

Prism Adaptation Treatment for Improving Functional Vision and Functional Movements in Patients with Spatial Neglect

Peii Chen, PhD

Senior Research Scientist, Kessler Foundation

Research Associate Professor
Physical Medicine & Rehabilitation
Rutgers New Jersey Medical School

Disclosure

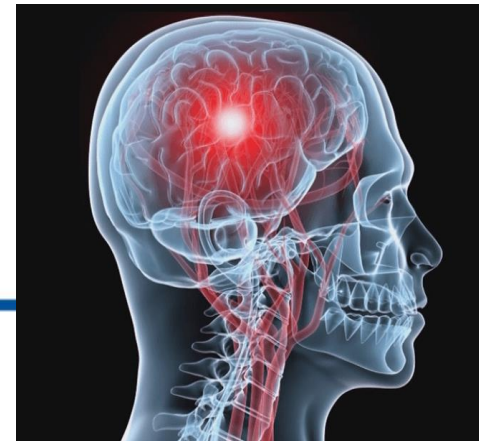
- Employed by the Kessler Foundation
- Funded by the New Jersey Commission on Brain Injury Research (CBIR17PIL021) and the National Institute on Disability, Independent Living and Rehabilitation Research (90SFGE0001 & 90IFDV0001) – *funding does not imply federal endorsement.*
- The developer of the Kessler Foundation Neglect Assessment Process (KF-NAP®) and the Kessler Foundation Prism Adaptation Treatment (KF-PAT®).
- The inventor on the US pending patent (No. 14/278,776) related key components of the KF-PAT portable kit.
- Receives no financial benefit from sales related to KF-NAP or KF-PAT
- The content creator and editor of the following websites
 - Network for Spatial neglect (kesslerfoundation.org/researchcenter/stroke/networkforspatialneglect.php)
 - Kessler Foundation Learning Center (www.kflearn.org)

Objectives

- To understand the ramifications of spatial neglect and how it impairs functional vision and functional movement, describe the clinical impact of spatial neglect
- To learn the principles of prism adaptation treatment for spatial neglect
- To determine the benefits of using prism adaptation treatment to treat patients with spatial neglect

Background

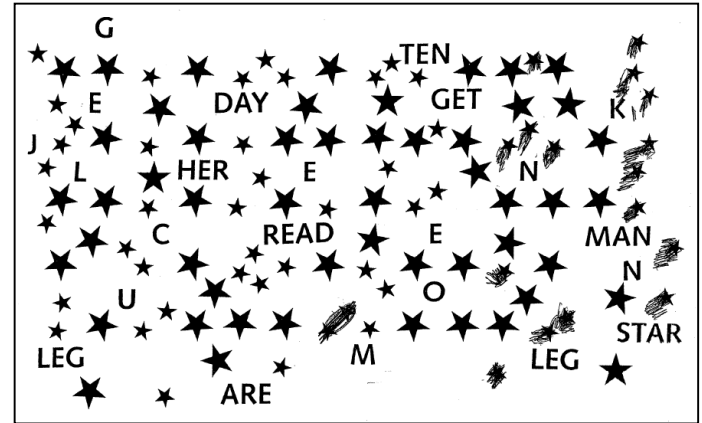
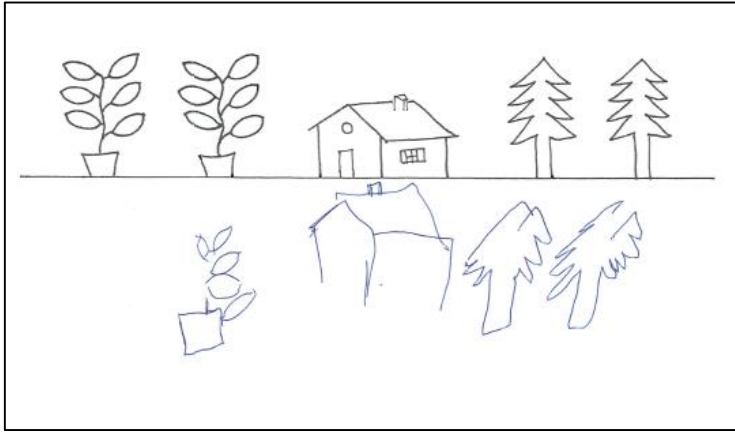
- Every year more than **795,000 Americans** have a stroke, and more than 80% survive the stroke.
- An estimated **7.2 million** American adults are **stroke survivors**. This number is likely to increase because the population is aging, and the stroke survival rate is improving.
- However, regaining functional independence after stroke can take years. One factor prolonging this recovery significantly is **spatial neglect**.
- **Spatial neglect** occurs in 50% of stroke patients and 30% of TBI patients in the **inpatient rehabilitation facility (IRF)** setting.



(video here)

