Against the Grain:
An Argument for Using Less Technology in Education

Jim Valkenburg
Director, Teaching/Learning Center
Delta College
1961 Delta Road
University Center, MI 48710
989-686-9034
jcvalken@delta.edu

Abstract

While technology allows us to find information about any subject, it also has had a somewhat negative impact on learning. Recent neurobiological research suggests that the brain is a dynamic, constantly changing organ that responds to the type of stimuli that it encounters in its environment. Media has a tremendous impact on how we perceive information, so the technology used to impart that information has a tremendous impact on brain function. The way people read, or don't read, for that matter, has changed with the resultant inability of people to deep process information because they do not deep read, nor deeply process, what they are researching. The technophiles say that there is no need to remember anything since all that information is online, but without information in our brains there is no way to synthesize, create or think critically.

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Julian Jaynes (1976) wrote that around the time of the first awakenings of western philosophy, humans began the long journey from internalizing the dictates of the tribe into a more personally generated understanding of reality. He stated that:

> …subjective conscious mind is an analogue of what is called the real world. It is built up with a vocabulary or lexical field whose terms are all metaphors or analogs of behavior in the physical world. Its reality is of the same order as mathematics. It allows us to shortcut behavioral processes and arrive at more adequate decisions. Like mathematics, it is an operator rather than a thing or repository. And it is intimately bound up with volition and decision. (p. 55)

From this statement, we may conclude that the origins of consciousness find their basis in reality, and, in turn, help the individual to ascertain what that reality is based upon *and* just what that consciousness of reality might allow the individual to do.

Eric Havelock was instrumental in helping us understand the great changes in consciousness as the western world moved from an oral to a literate transmission of cultural heritage—that is, of education, in general. In his "The Linguistic Task of the Pre-Socratics" (Robb, 1983), Havelock contends that the Pre-Socratics had to invent a language that would accommodate the literate presentation of abstract concepts (infinity, the one and the many, etc.), but that this new language also reflected the change in the locus of control from the society as a whole to a more individualistic perspective. (Plato clearly understood this principle and so, in *The Republic*, created a strictly regimented system of censorship to prevent "bad" ideas from despoiling the society.) Havelock saw that the media used by language was a "form of audience control" and that in the oral, as well as in the transition period from oral to literate communication of ideas, "language must be so managed as to provide maximum appeal to the ear." Later literate forms would also concentrate on "visual patterning of paragraphs and themes." (p. 8)

This education, this transmission of knowledge, is the key to the success and progress of the human species. The literate tradition brought with it the ability to create new ideas and to formulate new abstract concepts, like mathematics, in a format that would allow on-going inspection and reflection. Education, then, became more about acquiring new knowledge and skills and allowed people to analyze and synthesize information—to be critical *and* creative. People are educated in a formal setting (schools or educational programs) or in an informal setting on an individual basis. The change in the technology for transmitting information has had and continues to have an enormous impact on people and they way they perceive reality.

The change required to "breakdown" the bicameral mind just might be seen in the impact a new technology had on what we have come to see as a plastic brain that restructured and reorganized itself as the technology took hold. This new media, the movement from the oral to the written, created different living circumstances and

different needs and requirements to transmit information. Although there had been forms of written language, the Greeks invented a phonetically based alphabet that could be used to construct words, and in a relatively short time (hundreds of years), there was this thing called literature. Even though there was opposition to it, the new technology had an impact upon the old. As Postman (1993) would say “embedded in every tool is an ideological bias, a predisposition to construct the world as one thing rather than another, to value one thing over another, to amplify one's sins or skill or attitude more loudly than another.” (p. 13)

Harold Innis (2006), in his *The Bias of Communication*, contends that the change of literate media from papyrus, to the codex, to paper and to print have all created a new social environment that invited people to think about the world differently. In *Gutenberg Galaxy*, Marshall McLuhan (1962) stated that "any technology tends to create a new human environment.” (p. 7) We can see the change in the following:

> … the shift from the mechanical technology of the wheel [to] electric circuitry represents one of the major shifts of all historical time. Printing from movable type created a quite unexpected new environment—it created the PUBLIC. … What we have called ‘nations’ in recent centuries did not, and could not, precede the advent of Gutenberg technology anymore than they can survive the advent of electric circuitry with its power of totally involving all people in all other people. (McLuhan, 1962, p. 7)

A number of researchers have questioned the impact that electric circuitry, now morphed into computer technology, has on the ability of people to think critically and creatively. Others have shown that although the brain changes with respect to the things it comes in contact with the most, those changes are not necessarily positive. That is, we can create both good and bad habits of thought. This “change of mind,” as we shall see, seems both physical and metaphysical.

The question is as old as the mind /body debate concerning the underlying foundations of reality and the perception of that reality by humans. It stretches from the early attack on the oral transmission of cultural heritage and behavior by Plato through the current advocacy of technology as the means *and* the ends to attaining information. Along with the change in technological format, the ability to understand the relationships between various components of what one sees and experiences, and how one behaves has changed. To quote Mark Slouka (1995) "... the world provides context, and without context, ethical behavior is impossible." (p. 13) However, the continuous advocacy by the proponents of Artificial Intelligence (AI) and by the futurists who see the computer as the panacea for all human problems begs us to answer the question that no longer seems important to most—What *does* it mean to be human?

In the ongoing debate between mind and materialism, Jeffrey Schwartz (2005) states that:

> "Materialism, of course, is the belief that only the physical is ontologically valid and that, going even further, nothing that is not physical—of which mind and consciousness are the paramount examples—can even exist in the sense of being a

> measurable, real entity. (This approach runs into problems long before minds and consciousness entered the picture: time and space are only two of the seemingly real qualities that are difficult to subsume under the materialist umbrella)." (p. 28)

Indeed, even Douglas R. Hofstadter (2007), once a proponent of hard AI (that is, an advocate of the idea that artificial intelligence could and would come to fruition) has entered the fray to state that mind is far more than just the physical actions and reactions of neurons, and that is why it is so hard to describe and find.

Along with the difficulty of actually locating "mind," the comparisons that are constantly made between the brain and the computer add to the confusion. The computer works by following programs, algorithms and other symbolic languages. "The power of the computer [however] derives not from its ability to perform complex operations, but from its ability to perform many simple operations very quickly." (Schulman, p. 3) Performing a computing task, however, does not imply actual knowledge, just the ability to locate certain bits of information that is stored in the computer.

