Technology of the Generations and its Effects on Mental Health

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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STS Research Paper

Introduction

Over the past few decades, technology has advanced at a rapid rate. To put this into context, the word wide web became public less than 30 years ago. In 1992, the first Smartphone was developed and put onto the market. The first iPhone was released in 2007 and began changing the way we spent our time and completed everyday tasks. However, different social groups did not adopt these technologies the same way due to the ages of each group upon release, which caused both distinct societal effects as well as different physical differences on the brain. Other changing trends are prominent in society today, like the increase in psychological stress over the last decade, specifically for individuals aged 12 through 29. It would make sense to claim that these individuals may experience more stress during these ages due to education, job markets, and other external economic factors of our time, it is important to note that there has been a general upward trend in psychological distress for individuals who were born starting around 1985 (Twenge et al., 2019). With these increasing trends, it is crucial to determine the cause and improve the diagnosis and treatment options for mental illness. The central question for exploration is how different social groups have adopted internet-capable handheld devices and the respective effects on their mental health.

STS framework

Analysis will be performed through the Social Construction of technology (SCOT) framework. The Social Construction of technology argues that human actions shape technology and thus would propose that the development and advancements of internet-capable devices was

caused by the public's perception of such technology. The key concepts of SCOT include relevant social groups, interpretive flexibility, and stabilization. The relevant social groups are the users or producers of the technology. Interpretive flexibility holds that these different stakeholders have different interpretations and meanings of the technology. Stabilization is reached when one solution or group prevails over the others.

This study will explore how the relevant social groups make sense of the technology, and implications of the adoption of the technology by each social group. It will also discuss the inability for stabilization to be reached, at least for now. The social groups will be grouped by age generations, namely millennials and Generation Z. While there is no absolute date range for generations, millennials will be defined as being born between 1981 and 1996. In 2021, this would make millennials between the ages of 25 and 40. Generation Z will be defined as being born between 1997 and 2012, making them between the ages of 9 and 24.

Adoption by Different Social Groups

An important aspect in analyzing how the mental health of different social groups is affected by internet-capable handheld technology is to focus on how these groups make meaning of it. In SCOT, this is known as interpretive flexibility. This technology became relevant in society at different stages in people's lives and thus was adopted differently. Firstly, the meaning of this technology for millennials will be analyzed.

Millennials grew up alongside the internet. The oldest of this generation experienced the rise of the internet in their pre-teens, and many had access to computers in elementary school ("Benefits Strategies for Millennials in the Workplace", 2020). However, not many millennials

had access to computers and the internet outside of school. As seen in Table 1, computers were not a common item among households before the 2000s ("U.S. Households with Computers and Internet Use, 1984–2014", n.d.).

Table 1

Percent of Households with Computers and Internet

Year	% Household with Computer	% Household with Internet
1993	22.8	
2000	51	41.5
2007	69.7	61.7

The oldest of the millennials would have been 19 in 2000, meaning access to the internet through computers still was not widely available through their teenage years and start of adulthood. The 2000 census even states that for children ages 3 to 17, which is around the extremes of the generation, the internet was being used mostly for emails and school-related projects (Newburger, 2001). Internet-capable technologies were not yet being used for more than improving the efficiency of everyday tasks; they had not yet offered sweeping social changes to the way people communicated or spent their time.

Unlike millennials, Gen Z was born into an age of technology. With the release of the first iPhone in 2007, the oldest of the generation was age 10, while the oldest of the millennials was age 26. Looking at Table 1, both household access to computers and the internet increased substantially after 1993. With the introduction of handheld internet-capable devices during the childhood of the oldest Gen Z, it is not a sweeping claim to say Generation Z has not known a

life without internet-capable technology. To put this in perspective, a 2018 study found that 95 percent of Gen Z currently has a smartphone and 25% had a smartphone before the age of 10 (Watson, n.d.). An important social group who allows the adoption of these technologies is the parents of Generation Z children. Without the parents buying their children handheld devices like smartphones, the culture around them might not have developed as it did. In a survey of parents who were likely to buy their child a wireless device before age 13, 90% agree that a reason for doing so was to get hold of them easily ("Mobile Kids: The Parent, the Child and the Smartphone", 2017). Some of these parents may be part of the millennial generation, which could explain their willingness to interact with the technology they have seen evolve.

