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THE NET GENERATION BRAIN

When he was a premed student at the University of Rochester, C. Shawn Green used to stay up late on a lot of nights to play Counter-Strike. It's an action-packed video game that pits a team of counterterrorists against a team of terrorists. One morning in September 2000, Green sat down in front of his computer, not to return to the game, but to work on an experiment being conducted by the university's Brain and Vision Lab.

Something was wrong. The experiment was supposed to test whether deaf people had quicker visual reflexes than people with hearing. Participants had to identify an image flashing quickly on a computer screen that was filled with visual clutter. If the average Joe could pick out the target 50 percent of the time, would deaf people do better? But when Green took the test himself, he scored 100 percent. It must be a programming mistake, he thought, so he dragged his best friend into the lab. His buddy scored 100 percent too. Now Green was pretty sure there must be a programming error. So he brought a second friend into the lab. This one scored only 50 percent, just as expected.

What was happening? Then the light went on. Green and his best friend played video action games all night, while the other guy didn't. He was too busy being a resident advisor, helping out the younger students on his dormitory floor. It may not sound like an insight that ends up in the pages of the world's leading scientific journals, but it was. Green had stumbled onto concrete

evidence that interactive technology—in this case, action video games—can change the brain, and in particular, the way we perceive things. As Green and his mentor, Daphne Bavelier, described it in a seminal article in *Nature*, these games can make you notice more in your field of vision and speed up your processing of visual information.¹

When you consider the powerful evidence scientists have built over the past 20 years showing that brains change and evolve throughout a lifetime, Green's study is not as surprising as you might think. Everything we do, they've discovered, leaves a physical imprint on our brains. Scientists have found that parts of the brains of the best-informed London cabbies are larger than those of other drivers. The brain is particularly adaptable to outside influences in the first three years of life and then during teenage and early adult years, which is just when most Net Geners are immersing themselves in interactive digital technology 20 to 30 hours per week.

While there is much controversy, the early evidence suggests that the digital immersion has a tangible, positive impact. Not only do video game players notice more, but they have more highly developed spatial skills that are useful for architects, engineers, and surgeons. What's more, I can see from my own observations that the average Net Gener is quicker at switching tasks than I am, and quicker to find what they're looking for on the Internet. Although the research is in its early days, and not completely conclusive, the evidence in support of this is mounting. The Net Gen mind seems to be incredibly flexible, adaptable, and multimedia savvy.

I believe that we will see that being immersed in an interactive digital environment has made them smarter than your average TV-watching couch potato. They may read fewer works of literature, but they devote a lot of time to reading and writing online. As we will learn, that activity can be intellectually challenging. Instead of just numbly receiving information, they are gathering it from around the globe with lightning speed. Instead of just trusting a TV announcer to tell us the truth, there are assessing and scrutinizing the jumble of facts that are often contradictory or ambiguous. When they write to their blog or contribute a video, they have an opportunity to synthesize and come up with a new formulation, which leads to a giant opportunity for them. The Net Generation has been given the opportunity to fulfill their inherent human intellectual potential as no other generation.

Now I know that some people don't agree with me. English professor Mark Bauerlein thinks that young people today are "the dumbest generation." "Dumb," the Merriam-Webster online dictionary tells us, is an old English word that

means "lacking the power of speech." It can also mean lacking intelligence, as in stupidity, or "not having the capability to process data." Is that the case? We will see, later in this chapter, just how wrong the professor is.

THE BRAIN CAN CHANGE, EVEN AFTER CHILDHOOD

Back when I was a teenager, most scientists thought that the human brain had nowhere to go but down. For 400 years, as psychiatrist Norman Doidge tells us in his brilliant book, *The Brain That Changes Itself*, "mainstream medicine and science believed that brain anatomy was fixed. The common wisdom was that after childhood, the brain changed only when it began the long process of decline; that when brain cells failed to develop properly, or were injured or died, they could not be replaced."² This theory of the unchanging brain held that the brain was like a "glorious machine," Doidge writes. "And while machines do many extraordinary things, they don't change and grow."³

Modern scientists have now disproved this theory. The brain, Doidge and other scientists tell us, does change and grow throughout a person's life. The study that examined the greater memory capacity of London taxi drivers involved the scanning of those drivers' brains, which produced some amazing results. It turned out that the hippocampus, which is associated with memory function, was larger in these taxi drivers than it was in all other categories of drivers of the same age. Similarly, research conducted using musicians who played stringed instruments revealed that, even among those who started learning the violin, cello, or guitar as adults, the musicians' frequent repetition of their finger exercises led to a different brain structure than that of nonmusicians.⁴ Both these studies support the idea that continual and intense use of a particular brain region can lead it to respond like a muscle, increasing its size and presumably its efficiency.⁵

It might not take that long to train the brain to function differently either. Researchers already know that when blind people use their fingers to read, information from their fingers is processed through the visual cortex. In other words, they're using their fingers to "see." But what happens if sighted people are blindfolded? A series of studies exploring this very question showed that sighted people can improve tactile (Braille character) discrimination. What's more, after only five days of being blindfolded, their visual cortices had heightened responses to touch and sound. Another study showed that mentally rehearsing a move can produce changes in the motor cortex as big as those induced by physical movement. One group of participants were asked to play a simple five-finger exercise on the piano while another group were asked

to think about playing the same “song” in their heads using the same finger movements, one note at a time. Both groups showed a change in their brain functioning, with differences among the group who mentally rehearsed the song as great as those who physically played the piano.⁶

The research shows, in other words, that the brain can change throughout life as it responds to environmental influences. Children’s brains can change

“Anytime you engage in immersion over long periods of time, it’s going to reflect brain structures.”