The human brain is a biological, electro-chemical, idea processing, memory storage facility. It is designed to be filled with ideas that are generated by the millions of experiences and interactions with the environment the individual has each day. Those ideas and memories that are stored in each individual's brain are the foundation for the way that person understands the world (his or her schema of reality) and are the "stuff" from which each person generates ideas or responses to questions, or synthesizes information across disciplinary boundaries, or creates something entirely new in light of some given environmental stimulus. Although I will describe the findings concerning physical brain functions, mind does not seem to be merely physical. Deep thinking is a type of sorting of stored memories, but at the same time goes beyond the mere access of information because the resultant synthesis may include both similar and dissimilar ideas; that is, it goes beyond specialized search functions and locates and uses a greater and broader admixture of ideas. It is a dynamic process.

Computer technology is a distraction machine and is designed to bring people to as many different areas, sites, as possible. Most informational articles or snippets offered online are filled with hyperlinks to other, related, articles, snippets and ideas on other websites. Those very links are distractions that distort a person's understanding of the information because once accessed, the information is usually only skimmed, and the distractions are rife with hyperlinks to other ideas that, too, will be skimmed until a "relevant" link is found and clicked on to proceed to another link where the information will be skimmed until another link, and so on. Postman (1990) again cites the potential dangers:

> The tie between information and action has been severed. Information is now a commodity that can be bought and sold, or used as a form of entertainment, or worn like a garment to enhance one's status. It comes indiscriminately, directed at no one in particular, disconnected from usefulness; we are glutted with information, drowning in information, have no control over it, don't know what to do with it. (p. 6-7)

The unrelated hodge-podge of ideas created by gathering but not deeply processing bits and pieces of information makes it seem that learning is taking place, but it resembles the trip the person with ADD/ADHD inadvertently takes on a daily basis. There are a lot of neurons firing, but there is no central focus, no unifying pathway for all of the different brain cells that contain so many disparate ideas to follow. Without a sense of continuity and sequence that relates ideas together, without the goal of achieving a purpose, all the neuronal firing going on in the brain serves little positive function. If a person does not read deeply, s/he, in the long-term, will not focus on any one thing long enough to gain the insights necessary to use the myriad bits of information critically and productively. Of course, a person could pull those snippets off line and write an essay for class, but the information is only surface deep. Then it is on to the next thing that will be studied and researched, but again only at the surface level. We will see below that a student's ability to deep process information for later access for creative and critical purposes stems from how it is put into memory and how meaningfully s/he links and reflects upon those ideas.

I think the technophiles who say that we no longer have to remember anything because it is all online are either self-deluded or purposefully misleading the populace. Without the stuff of memory in our brains, without the ability to deep process and reflect on what we are learning, without the ability to link information in our own brains and to synthesize that information, we lose a great deal of our cognitive abilities and what that means in terms of being human. Without the connection between ideas, life becomes a never-ending game of Jeopardy—a bunch of "I know" but little "I understand." Let's take a look at current neurophysiological research to get a better handle on this idea of "deep processing."

The Brain Is

Citing Nobel Prize-winning biologist E. O. Wilson, Mark Slouka (1995) points out that the brain, "evolved in a bio-centric world, not a machine-regulated world," and that this may be "the best argument against the abstract communities and virtual landscapes of the digital age." (p. 134) With this perspective in mind we can get a better handle on current neurological research which suggests that "the brain that does the remembering is not the brain that formed the initial memory. In order for the old memory to make sense in the current brain, the memory has to be updated. Biological memory is in a perpetual state of renewal." (Carr, p.191) The biological brain is dynamic; as we noted above, the computer brain is static.

Research also suggests there is a significant change in the way the brain processes information when technology is the primary source and that there is a growing addiction to technology that has a negative impact not only on the way people learn but on the way they process information and interact with one another. Let's see why this happens.

The brain is constructed so that the hundred billion or so neurons in it can communicate with each other. There are two hemispheres connected by the corpus callosum which serves as a neural superhighway and allows the hemispheres to

constantly communicate. Along with this, there are nerve bundles called “fasiculi” that carry signals between the front and the back of the hemispheres. “It is clear that the brain is wired so that the front and back talk to each other and that evolution placed great value on these connections. Other than the major connection between the two hemispheres, this back-front connection is the most obvious wiring in the brain" (Zull, p. 38-39) Macroscopically, then, the brain is *wired* to communicate with itself.

Neurons are the repositories of everything we know and remember. They are wired and connected together by a network of axons and dendrites that join at the synapses. Dendrites receive impulses that are transmitted along the axon. Axons can vary in length according to the location and function of the neuron of which they are a part. “Because the short-axon neurons link neurons locally, they are the most important players in the game of information processing: highly evolved animals have relatively more short-axon neurons than long-axon neurons, reflecting their role in integrating and processing information.” (Schwartz, p. 104) Scientists are still trying to determine how many different types of neurons there are in the brain.

Schwartz (2003) then draws a vivid picture of the activity among the neurons which may each form up to one thousand synaptic connections and may receive electrical impulses from thousands of other neurons. When the electrical impulse, which is “the physical embodiment of the information sent from one neuron to another," is strong enough, a chemical neurotransmitter is released that will fire the neuron so that it may continue the transmission to other neurons that contain similar information. (p. 105-196) This forms a neural network or neural community.

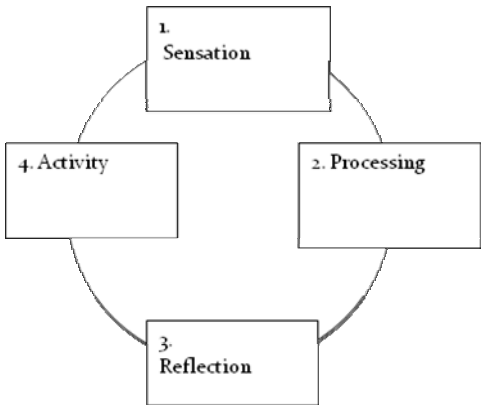
The brain is a latticework of small bits of knowledge that are located in small groups of neurons, neural communities. These communities are linked together according to Hebb’s concept of neural networks and create even larger neural communities which are created as it becomes necessary to understand the relationships of ideas and develop a synthesis of creativity. “The brain is a structure that at once is almost infinitely divided an infinitely connected." (Zull, p. 99) The individual neurons of each neural community are dynamic in nature: "Neurons that are repeatedly used grow stronger synapses and more effective neuronal networks. The more they fire, the more they send out new branches looking for more new and useful connections." (Zull, p. 117)

Michael Merzenich has developed the concept of lifelong “brain fitness.” In short, he believes that “the brain needs to learn, to reason, and to act”, and “without that stimulation, it deteriorates.” (Olsen, 2005b, p. 3) Although much of what happens in the brain seems automatic and beyond consciousness, it is consciousness and what the Buddhists call “mindfulness” that helps the brain to develop stronger neural pathways between neurons and thereby more extensive neural communities that operate in conjunction with one another. Advocates of strong AI, however, contend that there really is no such thing as consciousness:

> Work by physiology professor Benjamin Libet at the University of California at Davis shows that neural activity to initiate an action actually occurs about a third of a second before the brain has made the decision to take the action. The

> implication, according to Libet, is that the decision is really an illusion, that 'consciousness is out of the loop.' The cognitive scientist and philosopher Daniel Dennett describes the phenomenon as follows: 'the action is originally precipitated in some part of the brain, and off fly the signals to the muscles, pausing en route to tell you, the conscious agent, what is going on (but like all good officials letting you, the bumbling president, maintain the illusion that you started it all)'. (Kurzweil, 2005, p. 191).

