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Wellness in the Age of the Smartphone

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Wellness in the Age of the Smartphone

On June 29, 2007, the first iPhone was released to much fanfare, bringing mobile touch-screen technology to the mass consumer. It is hard to measure the impact of a new technology being released into the world, but surely the advent of smartphones must rival the invention of the incandescent light bulb in the 1800s for its impact on human life and culture.

For the "digital natives," those who have grown up in the age of the increasingly mobile internet, it is already hard to imagine the world without smartphones. We have quickly become accustomed to having the world's information tucked neatly into our pockets.

It would be difficult to argue (and this is not our intention) that this new technology has made the world worse off than before. On the contrary, the information, convenience and sheer power conferred to us by our mobile devices takes human civilization to new heights. These technologies help us with:

1. connection (to people and information)
2. communication (immediate and unrestricted), and
3. co-creation (ability to share and engage with others in real time)

Our devices help us to connect to one another, enhance learning and knowledge, and give us the ability to develop and share good ideas faster and farther than ever before.

But the benefits of technology and the related acceleration in the pace of development come at a cost. On a sheer biological level, we cannot possibly adapt quickly enough to the pace of change we are seeing in the world. Our bodies are not designed to sit at computers all day, our eyes are not designed to be staring at screens all day, and our brains are not designed to be constantly consuming and processing a never-ending stream of information.

On an emotional level, the way we relate to one another is changing so quickly that people are struggling with how to navigate interpersonal relationships in the new world. Some countries are describing "epidemics of loneliness"¹ as people struggle to create meaningful connections. Entire generations are cut off as the next generation moves to new styles and platforms of communication.

The problem with technology is not that it is bad, it is that it is *too good*.² The allure of technology and all its many benefits draws us away from other aspects of life. Our modern devices are so tantalizing, in fact, that we sometimes don't realize the sacrifices we are making along the way. While enjoying technology, we choose sedentary activities over movement, we

¹ See <https://www.nytimes.com/2016/09/06/health/lonliness-aging-health-effects.html>.

² From Jeremy McCarthy's talk at the 2017 Global Wellness Summit: *Wellness in the Age of Technology*. https://www.youtube.com/watch?v=9do_2uTnGLo.

choose virtual relationships over real ones, and we choose to consume information rather than reflect or take action on the things we have learned.

The intention of this paper is not to denounce technology, but to fully appreciate and recognize the benefits while creating greater awareness of the associated opportunity costs. There is a great deal of justified optimism and excitement about all of the advances that technology brings. Our hope is not to diminish this excitement, but to ensure that we slow down enough to contemplate the holistic impact, both positive and negative, on human wellbeing.

This Time is Different

We are in the midst of a technological revolution that is radically altering the way we live, work, and relate to each other. Technology and digitization is revolutionizing everything, making the old and often ill-used adage “this time is different” true. In a nutshell, major technological innovations are on the brink of wreaking momentous change throughout the world.



The problem with technology is not that it is bad . . . It's that it's *too good*.

Jeremy McCarthy



Whether we like it or not, whether we feel confident that we can deal with the change or not, this technological revolution³ will disrupt everything in a trend that is inescapable. Its scale, speed, breadth and complexity will be unlike anything we've experienced before.

We are already seeing the staggering confluence of emerging technology breakthroughs, covering wide-ranging fields as diverse as artificial intelligence, robotics, the “internet of things”, autonomous vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage, quantum computing—just to name a few!

The changes about to unfold under our eyes are so radical that, from the perspective of human history, there has never been a time of greater promise, but also of potential peril. The effects of rapidly changing technologies may bring tremendous benefits to society, but they can also create tremendous dislocations, such as structural unemployment or fueling social inequalities.

Things are moving incredibly fast, but we don't have yet a globally shared view of how technology will change our lives and that of future generations, and how it will reshape the

³ Schwab, K. (2016). The Fourth Industrial Revolution: What it Means, How to Respond. <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>.

economic, social, cultural and human contexts in which we live. Two features make the technology revolution unique and very different from the previous industrial revolutions:

- 1) It is evolving at an exponential rather than linear pace. This is the result of its multifaceted, deeply interconnected nature and the fact that new technology begets newer and ever more capable technology.
- 2) It entails a complete and unprecedented paradigm shift in how we live and work. It is not just changing the “what” and the “how” we are doing things, but also “who” we are. Our very humanness is being challenged.

This revolution moves us from a physical to a data-based environment by linking information technology and digitization to biology and genetics. It is likely that our future descendants will be OK with the digital world they will live in, because it will be all they know. It is not at all clear however, if the humans of today would approve of what life will be like in an increasingly digitized future. Unfortunately, we might not have that much of a say in the matter as there is a strong feeling of “inevitability” in the technological tides that are sweeping us along.⁴

Technology and Wellbeing

In any discussion about the impact of technology on health and wellbeing, there remains a strong case for optimism, and we have seen this optimism reflected in the current discussions within the wellness industry.⁵

There are good reasons to expect that human health and longevity will continue to improve with all of the new resources that our technologies bring us, for example:

- **Online health resources.** A wealth of health information is now available online with easily searchable databases where consumers can investigate symptoms and learn more about prevention and treatment options from the comfort of their own home.⁶

“

Whether we like it or not, whether we feel confident that we can deal with the change or not, this technological revolution will disrupt everything.

Thierry Malleret

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⁴ Kelly, K. (2016). *The Inevitable: Understanding the 12 Technological Forces that will Shape our Future*. Viking, 1st Edition.

⁵ Recent discussions at the 2016 and 2017 Global Wellness Summit for example. See <http://globalwellnesssummit.org>.

⁶ For example, the Mayo Clinic Symptom Checker: <http://www.mayoclinic.org/symptom-checker/select-symptom/itt-20009075>.

- **Big data.** There is a rising trend towards wearable wellness monitors and the ability for our devices to better measure our physiological functioning (movement, sleep, diet, heart rate, etc.) These devices may serve as a powerful tool for helping people monitor how their lifestyle and environments can influence their health metrics on a daily basis.
- **Wellness Apps.** Through our smartphones, consumers today have access to an infinite number of tools which can help promote a healthier lifestyle. From instructional apps on fitness, meditation and yoga, to nutritional diet tracking, to managing stress and emotional wellbeing, for most dimensions of human health and wellbeing, you can be sure, “there’s an app for that.”(Although as one of our authors points out, some preliminary research questions whether these technologies are really helping anyone.⁷)
- **Genetic testing.** New developments in genetic testing allow people to get a much better understanding of their unique individual health risks and personalized lifestyle recommendations that align with their particular genetic profile. New research on telomeres brings better understanding of how lifestyle factors affect longevity.
- **Stem cell research.** Stem cell research opens the door on new treatment options for a variety of diseases.⁸
- **Nanotechnology.** As devices shrink in size, we develop new ways to insert technology into the human body in ways that can be beneficial to health. It is estimated that in the future, microscopic nanoparticles will be able to deliver medicines more effectively, diagnose illnesses, and even make repairs.
- **Others.** Virtual reality, robotics, driverless cars, automation. It seems almost every innovation has an application to improve human health, longevity and happiness.

So what could possibly go wrong?

Technological Advance Comes at a Cost

The use of technology is not a new phenomenon. Our species has always sought to develop tools to influence the world around us and improve our lives. But there have been sacrifices made along the way. The development of clothing has protected us from the elements but has also caused us to be the only animal on the planet to feel ashamed and vulnerable in our own skin. The industrialization of food has provided us an abundant food supply, but has made us dependent on large corporations for our survival. We are provided the food that makes the corporations the most profit, not the food that gives us the best energy and quality of life.

⁷ Malleret, T. (2017). Trend Watch: Wearable Fitness Tech Struggling. <https://www.globalwellnessinstitute.org/global-wellness-institute-blog/2017/3/14/trend-watch-wearable-fitness-tech-struggling>.

