Welcome, everyone, to this first community workshop about the brain and education. This is an experiment of sorts - I want to thank Liz and Julie and many others at the school who have been super generous with their time and resources to give this a try. We thought the idea of having parents learn from each other in this format could hold some promise, so thank you for coming and I hope this at least sparks some additional conversations and connections that might not have happened otherwise.
My work has mostly focused on building education programs in non-traditional settings like summer camps, after school programs, museums, software, TV, etc.

At university I studied how learning happens in the brain, and how we might build education programs to better address the needs of students.

I'm also a first-year parent here at Woodinville Montessori
This is our agenda for today, which I hope to keep swift and light. Despite studying the brain for a while, I am deeply unqualified to tell you everything about how it works, but I do want to highlight some important areas that are relevant to education and parenting, in general.
Before I get to education and parenting I do want to cover at least some basic facts about how the brain works, just so we're all starting from the same place.
The first thing to know is that the brain continues to be a black box – there are some fundamental questions still unanswered. The Allen Institute for Brain Sciences is 15 miles from here and less than a year ago they published the "Top 5 unsolved mysteries in the brain" which includes some pretty basic stuff, like what it’s made of and how cells communicate.


As my cognitive neuroscience professor, Martha Farah, said to me on our first day of class: most of what I say to you will be wrong in a couple of years

Example: We used to just assume the brain contained 100 billion neurons. Now, after some careful study, we think it’s closer to 86 billion neurons

We continue to reshape how we think about the brain, updating our metaphors and adapting to new findings in research.
Neuroscience research includes animal studies, lesion studies, stimulation experiments, and neuroimaging.

- Neuroimaging measures brain activity by showing the regions of the brain that "light up," i.e. where there is blood flow and activity.
- Berenson-Allen Center for Noninvasive Brain Stimulation: get to see how neural pathways function with magnetic and transcranial DC stimulation.
- Fun fact: just by seeing a picture of a brain scan, people are more likely to find scientific conclusions credible.
In early childhood we go through a rapid period of synaptogenesis – synapses are created and connected.

As we get older, experience helps us form “trails” in our neural pathways, making our brain function more efficiently, consuming less energy.

Suppose you saw a chess player frantically moving around the board while another calmly sat there considering the next move. Activity does not equal proficiency.

The process of becoming more efficient is called synaptic pruning, and it’s important for the formation of efficient neural networks.

In brain scans of people with highly specialized skills, you’ll see a counter-intuitive activity map: less activity in areas of expertise (think golf scores – less is more).
Given what we know about how brains develop neural networks, we pay special attention to development in childhood.

Neuroplasticity can be structural (experience change a brain’s physical structure) or functional (brain functions move from damaged to undamaged area).

Structural neuroplasticity in childhood creates “sensitive periods” where networks are formed more rapidly and fluidly.

Later in life, networks are less formed and more rewired. This is an oversimplification, but gets the point across.
• Is neuroscience and education a “bridge too far”? (Bruer 1997) Can any meaningful practical application be made?
• Is cognitive science or educational psychology needed as an intermediary?
• Are the goals of neuroscience and education even the same?
• There is artistry to teaching, it cannot be the job of science alone to explain pedagogy or student behavior
The brain is a black box. What we do know about how neural networks form, consolidate, and adapt, gives us some insight into how people learn; however, classroom applications are challenging.
KEY INSIGHTS:
EDUCATION
• For what matters (to me) in education – the ability to synthesize new thoughts and ideas, to interact with old ones, to be open to new information, constructivism is a much more powerful and productive model.
• Clear tie-ins to Montessori education, including learner independence, holistic instruction, uninterrupted work time, mixed ages, role of the teacher
• “We learn through experience and experiencing, and no one teaches anyone anything. This is as true for the infant moving from kicking and crawling to walking as it is for the scientist with his equations. If the environment permits it, anyone can learn whatever he chooses to learn; and if the individual permits it, the environment will teach him everything it has to teach. ‘Talent’ or ‘lack of talent’ have little to do with it.” – Viola Spolin, 1963
The brain is always learning in growing, but not always (almost never) in a straight line.

Learning means we are deconstructing present knowledge and building up new conceptual models.