If we look at D. A. Kolb's concept of "experiential learning," we can get a better idea of why many people still do believe that consciousness does play a key role in how the human brain functions. James Zull discusses the cycle of learning that is based on "concrete experience." One has to remember, according to Kolb, "experience is *not* the whole thing. ...learning depends on experience, but it also *requires* reflection, developing abstractions, and active testing of our abstractions" (p. 17-8) That is, after a person experiences some internal or external sensation, s/he will then integrate, reflect upon and act upon that sensation.



This cycle of "Sense => Integrate => Act" is "essential for all nervous systems." (Zull, p.15) It allows the individual to assess the environment and to choose actions that will accommodate the circumstances and conditions one finds there. It is cyclical because the brain evaluates each action and reevaluates the changes those actions may cause. It is an instantaneous conscious feedback loop that is necessary for the individual to survive socially and as a living organism. An important aspect for the success of the learning cycle is the ability to reflect—that is, to assess the current situation with respect to other experiences and to decide on an appropriate course of action. Reflection is a willful activity of the individual that depends on the memories of the person. If we rely only on external memory databases, we lose an important aspect of our ability to think clearly and react appropriately to given situations.

Jeffrey Schwartz, in his role as therapist, uses the concept of mindfulness and the ability of the brain to redesign itself to help numerous patients. "At the core of Buddhist philosophy," he says, "lies the concept of mindfulness, or mindful awareness: the capacity to observe one's inner experience and what the ancient texts call a 'fully aware and non-clinging' way." (p. 10-11) Western science calls this particular activity "meta-cognition"—the ability to be aware of why and how one is formulating ideas and concepts. With Buddhist mindfulness, the individual "views his thoughts, feelings, and expectations much as a scientist to use experimental data—that is, as natural phenomena to be noted, investigated, reflected on, and learned from." (p. 11)

Cora Dzubak and I (2009) have advocated meta-cognitive approaches to learning for a many years. Our book, *The Engaged Mind: Cognitive Skills and Learning*, includes many techniques that can be used by the individual when learning, with particular

emphasis on mindfulness, reflection and attention. As Schwartz puts it, "Perhaps it would be possible to use mindfulness training to empower the impartial spectator to become more than merely an effete observer. (p.13) Mindfulness and reflection of what we have stored in our own memories, then, becomes the cornerstone of the higher levels of cognitive ability.

Memory

Memory is, and should be, more than storing isolated bits of information. Our brains constantly make connections between ideas. Each individual, however, can begin to train his or her brain to link information in a more meaningful way—can deepen the neural pathways between neurons and strengthen the neural communities that are formed. The brain's ability to redesign itself, it's plasticity, is seen in its "contingency." Nicholas Carr puts it this way, "What gives real memory its richness and its character, not to mention its mystery and fragility, is its contingency." (p. 9) The brain, according to Carr, regenerates itself after each act of recall because it "appears to restart the entire process of consolidation, including the generation of proteins to form new synaptic terminals. Once we bring an explicit long-term memory back into working memory, it becomes a short-term memory again. When we reach consolidation, we gain a new set of connections—a new context." (p.191)

There are a number of instantaneous neuronal events that occur when we access a memory. The hippocampus (found in the mid-brain) has been found to be responsible for processing environmental stimuli. It assembles and integrates sensory input and pulls information from long-term memory to be consolidated with the new information. "But it does not store the memories itself rather the integrative information finds its way back to various parts of the cortex in a form that is susceptible to recall, or reassembly, any time later." (Zull, p. 81) The hippocampus is the master integrator, and all of this can now be accessed via the neural community. Each neuron upon receipt of this newly integrated material has the potential to build new synaptic connections. Each new synapse helps to forge and strengthen the neural community.

The process of consolidation and integration of ideas can be understood as the means by which the individual forms new schema in order to understand and make sense of the world around him or her. In the words of Marvin Minsky "common sense is not a simple thing. Instead, it is an immense society of hard-earned practical ideas—of multitudes of life-earned rules and exceptions, dispositions and tendencies, balances and checks." (Kurzweil, 2005, p. 177)

"The key to memory consolidation is attentiveness," says Nicholas Carr, who continues, "Storing explicit memories and, equally important, forming connections between them requires strong mental concentration, amplified by repetition or by intense intellectual or emotional engagement. The sharper the attention, the sharper the memory." The information has to be processed deeply. "If we are unable to attend to the information in our working memory, the information lasts only as long as the neurons that hold and maintain their electric charge—a few seconds…. Then it's gone…" (Carr

p.193) The recurrent interaction between long-term and short-term (working) memory is of vital importance. "The depth of our intelligence hinges on our ability to transfer information from working memory to long-term memory and weave it into conceptual schemas." (Carr p. 124) Working memory, however, can only hold a limited amount of information.

When there is an influx of competing messages, our short-term, working-memory can become overloaded, and that overload "makes it much harder … to concentrate our attention on any one thing. The process of memory consolidation can't even get started." (Carr, p. 194) Using the Internet to function as our long-term memory will only decrease our ability to reflect and consolidate information because our working memory is so often overloaded by distractions and the mere weight of information. "We train our brain to be distracted—to process information very quickly and very efficiently but without sustained attention. That helps explain why many of us find it hard to concentrate even when we're away from our computers." (Carr, p. 194)

As people become more dependent on using the computer as their primary source of information, our brains become more accustomed to forgetting information almost as soon as it is accessed. People are "forced to rely more and more on the Net's capacious and easily searchable artificial memory," according to Carr, and it "makes us shallower thinkers." (p. 194) But we know that the brain has the capacity to, essentially, reinvent itself, that "no matter how many synapses in a particular neuron has, it also seems to have the potential to grow more." (Zull, p. 98) Continuous access to Internet sources of information seems to have the capacity to help our brain change in a negative way—the neural connections are lessened and the ability to reflect diminished because the brain is rewiring itself to accommodate the physical stimulus of short bursts of activity that bring the reward of information which can be quickly forgotten.

