



Neuroscience & training practices

Sinirbilim ve eğitim uygulamaları

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Is it true that adults are less able than children to learn because their brain is less plastic? Yes, it is.

However we can learn at every ages and science can help in the matter.

Here is an example which shows what happens when we do not dare to bridge gaps between two domains: science and adult training. It is widely accepted that instruction should be tailored to the learners so called «learning styles». Learners might be divided into visual learners, verbal learners and doers, Trainers are supposed to provide instruction that emphasizes pictures, words or exercises.

A recent review by researchers on this belief proved there is no evidence that validates the efficiency of managing learner styles. A thoughtful review of the data provides no support for style-based instruction.

If there is no harm in using different learning styles, efficiency is not proved. Now, how can neuroscience findings on brain confirm or adjust our training practices?

1. Basics on brain

With nearly 100 billion neurons and 100 trillion connections, the human brain remains one of the greatest mysteries in science and one of the greatest challenges in medicine.

Neurons have legs called dendrites which have spikes. A neuron has an axon, like an arm which neurons use to reach out the next neuron. Neurons send signals to the next neuron. Electric signals are transmitted through neuro transmitters which by the way is chemistry.

- Brain ability to learn depends on the number of neurons and connection density through synapses.
- The human brain is highly plastic. Neural connec-

tions can be reformed and new behaviors can be learned. Brain however is not unlimited: old neurons must disappear to allow new neurons and connections.

- The human brain is a social organ. Why? When babies we all needed to be socially connected to people taking care of us. It was necessary for survival. Our neurons were shaped by social interaction.

Hypocampus

Neurons are created in the hippocampus. Learning and memory happen thanks to new neurons and synapses and the room made by disappearing synapses. The hippocampus is the room for memory consolidation.

Working memory & Long Term memory

Short term is in forefrontal cortex. When learning, we create a set of links. We are all different on how long we process this. Once processed, it goes in the LT memory.

Long term memory is reinforced like when building a wall with bricks: let the cement dry. There is a time factor. Space learning over time, rather than mass learning all at once.

Adult learning is habit change.

Things block people from embedding the new learning and not forget it. 3 reasons:

- Adult learning is about habit changes. 40 % of our behavior is habits.
- Our brain is shaped to protect us because our brain has evolved and developed to protect us. The brain does not like changes and when we learn new things, the brain brings us back to the established patterns.

- In order to create new neuronal pathways, we need to repeat over and over to create new ones replacing the old ones. It takes time to create new pathways that overcome the habits.

Focused vs diffuse modes.

We have two different modes of thinking: **the focused mode** and **diffuse mode**.

We are in either in one mode or the other. Both these modes are highly important for learning.

The focused mode is when we concentrate on solving an issue or to make a decision. We use familiar established synapses. Diffuse-mode thinking is also essential for learning. It allows for the “big picture” perspective.

2. Consequences of age on the brain.

Brain plasticity. Brain plasticity decreases when we specialize ourselves in our adult functions. What happens?

Grey matter is the neurons - it can increase then decrease: research has shown that grey matter volume increases when learning new skills, and can fall back to baseline after 3 months without training.

White matter is synapses for connection: Research on piano players has shown it becomes harder to rewire circuits when getting older. For complex skills, adults have difficulties to **consolidate changes in the white matter. It is a limiting factor.**

Attention is steady. Studies suggest that sustained attention shows no decline at least till the age of 70 on the average.

There is gradual decline in human brain plasticity but teaching methods can mitigate limiting factors. Learning is possible all life-long.

3. Factors stimulating the adult brain.

How to enhance brain plasticity and maximize learning?

Social interaction, Emotional regulation, Motivation, Staying intellectually engaged, Challenge assumptions, Physical exercise, Maintain a healthy diet and sleep

4. Good practices in training.

Learning through collective problem solving

The brain makes patterns and desires to create new connections. When people solve a problem themselves, the brain releases a rush of positive neurotransmitters.

