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"USE IT OR LOSE IT"

The Role of Brain Exercises

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DISCLOSURES

- Nothing to disclose
- Proprietary names used in this presentation are for the purpose of examples and are not intended to serve as a product or company endorsement

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LEARNING OBJECTIVES

1. Define neuroplasticity and cognitive reserve
2. Identify and describe three classes of cognitive interventions
3. Describe the benefits of cognitive stimulation
4. Delineate the types of activities for brain exercises

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COGNITION

Cognition – the mental activities and processes involved in receiving, comprehending, storing, retrieving, and using information.

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COGNITIVE DOMAINS

- memory
- attention
- executive functions
- language
- calculation

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COGNITIVE DOMAINS

reasoning
processing speed
visual-spatial skill

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CONCEPTUAL BASIS

Neuroplasticity

Cognitive resilience

Cognitive reserve

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NEUROPLASTICITY

- ability of the brain to modify, change, and adapt structure and function in response to experience across the life span
- essential for healthy brain function

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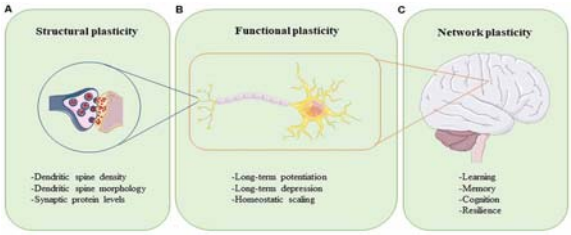
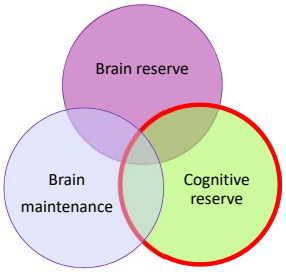
(Nelson, Jester, Petkus, & Andel, 2021; Arenaza-Urquiljo et al., 2020, Voss et al., 2017)

LEVELS OF NEUROPLASTICITY



(Koller & Chakrabarty, 2020)

COGNITIVE RESILIENCE



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(Stern, 2021; Arenaza-Urquiljo et al., 2020 ; Stern & Barulli, 2019)

COGNITIVE RESILIENCE

- Brain reserve – greater neurobiological capital (more neurons, more synapse)
- Cognitive reserve - neuronal network adaptability (efficiency, capacity, flexibility)
- Brain maintenance – reduced development of age-related brain changes & pathology (genetics and/or lifestyle)

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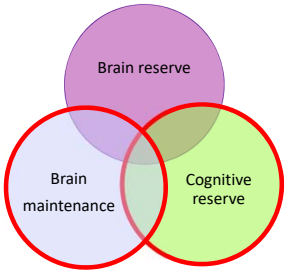
(Stern, 2021; Arenaza-Urquiljo et al., 2020; Stern & Barulli, 2019)

COGNITIVE RESILIENCE



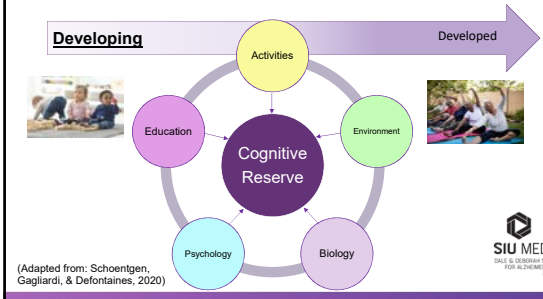
(Stern, 2021; Arenaza-Urquiljo et al., 2020 ; Stern & Barulli, 2019)

COGNITIVE RESERVE

- neuronal network adaptability (efficiency, capacity, flexibility)
- individual differences in cognitive or functional brain processes determine cognitive reserve

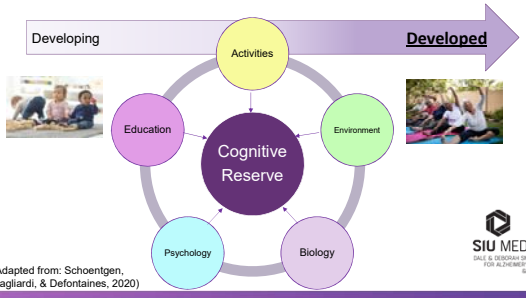
(Nelson, Jester, Petkus, & Andel, 2021; Arenaza-Urquiljo et al., 2020.; Stern & Barulli, 2019;Voss et al., 2017)

COGNITIVE RESERVE



(Adapted from: Schoentgen, Gagliardi, & Defontaines, 2020)