"The notion that memory can be 'outsourced,'" says Carr, "would have been unthinkable at any earlier moment in our history." (p. 181) In *Phaedrus*, Plato has Socrates attack the concept of installing writing as the primary source for knowledge. By the time he wrote *The Republic*, he has decided that the oral tradition is detrimental to the type of thinking necessary to form a good republic governed by those who have the ability to deal with the abstractions and ideals of reality. The literate heritage has remained central to western civilization since that time. With the current technology "Mnemosyne [the mother of the Muses] has become a machine. Not only has memory lost its divinity; it's well on its way to losing its humanness." (Carr, p.182)

You see, Socrates, Plato, was right. "As people [grew] accustomed to writing down … thoughts and reading the thoughts others had written down, they became less dependent on the contents of their own memory. People began ... to call things to mind not from within themselves, but by means of external marks." (Carr, p. 177) Writing had an impact on how people processed information and how they were able to access it later. Reading allows the reader to focus on a specific set of words that convey a specific meaning and to "disengage their attention from the outward flow of passing stimuli in order to engage … more deeply with an inward flow of words, ideas, and emotions."

That was—and is—the essence of unique mental process of deep reading. “It was the technology of the book that made this ‘strange anomaly’ in our psychological history possible. The brain of the book reader was more than a literate brain. It was a literary brain." (Carr p. 65)

Books allowed people to develop ideas in more concrete detail and to develop ideas in a way that would bear inspection by the reader. “The epistemological impact of printing was noticed only gradually. Europeans were hardly aware of the shift in the quality of knowledge, as the new knowledge format only subtly undermined the older oral world of discourse and rhetoric.” (Heim, p. 45) Knowledge became available to individuals to be perused at their leisure without the intrusion of others, unless, of course, that debate was welcomed and invited. The work of reading gave the individual the chance to share ideas with others far removed from a particular location. Unlike the oral form of communication, which is basically unconscious, writing became the means by which the individual could consciously revise his or her discourse to create a polished product that would better convey the intended message.

As noted earlier, when the literate tradition came to the fore, people had to recreate language to convey meaning in a new format. Not only did the work have to follow patterns and themes, but it also had to appeal to the rhythmic cadence of oral language. I have mentioned earlier that a great deal of what the brain does is unconscious. Speaking is one of the activities in which people participate that is carried out unconsciously. Of course, they know what they want to speak about, and they have a basic idea of where they want the conversation to go, but as the words flow from their mouths, they do not consciously choose which words to say. People only stop during conversation when they consciously hear a misspoken or mispronounced word.

Written language is different. After a draft is completed, people have the ability to go back and reflect on what they have written and how they have written it. That reflection upon written work allows people to find areas that need to be rewritten for semantic and/or syntactic clarity. All of these steps need to be taken for a person to be considered literate, and they have a profound impact on how our brains function and how we access information for discussion and debate. Essentially, the literate mind reflects on the information that is conveyed as it is written and as it is read. Working memory is usually not overtaxed because the reader or the writer is so focused on the one particular task at hand.

The Internet has a different effect on the process of thinking and remembering. “It places *more pressure* on our working memory, not only diverging resources from our higher reasoning faculties but obstructing the consolidation of long-term memories and the development of schemas…. The web is a technology of forgetfulness." (Carr, p.193) It frees us from the task of remembering.

Michael Heim suggests that we can link computer programs into a "cybernetic infrastructure” and compare that with the linking of information in the human brain. "When technology becomes a [sic] interconnected system, [w]hen a technology covers a

number of particular tasks, we can obtain information about the system [so that] our appliances communicate with one another in function…." (p. 75) But the programs that make the machines run are programmed and stay within relatively static, programmed boundaries. The human brain functions differently. Where the computer follows certain commands, the human brain can gather and apply ideas from one source and then refocus those ideas on a number of separate questions in an attempt to create a cohesive cogent whole. The human brain is plastic and changes with every function that is performed. While "programmed" to function, the brain also creates its own programs.

Plasticity

The concept of brain plasticity has finally found an audience, and the idea can bring with it profound change in the way people understand. "The wiring of the brain is plastic in the sense that it can be remodeled…," James Zull says, "sometimes dramatically. For example, in deaf people, the auditory parts of the brain can be invaded by neurons from the vision part, or, if a monkey loses an arm, the sensory neurons that map the arm can form new connections with the neurons used to map the face." (p. 115-116)

Michael Merzenich, who has conducted research on brain plasticity for decades and has developed programs that help individuals to find the neural means to adapt to catastrophic events in their lives. He has also been able to develop training programs that help "70- to 90-plus-year-olds to be more accurate aural-language receivers and language users." This is progress or brain growth for the age group that supposedly has the least plasticity and has a more difficult time adjusting to change. "After 40 hours or so of training … their performance on a cognitive assessment battery is like those of an average person who is 10 years younger. (Olsen, 2005b, p4)

According to Nicolas Carr, "virtually all of our neural circuits—whether they are involved in feeling, seeing, hearing, moving, thinking, learning, perceiving, or remembering—all are subject to change." (p. 26) James Zull would add that learning is about experience and "it changes the activity in our neurons. When the neurons are more active, they make more synapses." (p. 116) Learning, therefore is dynamic by nature. Regardless of whether the learning experience is smooth and easy or fraught with numerous starts and stops, "all phases of the learning cycle have the potential for progress or regress. Things change moment by moment." (Schwartz, p. 235)

Jeffrey Schwartz has also seen great success in his patients with OCD who establish a new behavior, a new goal, to replace obsessive behaviors. (Schwartz p. 2-28) It is, then, the ability of the brain to redesign itself that empowers the individual to change. So learning remains a genetic function anchored in the physical world, and each experience has a profound impact on the brain.

> Every time we perform a task or experience a sensation, whether physical or mental, a set of neurons in our brains is activated. If they're in proximity, these neurons join together… As the same experience is repeated, the … links … grow stronger and more plentiful through both physiological changes … and anatomical

> ones, such as the generation of new neurons or the growth of new synaptic terminals on existing axons and dendrites. (Carr p. 27)

The neural communities that I've been talking about continue to expand as more information is linked to that which is stored. John Locke's tabula rasa is, in part, correct because the child must learn everything about his or her environment from experience. What we know comes entirely through our experiences, through what we learn as we live. However, once the brain contains information, whatever other experiences and ideas we have are filtered by the past memories. The newly integrated memory also causes changes in the brain's physical structure and the way the individual understands the relationship between past and present. But since "our neural loops don't snap back to their foremost state the way a rubber band does; they hold onto their changed state. And nothing says the new state has to be a desirable one. Bad habits can be ingrained in our neurons as easily as good ones." (Carr, p. 34) Extinguishing a bad habit, then, *is* redesigning and creating a new neural community.

