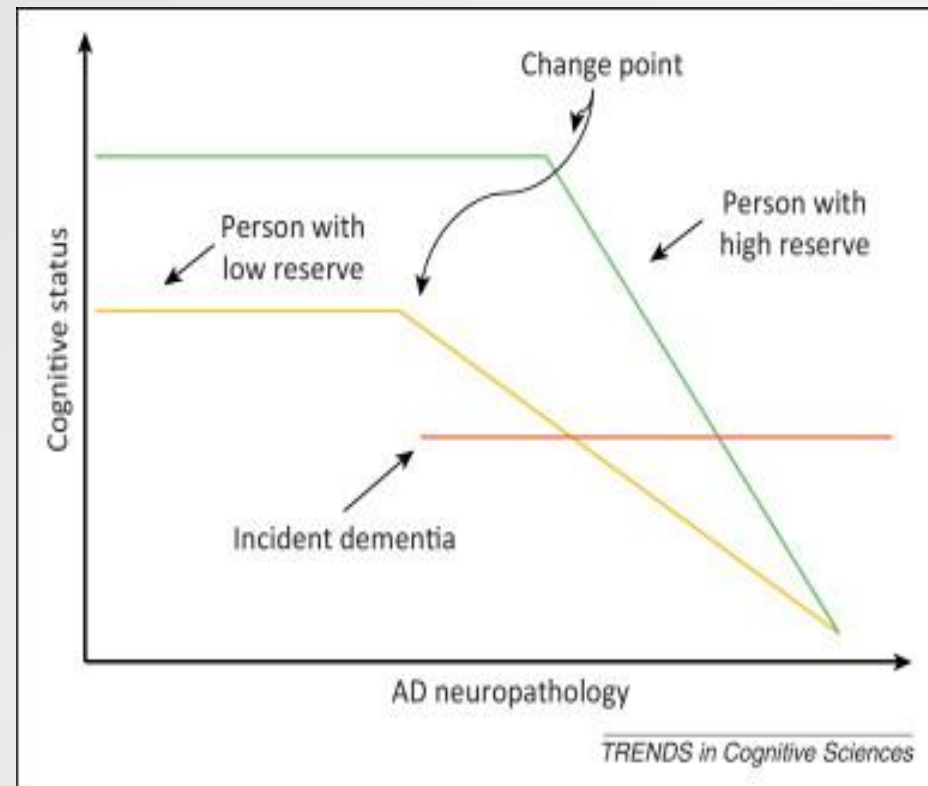
ΓΑ



- Πολλοί άνθρωποι, παρά τις εναποθέσεις βλαβών τύπου AD στον εγκέφαλο (π.χ. Αβ, tau), παραμένουν νοητικά υγιείς (δηλαδή χωρίς άνοια)
- Το ΓΑ επομένως, είναι ο προστατευτικός παράγοντας από επικείμενη νοητική έκπτωση/ άνοια