⁸ See <https://stemcells.nih.gov/info/basics/1.htm>.

Urbanization has brought us amazing cities that have become the world's hubs for work, culture and socialization. But we have become disconnected from the natural world.

Not many people would say that we should return to a time when clothing, food and shelter were unavailable. But it is important to understand that even our greatest technological advances have come at some cost.

In the technological revolution, there is a risk that the human costs of progress may be even greater. In the past, innovations spread slowly, on a millennial scale, giving our lifestyle, our culture, and even our brains and our bodies a chance to adapt to the changing world. Today, the world is changing rapidly from one generation to the next, or even from one decade to the next, and we do not have time to adapt.

The Costs of Technology

To better understand the sacrifices that we are making for our devices, we have reviewed the health literature for evidence of the adverse effects of technology on wellbeing. We have found substantial impact in six areas:

1. Sleep
2. Inactivity, Obesity and Physiological Health
3. Mental Wellness
4. Social Relationships and Loneliness
5. Distraction and Safety
6. Productivity

Sleep

Adults are expected to get eight hours of sleep per night⁹, yet the distraction of new technology may be preventing us from meeting this target. In the United Kingdom, 40% of adults admit to getting less than the NHS recommended six to nine hours¹⁰. In the United States, 43% of people from 16-64 say they "rarely or never" get a good night's sleep on weeknights. 60% say they experience a sleep problem every night or almost every night.¹¹

The growing prevalence of digital devices in bedrooms may well be the cause. A study of 10,000 teenagers in Norway, for example, found that teens sleep less when they have more computer

⁹ See <http://www.healthline.com/health/science-sleep-why-you-need-7-8-hours-night>.

¹⁰ See <https://www.sleepcouncil.org.uk/wp-content/uploads/2013/02/The-Great-British-Bedtime-Report.pdf>.

¹¹ See <https://sleepfoundation.org/media-center/press-release/annual-sleep-america-poll-exploring-connections-communications-technology-use->.

screen time.¹² The blue-light emitting screens on digital devices mimic the natural sunlight, which affects our circadian rhythms (sleep and wake cycles) disrupting our bodies' natural abilities to rest at night.

In a screen-free environment, natural blue light drops in the evening allowing for our bodies to begin the process of unwinding before sleep. But screen-based devices interrupt this natural process and keep us feeling alert by boosting our reaction times and suppressing the release of melatonin. As a result, using devices in the bedroom or during the hour or two before sleep makes it more difficult for us to fall asleep.



Screens are having a profound effect on our sleep *quality* too, something which the U.K. Sleep Council has coined 'Junk Sleep'. Sleep expert Dr Chris Idzikowski defines Junk Sleep as, "sleep that is of neither the length nor the quality that it should be in order to feed the brain with the rest it needs to perform properly." Some smartphone manufacturers have now recognized the phone's part in sleep deprivation and the latest iPhone operating system now includes an option for 'night shift,' giving screens a yellowish hue near bedtime, which is less likely to disturb sleep patterns.¹³

Despite the adverse effects on sleep, there is growing recognition that screen time is a fact of life for adolescents in modern society. Recreational use of small screen media is estimated to be

¹² See <https://www.theguardian.com/technology/2015/feb/03/teenagers-sleep-less-when-they-have-more-computer-screen-time-says-study>.

¹³ See <https://www.sleepcouncil.org.uk/wp-content/uploads/2013/02/The-Great-British-Bedtime-Report.pdf>.

about 3 hours/day for adolescents,¹⁴ and the impact on healthy sleep habits seems to be significant.

A systematic review¹⁵ evaluated 67 studies published between 1999 and 2014 that looked at the impact of screen time on sleep among school-age and adolescents. 90% of the studies showed that screen time adversely impacted sleep outcomes (in particular, shortened duration and delayed timing). Similar findings emerged from an analysis of the national Youth Risk Behavior Survey 2011-13.¹⁶ Adolescents with the highest level of physical activity and lowest level of sedentary behavior had the best chances for having sufficient sleep. A systematic review and meta-analysis¹⁷ of access and use of screen-based media (e.g. cell phones and tablets) reviewed 20 studies encompassing over 125,000 children.

Bedtime media device use was associated with:

- inadequate sleep
- poor sleep quality
- excessive daytime sleepiness

These effects were also noticed (to a lesser degree) even when the device was not actually being used but was merely *accessible* during bedtime.

Xu and colleagues¹⁸ quantified the impact of screen time on sleep and found that each additional hour of screen time resulted in:

- shorter sleep duration (3 minutes)
- longer sleep latency (1.6 minutes)
- later bedtime (4.0 minutes)

¹⁴ Suchert V, Hanewinkel R, Isensee B. Screen time, weight status and the self-concept of physical attractiveness in adolescents. *J Adolesc.* 2016;48:11-17.

¹⁵ Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep Med Rev.* 2015;21:50-58.

¹⁶ Kim Y, Umeda M, Lochbaum M, Stegemeier S. Physical Activity, Screen-Based Sedentary Behavior, and Sleep Duration in Adolescents: Youth Risk Behavior Survey, 2011-2013. *Prev Chronic Dis.* 2016;13:E131.

¹⁷ Carter B, Rees P, Hale L, Bhattacharjee D, Paradkar MS. Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis. *Jama, Pediatr.* 2016;170:1202-1208.

¹⁸ Xu H, Wen LM, Hardy LL, Rissel C. Associations of outdoor play and screen time with nocturnal sleep duration and pattern among young children. *Acta Paediatr.* 2016;105:297-303.

The time in front of a screen needed to have a negative impact on sleep is actually quite minimal. A study of 1,713 children¹⁹ showed that children watching more than 1.5 hours of TV per day had shorter sleep duration, compared to those watching less than that amount.

Other studies have shown that increasing levels of screen time are not just impacting sleep, but behavioral issues as well. Parent and colleagues²⁰ evaluated a community sample of 209 3-7 year olds, 202 8-12 year olds and 210 13-17 year olds and found that across the age groups, higher levels of screen time were associated with more sleep disturbances and higher levels of behavioral health problems.

Some might argue that this is not a new problem, and that televisions have been keeping us up late for decades. But the smartphone has brought us into the new era of the “attention economy.”²¹ Technology companies are able to monitor their users’ data in a way that wasn’t possible before and constantly tweak their algorithms to capture more and more of our attention. Netflix CEO Reed Hastings is quoted as saying, “we actually compete with sleep” more than they are competing with other broadcasting channels.²² For modern marketers, sleep is the enemy, and they are gathering vast amounts of data and technological resources to help them combat it. It’s a threat we should take seriously.

Inactivity and Obesity

Sleep is just one aspect of life interrupted by excessive screen time. In a study of adolescent girls,²³ researchers found that TV viewing was independently associated with a cluster of metabolic risks (e.g. weight, fasting glucose, insulin, HDL-cholesterol, triglycerides and blood pressure). Those who also had low levels of moderate-to-vigorous physical activity had an even higher metabolic risk. For children with overweight/obese parents, BMI and percent body fat increased significantly with each hour of TV watched.²⁴

¹⁹ Marinelli M, Sunyer J, Alvarez-Pedrerol M, et al. Hours of television viewing and sleep duration in children: a multicenter birth cohort study. *Jama, Pediatr.* 2014;168:458-464.

²⁰ Parent J, Sanders W, Forehand R. Youth Screen Time and Behavioral Health Problems: The Role of Sleep Duration and Disturbances. *J Dev Behav Pediatr.* 2016;37:277-284.

²¹ Davenport TH, Beck JC. *The Attention Economy: The new currency of business.* Harvard Business Review Press. 2002.

²² See <https://www.fastcompany.com/40491939/netflix-ceo-reed-hastings-sleep-is-our-competition>.

²³ Machado-Rodrigues AM, Leite N, Coelho-e-Silva MJ, et al. Metabolic risk and television time in adolescent females. *Int J Public Health.* 2015;60:157-165.

