Too Much Information:
living with a camp fire mind in a firewire world

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Presented to the Academy January 14, 2008

Longshoreman and philosopher Eric Hoffer presciently noted that "In times of change learners inherit the earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists."

The "too much information" this paper is about is also called information overload. When I consulted the essential research tool, GOOGLE, to start collecting information, I was rewarded with 1,880,000 hits for "too much information" and 1,250,000 for "information overload." Each search was accomplished in less that .2 second. The more I looked into the seemingly endless avenues of exploration the more excited but frustrated I became. Information overload was happening in real time. I was ready to just chuck it right there. But then as I explored I began to see clearer questions and broader issues. Two in particular drew my attention. The first was how a brain that evolved over millions of years of relative stasis would react to abrupt and unimaginable change. And the second is how can we work with that brain in a world that has radically shifted in the last couple of hundred years.

Information, as addressed in this paper, is news you can use. As such it is best timely and complete and true. The problems I have with information are that there's more than I can process, or I can't find the information I need. All this in a world where two weeks of the New York Times has more information than an 18th century person would encounter in a lifetime; where technical information is doubling every two years, and the rate of increase is also growing – by 2010 it will double in 72 hours! One million new books are being published and 100,000,000 scientific papers released every year. Over 3 billion websites

exist, and over 260,000,000 queries a day come to Google alone. Google's over 10,000 networked computers crawl through an index to those 3 billion pages, rank them with an equation that includes 500 million variables and spit out a few thousand listings. The ranking takes 500 milliseconds; the computers can handle a peak rate equal to 7 million queries per hour in 36+ languages. (Forbes, May 2003) Google reports that it is scanning more than 3,000 books per day, a rate that translates into more than 1 million volumes annually (NY Times 3/11/07)). Meanwhile people are sending enough text messages to say "hi" to everyone on the planet - every day. And the e-mails continue to flood in.

AT WHAT COST

A New York Times BITs (Business • Innovation • Technology • Society) blog by Steve Lohr, December 20, 2007, reported on the cost of information overload - $650 billion a year.

> Basex, a business research firm, specializes in studying how professionals and office workers – "knowledge workers" – do their work and use technology. It says the $650 billion figure is an estimate of the "cost of unnecessary interruptions" in terms of lost productivity and innovation. The number, notes Jonathan B. Spira, chief analyst for Basex, is mainly an effort to put a size on what is a big and growing problem. …
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> Others are trying to measure it too. The Basex press release quotes Nathan Zeldes, an engineer at Intel who studies computing productivity issues, who said, "At Intel, we estimated the impact of information overload on each knowledge worker at up to eight hours a week."…
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> The information-overload toll is largely a byproduct of workers grappling with the growing tide of e-mail, instant messages, cellphones, wikis, blogs and the like.
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> Workers get disoriented every time they interrupt what they are doing to reply to an e-mail or answer a follow-up phone call because they didn't reply within minutes.

> Spira said workers can spend 10 to 20 times the length of the original interruption trying to get back on track.

Dr. John M. Grohol in December, 2006, wrote an article in Psych Central:[1]

> There's so much going on in the world at any given moment, it seems impossible for any one person to keep up with it all. Talk to your friends or coworkers and you'll often hear a common thread — there's so much to do online, I often feel overwhelmed. Lost. "I get on to look for one thing, and get off 2 hours later completely forgetting to even look for the thing I got online originally for!"

Grohol continues.

> Information overload is the state of feeling overwhelmed by the amount of information available to us at any given moment, and not having the tools, skills, or capabilities to keep it organized in a reasonable manner. In more extreme cases, people can become depressed by the stress and anxiety information overload brings. … Today, more and more people are complaining about just feeling plain overwhelmed by the Internet.

How can we possibly keep up? Leonardo da Vinci kept up! He saw the dawn of the 16th century; he is considered one of the most brilliant people who ever lived and one of the last people to know all there was to know in his world – science, art, mathematics, engineering, anatomy music writing. But it seems impossible now, 500 years later to even know all there is to know about a small slice one of those disciplines.