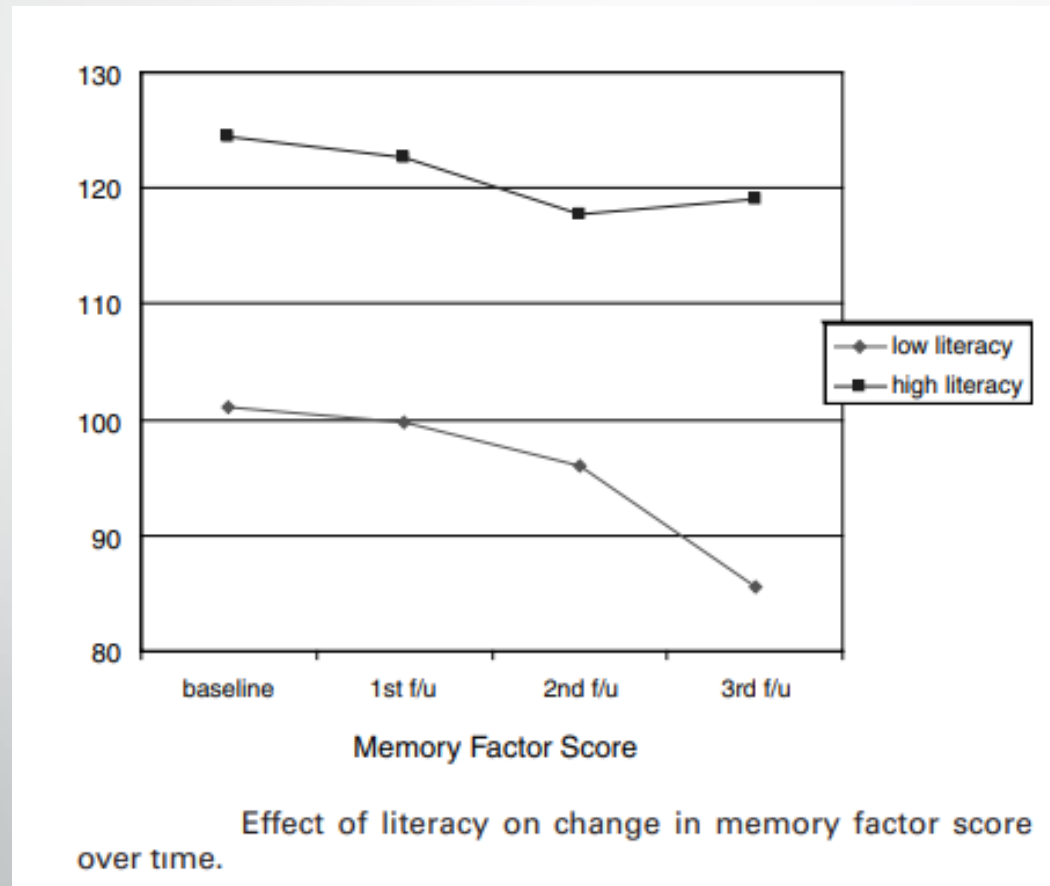
Η θεωρία του ΓΑ

- Η θεωρία του ΓΑ στοχεύει στο να εξηγήσει για ποιο λόγο ορισμένοι άνθρωποι που ο εγκέφαλός τους εμφανίζει αλλοιώσεις που χαρακτηρίζουν τη νόσο Αλτσχάιμερ εξακολουθούν να έχουν μία σχετικά φυσιολογική ζωή μέχρι να πεθάνουν, ενώ άλλοι -με αντίστοιχης έκτασης εκφύλιση του εγκεφάλου- εκδηλώνουν όλο το εύρος των σοβαρών συμπτωμάτων που συνδέονται με τη νόσο. Τι είναι όμως αυτό που επιηρεάζει με τέτοιο καταλυτικό τρόπο την εκδήλωση της νόσου Αλτσχάιμερ;
- Σύμφωνα με τους επιστήμονες, αυτό που κάνει τη διαφορά, είναι **ο βαθμός στον οποίο ο εγκέφαλός μας έχει ασκηθεί κατά τη διάρκεια της ζωής μας**. Οι σχετικές μελέτες δείχνουν ότι οι άνθρωποι υψηλού μορφωτικού επιπέδου, οι οποίοι έχουν επιλέξει διανοητικά απαιτητικά επαγγέλματα και παράλληλα, ασχολούνται συστηματικά με μία ποικιλία δραστηριοτήτων, έχουν 35-40% λιγότερες πιθανότητες να εκδηλώσουν τα χαρακτηριστικά συμπτώματα της νόσου Αλτσχάιμερ.
- Αυτό σημαίνει ότι ακόμα και αν ο εγκέφαλός τους προσβληθεί από τη νόσο, θα μπορέσει χάρη στο νοητικό απόθεμα που έχει δημιουργήσει στην πορεία των χρόνων να αντισταθμίσει τις αλλοιώσεις που θα εμφανιστούν, με αποτέλεσμα ορισμένοι από αυτούς τους ανθρώπους να μην διαγνωστούν καν με τη νόσο αφού μπορεί να μην εκδηλώσουν ποτέ τα συμπτώματά της στην καθημερινή τους ζωή.



*Representation of **how CR may mediate between AD pathology and its clinical expression** based on epidemiological and imaging studies. The x-axis represents AD pathology, slowly increasing over time. The y-axis represents cognitive function. We assume that AD pathology increases over time at the same rate in two individuals with high and low reserve. The amount of pathology needed before cognitive function is affected is greater with higher CR, leading to a later change point. It follows that more pathology will be needed for the person with higher CR to meet clinical diagnostic criteria for AD, thus delaying the onset of the disease. Also, at any level of cognitive performance, AD pathology will be more severe in the individual with higher CR. Once cognitive decline begins, it is more rapid in the person with higher CR. (Barulli & Stern, 2013)*

Cognitive Decline and Literacy Among Ethnically Diverse Elders

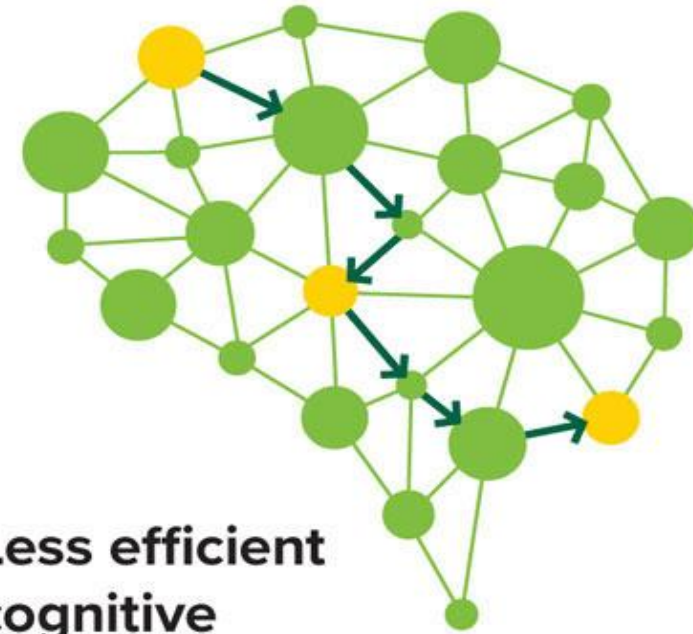


Neural pathways for message to travel inside brain



**More efficient
cognitive
processing**

Many different pathways for faster
neural communication, complex thought



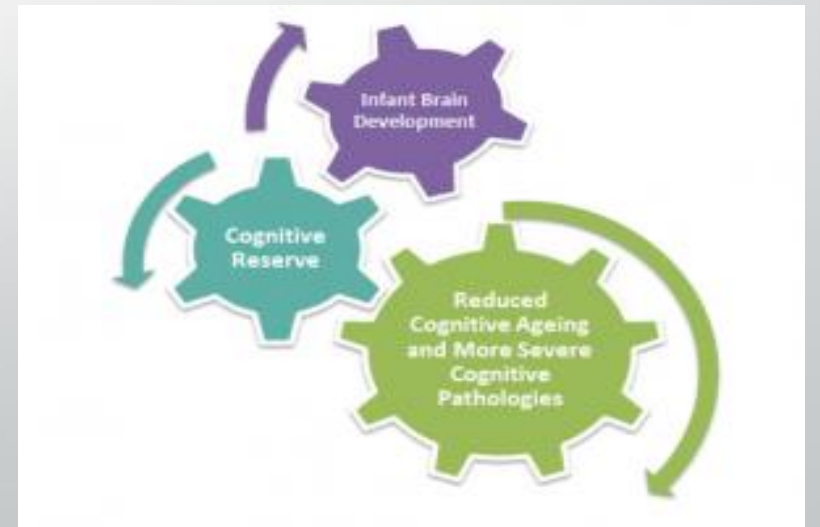
**Less efficient
cognitive
processing**

Lost neurons and connections
to stress and disease

*The brain on the **left** can send this message down **many different pathways**. Some are more heavily used, represented by darker arrows that represent learning, or routines. But, in a pinch, there are many other options. The brain on the **right**, which has **lost neurons and connections** to stress and disease, is much less efficient. Messages travel slower. Thinking is harder.*

