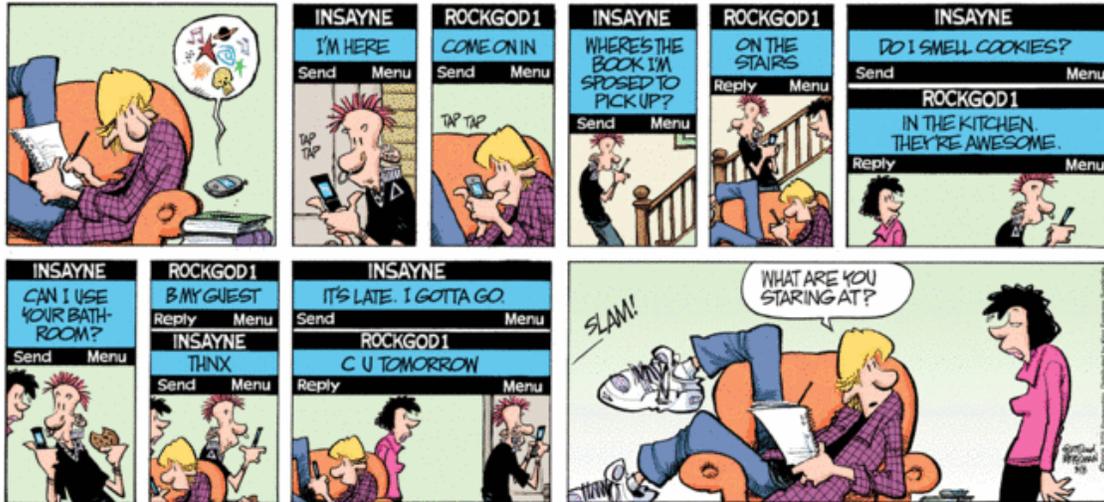


ZITS

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THE POTENTIAL HEALTH DANGERS OF CELL PHONE USAGE

SIMPLE TRUTHS

WHITE PAPER RESEARCH PAPER

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“Yes, that is very interesting...wait, hold on...sorry, had a message coming in...anyhow, where was I? All this...ha,ha,ha...my buddy sends the funniest Tweets, sorry... so, I was saying...oops, gotta take this, just be a minute...”

- Typical conversation with a cell phone owner

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WORLD WIDE CELL PHONE USAGE

There are a few inventions that become so prolific that it would be hard to imagine a world without them. The invention of the wheel and the development of agriculture come to mind; as well as the printing press, the TV, microwave ovens, computers and the Internet. They all are modern inventions that are deeply embedded into our daily lives, yet, without a doubt the current world reigning champ is the cell phone.

Here are a few simple statistical facts to emphasize the point: there are over 4.3 billion cell phone users worldwide and nearly nine in 10 (87%) Americans own a cell phone. When adjusted for age, 94% of Americans under age 45 have cell phones. In 1995 cell phone sales in North America exceeded the birth rate. 98,000 people make 911 calls from wireless cell phones.

Needless to say, cell phones are part of our everyday life. But, the more overpowering question, as with every invention in our civilized world, is if there is a downside to our progress, and more specifically what levels of health problems has our use of the cell phone brought to our doorstep?

RADIATION

On the surface of harmful cell phone use, is its potential to permanently damage brain cells through cellular phone frequencies. Believe it or not, science does not have a clear consensus on this issue. Instead of sounding a warning bell of despair, let's look at both sides of the argument to uncover the issues surrounding this topic.

Cellular phones operate with RF (Radio Frequencies); a form of electromagnetic energy located on the electromagnetic spectrum between FM radio waves and the waves used in microwave ovens, radars and satellites. The amount of RF a person is exposed to with the use of a cell phone depends on a number of factors:

- The distance from the base station;
- The duration and frequency of cell phone use;
- The age of the phone (older analog models involve higher exposure than newer, digital ones).