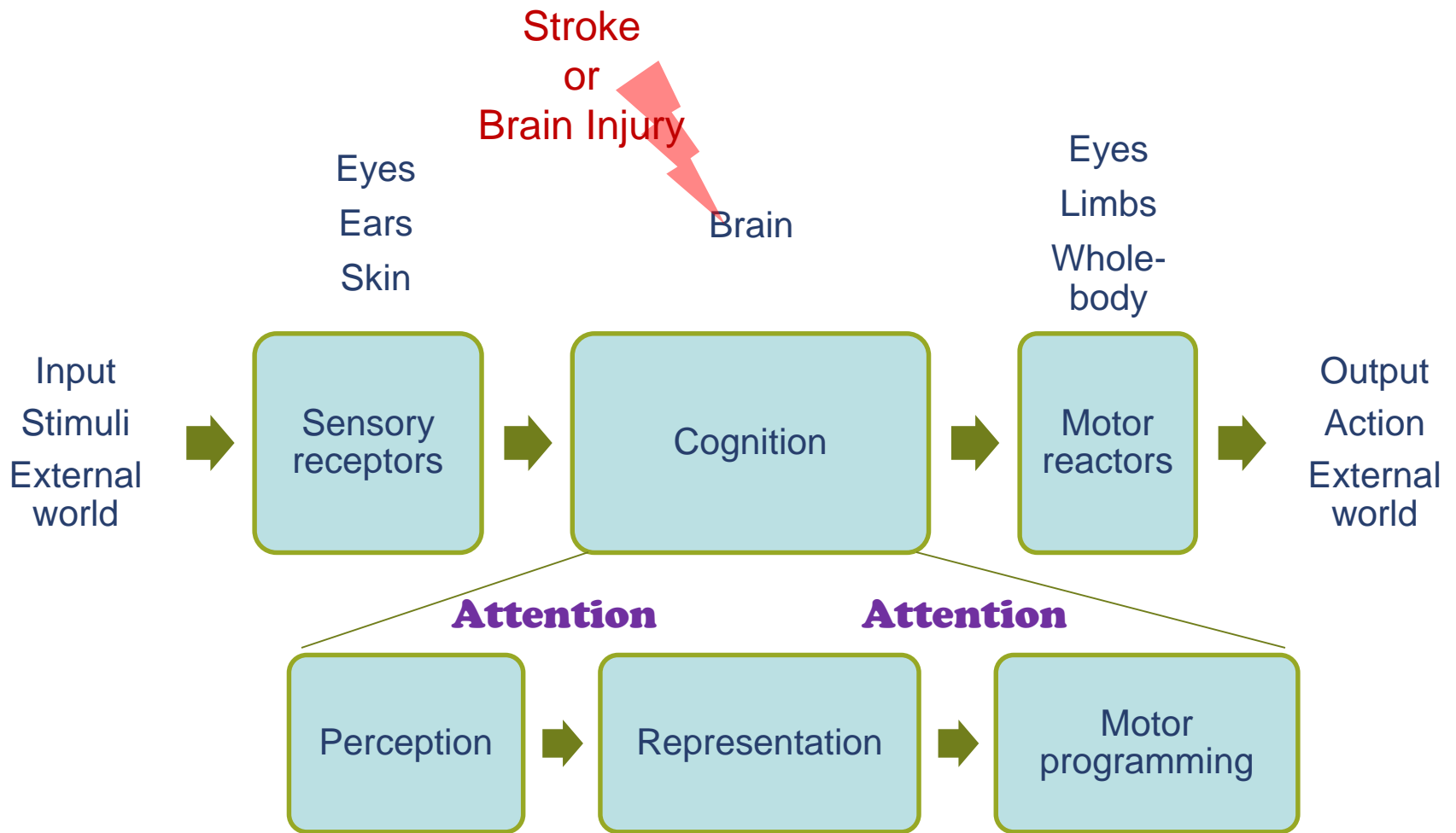
Spatial Neglect:

A syndrome of impaired spatial attention

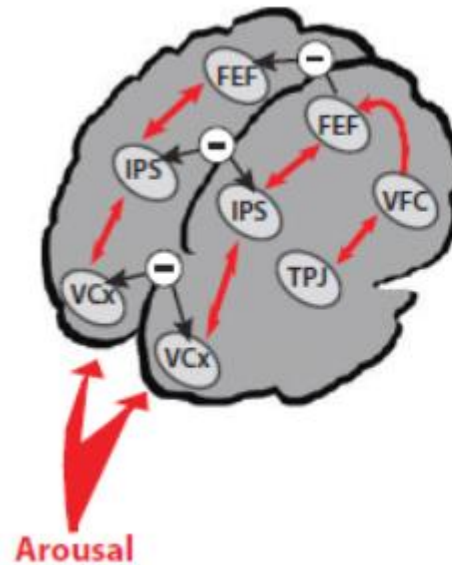
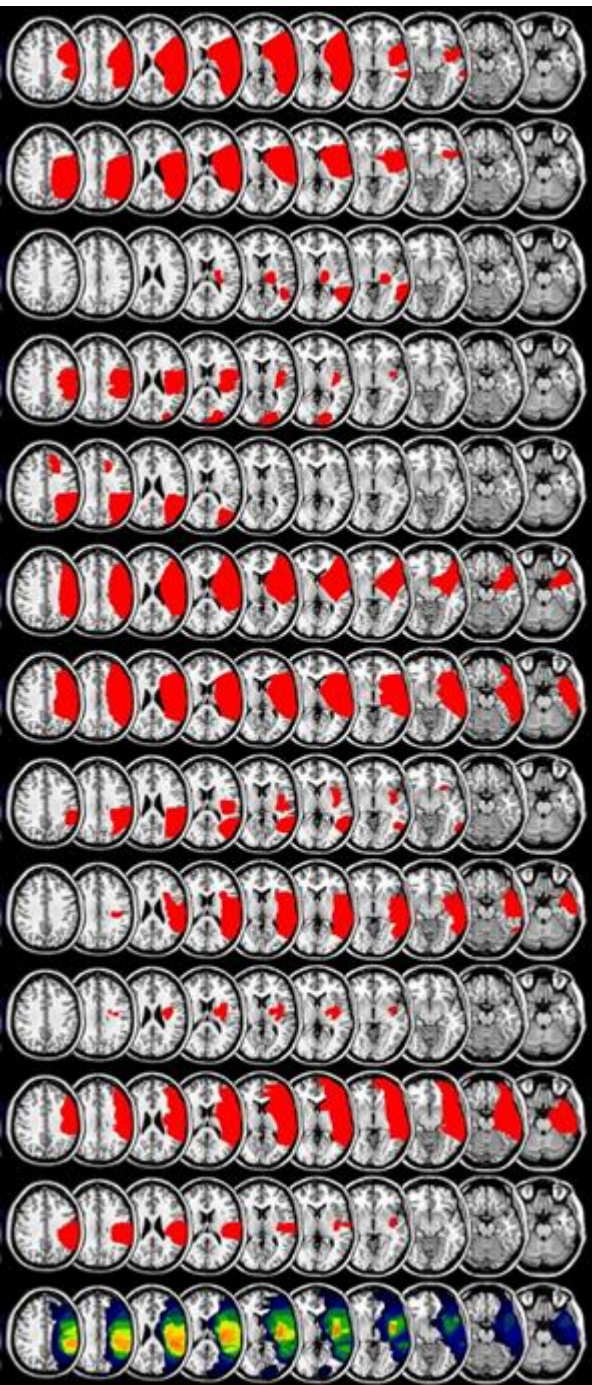