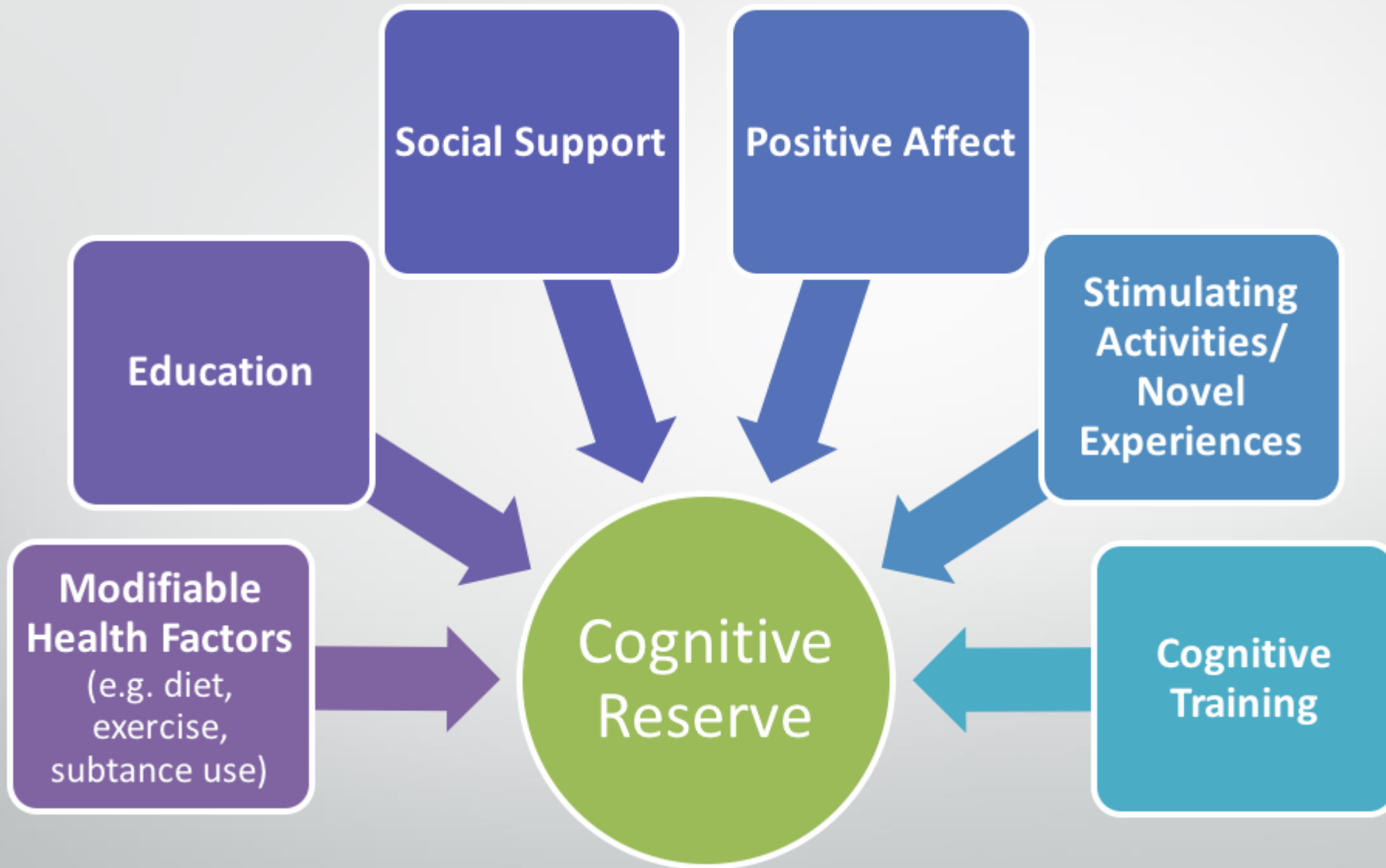
Παράγοντες που επηρεάζουν το ΓΑ

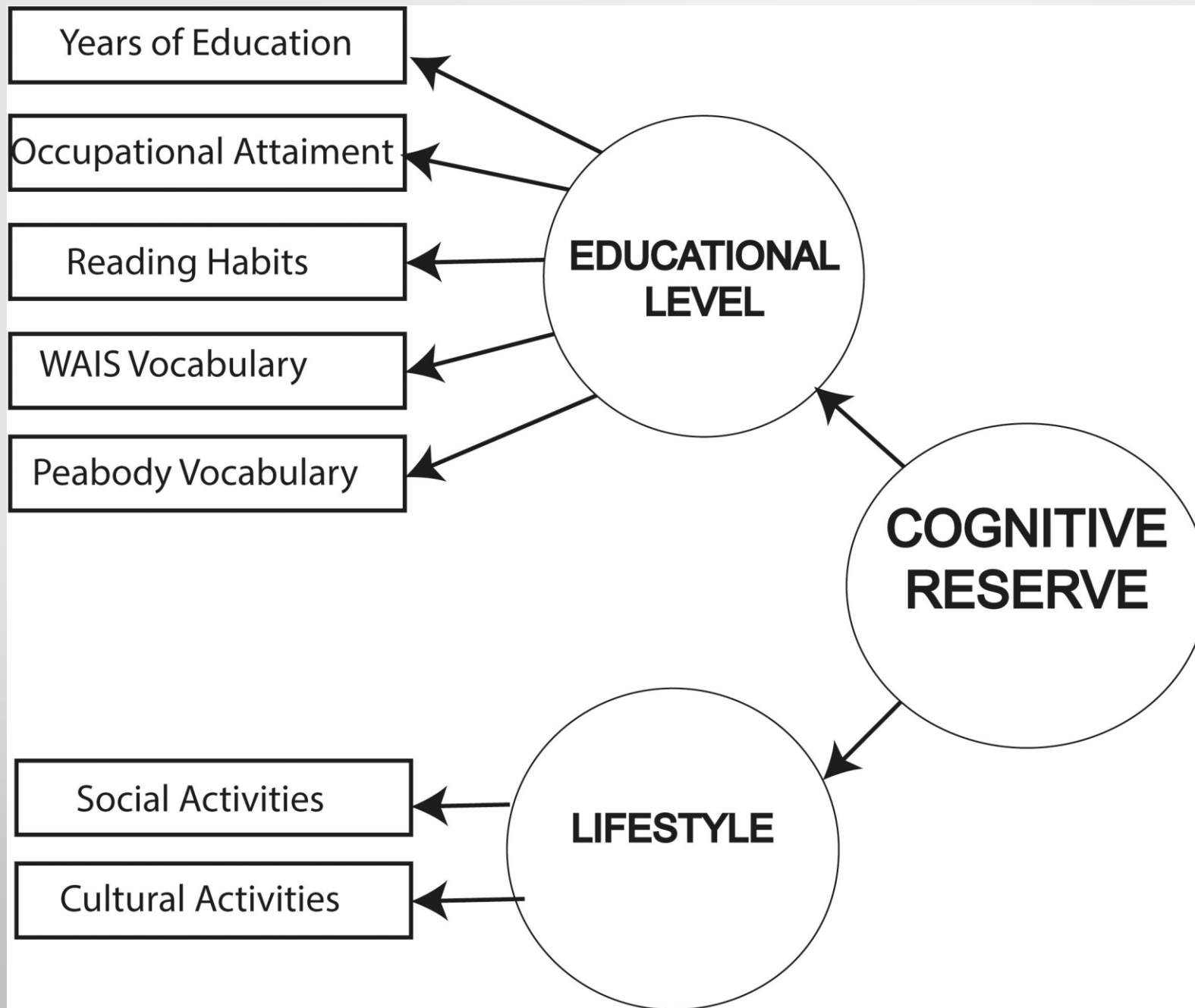
- Οι παράγοντες που επηρεάζουν το γνωστικό αποθεματικό λειτουργούν πριν ή και μετά από τις αλλαγές που επέρχονται λόγω ηλικίας ή παθολογίας
- Οι πιο βασικοί παράγοντες που επηρεάζουν το ΓΑ είναι:
 - Γενετικοί
 - Περιβαλλοντικοί



