

Don't Believe The Hype: Intelligence Isn't A Fixed Entity

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Saturday, November 6th, 2010

"It's not that I'm so smart, it's just that I stay with problems longer" - Albert Einstein

This article examines the link between working memory (WM) capacity and fluid intelligence (Gf). New studies suggest that WM capacity can be improved and that WM capacity has a direct link with academic achievement, making the training especially interesting for students who struggle and find themselves inferior to others. The article also wants to emphasize the importance of training on human brain development: genetics isn't always the key, and being proactive versus reactive (Practice makes perfect vs. No practice will make me good, I'm stupid by nature) is an important key in increasing the performance of your brain and achieving more.

Back in the day, in my pre neuroscientific era, I didn't know much about the brain and something I knew *especially* little about was intelligence. Despite how much the television wants to tell us that being intelligent is a gift and not something that can be achieved through hard work, it's a lie. We're told that lie through various *genius* characters in shows such as the quintessential Doogie Howser, House MD, Big Bang Theory and what not. The genius myth is just not what it is all that cranked up to be. Of course there are people who seem more *gifted* than others, but this might just as well be due to the stimuli and environmental effects over the course of their lives than it can be genetics. Don't have a limited mindset about intelligence, because if you do, you will surely fail in all your endeavors. It is how you perceive everyday as a chance to improve and what you do on a daily basis that matters. The ancient Greek philosopher Aristotle, who definitely ingrained this mindset into Alexander The Great's notorious mind said:

"We are what we repeatedly do. Excellence, then, is not an act, but a habit." - Aristotle

The whole genius *definition* is actually for another post, but it's all part of the same ballgame: *what is intelligence?*

Spearman's G?

There is no – universal – understanding of intelligence *per se*, but Spearman concluded – over 100 years ago – that people's performance on various intelligence tests all depended on a certain factor that he called the *G* coefficient. Various tests have shown that academic achievement has a definite correlation with the *G coefficient* [3]. There are two subtypes of *G*, crystallized intelligence *Gc* and fluid intelligence *Gf* [4]. Crystallized intelligence, *Gc*, depends on what you have learned and achieved already, i.e. past skills and experience. Examples of tests for *Gc* are vocabulary tests and general knowledge tests. Fluid intelligence however, is different. *Gf* depends on a person's ability to adapt to a new environment. The tests that look at *Gf* assess your adaptive intelligence, and are things like *Raven's Progressive Matrices*. *Gf* has been positively correlated with academic achievement,

more so than G_c . [3,6-8]

Thus, the question emerged: *can we improve G -coefficient through cognitive training?* This resulted in an abundance of studies that showed that various training programs could improve individuals' performance on specific kinds of tests. Unfortunately this only had a clear affect on crystallized intelligence G_c , which meant that people who practiced these games and puzzles etc. only became better at those particular skills, but it didn't change their ability to adapt to new and novel challenges. This meant that neuroscientists had to come up with a new test that could actually improve fluid intelligence (G_f) that could actually enhance the prefrontal and parietal parts of the brains operating efficiency [2].

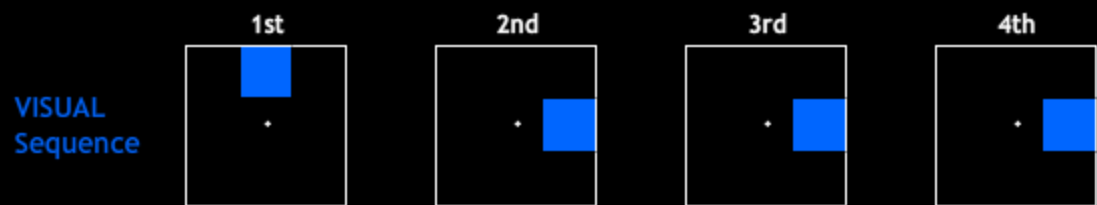
The Key To Fluid Intelligence?

Working memory (WM) is a complex task involving different parts of the brain. It primarily involves the *lateral intraparietal cortex* and *dorsolateral prefrontal cortex* — both areas crucial for focusing on the information at hand, and picking out the most relevant parts [4]. Working memory *per se* revolves around a person's ability to remember information for a brief period of time, and it was found by various studies that especially working memory has a direct influence on academic achievement [8]. Therefore, a lot of neuroscientists were interested in whether or not a persons WM capacity could be improved by *direct* training, and the results were astounding. Jaeggi et al. created a task called Dual-N-Back and studied its effect on healthy individuals WM capacity [1]. WM capacity was shown to increase over time and the longer the participants kept on training Dual-N-Back the more vast was the results on fluid intelligence (G_f). This was a remarkable find, because now instead of only increasing a person's ability to perform well on one area of tasks, the Dual-N-Back could actually transfer the effects of WM capacity to a variety of different tasks. [7]. As a side-effect, McNab et al., also showed [9] that cognitive training, specifically WM dependent training changed the density of dopamine D1 receptors in the prefrontal cortex and parietal parts of the brain significantly, allowing for better dopaminergic transmission in the frontal parts of the brain.

Dual-N-Back: How so?

N-back task

In this exercise, you will see a sequence of blue squares appearing one after another in different locations:



The presentation rate is quite fast. Every 3 seconds a new square appears.

If you look at the picture [above] to your right, you'll see that Dual-N-Back is based on your ability to hold information in your brain for a brief period of time. There are both visual and auditory input, and you work your way ahead in the Dual-N-Back, by starting at Dual-1-Back and then you continue further. In Dual-1-Back, you are only asked to remember one step back. This means that if you see a square in a spatial position the first time, you just remember that position and if it appears in the next square showed (after 3 seconds) you are supposed to press a key, if not you press nothing. In dual-2-back you have to look 2 steps back, which means that if you have a square in the same position as "1st" exemplified by the picture to your right, and the same spatial position for the square appears in the 3rd round you are supposed to press the key. That way you stress your working memory capacity because you constantly have to hold information in your brain at a given time.

Where do you get started? [Lumosity](#) (from where the picture to your right is taken) is one place where you can practice Dual-N-Back. If you are looking for free alternatives, [Soak Your Head](#) and [Brain Work Shop](#) are both excellent services.

That said, thanks for reading and I hope you'll utilize the information at hand. You could try to practice Dual-N-Back and report back with your subjective experience — I just started mine — now it's your turn!

Remember, the brain loves novelty (increases the wonderful molecule dopamine remember?) so trying new things like Dual-N-Back is always good for your brain.

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- Categorized under **Behavioral neuroscience**