²⁴ Steffen LM, Dai S, Fulton JE, Labarthe DR. Overweight in children and adolescents associated with TV viewing and parental weight: Project HeartBeat! *Am J Prev Med.* 2009;37:S50-55.

Similar findings have been observed among children in other countries as well. A Dutch cohort of 11 year olds²⁵ compared those with less than 6 hours of screen time per week to those with greater than 20 hours per week. The children with the higher screen time were found to eat more snacks and to have higher levels of body fat. In Malaysian children,²⁶ screen time, but not other sedentary behaviors, were positively associated with increased body mass index and waist circumference. In China, a study of 5,022 children (grades 1-6)²⁷ found that increasing screen viewing was a major contributor to the risk of obesity.

And technology-induced inactivity is not an issue only affecting children. Adults spend as much as 11 hours in a day in front of screens with about half that time spent on TV.²⁸ A cross-sectional study of 1,674 U.S. adults²⁹ used accelerometers to assess sedentary time while self-reports were used to measure screen time and sleep metrics. Comparing the adults with the least screen time (less than 2 hours/day) to those with the most (greater than 6 hours/day) showed that the latter had increased risk of trouble falling asleep and waking during the night.

Prolonged sitting that commonly occurs with excessive media use, is increasingly being recognized as a health risk in and of itself. One study found that each additional hour per day of sitting was associated with increased odds of poor sleep quality.³⁰ But when the sitting was combined with TV viewing, the results were even more alarming. Each additional hour of TV while sitting was associated with taking more time to fall asleep, poor sleep quality, higher risk for obstructive sleep apnea and earlier waking times.

Given the rise of obstructive sleep apnea and the recognition of the significant health risks it poses, this data is alarming.

²⁵ Berentzen NE, Smit HA, van Rossem L, et al. Screen time, adiposity and cardiometabolic markers: mediation by physical activity, not snacking, among 11-year-old children. *Int J Obes (Lond)*. 2014;38:1317-1323.

²⁶ Lee ST, Wong JE, Shanita SN, Ismail MN, Deurenberg P, Poh BK. Daily physical activity and screen time, but not other sedentary activities, are associated with measures of obesity during childhood. *Int J Environ Res Public Health*. 2014;12:146-161.

²⁷ Ren H, Zhou Z, Liu WK, Wang X, Yin Z. Excessive homework, inadequate sleep, physical inactivity and screen viewing time are major contributors to high paediatric obesity. *Acta Paediatr*. 2017;106:120-127.

²⁸ Americans spend 11 hours a day on TV, phone, radio and gaming. 2014. From Time <http://time.com/16458/nielsen-electronic-media-study-11-hours-a-day/>.

²⁹ Vallance JK, Buman MP, Stevinson C, Lynch BM. Associations of overall sedentary time and screen time with sleep outcomes. *Am J Health Behav*. 2015;39:62-67.

³⁰ Buman MP, Kline CE, Youngstedt SD, Phillips B, Tulio de Mello M, Hirshkowitz M. Sitting and television viewing: novel risk factors for sleep disturbance and apnea risk? results from the 2013 National Sleep Foundation Sleep in America Poll. *Chest*. 2015;147:728-734.

Video games have come under increasing scrutiny as a potential cause of health risks. A study of 116 male undergraduate students³¹ lends credence to these concerns. This study found that the length of video game play during one sitting was positively correlated with BMI and negatively correlated with duration of exercising. Correlations were even stronger among those who engaged in online games.

A systematic review³² focusing on health indicators associated with screen-based sedentary behavior among adolescent girls found strong associations between screen time and:

- increased weight
- more sleep problems
- musculoskeletal pain
- reduced psychological well-being and depression
- lower physical fitness
- less social support



Similar results have been seen in adults.

Could having a park nearby be part of the solution for reversing the trend towards sedentary behavior? One study seems to indicate this may be the case. Veitch and colleagues³³ looked at park availability and physical activity, TV time and obesity among women in Australia and the U.S. In Australia, women who had more parks nearby were more likely to meet recommended levels of physical activity and to have lower odds of being either overweight or obese. U.S. women with parks near their homes had lower odds of watching over 4 hours of television per

³¹ Ballard M, Gray M, Reilly J, Noggle M. Correlates of video game screen time among males: body mass, physical activity, and other media use. *Eat.* 2009;10:161-167.

³² Costigan SA, Barnett L, Plotnikoff RC, Lubans DR. The health indicators associated with screen-based sedentary behavior among adolescent girls: a systematic review. *J Adolesc Health.* 2013;52:382-392.

³³ Veitch J, Abbott G, Kaczynski AT, Wilhelm Stanis SA, Besenyi GM, Lamb KE. Park availability and physical activity, TV time, and overweight and obesity among women: Findings from Australia and the United States. *Health Place.* 2016;38:96-102.

day and had lower BMIs.³⁴ As technology becomes more alluring, communities will have to offer more enticing non-digital options to help citizens find balance.

Another factor that keeps people indoors, and sedentary on their devices is lack of safety. In Canada, researchers³⁵ looked at neighborhoods with high levels of disorder (such as drugs/drinking in public, gangs, crime, abandoned buildings, litter, etc.) and evaluated activity in 15,917 children aged 10 to 16 years old. Those living in neighborhoods with the highest level of disorder had up to a 45% increased risk of high use of television, computer and video games. Similar findings were seen in a study of 1,374 African-American men and women.³⁶ The perception of the presence of more neighborhood problems was associated with greater TV viewing in women. Men who reported concerns about walking after dark, for example, had lower levels of physical activity.

A comprehensive survey of 5,556 adults³⁷ found the following associations with the people watching the most TV (more than 14 hours/week):

- lower household incomes
- divorced/separated
- poor overall health perception
- higher BMI
- more depression
- eating dinner in front of the TV
- smoking
- less physical activity

In this study, as with the Carson and Strong studies reported above, community conditions (heavy traffic, crime, poor scenery, insufficient lighting) were associated with increased TV viewing as well.

³⁴ Veitch J, Abbott G, Kaczynski AT, Wilhelm Stanis SA, Besenyi GM, Lamb KE. Park availability and physical activity, TV time, and overweight and obesity among women: Findings from Australia and the United States. *Health Place*. 2016;38:96-102.

³⁵ Carson V, Janssen I. Neighborhood disorder and screen time among 10-16 year old Canadian youth: a cross-sectional study. *Int*. 2012;9:66.

³⁶ Strong LL, Reitzel LR, Wetter DW, McNeill LH. Associations of perceived neighborhood physical and social environments with physical activity and television viewing in African-American men and women. *Am J Health Promot*. 2013;27:401-409.

³⁷ King AC, Goldberg JH, Salmon J, et al. Identifying subgroups of U.S. adults at risk for prolonged television viewing to inform program development. *Am J Prev Med*. 2010;38:17-26.

It is hard to identify the exact mechanisms of causality in the relationship between screen time and health problems, but there are clues down to the cellular level. A 2016 study published in *Pediatric Obesity*³⁸ looked at TV viewing time and inflammatory markers in the blood of 167 children aged 7-10 years. This study found that each increment in one hour of TV viewing per week increased signs of inflammation by 4.4%. Further, Loprinzi³⁹ also demonstrated leukocyte telomere length (associated with longevity) negatively impacted by screen time.

Similarly, Howard et al.⁴⁰ used the Australian Diabetes, Obesity and Lifestyle Study to assess TV viewing time association and found that prolonged sitting was associated with increased inflammatory markers.

