Ann Natl Acad Med Sci (India), **49(1&2):** 48-54, 2013

Annals of the National Academy of Medical Sciences (India)

Technology and the Future Brain

K.N. Sharma

M.S.Ramaiah Medical Institutions & Hospitals, Bangalore.

Ann Natl Acad Med Sci (India), **49(1&2):** 48-54, 2013

Technology and the Future Brain

K.N. Sharma
M.S.Ramaiah Medical Institutions & Hospitals,
Bangalore.

Prologue :

It is indeed a pleasure and a proud privilege for me to be here and have the opportunity to share my thoughts with this august gathering. My happiness is imbued with a double grace. I represent here the National Academy of Medical Sciences, India on the occasion of its Golden Jubilee Celebrations 2011, and have the distinction of giving the Oration as Emeritus Professor of the Academy. It is equally fortunate that Shree Chitra Tirunal Institute for Medical Sciences and Technology, a highly prestigious institute in the country and with an image to dovetail Technology, and biomedical sciences into a close fabric, happens to be the venue of my talk. In keeping with the broad aims and objectives of both the Academy and Shree Chitra Institute which appear to be complementary, I have attempted to interface the impact of advancing technology and the exceptional progress in the field of neuro-sciences, into a viable and useful matrix. It is with this background that I have ventured to talk on the impact of growing technology on the understanding of the evolving brain – the ultimate goal of human endeavour. I must admit that, for this Oration I have heavily drawn from Gary Small and Gigi Vorgan's Book iBrain (1).

Before I turn to the topic let me appraise you very briefly the beginning, the growth, the present status as also the future expectations in the multi-dimensional development of the Academy. As some of you may already be knowing that the National Academy of Medical Sciences was started in the year 1961 and was inaugurated by none other than Shri Jawaharlal Nehru the then Prime Minister of India, on December 8, 1961 in Sapru House. He also graciously accepted the first Honorary Fellowship of the Academy. To top it all the first Convocation Address of the Academy was delivered by the then President of India Dr. S. Radhakrishnan on December 8, 1963. Since its inception, the Academy

Correspondence : Dr. K.N. Sharma, Executive Director, Gokula Education Foundation, (Health Sciences), M.S.Ramaiah Medical Institutions and Hospitals, Bangalore – 560 054. NAMS GOLDEN JUBILEE LECTURE delivered at Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram on May 7, 2011

has upheld the highest standards of academic excellence and presently enjoys the exalted position in the medical and scientific fraternity with highly acclaimed biomedical scientists amongst its Fellows. Among its various activities of intra-and extra-mural CME programmes by the Academy and its various State Chapters in the country, short term training and exchange programmes, Oration and Award Lectures, the Academy is profoundly influencing the growing impact extended not only to the nook and corner of India but extending well beyond the boundaries of the country.

Multidimensional Technology and Human Brain :

It is being universally acknowledged that the ever changing impact of growing multidimensional technology is not only changing our day to day life of how we live and behave but is also profoundly altering our brains as well. Talk of the daily exposure to high technology and its various forms like computers, videogames etc, and all are profoundly influencing our neurons and neuro-transmitter release, so much so that newer neural pathways are being strengthened while weakening some of the old ones,, and grossly influencing the ever prevailing chattering in the DMN (Default Mode Networking) system of the brain. In fact it is being claimed that our brains are evolving at a speed as never before, and while we are generally unaware of these changes taking place in the neural circuitry, they seem to become permanent with time. The interesting aspect is that the evolutionary brain processes have so rapidly occurred over a single generation and may represent one of the most extraordinary advances in human history.

As the brain evolves and shifts its focus towards new technological skills, it drifts away from fundamental social skills, such as reading facial expressions during conversation or grasping the emotional context of a subtle gesture. With the weakening of the brains neural circuitry controlling human contact, our social interactions may become awkward, and we may tend to misinterpret, and miss subtle, nonverbal messages. It is not unlikely that a decade from now continued slipping of social skills may result in a misread facial cue or misunderstood gesture and could result in a major disaster. The high-tech revolution is redefining not only how we communicate but how we reach and influence people, and exert political and social change.

