

Can Our Brains Handle the Information Age?

Bret S. Stetka, MD; Daniel Levitin, PhD | September 24, 2014

Editor's Note: *In his new book, The Organized Mind, best-selling author and neuroscientist Daniel Levitin, PhD, discusses our brain's ability—or lack thereof—to process the dizzying flow of information brought on us by the digital age. Dr Levitin also suggests numerous ways of organizing mass information to make it more manageable. Medscape recently spoke with Dr Levitin about the neuroscience of information processing as well as approaches potentially useful to overworked clinicians.*

The Fear of Information

Medscape: Your new book discusses how throughout history humans have been suspicious of increased access to information, from the printing press back to the first Sumerian writings. But I think most would agree that these were positive advancements. Do you think the current digital age weariness expressed by many is more of the same and that today's rapid technological progression will end up being a positive development for humanity? Or has the volume of data out there just gotten too big for the human brain to handle?

Dr Levitin: I have two minds about this. On one hand, there is this "same as it ever was" kind of complaint cycle. Seneca complained at the time of the ancient Greeks about the invention of writing—that it was going to weaken men's minds because they would no longer engage in thoughtful conversation. You couldn't interrogate the person who was telling you something, meaning that lies could be promulgated more easily and passed from generation to generation.

And then with the invention of the printing press, people decried the plethora of worthless and useless things that would be written and that it would soften people's minds because they would be reading a bunch of garbage instead of good information.

And, of course, television was supposed to rot our minds. But that was when we had *Gilligan's Island* rather than *Breaking Bad* and *The Sopranos*.

So I think there is this cycle of being resistant to new technologies, and there is a settling-in period required where we learn how to use them properly. The first things printed on the printing press were pornography, and one of the first uses of the computer was for, again, pornography.

But there are loftier uses these developments can be put to. So that's one side of the coin. On the other side of the coin it does seem as though the available amount of information has approached some kind of maximum in terms of the human brain's capacity to deal with it.

If we look back at our evolutionary history, the amount of information that existed in the world just a few thousand years ago was really just a small percentage of what exists now. By some estimates, the amount of scientific and medical information produced in the last 25 years is equal to all of the information in all of human history up to that point.

The human brain can really only attend to a few things at once, so I think we are reaching a point where we have to figure out how to filter information so that we can use it more intelligently and not be distracted by irrelevant information. Studies show that people who are given more information in certain situations tend to make poorer decisions because they become distracted or overwhelmed by the irrelevant information.

How We Organize Information

Medscape: You write a lot about how humans have made use of externalizing information. What does this mean?

Dr Levitin: Externalizing is a fancy way of saying "getting stuff out of your head, if you possibly can." And we all do this. We write notes to ourselves. Books are a form of externalized information. You don't have to remember Avogadro's number or Planck's constant. You can look them up. And of course Google and Wikipedia have replaced books as the de facto sources of information that people don't need to keep in their heads.

Say you're in a public building—a movie theater, an auditorium—where there are a lot of people who, in case of emergency, might need to make a quick exit. The doors in these public buildings don't have signs telling you whether to push or pull. The actual construction of the door gives you this information. If there's a big horizontal bar, you know to push it. If there's a U-shaped bar, you know to pull. That is externalizing the information into the environment.

But the idea is to maximize that principle. David Allen, the efficiency expert, recommends a mind-clearing exercise to deal with all of the things competing for neurologic resources. Take anything that is a nagging voice in your head and write it down. Get it out on paper and externalize it. Depending on how busy you are, you might do this once a week or once or twice a day.

But another example is if you hear on the weather report that it is going to rain, why try to keep it in your head to remember to bring your umbrella? Put the umbrella by the door so you don't have to.

Medscape: It's a common concern that physicians are becoming overreliant on technology to access information. Do you think the fact that doctors no longer have to memorize, say, dosages does a disservice to patients? Or might externalizing information to computers and smartphones free up valuable neurologic resources that could be used for something else?