Perhaps the most troubling research on the adverse effects from screen time are those showing increased mortality.⁴¹ Over 6.6 years of follow-up, adults who watched 5 or more hours of TV per day (compared to those who watch less than 3 hours per day) had a mortality risk that was 28% greater. Across the study, adults who increased their TV viewing time experience increased mortality while those who decreased their TV viewing time experienced decreased mortality. In one study involving 11,000 Australians, after age 25, each extra hour of watching TV decreased life span by 22 minutes.⁴²

The mortality connection to increased TV viewing was also supported in a review of data from the Australian Diabetes, Obesity and Lifestyle Study.⁴³

Most of the research to date on screen viewing is on television watching. Because there is far less research on the impact of other digital devices, we are forced to extrapolate from the data on television viewing and make some assumptions about our overall digital media consumption

³⁸ Gabel L, Ridgers ND, Della Gatta PA, et al. Associations of sedentary time patterns and TV viewing time with inflammatory and endothelial function biomarkers in children. *Pediatr Obes*. 2016;11:194-201.

³⁹ Loprinzi PD. Leisure-Time Screen-Based Sedentary Behavior and Leukocyte Telomere Length: Implications for a New Leisure-Time Screen-Based Sedentary Behavior Mechanism. *Mayo Clin Proc*. 2015;90:786-790.

⁴⁰ Howard BJ, Balkau B, Thorp AA, et al. Associations of overall sitting time and TV viewing time with fibrinogen and C reactive protein: the AusDiab study. *BJSM online*. 2015;49:255-258.

⁴¹ Keadle SK, Arem H, Moore SC, Sampson JN, Matthews CE. Impact of changes in television viewing time and physical activity on longevity: a prospective cohort study. *Int*. 2015;12:156.

⁴² See <http://www.cbsnews.com/news/tv-shortens-life-by-22-minutes-per-viewing-hour-says-study/>.

⁴³ Rogerson MC, Le Grande MR, Dunstan DW, et al. Television Viewing Time and 13-year Mortality in Adults with Cardiovascular Disease: Data from the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Heart Lung Circ*. 2016;25:829-836.

habits, which are clearly changing dramatically in the last decade. It is reasonable to assume that as our new technologies get better and better at delivering a never-ending stream of personalized content, the temptation to sacrifice physical movement for screen time will only be greater.

Mental Wellness

Researchers in the U.K. have found rising rates of depression and anxiety, particularly in teenage women with over one third reporting symptoms.⁴⁴ The cause is not clear but the rising rates seem to coincide with the growth of social media. Likewise, in the U.S., researchers began noticing an increase in teen depression and suicide beginning around 2012, just when smartphone usage was becoming more popular.

One of the researchers, Jean Twenge, found that teens who spend five or more hours a day online were 71% more likely to have at least one suicide risk factor.⁴⁵ And these were just the most extreme users of technology. Anything over three hours a day was linked to a pronounced increased of risk.



Another study from Leeds University in the U.K. has also shown that 'heavy' Internet users are five times more likely to suffer from depression than non-heavy users.⁴⁶ Another study of U.S.

⁴⁴ See <https://www.theguardian.com/society/2016/aug/22/third-teenage-girls-depression-anxiety-survey-trend-truant>.

⁴⁵ See https://www.washingtonpost.com/national/health-science/teenage-depression-and-suicide-are-way-up--and-so-is-smartphone-use/2017/11/17/624641ea-ca13-11e7-8321-481fd63f174d_story.html.

⁴⁶ See <http://news.bbc.co.uk/2/hi/health/8493149.stm>.

college students found that as mobile phone use increases so does anxiety.⁴⁷ We turn to our devices for positive things like education, entertainment, and connection. But somehow the impact on wellbeing seems to be negative.

A systematic review⁴⁸ assessed 37 studies (which included 14,487 participants) for the impact of screen time and especially TV viewing on early childhood cognitive development. The results showed that screen time had negative associations with cognitive development outcomes for 38% of the factors that were reported. On the other hand, time spent reading demonstrated beneficial associations with cognitive development outcomes for 60% of factors reported. The authors suggest that different types of sedentary behavior (reading vs. TV viewing) may have vastly different impacts on early childhood cognitive development.

Screen time has also been found to negatively affect a number of mental health indicators in school aged children and adolescents.⁴⁹ In another systematic review, strong evidence was found linking screen time to hyperactivity/inattentiveness, more internalization of problems and lower perceived quality of life. Higher screen times were also linked to lower self-esteem. In a study involving 11,676 German children and adolescents, television time was associated with worse attention deficit symptoms.⁵⁰

Hoang⁵¹ used data from the Coronary Artery Risk Development in Young Adults (CARDIA) to follow TV viewing and physical activity over 25 years in 3247 adults. They found that high TV viewing and low physical activity in early adulthood were associated with poorer measures of midlife cognitive function (e.g. executive function and processing speed).

Portuguese adolescent girls (aged 11-16) who engaged in more screen time complained of more headaches, poor mood, irritability and feeling more nervous. Boys who reported more screen time were also more likely to be irritable.

It is important to note that not all technology use is bad. A key study on screen use by teenagers by Oxford University in 2017 showed that teenagers' wellbeing increased as they spent time on

⁴⁷ See <http://www.sciencedirect.com/science/article/pii/S0747563213003993>.

⁴⁸ Carson V, Kuzik N, Hunter S, et al. Systematic review of sedentary behavior and cognitive development in early childhood. *Prev Med*. 2015;78:115-122.

⁴⁹ Suchert V, Hanewinkel R, Isensee B. Sedentary behavior and indicators of mental health in school-aged children and adolescents: A systematic review. *Prev Med*. 2015;76:48-57.

⁵⁰ van Egmond-Frohlich AW, Weghuber D, de Zwaan M. Association of symptoms of attention-deficit/hyperactivity disorder with physical activity, media time, and food intake in children and adolescents. *PLoS ONE*. 2012;7:e49781.

⁵¹ Hoang TD, Reis J, Zhu N, et al. Effect of Early Adult Patterns of Physical Activity and Television Viewing on Midlife Cognitive Function. *JAMA Psychiatry*. 2016;73:73-79.

screens up to a measurable 'Goldilocks point' of 'just right' screen-time.⁵² This limit varied by type of device and also by whether it was being used at the weekday or a weekend. The study suggests time should be limited to 1 hour and 40 minutes for weekday video-game play and under 2 hours for weekday smartphone use. Watching videos and using computers for recreational purposes appears to be less disruptive so limits during the weekdays were 3 hours 41 minutes and 4 hours 17 minutes respectively. For weekends, the limit was 3 hours 35 minutes for playing video games to 4 hours 50 minutes for watching videos. The authors speculate that 'moderate' levels of digital screen use are lower on weekdays because the weekdays are relatively richer in opportunities for socializing and learning compared to weekends. After these 'moderate' levels were reached, increased screen-time was associated with decreased wellbeing.

The always-on accessibility to the internet, however, has made it difficult for people to moderate their usage. Internet addiction seems to be on the rise and is now estimated to have a global prevalence of 6%.⁵³ An 'addiction' (as opposed to mere reliance or dependence) to technology is defined as excessive use, to the extent where time spent on devices impacts relationships, work, daily activities, and physical and mental health.

Those afflicted report a loss of control over internet use, associated professional, social or psychological problems, and preoccupation with using the Internet.⁵⁴ Internet addiction is associated with several other disorders including insomnia, anxiety, depression, stress, low self-esteem,⁵⁵ and lower quality of life.⁵⁶ Technology addiction is now treatable at in-patient facilities in both the U.S. and China.

Addiction to technology appears to take many different forms, with the impact varying according to the cause. The National Institute of Mental Health has found a strong and

⁵² Przybylski, AK & Weinstein, N. A large scale test of the Goldilocks Hypothesis: Quantifying the relations between digital-screen use and mental well-being of adolescents. *Association for Psychological Science*. 2017; 28(2): 204-215. <http://journals.sagepub.com/doi/10.1177/0956797616678438>.

⁵³ Cheng C, Li AY. Internet addiction prevalence and quality of (real) life: a meta-analysis of 31 nations across seven world regions. *Cyberpsychol Behav Soc Netw*. 2014;17:755-760.