On one side are there are those who feel it's almost impossible to NOT damage or at least incur some type of harmful impact on the brain. They say that much like a boxer taking repeated blows to the head, rapidly pulsing cell phones signal permanent brain damage. When we use cellphones there are always microwaves emitted and the brain reaches peak absorption in the UHF bands, right where cellular telecommunications operate, which send pulsed signals through the skull in a process one expert likens to "jackhammers on the brain." Proponents say there is nothing "safe" about the new 1.9 gigahertz broadcasting frequency. Microwave frequencies are the same as those used in radar and your microwave oven, and a person wouldn't think of sticking their head in the oven, but there is no hesitation to putting the cell phone to your ear.

Cell phone transmissions damage the ability of white blood cells to ward off infectious disease by disrupting the immune system's electromagnetic communications. Sensitive to subtle electromagnetic harmonies, human brains and bodies depend on tiny electrical impulses to conduct complex life-processes including the ability to read, recall and respond to words. Acting as antennas, our anatomies just as easily tune into spurious signals from radio and microwave transmissions. When it comes to cell phones, "a worse frequency could not have been chosen for the human anatomy."

The rate at which radiation is absorbed by the human body is measured by the Specific Absorption Rate (SAR), and its maximum levels for modern handsets have been set by governmental regulating agencies in many countries. In the USA, the FCC has set a SAR limit of 1.6 W/kg, averaged over a volume of 1 gram of tissue, for the head. In Europe, the limit is 2 W/kg, averaged over a volume of 10 grams of tissue.

One well-understood effect of microwave radiation is dielectric heating, in which any dielectric material (such as living tissue) is heated by rotations of polar molecules induced by the electromagnetic field. In the case of a person using a cell phone, most of the heating effect will occur at the surface of the head, causing its temperature to increase by a fraction of a degree. In this case, the level of temperature increase is an order of magnitude less than that obtained during the exposure of the head to direct sunlight. The brain's blood circulation is capable of disposing of excess heat by increasing local blood flow. However, the cornea of the eye does not have this temperature regulation mechanism and exposure of 2-3 hours duration has been reported to produce cataracts in rabbits' eyes at SAR values from 100-140W/kg, which produced reticular temperatures of 41°C. Premature cataracts have not been linked with cell phone use, possibly because of the lower power output of mobile phones.

The German biophysicist Roland Glaser has argued that there are several thermoreceptor molecules in cells, and that they activate a cascade of second and third messenger systems, gene expression mechanisms and production of heat shock proteins in order to defend the cell against metabolic cell stress caused by heat. The increases in temperature that cause these changes are too small to be detected by studies such as REFLEX, which base their whole argument on the apparent stability of thermal equilibrium in their cell cultures.

While some papers were inconclusive or inconsistent, a number of studies have now demonstrated reversible EEG and rCBF alterations from exposure to pulsed RF exposure. German research from 2006 found that statistically significant EEG changes could be consistently found, but only in a relatively low proportion of study participants (12 - 30%).

Another area of concern is the radiation emitted by the fixed infrastructure used in mobile telephony, such as base stations and their antennas, which provide the link to and from mobile phones. This is because, in contrast to mobile handsets, radiation is emitted continuously and is more powerful at close quarters. On the other hand, field intensities drop rapidly with distance away from the base of the antenna because of the attenuation of power with the square of distance. Several surveys have found increases of symptoms depending upon proximity to electromagnetic sources such as mobile phone base stations. A variety of self-reported symptoms for people who reported that they were living within 300 meters (984 ft) of GSM cell towers in rural areas, or within 100 m (328 ft) of base stations in urban areas. Fatigue, headache, sleep disruption and loss of memory were among the symptoms reported.

HEALTH IMPACTS

There are a number of reported health impacts that result from cell phone intrusion. Here is a summary of results:

- With the brain's electro-chemical communications repeatedly zapped by lightning-like cell phone pulses headaches, fatigue, lethargy, nausea, dizziness, depression, arteriosclerosis and even Alzheimer's can result from frequent or prolonged calls on cell phones.