Not only is there too much to know, but the problem of finding what we need in that enormous and growing haystack of information seems overwhelming. When there is too much to process, the computer I'm working on shuts down. What does my brain do? When I can't find what I need in all that stuff, what do I do? Information overload leads to stress, and that leads to a lack of productivity, decrease in the body's ability to maintain its healthy immune system, and psychological and physical decline.

[1] http://psychcentral.com/blog/archives/2006/12/08/grappling-with-information-overload/

It wasn't always like this. Sitting around a wood fire a million years ago, the light and warmth holding nature at bay, our ancestors grunted and gestured and groomed each other to communicate. While there was much to know about hunting and later gathering and, later still, agriculture, it was knowable. And the limited container provided by the wood fire was small enough allow us to see the gestures, hear the grunts. In order to survive in a hunting and gathering world, life required our ancestors process to multi-sensory information rapidly. Their very survival depended on apprehending the whole of sight, sound, and smell. Their brains must have been good at accepting the big picture and processing it rapidly. In fact *our* ancestors were the ones who noticed the cave bear coming, and, if they didn't outrun the bear, at least they were ahead of the ones who didn't become our ancestors.

Some records of these early times were created in the cave paintings in France 35,000 years B.C.E. Notched bones and clay figurines and cords with knots on them counted something worth remembering. 30,000 years later clay tokens were used for accounting in Sumer, and by 3,400 B.C.E. writing had appeared in Egypt. 3,300 B.C.E. saw cuneiform notation on clay tablets - the work of early bean, and sheep and grain counters. The cuneiform wedges were first used to document commerce, then observations relevant to commerce such as tides and seasons, then battles and campaigns, then warriors and kings, then literature as the stories were embellished. Information started to stack up. Papyrus and ink appeared in 1000 years later, and legal texts existed in Ur in 2100 B.C.E. The Code of Hammurabi was recorded in about 1700. By 1300 B.C.E. the Chinese had books.[2] And in 650 B.C.E. Ashurbanipal, king of Assyria established the first collected library by gathering all the cuneiform literature that existed at that time. In 331 the library of Alexandria was the largest in the world. In the first century B.C.E. Roman publishers produced 1000 copies of titles using slave scribes. In 105 C.E. paper was invented in China; by 260 books were replacing scrolls.

Jump to 1454 and Gutenberg's printing press and the race to too much information was on, but slowly. In 1477 the first printed advertising appeared in England. A cookbook came out in Venice in 1495 (in January, 2008, Amazon lists more than 70,000 different

[2] http://www.robotwisdom.com/ai/timeline/index.html

cookbook titles available). In 1837 the telegraph enabled people to communicate over distance almost instantaneously. The first telephone call came in 1876, and in 1879 the electric light bulb meant we could work all night long. 1924 saw the first fax, 1928 a crude television, and ENIAC (Electronic Numerical Integrator And Computer), in 1946, was the first purely electronic digital computer capable of being reprogrammed to solve a full range of computing problems.[3] In approximately 1969 development of what would become the Internet was initiated. In 1976 the Wang word processor made paper generation a lot easier, Xerox introduced electrostatic copying in 1960, and by the mid 1980s personal computers were proliferating. And e-mail and list serves and electronic file transfer and spider robots and search engines and computer viruses and spam followed. Now we also have instant access to all of this all of the time on or cell phones. Information overload.

Back in the days of the wood fire, and those days lasted thousands of years, there was a lot less information. And until the late appearance of linear writing, much of our productive brain activity was right-brained, whole picture, multi-sensory. Writing not only gave us a way to save and learn from experience, but it also put different requirements on brain function, more linear, more left brain. There's also evidence that as we've relied more heavily on linear mechanisms for taking in information we've lost our capacity to absorb the whole picture at one time. While a picture is worth 1000 words, and can be taken in all at once, 1000 words come in one at a time. That was fine when scrolls were handwritten, or books were pulled off the platen of a printer one sheet at a time. But with the advent of all there is all the time, we simply don't have the mental tools to keep up.

