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Commentary

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Technology and the Brain: Lessons from Patient Care, Social Media and the Internet

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OVERVIEW

Technology is sweeping through our society in unparalleled fashion, affecting our day-to-day life, education, social relationships, healthcare and business. Our human experience and neuroscience both determine how we interface with technology such that we have "good" (i.e., enjoyment, excitement) and "bad" (i.e., stress) experiences. With regard to healthcare, the patient-centered era features quality, affordable, and timely care; technology is a key part of that, particularly among younger generations. Indeed, the consumer movement related to new technologies may be passing some clinicians by, as new ways of communicating with others (text, e-mail, Twitter, Facebook, social media). More reflection is needed on how technology "changes" us, may become the focus of our worst attributes and causes significant problems (e.g., pathological Internet use, privacy/confidentiality breeches). Research approaches and frameworks are needed across many fields and disciplines of science, medicine and human behavior regarding our use of technology.

HUMAN NATURE AND HOW WE LEARN

A recent article distinguishes our species–*homo sapien*–by our ability to contemplate the future through cortical function;[1] *homo prospectus* is suggested since we thrive by considering our prospects and this foresight created civilization and sustains society. When making plans, we have higher levels of happiness and lower levels of stress than at other times, perhaps because this channels concerns into an organized plan. Studies show depressed people imagine fewer positive scenarios while overestimating future risks. We are also governed by the subcortical function, too, in many ways including addictions.

Cognitive psychology focuses on learning, memory and perception. Learning is a complex neurobiological and social phenomenon. How we learn is dependent on our personal experience and professional training, including what is formally taught and what we learn on our own. Discussing what we know, what we don't, and how to learn better/more is a key developmental step. Evaluating our strengths and weaknesses is also essential for professional development. Using our 'best' learning styles and facilitating others' gives us many ways to approach problems.[2-3]

Neurobiology informs us on learning, including Hebbian theory about adaptation of neurons in the brain during this process. Synaptic plasticity and increased synaptic efficacy arises from the presynaptic cell's repeated and persistent stimulation of the postsynaptic cell.[4] Similarly, behaviorists think of animal learning as the ingraining of habit by repetition. Injury and mental illness (e.g., schizophrenia) disrupt this. Repetition and planned redundancies help us enhance our retention by allowing us to "relearn" things as we build toward more complex skills. Visualization is another form of repetition, which may mentally 'prepare' us to perform tasks. Stress in moderation is helpful and in principle, fatigue, Multitasking and interruptions are to be minimized. Sociologic, educational and psychological researchers are exploring

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strategies for personalization of learning, which aligns teaching methods with learner goals – partly through technology.[5]

Critical thinking is the process of "purposeful, self-regulatory judgment, giving reasoned consideration to evidence, context, conceptualization, methods and criteria."[6] When applied to medical education, critical thinking allows practitioners to apply higher order cognitive skills to information in a way that leads to precise, consistent, sound, and logical action.[7] Early learners progress through a series of developmental steps (e.g., gathering information in rote) and advanced learners use algorithms and pattern analysis to guide decision-making. Still later, we use mental shortcuts (or heuristics) and metacognitive structures to rapidly process information in order to solve a problem. Critical thinking skills may be developed, but some individuals are thinking intuitively (fast) or deliberately (slow).[8]

Cognitive errors and biases have been studied for centuries, but Kahneman's work earned him the Nobel Prize and led to a new field of behavioral economics – similarly this science can be applied to use of technology. In that time, experiments in cognitive psychology and psychiatry illuminated perceptual biases: why we think as we think, when our decisions are prone to error, and how to reduce those errors.[8] If we understand why we err, we better allow ourselves to risk-taking mistakes.[9] Major cognitive biases include cognitive illusions (i.e., unconscious inferences interfere with interpretation of events/actions), "narrow" framing, selection bias, and confirmation bias.

RESEARCH AND OBSERVATIONS IN THE USE OF TECHNOLOGY

Researchers face many difficulties in developing an empirical approach to this work and in reviewing the extant literature. First, smartphones have become so ubiquitous that it is nearly impossible to employ true experimental methods. As a result, much of the literature consists of quasi-experimental and correlational studies. Second, the few truly experimental studies have investigated only momentary effects rather than long-term effects of smartphone use or impacton cognition. Third, we must control for disparities in technology users' socio-economic status, age, resources, social expectations and other dimensions. Fourth, the majority of studies also employ self-report questionnaires, which limits the findings (e.g., reliability, validity). Fifth, because the landscape regarding technology use is ever-evolving, so questionnaires may have a limited "half life." In summary, we have little broadly generalizable longitudinal evidence.