COGNITIVE RESERVE



(Adapted from: Schoentgen, Gagliardi, & Defontaines, 2020)

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COGNITIVE EXERCISE

COGNITIVE STIMULATION

COGNITIVE TRAINING

COGNITIVE REHABILITATION

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(Clare et al., 2018; Bahar-Fuchs, Clare, & Woods, 2013)

COGNITIVE EXERCISE

COGNITIVE STIMULATION

- non-specific engagement in a range of activities and discussions either individually or in a group setting i.e. reality orientation, reminiscence activities

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(Clare et al., 2018; Bahar-Fuchs, Clare, & Woods, 2013)

COGNITIVE EXERCISE

COGNITIVE TRAINING

- guided approach involving practice of standardized tasks targeting a particular cognitive function such as attention, memory, or problem solving
- computerized cognitive training (CCT)

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(Clare et al., 2018; Bahar-Fuchs, Clare, & Woods, 2013)

COGNITIVE EXERCISE

COGNITIVE REHABILITATION

- individualized approach with functional goals, creates compensatory strategies

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(Clare et al., 2018; Bahar-Fuchs, Clare, & Woods, 2013)

COGNITIVE EXERCISE

COGNITIVE STIMULATION (CS)

COGNITIVE TRAINING (CT, CCT)

COGNITIVE REHABILITATION (CR)

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(Clare et al., 2018; Bahar-Fuchs, Clare, & Woods, 2013)

ACTIVITIES – COGNITIVE STIMULATION

Discussion of past and/or present events

Word games

Puzzles – crossword, word search, sudoku, jigsaw

Music

Board games

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ACTIVITIES – COGNITIVE STIMULATION

Indoor gardening

Creative activities – baking, crafting, sewing

Socialization

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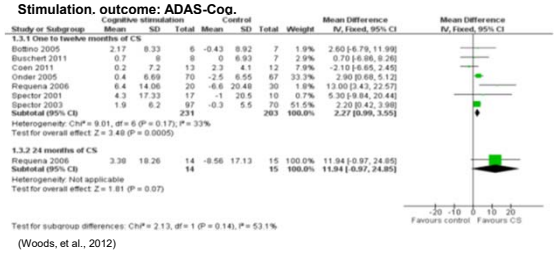
EVIDENCE FOR CS

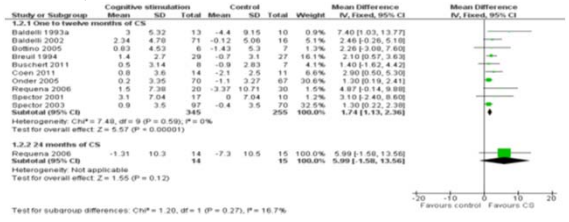
Figure 2. Forest plot of comparison: 1 Cognitive Stimulation vs No Cognitive Stimulation. outcome: ADAS-Cog.



(Woods, et al., 2012)

EVIDENCE FOR CS

Figure 3. Forest plot of comparison: 1 Cognitive Stimulation vs No Cognitive Stimulation, outcome: MMSE.



(Woods, et al., 2012)

ACTIVITIES – COGNITIVE TRAINING

Memory card games

Memorizing information/lists

Pattern detection games

Use of touch screens games to increase thinking speed

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ACTIVITIES – COGNITIVE TRAINING

Board games

Dance

Art

Music

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ACTIVITIES – COMPUTERIZED CT (CCT)

BrainHQ – Healthy older adults, ADHD, bipolar disease, depression, MCI, dementia, PD, MS, stroke, TBI

CogniFit – Healthy older adults, ADHD, depression, PD, stroke, PD, dyslexia, dyscalculia, insomnia, fibromyalgia

CogniPlus – Brain damage, ADHD, MCI

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(Irazoki et al., 2020; O'Shea et al., 2019)

ACTIVITIES – CCT

Cogmed – ADD, TBI, stroke, learning disorders, cognitive impairment

Luminosity – Healthy older adults

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(Irazoki et al., 2020; O'Shea et al., 2019)

EVIDENCE – CT MIDLIFE

Computerized Cognitive Training (CCT)

- Cognitive training group performed slightly better on reasoning (executive function)
- Control group performed slightly better on working memory
- No group difference on episodic memory

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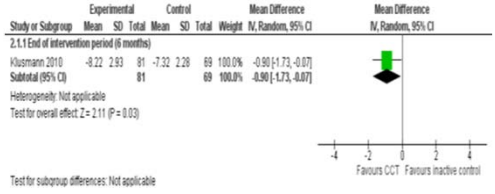
(Gates et al., 2019)

EVIDENCE – CT LATE LIFE

Figure 7. Forest plot of comparison: 2 Computerized cognition-based training versus inactive control, outcome: 2.1 Episodic Memory.