⁵⁴ Van Rooij AJ, Prause N. A critical review of "Internet addiction" criteria with suggestions for the future. *J Behav Addict*. 2014;3:203-213.

⁵⁵ Younes F, Halawi G, Jabbour H, et al. Internet Addiction and Relationships with Insomnia, Anxiety, Depression, Stress and Self-Esteem in University Students: A Cross-Sectional Designed Study. *PLoS ONE*. 2016;11:e0161126.

⁵⁶ Cheng C, Li AY. Internet addiction prevalence and quality of (real) life: a meta-analysis of 31 nations across seven world regions. *Cyberpsychol Behav Soc Netw*. 2014;17:755-760.

significant association between excessive use of social media use and depression.⁵⁷ An addiction to screens has also been said to make us more anxious. “Nomophobia,” for example, is a specific term coined in the last decade to describe the fear of being without a mobile device (arising from “no mobile phone phobia”).⁵⁸

Technology addiction and excessive screen time appears also to be having a profound effect on our brain development. A non-peer-reviewed study sponsored by Microsoft found that human attention spans are dropping (from around 12 seconds in the year 2000 to under 9 seconds today.)⁵⁹ As some media were quick to report,⁶⁰ this means the human attention span is now shorter than that of a goldfish.

Our inability to practice natural mindfulness is also potentially altering our brains. University College London has found that media-multitasking or switching rapidly from screen to screen and task to task may weaken the brain’s anterior cingulate cortex which is involved in high-level information and emotion processing.⁶¹ Other research suggests multi-tasking is a myth, and all we are doing when we switch from screen to screen is further dividing and fragmenting our attention.⁶²

The reality is, some of these problems will likely solve themselves as we learn to adapt to the changing technological landscape. Our brains may get better at managing the ubiquitous and incessant streams of information that seem to come at us from all angles in the modern world. Culture and society will also adapt, so that a shortened attention span may become less of a weakness (we can see this happening already with “short form content” becoming increasingly more popular.)

But the biggest challenges to mental wellness appear to come, not from the technology itself, but from the added pressures and pace of life in the digital age. For example,

⁵⁷ Lin, L., et al. Association between social media use and depress among U.S. young adults. *Depression and Anxiety*. 2016;00:1-9.

⁵⁸ Lepp, A, Barkley, JE, Karpinski, AC. The relationship between cellphone use, academic performance, anxiety, and Satisfaction with Life in college students. *Computers in Human Behavior*. 2014;31:343-350.

⁵⁹ Harris, R. How digital is affecting attention spans. *Marketing*. 2015. From <http://marketingmag.ca/consumer/how-digital-is-affecting-attention-spans-146742/>.

⁶⁰ McSpadden, K. You now have a shorter attention span than a goldfish. *Time*. 2015. From <http://time.com/3858309/attention-spans-goldfish/>.

⁶¹ Loh KK, Kanai R. Higher Media Multi-Tasking Activity Is Associated with Smaller Gray-Matter Density in the Anterior Cingulate Cortex. *PLoS ONE*. 2014;9(9): e106698. <https://doi.org/10.1371/journal.pone.0106698>.

⁶² Atchley, P. You can’t multitask so stop trying. *Harvard Business Review*. 2010. From <https://hbr.org/2010/12/you-cant-multi-task-so-stop-tr>.

- **Accessibility.** Technology allows us to be accessible to those who need us anywhere and at any time. This can be a benefit but it also blurs the lines between our personal and professional lives. Our professional demands seem to follow us into our leisure times creating stress and interfering with work-life balance.
- **Responsiveness.** Technology also allows us to respond immediately to issues that may arise. Again, this is a benefit of technology that comes at a cost. In a professional environment, immediate responsiveness is a competitive advantage, but, it requires that we maintain at least a little of our attention on our devices during waking hours.
- **Social Comparison.** Social media allows us to stay close to friends and family and to share with those around us our greatest accomplishments. But seeing everyone's highlights on their social media pages can make us feel insecure about our own lives.

Social Relationships and Loneliness

Facebook was launched in 2004 as a university networking site and seems to have quickly taken over the world, changing drastically the way people connect and communicate with one another. Once again, the problem with social networking sites is not that they are bad, it's that they are *too good*. Facebook, Twitter, Instagram, Snapchat, WeChat, etc. have become amazing resources that allow us to stay connected to friends and family from all over the world. There are many benefits to be had from interacting with others online, but when the social fabric of society is changing so quickly, it is worthwhile to bring some attention the sacrifices we may be making along the way.

“

The three organs of the body most hurt by technology are our brains, our eyes, and our hearts.

Dr. Amit Sood

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As might be expected, the data on the use of social networking sites is mixed, with the effects depending on the quality of interaction and individual personality traits.^{63 64 65} But several recent

⁶³ Seabrook EM, Kern ML, Rickard NS. Social Networking Sites, Depression, and Anxiety: A Systematic Review. *JMIR Ment Health*. 2016;3:e50.

⁶⁴ Yang CC. Instagram Use, Loneliness, and Social Comparison Orientation: Interact and Browse on Social Media, But Don't Compare. *Cyberpsychol Behav Soc Netw*. 2016;19:703-708.

⁶⁵ Pantic I. Online social networking and mental health. *Cyberpsychol Behav Soc Netw*. 2014;17:652-657.

studies support the idea that increases in social media use are associated with greater feelings of loneliness and social isolation.⁶⁶

Among children and adolescents, excessive use of social networking sites has been associated with poor self-rating of mental health and high levels of psychological distress, but the direction of this association and its causal nature isn't clear.⁶⁷

One area where screen time seems to be changing the social dynamic between people is in the interactions between physicians and their patients. The rise of electronic health records (EHRs) is growing rapidly due to the burgeoning government mandates requiring their use. But one study⁶⁸ suggests that there could be unintended consequences. The researchers observed 8 experienced family medicine doctors interacting with 80 patients, half using paper records and half using EHRs. The physicians spent more of the visit gazing at medical records during EHR visits (35.2%) vs paper visits (22.2%). Less time was spent gazing at the patient during EHR visits (45.6%) vs paper visits (52.6%). The authors suggest that spending more time looking at a screen and less time at a patient may negatively affect how the patient perceives the visit. In another study with practicing physicians only 27% of the time in clinical visit was spent in direct clinical contact, with most of the time spent on EHRs.⁶⁹

Ostensibly, the heightened interpersonal connectivity afforded by social media should be associated with an overall increase in psychological well-being, yet the problem of loneliness persists in the same societies where social media usage is likely at its highest (e.g., the U.S., the U.K., etc.). According to a nation-wide survey, commissioned by the Mental Health Foundation, 48% of British adults believe that people in the U.K. are getting lonelier as time progresses, 45% report feeling lonely at least some of the time, and 42% report having felt depressed due to being alone.⁷⁰

⁶⁶ See <https://www.telegraph.co.uk/technology/2017/03/06/much-social-media-increases-loneliness-envy-study/>.

⁶⁷ Sampasa-Kanyinga H, Lewis RF. Frequent Use of Social Networking Sites Is Associated with Poor Psychological Functioning Among Children and Adolescents. *Cyberpsychol Behav Soc Netw*. 2015;18:380-385.

⁶⁸ Asan O, P DS, Montague E. More screen time, less face time - implications for EHR design. *J Eval Clin Pract*. 2014;20:896-901.

