

Mastering Multitasking

It's part of every digital native's life. Can we help students do it right?

Urs Gasser and John Palfrey

interesting statistic

In 2007 alone, 161 billion gigabytes of digital content were created, stored, and shared around the world. This is equivalent to 12 stacks of books reaching from the Earth to the sun, or six tons of books for every living person (Gantz, 2008).

It's not only the exponential growth of digital information that is staggering. The number of communication channels is also growing rapidly. A business research firm recently calculated that a typical worker in the knowledge economy deals with 200 e-mails, dozens of instant messages, multiple phone calls, and several text messages a day (Spira & Goldes, 2007).

Looking at these numbers, one wonders how people who live digital lives can manage all the information that demands their attention. Our brains have an estimated maximum processing capacity of just 126 bits per second, and our short-term memory can hold only about seven items at once (Miller, 1956). Clearly, there's an enormous gap between the endless sea of information and the limited capacity of the human brain to take in and process that information.

During the first few decades of the information age, we've developed a number of approaches to cope with information overload. For example,

■ An analysis of postings to Usenet newsgroups revealed that users were more likely to respond to simpler messages in overload situations. The users in this study tended to end active participation if they received too much information (Jones, Ravid, & Rafaeli, 2004).

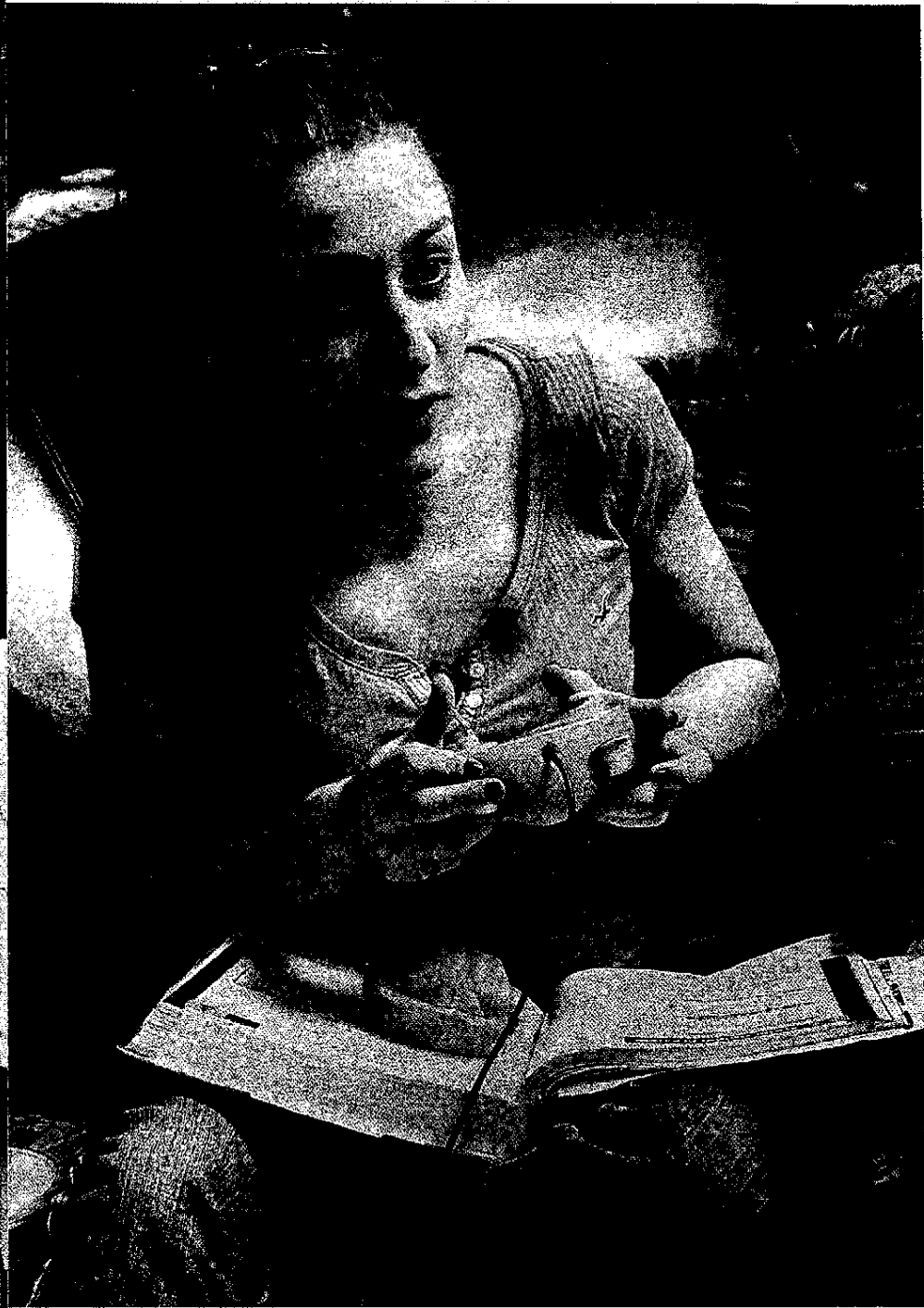
■ Studies involving online learning have shown that certain users ended up printing out online materials to eliminate the distractions of the technology and to avoid overload (Chang & Ley, 2006).