Research conducted by Dr Daniel Simons of the University of Illinois and Dr Daniel Levin of Vanderbilt University illustrates the problem of receiving input without being able to process it, seeing without observing.

In one experiment, people who were walking across a college campus were asked

[3] http://wikipedia.org / Goldstine, Herman, 1972, The Computer: from Pascal to Von Neumann. Princeton, University Press

by a stranger for directions. During the resulting chat, two men carrying a wooden door passed between the stranger and the subjects. After the door went by, the subjects were asked if they had noticed anything change.

Half of those tested failed to notice that, as the door passed by, the stranger had been substituted with a man who was of different height, of different build and who sounded different. He was also wearing different clothes.

"There have been some arguments that limits on visual memory are related to limits on the number of items we can attend to at once as well as to limits on the number of items we can count at a glance (typically both have capacity estimates of around three to four)," added Dr Simons.

So far as our brains are concerned, these studies suggest that the old adage "out of sight, out of mind" may be true. Indeed, it is a wonder that scientists are here to discuss the issue at all, given that the ability of our ancestors to dodge spears, clubs and pouncing lions may have been curbed by the limited capacity of human visual memory.

But, researchers said that a visual short term memory capacity of four was probably not much of a problem in the relatively slower-paced lives of our hunter-gatherer ancestors. Not so today, however. The fast pace of modern life is stretching our Stone Age brains to the limit.[4]

Another possible explanation for the survival of those hunter-gatherers is that they DID perceive more, but that with the emergence of linear language, and the dominance of the readers over those who didn't led to a demise in the ability to perceive widely, to survive in the wild.

Another part of Simons and Marois's study involved a subject who is instructed to view a video of people passing basketballs around, and to count the number of passes. I tried

[4] www.Telegraph.co.uk, 5/5/2004 The studies were originally published in the journal Nature by Drs Edward Vogel and Maro Machizawa of the University of Oregon, Eugene, and by Prof René Marois and Jay Todd of Vanderbilt University, Nashville.

this and felt rather smug that I'd noticed so many passes. In the debrief, they asked if I'd also noticed the gorilla? Apparently, but not to me, a woman in a gorilla suit had walked across the room, through the basketball passers, and even stopped, looked directly at the camera and pounded her chest, then walked off screen. When I watched the video the second time, sure enough there she was. I'm NOT going out in the wild until I address this lack of perception! Reassuringly, somewhat, when the video was shown to a large conference, less than 10% of the people noticed the gorilla. We're pretty good readers. But will that be adequate, as we receive more and more of our information visually – movies, charts and graphs and icons everywhere and millions of YouTubes with everything from how to make a great cup of coffee to how to more effectively use the internet, and how to launch a car using helium balloons.

This problem here is that we are confronting more input, much more than we can handle – whether it's e-mails, internet hits, phone calls, physical interruptions, junk mail or spam, or opportunities for serious and meaningful dialogue, there's just too much information. We have limited channels to input and process, and unlimited information coming our way. What can we do to survive?

Multitasking – myth or magic.

More and more people resort to multitasking – doing e-mails while talking on the phone; driving while talking on the phone, having lunch while talking on the phone, while we listen to music, and our spouse is telling us something important – I think it was important.

I have a hard time with multitasking, and the research supports that. Walter Kirn, in an article in the *Atlantic Monthly,* last November, *The Autumn of the Multitasker,*[5] notes

> It isn't working, it never has worked, … The scientists know this too, and they think they know why. Through a variety of experiments, many using functional magnetic resonance imaging to measure brain activity, they've torn the mask off multitasking and revealed its true face, which is blank and pale and drawn.

[5] Walter Kirn, *The Autumn of the Multitasker,* The Atlantic Monthly, November, 2007.

Multitasking messes with the brain in several ways. At the most basic level, the mental balancing acts that it requires—the constant switching and pivoting—energize regions of the brain that specialize in visual processing and physical coordination and simultaneously appear to shortchange some of the higher areas related to memory and learning. We concentrate on the act of concentration at the expense of whatever it is that we're supposed to be concentrating on.