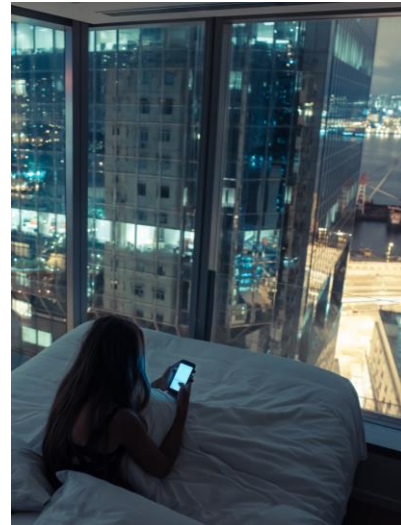
⁶⁹ Sinsky C, Colligan L, Li L, et al. Allocation of Physician Time in Ambulatory Practice: A Time and Motion Study in 4 Specialties. *Ann Intern Med*. 2016;165:753-760.

⁷⁰ Griffin J. The Lonely Society? London: Mental Health Foundation. 2010. <http://its-services.org.uk/silo/files/the-lonely-society.pdf>.

Importantly, nearly all indicators of loneliness reported in the survey are of the highest incidence among young adults aged 18-34 (as opposed to older adults). Similarly, in their book *The Lonely American*, Olds and Schwartz⁷¹ argue that loneliness in 21st century America is higher than in any previous generation, despite the fact that modern Americans “devote more technology to staying connected than any society in history”.

Some countries, including Britain and the U.S., are reporting “epidemics of loneliness” with one in three people over the age of 65 living alone.⁷² The relationship to technology is not clearly defined but it seems that as each generation moves to new communication platforms and technologies, the older generations are simply cut off from their children and grandchildren and become increasingly isolated.

This is seen as a true health epidemic because loneliness and social isolation are significant risk factors for mortality⁷³ and potentially even a bigger health risk than smoking or obesity.⁷⁴ Researchers have established that loneliness is related to serious health risks in children,⁷⁵



⁷¹ Olds J & Schwartz RS. *The Lonely American*. Beacon Press. 2010.

⁷² See <https://www.nytimes.com/2016/09/06/health/lonliness-aging-health-effects.html>.

⁷³ Holt-Lunstadt J, Smith TB, Smith MB, et al. Loneliness and Social Isolation as Risk Factors for Mortality: A meta-analytic review. *Perspectives on Psychological Science*. 2015;10:2,227-237.

⁷⁴ See <https://www.forbes.com/sites/quora/2017/01/18/loneliness-might-be-a-bigger-health-risk-than-smoking-or-obesity/#1816224e25d1>.

⁷⁵ Asher S & Paquette JA (2003). Loneliness and peer relations in childhood. *Current Directions in Psychological Science*. 2003;12, 75-78. doi:10.1111/1467-8721.01233.

adolescents,⁷⁶ and adults,^{77 78} and have suggested that it can increase risk of death by as much as 26%.⁷⁹

Distraction and Safety

All of the attention we give to technology in the modern world means we are taking our attention away from other aspects of our lives. In a now infamous blunder, at the 2017 Oscar Awards, Warren Beatty and Faye Dunaway announced the wrong recipient as the winner of the Best Picture Award. The Wall Street Journal speculated that the mix-up happened because the accountant in charge of the winner's envelopes was distracted while tweeting a backstage photo of actress Emma Stone.⁸⁰

In 2011, texting while flying was identified as a contributing factor in a helicopter crash that killed 4 people.⁸¹ In 2012, a crop dusting plane flew into some powerlines, causing the plane to crash and killing the pilot on board. Records showed he was using his cellphone during the flight and had been on a phone call shortly before the accident.⁸² In 2015, the U.S. National Transportation Safety Board found that a fatal airplane crash in Colorado may have been caused by the pilot taking selfies in the cockpit.⁸³ Experts say distraction may have been a culprit in the derailment of an Amtrak train in Seattle that killed three passengers.⁸⁴

⁷⁶ Jones AC, Schinka KC, van Dulmen MH, Bossarte RM, Swahn MH. Changes in loneliness during middle childhood predict risk for adolescent suicidality indirectly through mental health problems. *Journal of Clinical Child Adolescent Psychology*. 2011;40(6):818-24.

⁷⁷ Cacioppo JT, Hughes ME, Waite LJ, Hawkley LC, Thisted RA. Loneliness as a specific risk factor for depressive symptoms: cross-sectional and longitudinal analyses. *Psychology and Aging*. 2006 Mar;21(1):140-51.

⁷⁸ Patterson AC, Veenstra G. Loneliness and risk of mortality: a longitudinal investigation in Alameda County, California. *Social Science and Medicine*. 2010 Jul;71(1):181-6.

⁷⁹ Holt-Lunstadt J, Smith TB, Smith MB, et al. Loneliness and Social Isolation as Risk Factors for Mortality: A meta-analytic review. *Perspectives on Psychological Science*. 2015;10:2,227-237.

⁸⁰ See <https://www.wsj.com/articles/pwc-partner-in-charge-of-oscar-winner-envelopes-was-tweeting-backstage-minutes-before-best-picture-mix-up-1488227883>.

⁸¹ See <http://www.kansascity.com/news/local/article317436/NTSB-Text-messages-distracted-helicopter-pilot-before-fatal-Northland-crash.html>.

⁸² See http://globegazette.com/news/local/cell-phone-distraction-noted-in-cause-of-britt-plane-crash/article_b48b9b44-d9f9-11e2-9511-001a4bcf887a.html.

⁸³ See <https://www.csmonitor.com/USA/USA-Update/2015/0203/Distracted-in-the-cockpit-taking-selfies-likely-caused-fatal-plane-crash>.

⁸⁴ See <http://time.com/5075050/amrtak-train-derail-route-driver-engineer/>.

Perhaps no other aspect of daily life is as directly and dangerously impacted by technology distractions as is driving. The U.S. National Highway Traffic Safety Administration reported 3,477 distracted driving fatalities in 2015. They estimate 660,000 drivers per day using cellphones on U.S. roads.⁸⁵ A report in Doha, Qatar found that 80% of car accidents involve social media and cellphone usage while driving.⁸⁶

Young drivers are particularly at high risk given the high prevalence of cell phone use while driving combined with driving inexperience. Cell phone use (calls, texting, mobile app use, internet use) have been shown to increase the risk of crashes in teen drivers.⁸⁷ Using data from the Fatality Analysis Reporting System from 1999 to 2008, researchers in the U.S.⁸⁸ estimated that increased texting volumes caused more than 16,000 additional road fatalities between 2001 and 2007. A systematic review⁸⁹ identified a feeling of controllability, social norms and the perceived importance of the call as key factors driving this high-use behavior. This particular review also noted that most of the intervention strategies tried in various studies had been ineffective.

While any distraction can increase the risk of crashes, texting was found to be particularly detrimental to driver performance,⁹⁰ with impairment of vehicle control persisting over 3 seconds after the completion of the texting episode. This latter finding may be of particular importance given the frequency of texting at stoplights. Bernstein and colleagues⁹¹ used roadside observation to identify cell phone usage on 2,000 passenger vehicles. They found in drivers in motion that 3% were texting and 5% were talking. But when stopped, 14.5% were texting and 6.3% were talking. Given the possibility of impairment of vehicle control persisting

⁸⁵ See <https://www.nhtsa.gov/risky-driving/distracted-driving>.

⁸⁶ See <https://dohanews.co/taking-selfies-using-social-media-cause-of-most-accidents-on-qatar-roads/>.

⁸⁷ McDonald CC, Sommers MS. Teen Drivers' Perceptions of Inattention and Cell Phone Use While Driving. *Traffic inj prev.* 2015;16 Suppl 2:S52-58.

⁸⁸ Wilson FA, Stimpson JP. Trends in fatalities from distracted driving in the United States, 1999 to 2008. *Am J Public Health.* 2010;100:2213-2219.

⁸⁹ Cazzulino F, Burke RV, Muller V, Arbogast H, Upperman JS. Cell phones and young drivers: a systematic review regarding the association between psychological factors and prevention. *Traffic inj prev.* 2014;15:234-242.