■ Another study found that many young Internet users tended to avoid information overload by limiting the number of Web sites they visited (Hartmann, 2003). We have seen the same coping strategy among young people in our own focus groups and interviews.

But among *digital natives* (young people born after 1980 who have access to digital technology and the skills to use it), one coping strategy is clearly the most popular: multitasking. Digital natives typically say that when they multitask, they feel more "up-to-speed," more "productive," and "less stressed" (Aratani, 2007, p A1).

The Most Popular Coping Strategy

Whether a digital native is checking some facts on Wikipedia, playing a game on her PlayStation, reading a blog post, browsing the Web, watching a YouTube video, or working on a math homework assignment, there is a good chance that she is doing more than one thing at a time. A look over her shoulder would typically reveal that she has an instant messaging (IM) application open to chat with her friends, while the window of her preferred social networking site—like MySpace or Facebook—also appears on the screen. At the same time, the latest tunes downloaded from her favorite P2P



(peer to peer) network are probably playing in the background.

A growing body of research from various disciplines has begun to explore the phenomenon of multitasking. From the perspective of parents and teachers, many findings of these studies are worrisome. At best, multitasking slows

our kids down as they work on their homework. At worst, multitasking leads to a level of distraction that has far more serious consequences than a lower grade in school. For instance, according to a recent study, 46 percent of teenagers send text messages with their cell phones while driving (Parker,

2007). One teen noted, "I ran into my garage door three or four times because I was text-messaging. I had to pay for them all, too, and it was expensive" (de Vise & Otto, 2007, p. B1).

Against this backdrop, the conclusion of many parents and teachers we've worked with is simple: We should prevent digital natives from multitasking.

Easier said than done. In some instances, it might be possible to motivate young people to focus on only one activity at a time. From time to time, we ask our own students to close their laptops, put their iPhones away, and engage only in the classroom discussion. Some classrooms might even have a switch to shut down the WiFi connection (although these simple technological solutions rarely work well).

Most of the time, however, it's impossible to prevent kids from multitasking. A comprehensive study of the multitasking habits of digital natives, conducted by the Henry J. Kaiser Family Foundation (Foehr, 2006) found that four-fifths of young people age 8–18 multitasked while using media. Outside the classroom, in their dorms at home, when they hang out with their friends—in almost any imaginable context—digital natives constantly engage in multitasking, whether we like it or not.

What can parents and educators do about the multitasking habits of our digital natives? Put another way, what *should* we do about multitasking? Our answer is straightforward: We have to embrace and master it, while providing limits from time to time to create contemplative space for young people. This approach requires that we understand multitasking.

Understanding Multitasking

Reading a book while listening to music, eating a sandwich while watching TV, sending a text message while attending a meeting, instant messaging while doing homework,

answering phone calls while writing an essay—all these activities are usually referred to as multitasking. When attempting to understand what multitasking actually is, however, we should distinguish between two forms of behavior. Multitasking in the narrow sense, also known as *parallel processing*, happens when we do more than one thing at exactly the same time—for instance, reading while listening to music. *Task-switching*, in contrast, occurs when we rapidly change from one task to another. An example of task-switching is reading a book and responding to incoming instant messages as they appear.

