Is the internet bad for us?

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One night last year, Zach Levine invited a friend to sleep over at his family's Forest Hill home. Shortly after arriving, however, the friend pulled out a laptop.

Zach had been hoping for a tech-free night, even though the 12-year-old's parents call him the family's "most-plugged-in guy." But when Zach suggested the pair play the board game Monopoly, the friend ignored him, logging on instead to the single-player online game Minecraft.

When Zach asked him to put away the machine, the friend complied — then wandered over to a desktop computer and tried to download Minecraft.

Zach was hurt, but not really surprised. His classmates often prefer going online rather than talking face-to-face, the eighth-grader says, and the results worry him.

"They have trouble starting conversations, they don't look you in the eye, they don't really know how to converse with a friend," he says. "(The internet) turns you backward socially."

A man checks his phone outside of Union Station.

AARON HARRIS FOR THE TORONTO STAR

Nearly two decades after the advent of the modern-day internet, the use of wired digital technology, including smartphones, laptops and tablets, has exploded. The average Canadian spends more than 45 hours online each month, according to ComScore, a global internet use tracker. And a new nationwide Angus Reid/Vision Critical poll conducted for the Star found more the one-third of wired Canadians use internet-ready digital devices before getting out of bed in the morning, and nearly 50 per cent click away right before falling asleep.

In June 2012, Canadians sent nearly 270 million texts per day, according to the Canadian Wireless Telecommunications Association. In 2005, the monthly average was 4.1 million.

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But this explosion is not without costs. A growing body of research now suggests heavy technology and internet use across the wired Western world has negative effects on how we think and behave. It raises our stress levels. It shortens our attention spans and how efficiently we multi-task.

And mental health professionals are concerned enough about the web's omnipresence that in May, "internet use disorder" will be included as a topic bearing further research in the revised edition of the *Diagnostic and Statistical Manual of Mental Disorders* — the standard guidebook for diagnosing psychiatric illness across North America. There are now programs across North America that treat internet addiction, including one at Toronto's Centre for Addiction and Mental Health, which currently has more than 200 patients.

"It's easy to say, 'Oh, people have always worried about technology,'" says science journalist Nicholas Carr, the author of The Shallows: What the Internet is Doing to Our Brains, which was nominated for a 2011 Pulitzer Prize. "But it's also important to realize we've never had a technology like the internet, one that we interact with with such regularity and such intensity, and that we carry around with us all day in our pockets.

"I think we owe it to ourselves to worry about it."

Sharon Zikman, Zach's mom and a 46-year-old physician, says she sends about 20 emails or texts daily to her son and daughter, 17-year-old Alex, though both kids agree many are incoherent. Michael Levine, their father, says he is online most of the day, but only to stay in touch with work and family. For better or worse, the parents say, digital devices are a necessity of 21st-century life.

"When everybody else has it, it's really hard to extract yourself," says Michael, a 49-year-old technical writer.

While researchers are wary of branding the internet as good or bad, the worrisome results of overuse are beginning to crystallize. One major area of research is anxiety.

Sending an email or text establishes a process that experts — including addiction specialists — call "reward anticipation." Once a message is cast, the sender immediately craves a response. That craving creates low-level anxiety, which is ameliorated once the reply arrives, says Larry Rosen, a California-based psychologist and author of the 2012 book, *iDisorder: Understanding Our Obsession with Technology and Overcoming Its Hold on Us*. But, he says, the relief is short-lived: the cycle repeats once a new message is sent, creating a constant state of anxiety.

"Our predisposition as human beings is to reduce anxiety," Rosen says. "We want our bodies to stop reacting to it, and the way we do that is by checking our phones."

In a recent study of 175 college students, Rosen found taking a break from technology only exacerbates anxiety. The psychologist confiscated cellphones from half of his test subjects, then measured all the participant's anxiety levels every 20 minutes over an hour-long period. Those free to check their phones displayed a constant level of stress; those deprived exhibited a significant increase as the seconds ticked by, showing heightened signs of worry, frustration and despair.

