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Is the Brain Like a Muscle, Really?

Po Bronson

Back in 2007, Ashley and I reported on the science of praise for New York magazine, highlighting in particular the body of work by Dr. Carol Dweck. Dweck had done studies for over a decade – and we covered them all – including a brand new semester-long intervention that had been conducted with Lisa Blackwell at Life Sciences Secondary School in East Harlem.

Life Sciences is a health-science magnet school with high aspirations but 700 students whose main attributes are being predominantly minority and low achieving. The scholars split the kids into two groups for an eight-session workshop. The control group was taught study skills, and the others got study skills and a special module on how intelligence is not innate. These students took turns reading aloud an essay on how the brain grows new neurons when challenged. They saw slides of the brain and acted out skits. After the module was concluded, Blackwell tracked her students' grades to see if it had any effect.

It didn't take long. The students who had been taught that intelligence can be developed improved their study habits and grades. In a single semester, Blackwell reversed the students' longtime trend of decreasing math grades.

The only difference between the control group and the test group were two lessons, a total of 50 minutes spent teaching not math but a single idea: that the brain is a muscle. Giving it a harder workout makes you smarter. That alone improved their math scores.

Ever since that New York magazine story was published, it's been common now to tell kids the brain is like a muscle, and intelligence is malleable. The catch was that the students at Life Sciences were reading a four-page middle-reader version of neuroscience-lite that was somewhat edited to enhance, or sell, the idea that IQ isn't fixed.

So it's been a legitimate ongoing question whether we're really now telling kids the truth, when we tell the brain is a muscle. Just how malleable is IQ, really? Are we misleading them at all, when we suggest their IQ is something they can control?

As Ashley and I wrote in *NurtureShock*, children's IQs do change a lot as they develop. More than half of children will see significant swings in their IQ – not just once, but three times. And the swings are not minor. Two-thirds of children's IQ scores improve, or drop, more than 15 points. One-third of kids' scores jump more than 30 points. So there's clearly a lot of instability going on.

But does that give us license to suggest to kids their brains can really be altered, quickly? Are we lying to them if we ignore there's some element of genetic predestination?

Well, that's why yesterday's column here was, we believe, so important. Drs. Silvia Bunge and Allyson Mackey set up a special afterschool program at a low-performing elementary school in Oakland. For eight weeks, twice a week, kids came into one of two rooms to play board games, video games, and card games. These are games available at most retailers, but they'd been chosen by Bunge and Mackey because they demanded very specific cognitive skills. One set of games – in one room – challenged the kids' reasoning ability. The other set of games – in the other room – challenged those kids' processing speed.

Before and after the training, the scholars measured relevant components of the children's IQs. The scholars expected some modest improvement. But the results were staggering – the group that trained for reasoning ability saw their non-verbal intelligence scores leap 32%. The group that trained for processing speed saw their brain speed scores jump 27%. In just eight weeks – 20 hours total of training – the games had a drastic impact on the kids' IQ.

Now, Mackey does warn that kids who already come from enriched home environments might already have these games, or something similar, and in many ways they might have already trained their brains. So while Mackey suspects all kids could benefit from the game training, not all kids would benefit so much, so quickly.

Nevertheless, it's striking evidence that indeed, the brain is like a muscle. While every individual probably has upper limits to what we might be capable of, brain training – like weight training, or fitness training – can lift us towards those limits.

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New Research: $13 Christmas gifts = 13 point gain in kids' IQ

Po Bronson and Ashley Merryman
Shoppers, you might want to redo your gift list after you read this.

Dr. Silvia Bunge, a neuroscientist at UC Berkeley, has long been interested in understanding the development of children's intelligence. She's been measuring kids' intelligence and scanning their brains for several years in order to understand what exactly makes some brains function better than others. This has given her unique insight into the mental processes kids are capable of, and how to test for it. Last year, Bunge and her graduate students decided to see if they could train up, or sharpen, children's minds. Their study might sound remarkably simple, but the results have been flat-out astonishing.

