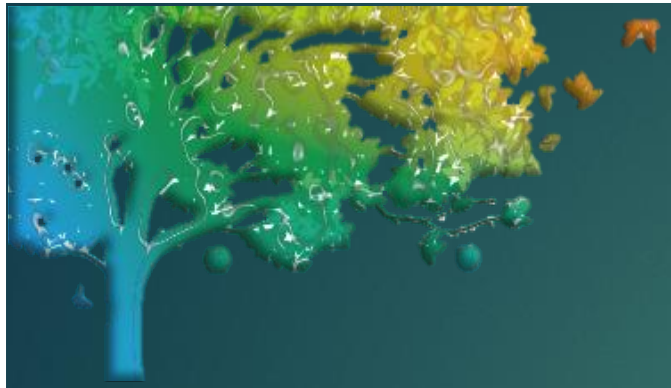

Cognitive Rehabilitation Devices in Ischemic Stroke Therapy

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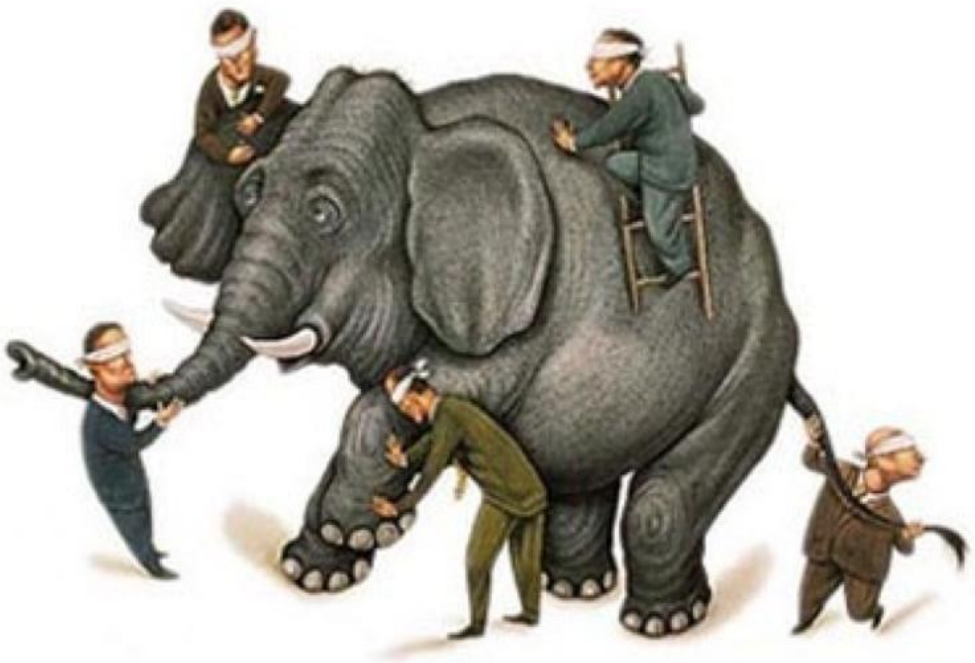
Neurosciences Research Center
Tabriz University of Medical Sciences

