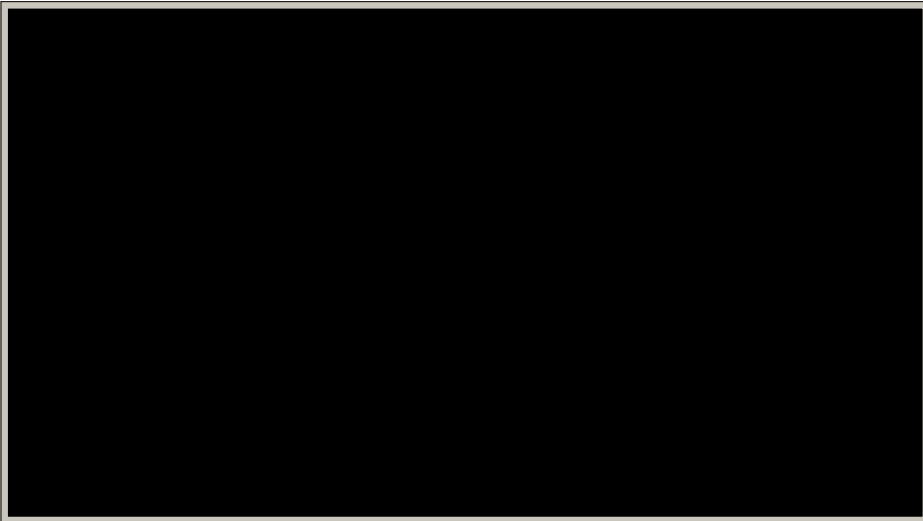


Neuroplasticity: Stretching the Brain

A Presentation By: Rashella D'Amico



Cultural Activities Change Brain Structure

- Music makes extraordinary demands on the brain.
- A pianist performing the 11th Variation of the Sixth Paganini Etude must play 1800 notes per minute.
- This requires speed and precision in visual-spatial reasoning, auditory processing and more.
- Studies have shown that the more these musicians practice the larger the brain maps for these areas become.

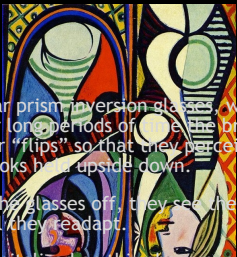


Cultural Activities Change Brain Structure

- Brain imaging shows that musicians have several areas that differ from non-musicians- the motor cortex and cerebellum.
- Imaging also shows that musicians who begin before age 7 have larger brain areas connecting both hemispheres.
- Musicians who play stringed instruments have larger brain maps for their active lefts hands and active neurons in these areas increase in volume over time to respond to the string timbres.
- The neurons and maps in the auditory processing parts of the brain responsible for detecting “brassy” sounds have been found enlarged in Jazz musicians playing trumpet.



Cultural Activities Change Brain Structure



- When people wear prism inversion glasses, which turn the world upside down, for long periods of time the brain changes and their perceptual center “flips” so that they perceive the world right side up and even read books held upside down.
- When they take the glasses off, they see the world as though it were upside down until they readapt.
- Betty Edwards capitalized on this phenomenon in her book- Drawing on the Right Side of the Brain (1978) by asking students to draw a picture of a Picasso sketch while looking at it upside down.



Constraint-Induced Movement Therapy

- Developed by Neuroscientist Edward Taub at the University of Alabama.
- CI therapy is neuroscience based rehabilitative treatment.
- CI therapy teaches the brain to “rewire” itself following an injury by forcing the brain to use areas of the body that have been affected.
- This is done by restricting the use of the unaffected parts and “shaping”
- There are programs for adults and children.
- Treatments focus on people who have suffered brain injuries- Stroke, Aneurysm, Parkinson’s, Multiple Sclerosis, TBI, Cerebral Palsy.



Constraint-Induced Movement Therapy

- In Taub's Clinic CI Therapy consists of 3 major factors:
 - (1) The stronger limb must be completely restrained for up to 3 weeks using a lightweight fiberglass cast or specialized mitt.
 - (2) The weaker limb must be trained using shaping techniques that mimic daily life.
 - (3) The therapy is intensive requiring several hours at a time for multiple weeks.