Dr Levitin: I see it as a good thing—I don't want to rely on a doctor's memory. It's not that doctors have bad memories, it's that we all have bad memories. It has been shown many, many times that memory is fallible. I want to be able to rely on my doctor as having an exquisitely tuned pattern recognition system so that when I walk in the door and he sees a cluster of symptoms, he puts it all together in a pattern-matching algorithm in his brain and says, you know, I think we should run this test, and you might have this, and this is what I think is going on from a diagnostic standpoint.

And from a treatment standpoint, I want my doctor to have acquired this pattern matching combined with some sort of intuitive Bayesian reasoning so that he or she is prescribing the thing most likely to work given who I am and my medical history and my cluster of symptoms.

But when it comes down to a dose or trying to remember the name of the generic for a brand name or vice versa, I love it that my doctor looks things up. It seems less fallible.

Medscape: Wasn't it Einstein who said, "Why should I memorize something when I know where to find it?", referring to phone numbers?

Dr Levitin: Yes. Again, it's about externalizing information. But to be clear, I am not saying that doctors don't need to be trained!

Patient-Driven Healthcare

Medscape: Patients are increasingly gaining access to their own medical information via digital means such as Websites and smartphone diagnostic applications. Do you think patients having more control over their own healthcare is a positive development?

Dr Levitin: Absolutely. When we talk about informed consent in the research laboratory and in patient care, doctors ask patients to sign a consent form, and the assumption is that they have been informed. Well, ethically speaking, the better informed a patient is, the better decision that patient can make about their own healthcare in consultation with their doctor and with loved ones. Patients arming themselves with information is important and a good idea, and websites like yours, Wikipedia, and the National Institutes of Health website make the information available.

However, the problem is that the layperson isn't trained, necessarily, to know how to distinguish a good source of information from a bad or biased source. The hazard is that somebody who hasn't engaged in critical thinking can end up at, say, a biased website and not realize it, and that is where consulting with medical professionals can help. I actually devote a chapter of the book to this kind of information literacy that I think is increasingly important. Here are two examples:

One involves patients increasingly asking their doctors the right questions. Suppose you go to your doctor and she says, "You know, your cholesterol levels are a little high. I'd like to start you on statins." Now, you've heard of statins, and you have friends who take them, so the recommendation may not surprise you. Your doctor explains that high cholesterol is associated with an increased risk for coronary heart disease, heart attacks, and other things, and the statins should bring down your cholesterol to safe levels. She writes a prescription.

From the way it is presented, you might think that the choice is to lower your cholesterol levels or have a heart attack. But to be fully informed, you want to ask your doctor for a particular statistic that doctors don't usually offer to you on their own—the *number needed to treat*, or the number of people that have to take the drug before one is helped. Some laypeople might think, "What kind of crazy statistic is that? The number must be 1. Why would my doctor prescribe something that won't benefit me?" But as you know, it doesn't work that way.

For one of the more popular statins that I researched, the number needed to treat is 300. So 300 people need to take it in order for 1 person to benefit. Still, you might say, "Why not? I'm not paying for it. My insurance covers it, and I will take a 1 in 300 chance in reducing my cholesterol as reasonable." But that same drug has a 5% probability of side effects, which include severe muscle and joint pain and gastrointestinal distress. So what I recommend in the book is to work through the math. For every 1 person helped, 15 people—that is, 5% of the 300—will experience side effects. So you are 15 times more likely to experience the harm of the medication than the benefit of it. I am not saying you should take it or not take it. I am just saying that you should be informed and have this conversation with your doctor.

The other example has your doctor mentioning a new drug, and you're trying to decide whether you want to take it. You look it up online and go to the first hit that Google gives you. The first question a patient needs to ask is, "Whose website is this? Has it been created by the drug manufacturer or maybe by the manufacturer of a competing drug? What biases might exist?" Also is the page current or a shill site? Some unscrupulous people will set up a site with a nice neutral-sounding name like, say, AmericansforBetterHealthcare.com (I'm making this up), and patients might assume it's legit. But they could be a shill for a pro or anti site regarding a particular treatment.