⁹⁰ Thapa R, Codjoe J, Ishak S, McCarter KS. Post and during event effect of cell phone talking and texting on driving performance--a driving simulator study. *Traffic inj prev.* 2015;16:461-467.

⁹¹ Bernstein JJ, Bernstein J. Texting at the light and other forms of device distraction behind the wheel. *BMC Public Health.* 2015;15:968.

even after completion of texting, texting while stopped may only have the appearance of being safer.

Klauer and colleagues⁹² used accelerometers, GPS data, cameras and other sensors in the vehicles of 42 newly licensed drivers (16.3 to 17 years of age) and found the following risks for crashes and near crashes:

- dialing a cell phone odds ratio 8.32
- reaching for a cell phone odds ratio 7.05
- sending/receiving texts odds ratio 3.87
- eating odds ratio 2.99

On the positive side, programs to reduce distracted driving are emerging that seem to have at least temporary benefits. A comprehensive campaign to reduce distracted driving at the University of Arizona reduced distracted driving by 32% (but the rate returned to baseline at six months).

Distractions during other activities carry their own set of risks. Recognizing that more than 50% of traffic fatalities in New York City are pedestrians,⁹³ Basch and colleagues observed pedestrian behavior at 10 intersections in Manhattan with the highest frequency of pedestrian-motor vehicle accidents. They found that among 3500 pedestrians observed, nearly 30% were distracted by mobile electronic devices while crossing during the “walk” signal and 26% during the “don’t walk” signal.

Distraction by technology may have other far reaching impacts that are less easy to quantify, such as affecting students’ performance at school and workplace productivity.

Productivity

Some might argue that the associated costs of technology use are more than offset by the amazing benefits and productivity that are afforded by our new technologies. The potential growth of an economy over the long-term equals the growth in its labor force plus the growth in its productivity (or the output per person). At the moment, the population is aging in most countries around the world; hence productivity is what is left to determine the ability of a country to grow and improve its standards of living over time.

⁹² Klauer SG, Guo F, Simons-Morton BG, Ouimet MC, Lee SE, Dingus TA. Distracted driving and risk of road crashes among novice and experienced drivers. *N Engl J Med*. 2014;370:54-59.

⁹³ Basch CH, Ethan D, Rajan S, Basch CE. Technology-related distracted walking behaviours in Manhattan's most dangerous intersections. *Inj Prev*. 2014;20:343-346.

But in spite of our recent surges in technological progress, productivity growth is negative or declining in most developed countries, including those that seem the most innovative, like the United States.⁹⁴ How can this be? Why is the world currently afflicted by what the economists call the “productivity paradox”?⁹⁵ With all the current excitement about innovation and technology, productivity rates should be increasing markedly, but they fall below expectations. Why aren’t the smartphone and all the groundbreaking technology that come with it (like AI – artificial intelligence) translating into higher productivity?

We don’t fully know the answers to these questions. Explanations and theories abound, but they differ and often disagree with each other. It seems that today, most innovations that we use in our daily life (our smartphones and all the apps that come with it, the internet, etc.) enhance our leisure time, not our business efficiency. Skype, Facebook, Twitter or Snapchat did not exist a few years ago and it’s hard to tell the extent to which they render our lives “better.”

An 'always on' culture with high expectations to monitor and respond to emails during non-work time may prevent employees from ever fully disengaging from work, leading to chronic stress and emotional exhaustion. Absenteeism and prolonged absences due to work burnout are problems both for businesses and for the people they employ. 57% of U.S. adults say a traditional vacation does not relieve their stress with many admitting to checking emails and taking phone calls while away, sometime multiple times a day.⁹⁶ The French government is leading the way in establishing the 'right to disconnect' for employees. A new law introduced in 2017 requires companies with more than 50 employees to establish hours when staff should not send or answer emails. The clearly-stated goals of the law are to prevent burnout by protecting employees' private time.⁹⁷

⁹⁴ See <https://www.weforum.org/agenda/2016/03/is-technology-making-us-less-productive/>.

⁹⁵ See <https://www.npr.org/2017/06/02/531173429/understanding-the-productivity-paradox>.

⁹⁶ See <https://loszachreport.wordpress.com/2012/08/22/the-vacation-paradox-why-some-companies-are-paying-workers-to-go-away/>.

⁹⁷ See <http://fortune.com/2017/01/01/french-right-to-disconnect-law/>



One thing is certain: the gains in consumer's welfare enabled by many innovative products (we use them because we "like" them) do not raise incomes, increase tax revenues or create entirely new products or new ways of doing things. Some psychologists and economists now argue that this kind of innovation has a perverse effect on productivity by "distracting" us. This is what our addiction to digital does: it distracts us; and in the end, it raises our stress levels and therefore affects negatively our productivity by raising the levels of absenteeism and also "presenteeism,"⁹⁸ being at work, but unhealthy or unproductive.

The Way Forward

This review of literature on the impact of technology on wellbeing raises some interesting questions. Perhaps the most important question pertains to whether technology and human wellbeing are at odds with one another. The research that we have reviewed to date raises some concerns, but the technology is evolving at a rate far faster than we can study it. Most of the research studies cited in this paper cover technologies from previous decades. It is uncertain how the findings can apply to the technology from today, not to mention the new technologies that will emerge in the years and decades to come.

It seems that what is needed is a new field of "Digital Wellness" that looks explicitly at the relationship between technology and wellness. Such a field could draw on a growing cadre of experts from across a variety of disciplines who are beginning to think about these issues. Sub-disciplines that fall under Digital Wellness include:

⁹⁸ "Being at work, but out of it." See <https://hbr.org/2004/10/presenteeism-at-work-but-out-of-it>.

- 1. Digital Ethics:** We are seeing what we “can” do with technology. The question remains around what we “should” do. Should we allow a few large technology companies to control our information and social networks? Should we share our data with corporations who wish to manipulate us? Should we allow media outlets to share information that is biased or inaccurate?

Examples:

- Design ethicist [Tristan Harris](#) on *Ethics for Designers*.
- Futurist Gerd Leonhard’s [Technology vs. Humanity](#).

- 2. Digital Citizenship:** As relationships and social networks move online, we need to establish new norms and guidelines for how we relate and interact with one another. How do we communicate with one another online? How do we debate and discuss important issues? How do we balance our professional and personal communications? For parents, how do we raise good digital citizens?

Examples:

- [The Digital Citizenship Institute](#).
- Researcher and author [Sherry Turkle](#).

- 3. Digital Mindfulness:** We need to bring greater awareness to our technology use and to establish clear intentions behind our evolution into the digital age. How do we design technologies that serve our highest values? How do we avoid being distracted by technology when it is not benefiting us?

Examples:

- Lawrence Ampofo’s website and podcast on [Digital Mindfulness](#).

- 4. Digital Nutrition:** It is hard to keep up with the deluge of information that we are receiving through our devices. We need better guidelines around appropriate amounts of media consumption. How do we determine which types of content and technology use are good for us and which are bad?

Examples:

- [Digital Nutrition](#) by psychologist Jocelyn Brewer.
- Tech ethicist [David Ryan Polgar](#)’s page on [Mental Obesity](#).
- The “Goldilocks Hypothesis”, in which researchers identify moderate amounts of technology use that are conducive to wellbeing.^{99 100}

⁹⁹ Przybylski, AK & Weinstein, N. A large scale test of the Goldilocks Hypothesis: Quantifying the relations between digital-screen use and mental well-being of adolescents. *Association for Psychological Science*. 2017; 28(2): 204-215. <http://journals.sagepub.com/doi/10.1177/0956797616678438>.

¹⁰⁰ See <https://www.scientificamerican.com/article/the-ldquo-goldilocks-rdquo-level-of-teen-screen-use/>.

- 5. Digital Education:** It seems that this generation is ill-equipped to teach the next generation about technology. Our kids are left to figure it out on their own. How should technology be integrated into our schools? What should we be teaching children about the healthy use of technology? How do we teach mindfulness in the age of distraction? Examples:

- Psychology professor and author [Jean Twenge](#).