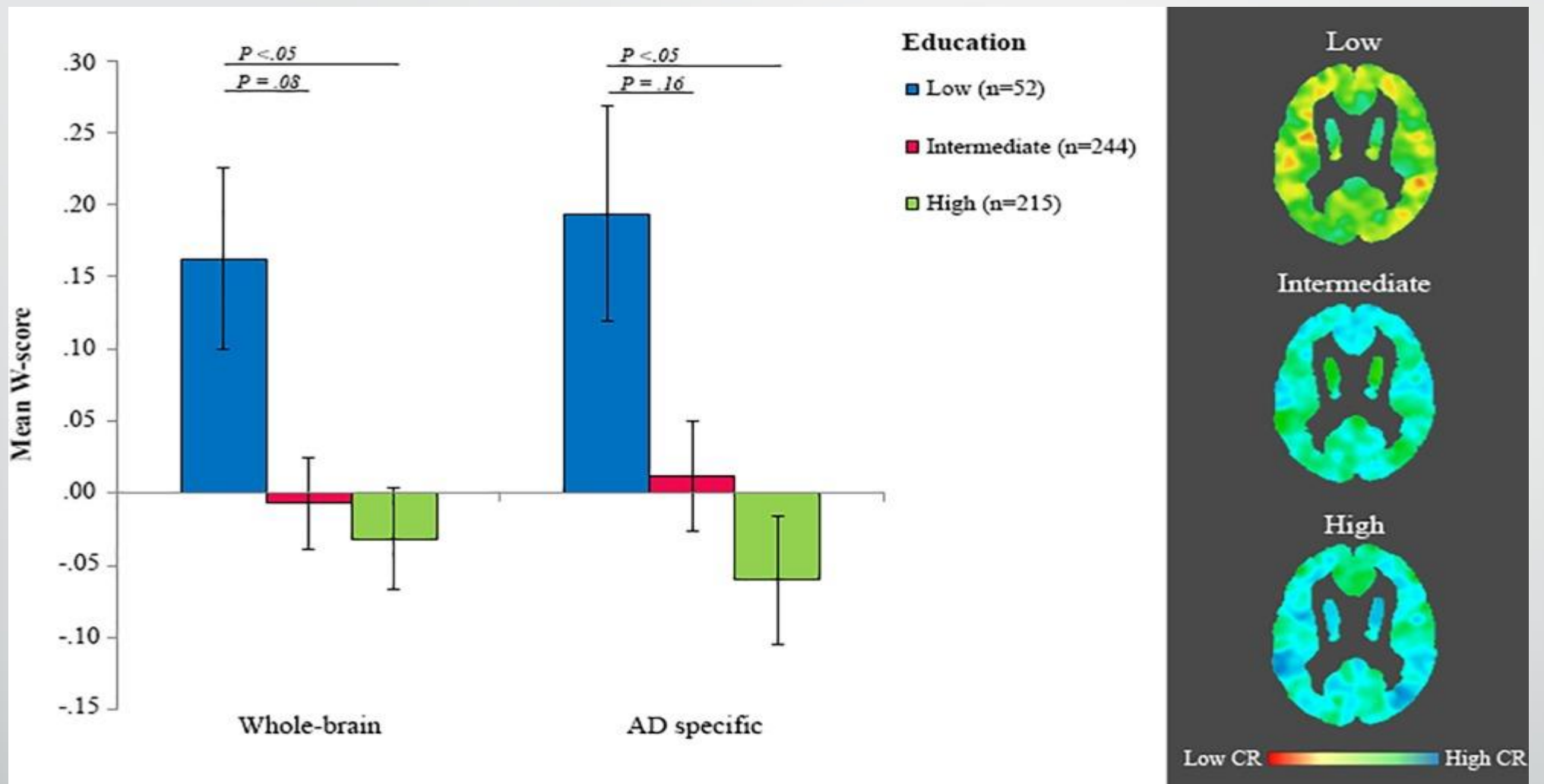
Παράγοντες που επηρεάζουν το ΓΑ

- Προνοσηρές νοητικές ικανότητες (IQ)
- Εκπαίδευση
- Επάγγελμα
- Τρόπος ζωής
 - Κοινωνικά δίκτυα
 - Κοινωνικές δραστηριότητες
 - Πνευματικές δραστηριότητες
 - Σωματικές δραστηριότητες





*Lojo-Seoane
et al., 2018*

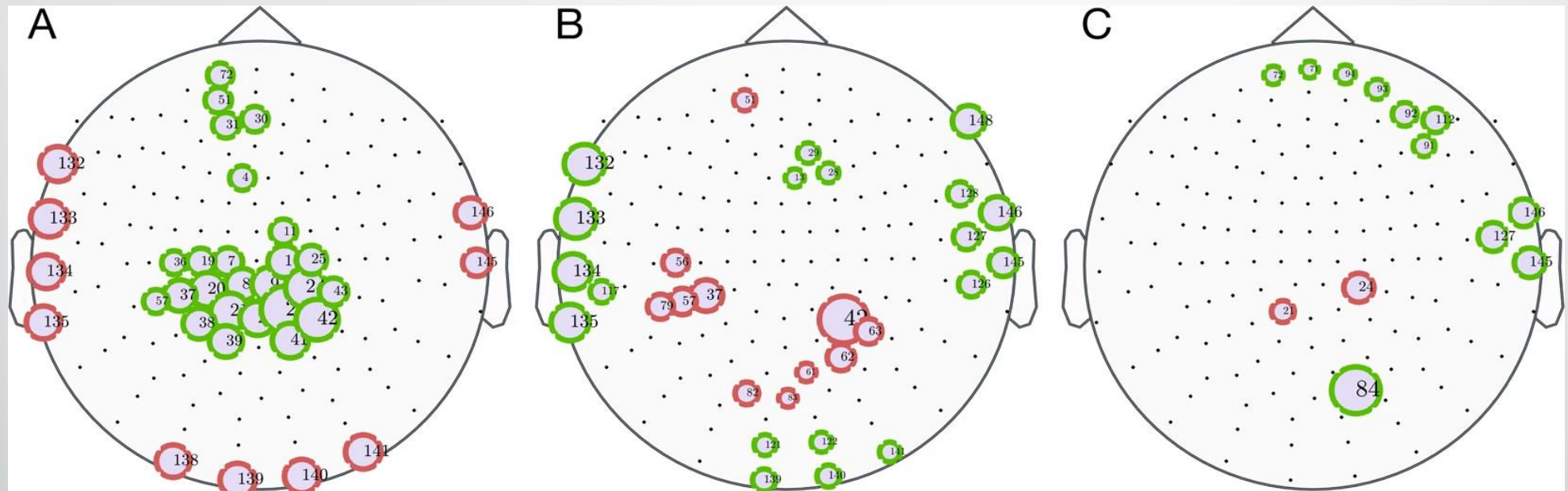


Left, mean W-scores in the whole-brain and temporoparietal mask for the total sample, across three levels of education (i.e. low [Verhage 1 to 3, n = 52]; intermediate [Verhage 4 and 5, n = 244]; high [Verhage 6 and 7, n = 215]). Right, W-scores in each GM voxel averaged across subjects with low (top), intermediate (middle), and high (bottom) educational levels. Low CR is reflected by positive W-scores, and high CR by negative W-scores. (van Loenhoud et al., 2017)



An example of two subjects in this study, who showed similar cognitive performance (global cognitive composite score = -2.65) despite striking differences in the amount of atrophy. Subject A shows substantially greater AD-related atrophy in the temporoparietal cortex and medial temporal lobes compared to subject B. Using the neuroimaging method we present in this article, this resulted in lower W-scores for subject A, which indicates greater CR (i.e. comparable cognitive function under worse conditions of the brain). Importantly, subject A is highly educated (i.e. university degree), while subject B has a low education (i.e. a primary school diploma) (*van Loenhoud et al., 2017*).