—JOHN SEELY BROWN, DIRECTOR EMERITUS OF XEROX PARC AND A VISITING SCHOLAR AT USC

to a greater degree than adult ones can, but the adult brain can and does change. “Neuroscience has shown that, in the most literal sense, the events of our lives get etched in the

very physical structure and the activities of the brain,” states Dr. Stan Kutcher, an internationally renowned expert on adolescent mental health, who with his son Matthew, a Net Gen neuroscientist, conducted a study measuring the effect of digital technology on human brain development for the nGenera research program.⁷

THE ADOLESCENT BRAIN: A WORK IN PROGRESS

By the time Net Generation kids reach their twenties, the typical Net Gener has spent over 20,000 hours on the Internet and over 10,000 hours playing video games of some kind.⁸ This immersion is taking place at a time when their brains are particularly sensitive to outside influences—adolescence and their teenage years. Recent studies show that although total brain volume is largely unchanged after age 6, the brain continues to undergo significant structural remodeling throughout the adolescent years and into early adult life. The studies show that brain regions associated with attention, evaluation of rewards, emotional intelligence, impulse control, and goal-directed behavior all change significantly between age 12 and 24. These neurological changes during adolescence may explain, in part, why many teenagers appear to be disorganized, have poor impulse control, and have difficulty making long-term plans.

Research done at the National Institute of Mental Health (NIMH) documented some of the physical changes that take place in the brain between the ages of 4 and 20. It turns out that the volume of nerve cells in the frontal and parietal lobes, which are thought to be responsible for goal-directed behavior and other higher functions, peaks at age 12.⁹ How can that be? NIMH researchers suggest that after age 12, the brain starts pruning, reducing connections among brain cells. Say, for example, you learned a language from your mother but stopped using it when you started speaking English. The pathways

needed to speak your mother’s language will die off, while the other neural pathways associated with speaking English will get stronger. In other words, you use it or you lose it. This pruning period lasts until about age 20.

Some studies suggest that the teen brain processes, operates, and functions differently than the adult one. Sarah-Jayne Blakemore of University College London conducted a series of studies in which participants were asked to answer hypothetical questions while their brain activity was monitored by MRI imaging. When the question was an impersonal one, the teens, whose average age was 15, used the same parts of their brain to answer as did the 28-year-old adults. But when they were asked a question like “You are at the cinema and have trouble seeing the screen. Do you move to another seat?” the teens used different parts of their brain to answer.¹⁰ As this evidence suggests, the teen brain itself—not just our understanding of it—is still a work in progress.

DIGITAL IMMERSION: DOES IT AFFECT THE TEEN BRAIN?

Gamers Notice More: They Process Visual Information More Quickly

Can growing up digital affect the physical structure or the activities of the teenage brain? If so, how? One significant clue comes from the study by Green and Bavelier referred to above, which was conducted using keen action game players, aged 18 to 23, who played action games like *Grand Theft Auto III* and *Crazy Taxi* for at least one hour a day. The researchers set up five experiments to test whether playing action video games affects what you notice in a jumble of visual information. As researchers who study visual attention can tell you, what you notice is quite different from what you see. If you happen to be reading these words at your computer, for example, you might not be paying attention to other things in your field of vision, like the coffee cup sitting on the side of your desk. That’s because your brain has a mechanism directing it to pay attention to some things in your visual field, and to pay less attention to the rest. In other words, it’s not what you can see that really matters; it’s what you notice.

Green and Bavelier’s experiment compared hard-core action game players with non-video-game players on a standard test—with the usual array of squares, diamonds, and circles flashing on a computer screen. The idea was to evaluate how much each group noticed outside the target they were focusing on. The experiment showed that experienced video game players noticed more. Then the researchers looked at whether video game players could process rapid-fire visual information more effectively than could nonplayers. Once again, the video game players were better at this. You might think it’s because the action game players had greater natural abilities; that’s why they were

attracted to the games in the first place. But it turned out, as Green and Bavelier showed in a third experiment, you could learn to speed up your visual processing after only 10 consecutive days playing Medal of Honor!

“Although video game playing may seem to be rather mindless, it is capable of altering visual attentional processing,” Green and Bavelier concluded. In other words, people who play a lot of video games can track more objects at one time than people who don’t. Second, they are better at monitoring a cluttered world; they can more quickly identify a target briefly presented in a field of clutter. And third, the experienced game players are better at processing a rapid stream of visual information. “We saw really big differences between the groups with the people who played the action games far outperforming the people who didn’t,” said Green and Bavelier. Yet, “the most important thing that we did in that paper was that we took a group of non-game-playing people, trained them on an action game, and saw similar improvements. This showed us the act of playing games can drive this improvement; it’s not necessarily a population bias that the people who actually played the action games also naturally had better vision.”

Gamers Develop Other Skills Too—Skills that Are Useful for Surgeons

Green and Bavelier’s finding builds on other research showing other ways that video game playing affects the brain. It improves hand-eye coordination, quickens reaction times, and benefits peripheral vision. It improves spatial skills, the ability to mentally manipulate a 3-D object, which is helpful for architects, sculptors and engineers, and might be associated with improved results in some fields of mathematics. It can even prove useful in the training of surgeons. Laparoscopic surgery is a minimally invasive technique in which a camera and operating instruments are inserted in the body via miniscule incisions of about a centimeter. Laparoscopic surgeons conduct their operations only by seeing the images from the tiny internal camera. In a 2004 study, it was observed that younger doctors who were video game players being trained in laparoscopic techniques learned the skills more quickly and made fewer errors than did non-game-playing counterparts.¹¹ In fact, the researchers found that a surgeon’s game-playing experience was a better predictor of his or her future success at laparoscopic surgery than was years of experience!

Video games also teach young people to work in teams. As Generation X came of age, the arcade video games available to them were largely about competition: scores were kept, and there tended to be a winner for every loser. In contrast, popular video games today highlight adventure and exploring what is around the corner, often in real time. They place extraordinary demands on

multidimensional visual-spatial skills; enhance abilities for divided attention;¹² and encourage players to discover rules through observation, trial and error, and hypothesis testing.¹³ They often require cooperation with opponents to defeat a common enemy offering problems to be solved collaboratively and creatively, and acting in a global community—signifying the movement of the game-playing experience to being social rather than a solitary activity.