Plasticity and the Net

The way we learn—through an oral tradition, a literate tradition or an electronic media such as the Internet—significantly affects the way we perceive reality and the way we respond to the environment. According to Susana Urbina, a professor of psychology at the University of North Florida, "Our environment, because of technology, is changing, and therefore the abilities we need in order to navigate these highly information-laden environments and succeed are changing." (Olsen, 2005a, p. 1)

"Researchers found that when people search the net they exhibit a very different pattern of brain activity than they do when they read book-like text. (Carr, p. 122) Readers, according to the research lead by Nicole Speer (2009), "dynamically activate specific visual, motor and conceptual features of activities while reading about analogous changes in activities in the context of a narrative." (p. 995) In other words, the reader recreates the scene and vividly portrays the actions about which they have read—their brains are actively engaged in a multi-sensory experience.

Research has also found that "experienced net users … display extensive activity across all those [same] brain regions when they scan and search web pages. The good news here is that web surfing, because it engages so many brain functions, may help keep older people's minds sharp. Searching and browsing seem to 'exercise' the brain in a way similar to solving crossword puzzles." (Carr, p. 122) However, in a 2005 interview, Michael Merzenich said that "our brain is modified on a substantial scale, physically and functionally, each time we learn a new skill or develop a new ability." (Carr, p. 118) He concluded that the brain is "massively remodeled" by repeated exposure to the Internet. "While acknowledging that it's now hard to imagine living without the Internet and online tools like the Google search engine, he stressed that THEIR HEAVY USE HAS NEUROLOGICAL CONSEQUENCES [emphasis Merzenich's]." (Carr, p. 119)

Jeffrey Schwartz tells us that:

> Plasticity must be a response to experience; after all, the only thing the brain can know and register about some perception is the pattern of neural activity it induces. This neural representation of the event somehow induces physical changes in the brain at the level of neurons and their synapses. These physical changes allow the representation of the event to be stored and subsequently recalled. (p. 108)

This important concept is echoed by Nicholas Carr when he states, "Given our brain's plasticity, we know that our online habits continue to reverberate in the workings of our synapses when we're not online. We can assume that the neural circuits devoted to scanning, and multitasking are expanding and strengthening, while those used for reading and thinking deeply with sustained concentration, are weakening or being rewritten." (p. 141) Carr goes on to say:

> In 2009 researchers from Stanford University found … that the heavy multitaskers were much more easily distracted by 'irrelevant environmental stimuli,' had significantly less control over the contents of their working memory, and were in general much less able to attain their concentration on a particular task. … infrequent multitaskers exhibited relatively strong 'top down attentional control,' the habitual multitaskers showed 'a general tendency for bottom-up attentional control.' (p.141-142)

Michael Merzenich paints a darker picture. As we multitask online, he says, we are "training our brains to pay attention to the crap." The consequences for our intellectual lives may prove 'deadly.'(Carr, p. 141-142)

Multisensory Learning

As an advocate of multi-sensory learning, I have urged people to use all of their senses when learning in order to help create a broader foundation for accessing information—that is, creating neural communities by actively, meaningfully and purposefully linking ideas together. Computer technology and the Internet are bringing aspects of multi-sensory learning to people but in a way that habituates them to the technology and prevents them from deep thinking, thinking critically or having the ability to synthesize.

When online, "the net delivers a steady stream of input to our visual, somatosensory, and auditory cortices. There are the sensations that come to our hands and fingers as we click and scroll, type and touch. There are the many audio signals ... The net engages all of our senses … and it engages them simultaneously." (Carr, p. 117) It is multi-sensory, but, as we shall see below, it is a multi-sensory experience rife with the very distractions that prevent deep thinking.

We have discussed earlier the contention of Nicole Speer and her research group that the act of reading activates the somatosensory areas of the brain. But the cognitive act of reading allows the reader to form a "crucial link" between "the sensory motor experience of the materiality" of a written work and "the cognitive processing of the text

content." However, “the shift from paper to screen doesn't just change the way we navigate a piece of writing. It also influences the degree of attention we devote to it and the depths of our immersion in it." (Carr, p. 90)

It is exactly that immersion in the technology that has had such a dramatic impact on the abilities of students to think critically and creatively. Before we continue, however, we have to address one important set of evidence that seems to support the contention that technology does not have an adverse affect on cognition. The increase of IQ scores over the past century has been spoken of as proof that technology has a positive impact on learning. However, most of the increase has been in the area of spatial visualization and tactile skills.

IQ

Part of the discussion about the increase of computer and Internet technology and the decrease in reading skills seems to find advocacy for technology in the strange fact that there has been a “continuing global rise in IQ performance for over 100 years.” Known as the “Flynn Effect,” the rise “is concentrated in nonverbal IQ performance (mainly tested through visual tests) but has also occurred, albeit to a lesser extent, in verbal IQ.” (Greenfield, p. 69)

> But, Flynn realized, that … over the course of the last century … Everyone began to wear … the same ‘scientific spectacles’ that were worn by the original developers of the IQ tests. … We weren't more intelligent than they, but we had learnt to apply our intelligence to a new set of problems. We had detached logic from the concrete, we were willing to deal with the hypothetical, and we thought the world was the place to be classified and understood scientifically rather than to be manipulated. (Carr p. 147)

Greenfield agrees that “rising IQ performance is attributable to multiple factors: increased levels of formal education, urbanization, societal complexity, improved nutrition, smaller family size, and technological development.” (p.69) The rise is also attributable to the behaviors an industrial and technical society focus on: spatial order and pattern recognition. Those types of behaviors are taught in both formal and informal educational settings.

Computer games, one type of informal educational setting, are especially focused on physical manipulation of spatial objects in virtual space and the manual dexterity necessary in using the mouse, the joystick or the keyboard to make it all happen. "Veteran game players were also found to be able to identify more items in the visual field,” and their brains seemed “capable of radically altering visual attentional processing." (Carr, p.139) There is growth, but not the cognitive growth we might hope for.