Functional brain networks reveal the existence of cognitive reserve and the interplay between network topology and dynamics



Differences between high and low CR groups at the node level (*Martinez et al., 2018*)

Reserve and Resilience

- <https://reserveandresilience.com/>
- <https://reserveandresilience.com/framework/>

DOI: 10.1016/j.jalz.2018.07.219

REVIEW ARTICLE

Alzheimer's & Dementia®
THE JOURNAL OF THE ALZHEIMER'S ASSOCIATION

Whitepaper: Defining and investigating cognitive reserve, brain reserve, and brain maintenance

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CR Definition

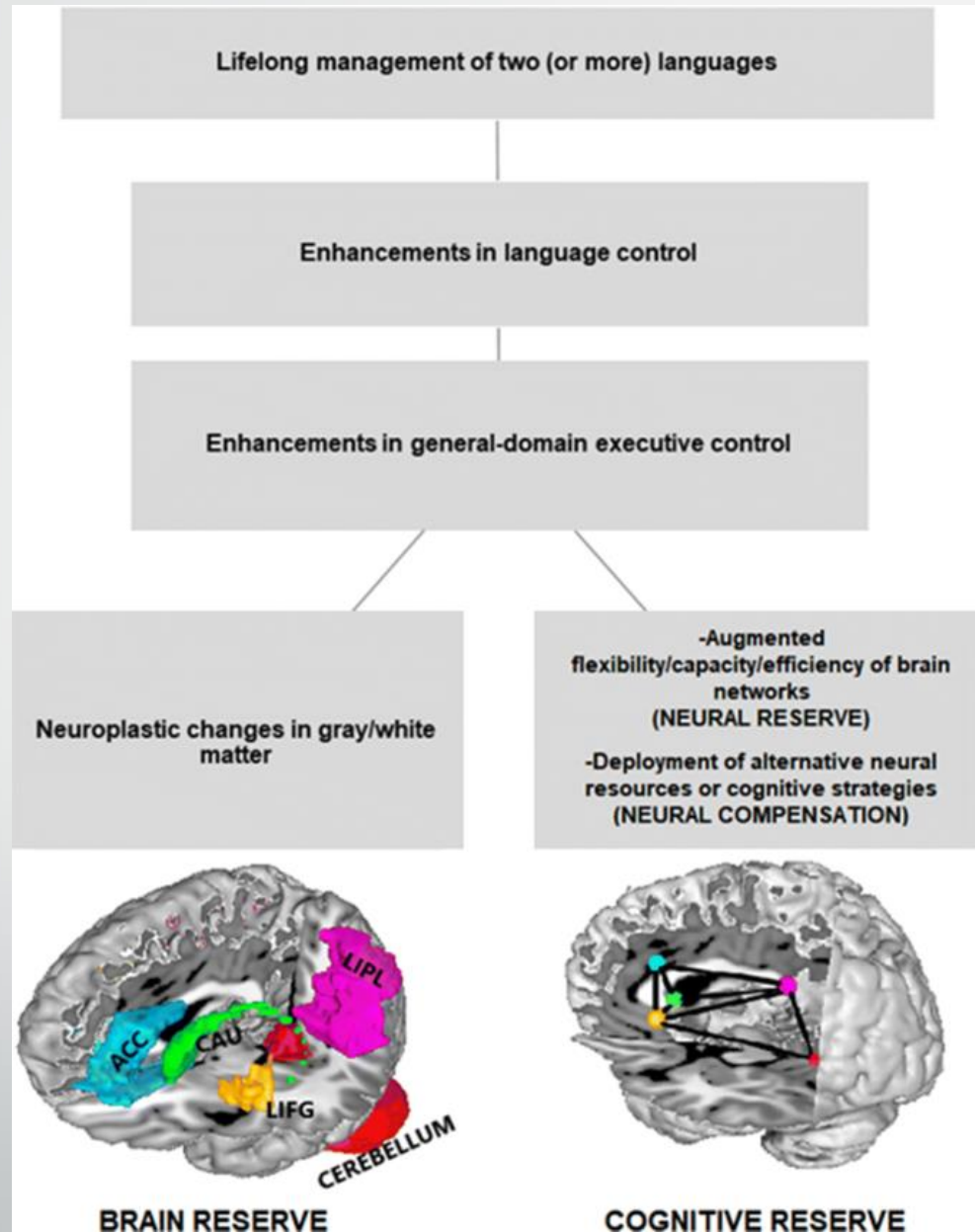
- Cognitive reserve (CR) is a property of the brain that allows for cognitive performance that is better than expected given the degree of life-course related brain changes and brain injury or disease.
- Property of the brain refers to multiple potential mechanisms including molecular, cellular and network levels. The working hypothesis is that these mechanisms help cope with or compensate for brain changes and brain injury or disease.
- These mechanisms can be characterized via biological or cognitive-experimental approaches.
- Better than expected cognitive performance ideally refers to trajectories measured longitudinally.
- CR can be influenced by multiple genetic and environmental factors, operating at various points or continuously across the lifespan.

Brain Maintenance

- Refers to the relative absence of change in neural resources over time as a determinant of preserved cognition in older age.
- Brain maintenance and cognitive reserve are complementary concepts. One refers to relative preservation of the brain while the other refers to sustaining cognition in the face brain changes.
- Both brain maintenance and cognitive reserve can be influenced by multiple genetic and environmental factors, operating at various points across the lifespan.

Brain Reserve

- Brain reserve has been used to reflect the neurobiological status of the brain (numbers of neurons, synapses, etc.). To the extent that BM is effective you have better BR at any point in time. BR does not involve active adaptation of functional cognitive processes in the presence of injury or disease as does CR.



Gallo et al., 2020

Cognitive Reserve in Ageing and AD

Cognitive reserve in ageing and Alzheimer's disease

Yaakov Stern

Lancet Neurol 2012; 11: 1006-12

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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.


