

DIFFERENT VOICE

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The Science of Thinking Smarter

A Conversation with Brain Expert John J. Medina

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You can hardly escape reading about neuroscience in the press these days, and it's easy to see why the topic fascinates managers. Intellectual capital, after all, is what business is all about in the knowledge economy. Yet as with any new field of knowledge, there's a lot of hype about the benefits that recent developments in brain science might bring—for example, the popular notion that executives can become better leaders by emulating the “management” secrets of the human brain. Unfortunately, if you truly emulated the management secrets of the brain, you would create an organization that ran something like the stock-market floor in the closing minutes of Black Friday.

Few people are better qualified to help managers sift through all the hype than John J. Medina, a developmental molecular biologist with special research interests in the isolation and characterization of genes involved in human brain development and the genetics of psychiatric disorders. Medina is a private research consultant, working primarily in the biotechnology and pharmaceutical industries on issues related to mental health.

His résumé is not entirely corporate: He also holds joint faculty appointments at the University of Washington, in the department of bioengineering, and at Seattle Pacific University, where he is the director of the Brain Center for Applied Learning Research. He is the author of numerous books, including *Brain Rules: 12 Principles for Surviving and Thriving at Work, Home, and School* (Pear Press, 2008).

HBR senior editor Diane Coudu recently met with Medina to discuss the relevance of neuroscience to practical management. They explored, among other things, the neuroscience of stress and the link between exercise and cognitive power. By unpacking the neuroscience of stress, for example, companies can find new ways to dramatically improve the productivity of their knowledge workers and thus gain a competitive edge.

We seem to read about neuroscience everywhere these days. Why are people so interested in it right now?

I think it's because the brain is the most fascinating and complex information-processing

tool we have, and we are getting a clearer view of how it works. That's quite an undertaking. There are as many neurons in a typical brain as there are stars in a galaxy. That's amazing and sometimes really weird. There is a region in some people's brains that responds only to pictures of Jennifer Aniston or to pictures of Halle Berry. For some people, parts of their brain light up only when they are presented with an image of Bill Clinton. Those experiments have actually been done! The brain turns out to be so sensitive to external experiences that you can literally rewire it through exposure to cultural influences. So we have to ask ourselves: What other inputs besides Jennifer Aniston are capable of rewiring your brain? Is there a Boeing brain? A Goldman Sachs brain?

It's fascinating to have a better understanding of how the brain works, but I have to sound a note of caution, despite the stunning achievements. So far, scientists know amazingly little about how to apply our knowledge to real-world settings. If we understood how the brain knew how to pick up a glass of water and drink it, that would represent a major achievement. People outside the science community, of course, understand even less. I would encourage businesspeople to be a little bit skeptical about what they read in the popular press. Occasionally, I'll pick up an article in a magazine that says the new brain science can improve the practice of business, and I'll say, "Really?" I speak several dialects of brain science and feel comfortable in behavioral, cellular, and molecular biology, and I know very little about how brain science can yet be applied to business. Obviously we all have brains and we use them all the time in business. But it's just too early to tell how the revolution in neuroscience is going to affect the way executives run their organizations.

So there's no real reason for businesspeople to grasp developments in neuroscience, apart from raw curiosity?

I certainly wouldn't say that. Some of the things we've learned have great potential practical value. Look at the impact of stress on the brain. Stress hurts the brain, and that inevitably hurts productivity in the workplace. Our brains were built to survive in jungles and grasslands—we were built to handle acute stress. Take a dramatic event in evolutionary

history: A saber-toothed tiger is either going to eat you or force you to run away. In either case, the stress is over in less than a minute. You can probably have several of these spikes throughout the course of the day and handle the stress fine. In fact, it looks like stress is actually good for us in that it makes our muscles move. But for hundreds of thousands of years, we've been built to handle stress for only about 30 to 60 seconds. Nowadays, our stresses are measured not in moments with mountain lions, but in hours, days, and sometimes months, as we deal with hectic workplaces, screaming toddlers, bad marriages, money problems. Our bodies aren't built for that. If you have the tiger at your doorstep for years, then all kinds of internal mechanisms break down, from sleep rhythms to specific parts of the immune system. Enduring chronic stress is a little bit like taking a giant airplane and sticking it into water. The airplane wasn't built to be in water; the brain wasn't built to endure chronic stress.

What physical damage does stress cause in the brain that can affect our work and lives?

Stress causes the body to produce a really nasty set of hormones going by the tongue-twisting name of glucocorticoids. They're good for short-term responses to trauma and strain, but they aren't supposed to hang around for long. Certain types of stress can cause these hormones to overstay their welcome, and if they do, real damage occurs to the body, including your brain. The webbing between brain cells that hold your most precious memories can become disconnected. The brain can stop giving birth to new neurons.

Stress hormones seem to have a particular liking for cells in the hippocampus, and that's a problem because the hippocampus is deeply involved in many aspects of human learning. The result? Stressed people don't do math very well. They don't process language very efficiently, and they have poorer memories, both short- and long-term. These, of course, are the skills needed for individuals to excel in business. One study even showed that adults with chronically high stress levels performed 50% worse on certain cognitive tests than adults with low stress. Other studies estimate the financial costs of this lost productivity at more than \$200 billion a year—and that's a conservative estimate.