Playing online games is good for your mind, according to Steven Johnson, writing in *Everything Bad Is Good for You*: “Games force you to decide, to choose, to prioritize.”¹⁴ Some of the world’s leading thinkers in this field agree. When James Gee, a teacher and theoretical linguist, started playing video games at age 60, he realized he had to think in a new way. To excel at a video game you have to learn skills that are crucial for any learning experience, such as understanding design principles, making choices, practicing, and discovering.¹⁵

Matthew Myers, for instance, is a 21-year-old student at Southern Methodist University. He’s the captain of his wrestling team, a church youth leader, and president of his dorm. He’s also second-in-command in his guild, and every week he spends a few hours playing World of Warcraft. “I’m taking a class on managing people and strategy,” he says. “I can take all the lessons that I learn in class and apply them to my guild.” He continues to note that managing a group of 40-plus players is a complex job. There are new players to recruit and current guild members who need help raising their skill levels as they pursue quests and run raids.

Gaming: A Lesson in Trial and Error

To SMU student Matthew, the vast landscape of the game is the perfect Net Generation classroom. It’s interactive, fun, and challenging. He gets to apply his knowledge in a game environment. I’ll bet it beats having to listen to a boring lecture any day. John Seely Brown, director emeritus at Xerox PARC and a visiting scholar at USC, argues that games like World of Warcraft have a positive impact on learning. “Unlike education acquired through textbooks, lectures, and classroom instruction, what takes place in massively multiplayer online games is what we call accidental learning,” he says. “It’s learning to *be*—a natural by-product of adjusting to a new culture—as opposed to learning *about*. Where traditional learning is based on the execution of carefully graded challenges, accidental learning relies on failure. Virtual environments are safe platforms for trial and error. The chance of failure is high, but the cost is low and the lessons learned are immediate.” Says Jerry Michalski, “Look at what it takes to run a guild raid in World of Warcraft. There is an immense amount of coordination, data management, and strategy.” Gamers are not a bunch of lon-

ers, he says. “We’re all bemoaning the so-called decline of social interaction. But kids are growing up with very deep social skills. They still hang out and when playing games or using the Web, they are interacting socially.”

INTERNET SCREEN TIME: DOES IT AFFECT THE WAY NET GENERERS ABSORB INFORMATION?

What about the overall effect of spending so much time in front of a screen—not a TV but an interactive screen? Does the medium affect the way we absorb the information? Back in the 1950s, Marshall McLuhan argued that it does. The way we receive information—by reading a book, watching a movie, or listening to someone on the telephone—has a big impact on the brain, and that impact is even more important than the actual content of the message. In other words, McLuhan said in his famous but somewhat oblique line, “the medium is the message.”

The great Toronto thinker did not, of course, have the benefit of modern brain scans. So Erica Michael and Marcel Just of Carnegie Mellon University did a brain scan to test McLuhan’s hypothesis. It turned out that he was right: the brain constructs the message differently for reading and listening. “Listening to an audio book leaves a different set of memories than reading does,” say Michael and Just. “A newscast heard on the radio is processed differently from the same words read in a newspaper.”

You’d expect, then, that information absorbed on the Internet would have a different impact than information obtained by reading the newspaper. A 2006 study of Net Geners certainly suggests it does. Researchers played the same newscast in four different ways—as a traditional radio newscast, as an online newscast played with one click, as an interactive Webcast where you click to get each news item, and as a Webcast that included links for details. Net Geners remembered less from the traditional newscasts—told from beginning to end—than they did from the interactive versions that gave them a chance to click to hear the news or learn more details.¹⁶

Net Geners Don’t Always Start at the Beginning

The boomers typically go from beginning to end—whether it’s writing an essay, watching *The Ed Sullivan Show*, or reading the instructions before working the remote control. That’s how boomers, who were raised before Web sites, learned to absorb information. The Net Generer doesn’t operate in this sequential way. Using tools like keywords in Google, hypertext, and “clicking, cutting, and pasting,” today’s young person can search for and organize information containing links to other information.¹⁷ William D. Winn, director of the

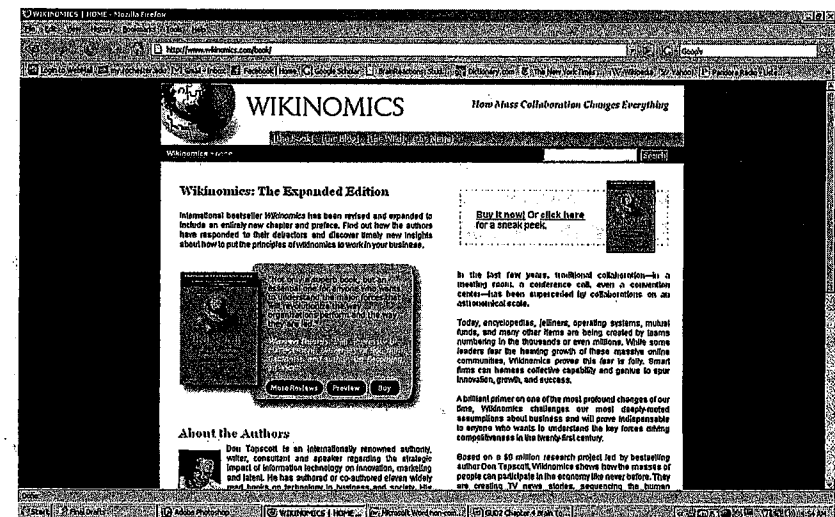
Learning Center at the University of Washington’s Human Interface Technology Laboratory, put it this way: children “think differently from the rest of us. They develop hypertext minds. They leap around. It’s as though their cognitive structures were parallel, not sequential.”¹⁸ This is one way that digital immersion has literally rewired brains under 40, Marc Prensky argues in his book *Digital Game-Based Learning*.¹⁹

For example, when faced with a novel software package or video game, young people tend to explore first, and then ask for help by consulting a social network when stuck later. “I know that when people start playing video games, kids especially, they jump right in and they start playing it; then if they don’t understand something, then they read the instructions to see what in the world they don’t understand,” says researcher Green. “Whereas, from my experience, older adults start by reading the instruction manual and then start playing the game, which is a real difference in kind of thinking about the problem.”