ΓΑ στη νόσο του Parkinson

Parkinsonism and Related Disorders 20 (2014) 1–7


Contents lists available at [ScienceDirect](#)

 Parkinsonism and Related Disorders

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



Review

Cognitive reserve in Parkinson's disease: A systematic review and meta-analysis 

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ARTICLE INFO

Article history:
Received 5 April 2013
Received in revised form 19 August 2013
Accepted 20 August 2013

Keywords:
Parkinson's disease
Cognition
Dementia
Cognitive reserve
Education

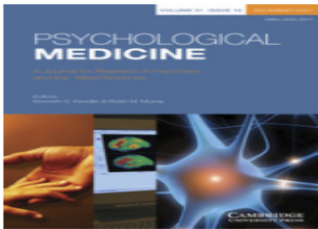
ABSTRACT

Background: The concept of cognitive reserve is proposed to explain the mismatch between the degree of pathological changes and their clinical manifestations and has been used to help understand the variation in the rate of cognitive decline and the development of dementias. It is not clear whether this concept applies to cognitive performance, cognitive decline and dementia in Parkinson's disease (PD). **Methods:** A systematic review was conducted using the most commonly described proxies for cognitive reserve of education, occupation and leisure activities. Thirty four papers were found on education and cognition in PD but there were no studies of the other proxies of reserve. A random effects meta-analysis was used to assess the associations between education and cross-sectional cognitive assessments, longitudinal global cognitive decline and a long term dementia diagnosis. **Results:** There was a significant association between higher education and cross-sectional performance of MMSE, global cognition, mild cognitive impairment, attention, executive function, visuospatial function and memory. There was a small but significant association between higher education and a reduced rate of cognitive decline. There was no association with a final dementia diagnosis. There was not enough information to perform an analysis on the rate and timing of transition to dementia. **Conclusions:** Higher levels of education are associated with significantly better cognitive performance and a small but significant slowing in cognitive decline but are not associated with a reduction in long-term dementia in PD. More detailed, standardized, longitudinal studies are required to study conclusively the effects cognitive reserve in PD.

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Higher levels of education are associated with significantly better cognitive performance and a small but significant slowing in cognitive decline but are not associated with a reduction in long-term dementia in PD. More detailed, standardized, longitudinal studies are required to study conclusively the effects of cognitive reserve in PD.

CR in Neuropsychiatry



Psychological Medicine

Article contents

Abstract

Cognitive reserve in neuropsychiatry


Published online by Cambridge University Press: 06 April 2006

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Abstract

Background. The idea that superior cognitive function acts as a protective factor against dementia and the consequences of head injury is well established. Here we suggest the hypothesis that cognitive reserve is also important in neuropsychiatric disorders including schizophrenia, bipolar disorder and depression.

Method. We review the history of passive and active models of reserve, and apply the concept to neuropsychiatric disorders. Schizophrenia is used as an exemplar because the effects of premorbid IQ and cognitive function in this disorder have been extensively studied.

Results. Cognitive reserve may impact on neuropsychiatric disorders in three ways: by affecting the risk for developing the disorder, in the expression of symptoms within disorders, and in patients' functional outcome. Cognitive failure below a certain threshold may alone, or in combination with common psychiatric symptoms, produce neuropsychiatric syndromes.

Conclusions. Consideration of cognitive reserve may considerably improve our understanding of individual differences in the causes and consequences of neuropsychiatric disorders. For these reasons, the concept of cognitive reserve should be incorporated in future studies of neuropsychiatric disorder. It may be possible to enhance cognitive reserve through pharmacological or non-pharmacological means, such as education, neurocognitive activation or other treatment programmes.

ΓΑ και Δημιουργικότητα



The Relationships Between Cognitive Reserve and Creativity. A Study on American Aging Population

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The Cognitive Reserve (CR) hypothesis suggests that the brain actively attempts to cope with neural damages by using pre-existing cognitive processing approaches or by enlisting compensatory approaches. This would allow an individual with high CR to better cope with aging than an individual with lower CR. Many of the proxies used to assess CR indirectly refer to the flexibility of thought. The present paper aims at directly exploring the relationships between CR and creativity, a skill that includes flexible thinking. We tested a sample of 72 adults (aged between 45 and 78) assessing both their level of CR and their creativity. To evaluate CR we used the proxies commonly used in literature, namely, three subtests from the WAIS (vocabulary, similarities, and digit span) and the years of education. We also used an *ad-hoc* test asking people to report how frequently they tend to perform activities that are believed to increase CR. We used verbal creativity tasks (alternative uses and generation of acronyms) to assess individual levels of creativity. We asked participants to describe their main occupation (present or past) and coded each occupation as creative or not creative. Results (controlling for age-related differences) showed that scores from the WAIS correlated positively with creativity performance, even though correlations varied across the subtests. Focusing on the frequency and type of activities that people perform, and comparing individuals who have or had a creative job to those with a routine job, a clear relationship between creativity and CR emerged. This effect was more relevant than the level of job complexity. Implications for the study of CR and aging are discussed.

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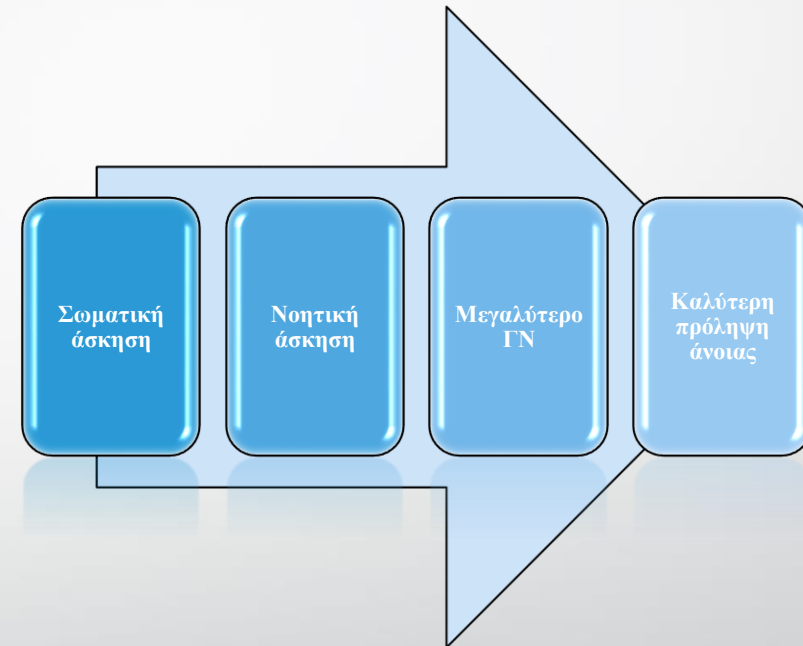
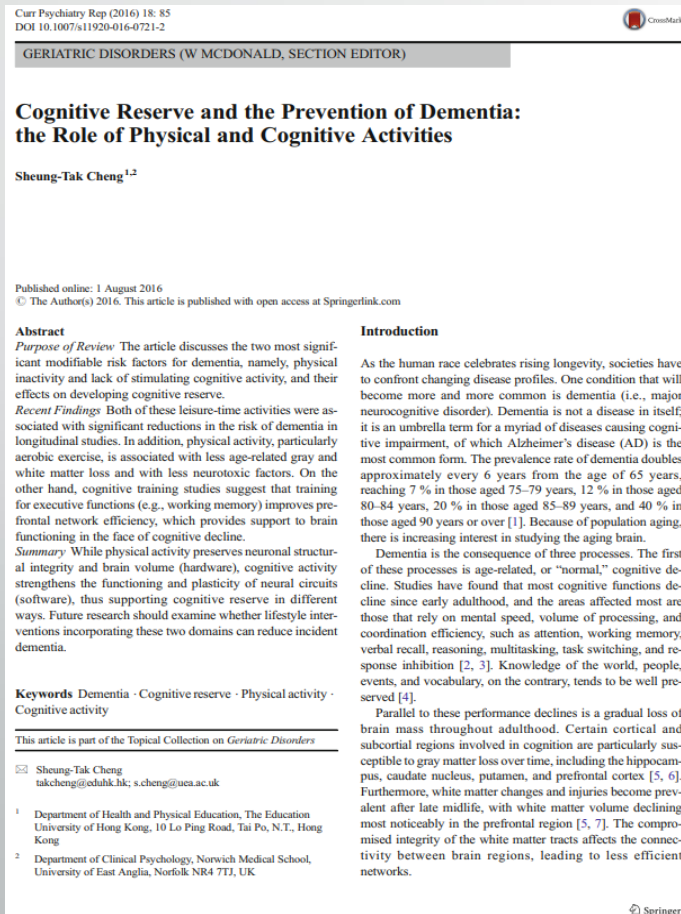
Edited by:
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Focusing on the frequency and type of activities that people perform, and comparing individuals who have or had a creative job to those with a routine job, **a clear relationship between creativity and CR emerged.** This effect was more relevant than the level of job complexity.