2022

Stroke



Neurosciences Research Center
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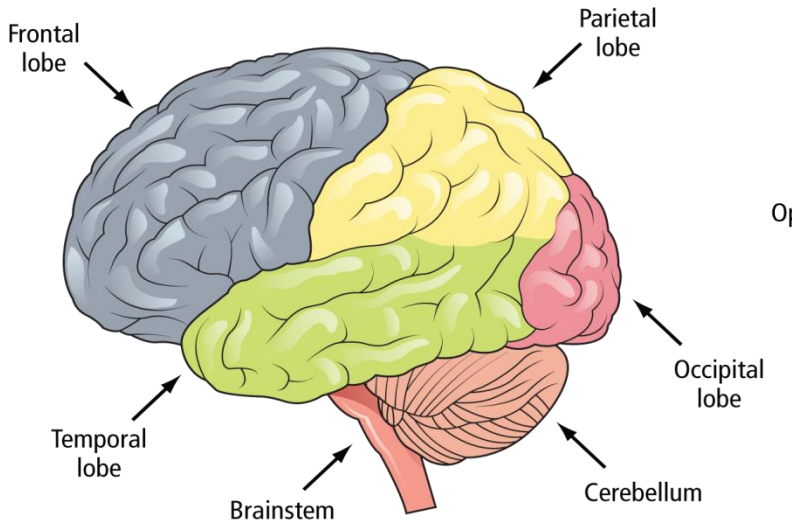
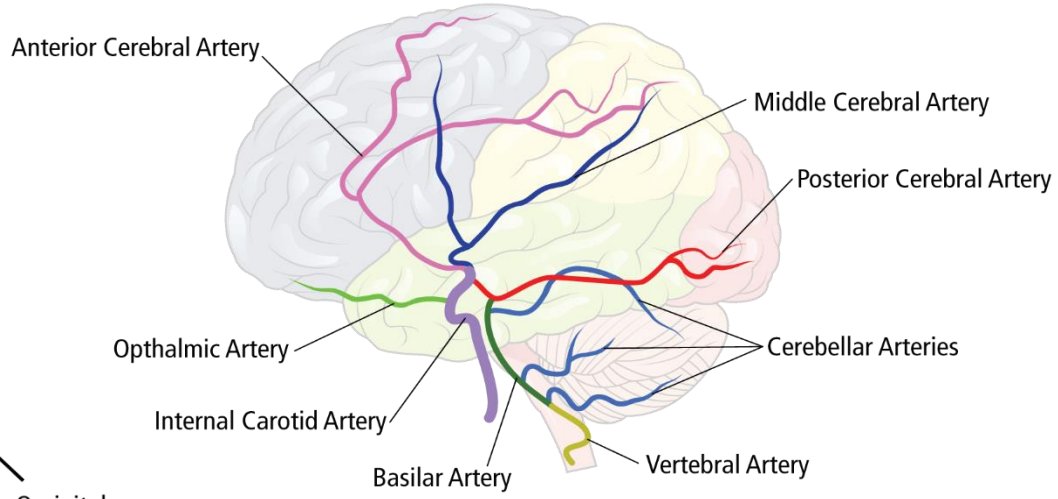
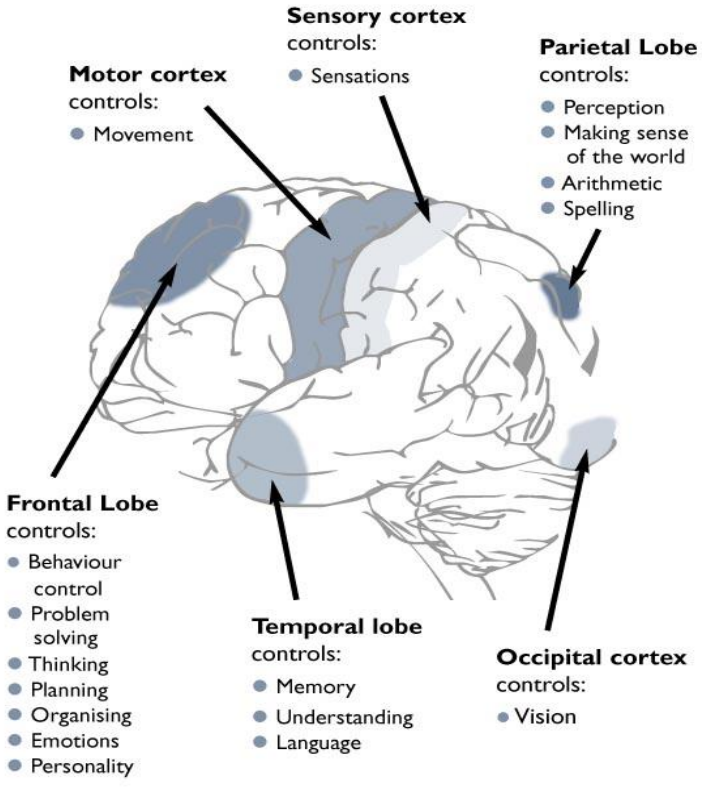
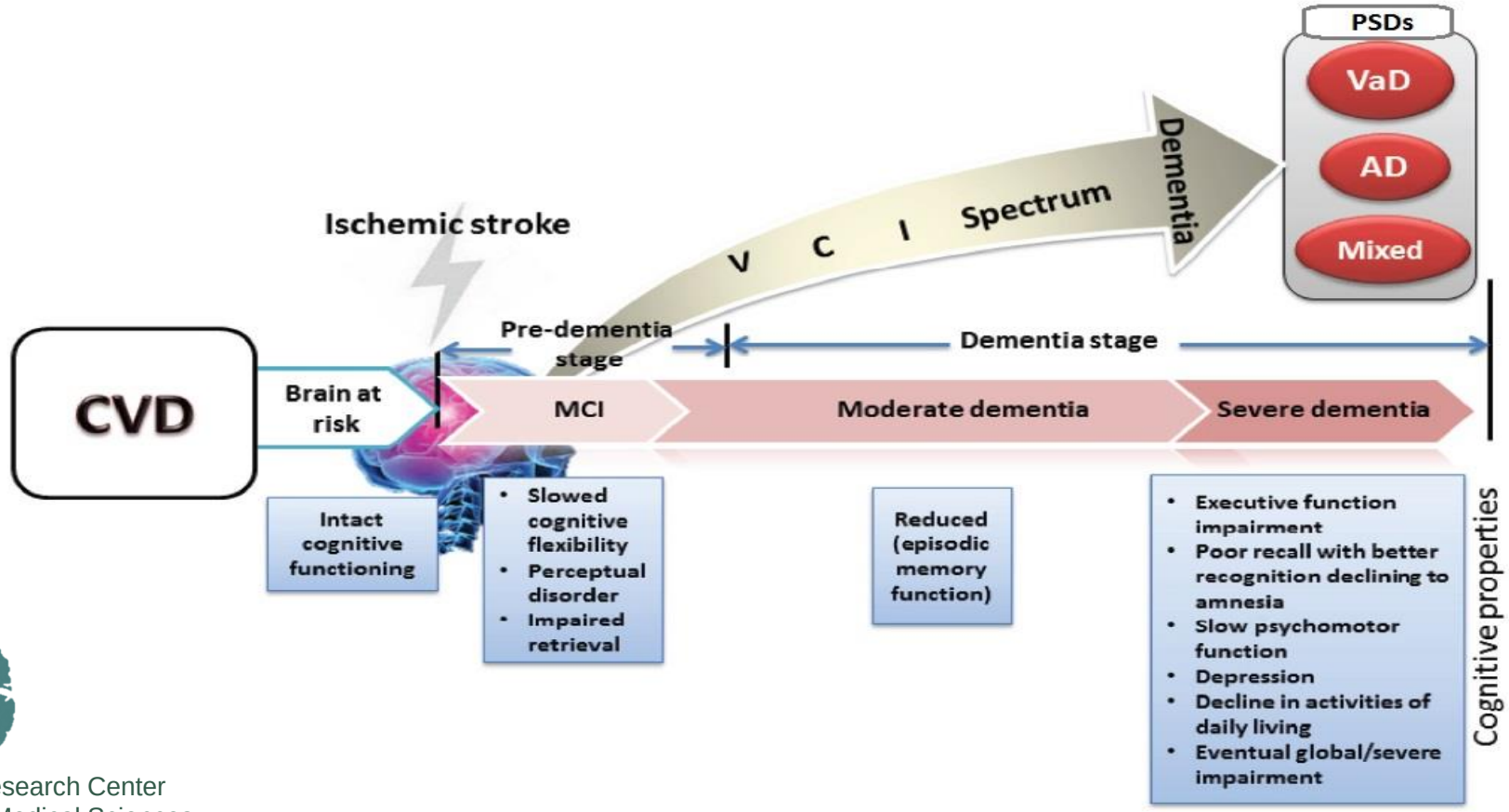
Brain Anatomy & Cognitive Impairments







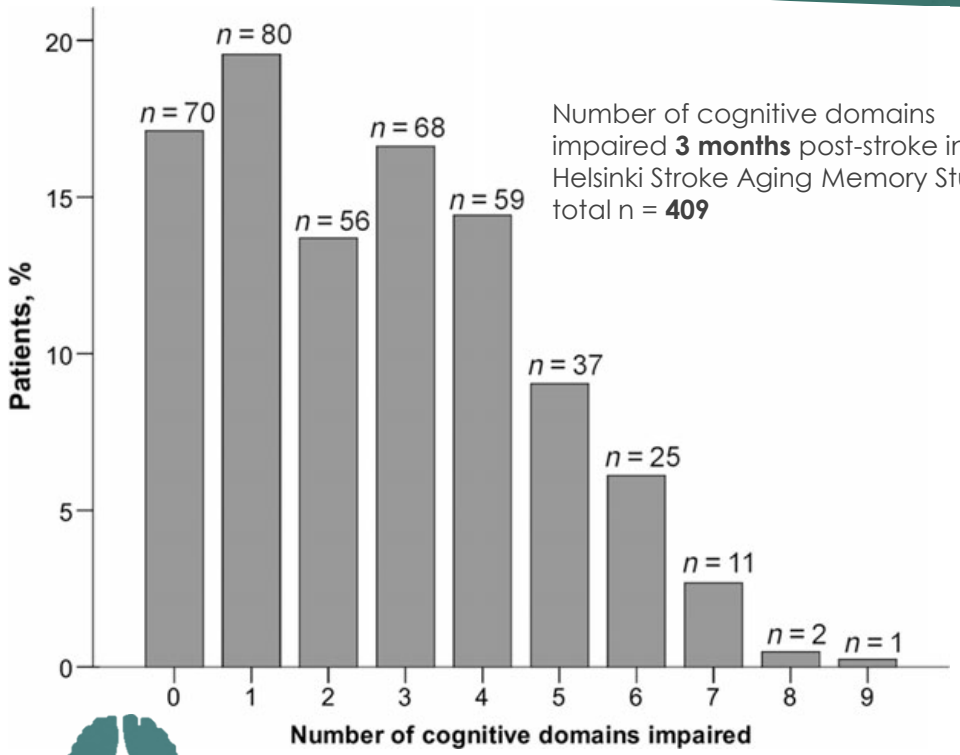
Vascular Cognitive Impairment Progress



Stroke & Cognitive Impairments

- Up to two-thirds of stroke survivors have a cognitive deficit after the stroke.
- Approximately one-third of those develop dementia.
- Only 16 to 20% of stroke survivors with cognitive impairment improve.