One of the most popular and respected actors of our time, Christopher Walken, has been in over a hundred films. Just to name a few: King of New York, The Dead Zone, At Close Range, and The Deer Hunter. He is best known for being able to portray the most intimidating characters and delivering performances with an edge of danger. Before he got his start in Hollywood, he spent his teenage years performing with a traveling circus. He acted out performances with the owner of the circus who did various lion taming tricks. But Walken can't exactly be called a lion tamer. As part of the act, he pretended to be the son of the circus owner, who did most of the actual lion taming. When the tamer was done performing tricks with several lions, he would leave Walken to face one lion on his own. Walken could easily make this lion do tricks by cracking a whip. While his lion taming act was mostly for show, spending his teenage years around lions may have helped harden him for his later roles as various dangerous men.





Spatial neglect is a disorder of spatial attention, affecting ... spatial perception (visual, auditory, tactile, proprioception), spatial representation (spatial memory, mental imagery), and motor control (directional movement, mobility).



Corbetta, M., & Shulman, G. L. (2011). Spatial neglect and attention networks. *Annu Rev Neurosci*, 34, 569-599. doi: 10.1146/annurev-neuro-061010-113731



Thiebaut de Schotten, M., Tomaiuolo, F., Aiello, M., Merola, S., Silvetti, M., Lecce, F., . . . Doricchi, F. (2014). Damage to white matter pathways in subacute and chronic spatial neglect: A group study and 2 single-case studies with complete virtual in vivo tractography dissection. *Cerebral Cortex*, 24(3), 691-706. doi: 10.1093/cercor/bhs351

Goedert, K. M., Chen, P., Boston, R. C., Foundas, A. L., & Barrett, A. M. (2014). Presence of motor-intentional aiming deficit predicts functional improvement of spatial neglect with prism adaptation. *Neurorehabilitation and Neural Repair*, 28(5), 483-492. doi: 10.1177/1545968313516872

Impact of Spatial Neglect

- Prolonged hospitalization
 - Poor rehabilitation outcome
 - Higher risk of in-hospital falls
 - Less likely returning home after inpatient rehab
- True for both stroke and TBI
- Chen, P., Ward, I., Khan, U., Liu, Y., & Hreha, K. (2016). Spatial neglect hinders success of inpatient rehabilitation in individuals with traumatic brain injury: A retrospective study. *Neurorehabilitation and Neural Repair*, 30(5), 451-460. doi: 10.1177/1545968315604397

Impact of Spatial Neglect ... On Family Caregivers

Impact of Spatial Neglect ...

On Family Caregivers

	Family caregivers of stroke survivors <i>without</i> spatial neglect	
Care and assistance (e.g., housekeeping, transportation, meals, dressing, using the bathroom, medication management, finance, etc.)	1.6 hours per day	
General supervision (i.e., keep an eye on the patient)	5.5 hours per day	

Impact of Spatial Neglect ...

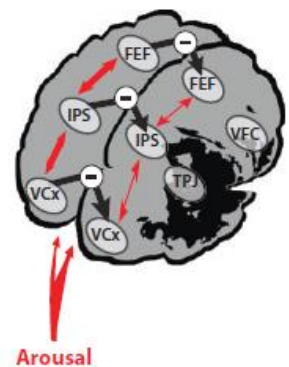
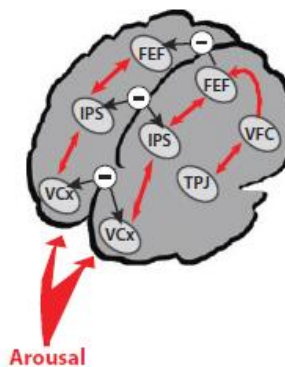
On Family Caregivers

	Family caregivers of stroke survivors <i>without</i> spatial neglect	Family caregivers of stroke survivors <i>with</i> spatial neglect
Care and assistance (e.g., housekeeping, transportation, meals, dressing, using the bathroom, medication management, finance, etc.)	1.6 hours per day	4 hours per day
General supervision (i.e., keep an eye on the patient)	5.5 hours per day	17 hours per day

Spatial neglect is a complex syndrome.

Spatial neglect is a disorder of spatial attention, affecting ... spatial perception (visual, auditory, tactile, proprioception), spatial representation (spatial memory, mental imagery), and motor control (directional movement, mobility).

- Co-occurrence of other disorders or deficits
 - Perseverative behaviors
 - Anosognosia for spatial neglect
 - Anosognosia for hemiplegia
 - Hemianopia (visual cortex injury)
 - Aphasia (left brain injury)
 - Delirium (right brain injury)



Guidelines for Adult Stroke Rehabilitation and Recovery A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Endorsed by the American Academy of Physical Medicine and Rehabilitation and the American Society of Neurorehabilitation

The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists and the American Congress of Rehabilitation Medicine also affirms the educational value of these guidelines for its members

Class IIa with level A of evidence

- prism adaptation
- visual scanning training
- optokinetic stimulation
- virtual reality
- limb activation
- mental imagery
- neck vibration combined with prism adaptation