Net Geners Look at It Differently

The differences between Net Geners and boomers even show up in the way their eyes move around the screen. Try this out: Take a look at my Web site for *Wikinomics*. If you’re a boomer, I bet you’ll start looking at the top left corner as you search for the text to tell you what this is all about. Your eyes will probably move from left to right, from top to bottom. You’ve been trained to read that way.²⁰

FIGURE 4.1 THE WIKINOMICS WEB SITE



If you are a member of the Net Generation, on the other hand, you'll probably view it differently. I would guess that you started with the image of the book cover jacket. Then you moved on to the colored call-out box and text that explains what *Wikinomics* is about, "how mass collaboration changes everything," and that I am soliciting your help in making the *Wikinomics* Playbook. Then you likely turned to the body text to confirm your initial assumptions about the Web page. You see it this way because you've grown up digital and you've been trained to understand the meaning of a number of recognizable icons or images that quickly give you information at a glance. From your preschool days navigating on *SesameStreet.com*, you probably learned that size and color are cues signaling the importance of that piece of information.

Visual Experts

Net Geners who have grown up digital have learned how to read images, like pictures, graphs, and icons. They may be more visual than their parents are.²¹ A study of Net Gen college students showed that they learned much better from visual images than from text-based ones. Students of a Library 1010 class at California State University (Hayward) tended to ignore lengthy step-by-step text instructions for their homework assignments, until the instructors switched their teaching methods to incorporate more images. The results were dramatic: students' scores increased by 11 to 16 percent.²²

The early evidence suggests, as we discussed earlier in this chapter, that digital immersion may alter Net Geners' visual systems, especially the speed of their visual reflexes. It may also alter the way they like to take in information and what they remember. But does it also affect the way they think?

MULTITASKING: ARE NET GENERATIONS BETTER AT SWITCHING ATTENTION?

Media multitasking is a quintessential characteristic of the Net Generation brain. Three out of every four Net Gen students claim to instant message while doing their homework.²³ Moreover, in a national study of over 2,000 young people, aged 8 to 18, researchers found that participants were able to squeeze the equivalent of 8.5 hours of electronic media into 6 chronological hours because of their penchant for multitasking.²⁴ Most parents can't understand it. Boomers usually have trouble focusing on a complicated task if the TV is on, the music is cranked up, and friends are checking in every few minutes. Are Net Geners any better at it than boomers are? Have they learned to be top guns of multitasking?

Many commentators are quick to say no. They complain that the digital world is cutting the Net Geners' attention span. "Most kids have the attention

span of a gnat," complains one observer. They're "screenagers," said another,²⁵ or even "The ADD [attention deficit disorder] Generation."²⁶

Most researchers take a dim view of multitasking. Psychological research has shown that our ability to do two things at once is limited. We can obviously walk and talk, but that's because walking and talking tap into two different mental channels, and one of those activities, walking, is automatic for adults. But if we try to think of two things that tap into the same channel, like a verbal one, we run into trouble. We're more likely to make mistakes. We slow down. Our brains cope with the overload of capacity by switching from one task to another, and unlike

"It is a part of human nature to be bored and not pay attention a lot of times. But the occasional or frequent daydreaming and boredom aren't ADD, damn it!"

—REBECCA DOBRZYNSKI, 20,
PHILADELPHIA, PENNSYLVANIA

computers we don't switch very efficiently. The result, according to University of Michigan psychologist David Meyer, is that multitasking might double the time it takes to do two tasks, compared with doing them one at a time. There's little evidence that teens are any better than adults, he said. "To think that you're invulnerable because of age, it's delusional," he told one of my colleagues. "It's a myth."²⁷

To see whether young people really can multitask more effectively than older people, the Oxford Future of the Mind Institute conducted a study comparing Net Geners, aged 18 to 21 years, with people age 35 to 39. Net Geners performed 10 percent better on intensive problem-solving exercises without disruption than those aged 35 to 39 years. However, interruptions from communication-based messages (phone call, cell text message, or IM) caused the Net Geners to lose their cognitive advantage over their older counterparts. In other words, the thirtysomethings caught up in speed and accuracy.²⁸ So even though the Net Geners "think" more quickly, they are less effective at recovering from disruption when faced with a complex cognitive task.

Yet I see a different picture when I observe young Net Geners outside the laboratory—and the way they handle a multitude of streams of information coming in on their laptops or the tiny screens on their BlackBerrys and mobile phones. Is it possible the lab research is not yet sophisticated enough to measure the complexity of what occurs in the real world? My daughter Niki is a great example of this hyperconnected generation. She prefers to work at our kitchen table when she's not traveling on a work assignment, even though she has a killer office set up in her bedroom. She says she'd rather "be where the action is"—working while dealing with the dog, having her parents come in and out (rooting around the refrigerator), window for work documents open, multiple

Internet windows open for research, IM and Facebook windows open for communication, and ear buds in for music. Still she was a straight A student and is a rising star at the consulting company where she now works. I don't know how she does it. I simply can't work and listen to music at the same time. Geez, to me, my kids seem like air traffic controllers, constantly monitoring all those open windows on their computers.

When I look at my own children, their friends, and legions of other Net Geners, this is what I see: They're faster than I am at switching tasks, and better than I am at blocking out background noise. They can work effectively with music playing and news coming in from Facebook. They can keep up their social networks while they concentrate on work; they seem to need this to feel comfortable. I think they've learned to live in a world where they're bombarded with information, so that they can block out the TV or other distractions while they focus on the task at hand.

"People will often ask me, 'Are kids today different than kids 20 years ago?' Well, yes, they are. Because the world is different, their brains have wired up in a different way."

—MARTIN WESTWELL, OXFORD

agrees. "Their attention spans are not short for games, for example, or for music, or rollerblading, or for spending time on the Internet, or anything else that actually interests them," he writes. "It isn't that they can't pay attention, they just choose not to."²⁹

They May Be Faster Switchers, but Can They Think?