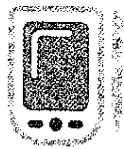
Although there is often only a fine line between the two types of behavior, they have different implications. Parallel processing, for instance, may indeed increase efficiency, especially when one of the tasks involves motor activities like walking, or other actions that have become routine (Tugend, 2008). In contrast, the rapid switching between different mental tasks can decrease efficiency, especially if those tasks demand more challenging cognitive processes. Studies show that each shift of attention from one task to another requires the activation of different neural circuits, probably coordinated by the frontal lobe (Rubinstein, Meyer, & Evans, 2001).

These switches cost time, especially when the mental task is new or unfamiliar.

What Are the Costs?

“Instant Messaging Found to Slow Students’ Reading” (Viadero, 2008). “Multitasking Teens May Be Muddling Their Brains” (Hamilton, 2008). A glance at such news headlines would certainly lead us to conclude that the effects of multitasking are potentially devastating. However, only a relatively small number of studies have actually looked into this question, and we need to interpret the results cautiously. Let’s look at some of the findings.

In a study that investigated the effects of media multitasking in the classroom, one group of college students was allowed to use laptops during a lecture, and another group was not. The students using laptops scored lower on a traditional test of memory on the lecture’s contents. The researchers also noted, however, that the students’ overall performance in the course was not adversely affected by the fact that they were encouraged to use laptops in class and had been actively multitasking



Instant messaging is likely to create a cognitive style “based on quick, superficial multitasking.”



throughout the semester; this outcome may have occurred because the course was nontraditional, highly dynamic, and interactive (Hembrooke & Gay, 2003).

In a survey, the amount of time students reported they spent instant messaging was significantly related to their self-reports of distractibility from academic reading. The study concluded that instant messaging is likely to create a cognitive style “based on quick, superficial multitasking rather than in-depth focus on one task” (Levine, Waite, & Bowman, 2007, p. 565).

A more recent study revealed that students who fielded instant messages while completing an academic reading

assignment needed roughly 50 percent more time to complete the assignment than students in two other groups: one that read the academic assignment with no interruptions and one that answered the instant messages first and then read the assignment. Although students in all the groups apparently still managed to understand what they had read, one of the researchers pointed out,

students who are managing their busy lives may think they are accomplishing more by multitasking, but they will actually need more time to achieve the same level of performance on an academic task. (Viadero, 2008)

A field study found that computer users spent, on average, nearly 10 minutes switching from one task to another when they got an alert of an incoming e-mail or instant message. Depending on the interruption, they spent another 10 to 15 minutes before returning to the disrupted task. In almost 30 percent of the cases, it took more than two hours to resume the task, because users often visited several other applications after checking the incoming messages (Iqbal & Horvitz, 2007).

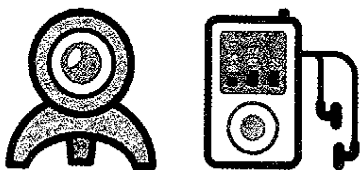
Other researchers have found that interruptions can actually facilitate decision-making performance if the interrupted tasks are simple and the interruption is dissimilar to the original task (see Speier, Valacich, & Vessey, 2007).

And finally, one study used functional magnetic resonance imaging to examine brain activity while participants learned to predict weather outcomes for two different cities (Foerde, Knowlton, & Poldrack, 2006). During the learning, the researchers added a second task that required participants to listen to high and low beeps and keep a mental count of the high tones. The distraction of the beeps did not reduce the accuracy of weather predictions, thus demonstrating that people can learn while multitasking. However, the distraction did decrease the degree to which the partici-

pants used declarative memory (which relies on a medial temporal lobe system), as opposed to habit learning (which relies on the striatum) to complete the task. Although both types of memory system can support learning, declarative memory allows more flexible use of the knowledge learned. Thus,

according to researcher Russell A. Poldrack, "Even if you can learn while distracted, it changes how you learn, making the learning less efficient and useful" ("Study: Multitasking Hinders Learning," 2006).

What can we learn from such studies? Although we must be careful in generalizing these findings, three things are noteworthy from an educator's perspective:



■ Multitasking does not render learning impossible. It does not even necessarily make it more difficult to accomplish tasks. However, we can safely conclude that task-switching in particular increases the amount of time needed to finish a task.