Digital Natives and Digital Immigrants: the widening hiatus

Young minds tend to be the most exposed, as well as most sensitive, to the impact of digital technology. To-days young people in their teens and twenties, who have been dubbed Digital Natives, have virtually not known a world without computers. These natives rarely enter a library; they use Google, Yahoo and other online search agencies. The neural networks in the brains of these digital Natives differ dramatically from these of digital immigrants; people who came to digital / computer age as adults. We are witnessing the beginning of a deeply divided brain gap between the younger and the older minds – in just one

generation. What used to be simply a generation gap that separated young peoples values, music and habits from those of their parents has now become a huge divide resulting in two separate cultures. Where will this all lead to, is a stark question facing us to-day and to which we must find a quick and feasible answer before it is too late.

During this pivotal point in brain evolution it is important that Natives and Immigrants alike can learn the tools they need to take charge of their lives and their brains, while both preserving their humanity and keeping up with the latest technology. In fact we all should help our brains adapt and succeed in this ever accelerating technological environment. Whether our communications involve talking, written words, or even just emotions, different brain regions control and react to the various types of communications. Language – either spoken or written for instance, is processed in Broca's area in our frontal lobes. However, neuroscientists have now found that when volunteers viewed emotions during functional MRI scanning, the emotions activated right inferior frontal gyrus, a region that controls nonverbal communication skills.

The brains of computer-savvy and computer naïve subjects did not show any difference when they were reading the simulated book text. By contrast, the two groups showed distinctly different patterns of neural activation when searching for Google. Computer-savvy used a specific network in the left front part of the brain – the dorsolateral frontal cortex. The Internet-naïve subjects showed minimized, if any, activation in this region.

All of us, Digital Natives and Immigrants, will master new technologies and take advantage of their efficiencies, but we also need to maintain our people skills and humanity. Whether in relation to a focused Google search or an empathic listening exercise, our synaptic responses can be measured, shaped and optimized to our advantage, and we can survive the technological adaption of the modern mind. And this is the message, I would like not only to propagate but to emphasize.

Information Age versus Conceptual Age : ***Brain impact***

For a meaningful success of tomorrow, bridging the brain gap will require two major interventions. We need to help Digital Natives learn to advance their interpersonal skills and human relations and teach Digital Immigrants to hone their technology skills. However, both generations must maintain and enhance their abilities to talk face to face, understand subtle nonverbal cues during conversations, and build empathic ways of relating to one another, off line. And this is of particular relevance to the type of gathering here. The medical faculty who are I hope gathered here in large numbers. don't have to be told how much we lack empathy as and when we are dealing with our patients to-day. And this is what needs to be corrected on a high priority. We can indeed have an impact on our existing neural circuitry and help ourselves to adapt to brain evolution as it unfolds. Also, with age, there is a greater convergence between the specialized right

and left brain – the logical and analytical Left brain reaching out to conceptual Right brain as we are inching from the present Information Age to Conceptual Age; and therefore Right brain is likely to be the key for tomorrow's needs and success.

In other words, reaching a balance wherein we use technology effectively while remaining connect to others in a personal way will help bridge the brain gap between Digital Immigrants and Digital Natives. However, we first need to determine our various strengths and weaknesses eg. in text messaging, email etiquette, eye contact during conversations, or perhaps multitasking skills, and these following self assessments and resulting scores, one can better know 'when to begin training your brain'. For instance, research participants' self rating scale scores correlate significantly with their brain function measures on actual PET and MRI scans. For example, nonverbal communication skills are distracted by technology's lure so much so that with too much technological involvement, our nonverbal communication skills tend to suffer. Similarly, self-esteem (ability to assert and express ourselves is an important social skill), empathic abilities and listening skills, multitasking and attention can all be assessed for individuals; and persons with low scores on self assessment should be helped to try several strategies to help unwind and relax without technology. On the other hand digital immigrants or anyone who feels technologically challenged can catch up with their younger colleagues and jump-start their technology skills.