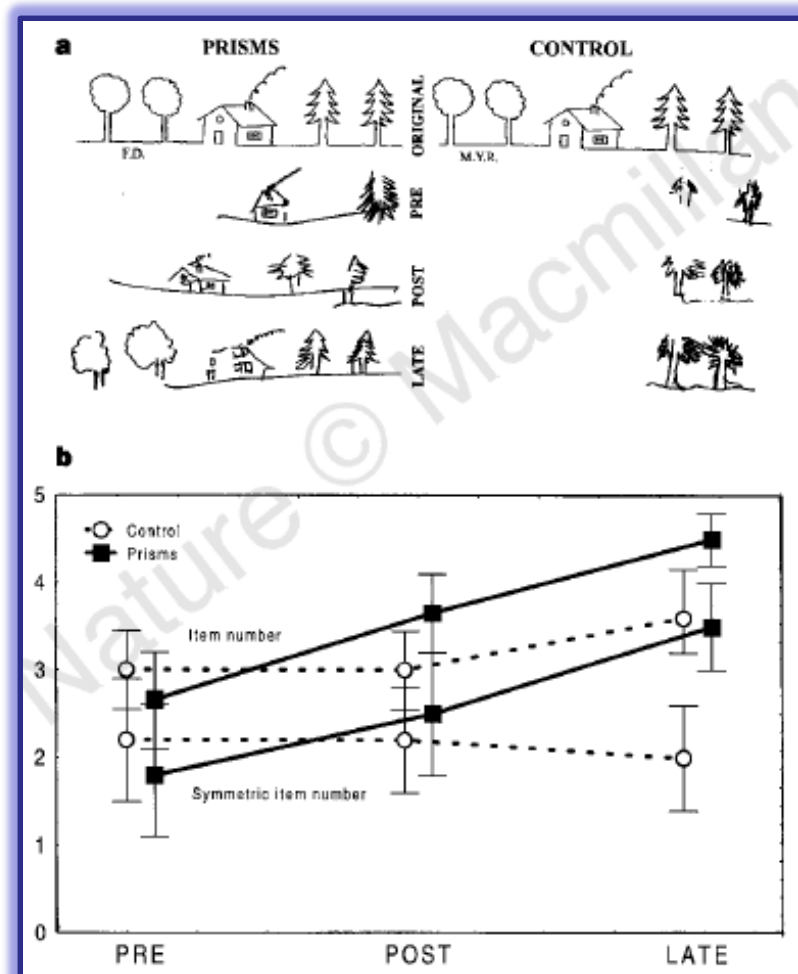
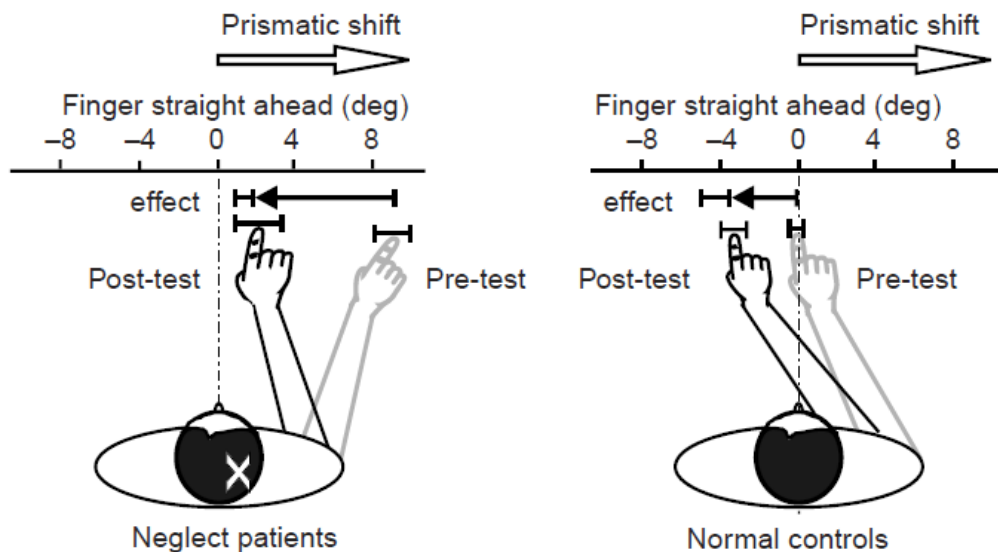
Class IIb with level B of evidence

- rTMS

		SIZE OF TREATMENT EFFECT			
		CLASS I Benefit >>> Risk Procedure/Treatment SHOULD be performed/administered	CLASS IIa Benefit >> Risk Additional studies with focused objectives needed IT IS REASONABLE to perform procedure/administer treatment	CLASS IIb Benefit ≥ Risk Additional studies with broad objectives needed; additional registry data would be helpful Procedure/Treatment MAY BE CONSIDERED	CLASS III No Benefit or CLASS III Harm Procedure/ Test Treatment COR III: No benefit Not Helpful No Proven Benefit COR III: Harm Excess Cost w/o Benefit or Harmful Harmful to Patients
ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT	LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	<ul style="list-style-type: none"> ■ Recommendation that procedure or treatment is useful/effective ■ Sufficient evidence from multiple randomized trials or meta-analyses 	<ul style="list-style-type: none"> ■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from multiple randomized trials or meta-analyses 	<ul style="list-style-type: none"> ■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from multiple randomized trials or meta-analyses 	<ul style="list-style-type: none"> ■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Sufficient evidence from multiple randomized trials or meta-analyses
	LEVEL B Limited populations evaluated* Data derived from a single randomized trial or nonrandomized studies	<ul style="list-style-type: none"> ■ Recommendation that procedure or treatment is useful/effective ■ Evidence from single randomized trial or nonrandomized studies 	<ul style="list-style-type: none"> ■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from single randomized trial or nonrandomized studies 	<ul style="list-style-type: none"> ■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from single randomized trial or nonrandomized studies 	<ul style="list-style-type: none"> ■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Evidence from single randomized trial or nonrandomized studies
	LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies, or standard of care	<ul style="list-style-type: none"> ■ Recommendation that procedure or treatment is useful/effective ■ Only expert opinion, case studies, or standard of care 	<ul style="list-style-type: none"> ■ Recommendation in favor of treatment or procedure being useful/effective ■ Only diverging expert opinion, case studies, or standard of care 	<ul style="list-style-type: none"> ■ Recommendation's usefulness/efficacy less well established ■ Only diverging expert opinion, case studies, or standard of care 	<ul style="list-style-type: none"> ■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Only expert opinion, case studies, or standard of care

Volunteer?