Cognitive Impairment Rate



Number of cognitive domains impaired **3 months** post-stroke in the Helsinki Stroke Aging Memory Study; total n = **409**

Post-stroke cognitive impairment is common even after successful clinical recovery, European journal of neurology, 2015, al., Jokinen, et.

Cognitive domain	*n* (%) All patients *n* = 409	Patients with mRS = 0–1 *n* = 152
Memory functions	227 (60)	77 (52)
Visuoconstructional and spatial functions	216 (55)	54 (36)
Executive functions and attention	181 (49)	52 (34)
Aphasia	114 (29)	23 (15)
Reading and writing	112 (30)	16 (11)
Abstract reasoning	106 (29)	26 (17)
Arithmetic	71 (20)	12 (8)
Neglect	29 (8)	2 (1)
Agnosia	13 (3)	1 (1)

Frequencies of impairment in each cognitive domain in the whole cohort and in a subgroup of patients with **excellent clinical recovery (mRS = 0–1)** 3 months after ischemic stroke in the Helsinki Stroke Aging Memory Study

The Nature of Cognitive Impairment Post Stroke

Attention	•Focus attention, sustained attention, selective attention, divided attention
Memory	•Visual memory, auditory memory, working memory, eispodic memory, semantic memory, working memory, procedural memory
Executive Function	•Initiation, processing speed, problem solving, planning
Perception, praxis	•Visuo-spatial, visuo-perceptual, Unilateral neglect, inattention, apraxia, agnosia, prosopagnosia
Language	•Aphasia: Broca's, Wernicke's,transcortical motor/sensory or mixed, conductive, global

Assessment of Cognitive Impairment Post Stroke

- **Mini-Mental Screening Evaluation (MMSE):** attention, calculation, recall, language, ability to follow simple commands, orientation
- **Montreal Cognitive Assessment (MoCA)**
- **Clock-Drawing Test (CDT):** visuospatial, praxis, attention
- **Addenbrooke's cognitive examination (ACE-R):** attention, memory, verbal fluency, language and visual- spatial orientation.
- **Stroke Impact Scale (SIS):** hand function, memory, emotion, mobility, communication and social participation.
- **Domain-Specific Neuropsychological Tests**
- **CANTAB**

Cognitive rehabilitation interventions aims

1. Reinforce, strengthen or **re-establish previously learned patterns of behavior.**

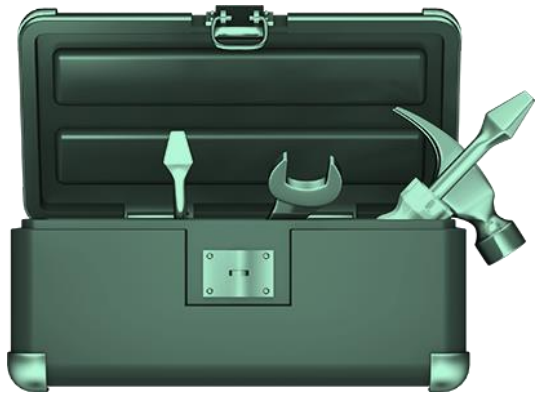
2. Establish new patterns of cognitive activity through **internal compensatory cognitive mechanisms** for impaired neurological systems.

3. Establish new patterns of activity through **external compensatory mechanism** such as external aids, or environmental structuring and support.

4. **Enable persons to adapt** to their cognitive disability.

Rehabilitation toolbox

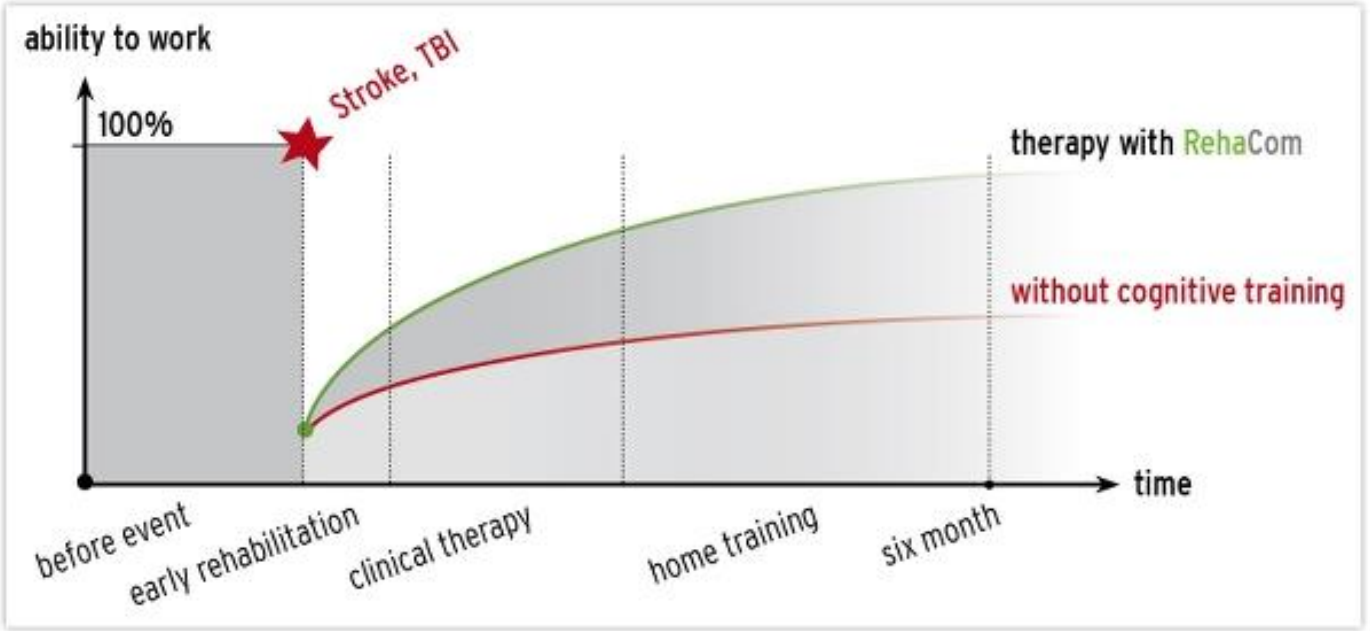
- **Pharmacological agents** → **Medical intervention**
- **Paper and pencil tools** → **Traditional tools**
- **Mental Imagery** → **Traditional tools**
- **Software and games** → **Novel tools**
- **Virtual reality** → **Novel tools**
- **Repetitive transcranial magnetic stimulation (rTMS)** → **Novel tools**
- **Transcranial direct-current stimulation (tDCS)** → **Novel tools**
- **Neurofeedback** → **Novel tools**
- **Acupuncture** → **Novel tools**



