Learn Like A Genius

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Using Brain Science for Accelerated Skill Development

Neuroplasticity

Teachers Change Brains with Surgical Precision, Literarily

Webster online
Full definition of surgery
1: a branch of medicine concerned with diseases and conditions requiring or amenable to operative or manual procedures.

- Teaching is tantamount to brain surgery. While it is quicker with a scalpel, we use cognition to change student's brains physically and/or functionally (neuroplasticity), and we do it in very specific ways depending upon the subject.
- We know how to build our muscles and are not surprised when they change with exercise.
- It just takes a long time for the necessary large-scale neurobiological changes to occur. We easily accept this with our bodies. If someone decides to start working out and eating well we know that, over time, their body will gradually change. Even if they are very dedicated we know there will be little change in the short term. We don't think they lack 'muscle talent' when they don't get bigger right away.
- And that is just normal everyday life. Think about the level of training needed for the different levels of athletics. Now think of the cognitive training beyond regular competence for high educational performance.
    - This is the model we use for giftedness education. Why should it be special?

Neuroplasticity/Learning Happens in Your Brain

- Neuroscience has improved dramatically over the last 30 years. The advent, and more importantly improvement, of fMRI (Functional Magnetic Resonance Imaging) as well as other diagnostic tools have pushed the field forward at an astonishing rate.
- It is enlightening the best cognitive/educational psychology has brought to bear since the middle of the 20th century or so (and more really). Seen as part of that big picture there are exciting things to learn about how we learn, and many of them are quite counterintuitive.
- Everybody has some of this, the great teachers have most of it, but few know the terms and how these concepts are organized as part of a larger model. This is because the research has only recently been

disseminated and those of us who teach are, understandably, very far removed from the field of cognitive and behavioral psychology and neuroscience.

- Neuromyth

> The popularization of neuroscientific ideas about learning – sometimes legitimate, sometimes merely commercial – poses a real challenge for classroom teachers who want to understand how children learn. Until teacher preparation programs are reconceived to incorporate relevant research from the neuro and cognitive sciences, teachers need translation.. . . Meanwhile, the success of our schools will continue to be narrowly defined by achievement standards that ignore knowledge of the neural and cognitive processes of learning. . .these naïve misinterpretations of science have spread throughout the folk psychology of educators in recent years. . .The problems facing scientists and teachers are only exacerbated by the popular media, particularly those who sensationalize the, "Bold new findings," of scientists and exaggerate their immediate impact on society. . .An exchange of knowledge between neruo- and cognitive scientists and educators will help generate a better understanding of how learning takes place in real-world contexts." (Hardiman, Rinne, Gregory, & Yarmolinskaya, 2010. pp. 145, 157)
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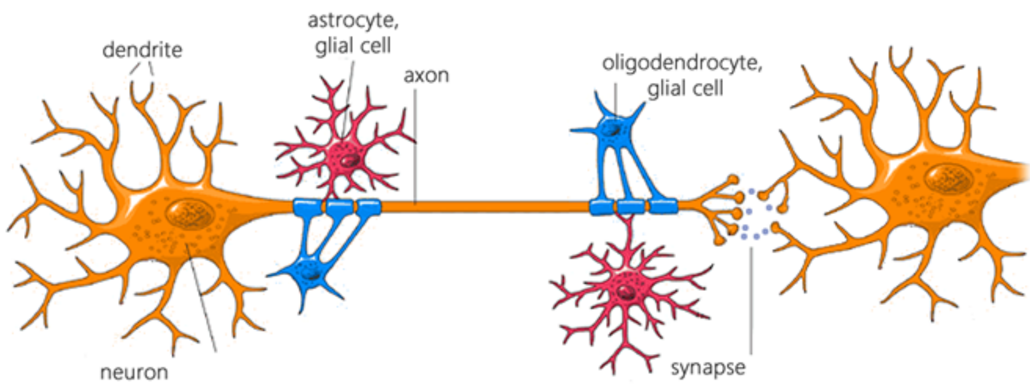
> The need for translators and for greater collaboration between educators and neuro- and cognitive scientists has been previously described by a number of researchers [Ansari and Coch, Fischer et al., Hinton and Fischer, Kuriloff et al., Ronstadt and Yellin]." "These translators, trained in multidisciplinary programs tied to school of education, can return to schools and school districts with sufficient background in the neuro- and cognitive sciences to provide perspective and transmit knowledge to their colleagues." (p. 157) emphasis added.