This naturally entails periods of positive proficiency, and periods of negative proficiency. That's okay! In fact, it's necessary.
● Everyone constructs intelligence differently, and there are multiple intelligences (Gardner)
● Traditional measures of intelligence, e.g. IQ, leave out many learners who think differently
● This is not the same as learning styles.
KEY INSIGHTS:
PARENTING
Neuroscientist Daniel Wolpert says that the reason for our brains is not to reason, think, or feel, but to “produce adaptable and complex movements.” Evidence from the natural world suggests that brains are only important insofar as they allow us to move (e.g. sea squirts, koalas), and controlled studies with students have shown that exercise has both a near- and medium-term effect on learning novel language. The reason is thought to be a result of network growth through a higher expression of brain-derived neurotrophic factor (BDNF) and dopaminergic pathways.

- Screen time isn’t inherently bad, but it takes the place of movement. McDonald’s isn’t inherently bad, but it takes the place of more productive calories.

References:
• A lot of times we are looking for an easier/better way to learn. This comes from the idea that knowledge is delivered, not built.
• Education isn’t just communication, it’s a reshaping of who we are. A changing of our brain. In that context, you need struggle. Not too heavy, but not too light, either.
• Technology is trying to address this, but it’s not an easy sell. Great teachers know instinctively to address this. Parents, most of all, need to embrace this.
• We are really bad at conflating ease of communication with learning. We learn less in a “good” lecture than a “bad” one.
  ○ Source: https://www.pnas.org/content/116/39/19251
● Most parents present will likely default to overstimulation, but there is real value in letting kids get bored
● Brain isn’t just for thinking. It’s for adjusting, prioritizing, connecting.
● Contrast with the heart. It’s always on, beating to let us know it’s doing something. Brain is quiet, not active sometimes so we feel like it’s not “on.” But it’s all needed for sporadic coding.

References:
The research suggests learning is constructed, not delivered. As a result, education should be inclusive of multiple intelligences, gracious to wavering performance, physical and active, expectant of resistance, and free to wander.
- Anything that is understood poorly can be wielded powerfully. Because the brain is a “black box,” people leverage its mystery for uneven results.
- Many of these myths can be chalked up to what we mean by “learning” – not everyone defines it the same way.
- Most, if not all, are founded in “half-truths” – studies that showed a specific effect but were never meant for broader applications.
● Evolution doesn’t mess around. No excess capacity here. Brain is not lazy.
● The brain is 2% body mass, yet consumes 20% daily glucose in adults, 50% in children.
● A bell cannot be unrun. This has reverberated for a while – since 1890s!
Broca and Wernicke, 19th century psychiatrists, discovered lateralization of speech and language areas to the left side of the brain. This was overgeneralized to mean that there is more hemispheric specialization than there actually is. Evidence most strongly suggests that functions cannot be localized acutely, but instead attributed to widespread networks.

References:
- Elizabeth Waters: The Left Brain vs. Right Brain Myth (2017): https://www.youtube.com/watch?v=ZMSbDwpjyF4
● Classical music does not make you smarter.
● The myth is based on a study that examined the effect of classical music on an origami task.
● Another study showed that pop music achieved better results, leading to the conclusion that music affected engagement more than learning.
● Lumosity is another example of temporary effects (though there’s a good case to be made for its use for clinical rehabilitation).

References:
● Frances Rauscher, et. al.: Music and spatial task performance (1993): https://www.nature.com/articles/365611a0
Critical periods, in which someone is only able to learn a new skill or ability within a distinct “window” of time, are rare (visual processing).

Sensitive periods, in which someone is more sensitive to learning a new skill or ability, are more common (language acquisition).
The VARK classification – visual, auditory, reading/writing, kinesthetic – suggests people “learn better” in different modalities.

This is not supported by the research, but continues to be used as a pedagogical framework.


- Important distinction between “communication preference” and “learning performance.”
  - “It might help you learn about yourself, but it might not help you learn”

- Still, it is widely adopted by classroom teachers and instructional designers, aiming to “match” instruction to a LS
  - More than 90% of teachers still believe this

- LS is built on the faulty premise that learning is delivered, not built (constructivism)

- It also falls into a “fixed identity” fallacy – that people are just one thing, in every context. I.e. introvert, extrovert
A “neuro-skeptical” parent will be wary of “brain claims” made by popular science and marketers.
Takeaways

• The brain is still a black box; however, we do have a good idea of how experience shapes the formation of neural networks.

• With regard to education, neuroscience research shows that learning is constructed, dynamic, and diverse.

• With regard to parenting, neuroscience research shows that children need exercise, room to struggle, and self-regulation.

• Neuromyths are widespread and sometimes leveraged. Any “brain claims” deserve a healthy amount of skepticism.
Thank You

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Q&A