Constraint-Induced Movement Therapy

- Leads to a very large use-dependent functional plastic brain reorganization, so that a more extensive area of the cerebral cortex is involved in innervating the movement of patients than before therapy.
- Demonstration of a change in brain function associated with a therapy-induced improvement in recovery of motor ability in humans.
- Produces changes in regional blood flow and metabolic rate in the brain.
- Produces a profound increase in grey matter in the sensorimotor area, more anterior motor areas, and the hippocampus on both sides of the brain, a structural brain change.

Frederick

- Had a massive stroke in the womb which caused damage to his brain.
- The entire left side of his body was affected by cerebral palsy
- He was not able to walk or talk until the age of 4
- He could only walk with a leg brace.
- His speech was labored
- He could use his left arm, but not hand
- Visited Taub Clinic for CI therapy at 8 years old.
- After only 19 days he showed significant progress



Barbara Arrowsmith Young

- Born in Toronto in 1951
- Unidentified learning disability that affected speech, spatial reasoning and logic.
- Asymmetrical body that left her off balance
- Had areas of brilliance as a child- auditory visual memory were remarkable.
- Struggled mentally and emotionally.
- Developed exercises to encourage plastic changes in her brain and others.





Arrowsmith PROGRAM BACKGROUND



A Cognitive program for students with **learning disabilities**

Home

Strengthening Learning Capacities®

- In 1980 Barbara founded the Arrowsmith School for Learning Dysfunction.
- Using the principles of neuroplasticity her program addresses 19 different areas.

Motor-Symbol Sequencing- This capacity is involved in the process of learning and consistently producing a symbolic sequential motor pattern (e.g., writing out the alphabet, or numbers). All sequential symbolic processes involving input through the eye (e.g., reading), output through the hand (e.g., writing) and mouth (e.g., speaking) are impaired when there is a weakness in this capacity.

Symbol Relations- This capacity is involved in understanding the relationships among two or more ideas or concepts. A weakness in this capacity may result in the following difficulties.



Arrowsmith PROGRAM BACKGROUND



A Cognitive program for students with **learning disabilities**

Home

Strengthening Learning Capacities®

- **Memory for Information-** This is the capacity for remembering chunks of information such as instructions.
- **Predictive Speech-** This is the capacity for the sense of how symbols (words and numbers) interconnect sequentially into fluent sentences and procedures. This occurs in thinking, speech and writing.
- **Speech Pronunciation-** This is the ability to learn how to pronounce syllables and then to learn how to integrate the syllables into the stabilized and consistent pronunciation of a word
- **Auditory Speech Discrimination-** This is the ability to discriminate between similar sounding speech sounds (e.g., fear - hear, doom - tomb).



Arrowsmith PROGRAM BACKGROUND



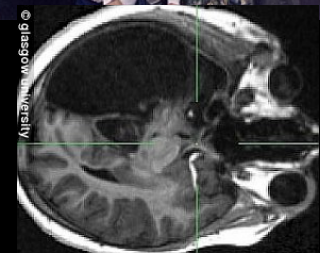
A Cognitive program for students with **learning disabilities**

Home

Strengthening Learning Capacities®

Michelle

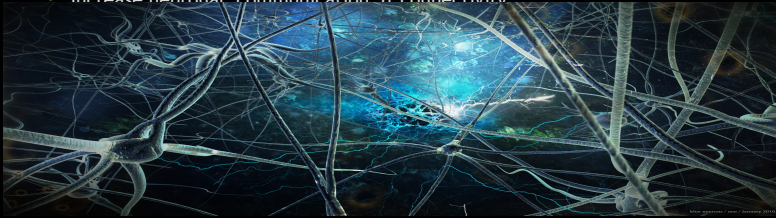
- Left Hemisphere never developed
- Right hemisphere rewired to take over functions
- Is blind in her "right visual field"
- She has extraordinary calculating skills
- Hyper-development of hearing
- Super-sensitivity to touch



© Glasgow University

Building A Brain Based Intervention

- Engage Motor Parts of the Brain by building in exercise and movement.
- Engage Cognitive Parts of the Brain by increasing intellectual demands.
- Engage the Senses by doing activities that require taste, touch, hearing & smell.
- Increase neuronal communication & connectivity.