■ Multitasking is likely to change learning qualitatively by making the learner rely on different memory systems that vary in flexibility when it comes to the use of knowledge.

■ The loss of attention and the time spent switching from task to task is likely to have an adverse effect on digital natives' ability to learn complex new facts and concepts.

Giving Students the Facts

Where does all this leave us as educators? Should we expend all our effort in trying to prevent digital natives from

multitasking? The answer is no. As one of our student researchers said in a blog post, "I believe the solution is emphatically not to limit access—at least not for older teens. Rather, I think the key lies in laying out the facts and discussing strategies" (Kimball, 2008).

What we suggest, therefore, is engaging in a structured conversation with digital natives about multitasking as one strategy that can help them cope with the sea of information. An understanding of the way multitasking challenges learning can even help students practice intentional learning and thus improve the performance of their working memory. Ideally, such a conversation about the uses and limitations of multitasking would be part of school

Multitasking is not going away.

information and media literacy programs.

A sample curriculum on multitasking could consist of four sessions. In the first session, students would discuss their experiences with multitasking and information overload. In a series of experiments, students would then experience the limits of their working memories—for example, by trying to remember items on a grocery list (they will be able to remember roughly seven items), or by trying to remember three random letters while continuously subtracting 4 from the number 91 for 20 (and then 30 and 40) seconds. This introductory session demonstrates that our working memory is a bottleneck and that splitting our attention between two cognitive tasks impairs memory performance.

The second session would familiarize

students with current research findings on multitasking. Discussion topics would include a brief overview of the different types of multitasking and what the research says about their various effects on life (including driving!) and especially on learning. This session, which may also include experiments, would address the guiding question, in what types of situations does multitasking work (or not)?

The third session would build on insights from session 2, giving students the opportunity to experiment with media multitasking and to share their experiences with peers and teachers. This session would also include practical advice to help focus attention (Lavie, 2005) and to improve multitasking. Certain tactics—like taking power naps, alternate tasks, or taking a break before moving on—have been proven to counteract what has been called *techno-brain burnout* (Small & Vorgan, 2008).

In the fourth and final session, students would share alternate strategies they use to cope with information overload, such as *chunking* (grouping bits of information to reduce the number of "chunks" you need to remember). The session would also present technologies that can help, ranging from syndication technologies to recommendation systems. The final session might also give students the opportunity to experience a contemplative environment without distraction, thus demonstrating the advantage of sometimes closing laptops and turning off cell phones.

Giving Students Control

Given its widespread use by digital natives, multitasking is not going away. Nor is multitasking necessarily a bad thing. It seems quite desirable, for instance, for an airline pilot to be able to communicate with air traffic control while activating the thrust-reverser

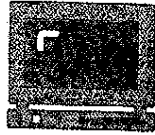
when landing. And it is useful to know that some surgeons perform stressful tasks more quickly and accurately when listening to self-selected music (Baker, 1994).

At times, though, multitasking can be inefficient—even flat-out dangerous. Educators can help students gain

control of their learning in a digital age not by trying to prevent them from multitasking, but rather by engaging them in intentional conversations about its promises and limits—and by structuring environments in which young people can see the costs and benefits for themselves. ■

References

- Aratani, L. (2007, February 26). Teens can multitask, but what are costs? *Washington Post*, p. A1.
- Baker, L. (1994). Research shows right music may improve surgeon's perform. *UB Reporter*, 16(5). Available: www.buffalo.edu/ubreporter/archives/vol26/vol26n5/17.txt
- Chang, S. L., & Ley, K. (2006). A learning strategy to compensate for cognitive overload in online learning [Online article]. *Journal of Interactive Online Learning*, 5(1), 104–117. Available: www.ncolr.org/jiol/issues/PDF/5.1.8.pdf
- de Vise, D., & Otto, M. (2007, November 22). Concern grows as teens die in crashes. *Washington Post*, p. B1. Available: www.washingtonpost.com/wp-dyn/content/article/2007/11/21/AR2007112102366_2.html
- Foehr, U. G. (2006). *Media multitasking among American youth: Prevalence, predictors and pairings*. Menlo Park, CA: Henry J. Kaiser Family Foundation. Available: www.kff.org/enmedia/upload/7592.pdf
- Foerde, K., Knowlton, B. J., & Poldrack, R. A. (2006). Modulation of competing memory systems by distraction, *PNAS*, 103(31), 11778–11783.
- Gantz, J. F. (2008). *The expanding digital universe: A forecast of worldwide information growth through 2010* (IDC White Paper). Framingham, MA: IDC. Available: www.emc.com/collateral/analyst-reports/expanding-digital-idc-white-paper.pdf
- Hamilton, J. (2008, October 27). Multitasking teens may be muddling their brains. *Morning Edition* [Radio broadcast].