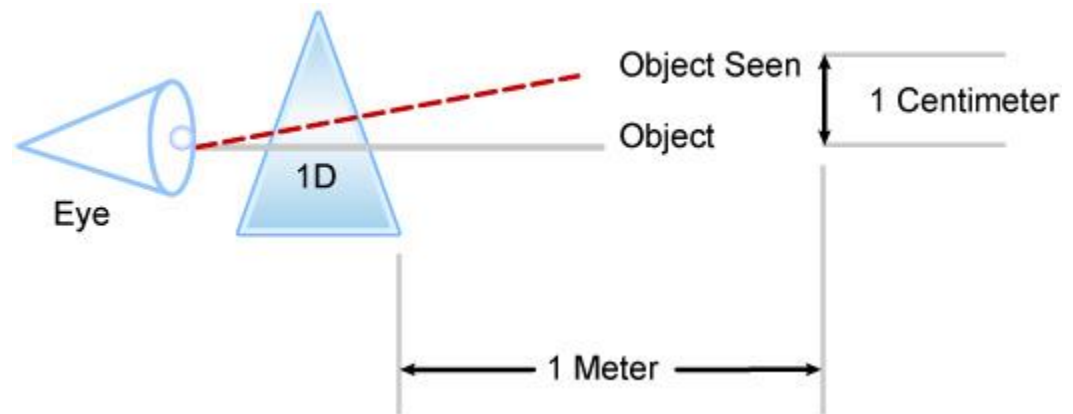
Seminal study



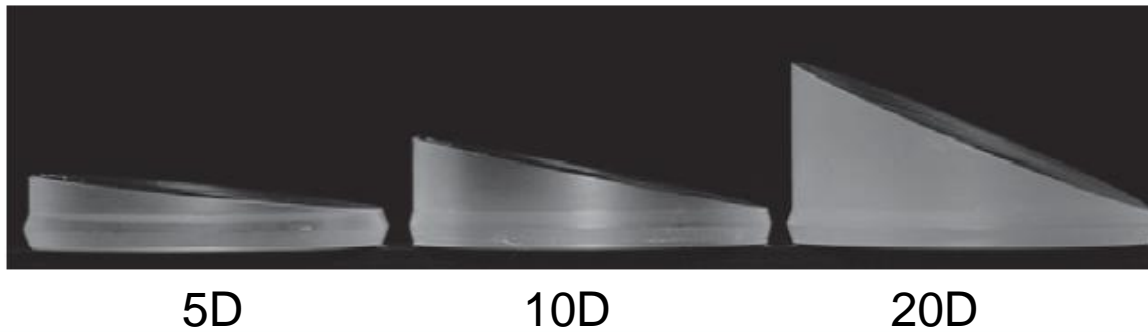
Rossetti, Y., Rode, G., Pisella, L., Farne, A., Li, L., Boisson, D., & Perenin, M. T. (1998). Prism adaptation to a rightward optical deviation rehabilitates left hemispatial neglect. *Nature*, 395(6698), 166-169. doi: 10.1038/25988

Why using 20-Diopter prisms?

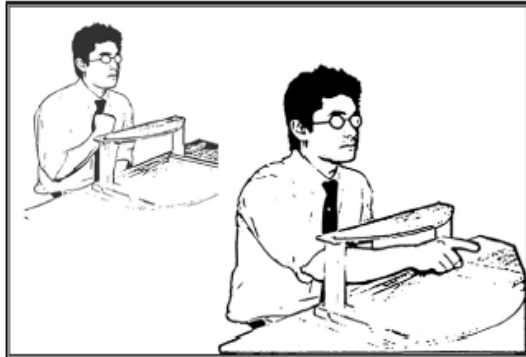
Answer: To induce larger and longer-lasting **prism aftereffect**



20 diopter prism lens shift the entire visual field for about 11.4 degrees of visual angle.



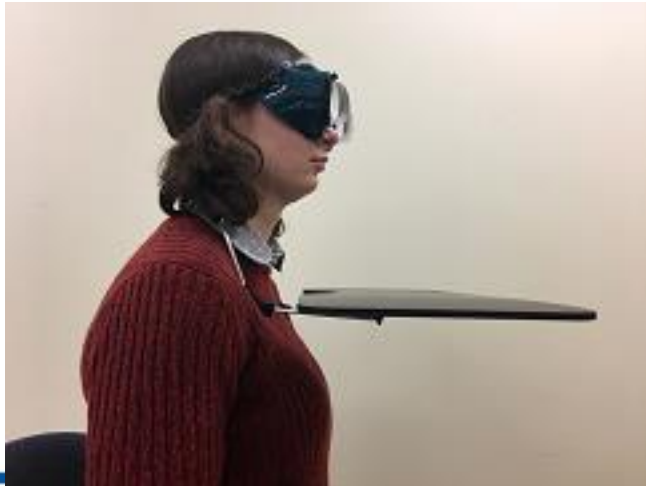
In addition to use 20-D prism lenses, blocking visual feedback of arm movement is another way to **enhance prism aftereffect.**