Software and games

Commercial approved and available Software

Software and games



Commercial approved and available Software

Software and games

- Problem-solving
- Working memory
- Divided attention
- Flexibility

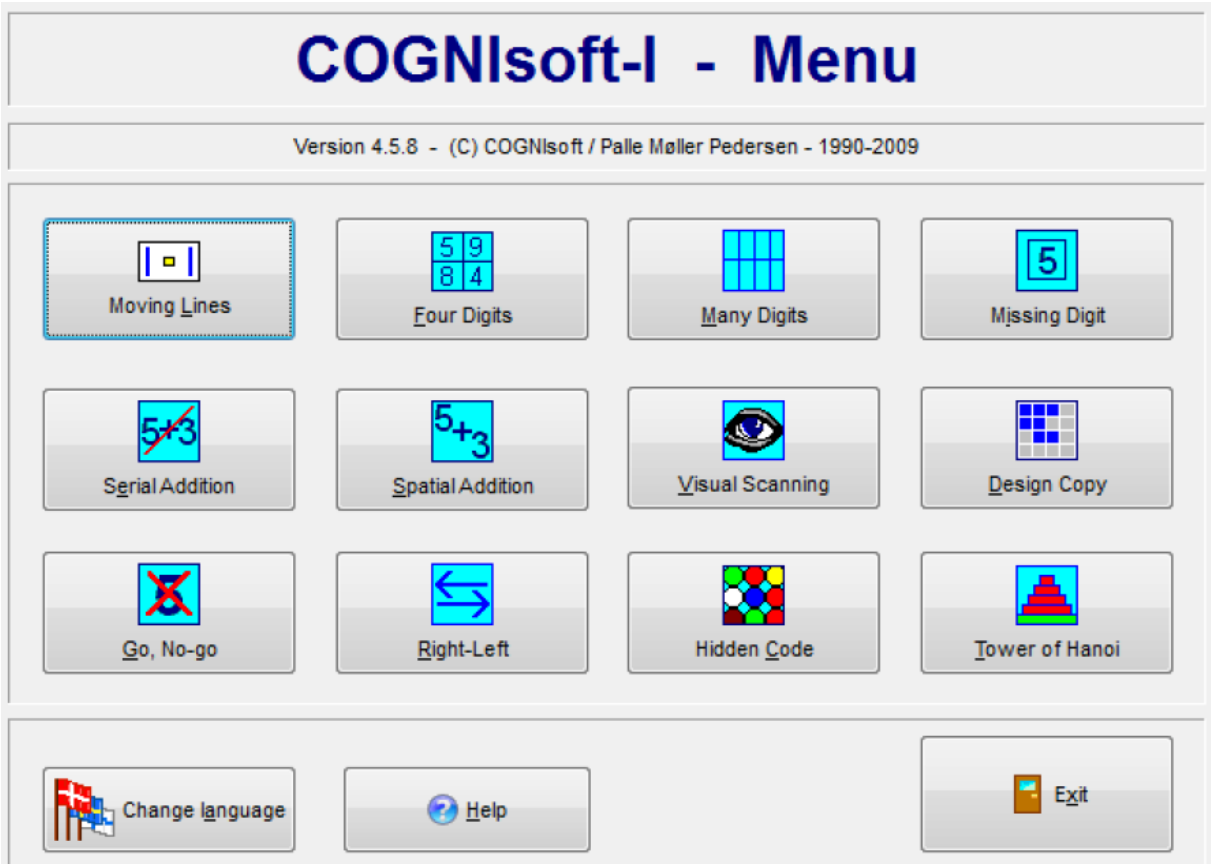
Commercial approved and available Software

Software and games

Targeting the specific areas of attention

Commercial approved and available Software

Software and games



Study-dependent designed software

Software-based Cognitive Rehabilitation

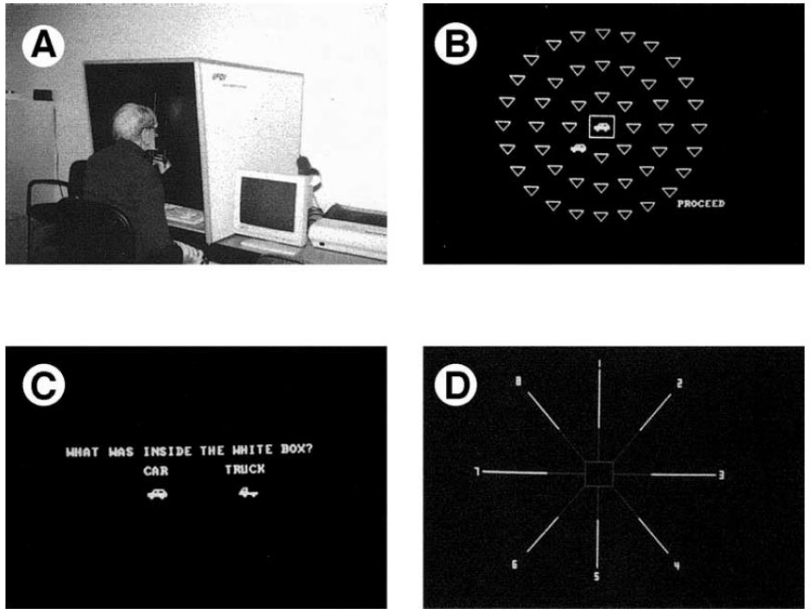
Lin, Z., Tao, J., Gao, Y., Yin, D., Chen, A., and Chen, L. (2014). Analysis of central mechanism of cognitive training on cognitive impairment after stroke: Resting-state functional magnetic resonance imaging study. *J. Int. Med. Res.* 42, 659–668

Lin et al., 2014	Stroke, post-acute (6–10 m) with EF and memory deficit	*N* = 34: IG = 16 pCG = 18	RehaCom software package (EF, memory)	1 h, 6 d/w, 10 w = 60 h (unkn.)	Rehab.?	WMS:		
						Information	–	–
						Orientation	–	–
						Mental control	–	+
						Logical memory	–	+
						Digits forward and backward	–	±
						Visual reprod.	–	+
						Assoc. learning	–	+
						Memory quotient	–	+