As we burrow deeperinto the internet's knotty maze, scientists also caution it's taking a profound toll on the way we behave. The way we act online is beginning to manifest itself in our 3D lives, says Elias Aboujaoude, a Stanford University psychiatrist and author of the 2011 book, *Virtually You: The Dangerous Powers of the E-Personality*.

New research has found a strong correlation between more Facebook friends and bipolar mania, narcissism and obsessive-compulsive behaviour. One controversial study, published recently in the influential journal *Pediatrics*, traced excessive social media use by children and adults to what researchers labelled "Facebook depression." (The phenomenon was disputed last year by researchers at the University of Wisconsin.)

"The internet ... is creating major shifts in our personalities and our psychological health," Aboujaoude says. "These include a tendency to act in less-mature ways — narcissism, continuously putting yourself on a pedestal, grandiosity. The consequence is to become more and more like your avatar. In a way, that transforms your life not only before the browser but in your offline life as well."

Karen Blair, co-founder of the Canadian culinary competition Gold Medal Plates and a mother of two, has seen a change in how her husband and her 14-year-old daughter behave with digital technology always at their fingertips. Her husband, whom she also works with, struggles to unplug while on vacation, and she constantly coaches her 14-year-old daughter on social etiquette, especially during one-on-one interactions.

"When you're (talking) with someone else and you're not talking to (my daughter), you can all-of-a-sudden turn back and she's on her technology, she's not *there*," sighs Blair, who lives in Toronto's east end.

In her 2011 book *Alone Together: Why We Expect More from Technology and Less from Each Other*, Massachusetts Institute of Technology psychologist Sherry Turkle notes that we've handed over our lives to our devices.

"Overwhelmed by the volume and velocity of our lives, we turn to technology to help us find time," she writes. "But technology makes us busier than ever and ever more in search of retreat. Gradually, we come to see our online life as life itself."

Researchers say this is especially pronounced among teenagers and young adults who have come of age with the internet. Zach, for example, estimates he spends up to six hours online each day. Alex, who got her first cellphone in Grade 3 when she started travelling to school by herself, puts her daily total closer to five hours, though she texts incessantly.

But when relationships exist predominantly online, what happens to real-world interaction, when someone shyly begs a friend for homework help or boldly asks a crush on a date? Some experts worry critical communication skills are underdeveloped among a growing cohort of plugged-in preteens and teenagers.

Last year, sociologist Clifford Nass and a team of Stanford colleagues published a groundbreaking survey of more than 3,000 girls age 8 to 12 from across Canada and the U.S. Nass asked how often the girls interacted face-to-face with people their own age. Those who identified as heavy technology users said they felt "less normal" and "rejected" by their peers during human interactions, Nass wrote in an essay published last year in *Pacific Standard* magazine.

On the other hand, face-to-face communication was "the one positive predictor of healthy emotional interactions, as well as feelings of social success....," Nass wrote. He blames the tween girls' social unhappiness on a failure to learn emotional behaviour, a direct result of the amount of time spent with their screens.

"If you want to understand emotional life, you get that from watching other people," Nass says. "When you're face to face, you have to move quickly, you have to think fast, you really have to focus because people's faces and emotions can change in a matter of seconds. When you're texting or on Facebook, you have plenty of time, you can think through things. By not really exercising those abilities, they atrophy."

Inside the Levine's home one recent evening, the family banters garrulously about technology. They extol its joys, sharing how Zach studies Torah with his grandfather over Skype. Later, Sharon playfully chided Alex, who was checking her iPhone every few minutes.

Michael and Sharon put great effort into controlling their family's technology use, including banning devices from the dinner table and insisting on offline hobbies like part-time jobs, sports and theatre.

"We have lots of technology, but heavy limits," Sharon says.

Still, Michael remembers a car ride not long ago with Alex and two of her teenage friends, silent except for the muted tapping of fingers on touch screens. And Zach regularly receives texts from friends at 5 a.m.