Give students the opportunity to experience a contemplative environment.

- Washington, DC: National Public Radio. Available: www.npr.org/templates/story/story.php?storyId=95524385
- Hartmann, M. (2003). *The Web generation? The (de)construction of users, morals, and consumption*. Brussels: Free University of Brussels.
- Hembrooke, H., & Gay, G. (2003). The laptop and the lecture: The effects of multitasking in learning environments. *Journal of Computing in Higher Education*, 15(1), 46–64.
- Iqbal, S. T., & Horvitz, E. (2007). Disruption and recovery of computing tasks. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 677–686). New York: Association for Computing Machinery.
- Jones, Q., Ravid, G., & Rafaeli, S. (2004). Information overload and the message dynamics of online interaction spaces. *Information System Research*, 15(2), 194–210.
- Kimball, D. (2008, September 5). Attention intervention: Digital natives and the myth of multitasking. *Digital Natives* [Blog]. Available: <http://blogs.law.harvard.edu/digitalnatives/2008/09/05/attention-intervention-digital-natives-and-the-myth-of-multi-tasking>
- Lavie, N. (2005). Distracted and confused? Selective attention under load. *TRENDS in Cognitive Sciences*, 9(2), 75–82.
- Levine, L. E., Waite, B. M., Bowman, L. L. (2007). Electronic media use, reading, and academic distractibility in college youth. *CyberPsychology and Behavior*, 10(4), 565.
- Miller, G. A. (1956). The magical number

- seven, plus or minus two: Some limits on our capacity to process information. *Psychological Review*, 63(2), 81–97.
- Parker, P. (2007, July 11). AAA study: 46 percent of teens text while driving. *Albuquerque Tribune*. Available: www.abqtrib.com/news/2007/jul/11/aaa-study-46-percent-teens-text-while-driving
- Rubinstein, J. S., Meyer, D. E., & Evans, J. E. (2001). Executive control of cognitive processes in task switching. *Journal of Experimental Psychology: Human Perception and Performance*, 27(4), 763–797.
- Small, G., & Vorgan, G. (2008). *iBrain: Surviving the technological alteration of the modern mind*. New York: Collins Living.
- Speier, C., Valacich, J. S., & Vessey, I. (2007). The influence of task interruption on individual decision making. *Decision Sciences*, 20(2), 337–360.
- Spira, J. B., & Goldes, D. (2007). *Information overload: We have met the enemy and he is us*. New York: Basex.
- Study: Multitasking hinders learning. (2006, July 26). *eSchool News*. Available: www.eschoolnews.com/news/top-news/index.cfm?i=37130&CFID=14838482&CFTOKEN=17360141
- Tugend, A. (2008, October 26). Multitasking can make you lose . . . um . . . focus. *International Herald Tribune*. Available: www.iht.com/articles/2008/10/26/business/25shortcuts.php
- Viadero, D. (2008, August 15). Instant messaging found to slow students' reading. *Education Week*. Available: www.edweek.org/ew/articles/2008/08/27/01im.h28.html
- Copyright © 2009 Urs Gasser and John Palfrey.

Urs Gasser is Associate Professor of Law at the University of St. Gallen, Switzerland, and a Faculty Fellow of the Berkman Center for Internet and Society at Harvard University; ugasser@gmail.com. **John Palfrey** is Henry N. Ess III Professor of Law and Vice Dean for Library and Information Resources at Harvard Law School; jpalfrey@law.harvard.edu. They are coauthors of *Born Digital: Understanding the First Generation of Digital Natives* (Basic Books, 2008). Their research project on digital natives can be found online at www.digitalnative.org.