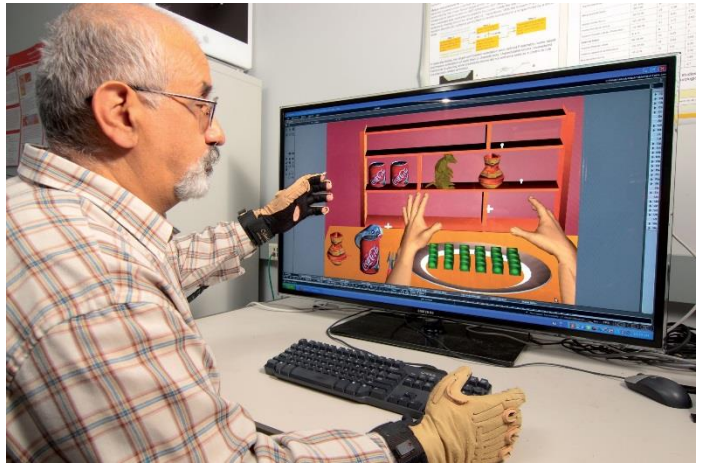
Software-based Cognitive Rehabilitation

Prokopenko, S. V., Mozheyko, E. Y., Petrova, M. M., Koryagina, T. D., Kaskaeva, D. S., Chernykh, T. V., et al. (2013). Correction of post-stroke cognitive impairments using computer programs. *J. Neurol. Sci.* 325, 148–153.

Prokopenko et al., 2013	Stroke, acute—post-acute (<2 w) with mild cognitive impairments to mild dementia	*N* = 43: IG = 24 CAU = 19	Neuropsychological computer training (sustained, selective, divided, and alternating att.)	30 min, 7 d/w, 2 w = 15 h (unkn.)	Rehab.	Schulte's tables	±	±
						Clock drawing	−	±
						MMSE	−	±
						MoCA	±	±

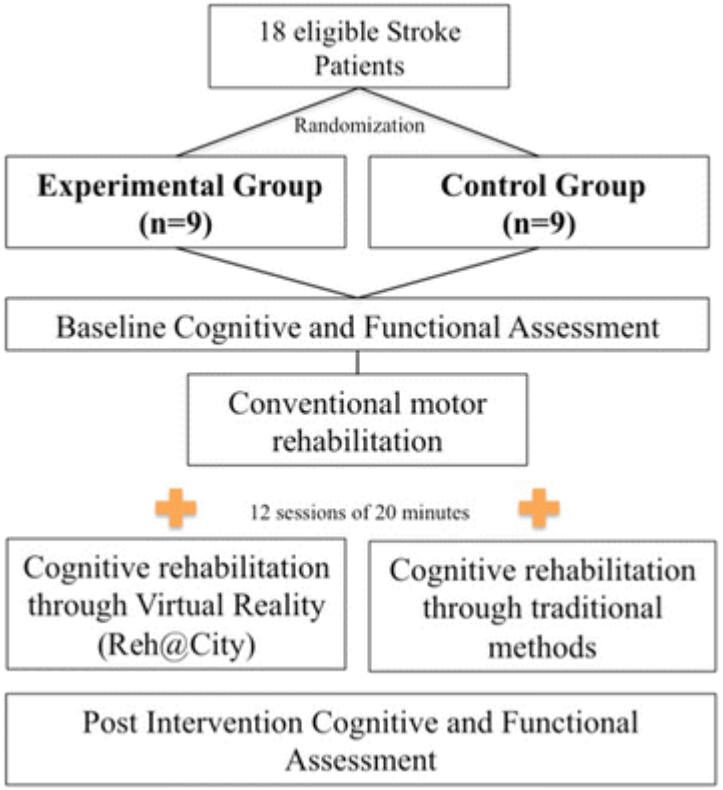


Virtual reality



Virtual reality-based Cognitive Rehabilitation

Faria, Andrade, Soares, Badia. Benefits of virtual reality based cognitive rehabilitation through simulated activities of daily living: a randomized controlled trial with stroke patients Journal of Neuro Engineering and Rehabilitation (2016) 13:96

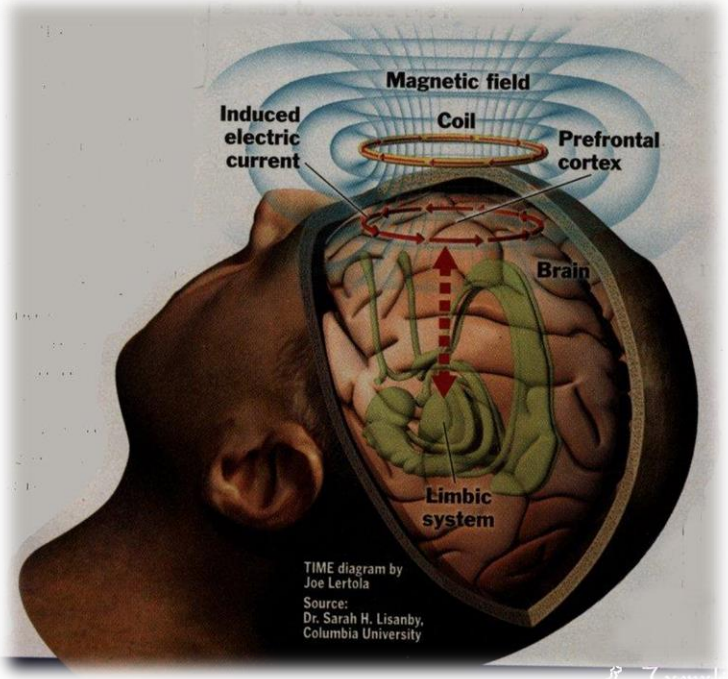


Virtual reality-based Cognitive Rehabilitation

	Experimental ($n = 9$)				Control ($n = 9$)					
	Pre	Post	*W*	*p*	Pre	Post	*W*	*p*	*MW*	*p*
ACE-Total	72 (61–75.5)	81 (68–86.5)	44.000	**.011**	66 (54.5–81)	69 (58–78)	24.000	.398	13.500	**.014**
MMSE	23 (20.5–26)	29 (25–29)	34.000	**.025**	23 (20.5–26)	26 (21–26.5)	28.500	.136	18.000	**.050**
ACE-Attention	15 (14–16.5)	18 (16.5–18)	28.000	**.018**	14 (12–16.5)	16 (12.5–17)	13.500	.518	17.500	**.040**
ACE-Memory	15 (13–18)	18 (15–21.5)	28.000	**.017**	18 (11–19.5)	18 (12.5–21)	11.000	.336	23.000	.136
ACE-Fluency	5 (2.5–6)	6 (4–7.5)	27.000	.196	6 (4–8)	5 (2.5–5.5)	2.500	**.027**	13.000	**.014**
ACE-Language	22 (21.5–23)	24 (21–26)	33.500	.191	19 (16–22)	21 (17–24.5)	22.000	.168	32.500	.489
ACE-Visuo-spatial	12 (7.5–14.5)	14 (13–15)	28.000	**.017**	12 (7.5–13.5)	14 (7–15.5)	16.000	.246	26.500	.222