The troubles of technology use have undeniably seeped into the Levines' daily lives. But Michael wonders if it even matters.

"I think it's so prevalent," he says, "I wouldn't even give it a second thought."

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It was exam time, but few of the would-be studies in the third-floor reading room at the University of Toronto's Robarts library were actually studying. Instead, the pattering of iPhone keystrokes punched holes in the silence. Stacks of books sat ignored while their owners fiddled with their BlackBerrys, then their laptops, then their BlackBerrys again.
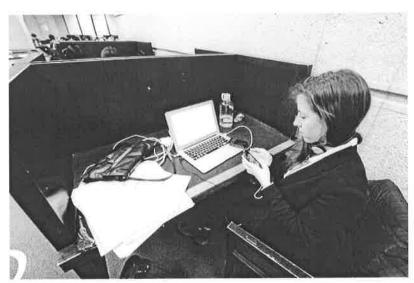
Surrounded by dozens of inveterate multi-taskers,Robin Newman, a 26-year-old former events co-ordinator for a Toronto non-profit, sat in the room's pale fluorescent glow, studying for the GRE exam she was taking that weekend. The standardized test, she believed, was her ticket to graduate school in New York. And yet she was distracted, scrolling through Facebook photos of online friends.

Like most people, Newman is a dervish of never-ending, often-unfocused internet use, constantly plugged in to her laptop, smartphone or iPod, often at the same time. While she insists digital multi-tasking is not difficult and allows her to juggle a seemingly impossible number of tasks, Newman acknowledges her ability to focus is increasingly fragile.

"You're too spread out," she said of her digital habits. "I do know it (diminishes) my ability to do certain things better."

Scientists agree. New research examining how digital technology affects our cognitive functions is beginning to paint a dismal portrait of how our internet-saturated brains operate. Neuroscientists believe using digital technology excessively can decrease the brain's capacity for intense focus and ability to store memory, leaving us perpetually distracted and incapable of deep or profound thought.

Experts used to believe the brain was unchanging, and fully developed by the age of 20. But research has found the brain constantly alters over time — a process called neuroplasticity. The neural pathways we use to complete any activity — playing the piano or baking bread, for example — are strengthened when we repeat it, writes Norman Doidge, a Toronto psychiatrist and neuroplasticity expert, in his 2007 book *The Brain That Changes Itself*. But those same pathways can deteriorate from underuse.

Scientists have yet to determine what exactly the brain looks like after years of internet use, but they say exposure to a deluge of text messages, Tweets and hyperlinks is leading to a slow but steady rewiring of its neural circuitry.

"People are spending more time with technology, so their brains are getting wired to go with the technology," says Gary Small, a neuroscientist at the University of California, Los Angeles and the author of *iBrain: Surviving the Technology Alteration of the Modern Mind*.

In a landmark 2008 study, Small gathered 24 adult volunteers — half internet greenhorns; the other half experienced surfers — and outfitted them with goggles projecting a Google search page and a hand-held keyboard. Under an MRI scan, the test subjects were asked to Google U.S. mountain geography, the health benefits of walking and the nutritional contents of coffee.

Among the internet-savvy volunteers, Small recorded heightened brain activity, especially in the prefrontal cortex, which is critically responsible for attentiveness, problem-solving and strategic thinking, compared with the web neophytes. Years of internet use left their cranial fireworks sparking brighter than the newbies. He then asked the novices to spend one hour online each day for a week. When they returned to the test centre a week later and lay through a second brain scan, Small discovered an astounding development.

"After just five days of practice, the exact same neural circuitry in the front part of the brain became active in the internet-naïve subjects," he later wrote in *iBrain*. "Five hours on the internet, and the naïve subjects had already rewired their brains."

The results, Small has written, were the first evidence that internet use (in this case, Google searching) tinkers with our brains. And they were, to an extent, positive: the internet-savvy volunteers were exercising a larger portion of their brains than those with little internet experience, notably in the regions controlling decision-making and complex reasoning.