Jordan Grafman leads the cognitive neuroscience section at the National Institute of Neurological Disorders and Stroke (NINDS). He acknowledges that the experience of growing up digital may make this generation quicker to switch from one thought to another. "If you're multitasking a lot as a kid, the likelihood is that your brain will develop around your adaptive behavior," he says. "Would it change the brain to optimize multitasking? The answer might be yes." But then he asks the core question: "Does optimizing for multitasking result in better functioning—that is, creativity, inventiveness, productiveness? The answer is, in more cases than not, no." While Net Geners may learn to switch focus on more quickly than their parents do, he says, that doesn't mean they'll be able to think more creatively or more deeply about a complicated issue. "The more you multitask," he says, "the less deliberative you become;

So why do some Net Geners seem to have attention deficit disorder in class? Isn't it possible that the answer is because they're bored—both with the slow pace and with the content of the lecture? Author Marc Prensky

the less you're able to think and reason out a problem and the more you're willing to rely on stereotypical solutions." Meyer agrees. "You can't think deeply about a subject, analyze it, or develop a creative idea if you're constantly distracted by an e-mail message, a new site, or a cell phone call," he says. Boomers can't do it; kids can't either.

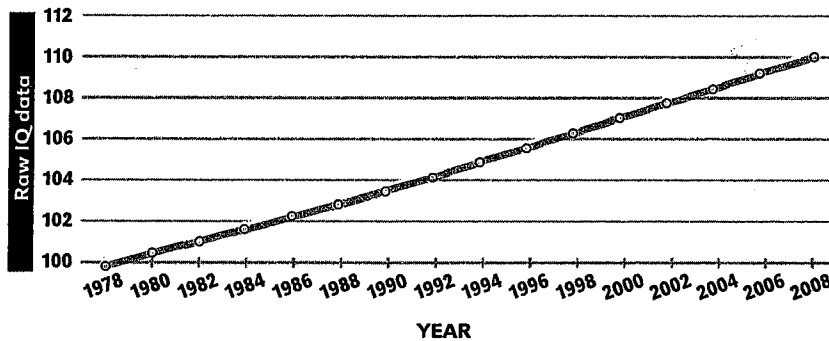
A Critique from the House of Lords

The question these eminent scientists raise was eloquently expressed by Baroness Susan Greenfield, the glamorous and iconoclastic neurobiologist who sits in England's House of Lords, England's unelected upper house in the British government. I think it is worth exploring her argument, because she reflects the views of so many critics of digital immersion. On April 20, 2006, the baroness rose in the august chamber. Her fellow peers had just witnessed a scene that could be straight out of Monty Python, when the eleventh Baron Monson stood up to suggest that ordinary people might not realize that if you change the time on the country's clocks and watches so that the sun sets later at night, it will also rise later in the morning.

Greenfield, a pharmacology professor at Oxford, asked the unelected upper house a pertinent question: "Could this screen and multimedia culture impact our thinking and learning?"³⁰ She answered it with her trademark panache. "When we of the twentieth century read a book, most usually the author takes you by the hand, and you travel from the beginning to the middle to the end in a continuous narrative series of interconnected steps," she said.

"We then, of course, compare one narrative with another. In doing so, we start to build up a conceptual framework that enables us to evaluate further journeys, which in turn will influence our individualized framework. One might argue that this is the basis of education—education as we know it. It is the building up of a personalized conceptual framework, where we can relate incoming information to what we know already. We can place an isolated fact in a context that gives it significance. Traditional education has enabled us, if you like, to turn information into knowledge.

"Now imagine that there is no robust conceptual framework. Imagine you are sitting in front of a multimedia presentation where you are unable, because you have not had the experience of many different intellectual journeys, to evaluate what is flashing up on the screen. The most immediate reaction instead would be to place a premium on the most obvious feature, the immediate sensory content—we could call it the 'yuk' or 'wow' factor. You would be having an experience rather than learning. Here sounds and sights of a fast-

FIGURE 4.2 IQ SCORES ARE ON THE RISE^{32*}

Source: *The Net Generation: A Strategic Investigation*, © nGenera 2008

*Data is from the U.S.

paced, fast-moving multimedia presentation would displace any time for reflection or any idiosyncratic or imaginative connections that we might make as we turn the pages and then stare at the wall to reflect.”

Greenfield called for more study to see just how new technology is affecting the developing brain. Of course we need to study this; so much is unknown. But are the Baroness and her fellow critics right? Is screen time turning young people into a generation who just say “wow” and “yuk” instead of thinking about what they’re reading? Mildly alarmed, I read the rest of the Baroness’s speech to see what evidence she had amassed to back up her concern. Greenfield’s argument led with a complaint that children are using the Internet without the benefit of how-to lessons, presumably from adults. That’s when I started to chuckle. Just imagine: she wants the teachers to show the Net Generators how to use the Internet! I think, as my daughter Niki might put it, that’s an LOL, or an OMG (or, for the benefit of the Baroness, that’s “laugh out loud” or “oh my God”).

And where was the proof that they fail to develop the intellectual skills to evaluate what they were reading? Even Baroness Greenfield had to acknowledge that there is, according to the National Literacy Trust, “no conclusive evidence that reading standards are deteriorating.”³¹ According to the Literacy Trust, she told her peers, reading from a screen is just as good as reading from a book.

TECHNOLOGY AND THINKING

In the fall of 2007, the National Endowment for the Arts in the United States released a report with a disturbing title: *Reading at Risk*. It revealed that only one-third of 13-year-old kids in the United States are daily readers of literature—down 14 percent from two decades ago. And nearly 1 in 5 17-year-old

kids don’t read literature at all, double the number of non-literature readers there were 20 years earlier. The survey did not, however, show that young people are reading less. They read more online than offline, and that’s usually non-fiction, which was not included in the survey of literature.³³

Now, as the writer of 12 books, I would never argue that kids should stop reading and buying books and just pick up bits of info on the Internet. I can only encourage young people to read more to expand their horizons and formulate the conceptual framework that the Baroness thinks is so crucial for the intelligent reader. Reading books of fiction and nonfiction is obviously important. Kids emulate their parents’ reading habits, and if their parents read to them as youngsters, they’ll probably love to read too. My wife reads a novel a week, and Niki and Alex have followed in her footsteps. Both are voracious readers of books, including plenty of fiction. So if you’re a parent and you think your kids should love reading, read to them as kids and show them the love of reading by your own behavior.