It could be assumed that any .gov site is probably more neutral than a .com, as we assume it goes through some kind of vetting. You should also look at other sites that link to the site. If the Centers for Disease Control and Prevention (CDC) is linking to it, that tells you it's probably a good source, although maybe the CDC is saying don't trust this site. These are all good questions to ask.

The Pitfalls of Multitasking

Medscape: You write about the downsides of multitasking, something many busy clinicians are likely familiar with. What is happening biologically when we multitask, and why it is not usually the best way to get things done?

Dr Levitin: Neurologically, when we "multitask," we are not actually doing several things at once. Instead, our brain is rapidly shifting from one thing to another, so we are actually sequentially unitasking. Unitasking is normally associated with good outcomes—you focus your attention on one thing for a sustained period of time, and you get quality creative work done. But if you are fractionating your attention into little five-second increments or one-second increments, moving from texting to your phone to email to your work, the effect is lowered productivity.

People who multitask think that they are doing a lot of things and being productive. And it's true that they are busy. They are engaged, and their arousal levels are high, physiologically, but according to a number of studies, they are actually getting less done. They are not saving time. They are wasting time. Multitasking also produces the stress hormone cortisol, which dulls your senses and cognition.

Medscape: In a recent *New York Times* op-ed, you discuss ways to avoid multitasking and better use our time. What can busy clinicians do to be more efficient?

Dr Levitin: It's difficult, but exercise the discipline to unitask. Allow yourself to become absorbed in one thing for a period of time before moving on to the next and avoid the constant distractions of text and emails. Some people open up a separate email account, and they only give the address to a few people who they need to be in touch with all the time. People get second cell phone numbers, and they only give that to a limited number of people for the same reason. It depends on your social circle. If you have people texting you all the time for reasons that are not urgent, you either have to ask them to stop or set up a separate phone number for the people you really need to hear from.

And the other thing, as I mentioned in the *Times* piece, is that taking breaks is really important. There is a reason that air traffic controllers are required to take them—they have a duty cycle of working for 60 to 120 minutes and then break for 15 to 30 minutes. It is law because it has been shown to work. You need to give your brain a chance to process and consolidate the information that it has been dealing with and reset itself. This is called the brain's "day-dreaming mode," when we are not actively engaged in a task but letting the brain process the information it has acquired.

Medscape: And often creative, innovative ideas are generated in this mode, correct?

Dr Levitin: Yes, much of our creative activity comes from there—the discovery of the benzene ring by August Kekulé, for example, and also Francis Crick's dream about the double helix of DNA. I think it is why judges often take things under advisement. After all the facts are in, they will take a few days before they render a decision. It is giving them a chance to ruminate about what they've heard. It wouldn't bother me if my doctor said to me, "We're looking at some lab results, and I need some time to think about this." I don't want the doctor making a snap judgment, unless of course it's an emergent situation. So depending on a clinician's specialty, I think many could benefit from taking breaks and using the day-dreaming mode to their benefit.

Clinician Takeaways

Medscape: What other information in your book might be useful for clinicians?

Dr Levitin: I have been teaching medical students for 15 years, so I know what their training involves. In my

experience, most doctors are not trained in the same way as science graduate students in terms of advanced statistical modeling. I am not faulting the doctors, but I think medical schools need to be teaching Bayesian inferencing, for one, to improve estimates of something based on new information. It is something anybody can learn in an afternoon.