- Cell phones can murderously modify moods. In brains and bodies seriously derailed by tiny imbalances in trace minerals and hormones, depression, suicide, anger, rage and violence can result when calcium and serotonin levels are disrupted by cell phone transmissions.
- There is also a higher incidence of cardiac problems in terms of the timing function in hearts resulting in more heart attacks and more heart disease
- Cell phone emissions may cause an increase in asthma and an increase in asthma-related death rates as well as reduce the effectiveness of anti-asthmatic drugs, and retard recovery from illness. In addition, the production of histamine, which triggers bronchial spasms, is nearly doubled after exposure to mobile phone transmissions.
- Sleep, EEG and waking rCBF have been studied in relation to RF exposure for a decade now, and the majority of papers published to date have found some form of effect. While a Finnish study failed to find any effect on sleep or other cognitive function from pulsed RF exposure, most other papers have found significant effects on sleep. Two of these papers found the effect was only present when the exposure was pulsed (amplitude modulated), and one early paper actually found that sleep quality (measured by the amount of participants' broken sleep) actually improved.
- Cell phone radiation may also cause DNA damage, impaired DNA repair, and interfere with cardiac pacemakers.
- Electromagnetic radiation across the spectrum increases brain tumors in human populations. Rare tumors on the outside of the brain are more than doubled among cell phone callers - particularly on the right side of the head where phones are usually held.
- Studies suggest that cell phone radiation contributes to brain dysfunction, tumors, and potentially to conditions such as autism, attention deficit disorder, neurodegenerative disease, and behavioral and psychological problems.

CELL PHONES AND ACOUSTIC NEUROMA

There has been a good deal of discussion in scientific circles recently over the concern that radio-frequency (RF) radiation, from cell phone usage, may cause damage to the human brain in the form of an acoustic neuroma. An acoustic neuroma is a non-cancerous (benign), often slow-growing tumor of the nerve that connects the ear to the brain. It is located behind the ear right under the brain.

Acoustic neuromas are relatively uncommon. The incidence of acoustic neuroma among tinnitus patients is approximately one in one thousand individuals as opposed to one in one hundred thousand in the general population. This is the reason many ENT physicians require an MRI of their tinnitus patients; to rule out the possibility of acoustic neuroma.

In 2004 a landmark study was completed at the prestigious Karolinska Institute in Stockholm, Sweden on the use of cell phones and acoustic neuroma. The study, published in *Epidemiology*, provided conclusive proof that use of cell phones over a 10 year period significantly increased the user's chance of developing acoustic neuroma. It showed there was no increased incidence of the tumor within 10 years but that after that time the risk increased two-fold. When tumors appearing on the same side of the head as used for cell phones were compared, the risk increased four-fold.

Researchers said they found no association between the tumors and the amount of use measured in hours or cumulative number of calls but rather on the length of time those in the study had been regular users of cell phones. Overall research found that it usually takes 20 years or more for solid tumors to develop.

For adults who got their first cell phones as a Christmas present in their late teens, or adults who were forced to join the rank of business users, 10 to 20 years seems like a remote risk. But what about children who are now beginning to use cell phones at 8 to 10 years old. Children could be more susceptible to damage from radiation because their immune system is not fully developed. Children starting cell phone usage at a younger age will be exposed for longer periods of time, so a child at 10 can begin showing problems by the time they are 20 or 30.

To be sure, there are clinical studies that show cell phones do not cause acoustic neuroma or other brain tumors. However, the majority of these studies were conducted on users of less than ten years suggesting that there is no substantial risk of acoustic neuroma in the first decade after starting mobile phone use. However, an increase in risk after longer term use or after a longer lag period could not be ruled out.

NO DEFINITIVE RESULTS

When it comes to definitive health impacts the results are mixed. Numerous studies have been done, including those by the federal government that generally concluded that no types of cancers or cell changes have been detected as a result of cell phone usage against one's head.

Studies have concluded that there is no substantial risk of acoustic neuroma in the first decade after starting mobile phone use. However, an increase in risk after longer term use or after a longer lag period could not be ruled out. That there is no overall increased risk of glioma or meningioma observed among cellular phone users, although, for long-term cellular phone users, results need to be confirmed before firm conclusions can be drawn.

In some studies brain cancer patients didn't report more cell phone use than the subjects who were free of brain cancer. In fact, for reasons that remain unclear, most of the studies showed a tendency toward lower risk of brain cancer among cellular phone users, and when different types of brain cancer were considered, none were consistently associated with cell phone use. In other studies, when specific locations of tumors within the brain were considered, no associations with cell phone use were found. None of the studies showed a clear link between the side of the head on which the brain cancer occurred and the side on which the cellular phone was used.