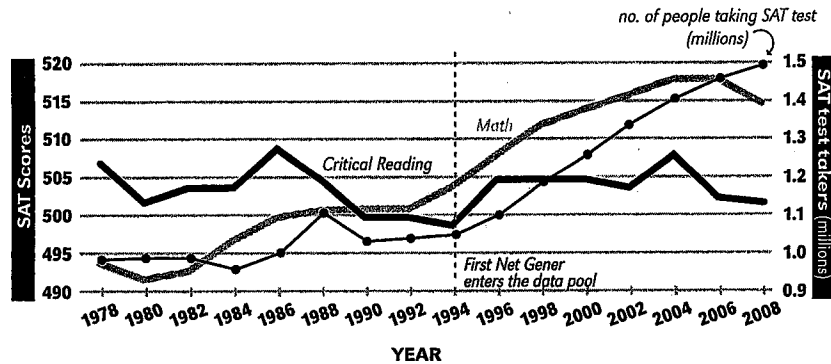
Yet the real question is whether screen time discourages kids from developing the critical thinking skills that the Baroness mentioned in her speech. I do not share the Baroness’s suspicions. Far from anesthetizing young brains, digital immersion can, in my opinion, help them to develop critical thinking skills, the ones you need to navigate in today’s fast-paced information-saturated world.

You Need Those Key Mental Skills to Read and Search

Back in 1992, P. David Pearson, a comprehension theorist at the University of Illinois, set forth the skills that a good reader uses to understand a text. The good reader activates prior knowledge, makes sure she understands what she’s reading and reads it again if necessary, makes inferences, and synthesizes or summarizes what she’s learned—which is what you need to do to develop the intellectual framework that Baroness Greenfield mentioned in her speech. It turns out that searching for information on the Internet requires those same skills—and then some—according to a study in the September 2003 issue of the *Journal of Adolescent and Adult Literacy*.³⁴

Searching for information on the Internet is obviously a different exercise than reading a book. You read or scan until you have found what you wanted, and then you click on a key word to hunt for more information. Unlike the journey you take when you read a book, no one is holding your hand or serving as your guide. You’re on your own. But it requires the same skills you need to read a book—plus the ability to scan, navigate, analyze whether information is pertinent, synthesize, and remember what question you’re trying to answer as you

FIGURE 4.3 MORE STUDENTS TAKING SAT BUT SCORES REMAINED STABLE OR UP*



Source: The College Board³⁷

*Large numbers of students take the SAT, not just the elite, top students, as was the case in the past. These data points correspond to both the restructuring of the SAT to include a written section and a decrease in the amount of people taking the test more than once. The rate of students who take the test only once increased to 49 percent from 44 percent, and the rate of students who took the test three times dropped to less than 13 percent from about 15 percent the previous year.

click on the links. The RAND Reading Study Group put it this way in 2002: “Accessing the Internet makes large demands on the individuals’ literacy skills; in some cases, this new technology requires readers to have novel literacy skills.”³⁵

In some ways, searching on the Internet is more demanding than reading in the conventional way, according to Donald Leu, codirector of the New Literacies Research Team at the University of Connecticut and a member of the International Reading Association’s International Hall of Fame. The online reader must not only read the text and understand it, but create his own mental journey as he clicks on the links to search for information. Because the reader is doing these two things at the same time, “online reading comprehension becomes by definition more complex.”³⁶ Leu believes we need to redefine literacy to include “literacy skills necessary for individuals, groups, and societies to access the best information in the shortest time to identify and solve the most important problems and then communicate this information.” Reading online, in other words, is not necessarily any less intellectually challenging than reading a book. It’s just different, and it requires different skills.

Making Sense of the Mass of Information

As boomers, we spent a lot of time hunting for information. We couldn’t always find it—maybe the library was closed on the night we had to finish that essay—so we grew up with a lot less information at hand than the Net Genera-

tion has. It made life easier in some ways. It’s easier to jump to a conclusion when you don’t have a lot of information to analyze. The Net Generation has the opposite problem—an avalanche of information coming from an astounding diversity of sources. This presents a real intellectual challenge. You have to make sense of different kinds of information that may be contradictory or ambiguous or just plain confusing. You have to really think about it to come up with an original view. You have to integrate that information into an argument or a solution, says author Prensky. That encourages what he calls “problem-based learning.” If you practice it a lot, you may get better at it and improve your critical thinking skills. Now, of course there is a big if in that sentence. It may not work out that way. As Kutcher, the expert in adolescent mental health, points out, we tend to pay attention to the information we already think is true. People tend to look for information that confirms their belief and reject information that contradicts it. Even academics do this, Kutcher says: “That’s the problem with the digital age. You can find stuff you like and ignore the rest.”

But let’s talk about the potential. The availability of vast amounts of information—when and where you want it—could help Net Geners develop the conceptual frame of reference needed to interpret incoming information, which is so crucial for the sophisticated reader. After all, they’re not just clicking. They’re reading a wider array of material than I did at school. They may even find that their frame of reference is challenged by new information, and will evolve. That to me is one of the characteristics of intelligence. So I believe the challenges of the Internet can actually provoke the Net Gen to do the hard thinking to make sense of a broader scope of information than the one that would have been available to the boomer. In fact, according to the Kutchers, “there is emerging evidence suggesting that exposure to new technologies may push the Net Gen brain past conventional ‘capacity limitations.’” They argue the Net Gen brain may be able to execute certain perceptual tasks more rapidly, and may maintain more items in working memory.³⁸

Scanning Helps

In order to deal with all that incoming information, you have to be a great scanner. Digital immersion has given the Net Generation the visual skills that make them superior scanners. They’ve learned to develop the filters they need to sort out what’s important from what’s not. But—and this is a big but—the outcome turns on the filter they choose, Stan Kutcher explains. If they are simply swayed by visual clues, they could easily be misguided by savvy designers. If, on the other hand, they learn to override the visual clues and zoom in on key words of

importance, then they have developed a huge skill for dealing with the massive information inflow in this media-saturated world.