(Gates, et al., 2020)

EVIDENCE – CT MCI

CCT versus Active & Inactive Controls

1. None of the 8 trials examined development of dementia
2. No data to state that CT prevents dementia
3. Low quality evidence favoring CCT for improvement in global cognitive function, episodic memory, and working memory

(Gates et al., 2019)

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EVIDENCE – PREVENTION

CCT - MCI

1. No evidence that CCT prevents dementia
2. Improvement in visual and/or verbal episodic memory
3. Improvement in other cognitive domains

(O'Shea, De Wit, & Smith, 2019)

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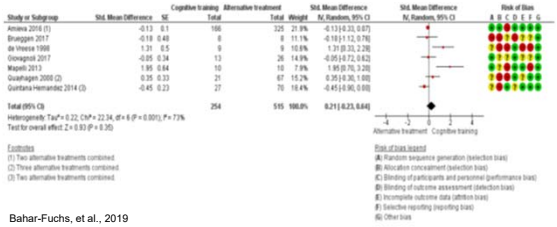
EVIDENCE – CT DEMENTIA

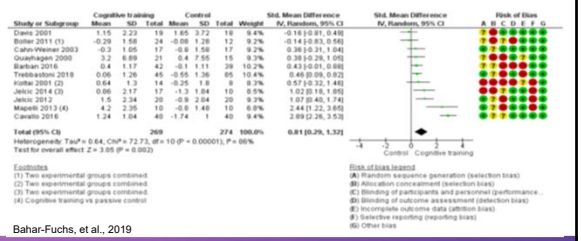
Figure 6. Forest plot of comparison: 3 Cognitive training vs alternative treatment immediately post intervention,



Bahar-Fuchs, et al., 2019

EVIDENCE – CT DEMENTIA

Figure 9. Forest plot of comparison: 1 Cognitive training vs control immediately post intervention, outcome: 1.6 Change in delayed memory.



Bahar-Fuchs, et al., 2019

EVIDENCE – CT EXERCISE

Simultaneous versus Sequential Exercise

1. Significant improvement in composite memory in SIM group
2. Executive function and reaction time improved in the SEQ group
3. Non-verbal abstract reasoning and complex attention in SIM group

(McEwen et al., 2018)

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EVIDENCE SUMMARY

1. CS, CT, or CCT does not prevent dementia
2. The evidence is mixed as to the effectiveness of CS, CT, or CCT in improving global and specific cognitive domains.
3. CS, CT, and CCT may offer some improvements in certain cognitive functions

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EVIDENCE SUMMARY

4. CS, CT, and CCT may offer some improvement in quality of life and ability to perform Activities of daily living for some individuals
5. Combining CS, CT, or CCT with aerobic exercise may offer a synergistic effect for improving certain cognitive functions

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EVIDENCE SUMMARY

6. There is no evidence to date for significant harm from CS, CT, CCT other than the cost of commercially available programs

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RECOMMENDATIONS

RESEARCH

1. There is a significant need for further research in this area:
    a. higher quality studies
    b. leveraging newer technologies i.e. virtual reality, artificial intelligence/machine learning

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RECOMMENDATIONS

CLINICAL

1. Healthy older people should be encouraged to participate in CS and CT activities despite the modest benefits
2. Those with subjective cognitive complaints and MCI should be encouraged to use CS and CT

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RECOMMENDATIONS

CLINICAL

3. Those with dementia should be encouraged to participate in CS programs
4. Brain health should be incorporated into the public health paradigm from a life span perspective beginning in childhood

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REFERENCES

Arenaza-Urquiljo, E. M., Bartres-Faz, D., Belleville, S., Cantillon, M., Chetelat, G., Clouston, S. A. P., ...Vuoksimaa, E. (2020). Whitepaper: Defining and investigating cognitive reserve, brain reserve, and brain maintenance. *Alzheimer's Dementia, 16,* 1305-1311. doi: 10.1016/j.jalz.2018.07.219

Bahar-Fuchs, A., Clare, L., & Woods, B. (2013). Cognitive training and cognitive rehabilitation for persons with mild to moderate dementia of the Alzheimer's or vascular type: A review. *Alzheimer's Research & Therapy, 5,* 1-14. doi: 10.1186/alzrt189

Bahar-Fuchs, A., Martyr, A., GohAMY, Sabates, J., & Clare,L. (2019). Cognitive training for people with mild to moderate dementia. *Cochrane Database of Systematic Reviews*, *3*. 1-287/ doi:10.1002/14651858.CD013069.pub2.