Just as the brain controls our ability to search online or answer email, it defines our humanity – our self awareness, creativity, social intuition and ability to experience empathy, and a range of complex emotions. One key region of the brain for such emotions which makes us feel human and defines these mental states, is insula. The front part of insula recasts a bodily sensation into a human emotional experience. Functional brain imaging studies show that sensations like smell, taste, touch, pain and fatigue can activate insula, which transforms feelings into more complex human experiences. Because it modulates cravings, the insula also triggers behaviours that can lead to addiction to drugs, alcohol, tobacco, sex or Internet. Insula helps the brain sort out what is going on internally versus externally, which allows us to self-awareness and engage in social interactions. The insula is also finely tuned that it even anticipates experiences before they occur. You might have experienced that when you walk outside on a cold winter day, our body traces the experience in advance.

The insula partners with another brain centres to contribute to the human experience. In the frontal lobe, the ventromedial prefrontal cortex controls moral decision making; whole orbito frontal cortex helps us to make decisions about our future behavior. The anterior cingulate controls our ability to recognize facial expressions and intense emotions like rage and love. When we make mistakes, the anterior cingulate also fires, indicating its role in our experience of guilt and remorse.

Human Behaviour and Social Skills :

A critical aspect of what defines human behavior is to act appropriately in social situations and experience empathy. People who lack empathy to the extreme are sometimes called sociopaths. They tend to feel no guilt and have no capacity for love. They can be chronic liars and ostracized by society.

Functional MRI scan show that whether volunteers shot an aggressive humanoid in videogame or healed a wounded character, activation of two specific areas took place: the prefrontal cortex often involved in complex reasoning, and the amygdala, a region that controls emotion.

Brain scanning has not only isolated the neural networks that define our humanity but also shown that we can take control and train our brains to refine our human behavior and social skills. Also the more mature brain is more resilient than the younger brain and less prone to sadness and depression.

Off-line brain training may counteract many negative consequences of extensive time online, particularly the neglect of a healthy lifestyle. New technology has brought us remarkable advances, and the challenge is to take advantage of technology without letting it take over other important aspects of personalities. By identifying areas in our lives where off-line brain training can counteract the impact of digital stimulation on our minds' neural pathways, we can take control of how our brains adapt to the new technology. Try to cut back time you spend using all types of technology – answering email, cell phone talking, text messaging, television, or anything that does not involve face-to-face interactive contact with other every day. Make a conscious effort to spend more time with people you care about, and adopt other healthy lifestyle habits.

Spending hours in front of computer can atrophy the brains neural circuitry that controls recognition and interpretation of nonverbal communication skills that are essential for both personal and professional success. F MRI studies show that when we focus our attention on another persons facial expression and tone of voice, brain activity in its medial prefrontal cortex increases. This brain region is critical for understanding other peoples intentions. To increase awareness of these important communication-skills, general body language for example style of waving, nodding etc, or facial expressions such as a grin, a frown or even a perplexed look tells a lot about the person what he may be feeling or attempting to convey. Similarly eye contact which can communicate a range of emotions, such as anger, passion, sadness etc, or touch (just as eye contact conveys a message, so does physical contact), or appearance per se (people often express themselves by the way they dress and wear their hair etc), are all important to improve non-verbal communication skills. Also, fine tuning so as to translate nonverbal cues, looking for nonverbal / verbal disconnects and overall take big picture – body language, will all help to fit the particular situation. If on the other hand if we anticipate an uncomfortable outcome to conversation, we may tend to avoid face-to-face

interactions by choosing the least direct approach. In such a situation some of the strategies would be; face your fears – assert yourself by talking directly about your feelings. Stick to the facts: avoid making judgment or negative statements and focus on specifics. Assert nonverbally and listen and respond.