A New Form of Intelligence: "Distributed Cognition"

Digital immersion may encourage a new form of intelligence, according to Henry Jenkins, director of the Comparative Media Studies Program at the Massachusetts Institute of Technology.³⁹ Jenkins notes that more than half of teens create media content, while about one-third share content. "In this 'participatory culture,' the ability to interact with both people and computers can expand our mental capabilities," he contends. That may be surprising, because we usually think of intelligence as something an individual possesses, or not, but Jenkins argues that video game playing may help people tap into a collective form of intelligence—"distributed cognition." This means that intelligence is heightened through collaboration with other people and with machines.

Does the Internet Squelch Creativity?

What about creativity? The Baroness is worried: "Surely we are at risk of losing our imagination, that mysterious and special cognitive achievement that until now has always made the book so very much better than the film." Her evidence? Because they're sitting in front of a computer, kids are spending less time playing, letting their imaginations "roam free." Obviously kids need to play (and so do adults), but should we blame the Internet for the decline of unstructured playtime? Or should we point the finger at parents who structure every minute of their children's day with organized activities? Contrary to what the Baroness says, I think the Internet is great for creative young minds. Remember that the vast majority of teens play video games, and, as Jenkins notes, play for them is not a giddy childlike activity. They enjoy the "fun of engaging attention," he writes. This kind of play is deeply creative. It involves trial and error, learning by experiment, role playing, failure, and many other aspects of creative thinking.

It's certainly a lot more creative to check out things on the Internet than it is to sit in front of a TV. It's a boon for young writers, like 13-year-old Zöe Knowles, who lives a few blocks from me in Toronto. She has been writing her first novel, and she also contributes stories to a Web site called FicWad. These are little stories that might play off of a TV show, a film, or a comic, or they can be original pieces. One of her stories has been read by over 1,400 kids; she gets lots of feedback from the readers too. Think of what that response means for the creative youngster. Isn't that better than writing on paper and hoping that some day it might get published?

Is Memory Fading?

Memory of specific facts, the Baroness notes, may no longer be as important now that you can check the date of the Battle of Hastings with a click or two. Now here I agree with her. Why should we spend agonizing hours in school memorizing long passages or historical facts when you can look them up in an instant?

It makes me think of a brilliant twentysomething guy who worked for nGenera right out of college before becoming a star in the strategy practice at Deloitte. He's off the chart with his GMAT score and a really bright star in his organization, but he admits that he has no knowledge at all of the geography of the United States. He says he can Google it, and furthermore, if he were to be tested on the geography of the United States, he can memorize it in an hour, so why should he bother keeping that information? He'd rather concentrate on higher-ordered thinking tasks.

Now I'm not arguing here that you don't need to remember or know about geography. The fact that almost half of all 18- to 24-year-olds think it is not important or necessary to know where countries in the news are located and that about three-quarters of all college-educated young people can't identify Iraq, Iran, Saudi Arabia, and Israel on a map is a travesty.⁴⁰ You still need to know that events like the Battle of Hastings happened if you want to look them up on Wikipedia. But you might not have to stress about the details—those you can check.

What's more, Net Geners do learn memory skills while they're immersed in the Internet, and they certainly need more memory skills to surf the Web than they do to watch TV. Watching TV doesn't demand anything in the way of memory skills (as long as you can remember how to work the remote control). A young person today doesn't just sit and watch TV, as we have seen. He or she uses TV as background music while surfing the Web. In doing so, the Net Generer must remember dozens, perhaps hundreds, of applications. They access hundreds, perhaps thousands, of sites. Many require IDs and passwords and, given the dismal state of identity management, a typical teen needs to keep track of dozens of them. A video game may have dozens or hundreds of characters. They need to organize and file information and remember how to access it. Then there are your 100 to 700 Facebook friends—now who is the guy in the red hat again?—not to mention learning a new language of acronyms, like OMG and LOL; the names of dozens of bloggers; and a thousand Web sites. So Net Geners still need memory skills, but for different reasons.

Focus Is Important

Yet many Boomers still suspect that the Internet is weakening their power of concentration. "I'm not thinking the way I used to think," Nicholas Carr, the former executive editor of *Harvard Business Review*, wrote in an article called "Is Google Making Us Stupid?" which appeared in the summer issue of *Atlantic Monthly*. "I can feel it most strongly when I'm reading. Immersing myself in a book or a lengthy article used to be easy. My mind would get caught up in the narrative or the turns of the argument, and I'd spend hours strolling through long stretches of prose. That's rarely the case anymore. Now my concentration often starts to drift after two or three pages. I get fidgety, lose the thread, begin looking for something else to do. I feel as if I'm always dragging my wayward brain back to the text. The deep reading that used to come naturally has become a struggle." The Internet, Carr argues, is shaping the way he thinks: "It's chipping away my capacity for concentration and contemplation. My mind now expects to take in information the way the Net distributes it: in a swiftly moving stream of particles. Once I was a scuba diver in the sea of words. Now I zip along the surface like a guy on a Jet Ski."

The Internet, Carr notes, is extraordinarily helpful for a writer, but he's concerned that it will fill up those quiet spaces where you could read deeply, "not just for the knowledge we acquire from the author's words but for the intellectual vibrations those words set off within our own minds."

It is an eloquent, thoughtful article full of fascinating historical information on the impact of new technology on human thinking, which suggests that Carr managed to overcome his distraction to find a quiet space to write and think. But what about the rest of us, and Net Geners in particular? Have we lost that quiet space as we zip around on the Internet? There is no question that you need to block out distractions to think clearly or to imagine something. And when you are standing in a teeming marketplace of ideas, it is challenging to focus. But it can be done (try meditating), and I believe that the benefits of that huge inflow of information far outweigh the challenges.

What's more, I think the Net Gener is better able than the typical boomer to handle it. I can see from my own children that they know when they have to focus, block out the distractions, and seek a quiet mental place when they need to think deeply. Some of us go for a walk, or sit in front of a fire, or get in the bath to think. It doesn't matter where you do it, as long as you can let your mind work. Personally, when I'm writing I have four tools working and that's it: my word processor, e-mail for communicating with various sources, a wiki for sharing and coediting content with colleagues, and a browser—Google—for finding information. No social networks, no instant messaging, no iTunes, no

television, no radio, no games. I'd recommend to any Net Gener that deep thinking is best done using only the tools and information sources that are pertinent. And for breaks I take a walk, resisting my natural temptation to eat something or fire off a few messages on my BlackBerry.