First, they went looking for off-the-shelf board games, card games, and video games that demanded distinct mental functions. One group of these games was chosen because they'd give children's *reasoning ability* a workout – these games require forethought, planning, comparisons and logical integration. The games chosen were card games like SET, the traffic-jam puzzle Rush Hour, and Qwirkle, a cross between Dominos and Scrabble. For the Nintendo DS, they chose Picross and Big Brain Academy. There were also two games for the computer – one called Azada, another called Chocolate Fix.

Bunge's team brought the games to an elementary school in Oakland with historically low state test scores. The researchers asked some second, third and fourth graders to stay after school to play. The kids' IQ averaged a 90, and their brain speed (a subtest of intelligence) ranked them at only the 27th percentile. The children's parents, on average, were high-school dropouts. These were the kids every education policy hopes to target, and every thought leader has an opinion on how to improve.

Twice a week, the kids played the games for an hour and fifteen minutes. Every fifteen minutes the kids moved to a new table, to make sure their brains always had something new to figure out. (The neuroscientists thought it was important the sessions remained fun.)

After just eight weeks – twenty total hours of game playing – Bunge's team retested the children's intelligence. They were specifically interested in the kids' reasoning ability. According to the classic theories of intelligence, reasoning ability is considered both the core element of intelligence and also the hardest to change. Allyson Mackey, Bunge's graduate student who supervised the study, thought she might see gains of 3 to 6 points, at most.

"From adult training studies, we knew some improvement was possible," said Bunge. "But it was enormous."

The children's reasoning scores, on average, leapt 32%. Translated to an IQ standard, that bumped them 13 points.

For comparison, consider that a 12 point gain is normally how much a child's IQ goes up after *an entire year of school*. By giving the children precisely targeted games, Bunge and Mackey were able to beat that, in just 20 hours of game playing.

Reasoning ability was not the neuroscientists' only target. Bunge's team was also interested in another component of intelligence, called *processing speed*. So, at the same time, a second group of games was assembled, and a second group of kids spent their afternoons in that classroom. "Those games didn't require memory or strategy, just very rapid visual recognition," described Mackey. These included traditional card games like Spoons and Speed, the video game Brickbuster, the board game Blink, and Perfection, in which kids must push 25 plastic shapes into a springboard in under a minute.

After the eight weeks, these kids' cognitive scores were tested as well. The kids who trained for speed saw their processing speed scores leap 27%; they began well-below average, but quickly reached a level far above-average. In football, a famous adage is "You can't teach speed." That doesn't seem to be the case for the brain.

Each group's improvements were domain-specific, so it was clear the games were the cause. The speed group saw only insignificant gains in reasoning ability. Those who trained on the reasoning games (and improved their reasoning) saw almost no speed benefit. Neither group saw improvement in working memory. This also suggests that cross-training is necessary for full-scale intelligence.

Bunge has concluded, "All parts of intelligence are malleable. They're all in the brain, and all of the brain shows plasticity. There's no evidence that some regions are most or less plastic than others." The presumption that some components of intelligence are more fixed than others isn't backed up by the new science.

Bunge's team, thrilled with their results, are continuing to build on this with new experiments. They're currently looking for more schools in Northern California to participate. The original study is now being reproduced, with kids who are having their brains scanned before and after the game training. Bunge is hoping to learn what's changed, on a neural level, in just eight weeks. She expects to find a pattern toward greater efficiency – more focused activity in the specific regions required by the tasks, and less activation of unnecessary brain regions. She might also find how the frontal lobe and the parietal lobe fire in concert, or even a physical change in the nerves connecting the two brain regions, making the network faster.

Perhaps the most important finding in Bunge's data is that the training helped the neediest kids the most. The farther down a child started on the rankings, the quicker and greater was his cognitive improvement. This is extremely rare in education interventions. Usually, smart kids benefit most, and the kids who struggle at the beginning only fall farther behind. Broadscale education reforms like smaller classes, teacher training, charter schools, and all-day schedules have pricetags in the millions of dollars.

Compare that to the cost of these games, which average only $13 (and Brickbuster [also called Breakout or Brickbreaker] can be played online for free):

Deck of Cards $1.25
Blink $5
Azada $7
SET $10
Perfection $12
Chocolate Fix $12

Rush Hour $18
Qwirkle $19
Big Brain Academy $26
Picross $20