- Do we really only use 10% of our brains(Hill & Schneider, 2006, p. 656)
  - fMRI real time imaging of a brain learning a task (Hill & Schneider, 2006, p. 656)
- Process Efficiency Change – less is more
  - During this process the brain is working through confusion to find the perfect efficiency point for that task. This occurrence has been called a process efficiency change. (Ibid)
  - At first the fMRI image is lit up like a Christmas tree. Most notably the pre-frontal cortex, responsible for executive function, is very involved. As the task is learned more and more regions drop out as the brain finds the perfect efficiency point for the desired ability. Here the skill can be reliably executed. This process involves difficulty and frustration as the brain is trying to figure out how to best deal with it.
- Just as we can lift weights in order to change and strengthen our muscles so too can we engage in exercises that physically and/or functionally change the brain. (Doidge, 2007)
  - Violinists left hand representations, London cab drivers Hippocampi. On and on.
- This is the idea of neuroplasticity. A concept that some still find hard to believe.
  - The book, *The Brain That Changes Itself*, (Doidge, 2007) follows the transition from the old thinking of specialization in the brain to our current understanding of how we can change it by the choices we make.
  - The old ideas that the brain is done evolving after childhood have been debunked. The brain is plastic for life.
- Training your brain - Everything we do or think is a neural representation in the brain. Neurons talking to other neurons. We have an estimated 100 billion neurons (give or take a few billion) that create more than 100 trillion connections.
  - Such communications are neural networks.

- Synapses are gaps between neurons across which action potentials (electrochemical nerve impulses) travel.
- Action potentials travel down an axon which is punctuated by little gaps called the nodes of Ranvier.



- Just as with the electricity we use, if the conduit is not insulated then the action potential leaks out and the signal is not as powerful (does not travel as fast). The more insulated the axon the faster it travels.
- There are cells attached to axons called oligodendrocytes. Each time an action potential travels through an axon oligodendrocytes are activated to produce an insulating substance called myelin, which forms a covering known as the myelin sheath. (Araque & Navarrete, 2011; Wake, Lee, & Fields, 2011)
- The more insulated the axon the faster the action potential travels (i.e. faster cognition, finger movements, etc.). That is why thoughtful repetition over and over creates solid technical foundation and speed *in all domains*.
- Learning; slow accurate movements/thoughts create accurate neural representations for myelination.
- Eventually enough myelin accumulates for a process called saltatory conduction to take place. This change between the processes has been called the "Lillie Transition. "(Young, Castelfranco & Hartline, 2013) In this process the action potential leaps across the axon at far greater speeds. Specifically, it originates on both ends of the axon and meets in the middle instead of linear conduction from one end to the other.
  - Interestingly during the onset of the "Lillie Transition" action potential velocity decreases before the significant increase of saltatory conduction. This may explain why sometimes, after working a lot on something, we can seem to regress.

Helpful reading

Araque, A., & Navarrete, M. (2011). Electrically driven insulation in the central nervous system. *Science*, 333(6049), 1587-1588. doi: 10.1126/science.1212525

Coyle, D. *The talent code*. (2009). New York, NY: Bantam; Random House.

Doidge, N. (2007). *The brain that changes itself*. New York, NY: Viking; Penguin.

Goodhart, G. (2014). Why music education matters in academics: It may not be what you think. *American String Teacher, 64*(3), 26-29.

Hardiman, H., Rinne, L., Gregory, E., & Yarmolinskaya, J. (2011). Neuroethics, Neuroeducation, and Classroom Teaching: Where the Brain Sciences Meet Pedagogy. *Neuroethics, 5*(2), 135-143.

Hill, N. M., & Schneider, W. (2006). Brain changes in the development of expertise: neuroanatomical and neurophysiological evidence about skill-based adaptations. In K. A. Ericsson, N. Charness, P. J. Feltovich, & Robert R. Hoffman (Eds.), *The Cambridge Handbook of Expertise and Expert Performance,* (pp. 683-703). New York, NY: Cambridge.

Young, R. G., Castelfranco, A. M., & Hartline, D. K. (2013). The "Lillie Transition": Models of the onset of saltatory conduction in myelinating axons. *Journal of Computational Neuroscience, 34*(3), 533-546.