$p < .05$ is indicated in bold

Repetitive transcranial magnetic stimulation (rTMS)

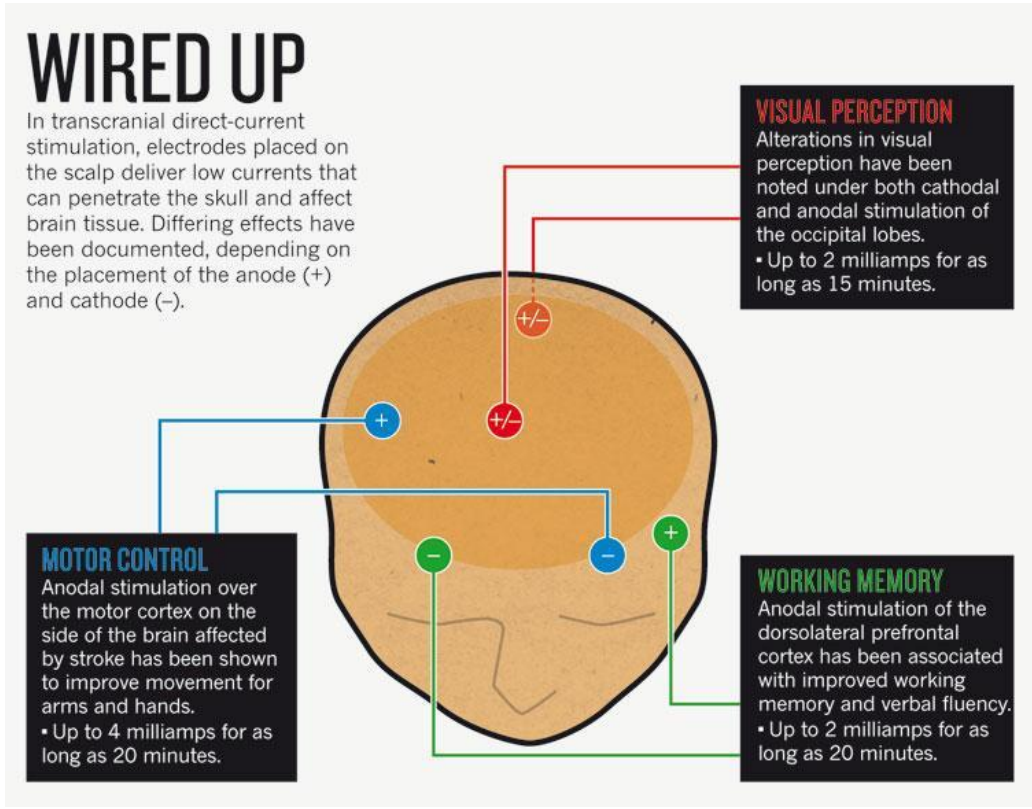


rTMS-based Cognitive Rehabilitation

Park and Yoon, The effect of computer-assisted cognitive rehabilitation and repetitive transcranial magnetic stimulation on cognitive function for stroke patients, 2015, J. Phys. Ther. Sci. 27: 773–776.

Material	Intervention	Before	After
		Mean±SD	Mean±SD
K-MMSE	rTMS (n=10)**	17.90 ± 2.470	19.50 ± 2.369
	Cogrehab (n=10)**	18.00 ± 1.886	20.30 ± 2.058

Transcranial direct-current stimulation (tDCS)



tDCS-based Cognitive Rehabilitation

Yun, Chun, Kim, The Effects of Transcranial Direct-Current Stimulation on Cognition in Stroke Patients, Journal of Stroke 2015;17(3):354-358.

Left fronto-temporal anode stimulation

current intensity 2 mA, for 30 minutes

A 3-week program

tDCS-based Cognitive Rehabilitation

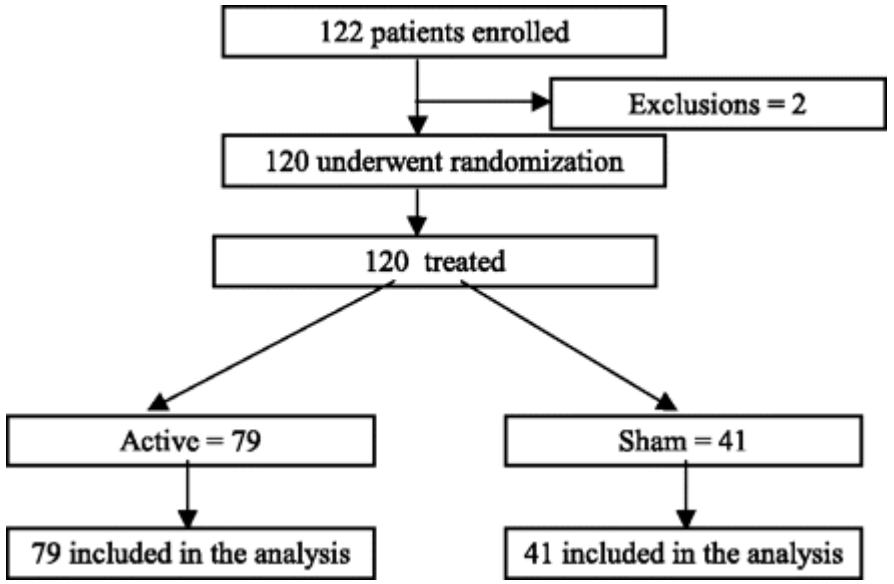
	Left-FTAS	
	Before	After
K-MMSE	20.1±4.8	23.9±3.0*
FDST	4.6±1.4	5.0±1.2
BDST	2.8±0.9	3.0±0.9*
FVST	3.3±0.5	3.6±0.8*
BVST	2.6±1.2	3.3±1.4
ViLT-R	32.6±17.0	36.7±15.7
VeLT-R	16.1±11.2	27.6±14.3*
VCPT (second)	0.5±0.1	0.5±0.1
ACPT (second)	0.7±0.1	0.6±0.2
K-MBI	59.0±22.7	68.7±21.2*