What does this mean in practice? Consider a recent experiment at UCLA, where researchers asked a group of 20-somethings to sort index cards in two trials, once in silence and once while simultaneously listening for specific tones in a series of randomly presented sounds. The subjects' brains coped with the additional task by shifting responsibility from the hippocampus—which stores and recalls information—to the striatum, which takes care of rote, repetitive activities. Thanks to this switch, the subjects managed to sort the cards just as well with the musical distraction—but they had a much harder time remembering what, exactly, they'd been sorting once the experiment was over.

Even worse, certain studies find that multitasking boosts the level of stress-related hormones such as cortisol and adrenaline and wears down our systems through biochemical friction, prematurely aging us. In the short term, the confusion, fatigue, and chaos merely hamper our ability to focus and analyze, but in the long term, they may cause it to atrophy.

The next generation, presumably, is the hardest-hit. They're the ones way out there on the cutting edge of the multitasking revolution, texting and instant messaging each other while they download music to their iPod and update their Facebook page and complete a homework assignment and keep an eye on the episode of The Hills flickering on a nearby television. (A recent study from the Kaiser Family Foundation found that 53 percent of students in grades seven through 12 report consuming some other form of media while watching television; 58 percent multitask while reading; 62 percent while using the computer; and 63 percent while listening to music. "I get bored if it's not all going

> at once," said a 17-year-old quoted in the study.) They're the ones whose still maturing brains are being shaped to process information rather than understand or even remember it.
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> This is the great irony of multitasking—that its overall goal, getting more done in less time, turns out to be chimerical. In reality, multitasking slows our thinking. It forces us to chop competing tasks into pieces, set them in different piles, then hunt for the pile we're interested in, pick up its pieces, review the rules for putting the pieces back together, and then attempt to do so, often quite awkwardly. (Fact, and one more reason the bubble will pop: A brain attempting to perform two tasks simultaneously will, because of all the back-and-forth stress, exhibit a substantial lag in information processing.)

I spoke with Qory Wainio, senior at Fresno High School. Qory multitasks, and feels better doing it. "It cuts the boredom, reduces fatigue," he said. He doesn't feel as efficient when he focuses on only one thing at a time. He described doing homework while listening to music, checking myspace, keeping track of e-mail, conducting up to 10 simultaneous instant message chats and text messaging (at up to 50 words per minute. He also keyboards at 80 words per minute). And Qory had a very good report card last semester. So for Qory at least, it seems to be working.

For those of us who do not function well with multiple inputs, …focus like a laser.

The power of choice

How can we work effectively with this brain we have inherited in a world it may not be ready for, a world of too much information. Rather that feel overwhelmed by it, Qory exercises his power of choice. "How do you find what you really need out there?" I asked. "I don't let it all in. I only pay attention to what's important to me," he said. "You have to be really clear about what you want." He gets his information from the internet, Google and Wikipedia being first sources, but also from books and manuals. "I use myspace and facebook, too, and other social networking tools.

We can exercise the power of choice to find what's really important. But faced with unlimited choices where do we start? How do we filter it all? Which are the most useful sources from which to absorb the information we need through the limited channels we have? There are sole-source and multiple-source channels. Sole sources could be experts, or radio talk show hosts who provide "all you need to know" or " think so you don't have to." Sole sources make it easier to find useful information, but may not be reliable. Sole sources for news, *The Fresno Bee, Fox News, The Economist,* reflect the editorial policy of the owners. Blogs, and there are now millions, offer independent sources for information that are regularly challenged as well as supported in the comments that readers contribute. To get good information, you have to choose single source channels carefully, and investigate their biases.

Multiple-source channels have the capacity to do a better job of filtering information. In *Ganging up on information overload*[6]*,* Borchers, et al., describe a collaborative filtering technology that enables us to get better information.