These 5 disciplines: Digital Ethics, Digital Citizenship, Digital Mindfulness, Digital Nutrition and Digital Education are exploring important questions around how technology integrates with our culture, community and government to support human wellbeing rather than jeopardize it. We have established the Digital Wellness Initiative with the support of the Global Wellness Institute to serve as a support hub to begin gathering resources and information in these areas.

In the meantime, we see three philosophical objectives that are worthy of consideration:

1. **Do not accept the inevitability of technology.** We should not sit idly by while the digital landscape emerges without questioning and challenging whether humanity is helped or hindered by technological progress. We tend to assume that the way things are are the way things have to be but this is not necessarily the case. Do we have to share our data with large corporations, knowing it will be used to manipulate us? Do we have to have our search engines and social networks funded by corporate advertising? These are the models that are emerging today, but they aren't necessarily the only ways of achieving technological advances.
2. **Establish guidelines around "Digital Nutrition."** There is a great analogy between food and technology because technology, like food, is not inherently good or bad. It really depends on the quality and quantity of what is being consumed. We need to study technology consumption, as we have done with food, to better understand what healthy consumption looks like. We should establish guidelines around healthy technology use and push our technology providers to help us live up to them.
3. **Cherish and cultivate our "non-digital humanity."** As technology becomes more and more compelling we are at risk of losing sight of what it means to be a human without technology. While virtual experiences are on the rise, real human experiences appear to be waning: physical movement, real world relationships and sexuality, mind wandering, creativity, play, etc. We should cherish, protect and hold sacred our non-digital humanity in the same way that we might protect an endangered species. Indeed, non-digital humans may someday be an endangered species.

Ironically, it may be technology in the end that helps us to solve some of these problems. Just recently, we have seen a rapidly rising consciousness on this issue coming from within the tech

industry itself. Chamath Palihapitiya, for example, a former executive from Facebook has expressed regret for his role in creating these new technologies “that are ripping apart the social fabric of how society works.”¹⁰¹ And Sean Parker, the founding president of Facebook, now describes himself as a “conscientious objector” against social media. He recently criticized Facebook for “exploiting a vulnerability in human psychology,” saying, “God only knows what it’s doing to our children’s brains.”¹⁰²

A group of technology experts and “Silicon Valley insiders” has joined forces with Tech Ethicist Tristan Harris to create a code of conduct for the technology industry.¹⁰³ They have launched the Center for Humane Technology with a mission to “reverse the digital attention crisis” and “realign technology with humanity’s best interests.”¹⁰⁴ They call their movement, “Time Well Spent”¹⁰⁵ to suggest that technology should be helping us use our time more productively and meaningfully, rather than distracting us from the things that are most important.

These kinds of movements appear to be making a direct impact. In early 2018, Facebook CEO Mark Zuckerberg announced that he was making improvements to Facebook “to make sure the time we all spend on Facebook is *time well spent* [emphasis added].”¹⁰⁶ In the announcement, Zuckerberg said he is making a “major change” to Facebook to help users “have more meaningful social interactions.” This may be the first big announcement of a major technology company to make users’ well-being a priority.

We are right to be wary of Facebook’s intentions here,¹⁰⁷ but we will need the technology companies to play an active role to align the role of technology with human wellness. The great irony of technology is that it is not only the greatest threat to human wellbeing, it may also be the greatest hope for our future.

The Future

We are only beginning to understand the impact that the most ubiquitous innovations and technologies, like social media or our smart phones, are having on us. But as we enter an era

¹⁰¹ See <https://www.theguardian.com/technology/2017/dec/11/facebook-former-executive-ripping-society-apart>.

¹⁰² See <https://www.theguardian.com/technology/2017/nov/09/facebook-sean-parker-vulnerability-brain-psychology>.

¹⁰³ See <http://abeautifulperspective.com/2018/03/02/inside-the-fight-to-make-tech-more-humane/>.

¹⁰⁴ See <http://humanetech.com/>.

¹⁰⁵ See <https://www.theverge.com/2018/1/17/16903844/time-well-spent-facebook-tristan-harris-mark-zuckerberg>.

¹⁰⁶ See <https://www.facebook.com/zuck/posts/10104413015393571>.

¹⁰⁷ See <http://psychologyofwellbeing.com/201706/facebooks-new-mission-sounds-noble.html>.

dominated by big data, new algorithms will churn 24 hours a day, seven days a week, through petabytes of information to study each of us and our patterns of behaviour around technology.

In the future, algorithmic solutions will assess how “well” we are and will hence determine how much we pay for insurance, receive in medical reimbursements, and possibly even the terms of our social contract. Our technologies will gather data via different apps that will advise their users, but also companies and possibly public organizations, on what interventions should be made to improve certain outcomes. As they evolve, these technologies will become more integrated (or some might say intrusive.) The day will arrive when companies or governments implant embeddable chips under our skin and use bio-sensing wearable devices to track our walking behaviour.

The impact of newer innovations such as AI (artificial intelligence) or synthetic biology are much harder to grasp because they redefine what it means to be human. As one example, we may see “designer babies” sooner than we realize, along with a whole series of other “edits” to our humanness – from eradicating genetic diseases to augmenting human cognition. These advances will raise some of the biggest ethical and spiritual questions ever faced. Should we, for example, use the mind-blowing advances in biology only to cure disease (and possibly repair injury), or rather to make ourselves “better” humans? If we go towards the latter, do we risk turning parenthood into an extension of the consumer society, in which case our children become “commoditized” as objects of our manufacture?

We face similarly complex questions with AI. How will we manage technology when it has the ability to outthink us?¹⁰⁸ Amazon and Netflix already possess algorithms that predict which films and books we would like to watch and read. The time when a dating or work placement site tells us which partner or job is our best match is not far away. What do we do then? Which advice do we trust: the one of our family and friends or the algorithm contained in the app?

When we try to get a sense of the consequences these different examples will entail for the human race, we are in *terra incognita*. As knowledge and discoveries in these fields progress, we will have to redefine and reinvent our moral and ethical boundaries. As human beings and as social animals, we will have to think individually and collectively about how to respond to questions such as: Should I want to live forever? Do I want a “perfect” baby? (And if I do, should I pay for it?) Shall I check the history of my future spouse? If we are able to, should we banish unpredictability? Should we administer anandamide – the “bliss molecule” - to those populations who are genetically disadvantaged, and therefore less “happy” than others? The list is endless.

¹⁰⁸ A situation Stanley Kubrick foresaw in “2001: A Space Odyssey”, filmed in 1968, in the confrontation between Hal and Dave

At the same time, we will have to start worrying that these incredible discoveries could also be manipulated to serve special interests. As Stephen Hawking says when considering the implications of artificial intelligence: "the short-term impact depends on who controls it; the long-term impact depends on whether it can be controlled at all. . . We should all ask ourselves what we could do now to improve the chances of reaping the benefits and avoiding the risks."¹⁰⁹

Another substantial risk to foresee is in the predictive power of artificial intelligence and machine learning. If our own behaviour in any situation becomes predictable, how much personal freedom do we have in the end to deviate from the prediction? Could this development potentially lead to a situation where human beings themselves begin to act as robots? This also leads to a more philosophical question: how do we maintain our individuality, the source of our diversity and democracy, in the digital age?

Clearly, we have raised more questions than we have answers to with our current understanding. But asking these questions and considering where they take us may be critical to the survival of our species (at least as we know it today.)

If an outside observer were watching life on planet earth in the 21st century, it would be easy for them to assume that humanity exists to help technology flourish. Our job is to ensure that technology only exists to help humanity flourish.

¹⁰⁹ From <http://www.independent.co.uk/news/science/stephen-hawking-transcendence-looks-at-the-implications-of-artificial-intelligence-but-are-we-taking-9313474.html>

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