Differing Use

Since millennials and Generation Z grew up with different technologies, analysis will be done on how each social group makes sense of the current technology. For millennials, their earliest forms of social media, namely MySpace and Facebook, were forms or connecting with friends and sharing their life statuses. They did not have many internet platforms available for entertainment. Generation Z, however, primarily uses internet-connected devices as a form of entertainment and a time filler ("Social Media for Every Generation", n.d.). Table 2 shows the top three platforms used weekly by Gen Z and millennials.

Table 2

Top Three Internet Platforms used by Gen Z and Millennials

Platform	% Generation Z Platform Use	% Millennial Platform Use
Facebook	-	87
YouTube	89	86
Instagram	74	71
Snapchat	68	-

The top platforms used by Generation Z follow with the group's main use of internet-connected devices being for media and entertainment. With millennials typically using technology to stay connected with friends and family, their use of Facebook, compared to Gen Z at 36%, also follows. Another differing use of this technology is that Gen Z typically spends more time on fewer platforms whereas millennials spend less time on more platforms (Cox, 2019). While this may not have the most substantial impact on how technology has been affecting the mental health of its users, it is an interesting note.

Mental Health of Millennials and Generation Z

To attempt to analyze the possible effects of technology on the mental health of millennials and Gen Z, we must first look at the trends in psychological distress and major depressive episodes. In a study of mood disorder indicators, psychological distress between 2008 and 2017 generally rose among most age groups, with the largest increase among 20 to 21 year olds. While this makes logical sense in average situational settings for 21 year olds, trends were

found to be most dependent on cohort, rather than time period or age. Cohorts experiencing serious psychological distress were highest among Boomers and Gen Z. There is a consistent increase in distress from the millennial cohort onward, with those born in 1985 at the lowest since 1980 and those born in 1999 at the highest distress. According to the data, the 1999 cohort was 49% more likely than the 1985 cohort to report serious psychological distress with age and time period controlled. The trends are almost identical for major depressive episodes (Twenge et al., 2019). If time and age are not a factor in psychological distress, it is reasonable to assume that the cause is from other social factors.

However, it is difficult to analyze the cause through the Stabilization concept of SCOT, which is the prevailing of one social group in the midst of competing groups. It has been shown that millennials and Generation Z use internet-connected handheld devices for relatively the same tasks, though the frequency of use and time spent on the different platforms available differ between the two social groups. However, this does not explain why younger generations are experiencing psychological distress at higher rates. The analysis will instead focus on how brain development is affected by technology use, and how this brain development may impact mental health. Although this topic hasn't been widely researched, it has been proposed by medical experts that brains are physically developing differently because of the constant interaction with technology (Zachos, 2015). With the almost constant use of technology by Gen Z during development, there is evidence of many negative side effects, such as poor social skills, anxiety, ADHD, and even depression (Scott et al., 2016).

Brain Development

The human brain is not fully developed until the age twenty-five. The brain develops most rapidly in the first five years of life, and all of the basic structures are formed by age 9. However, the brain continues to develop and form connections until adulthood (Adolescent Brain Development 2019). During this time, environmental factors can have a large influence on the way the brain develops. For example, intense periods of stress can weaken the architecture of the brain, which damages the neural connections (Teen Brain Development 2018). These alterations to development can have negative effects on the fully developed brain. It is interesting to note that the prefrontal cortex, which is responsible for decision-making, emotional reactions, and focusing, among other functions, is also the last part of the brain to develop. As a result, adolescent brains use the amygdala to take charge of most of these functions. The amygdala is responsible for gut reactions and has an increased role in the emotions and aggressions of adolescents (Teen Brain Development 2018). This explains the general mood patterns of teenagers, and cannot be overlooked in analysis of potential impacts of technology since mood patterns and actual mental disorders are sometimes difficult to separate.

In order to analyze how technology can affect the mental health of the different social groups, it is crucial to understand how the technology affects developing brains versus fully developed brains. Analysis will be done on how the different social groups literally make sense of the technology by discussing the effects on brain development and structure. Developing brains reflect the Generation Z cohort, and fully developed brains reflect the millennial cohort.

Technology Effects on the Developing Brain

The developing brain is the most susceptible to environmental influences. During adolescence, the brain's development is at the "critical period" where any major disturbances to regular development could cause permanent impacts later in life (Lockhart, Sawa, & Niwa, 2018). Such disturbances could come from excessive use of internet-capable devices.