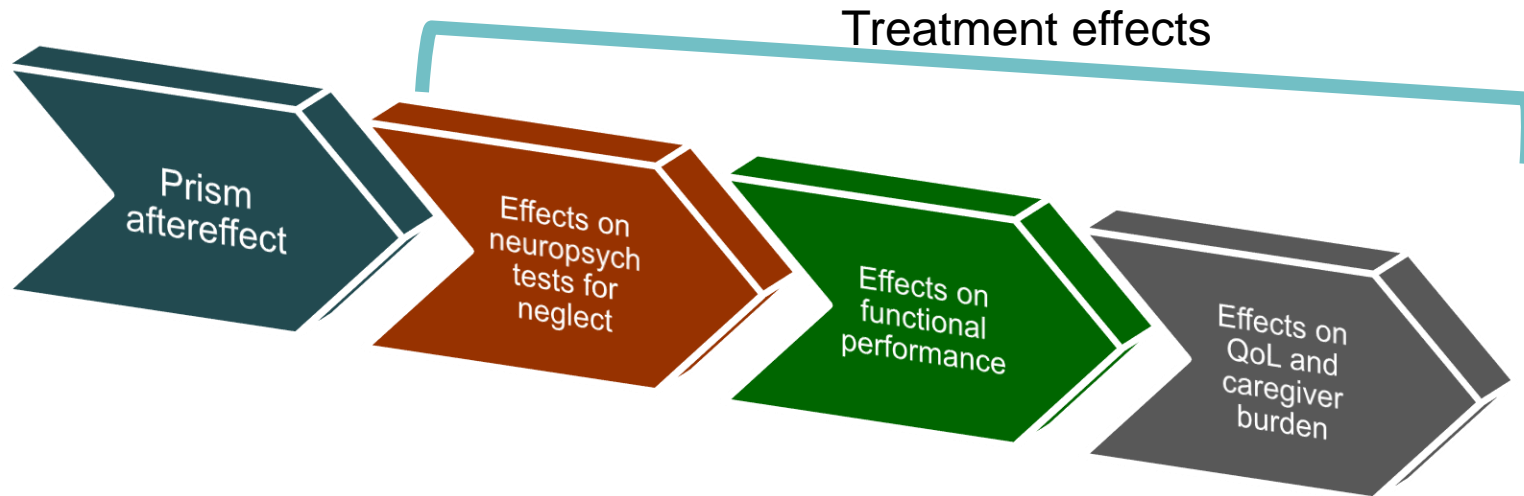


Keane et al. (2006)



Wilm & Mala (2010)





Goedert, K. M., Chen, P., Foundas, A. L., & Barrett, A. M. (2018). Frontal lesions predict response to prism adaptation treatment in spatial neglect: A randomized controlled study. *Neuropsychological Rehabilitation*, 1-22. doi:10.1080/09602011.2018.1448287

Chen, P., Goedert, K. M., Shah, P., Foundas, A. L., & Barrett, A. M. (2014). Integrity of medial temporal structures may predict better improvement of spatial neglect with prism adaptation treatment. *Brain Imaging and Behavior*, 8(3), 346-358. doi: 10.1007/s11682-012-9200-5

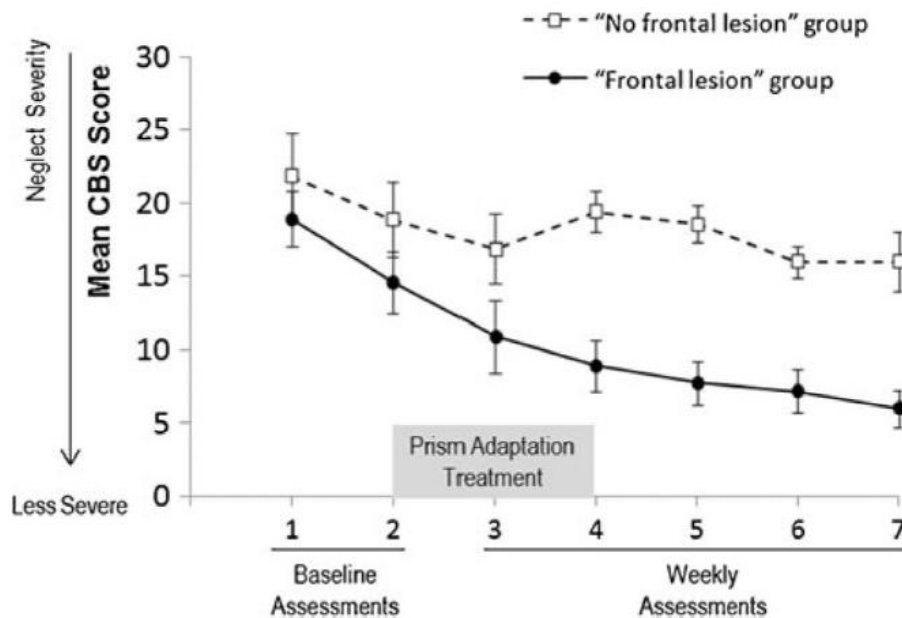
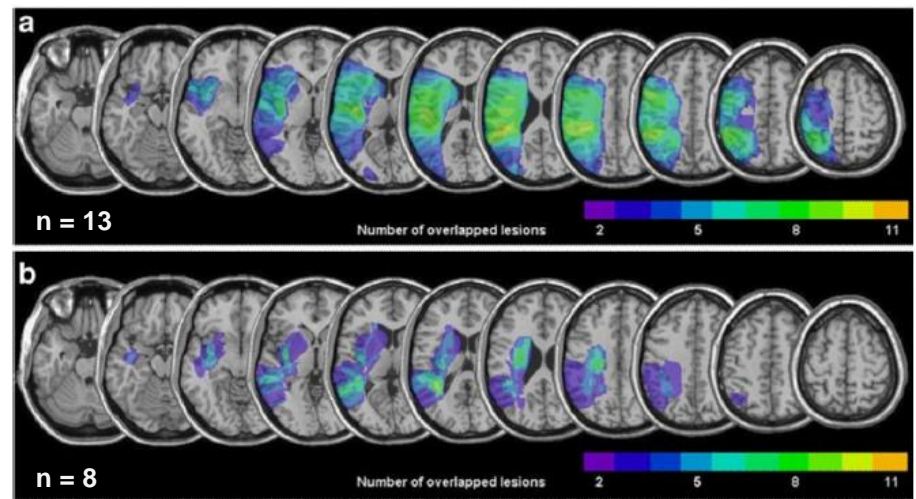
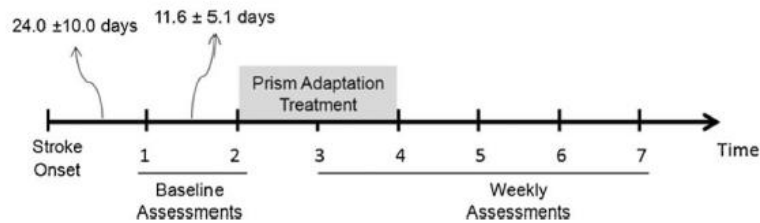
Goedert, K. M., Chen, P., Boston, R., Foundas, A. L., & Barrett, A. M. (2014). Presence of motor-intentional aiming deficit predicts functional improvement of spatial neglect with prism adaptation. *Neurorehabilitation and Neural Repair*, 28(5), 483-492. doi: 10.1177/1545968313516872