The brain isn't interested in reality; it's interested in survival.

Are there any genetic buffers against stress?

Some people do seem to have brains that are wired in such a way that they can overcome an enormous amount of stress. One extraordinary case in the psychiatric literature is a woman identified only as “Jill,” who endured unimaginably horrific abuse at the hands of her father, culminating in his killing himself in front of her. Nevertheless, she developed into a charming and quite popular young woman at school. She became a talented singer, an honor student, and president of her high school class. By every measure, she was emotionally well-adjusted and seemingly unscathed by the awful circumstances of her childhood.

Although the science of molecular genetics is not yet able to predict why certain people are as resilient as Jill, brain science is beginning to shed light on the genetic components of why more people do *not* have much resilience under stress. For example, there's a gene called 5-HTT. It helps regulate mood. You are much more likely to become clinically depressed under stressful circumstances if you have a mutation in this gene than if you don't. I suppose that at some point in the future we may be able to tell stress-tolerant from stress-sensitive individuals with a simple blood test, looking for the presence of mutations in genes such as 5-HTT. I should probably add, though, that Jill's story is not typical. Almost nobody could come out of her experiences unscathed.

Let's talk about memory. How reliable is it?

Brain research is pretty clear on this point. Bona fide recorded memory is a very rare thing on this planet. The reason is that the brain isn't interested in reality; it's interested in survival. So it will change the perception of reality to stay in the survival mode. Unfortunately, many people still believe that the brain is a lot like a recording device—that learning something is like pushing the “record” button and remembering is simply pushing “play-back.” In the real world of the brain, however, that metaphor is an anachronism. The fact is that the actual moment of learning—the moment of fixing a memory—is so complex that we have little understanding of what happens in our brains in those first fleeting seconds. Long-term memory is even worse. That's because, much like cement, memory takes a long time to settle into its permanent

form. While it's busy hardening, human memory can very easily be modified, as traces of earlier memories leave their imprint upon it. All of which is to say that our understanding of reality is approximate at best.

Is there any hope for producing reliable long-term memories?

Yes, but you will need to consistently reexpose yourself to the information. The phenomenon is called “elaborative rehearsal,” and it's the type of repetition shown to be the most effective for the most robust retrieval. We do know, for example, that you can improve your chances of remembering something if you reproduce the environment in which you first put it into your brain. If, say, you learn something while you are sad, you will be able to recall it better if at retrieval you are somehow made suddenly sad.

I wish I could tell you what all this means for business—for marketers, for example. How often must you repeat the message before people buy a product? What determines whether customers still remember the product's name and characteristics six months later or a year later? Scientists still don't know the answers to those questions. All I can say is that memory is not fixed at the moment of learning, and repetition improves the odds of retrieval.

Is it true what the psychiatrists and psychologists often tell us, that experiences in infancy and early childhood determine our destiny?

They're important but we're learning every day how much the brain grows and changes throughout our lifetime. Right now, right as we're speaking with each other, our brains are changing. The brain is like a muscle. The more activity you do, the more experience you have, the larger and more complex the brain becomes. Eric Kandel won the Nobel Prize for showing that when people learn something it's because the wiring of their brains changes. You can test sea slugs or human beings, and you will come up with the same results—any creature that ends up learning something does so because of physical changes in its neural architecture. This is astonishing. We used to think that we were born with all the neurons we were ever going to get and that it would be hard, if not impos-

sible, to change them beyond a certain age. But it's been quite clear for a while now that the physical changes neurons undergo when learning something happen to anybody's brain at any age. The brain remains quite plastic until we die. We are lifelong learners. That's excellent news indeed.

People claim that exercise is good for the brain. That seems to make good common sense, but what's the neuroscientific link between the two?

There's no end of research that connects exercise—especially aerobic exercise—with brain health. The links are many and varied. Just for starters, exercise is known to be good for the cardiovascular system. The brain has blood vessels as well, so it follows that exercise keeps the blood vessels in the brain healthy. One important consequence of this is that people who exercise are 50% less likely to contract Alzheimer's disease. Why is that? You might not know this, but the majority of Alzheimer's cases are probably not attributable to genetic factors, and there's a growing body of scientific opinion that many nongenetic Alzheimer's cases are vascular in origin. What seems to be happening is that some people suffer a lot of microstrokes that damage their brain in the same way that the genetic Alzheimer's sufferers experience. Aerobic

exercise that improves the vascular system obviously reduces the instance of these microstrokes and, with that, the likelihood of ending up with Alzheimer's.

In the absence of genetic testing, do you see any merit in the sort of psychological testing some businesses use, such as the Myers-Briggs test?

Oh dear—I have to admit to a certain grumpiness here. I have a very specific objection to how these tests are sometimes hyped. I've heard people claim that tests such as Myers-Briggs are based on "sound neurological principles"—that brain science proves their validity, or even that these tests were designed with brain science in mind. The fact is that most of these tests—including IQ tests—were developed long before we knew very much about how the brain processes anything. That doesn't mean that someday we won't be able to create tests based on sound neurological principles. Research is proceeding at such leaps and bounds that anything is possible. You don't have to hype the science. What it actually is turning up is astonishing enough.

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