Problem-based learning enables the participants to interact with each other, and work out their solutions. Trainers shall select activities which will trigger collective work.

Remove the threat to engage.

For thousands of years, Our brains wonder: how new people we meet threaten or support us? It cannot be assumed that groups of diverse persons will trust each other. Trust must be earned. When people make strong social connections, oxytocin is released in the brain in order to disarm threat response.

Chunks

Provide smaller chunks of information and facilitate the full attention of the participants will make easier to store in and retrieve the information from long term memory. The recommended average time for concentration is 12'. Alternate focused and diffused modes of thinking. Remember we can focus attention with cortex on one thing only; we cannot read and listen things which are different.

Motivation

Research was conducted on learning tasks under conditions of monetary reward, punishment or with no reward. All groups learned equally well. But those in the reward group retained the learned skills better 30 days later. The brain is not a passive device. It can be stimulated by reward which helps consolidate LT memory.

Online education: engaging strategies.

One thing only on games. Games touch the rewarding zones of the brain: Dopamine activates pleasure, motivation and automaticity. Games use different parts of the memory which consolidate information.

The illusion of competence

Short term memory can be filled with material that allow the participants to have the correct answer. However, once the test is completed, the learning goes away if not in the long-term storage. The evaluations done by instructors should assess the long-term memory.

Automaticity through practice

When learning something we connect neurons which we reinforce through practice. We can say we understand something and realize what was understood when the neuron connection was solidified. The spikes from the dendrites solidify during our sleep.

Exaggerate perceptual features

Research for militaries demonstrated exaggerating the shapes of planes by the time of the learning is efficient for recognizing them in the field. In languages, exaggerating phonetic sounds for learning a language also works.

Schedule of practice (unpredictable time)

To build the new neural structures, practice at random intervals, is better than blocked practice. One possible reason for this is that participants have to work harder for a task performed randomly compared to one performed repeatedly.

5. Current research endeavors

Transcranial Direct Current Stimulation

A weak electrical current on the head stimulates neurons. This is a non invasive process which uses electrical currents. Electrodes are placed on the individual head during a task where a direct current stimulates the brain. A US Air Force training study involving pilots selecting drone targets. Receiving current stimulation saw improved accuracy for 40 minutes instead of a decline after 20 minutes of regular training.

According to the latest findings, electrical stimulation during learning can increase the speed of calculation and memory recall.

Medicine is another way. For instance drugs used as anti-epileptic has been found to enhance the learning

in adults.

the BRAIN Initiative

In 2013, Obama launched the BRAIN Initiative. This research explores how the brain records, processes, and retrieves quantities of information. Three examples which can or are used for adult

learning:

- MRI Magnetic Resonance Imaging: this is a technic used by researchers on how brain functioning works.

- Brain computer interface (BCI)

Identifying the neural mechanisms underlying plasticity is fundamental to understand human learning.

- Adaptive learning under **expected uncertainty and unexpected uncertainty**

Successful learning and decision making require a distinction between the range of experienced outcomes (also called expected uncertainty) and variability reflecting real changes in the environment (which is called: unexpected uncertainty).

Expected uncertainty could indirectly influence learning because a level of variability for detection of surprising events should increase the gain of learning, vs unexpected uncertainty.

Targeted Neuroplasticity Training (TNT).

The US Defense works on the body's peripheral nerves. The program is called Targeted Neuro- plasticity Training (TNT). They want to know how activation of our nerves can strengthen neurons connections in the brain. DARPA research focuses on gaining a clearer and more complete un- derstanding of how nerve stimulation influences synaptic plasticity, how cognitive skill learning processes are regulated in the brain, and how to boost these processes to safely accelerate skill acquisition. In short, TNT could reduce the time and cost needed to learn.

Conclusion

I hope this sensitized you about daring to pay attention to research findings and how it helps to better understand how and why adjusting training practices.

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