

Attention, attention: your most valuable scientific assets are under attack

How digital contraptions and online accounts are contributing to academic attention deficit disorder

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You have no idea how hard it was for me to get these words onto this page. No, I do not have a terrible bout of writer's block. There is not a pedantic editor standing in my way. And it is not because I don't have the time to prod at my wireless keyboard. I cannot even blame the distraction of my 3-month-old son who has decided that the only options in life are to scream or be bounced.

Believe it or not, the fault lies entirely with my thumb—my right thumb, to be exact. This is the digit that I use to unlock my iPhone, to click on my email app, to scroll through my Twitter feed, and to text. It is my thumb that gets snared by online clickbait, leading me down the rabbit hole of Internet oblivion. It is this undisciplined and calloused thumb of mine that is responsible for my shrinking attention span, lack of productivity, and inability to sit down and write more than 140 characters.

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The “online” university

Laugh at me all you want, but have you spent much time on a university campus lately? Check out an undergraduate classroom, visit the library, hit up the gym, peek in on a

research laboratory, or stop by a faculty meeting and you will see that I am not the only one who would be well served by a thumb amputation. Sometimes it seems like all of academia has lost the ability to look someone in the eyes and listen for more than five minutes at a stretch without getting sucked back into the void of their digital devices.

Of course, I am far from the first to sound the alarm bells of our growing obsession and seeming addiction to social media and all things Internet. But I believe it is fair to say that most scientists, especially senior scientists, have disregarded these warnings, thinking they are aimed at online-obsessed, Facebook-reared post-millennials rather than seasoned, lab-hearty scholars with highly groomed intellects, finely tuned abilities to focus, and masterly time-management skills. Although many researchers may turn their noses up at the mindless distractions of Instagram and Reddit and may feel that they are above the endless banter of Snapchat and WhatsApp, those same researchers are often very quick to update their scientific social media accounts at each and every hour of the day and night, not to mention the multitude of scientists who have become incessantly active on Twitter.

As any active academic can attest, the world of research, publishing, and teaching is becoming bogged down with digital accounts and endless online updates. It is no longer enough to have a CV. You need LinkedIn, Google Scholar, and ResearchGate. And while you are at it, get yourself Scopus, ORCID, and ResearcherID profiles. To be thorough, you should also sign up for ImpactStory, Academia.edu, and Loop. Do not stop there. Track and record your peer-review activity through Publons, Elsevier's

Reviewer Recognition Platform, and Peerage of Science. Submitting a research article sometime soon? You should probably upload the manuscript to a preprint server like bioRxiv and deposit the raw data in Dryad. And do make sure to blog and tweet about your work to get maximum impact.

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Relax, take a deep breath, and wipe the sweat off your brow. You have wasted an entire day signing up for and propagating these services, but now you can sit back and take solace in the knowledge that anyone who googles your name will find oodles of information about your boundless productivity and academic activity. Enjoy this period of peace and quiet because the moment you open your inbox, you will be inundated with dozens of notifications on your new scientific social media portfolio.

“Bloody spam”, you will shout at the screen as you quickly delete these emails, which will arrive in greater numbers each week. But try as you might, you won't be able to resist following some of the links. Cool, so and so from Cornell started following you. How interesting, a student from Tanzania liked one of your papers. Wow, three others shared the same paper on Twitter. And, my goodness, that essay you posted online is starting to go viral.

Soon, you won't need an email to remind you to check in on your online accounts. You will do it intuitively while waiting in line for coffee, sitting through a boring meeting, and trying to write a grant. Then, my friend, you will be like me, cursing your thumb for stealing your most valuable scientific asset: your attention span.

The burgeoning attention economy

We live in an era of constant online distraction, and sadly, this is by design rather than by accident. In a recent feature article for the *Guardian Weekly* newspaper, Paul Lewis describes how even some of the designers, engineers, and developers of Silicon Valley are growing uneasy with the so-called attention economy that they helped create [1]. For the article, Lewis interviewed a range of social media pioneers, including software engineer Justin Rosenstein, who a decade ago developed the prototype for what became the Facebook "like" button, a feature which he now characterizes as giving "bright dings of pseudo-pleasure". Rosenstein recounted how this past August he started using extreme measures to limit his use of social media and other addictive online technologies, going so far as to instruct his assistant to activate parent-control features on his iPhone, thus, preventing him from downloading apps.

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"It is revealing", wrote Lewis, "that many of these younger technologists are weaning themselves off their own products, sending their children to elite Silicon Valley schools, where iPhones, iPads, and even laptops are banned". This touches upon the crux of the problem: if the very people who designed these technologies are taking such extreme measures to abstain from them, then how does the average person stand any chance at online self-control?

Research shows that we touch, tap, or swipe our smartphones on average 2,617 times a day [2] and that simply having the

device in the room, even if it is turned off, is enough to impair cognitive capacity [3]. It is becoming clear that these new technologies employ the same techniques long used by the gambling industry, namely variable rewards. Just like a slot machine, many of the most popular and addictive apps have a swipe-down-to-refresh mechanism, whereby each time you drag and hold you do not know if you will get a new update or nothing at all. Similarly, explains Lewis, "LinkedIn exploits a need for social reciprocity to widen its network ... [and] YouTube and Netflix autoplay videos and next episodes, depriving users of a choice about whether they want to keep watching".