Many animal experiments have also been conducted and have yielded conflicting results. A few of these studies have suggested that low levels of RF could accelerate the development of cancer in laboratory rats. However, many of the studies that showed increased tumor development used rats that had been genetically engineered to be predisposed to develop cancer in the absence of RF exposure. Other studies exposed the animals to RF for up to 22 hours per day. Since these conditions are not similar to the conditions under which people use wireless phones, we do not know with certainty what the results of such studies mean for human health.

In summary, there is now considerable evidence that shows no consistent association between cell phone use and brain cancer, although more research is needed before any definite conclusions can be drawn. The World Health Organization, based upon the consensus view of the scientific and medical communities, has stated in the past that cancer is unlikely to be caused by cellular phones or their base stations and that reviews have found no convincing evidence for other health effects.

Science is not a haphazard venture. It takes years of study to come to a conclusion. The obvious problem for people world-wide is that they may be unwittingly exposing themselves to irreversible and lethal health impacts before science comes to a definitive conclusion. It just makes sense to play it safe.

OTHER POTENTIAL HEALTH HAZARDS

It's one thing to say that the cell phone is a direct cause of dire health problems. But, it's not a far reach to look at some practical observations of cell phone usage to identify irritating if not life threatening health impacts.

NECKS AND THUMBS

As our digital devices worm their way into our lives we have even given a name for some of the ailments they produce, for example: "BlackBerry neck". Orthopedists and others who specialize in muscle and joint injuries say there's no question that the surge of handheld technology is leading to a new wave of aches and pains where the neck and upper back seem to be taking the brunt of the pain. It seems that small screens cause us to hold our devices in strange positions that lead to strains and pains in our neck and produce an assortment of back and neck pains that are reminiscent of the ergonomic pains introduced by our laptops .

Editor Note: I received an iTouch for Christmas and was elated that I could sit in bed and watch YouTube comedy shows. That lasted about two nights when my neck began to hurt so bad and waking up with excruciating headaches in the middle of the night I had to turn off my new toy.

Thumbs also take a beating. People who send upward of 100 text messages a day may experience pain in their thumbs and wrists. The thumb muscles, which spread across the back of the hand and into the wrist, aren't used to all that up-and-down motion with the tiny keyboards that are becoming increasingly standard on cell phones. The keys are so small that it just means the thumb muscles have to work harder and the thumbs don't get any rest because they're constantly text messaging. Although our fingers are pretty good with the flexion, but every time we lift them up we use tendons that go over the top and side, and that motion can cause a tendonitis to occur at the wrist.

LOUD MUSIC

Although mobile phones are not the only devices that must share blame for exposing our ears to potentially loud noises, there is a convergence as technology brings more and more of our gadgets together, and as a result a growing number of people are using their mobile phones to store and play their favorite music. According to statistics from the U.S. Centers for Disease Control and Prevention about 12.5 percent of children and adolescents 6 - 19 years old and 17 percent of adults between 20 - 69 years of age have suffered permanent damage to their hearing from excessive exposure to noise. In total, this accounts for more than 30 million people. Sounds louder than 85 decibels can damage hearing. Normal conversation is about 60 decibels, and stereo headphones out of our MP3-enabled devices often reach 100 decibels.

PHANTOM VIBRATIONS

We use to have things that go bump in the night and now we have things that go bump in the day. A new annoying side effect of the wireless era phenomenon called "phantom vibrations" are being experienced by some habitual mobile device users. Our reliance on our cell phones may actually be "training" some of us to believe it is vibrating when it is not. In the case of cell phones, people are rewarded when they pick up their calls and read their incoming text messages, which causes them to pick up their cell phones more and more frequently. As people repeat this behavior over and over again, connections between nerves in their brain become stronger and new ones are formed, which helps to make the behavior automatic. And sometimes, as is the case with vibrating cell phones, the behavior becomes too automatic or it may be our modern way of rewarding ourselves for being socially connected.