In a medical situation, an example would be a patient showing up with a blue face and the doctor trying to figure out if they have the "blue face disease" or not. Maybe the blue face disease only occurs in one out of a million people who present themselves to a doctor, and there are other causes of having a blue face like having stuck your head in a bowl of blueberries or lack of oxygenation. There are multiple potential causes, so you don't want to jump to conclusions. You want to think about the rarity of the disease, right? Doctors do this intuitively, but they don't always work it out mathematically because they haven't been given the tools. This is where Bayesian modeling could be useful.

Here's another example: Suppose you bump into somebody at your local Starbucks, and without looking at them I ask you what the odds are that the person you bumped into is the Queen of England?

Medscape: I would say next to zero.

Dr Levitin: Right. Now, I say, oh, by the way, the Queen of England is visiting your town today. What are the odds that the person you bumped into is the Queen of England?

Medscape: Higher, maybe half a percent.

Dr Levitin: Right, you adjusted it based on new information, and with Bayesian inferencing, you could actually work this out in numbers. You might start with the population of your town during the day, the proportion of people who are in the Starbucks at any given time, and the likelihood that the Queen would go to a Starbucks—then you could come up with a reasonable numerical estimate.

Now, suppose I tell you the Queen of England is visiting Brooklyn and she has decided to visit *your* Starbucks and, in fact, they have closed it off. Nobody is allowed in it except her and her entourage, but you emerged from the bathroom unknowing that all of this was going on and you bump into somebody. Now what are the odds?

Medscape: It's either the Queen, a member of her entourage, or a Starbucks employee. The odds are much higher.

Dr Levitin: Exactly. This is the essence of Bayesian reasoning, and it has deep implications for medical decision-making. One other issue that could be relevant to clinicians is our tendency to fall into errors of reasoning. I'm not ragging on doctors here. Of course, medicine has had tremendous successes, and a number of diseases that were likely to kill a large proportion of the population have been entirely eradicated. Doctors have expertise that no one else has, and they are very good at what they do. But they are human.

Take cardiac bypass surgery. The last time I looked at the statistics, there were half a million performed in the United States every year. Now, what is the evidence that it is helpful? Randomized clinical trials show no survival benefit in most patients who have the surgery, but surgeons are thinking about the logic of the procedure as justification for it. You have a plugged vessel. You bypass the plug. You fix the problem. End of the story.

So if doctors think a treatment *should* work, they tend to think that it *does* work even when the clinical evidence isn't there. Angioplasty went from 0 to 100,000 procedures a year with no clinical trials. Like bypass surgery, the popularity was based simply on the logic of the procedure.

That said, I have been focusing here on high-profile cases like cardiac procedures and prescription drugs, but the

fact is that if you have something wrong with you, you don't go running to a statistics book. You go to a doctor, and, you know, good doctors are really amazing at what they do.

Medscape: You also provide a number of tricks for working around memory deficiencies in your book—practical tips like leaving a strange object by the door so you are reminded to complete some task. Have you worked at incorporating these approaches into, say, dementia or Alzheimer disease management?

Dr Levitin: I haven't worked directly with this, but I believe that these are helpful for people with Alzheimer disease or other cognitive impairments. Externalizing is what it is about. Even if you don't have Alzheimer disease, having things like a pill dispenser with the days of the week and the times of day is very helpful. I talk about the neurologic reasons for this. Taking a pill is such a commonplace activity that unless you have the mind of a Zen master, in all likelihood you've forgotten the act five minutes after completing it. And this is worse in cases of dementia.

The reason you don't forget that you ate breakfast is that your homeostatic system is telling you that you are not hungry. But you've got no homeostasis for having taken most pills.

Medscape: What's next for you?

Dr Levitin: We are undertaking a number of studies in our lab and with our collaborators on trying to better understand this mind-wandering mode and its efficacy in creativity and productivity. We are looking at possibly doing developmental studies looking at how children develop, and by developmental I mean the way that the mind-wandering mode functions in people of different ages.

We are also looking at empathy in humans and mice—trying to understand the factors that increase empathy. And I haven't decided what my next book will be, but I'm writing all the time. I write every day.

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