But while the brains of heavy internet users were more active, there was evidence in Small's study suggesting they also were less efficient. Consider what happens when we're faced with a basic 500-word online news article, peppered with hyperlinks. As science journalist Nicholas Carr details in his 2010 book, *The Shallows: What the Internet Is Doing To Our Brains*, when a reader scrolls over a hyperlink, the brain stops processing the content on the page, allowing the prefrontal cortex a brief moment to consider the new option: to click or not to click.

That disruption halts the information gathering and interpretation process. Scientists say the more often that happens — as we wander through Wikipedia or traverse a web of Reddit links — the harder it becomes to retain information.

In other words, "we're optimizing our brains for distracted, piecemeal, very rapid-paced information processing," Carr said in an interview. "And we're probably weakening our ability to screen out distractions and read deeply and concentrate on one thing."

All that stimulation has a negative effect, says psychologist Larry Rosen, author of *iDisorder: Understanding Our Obsession with Technology and Overcoming Its Hold on Us*. "The problem is that when you have a hyperactive brain, you're not thinking very clearly."

For better or worse, digital multi-tasking has become ingrained in our busy, harried lives. Children text message friends while video-Skyping with their parents; lovers at the movies spend the previews writing emails on their iPhones; teenagers from YouTube to Twitter to text message without hesitation.

In a 2010 Kaiser Family Foundation study of more than 2,000 8- to 18-year-old Americans, the average respondent claimed nearly 11 hours of daily media multi-tasking, a more than three-hour daily increase since 1999.

But scientists are divided on its cognitive effects. In 2009, a team of Stanford researchers ran groups of "heavy media multi-taskers" and "light media multi-taskers" through a series of cognitive tests in which college students were shown an image of a red rectangle and asked to spot its reorientation when a second image, which included a distracting blue rectangle, was displayed. The heavy media multi-taskers failed miserably.

"They showed very high distractibility, an inability to filter out information and difficulty with focus," Clifford Nass, a Stanford University sociologist and study author, said in an interview. "They literally are worse at switching from one task to another."

While switching back and forth from one digital device to another may appear seamless in practice, brain power, Nass said, is effectively spread too thin for hard, critical thinking or effective memory recall. As tasks are piled on, the prefrontal cortex finds it increasingly difficult to manage multiple actions.

This inability to focus, Nass said, means heavy multi-taskers often perform "bottom-up" rather than "top-down" thinking — they attempt to draw conclusions from many pebbles of information instead of solving problems by searching for a big-picture solution, a central threat. Nass's results suggest the ceaseless to and fro corrupts critical thinking.

"High multi-taskers … don't use their insights, they don't leverage their understanding of things to make things more efficient," he said.

But if, as scientists posture, the brain is wired like a humming city, always adapting, digital multi-tasking can be harnessed. The brain can be trained.

"It's a bit like a physical workout," Small said. "You exert more energy initially, but with practice you can do more, you're efficient. If we get too much of a good thing and we're constantly multi-tasking, the quality of our lives deteriorates. It's a question of balance."

When Newman wakes up each morning, her BlackBerry, which also serves as an alarm clock, rests on the floor next to her bed. The smartphone, along with an iPhone and laptop, are with her throughout the day, and the trio of digital technology is at arm's reach when she falls asleep.

Even when she tells herself to close the lights at 10 p.m. she, like many, often falls into a distracted pattern online. Next thing she knows, the clock strikes 1 a.m. "You've just been aimlessly searching through the internet, finding yourself in that snowball effect of one click to another click," she said.

Newman performed poorly on her GRE last month. In the weeks since, she has considered rewriting the four-hour-long exam. She acknowledges her attempt to study while juggling social media was inefficient, if not an entirely bad idea.

"You have to be disciplined to say, 'I have this tool of the internet, how am I going to use it?'" she says. "You can use it for really great purposes, or really no purpose at all."