PHONE ALLERGIES

Those with allergies to certain metals, such as nickel, may experience yet another side effect of exposure to their cell phones in the form of contact dermatitis. In recent years, dermatologists have begun to see an increasing number of contact dermatitis patients who are allergic to these metal components in their cell phones because a certain portion of the population is extremely nickel-sensitive. Since nickel is a metal that's used in a wide variety of products, including jewelry, belt buckles and watchbands it's the most common cause of contact dermatitis in the developed world.

DOCTORS' DIRTY CELL PHONES

New research suggests that one cell phone-related health threat comes from their doctors' mobile devices. In a study published in the journal *Annals of Clinical Microbiology*, researchers screened the mobile phones

of 200 health care workers in hospitals for germs that are known to be dangerous to human health. They found 94.5 percent of the phones tested -- nearly 19 out of 20 -- were contaminated with some kind of bacteria. It seems that cell phones are a haven for a variety of microbes -- some of which are pretty nasty including "MRSA Superbugs" -- bacteria that are resistant to one or more commonly used antibiotics. Despite this, the researchers found that only about 10 percent of the health care workers studied cleaned their cell phones on a routine basis.

CELL PHONES AND THE ROAD

Driver inattention is estimated to be a factor in between 20 to 50 percent of all police-reported crashes. Driver distraction, a sub-category of inattention, has been estimated to be a contributing factor in 8 to 13 percent of all crashes. Researchers at Carnegie Mellon University studied the brain waves of drivers using cell phones -- and they found that even just listening to a conversation reduced the amount of brain activity devoted to driving by 37 percent. The U.S. Department of Energy found that using a cell phone severely impairs memory and reaction times. The quality of driving showed a "significant deterioration," according to the 2008 study.

A 2005 study by the Insurance Institute for Highway Safety found that drivers using cell phones -- even hands-free -- were four times as likely to have an accident involving an injury. "Hands-free" mobile speaker-phones cause even more crashes because they typically emit 10-times more brainwave interference than handheld units. Other studies show that electromagnetic signals from cellular phones reduce the ability to concentrate, calculate and coordinate complicated activities such as driving a car and that for all drivers dialing out on their cell phones, the heightened probability of cracking up your car persists for up to 15-minutes after completing a call.

Drivers who talk on either handheld or hands-free cellular phones are as impaired as drunken drivers. Simulations are particularly useful for comparing cell phone use while driving with the known-dangerous drunk driver. Drivers in the cell-phone condition exhibited a sluggish behavior (i.e., slower reactions) which they attempted to compensate for by increasing their following distance. Drivers in the alcohol condition exhibited a more aggressive driving style, in which they followed closer, necessitating braking with greater force. After controlling for driving difficulty and time on task, the study concluded that cell phone drivers exhibited greater impairment than intoxicated drivers and found that response time while using both hands-free and hand-held phones was approximately 0.5 standard deviations higher than normal driving (i.e., an average driver, while talking on a cell phone, has response times of a driver in roughly the 40th percentile).

Still, 80 percent of drivers admit to having had a cell phone conversation while driving, according to a May 2008 Nationwide Insurance poll -- even though more than 40 percent of those surveyed said they'd been hit or almost hit by another driver who was talking on a cell phone.

TEXTING

The scientific literature on the dangers of driving while sending a text message from a mobile phone, or driving while texting, is limited. A simulation study at the Monash University Accident Research Centre provided strong evidence that retrieving and, in particular, sending text messages has a detrimental effect on a number of safety critical driving measures. Specifically, negative effects were seen in detecting and responding correctly to road signs, detecting hazards, time spent with eyes off the road, and (only for sending text messages) lateral position. Surprisingly, mean speed, speed variability, lateral position when receiving text messages and following distance showed no difference. A separate, yet unreleased simulation study at the University of Utah found a six fold increase in distraction-related accidents when texting.

On July 27, 2009, the Virginia Tech Transportation Institute released preliminary findings of their study of driver distraction in commercial vehicles. Two studies, comprising about 200 long-haul trucks driving 3 million combined miles, used video cameras to observe the drivers and road; researchers observed 4,452 safety-critical events, which includes crashes, near crashes, safety-critical events, and lane deviations. 81% of the safety critical events had some type of driver distraction. Text messaging had the greatest relative risk, with drivers being 23 times more likely to experience a safety-critical event when texting. The study also found that drivers typically take their eyes off the forward roadway for an average of four out of six seconds when texting, and an average of 4.6 out of the six seconds surrounding safety-critical events.