Mental Breaks Are Important, Too

When you're thinking deeply, mental breaks can be productive. We boomers shouldn't kid ourselves: we took lots of breaks at work or at school, coffee breaks or that slow walk to the water cooler. Net Geners take breaks too, Facebook breaks, and I would suggest that's better for you than a shot of caffeine, or certainly a quick cigarette. I think it's better for productivity, much like the way elite athletes must take a break from intense training to rest their muscles on the road to ultimately achieving their best performance.

"If you're no longer working effectively, a distraction such as Wikipedia or YouTube can help you return to the task with a fresh perspective."

—KEVIN DASILVA, 26, CAMBRIDGE,
ONTARIO, CANADA

So I don't believe that multitasking—or more properly, quick switching—is necessarily bad for Net Geners' brains. It may help them. If they can learn to feed off of more sources of information in real time, while they are writing an essay or tackling a complicated problem, I think they're more productive than I was at their age, when I sat down with some textbooks and tried to make sense of them and come up with a novel idea. I think the kids have got it right. Allowing yourself to absorb new bits of information while you're working is not necessarily a distraction. Working this way certainly helps me to develop the capability to think profoundly. Real creative thinking and problem solving just can't be captured in a lab. Our brains are far too complicated and mysterious for that.

CONCLUSION: THE KIDS ARE ALL RIGHT

Over my career, I have listened to thousands of people make dire predictions about what technology will do to young brains. TV was supposed to melt their minds. Video games would turn them into zombies. It hasn't happened. Now I hear people express firm opinions that digital immersion is making kids stupid, without any convincing evidence.

Take Mark Bauerlein, the English professor who wrote *The Dumbest Generation: How the Digital Age Stupefies Young Americans and Jeopardizes Our Future*. The premise of his book is that youth today are stupider than any preceding generation because they spend so much time immersed in digital technology, especially the Internet. But are they really the dumbest generation? Even

Bauerlein has to admit that raw IQ scores have been going up three points a decade since World War II, and that screentime's ability to improve certain visual processing skills may have played a role in the rise in recent years.⁴¹ After noting that inconvenient fact, the professor acknowledges that Net Geners may be "mentally agile" but says they are "culturally ignorant." They don't read the great works of literature, he complains, and their general knowledge is poor—they suffer from what he calls "vigorous indiscriminate ignorance." So now he's arguing that they're not mentally slow, just ignorant. But are Net Geners any more ignorant than boomers were at their age? Apparently not.

The professor hunts for more evidence to support the grandstanding title of his book from school test scores. Yet far from doing worse, American students—at least in grades four through eight—are doing better in math and reading than they did a few years ago.⁴² The average scores of seniors haven't changed much for most courses. It seems the professor cannot prove that Net Geners are dumber than earlier generations, so he tries one more time. "No cohort in human history has opened such a fissure between its material conditions and its intellectual attainments," he thunders. "None has experienced so many technological enhancements and yielded so little mental progress."⁴³ In other words, they should be doing better, presumably because of the Internet. So which is it? The Internet is a force for stupefaction or enlightenment?

He didn't convince me. This generation is not dumber. Far from it. Many of the Net Geners are using technology to become smarter than their parents ever could be. As we've seen in this chapter, growing up digital has equipped these Net Geners with the mental skills, such as scanning and quick mental switching, that they'll need to deal with today's overflow of information. I believe they know when they have to focus, just as the most intelligent members of my generation did. They may think and process information in a different way than most boomers do, but that doesn't stop them from coming up with brilliant insights, or new models of doing business and winning an election.

Yet the picture, as we'll see in the next chapter, is a lot more complex. The evidence suggests that the top students are reading more and performing spectacularly well in school. The bottom ones are failing and falling behind—for reasons that have little to do with the Internet and more to do with a failing educational system, problems with the family, poverty, and other social causes.

They would be doing better if the educational system changed to embrace the way they learn, think, and process information. As you'll see in Chapter 5, some educators are changing, but the system is still stuck in the old lecturing mode. I believe that if Net Geners are given the tools to handle the overflow of

information available today on the Internet—as some Net Geners already are—they have the potential to be the smartest generation ever. Some are already entering adulthood with the intellectual skills to handle the demands and the opportunities provided by the Internet. Is the whole generation ready? Of course not. But we shouldn't blame technology.

"Technology provides me with the resources to pull in all the loose ends, connect the dots, and learn in the most haphazard and nonlinear fashion imaginable."

—ERIK RUBADEAU, 26, TORONTO

SEVEN GUIDELINES FOR A SHARPER MIND

- ① **Work on your wiring**—play a new instrument, learn a second language, or pick up a taxi route. You can do it; you have lifelong neuroplasticity on your side.
- ② **Work on your wiring the Net Gen way**—get fluent with the technology by immersing yourself. Try speed text messaging on your mobile phone (not while driving, of course), using IM and MySpace at the same time, or playing action video games.
- ③ **Multitask wisely.** Don't answer every e-mail instantly; check it in chunks, ideally a few hours apart.
- ④ **Know when it's best to concentrate on just one task.** Deep thought, reflection, critical thinking, innovation, and creativity are fostered best using a single-task focus.
- ⑤ **In today's fast-paced, stressed-out world, take a cue from Net Geners and get in the right rhythm of serial focusing.** Ramp up to peak performance, then give your brain a break and cool down before ramping up again. It's as simple as: rinse, lather, repeat.
- ⑥ **Practice scanning.** Instead of trying to read the whole article, or even scanning it in the traditional way, try looking for key words to see whether it's worth even a quick read.
- ⑦ **Study how you learn the best.** See environments, learning tools (online courses, language immersion programs), and professors, teachers, and mentors who best fit your approach to learning for your specific needs. Customize to maximize your learning capabilities and potential.