> When information is abundant, the knowledge of which information is useful and valuable matters most. We all use our network of family, friends, and colleagues to recommend movies, books, cars, and news articles. Collaborative filtering technology automates the process of sharing opinions on the relevance and duality of information. Collaborative filtering is one technique among many information filtering techniques that range from unfiltered to personalized and from effortless to laborious. Libraries or the Web are good examples of unfiltered information sources. E-mail directed to one recipient is a good example of a filtered information source. A best-seller list requires little effort for the user, but provides the same recommendations to all users. Filters based on demographics, such as age, sex, or marital status, require some effort from the user in providing the demographics, and provide some level of personal filtering…. Collaborative filtering requires relatively little effort from the user, and provides individually

[6] *Ganging up on information overload*, Borchers, A. Herlocker, J. Konstan, J. Reidl, J. Minnesota Univ., Duluth, MN; from *Computer,* Apr 1998 Volume: 31, Issue: 4

> targeted recommendations…. Effort, of course, can be reduced via automation. While collaborative filtering is not necessarily effortless, it requires a relatively small amount of effort on the part of the user and provides very individualized recommendations.

The Del.iciou.us website enables users to share webpage bookmarks that are indexed and categorized. The comments following the recipes on Epicurious.com, or the reviews after an Amazon.com product description, offer a real-world check on the information provided. On these sites, you can read reviewers' other submittals to see what biases they have. Another kind of collaborative filtering happens in the context of a study group, or book group, or on-line social network where it's possible to explore and question and evaluate information more fully. Social networks expand our exposure to new perspectives and resources within a common context. Qory Wainio introduced me to an online information processing tool called "Digg." Digg describes itself as, "…a place for people to discover and share content from anywhere on the web. From the biggest online destinations to the most obscure blog, Digg surfaces the best stuff as voted on by our users. You won't find editors at Digg — we're here to provide a place where people can collectively determine the value of content and we're changing the way people consume information online" (http://digg.com/about).

Active or Passive Brain Development

In addition to selecting good sources for information, we need to enhance our capacity to think—especially knowing that as we age we lose maybe a thousand neurons everyday. There's apparently no replacing these lost neurons, but we can create new neural connections; each neuron can have as many as 10,000 connections to other neurons. Research indicates that it is the patterns of neural activity, rather than the hardwired linear computer processing of my Macintosh, that distinguish human intelligence. Is there something that helps builds new neural connections? Yes—more experience, especially interactive experience. In a time when television viewing averages 5 hours a day per household, we need to go places and do things outside our usual world.

On one of many new websites advocating "brain health" or "brain development," Alvaro Fernandez from SharpBrains writes:[7]

> Don't train your brain to become a visual, unreflective, passive recipient of information. If you are the average American, stop watching TV 5 hours a day. You may have heard the expression "Cells that fire together wire together." Our brains are composed of billions of neurons, each of which can have thousands of connections to other neurons. Anything you do in life is going to activate a specific constellation of neurons. Visualize one million neurons firing at the same time when you watch a TV program. Now, the more TV you watch, the more those neurons will fire together, and therefore the more they will wire together (meaning that the connections between them become, literally, stronger), which then creates automatic-like behaviors. You are making yourself a more passive, unreflective, person, the more TV you watch—exactly the opposite of what you need to prioritize and process the growing amount of information we have available these days.

The experience of writing this paper has flung me headfirst against the challenge of too much data, too many ideas, too many potential paths meandering in the directions of fascinating possible areas of study. Luckily, I've been able to harvest bushels of useful perspectives and reliable data by collaborative filtering: not only a number of books, websites and Wikipedia entries, but my good friends Vern Crowder and Marij Bouwmans, my daughter Darrow and her friends, my wife Patience—all helped me shape my inquiries and test my assumptions as I began to research and then to write. And once I was launched, these resources and others also made it possible to exert power of choice over the infinite number of possible papers I could have written—and also to get you home at a reasonable hour tonight.

[7] http://www.sharpbrains.com/

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http://www.commoncraft.com/work little videos explaining Wikis, Blogs, RSS, and Social Networking, “in Plain English” along with how to get started.

www.sharpbrains.com fun tools to play with your brain,