Motorists who talked on either handheld or hands-free cell phones drove slightly slower, were 9 percent slower to hit the brakes, displayed 24 percent more variation in following distance as their attention switched between driving and conversing, were 19 percent slower to resume normal speed after braking and were more likely to crash. Three study participants rear-ended the pace car. All were talking on cell phones. None were drunk.

CELL PHONE COMPARISONS TO DRUNK DRIVING

We don't think people should drive while drunk, nor should they talk on their cell phone while driving yet we still don't see that the use of cell phones and texting while driving is comparable to the risk of crashing while driving dead drunk. Cell phone users have been found to be 5.36 times more likely to get in an accident than undistracted drivers. Other studies have shown the risk is about the same as for drivers with a 0.08 blood-alcohol level. Drivers drunk at the 0.08 percent blood-alcohol level drove a bit more slowly than both undistracted drivers and drivers using cell phones, yet more aggressively and were twice as likely to brake only four seconds before a collision would have occurred hitting their brakes with 23 percent more force.

One way of looking at this unfortunate trend is that the percentage of drunk drivers at any time is much lower which means the risk of talking on a cell phone and driving is probably much higher than driving intoxicated because more people are talking on cell phones than driving while drunk.

TALKING & WALKING

Children are more distracted while crossing the street if they happen to be talking on a cell phone. What they found was that when children were on the cell phones, their attention to traffic -- the number of times a participant looked right or left -- went down 20 percent. The risk of getting hit by a car, or the number of close calls, went up 43 percent.

Editor's note: At first I thought this quip was slightly absurd and trite. So I tested it by walking through my local grocery store while talking on my cell phone. In fact, I bumped into 6 people without seeing them within a span of 15 minutes. Everyone accepted my apology except for one older woman who called me rude for not paying attention.

UNBORN BABIES

Medical experts say media reports of a study that suggests a pregnant woman's cell phone use could cause later behavioral problems in her baby raise unnecessary alarm. The researchers found that the mothers who said they used cell phones during their pregnancy also reported a higher level of behavioral problems in their children.

But while the results suggested an increased risk of hyperactivity, impulsivity and difficulty concentrating in children whose mothers used cell phones during pregnancy, epidemiological experts -- including one of the

paper's authors -- said it would be a mistake to assume that the findings were conclusive. He said one problem was that the information was obtained through interviews with the mothers, who may not have given accurate accounts of their cell phone use when pregnant. Alternatively, he noted, perhaps mothers who were heavy users of cell phones were more likely to report behavior problems in their children.

Additionally, the authors "only briefly mentioned the possibility that maternal cell phone use, especially postnatal use, could have adverse effects on child behavior in ways having nothing at all to do with radio frequency fields," he said. One possibility: Mothers who were constantly on their cell phones may have paid less attention to their children, who subsequently acted out.

CELL PHONE ADDICTION

Carrying similar risks of long-term lethality, and strangely just as legal, cell phone addiction mirrors the prestigious early allure of smoking - as well as an immensely profitable industry's steadfast denial of risk and responsibility. Does your teen panic if she realizes she forgot her cell phone at home? Is she moody and frustrated if she can't check her messages during dinner or a family outing? She may have a cell phone addiction as more and more parents are noticing obsessive behaviors in their teens. Most teens spend an average of one hour a day on their cell phones. Add in the extra time they spend e-mailing, IMing, talking in person, or communicating through MySpace or Facebook, and it's not surprising so many children are getting hooked on their high-tech gadgets.

Although reliable studies on cell phone addiction are sparse, a study from China found that nearly one-third of high school students showed signs of addiction, including paranoia, when they were without their phones, and two-thirds were "constantly worried" that they would miss a text message when their phones were off. In Britain, researchers concluded that people are so dependent on their cell phones that they see them as "an essential item, an extension of self."