Clare, L., Teale, J.C., Toms, G., Kudlicka, A., Evans, I., Abrahams, S., ...Thompson-Coon, J. (2018). Cognitive rehabilitation, self-management, psychotherapeutic and caregiver support interventions in progressive neurodegenerative conditions: A scoping review. *NeuroRehabilitation, 43,* 443-471. doi: 10:3233/NRE-172353

Irazoki, E., Contreras-Somoza, L. M., Toribio-Guzman, J. M., Jenaro-Rio, C., van der Roest, H., & Franco-Martin, M. A. (2020). Technologies for cognitive training and cognitive rehabilitation for people with mild cognitive impairment and dementia: A systematic review. *Frontiers in Psychology, 11,* 1-15. doi: 10.3389/fpsyg.2020.00648

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REFERENCES

Gates, N.J., Vernooij, R. W. M., Di Nisio, M., Karim, S., March, E., Martínez, G., & Rutjes, A. W. S. (2019). Computerized cognitive training for preventing dementia in people with mild cognitive impairment. *Cochrane Database of Systematic Reviews , 3,* 1-103. doi: 10.1002/14651858.CD012279.pub2.

Gates, N. J., Rutjes, A. W. S., Di Nisio, M., Karim, S., Chong, L. Y. , March, E., Martínez, G., & Vernooij, R.W.M. (2019) Computerized cognitive training for maintaining cognitive function in cognitively healthy people in midlife. *Cochrane Database of Systematic Reviews*, *3.* doi: 10.1002/14651858.CD012278.pub2.

Gates, N.J., Rutjes, A. W. S., Di Nisio, M., Karim, S., Chong, L. Y., March, E., Martínez, G., & Vernooij, R.W.M. (2020). Computerized cognitive training for 12 or more weeks for maintaining cognitive function in cognitively healthy people in late life. *Cochrane Database of Systematic Reviews*, *2,* 1-104. doi: 10.1002/14651858.CD012277.pub3.

Koller, E. & Chakrabarty, P. (2020). Tau-mediated dysregulation of neuroplasticity and glial plasticity. *Frontiers in Molecular Neuroscience, 13,* 1-23. doi:10.3389/fnmol.2020.00151

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REFERENCES

McEwen, S. C., Siddarth, P., Abedelsater, B., Kim, Y., Mui, W., Wu, P., ...Merrill, D. A. (2018). Simultaneous aerobic exercise and memory training program in older adults with subjective memory impairments. *Journal of Alzheimer's Disease, 62,* 795-806. doi: 10.3233/JAD-170846

Nelson, M. E., Jester, D. J., Petkus, A. J., & Andel, R. (2021). Cognitive reserve, Alzheimer's neuropathology, and risk of dementia: A systematic review and meta-analysis. *Neuropsychology Review, 31,* 233-250. doi: 10.1007/s11065-021-09478-4

Schoentgen, B., Gagliard, G., & Defontaines, B. (2020). Environmental and cognitive enrichment in childhood as protective factors in the adult and aging brain. *Frontiers in Psychology, 11,* 1-11. doi: 10.3389/fpsyg.2020.01814

O'Shea, D. M., De Wit, L., & Smith, G.. E. (2019). Doctor, should I use computer games to prevent dementia? *Clinical Gerontologist, 42,* 3-16. doi: 10:1080/07317115.2017.1370057

Stern, Y. (2021). How can cognitive reserve promote cognitive and neurobehavioral health? *Archives of Clinical Neuropsychology, 36,* 1291-1295. doi: 10.1093/arclin/acab049

Stern, Y., & Barulli, D., (2019). Cognitive reserve. In S. T. DeKosky & S. Asthana (Eds.), *Handbook of Clinical Neurology,* (pp. 181-190). doi: 10.1016/B978-0-12-804766-8.00011-X

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REFERENCES

Voss, P., Thomas, M. E., Cisneros-Franco, M., & de Villers-Sidani, E. (2017). Dynamic brains and the changing rules of neuroplasticity: Implications for learning and recovery. *Frontiers in Psychology, 8*, 1-11. doi: 10.3389/fpsyg.2017.01657

Woods, B., Aguirre, E., Spector, A.E., & Orrell, M. (2012). Cognitive stimulation to improve cognitive functioning in people with dementia. *Cochrane Database of Systematic Reviews*, *2*, 1-72. doi:10.1002/14651858.CD005562.pub2.

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