Equally as concerning is the role that social media and their attention-grabbing designs are having on politics and news, creating a culture in which sensationalism, shock, and impulse are prioritized over fact, thoughtfulness, and reason. I cannot help but wonder how these same technologies are impacting science.

A study by web researcher José Luis Ortega found that scientists who actively tweet about their research are more likely to have that research disseminated, thus, improving the prospects of increased citations [4]. In a similar study, Ortega showed that "journals with their own Twitter account obtain more tweets (46 percent) and citations (34 percent) than journals without a Twitter account" [5]. But alongside the benefits of increased impact from these technologies come many drawbacks.

For better or worse, it is now easier than ever for researchers and students to compare themselves to their peers and colleagues. I am ashamed to admit that part of my online morning routine involves a quick stop at my Google Scholar page just to make sure my H-index has not shrunk overnight. With one click on ResearchGate, I can see the activity and rankings of my coworkers in the biology department at the University of Western Ontario, including the most popular members by publication reads. Using ImpactStory, I can follow the activity that my publications are generating online, from blog and Reddit posts to news stories and Wikipedia entries. Five minutes on Twitter and I have my fingers on the pulse of all the academic boastings and moanings that the day has to offer.

Does any of this information make me a better scholar? On top of being a diversion, it certainly makes me more self-conscious and

self-obsessed; it fills me with brief flashes of aggrandizement and arrogance and a long-lasting sense of inferiority, which, in some ways, echoes studies showing higher rates of anxiety and depression among teens and young adults who regularly use social media [6,7]. That these technologies contribute to our continuous attention deficit and can cause us to constantly compare ourselves with others may not be the worst of it. They might also be inhibiting another invaluable behavior: boredom.

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Embracing boredom

In her new book *Bored and Brilliant*, journalist and podcaster Manoush Zomorodi argues that our gadgets are robbing us of the age-old problem of ennui. Indeed, for many of us, myself included, the minute we find ourselves with nothing to do, we immediately reach for the soothing diversion of a smartphone to rescue us from boredom, which Zomorodi believes is obstructing the creativity of a wondering mind. This is not such a strange concept. Just think of all the times you have had an interesting idea or found a solution to a problem while doing absolutely nothing—standing in the shower, walking to work, waiting for an elevator.

As a marathon runner, I can vouch for the benefits of boredom. Every week I spend hours training by myself without any digital devices (I use an analog watch) or distractions apart from the passing scenery. Not surprisingly, my runs are the times of the day when I do my best and most creative thinking, be it outlining an undergraduate lecture, solving a pesky experiment, or rewriting an abstract in my head. In fact, whenever I find myself intellectually constrained, I reach for my sneakers and head for the trails.

Zomorodi provides a number of compelling reasons of why we should embrace an aimless mind and spend time away from our devices. She notes that "whenever society

acquires a new technological skill or ability, there's an unsettling period during which we're besotted with the technology, using it indiscriminately without really understanding its effect. While swearing off our devices isn't necessarily the solution, for many of us the honeymoon phase with our gadgets is decidedly over" [8]. We could all benefit from having better ideas and more of them, but scientists in particular should take heed of Zomorodi's advice, for the true currency of their job *is* ideas.

Discriminating distractions

Digital contraptions and the attention economy are not going away, and they will likely have increasingly central roles in our daily lives and in science. As the research landscape continues to shift toward bigger and bigger data, scientists will inevitably be spending more and more time online, and will therefore be particularly susceptible to digital distractions. As a bioinformatician, I am finding it almost impossible to stay on track during my analyses. I scan the news while waiting for my BLAST results, scroll through Twitter while the alignment runs, and what I would not give to have back all that precious time I wasted during genome assemblies. I find myself in a conundrum: how can I wean myself of these bad habits while still spending hours a day on my computer?

The answer likely lies in first accepting the inevitability and near ubiquity of online contraptions in our personal and professional

lives, and then learning how to leverage these devices and their software for our own constructive needs, rather than the other way around. It is also important to differentiate between effective and ineffective online tools and services. For scientists, these services range from the handy and very useful to the impractical and improvident. Uploading a manuscript to a preprint server like bioRxiv, for example, may take a bit of time, but it has many appreciable benefits [9], including the advantage of constructive feedback before or during the conventional peer-review process. Conversely, continually logging on to ImpactStory or ResearchGate to evaluate your online scientific celebrity status is arguably a complete waste of time. But as many of us already know, restricting our use of these less productive tools is harder than it sounds.

And so, you might ask, how did I ever end up getting these words onto this page. The old-fashioned way, of course: with a pencil, eraser and pad of paper, and my iPhone and laptop eagerly awaiting my attention in another room. If only you could see my handwriting, you would realize just how dire the situation has become.

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Conflict of interest

The author declares that he has no conflict of interest.

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