People often have difficulty being assertive when they have low esteem. Individuals with little confidence may feel that their needs are not worthy of another persons consideration, so they don't express them. Low self-work also can lead to the online disinhibition effect – people start sharing their very personal feelings, wishes and thoughts. Some of the strategies that help boost feelings of self esteem would be looking for triggers - pinpointing what makes you feel vulnerable, look for reevaluating goals, make moral choices and focus on your strength. Having positive expectations about the future often builds self-esteem. Learning empathy is another important attribute and involves recognizing feeling in others, learning to listen, and letting others know you understand. Strengthening your social relationships through improved empathic skills will counteract the isolation that is typical of the new high-tech digital age.

Multitasking and Human Memory :

Even people who can assert themselves will, and who have great empathic skills may be challenged by multitasking. Also, it has been shown that the brain can be less efficient when attention constantly shifts from one task to another. Multitasking can also impair memory ability. The key is to manage new technology and control the power it wields, rather than let it control you. When we minimize our multitasking, we generally improve our ability to pay attention. Many of the strategies that help us focus attention also help us reduce stress and chance for our ability to relax. Patterns in mediators (like Buddhist monks for instance), showed significantly increased activation in the neural connections between frontal lobe (thinking) and amygdala (feeling) and thus meditation could be quite useful to digital natives. For balancing the creative mind with new technology environment, some of the strategies that can be useful include pursue new interests, brain storm, be patient, carry an idea recorder (note pad or tape) and alternate high-tech and low-tech strategies.

Socially challenged digital natives and tech-heavy digital immigrants can expect to change overnight with greater awareness of their human contact challenges. Coupled with social skills practice, they may see improvement in themselves, and others may see it too.

Modern Technology *versus* Human Creativity :

According to Albert Einstein, “it has become appallingly obvious that our technology has exceeded our humanity”. And at this critical moment in brain evolution, digital natives and digital immigrants need to share one another's knowledge and experience to move forward and thrive rather than collide. It is becoming essential to interface both high-tech know-how and personal

interaction skills in order to enhance job efficiency, while still maintaining our humanity; and this is not only possible but is rather necessary. The face-to-face communication exercises and the technology toolkits and strategies developed are important steps towards bridging the brain gap. Finding creative ways to bring together younger and older individuals will help optimize the neural circuitry for both generations. Technology-savvy and emotionally intelligent minds can also complement one another's abilities within a generation.

Although digital immigrants have the advantage of early life training in social skills and direct communication, too much exposure to new technology, can create an imbalance in their professional lives and personal relationships. In contrast digital natives who have an added complication of much less early training in interpersonal communication, will have to find solutions varying according to each individual, but all will involve finding a balance adapting to new technology and nurturing our unique people skills and sensibilities.

Evolving Brain and Neuronal Plasticity:

May I end on an optimistic note and say with some confidence that as the digital natives and immigrants learn to come together rather than collide, their brain neural circuitry will adapt for the better. The weakened frontal lobes of digital natives will build new neural pathways from face-to-face interactions with digital immigrants. As our society bridges the gap the future brain will emerge. Not only will this future brain be technology-savvy and ready to try new things, it will have mastered multitasking and paying attention and fine-tuned both to its verbal and nonverbal skills. It will know how to assert itself as well as express empathy, have excelled people skills, and be able to nurture its own creativity. Brain-computer interface technologies detect and translate the brain's physiological electrical signals in order to control an output device, and could lead to the next evolutionary leap in human brain development. Not far into the future, we will have the capacity to monitor and stimulate brain activity of individual cells or neurons using photo-sensitive protein controlled by a laser down to millisecond, the time dimension a brain's cells natural communication skills. As we anticipate and manage the pitfalls, such as high-tech addiction, videogame-brain, and too much multitasking, bringing together digital natives and digital immigrants should continue as one of our foremost pressing priorities. As we bridge the brain gap and learn to communicate and work together at all ages, we will be poised to adapt to whatever new advances come our way, and thus we may not only survive the technological alteration of the modern mind but may also thrive because of it.

REFERENCES :

1. iBrain, Surviving the technological alteration of the modern mind. Gary Small, and Gigi Vorgan, Harper Collins Publishers 2008, New York, NY 10022.