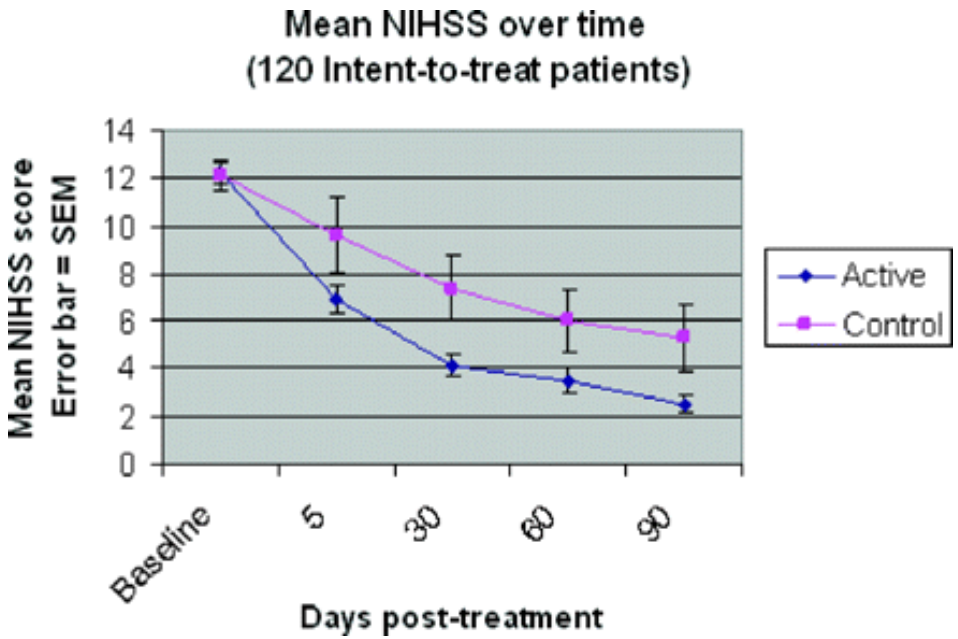
K-MMSE, Korean version of the Mini-Mental State Examination *
FDST, forward digit span test
BDST, backward digit span test *
FVST, forward visual span test *
BVST, backward visual span test
ViLT-R, visual learning test-delayed recall
VeLT-R, verbal learning test-delayed recall *
VCPT, visual continuous performance test
ACPT, auditory continuous performance test
K-MBI, Korean version of the modified Barthel Index *

Photo bio-modulation based Cognitive Rehabilitation

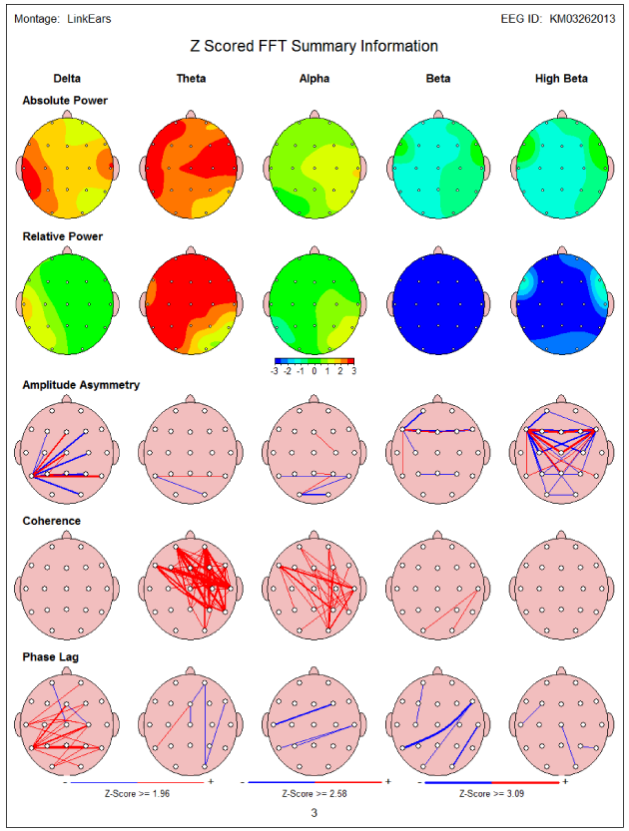
Photo bio-modulation based Cognitive Rehabilitation

Lampl, Yair, et al. "Infrared laser therapy for ischemic stroke: A new treatment strategy." *Stroke*38.6 (2007): 1843-1849.





Neurofeedback



Neurofeedback-based Cognitive Rehabilitation

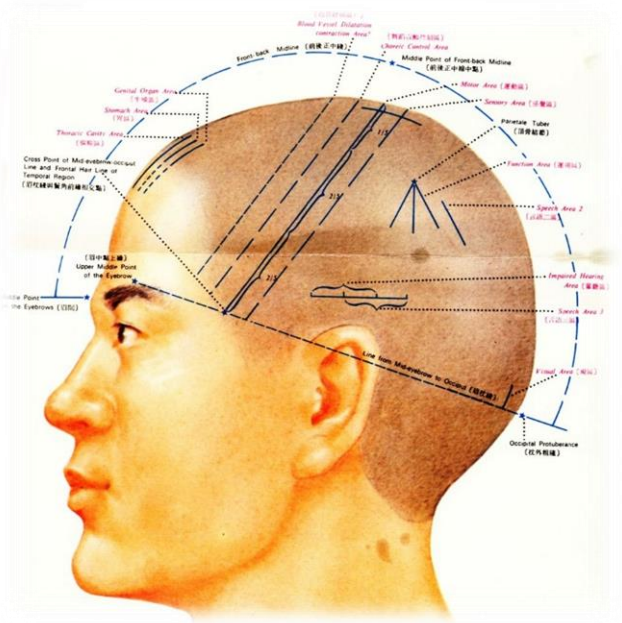
Cho, Kim, Jung, Effects of neurofeedback and computer-assisted cognitive rehabilitation on relative brain wave ratios and activities of daily living of stroke patients: a randomized control trial, 2016, J. Phys. Ther. Sci. 28: 2154–2158,

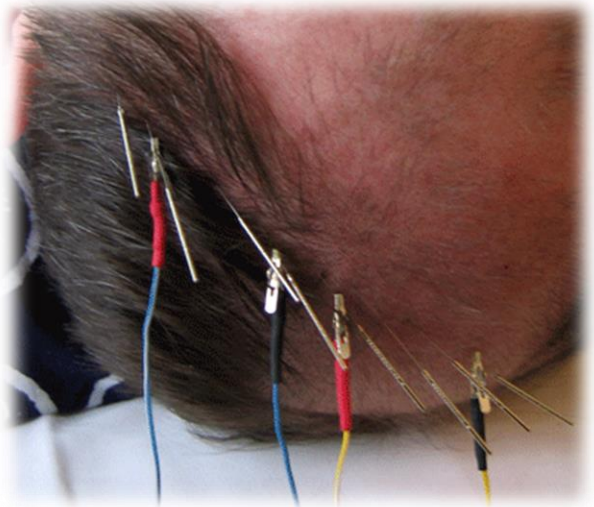
FIM	NFB		CACR	
	pre	post	pre	post
Motor	58.0 ± 13.1	59.6 ± 13.1**	54.6 ± 18.6	56.9 ± 17.6***
Cog	24.4 ± 5.2	25.8 ± 4.5**	24.5 ± 5.3	25.4 ± 5.2***
Total	82.4 ± 17.6	85.5 ± 16.2***	79.1 ± 21.8	82.3 ± 21.0***