Studies have found 22 percent of cell phone users considered themselves to be heavy or very heavy users and 8 percent had experienced monthly bills that were over \$500. Although it could be a long time before a cell-phone addiction might be recognized as a genuine mental disorder, if ever, nevertheless, it can definitely qualify as maladaptive behavior.

SLEEP DEPRIVATION

Studies have found that there is a relationship between excessive cell phone use and sleeping problems, such as disrupted sleep, restlessness, stress and fatigue, among youth 14 to 20 years of age.

The results showed that youth in the experimental group had "increased restlessness with more careless lifestyles, more consumption of stimulating beverages, difficulty in falling asleep and disrupted sleep, more susceptibility to stress and fatigue". Furthermore, there seems to be a connection between excessive cell phone use and a tendency toward unhealthy habits such as smoking and drinking among youth.

The study suggests that youth are delaying their biological clocks in order to remain in constant connection with the world. The impact on mental health and cognition could be detrimental if youth continue to disrupt their sleep patterns at a period in life where sleep is so critical. It makes me wonder if this trend will hinder the potential of today's youth.

MULTI-TASKING

Before we begin on this topic, here is the on-line link to the PBS series concerning our use of digital devices. It is a provocative, in-depth look at the topic:

DIGITAL NATION

Life on the Virtual Frontier

FRONTLINE PBS

http://www.pbs.org/wgbh/pages/frontline/digitalnation/?utm_campaign=homepage&utm_medium=proglis&utm_source=proglis

There are a group of digital aficionados who truly believe they are great at multi-tasking, which is defined as looking at multiple media at the same time. Stanford professor Clifford Nass has been studying the effectiveness of self-proclaimed multitaskers. As it turns out, multitaskers are terrible at every aspect of multitasking. They get distracted constantly and their memory is highly disorganized. Recent work suggests they're worse at analytic reasoning and multitasking may be creating people who are unable to think well and clearly.

The question is whether people who are constantly multi-tasking are doing something advanced and new in thinking or something that is psychologically impossible to master? It turns out multitaskers are terrible at

every aspect of multitasking. They're terrible at ignoring irrelevant information; they're terrible at keeping information in their head nicely and neatly organized; and they're terrible at switching from one task to another. Ordinarily people generally ignore irrelevancy -- multitaskers love irrelevancy. They get distracted constantly. Multitaskers are essentially short term thinkers that are very disorganized

ATTENTION SPAN

Paying attention isn't a simple act of self-discipline, but a cognitive ability with deep neurobiological roots — and this complex faculty is being woefully undermined by how we're living by the effects of "our high-speed, overloaded, split-focus and even cybercentric society" on attention. It's hard to concentrate and think creatively.

Attention is now considered an organ system. It has its own circuitry in the brain, and there are specialized networks carrying out its different forms. Each is very specific and can be traced through neuro-imaging and even some genetic research.

There are three types of attention.

The first is orienting — the flashlight of your mind. In the case of visual attention, it involves parts of the brain including the parietal lobe, a brain area related to sensory processing. To orient to new stimuli, two parts of the parietal lobe work with brain sections related to frontal eye fields.

The second type of attention spans the spectrum of response states, from sleepiness to complete alertness.

The third type is executive attention: planning, judgment, resolving conflicting information. The heart of this is the anterior cingulate — an ancient, tiny part of the brain that is now at the heart of our higher-order skills. It is executive attention that lets us move beyond our impulsive selves, to plan for the future and understand abstraction.

We are programmed to be interrupted. We get an adrenalin jolt when orienting to new stimuli: Our body actually rewards us for paying attention to the new. So in this very fast-paced world, it's easy and tempting to always react to the new thing. But when we live in a reactive way, we minimize our capacity to pursue goals. But the interruption we are facing today may have taken us over the top of our capacities to handle them.

The implications of how interruptions affect us are that this degree of interruption is correlated with stress and frustration and lowered creativity. When you're scattered and diffuse, you're less creative. When your times of reflection are always punctured, it's hard to go deeply into problem-solving, into relating, into thinking. Interruptions are correlated with stress, and a cascade of stress hormones accompany that state of being. Stress, frustration and lowered creativity are pretty toxic.