While IQ scores have risen, those cognitive aspects of learning that we respect the most have not risen with them. Flynn himself asked "how can people get more intelligent and have no larger vocabularies, no larger stores or general information, no greater ability

to solve arithmetical problems?" (Carr, p. 146) As more media technology is used in formal and informal educational settings “verbal IQ has risen, [but] verbal SATs have fallen.” Greenfield sees this as a possible result of the “decline in recreational reading.” (p. 69)

Michael Merzenich looks at intelligence as a genetic ability can be cognitively expanded as we process all of the words and events we experience. He believes that we have to put definitions, facts and data into our brains because one “cannot make associations about things that you have not recorded.” He sees the Internet as a learning aid that has “increased the operational capacities of the average world citizen.” He also believes that the Internet can help a person’s brain to “gather more information to get more answers right, and to see more possible associations than would otherwise be the case. (Olsen, 2005b, p. 3)

Many advocates of technology propose that the Internet contains all of the knowledge we will ever need. "It's true we don't remember anything anymore, but we don't need to," says Jeff Hawkins. He continues that "we might one day sit around and reminisce about having to remember phone numbers, but it's not a bad thing. It frees us up to think about other things. The brain has a limited capacity, if you give it high-level tools, it will work on high-level problems." (Olsen, 2005a, p. 3)

However, as discussed earlier, current neurological research is at odds with Mr. Hawkins conceptualization of the human brain. There are over 100 billion neurons in the human brain, each of which can form hundreds, if not thousands, of synaptic connections to other neurons. That is, 10^{14} synapses (quite an impressive number). It is those connections, those neural communities that engender our ability to develop and use higher order cognitive abilities. Remember, our brains are designed to remember and use stored information and to respond to whatever the environment throws our way. We have not really touched the possibilities of the human brain because our educators do not understand this simple set of facts. If we connect ideas, create eclectic learning environments, we can improve the way students learn, connect, access and use the ideas that are in their brains. If we don’t ask them to put anything in there, they will not be able to use cognitive skills to respond when necessary to events that may prove dangerous to our species.

The rise in IQ scores more than likely reflects the technologies that have been developed and adopted since the beginning of the 20th century which have had an impact on our perceptions of reality and understanding of what is necessary to know**.** Through the 19th century people lived “in a world of substance rather than symbol, they had little cause or opportunity to think about abstract shapes and theoretical classification schemes." (Carr, p. 147) The current century has changed how people approach the learning necessary to effectively engage in that technology and that new reality. The new methods are the result of the brain changing to accommodate the new technology.

Mark Slouka warns that the computer is "rapidly developing into a sort of deluxe copying machine, increasingly capable of imitating certain aspects of our lives.” (p. 27)

Using the computer is a type of informal education that shapes the way people think about the machine and creates an atmosphere of acceptance without any real questioning of where we are going and what impact this might have on us. As Nicholas Carr points out:

> "Our focus on the medium's content can blind us to these deep effects. We're too busy being dazzled or disturbed by the programming to notice what's going on inside our heads. In the end, we come to pretend that the technology itself doesn't matter. It's how we use it that matters, we tell ourselves. The implication, comforting in its hubris, is that we're in control. The technology is just a tool, inert until we pick it up and inert again once we set it aside." (Carr, p. 3)

In what appears to exemplify the positive and negative aspects of Internet technology, Michael Merzenich notes that human brains have the ability to specialize and to learn the skills and knowledge of our ancestors that have been developed over the centuries. Our ability to learn this accumulation of cultural lore can be seen as "cultural evolution via brain plasticity." However, he continues, "With the Internet and contemporary technology evolving at a lightning pace over the past 40 years, the demands of uploading from our cultural history are incredible, and we're seeing more and more people falling off the boat." (Olsen, 2005b, p2) The technology, then, can be seen as a double edged sword—it offers fabulous rewards when we search for information, yet it also assumes an Emperor's new clothes aspect in that it leaves us without the stuff we need in our brains to be able to function cognitively.

If the intent of technology is to make us smarter, then it becomes difficult to explain why we see so many more students entering colleges and universities without the reading, writing and mathematics skills required for college-level work.

Media and Technology

In his speech before the German Informatics Society on October 11, 1990, Neil Postman pointed out that:

> …anyone who has studied the history of technology knows that technological change is always a Faustian bargain: Technology giveth and technology taketh away, and not always in equal measure. A new technology sometimes creates more than it destroys. Sometimes, it destroys more than it creates. But it is never one-sided. (p. 2)

Patricia Greenfield concurs that every media will develop "some cognitive skills at the expense of others." She concedes that visual media, television, the Internet and computer games allow individuals to develop "impressive visual intelligence;" however, she continues, "the cost seems to be deep processing: mindful knowledge acquisition, inductive analysis, critical thinking, imagination and reflection." (p.71) She says that both formal and informal education socialize children but that "it is difficult for schools to teach reflective habits of mind to children whose informal education and cognitive socialization have not prepared them for this kind of learning and thinking." Children have to be taught how to think critically, how to use the cognitive processes that the brain

is structured for; they have to be shown the value of mindful reflection. "The developing human mind," Greenfield concludes, "still needs a balanced media diet, one that is not only virtual, but also allows ample time for the reading and auditory media experiences that lead to these important qualities of mind." (Greenfield, p. 71)

Neil Postman (1993), who has for decades challenged educators to actually think about what they are doing, believes that "new technologies alter the structure of our interests: the things we think *about*. They alter the character of our symbols: the things we think *with*. And they alter the nature of community: the arena in which thoughts develop." (p. 20)

One needs only to walk into any library, and school, college or university to understand the breadth of the immersion of the computer. "The public library was an oasis of bookish tranquility where people searched through shelves of neatly arranged volumes or sat in carrels and read quietly. Today … Internet access is rapidly becoming its most popular service." (Carr, p. 97) Post-secondary colleges and universities are rapidly moving from personal service to online advising, online registration, online everything, often at the expense of offering quality service to the students. Teachers can't seem to function without a PowerPoint presentation, and students have come to expect them. The computer has become *the* learning tool of choice. We have become hooked on the idea that everything we do has to be fast-paced and now.

At the CRLA conference in Salt Lake City last year, I gave a presentation about the benefits of multi-sensory learning. Part of the presentation had to do with the creation and use of flash cards to help students learn and process information. As the discussion progressed, one or two members of the audience contended that using the computer to develop flash cards was as effective as having the student make them by hand on actual 3x5 cards. I beg to differ.

The multi-sensory process of making flash cards requires that the individual say the term aloud as it is written down. Since the person is also seeing what s/he writes, all three "primary" processing areas of the brain are employed—the visual cortex, the temporal auditory lobes and the kinesthetic/tactile mid-brain. The person writes one term on one side of the card and the definition or information related to that term on the other. Everything written down is said aloud. To enhance the cards, the person might color code certain specific topics and draw diagrams for specific details to assist memory. As the individual goes through the cards and reads them, again aloud, s/he is again using all of the "primary" processing areas. Another good practice is when one has gone through the pile of cards to turn them over and look at them from the back—that is from the definition. That way the individual has seen the information in at least two different contexts.