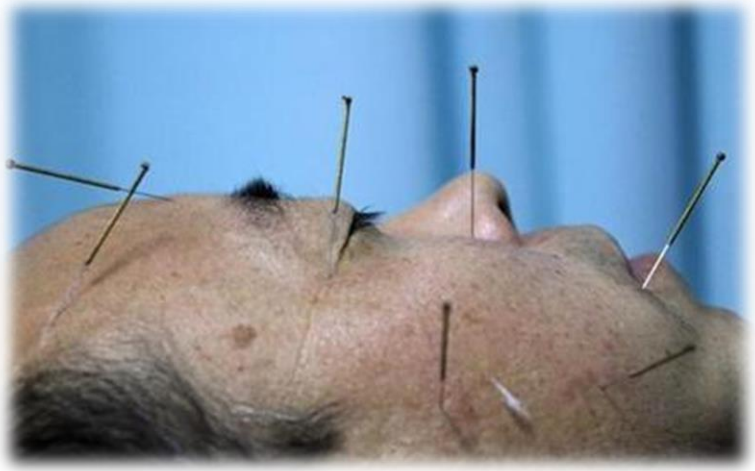
Comparison of activities of daily living (ADL) of the groups

NFB: neurofeedback training group,
CACR: computer assisted cognitive rehabilitation training group,
FIM: functional independent measure,
Motor: motor subscale score,
Cog: cognition subscale score,
Total: functional independent measure total score.

Acupuncture







Acupuncture-based Cognitive Rehabilitation

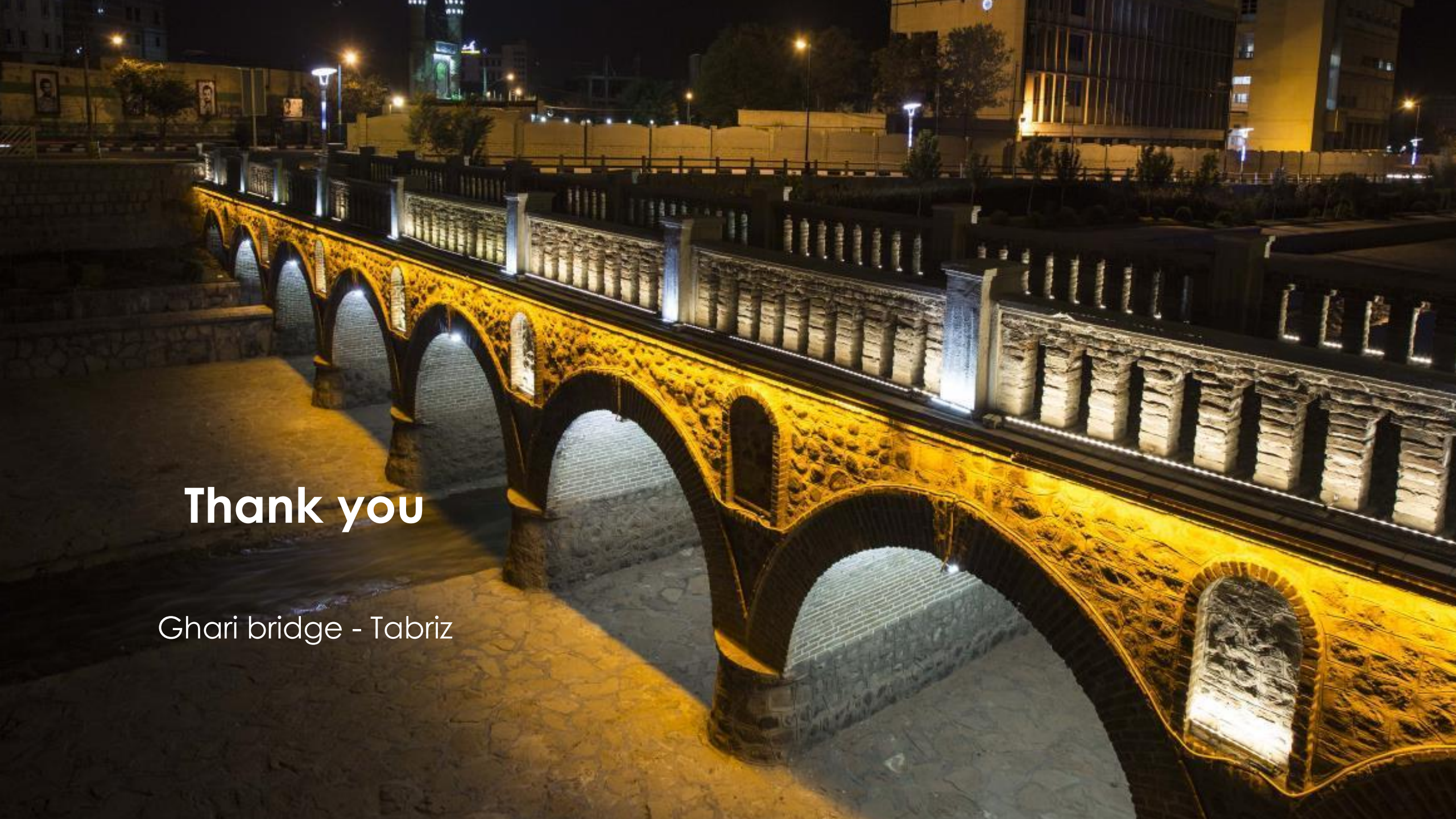
Dependent Variables	Source of Variation	SS	df	Mean Square	F	P
△ MMSE	Acupuncture	187.334	1	187.334	112.824	.000
	RehaCom	147.750	1	147.750	88.984	.000
	Acup * Reha	10.380	1	10.380	6.251	.013
△ MoCA	Acupuncture	179.662	1	179.662	123.745	.000
	RehaCom	167.951	1	167.951	115.679	.000
	Acup * Reha	7.247	1	7.247	4.991	.027
△ FIM	Acupuncture	509.116	1	509.116	61.220	.000
	RehaCom	477.784	1	477.784	57.452	.000
	Acup * Reha	52.537	1	52.537	6.317	.013

Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), and Functional Independence Measure (FIM)

Jiang, Yang, Tao, Huang, Li, Ye, Chen, Hong, Chen, Clinical Efficacy of Acupuncture Treatment in Combination With RehaCom Cognitive Training for Improving Cognitive Function in Stroke: A 2 2 Factorial Design Randomized Controlled Trial, JAMDA 17 (2016) 1114e1122

Final notes

- Ischemia severity
- In period of 1-12 weeks
- Good cognitive assess tools
- Using appropriate cognitive rehabilitation tools (computer based techniques are common)



Thank you

Ghari bridge - Tabriz