Technology Entry Into Life Day-to-Day

New digital communication includes: e-mail, standard message service (SMS) text messaging, multiple message service (MMS) messaging, instant messaging; proprietary networks like Twitter direct messages, Facebook and increasing use of psychiatric apps;[10] Pinterest, Instagram, Tumblr, Snapchat, WhatsApp, YikYak are yet others. As of 2014, 90% of adults have a cell phone and 58% have a smartphone;[11] the rate is probably higher regarding smartphones for teenagers. Aside from entertainment purposes, those aged 13 to 54 years in the U.S. use a majority of their smartphone time to socialize with others, manage their health, and research information.[12] Worldwide Internet users include: Asian and Pacific (44.8 percent), Europe (21.5 percent), North America (11.4 percent), Latin America (7.0 percent), Middle East (3.7 percent) and Oceania (1.0 percent).[13]

The expanding use of social media and advances in digital connectivity pose challenges on how to integrate new trends in technology with existing paradigms. Social networking has been defined as "web-based services that allow individuals to: 1) construct a public or semi-public profile within a bounded system, 2) articulate a list of other users with whom they share a connection, and 3) view and traverse their list of connections and those made by others within the system."[14] In a recent survey of the U.S. general population, 78% of Internet users reported to go online at least once a week, with 87% of them checking email at least once per day, and 20% sending instant messages on a daily basis.[15] Internet users tend to: surf the Web (78%), social network and video-share (51%), play online video games (36%), download or watch videos (35%), and download or listen to music (33%).[15] The number of people who use social media is on the rise, and the data is staggering (e.g., Facebook reported 1.39 billion at-least-monthly users and 890 million daily active users on average in 2014 *versus* 360 million total users in 2009).

Technology Entry into Clinical Care

Many wonder, "How do these new technologies fit in?". Folks get help on an Internet-based spectrum: 1) health information *via* websites; 2) support groups and participation in a "community"; 3) formal educational resources with evaluation; 4) tools for self-directed assessment, lifestyle change, or decision-making (e.g., diabetes, depression); 5) one-time medical advice/consultation or general advice in a group led by a professional; and 6) telebehavioral health (TBH) services by video or Internet; and 7) asynchronous options.[15]

The patient-centered healthcare movement and technology have interesting intersections in psychiatry.[16] The field of child and adolescent psychiatry is rapidly trying to adjust to the use of social media and patient-doctor texting, e-mailing and such; this research is different than neurobiology, autism, and genomics; even beyond clinically based innovations (e.g., Institute for healthcare Improvement's Triple Aim).[17] In order to understand social media, we need to understand the person behind the patient, and why/how they do what they do.[18-19]

In healthcare and particularly psychiatry, "quality" care typically depends on patient-doctor engagement, the therapeutic relationship, and shared decision-making for treatment.[20] A bio-psycho-socio-cultural (BPSC) model of care has been suggested,[21] as we explore beliefs, norms, and values, and ethnic, culture and language issues that affect health. The importance of the therapeutic alliance in successful treatment is well established across disciplines. Efforts to establish rapport and consistent boundaries allow the provider to accurately "see" the patient

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and be seen as a professional – not as a friend – so patients can feel comfortable revealing themselves.[22] Effective communication facilitates such disclosure. When the parameters of the therapeutic frame are significantly and repeatedly blurred, there are interferences and trust erodes.

Since patients are increasingly seeking information through the Internet and social media, shouldn't we discuss how they use of technology and how it affects the therapeutic relationship as part of the informed consent process? Should we search for information about patients on public sites to be better informed or does this conflict with a patient's right to privacy? Finally, how do we maintain patient safety, monitor potential concerns and manage emergency situations? How does asynchronous technology change our communication? Social science studies suggest that a task-oriented focus with a depersonalized content may occur, by phone, text and even video.[23-24]

Boundaries and potential dual relationships are challenging in mental healthcare, as requests for other contact between visits (e.g., texts, e-mails) are increasing.[25] Asynchronous written or e-mail language is good for answering yes/no questions, trading a piece of information (e.g., confirming appointment, medication side effect), but it is not synchronous. Emails 'should' be sent during regular working hours to attend to expectation and boundary issues.[25] Asynchronous methods do not afford vocal nuances like pitch modulations, changing volume, and meaningful pauses, and there is no accompanying body language; this may lead to misinterpretations and have unexpected consequences.

A recent study found 73% of residents in multiple specialties had Facebook profiles, 6% of whom had friend requests from patients, and 4% of which were accepted.[26] But consider the hypothetical case of the therapist, who, while browsing his/her own Facebook account one evening, comes across a "friend request" from a current patient with whom he/she is engaged in therapy. The therapist must now consider the implications behind the request, choose whether or not to accept, and determine how best to respond to the patient regarding her decision. Does this request reflect a desire on the part of the patient to push the boundaries of the therapeutic frame, perhaps related to some aspect of his presenting problem or in response to an unfolding dynamic in session?