But information is not knowledge, so the individual may wish to go a few steps further—to go beyond rote memorization and to reflect on the relationships of the ideas by linking them together in a purposeful manner. To do this, all one has to do is tell a story by selecting any one of the cards and finding other cards that relate to it. As each

card is placed on a table or other flat surface, the person begins to tell a story about how the ideas connect to each other. The cards are laid in whatever pattern the individual chooses. One story finished, the person can begin another story with a different card as the starting point, creating a new pattern of connections, so a new channel is formed, and the ideas come into focus sharpened and condensed.

As we have seen above, researchers have found that the hippocampus plays the key role in integrating sensory input with long-term memory. That is, each time a person experiences some sensation, the hippocampus pulls bits of related information from long-term memory, places it in working- or short-term memory and assembles new and old information together. That done, the new memory is sent back to the original neurons. If the change in information is strong enough, the neuron creates a protein that enables the growth of new synapses thereby strengthening the memory by allowing connection with other neurons containing similar information. New neural pathways and new neural communities are created.

When you create patterns with your hands, you nurture an intimate relationship with the information by the very act of creating the new synthetic pattern. Each pattern is a new start, but each pattern forms in a series of flashes of recognition, another part of holistic understanding. As Nicole Speer and her team showed about brain activity when reading, and which, I believe, can be applied to the reading and pattern creation of using flash cards, "the collection of medial brain regions we found to be associated with situation changes [in a text] closely resembles a network of regions that have been recently associated with the act of projecting one's self into a remembered, anticipated, or imagined situation." (p. 997) In other words, each new pattern creation causes the brain to recall other, related patterns and to anticipate the possibility of additional patterns in the future.

This mindfulness is reminiscent of the literate process of writing and reading. "Starting in first grade, better readers are also more reflective than less skilled readers. And reflection (contrasted with impulsivity) is associated with inductive problem-solving competence…" (Greenfield, p. 71) For our flash card user, every picture tells a story; every story helps to heighten cognitive growth. Every time an idea is used the neural pathway to it is strengthened. Every time ideas are linked together, neural communities are strengthened and the potential for cognitive growth heightened. It may reflect "a more general neural mechanism for grounding cognition in real-world experiences." (Speer, p.998)

The individuals who advocated using the computer to develop the flash cards said it was an equally multi-sensory activity because the student would keyboard the words and letters in, seeing what s/he was doing and saying the words aloud for auditory stimulation. They were, of course, correct. But it becomes more difficult and more distracting to try to rearrange the information in order to tell a story, the computer flash cards are more difficult to color coordinate and it is more difficult to draw diagrams or doodle on the virtual cards. The patterns remain two dimensional and static.

The nature of the computer is multi-sensory and does lend itself to real-time activity—real and virtual. However, researchers suggest that "certain cognitive skills are strengthened, sometimes substantially, by our use of computers and the net. These tend to involve lower-level, or more primitive, mental functions such as hand-eye coordination, reflex response, and the processing of visual cues." (Carr, p. 139) The perception tends to be that of a virtual world, one that exists along side, an alternate to reality. Video game players, for instance, take little time to reflect on the events they see on the screen; there is simply not enough time because the next event is programmed to begin immediately upon the completion of the previous task.

Marshall McLuhan (1964), who likened himself to Louis Pasteur when he was trying to convince doctors that "their greatest enemy is quite invisible, and quite unrecognized by them" (p. 32), suggested that "the effects of technology do not occur at the level of opinions or concepts, but alter … patterns of perception steadily and without any resistance." (p. 33) Media are more than just the vehicles that contain information. They also have a significant impact on how we process that information. The computer, while showing information on a glowing screen, also changes the way we perceive everything else around us.

Nicolas Carr cites Mark Federman, an education researcher at the University of Toronto, who argued "that literacy, as we've traditionally understood it, 'is now nothing but a quaint notion, and the static form that is as irrelevant to the real questions and issues of pedagogy today as is recited poetry—clearly not devoid of value, but equally no longer the instructing force of society.'" (p. 117) Federman went on to say "the time has come … for teachers and students alike to abandon the "linear, hierarchical, world of the book and enter the Web's 'world of ubiquitous connectivity and pervasive proximity'—a world in which 'the greatest skill' involves 'discovering the emerging meaning among contexts that are continually in flux.'" (p. 117)

In contrast to this view that the technology is the best way to learn, Patricia Greenfield asserts that reading is the key to developing good critical thinking skills. "The amount of out-of-class reading done during the college years is a statistically significant predictor of critical thinking skills. One reason for this may be that books … requir[e] mental effort." (p. 71)

Reading allows the individual to quietly form a bond with the author, to decipher and interpret the meaning conveyed by the tone and tempo of the language used. It allows the reader to draw conclusions and make inferences about meaning. It gives him the time to reflect and to deep process the information in a way that is formed and supplemented by his or her personal foundation of knowledge.

Walter Ong (1987), who believed that the history of language was the history of mind, feared that there has not been enough study about the impact of computer technology on the mind and proposed that to "understand the effects of the computer on thought and consciousness we need disciplined study, which can profit from use of the computer where this is helpful…" (p. 377). Nicholas Carr suggests that:

> Reading and writing are unnatural acts, made possible by the purposeful development of the alphabet and many other technologies. Our minds have to be taught how to translate the symbolic characters we see into the language we understand. Reading and writing requires schooling in practice, the deliberate shaping of the brain. (Carr, p. 51)

Distraction

One of the most difficult things for the literate individual to overcome is distraction. Distraction can be anything that diverts one's attention from its original focus. This diversion has a negative impact on how one pays attention to details and reduces one's ability to process information and later reflect deeply about the subject.

Other than the question of how the brain is physically affected and rewired by the use of technology, another problem seems to be that of distraction. Whenever one uses a website, there are usually a variety of informational tidbits that one can find on the screen. "A single webpage may contain a few chunks of text, a video or audio stream, a set of navigational tools, various advertisements, and several small software applications, or 'widgets,' running in their windows." (Carr, p. 91) The calendar may pop up on the screen with an advice about a meeting an hour hence, a new email message may arrive, we may decide to click on a hyperlink, and we may decide to open another software program. There is so much we can do, and that distraction may have a negative impact on how well and how soon we complete a particular task.

"What we're trading away in return for the riches of the net—and only a curmudgeon would refuse to see the riches," says Nicholas Carr, "is what Karp calls 'our old linear thought process'." On the computer, the tendency is to click on those other links to make sure we get it all. Our focus is dissipated among a number of other distractions, and that distraction may have drastic cognitive results.

In his classic dystopian short story, "Harrison Bergeron," Kurt Vonnegut introduces the concept of socially imposed distractions on individuals who exhibit certain qualities of excellence. These distractions, called "handicaps," were supposed to guarantee equality among all of the citizens of the society. Counterweights were placed on those who might benefit from their physical prowess, implants were placed that would sound horrific noises into the brains of the intelligent to prevent them from thinking clearly. All very nicely contrived, and all ostensively ensuring that the stated goal of the society—equality—would be met.