Cognitive Reserve and the Prevention of Dementia: the Role of Physical and Cognitive Activities



While physical activity preserves neuronal structural integrity and brain volume (hardware), cognitive activity strengthens the functioning and plasticity of neural circuits (software), thus supporting cognitive reserve in different ways.

Cognitive Reserve and Lifestyle/ leisure activities

 Journal of Clinical and Experimental Neuropsychology
2003, Vol. 25, No. 5, pp. 625–633
1380-3395/03/2505-625\$16.00
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Cognitive Reserve and Lifestyle

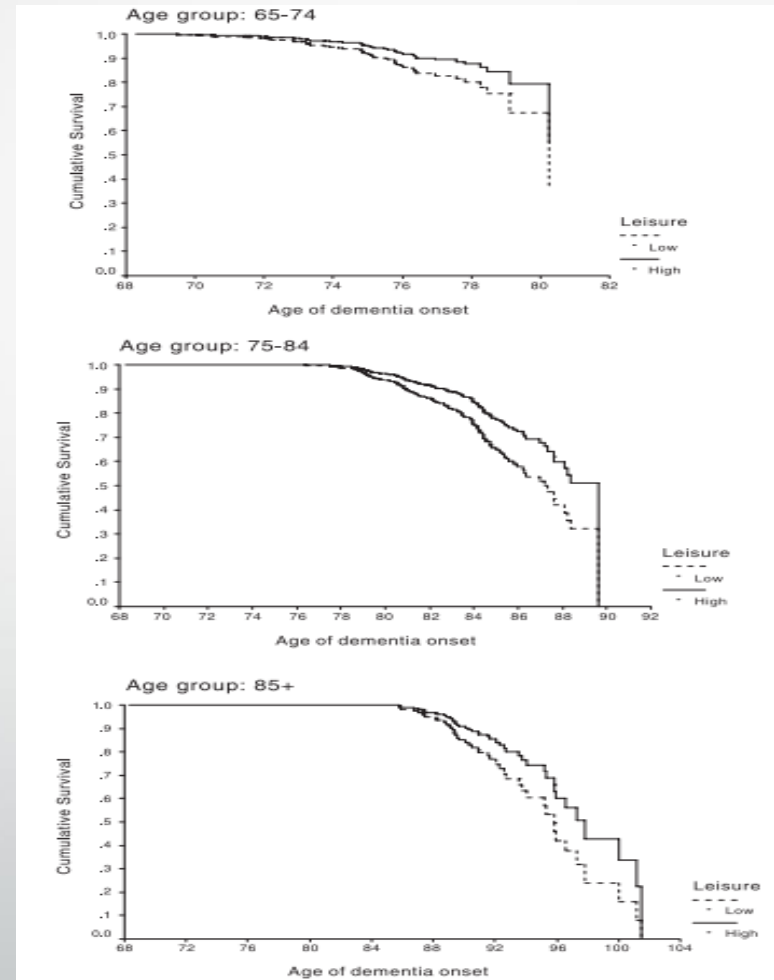
Nikolaos Scarmeas and Yaakov Stern

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ABSTRACT

The concept of cognitive reserve (CR) suggests that innate intelligence or aspects of life experience like educational or occupational attainments may supply reserve, in the form of a set of skills or repertoires that allows some people to cope with progressing Alzheimer's disease (AD) pathology better than others. There is epidemiological evidence that lifestyle characterized by engagement in leisure activities of intellectual and social nature is associated with slower cognitive decline in healthy elderly and may reduce the risk of incident dementia. There is also evidence from functional imaging studies that subjects engaging in such leisure activities can clinically tolerate more AD pathology. It is possible that aspects of life experience like engagement in leisure activities may result in functionally more efficient cognitive networks and therefore provide a CR that delays the onset of clinical manifestations of dementia.