Engage the Motor Parts

- Exercise stimulates the production of brain chemicals, such as BDNF (brain-derived neurotrophic factor) which encourage growth of new nerve connections.
- Physical activity causes the brain to release endorphins to make you feel good.
- Movement helps learning, since the brain's cerebellum coordinates movement of the body and formulation of thoughts, it helps engage more neurons and increase memory capacity.
- Physical actions- walking, talking aloud, or even driving activates numerous motor centers to support cognitive functions.
 - Crawling strengthens the area of the brain responsible for reading.
 - Juggling can increase grey matter in as early as 7 days.

Engage the Cognitive Parts

- Ask questions about every day things.
- Use descriptive language
- Practice sequencing
- Compare and contrast
- Memorize
- <http://www.qualityoflife.org/brainworks/games/>
- <http://www.kidspych.org>

Engage the Senses

- Sensory stimulation engages the brain- engage touch, smell, movement and hearing.
- Get dressed in the dark or with your eyes closed.
- Learn simple braille.
- Sit quietly for 5 minutes and identify all the sounds.
- Lightly Scratch your scalp
- Brush your limbs with various textures

Increase Neuronal Communication and Connectivity

- Cross crawling (touching your right hand to your left knee and vice versa).
- Using your non-dominant hand to complete daily tasks, i.e. brushing teeth.
- Making a figure 8 on paper or in the air.
- Use images and visualization.
- Use alternate-colored pens to write a series of color names but try to read only the color.

Books on Brain Development

- The Brain That Changes Itself (2007) Norman Doidge, M.D.
- A Better Brain At Any Age (2009) Sondra Kornblatt
- Think Smart (2009) Richard Restak, M.D.
- Buddha's Brain (2009) Richard Hanson, Ph.D.
- Smart But Scattered (2009) Peg Dawson
- Brain School (2010) Howard Eaton
- The Whole Brain Child (2012) Daniel Siegel, M.D.
- The Woman Who Changed her Brain (2012) Barbara Arrowsmith Young
- How To Create A Mind (2013) Ray Kurzweil

Further Reading

- Taub E., Uswatte G. and Mark V.W. (2014). The functional significance of cortical reorganization and the parallel development of CI therapy. *Frontiers in Human Neuroscience*, 8:396.
- Taub, E., Uswatte, G., Mark, V.W., Morris, D.M., Barman, J., Bowman, M.H., Bryson, C., Delgado, A., Bishop-McKay, S. (2013). Method for enhancing real-world use of a more-affected arm in chronic stroke: transfer package of CI therapy. *Stroke*, 44, 1383-1388.
- Taub, E., Uswatte, G., King, D. K., Morris, D. M., Crago, J. E., & Chatterjee, A (2006). A placebo controlled trial of Constraint-Induced Movement therapy for upper extremity after stroke. *Stroke*, 37, 1045-1049.
- Taub, E., Ramey, S., DeLuca, S., & Echols, K. (2004). Efficacy of Constraint-Induced (CI) Movement therapy for children with cerebral palsy with asymmetric motor impairment. *Pediatrics*, 113, 305-312.

Further Reading

- Taub, E.(2004). Harnessing brain plasticity through behavioral techniques to produce new treatments in neurorehabilitation. *American Psychologist*, 59(8), 692-704.
- Taub, E., Miller, N. E., Novack, T. A., Cook, E. W. III, Fleming, W. C., Nepomuceno, C. S., Connell, J. S., & Crago, J. E. (1993). Technique to improve chronic motor deficit after stroke. *Archives of Physical Medicine and Rehabilitation*, 74, 347-354.
- Taub, E. (1980). Somatosensory deafferentation research with monkeys: Implications for rehabilitation medicine. In L. P. Ince (Ed.), *Behavioral Psychology in Rehabilitation Medicine: Clinical Applications* (pp. 371-401). New York: Williams & Wilkins.