Fortis, P., Chen, P., Goedert, K.M., & Barrett, A.M. (2011). Effect of prism adaptation on "Aiming" spatial bias and functional abilities in neglect patients. *NeuroReport*, 22, 700-705. doi: 10.1097/WNR.0b013e32834a3e20

Kessler Foundation Neglect Assessment Process (KF-NAP™)

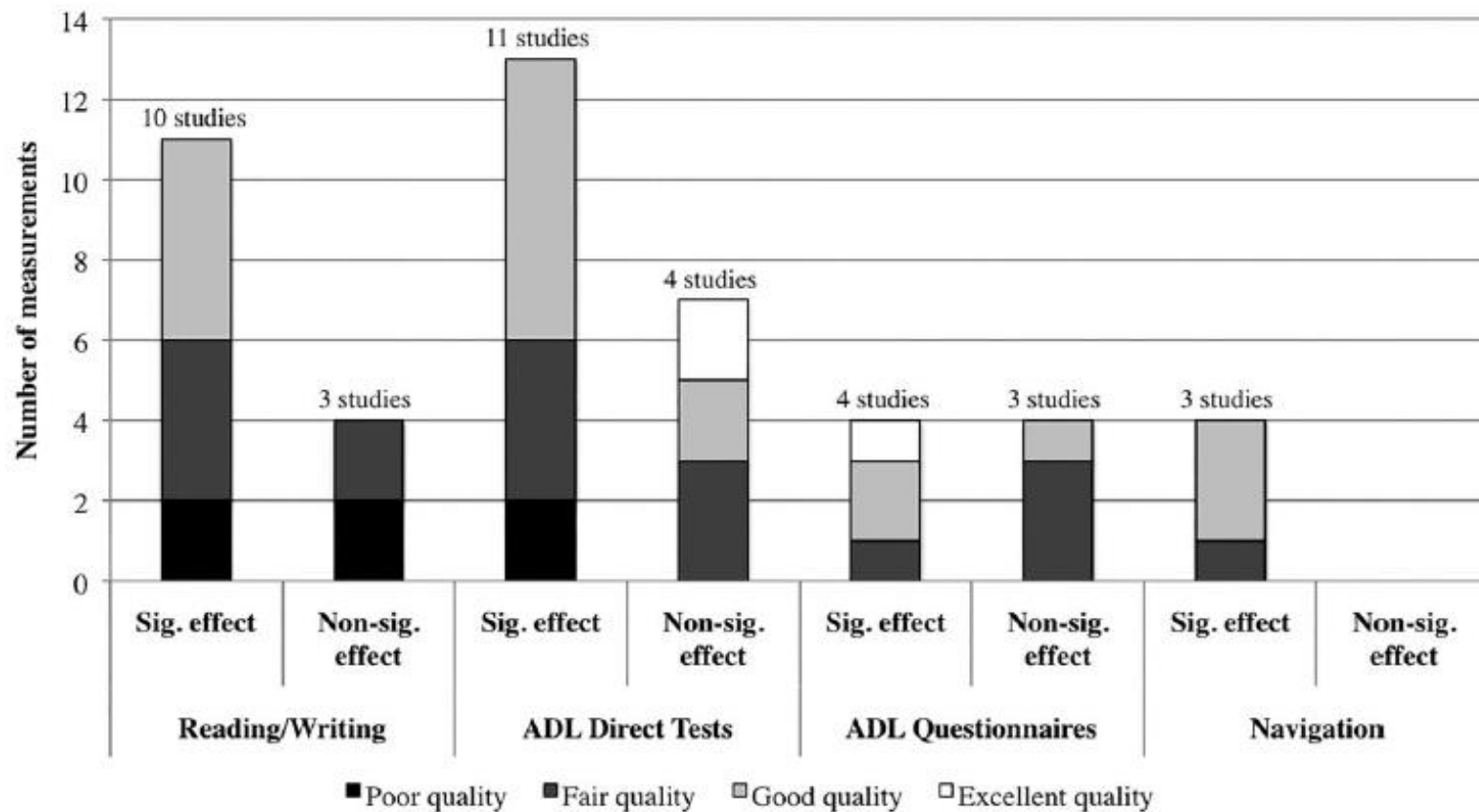
How to use the Catherine Bergego Scale to assess spatial neglect

	Category	0 no neglect	1 mild neglect	2 moderate neglect	3 severe neglect	NA (provide reasons)
1	Gaze orientation			X		
2	Limb awareness				X	
3	Auditory attention		X			
4	Personal belongings				X	
5	Dressing					X Too much help from CG
6	Grooming		X			
7	Navigation				X	
8	Collisions	X				
9	Meals				X	
10	Cleaning after meals	X				
Neglected side (circle one): <u>left-sided</u> spatial neglect <i>right-sided</i> spatial neglect						
Sum of assigned scores: <u>16</u> × 10 = Final score <u>17.78</u> Number of scored categories: <u>9</u>						
Neglect severity (circle one): Absent (0); Mild (1-10); <u>Moderate</u> (11-20); Severe (21-30)						