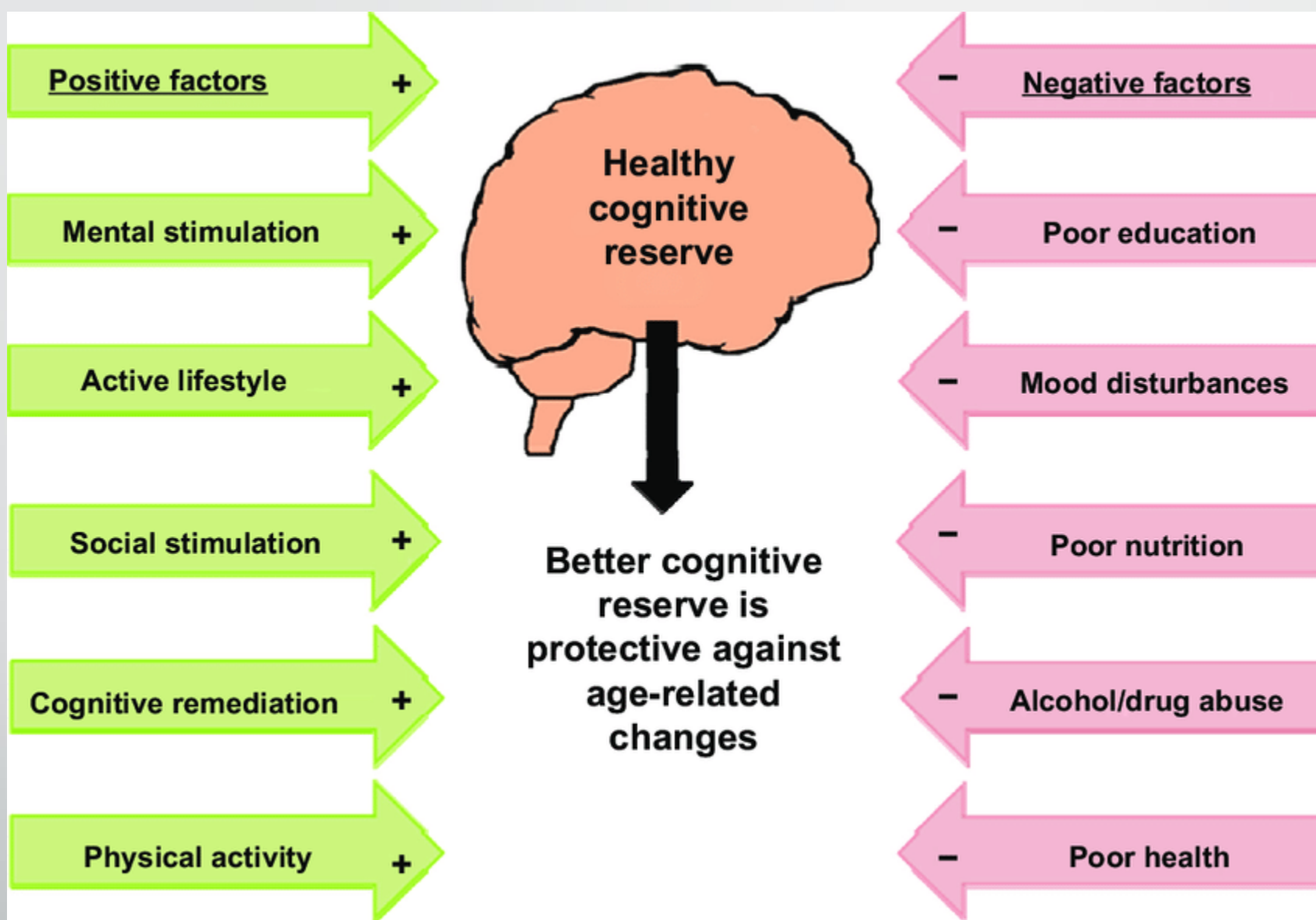
Leisure Activities



Aspects of life experience like engagement in leisure activities may result in functionally more efficient cognitive networks and therefore provide a CR that delays the onset of clinical manifestations of dementia.

Preventing cognitive decline and dementia

- <https://www.nia.nih.gov/health/preventing-alzheimers-disease-what-do-we-know>



Contributing factors of cognitive reserve. Notes: + **contributes to positive neuroplasticity** which supports cognitive reserve; -**contributes to negative neuroplasticity** which does not support cognitive reserve (*Vance et al., 2012*)

Πως θα αυξήσουμε το ΓΑ σε κάθε ηλικία?

- Διαβάζοντας βιβλία
- Κάνοντας φυσική άσκηση
- Κάνοντας εξωτερικές δραστηριότητες (ψώνια, ταινίες κλπ.)
- Μαθαίνοντας μία ξένη γλώσσα
- Λύνοντας σταυρόλεξα
- Εξασκώντας ένα χόμπυ

Προστατευτικοί και προδιαθεσικοί παράγοντες στις άνοιες – Νόσο Αλτσχάιμερ (Ν. Σκαρμέας)

- Η θεωρία του «νοητικού αποθέματος» προτείνει ότι υπάρχουν **διαφορές από άτομο σε άτομο** ως προς τη δυνατότητα καταπολέμησης της ΝΑ. Παραδείγματος χάριν σημαντικό ποσοστό των ανθρώπων που έχουν βλάβες τύπου ΝΑ στον εγκέφαλο τους δεν πάσχουν από συμπτώματα της ΝΑ. Υποστηρίζεται ότι άνθρωποι με **μεγαλύτερο νοητικό απόθεμα πιθανώς να μπορούν να αντιρροπούν βλάβες τύπου ΝΑ στον εγκέφαλο τους** (πχ χρησιμοποιώντας υγιείς – μη προσβεβλημένες περιοχές του εγκεφάλου ή λόγω πιο ‘αποτελεσματικής’ λειτουργίας του εγκεφάλου) **ώστε να εκδηλώνουν τη νόσο αργότερα ή και καθόλου.**

Προστατευτικοί και προδιαθεσικοί παράγοντες στις άνοιες – Νόσο Αλτσχάιμερ (Ν. Σκαρμέας)

- Παράγοντες που επηρεάζουν το νοητικό απόθεμα και επομένως και τον κίνδυνο για ανάπτυξη ΝΑ περιλαμβάνουν το **νοητικό πηλίκο (IQ), το επάγγελμα, την εκπαίδευση, και τις γενικότερες βιωματικές εμπειρίες**. Πολλές μελέτες δείχνουν ότι άνθρωποι με υψηλότερο νοητικό πηλίκο, υψηλότερη εκπαίδευση, πιο απαιτητικά επαγγέλματα και περισσότερες δραστηριότητες ελεύθερου χρόνου (συμπεριλαμβανομένων πνευματικών, κοινωνικών, αλλά και φυσικών-σωματικών δραστηριοτήτων) έχουν μικρότερες πιθανότητες ανάπτυξης ΝΑ. Το αν οι συσχετίσεις αυτές είναι πραγματικά αιτιολογικές (δηλαδή υπάρχει πραγματική προστασία) ή απλώς μεθοδολογικά σφάλματα επιστημονικών μελετών είναι αντικείμενο διαφωνίας στην επιστημονική κοινότητα.

It's quiz time!



Το ΓΑ αποθεματικό συσχετίζεται με:

- Τις δραστηριότητες που κάνουμε
- Την εκπαίδευση
- Το είδος γυμναστικής που κάνουμε
- Όλα τα παραπάνω

➤ Όλα τα παραπάνω

Το CR διαφέρει απόλυτα από το BR

- Σωστό
- Λάθος
- Λάθος. Μπορεί να διαφέρουν, αλλά είναι και αλληλένδετα

Μπορούμε να αυξήσουμε το ΓΑ ή είμαστε αποκλειστικά γεννημένοι με αυτό?

- Φυσικά και μπορούμε!

Ένα ηλικιωμένο άτομο με υψηλό ΓΑ θα εμφανίσει άνοια πιο γρήγορα απ' ότι ένα άτομο με χαμηλό ΓΑ

- Σωστό
- Λάθος
- Λάθος



Thank you!