Two of the primary characters of the story are affected by this social goal. George, the father, is evidently very intelligent, and every few seconds his implant sounds amplified crashing of bottles, car crashes, bombs exploding, anything to distract cogent thought. Hazel, the mother, is of "average" intelligence and wears no handicaps. When Harrison, the son, of superior athletic and intellectual abilities, as seen by the numerous handicaps he is forced to wear, is killed after a supreme effort of rebellion,

George and Hazel are not able to reflect upon his death even though it had happened before their eyes. They were distracted.

Our current distraction as a result of using the computer may not be as dramatic or as contrived as that in Vonnegut's story, but as Michael Heim (1993) points out "we are overwhelmed by the amount of information in our current information age … our attention span shortens," he says, and "we collect fragments. We become mentally poorer in overall meaning … [and] some people even believe that literacy or culture is a matter of having the right facts at our fingertips." (p. 10)

Heim continues that "the computer doesn't merely place another tool at your fingertips. It builds a whole new environment, an information environment in which the mind breathes a different atmosphere. … the computer … belongs to an information-rich world—which soon becomes an information-polluted world." (p. 13) Nicholas Carr takes issue with those people who argue that literacy does not have the value that has been attributed to it. "Their arguments are another important sign of a fundamental shift taking place in society's attitude toward intellectual achievement. Their words also make it a lot easier for people to justify that shift—to convince themselves that surfing the web is a suitable, even superior, substitute for deep reading and other forms of calm and attentive thought. (p. 112)

Matt Richtel (2010b) notes that the brains of computer users "are rewarded not for staying on task but for jumping to the next thing." He continues, "The worry is we're raising a generation of kids in front of screens whose brains are going to be wired differently." (p. 1-2) Jakob Nielsen conducted a study tracking people's eye-movements while they "read pages of text and browse other content. Nielsen found that hardly any of the participants read online text in a methodical, line-by-line way, as they typically read a page of text in a book." In his 2006 study, he found that "the vast majority skimmed the text quickly, their eyes skipping down the page in a pattern that resembled, roughly, the letter F." The subjects would read the first two or three lines as they normally would, but then "their eyes would drop down a bit, and they scanned about halfway across a few more lines. Finally, they let their eyes curiously drift the little further down the left-hand side of the page." (Carr, p. 134-135) These findings were confirmed by an nGenera corporation study that found of the six thousand young people interviewed "Digital immersion … has even affected the way they absorb information. They don't necessarily read a page from left to right and from top to bottom. They might instead skip around, scanning for pertinent information of interest.'" (Carr, p.9)

People who multitask do not read deeply and have "more trouble focusing and shutting out irrelevant information." (Richtel, 2010a, p. 2) While hyperlinks serve the purpose of ensuring that we can access all the information there is to know about a given topic, they "encourage us to dip in and out of a series of texts rather than devote sustained attention to any one of them;" and, continues Nicholas Carr, "they are designed to grab our attention. Their value as navigational tools is inextricable from the distraction they cause." (Carr, p. 90) The technology is rewiring our brains and restructuring the way we look at information. It is changing how the brain works.

Conclusion

In the on-going argument between form and function, one begins to feel like Matt Slouka when he says, “Trapped in an increasingly alien world, a world more and more at odds with our biological selves, the wonder is not that some of us act strangely at times or hold irrational beliefs but that we cope at all." (p. 134)

The brain needs to learn and reason and act, but by reducing the depth of learning, the “Technopoly eliminates alternatives to itself in precisely the way Aldous Huxley outlined in *Brave New World*.” (Postman, 1993, p. 48) Without the ability to function cognitively, according to Michael Merzenich, the brain “deteriorates. I assume that we brain scientists understand this with increasing clarity, and whatever else the information explosion contributes to humankind, we'll understand … what the average individual has to do to maintain lifelong "brain fitness." (Olsen, 2005b, p3) Hopefully, we will actually use that information.

According to Neil Postman (1993), “those who have control over the workings of a particular technology accumulate power and inevitably form a kind of conspiracy against those who have no access to specialized knowledge made available by that technology.” (p. 9) We don’t have to worry about the knowledge being available, but what the technology itself is doing to us as we access that knowledge.

> In the words of Frederick Taylor we have, I believe, the first clear statement of the idea that society is best served when human beings are placed at the disposal of their techniques and technology that human beings are, in a sense, worth less than their machinery." (Postman, 1993, p. 52)

Currently, says Matt Slouka, the majority of the population has little trouble seeing what is real. “We know, for example, that Homer Simpson is a cartoon character on TV, while our neighbor, however much he may act like one, is not.” He continues, though:

> Within a few years, however, distinctions such as these will be less automatic. We'll be able to immerse ourselves in an entirely synthetic world, a world that exists only as a trick of the senses, a computer-induced hallucination. And when we emerge from cyberspace—that strange non-place beyond the computer screen—all indicators suggest that we will find it increasingly difficult to separate real life (already demoted to the acronym RL on computer Nets around the world) from virtual existence. Or worse, we will know the difference but opt for the digitized world over the real one. (p. 5)

Yet, as Patricia Greenfield tells us “imagination is important in scientific discovery as well as in the creation of literature and art. [However] there is evidence that visual technology inhibits imaginative response.” (p.71)

So are we to leave our memory and our imagination to the machine and go about our business without concern for where the technology may be leading us? What do we

do when we no longer have the think for ourselves or ask questions? If everything is in the brain of the machine, what is the point of being human?

In 1971, an animated movie was transmitted on television. It was called *The Point*. The story was about a little boy, Oblio, who was faced with an overwhelming series of travails because he did not look like everyone else. You see, everyone in his society had a point at the top of their heads—Oblio didn't. He had a round head. He was different. By overcoming the journeys that represented his rite of passage, Oblio proved that "You don't have to have to have a point to have a point!"

While the story of Oblio allows us to see the value of being unique and free in spirit, to learn from all that we see, hear and do, we should guard ourselves so the point that Neil Postman made in 1990 does not come to pass: "in a world without spiritual or intellectual order, nothing is unbelievable; nothing is predictable, and therefore, nothing comes as a particular surprise." (p. 5)

We stand at a critical juncture. All of our great social experiments—free, open and high quality education, acceptance of individual incentive, independence, democracy—may be in the balance. I believe it is time to actually think critically about why and how we use technology—to find its benefits but to be aware of its dangers. Perhaps we still have the chance to prove the Borg incorrect. Perhaps "Resistance is *not* futile."

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