The Concept of Pathological Internet Use (PIU)

There is an array of terms that have emerged in recent years to describe addictive technology behavior, including, but not limited to: Internet addiction, Internet addiction disorder, excessive Internet use, problematic Internet use, computer addiction, cyber addiction, net addiction, compulsive Internet use, Internet dependence, Internet overuse, Internet related disorder, Internet behaviour dependence and pathological Internet use. A review of the scientific literature shows rates between 1-40% in different countries.[27] Universal components that constitute a pathological internet use (PIU) definition include inability of a person to control Internet use, preoccupations, urges or behaviors with marked distress, and functional impairments. Who are these people?

- Those who appear to never have had a problem and it is new, and/or
- Those still developing as a person (e.g., children, teenagers), and/or
- Those with pathology that simply took a turn toward the Internet (e.g., a gambler who now gambles mainly by the Internet), and/or
- Those with other addiction or impulsivity problems, and the Internet may have "unmasked" the underlying behavior, trait/personality or more aptly showed a state/disorder.

The diagnostic and statistical manual, 5th Edition[28] has integrated behavioural addiction (non-substance-related addictive disorders) as an official diagnostic category, while including Internet gaming disorder into the appendix pending further research. The Young Diagnostic Questionnaire (YDQ) was developed per diagnostic and statistical manual of mental disorders, fourth edition (DSM-IV) diagnostic criteria for pathological gambling, based on Internet usage over the past six months.[29] Clinical impairment or distress is indicated by: (1) preoccupation with the Internet; (2) need for longer amounts of time online to achieve satisfaction; (3) repeated unsuccessful efforts to control, cut back, or stop Internet use; (4) restlessness, moodiness, depression, or irritability when attempting to cut down or stop; (5) staying online longer than originally intended; (6) jeopardizing or risking the loss of a significant relationship, job, or educational/ career opportunity; (7) lying to others to conceal the extent of use; and (8) escaping from problems or of relieving a dysphoric mood. The Internet Addiction Test (IAT) may apply better to social media.[30]

There are socio-demographics and other variables that have been linked with pathological users. These include the age of first exposure to the Internet, gender, Internet access at home, city residence, living in metropolitan areas, higher family income levels and migrant status.[31-32] These factors included: loneliness, low life satisfaction, low well-being, low social support, low academic achievement and dysfunctional social behaviors. Adult-specific populations were linked with an insecure attachment style, lack of familial love and child maltreatment experiences.

There is overwhelming evidence suggesting PIU is significantly associated with neurological complications, psychological distress, social problems and parental discord.[33] In an examination of adult and adolescent populations,[31-32,34] unambiguously shared psychopathologies have emerged among pathological users. Nearly 86% of those diagnosed with PIU also meet the diagnostic criteria of another DSM-IV disorder.[35] These include depression, anxiety, compulsivity, sleeping disorders, attention deficit hyperactivity disorder (ADHD) and hos-

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tility. Adolescent-specific populations were shown to be linked with social phobia, phobic anxiety, schizophrenia, psychoticism, obsessive-compulsive disorder, affective disorder, substance and alcohol use. Adult-specific disorders include dissociative experiences, depersonalization and alcohol abuse.

Many important questions remain: 1) What is the relationship between PIU and social media, exactly? 2) What is the relative weighting or impact of experiences, behaviors, traits and states? 3) If PIU and other disorders co-occur, how do we assess and treat them similarly or differently? 4) What is the relationship, specifically, between PIU and substance use? 5) How dangerous is PIU (e.g., suicidality among adolescent populations).

CONCLUSIONS

Technology is part of our regular life activities and it may have healthy and unhealthy dimensions. Educators, researchers and technologists may need to learn more about these pros and cons of technology. It may also be worthwhile to reflect on personal and professional boundaries related to technology. Clinicians may have to add questions to interviews in order to learn how social media, e-mail, texts and apps impact a patient's life, communication, and illness. They also need a dependable evidence base on which to make decisions. These topics above appear to dovetail with findings from the research on smartphones,[36] violent television and video games.[37] These technologies affect attention, learning, and memory in ways that may go unnoticed by participants. Multitasking may work for some moments, but be problematic at other times.

More research appears indicated regarding the social, psychological, cultural, and biological contributors to cognition related to technology. Perhaps teams of scientists and clinicians across professions and disciplines are best equipped to sort out the complexities both studies of healthy adults (and other ages) and patient populations could be beneficial, using a variety of methodologies. The inclusion of statistics, mathematical models, and other quantitative sciences could also shed light on what works and what doesn't.

CONFLICTS OF INTEREST

The author declares that he has no conflicts of interest.

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