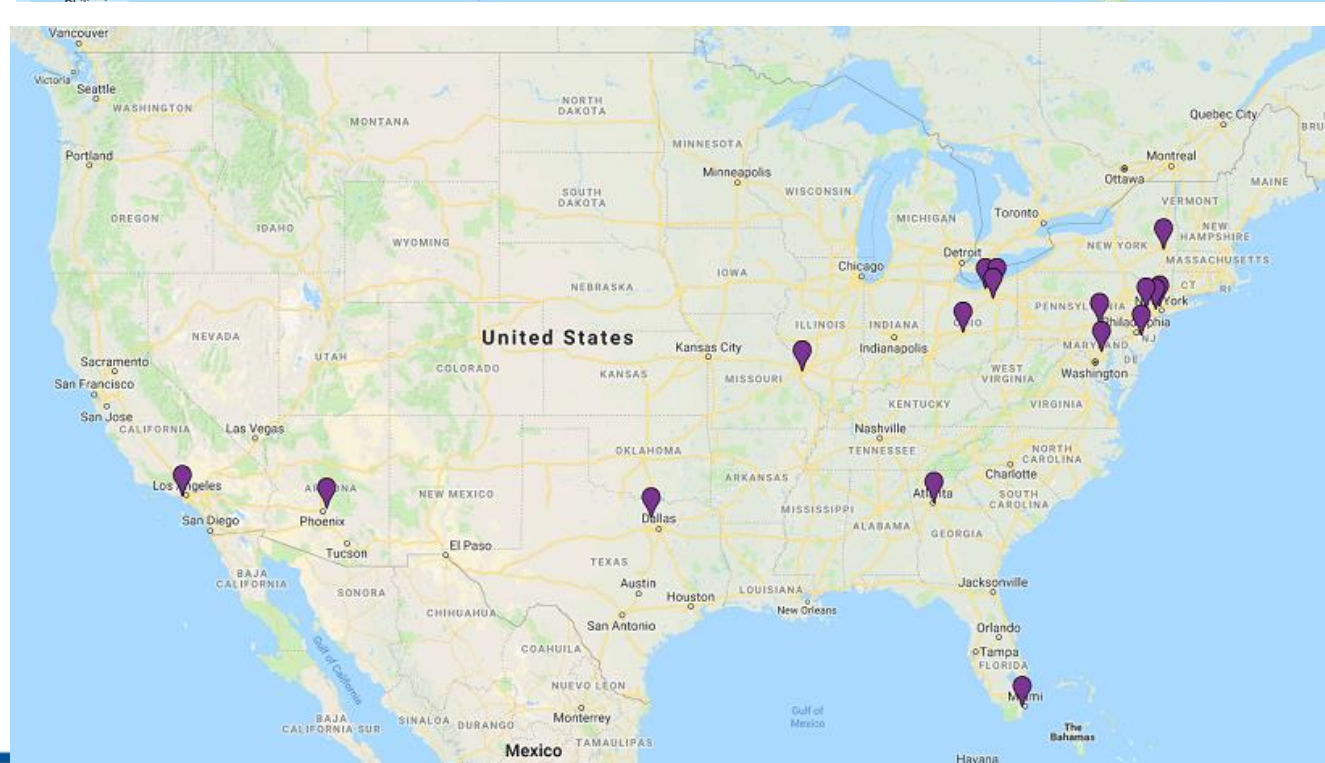
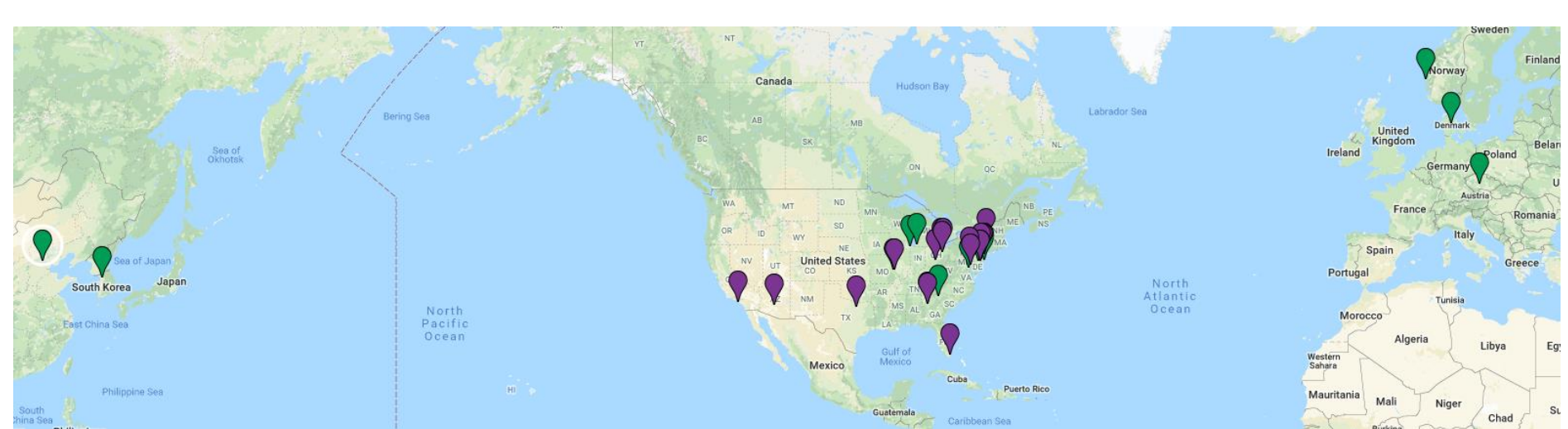


Replication and confirmation of the result --

Goedert, K. M., Chen, P., Foundas, A. L., & Barrett, A. M. (2018). Frontal lesions predict response to prism adaptation treatment in spatial neglect: A randomized controlled study. *Neuropsychological Rehabilitation*, 1-22. doi:10.1080/09602011.2018.1448287



(video here)



Acknowledgement



A.M. Barrett, MD



Mooyeon Oh-Park, MD



Kimberly Hreha, EdD, OTR/L



Jenny Masmela (representing all the research assistants, students, and interns working with me since 2007)