A study was completed that found a link between increased screen time for children and lower white matter integrity in the brain, which is associated with cognitive function. The study included forty-seven children aged 3 to 5 years who had no history of neurodevelopmental disorders. An assessment of language, literacy, and rapid naming was given to the children before their MRI, which focuses on memory retrieval and execution. A ScreenQ assessment was also given, which measures composite measure of screen-based media use for children. A score between zero and twenty-six was given to each child, with higher scores indicating screens usage above the American Academy of Pediatrics recommendations. A correlation was found between higher ScreenQ scores and lower integrity of white matter tracts in the brain (Hutton et al., 2020). While this study has limitations in its size and methodology, it gives credibility to the idea of screen-based technologies negatively affecting the developing brain.

Other studies have shown loss in white matter from excessive internet use that compromise connections within and between hemispheres. The loss of integrity has also been shown to affect paths between cognitive and emotional parts of the brain. These impairments to neural paths can cause signals to slow down, or even misfire (Dunckley, 2014). Reduced cortical thickness has also been proven for teenages who are "addicted" to the internet and gaming (Dunckley, 2014). Cortical thickness is indicative of cognitive abilities, thus it could be inferred that excessive internet use reduces the cognition of adolescents and could have lasting impacts.

On a more qualitative analysis, other research suggests that developing brains depend on four factors, namely movement, touch, human connection, and exposure to nature. With increasing use of internet-capable devices, many parts of the brain are understimulated, while visual and auditory systems are overstimulated. This imbalance causes changes in development and brain networks to be altered or impaired (Rowan, 2017). While this field is still fairly new and not extensively researched, studies have been conducted to prove the negative effects of technology use on developing brains, which can have many future implications.

Technology Effects on Developed Brains

The majority of brain development occurs in the first few years of life, but brain plasticity, or experience-dependent change, allows for continued changes in brain structure throughout life. This means that the constant use of internet-capable devices by millennials has the potential to have negative effects.

As previously mentioned, millennials tend to use media to connect with friends and family, and research has shown a correlation between the size of these social networks and the brain structure of developed brains. Specifically, network size is correlated with an increase in gray matter in part of the amygdala that affects emotions, memory, and fear conditioning. This finding is consistent with other research that suggests an increase in gray matter occurs to support social networks (Gottschalk, 2019). However, it is unclear whether this study sees an increase in gray matter as a positive or negative effect. Previous research has explored the effects of excess gray matter in teenagers and have found it to cause chaotic thought patterns as there are too many connections within the brain. With age, gray matter decreases to allow the brain to

work more efficiently (Hill, 2010). If adults are seeing an increase due to internet and media use, this could negatively impact their brain's functions.

Other studies have shown atrophy in gray matter due to excessive internet use. This loss was found in the frontal lobe, where executive functions occur, as well as in the striatum which controls reward pathways and impulse control (Dunckley, 2014). The constant use could also shrink the outermost part of the brain and atrophy the frontal lobe, reducing functionality even if very slight (Zachos, 2015). Both an increase and decrease in gray matter in adults seems to have negative impacts. Thus it would not be a stretch to conclude that any significant, unexpected changes in brain structure due to technology in fully developed brains could be detrimental to cognitive function and emotional regulation.

Brain Development and Mental Illness

Normal brain maturation trends show a linear increase in white matter and a pre-adolescent increase and post-adolescent decrease in cortical gray matter. There is also a selective pruning of synapses during adolescents since there is an overabundance in younger brains (Giedd et al., 1999). Disruptions to the brain during "critical" development by environmental factors could have future implications on the brain's functions (Gottschalk, 2019). This could explain why excessive use in young children has the potential to affect the mental health of teenagers, as well as an increased use in teenagers subsequently affecting their mental health into early adulthood. It would also explain why the millennial cohort has less mental distress, since they did not have the same technological disruptions during significant brain development.

It is known that mental illness can result from environmental factors. To analyze the potential impact of internet-capable devices on mental disorders, brain structures will be discussed. A study was conducted that analyzed nearly 200 structural brain imaging studies, involving over 7,000 people with schizophrenia, bipolar disorder, depression, addiction, obsessive-compulsive disorder, or anxiety, as well as 8,500 healthy individuals. Through all of the data, correlations were found between mental disorders and a loss of gray matter in certain parts of the brain that deal with executive functioning (Lewis, 2015). However, it is unclear whether the areas where gray matter was affected by excessive technology use overlap or affect the areas where gray matter was found to be reduced in brains with mental disorders. The studies discussed cover different parts of the brain, but functionalities do overlap between the two. It is a step in the right direction to discuss this possibility, but further studies would be needed to make a valid conclusion.

Reduction in synapses has also been studied with regard to mental illness. For example, a study on schizophrenia concluded that changes in the brain structure of someone with schizophrenia were due to a significant reduction in synapses. The age of onset for schizophrenia is the highest in adolescence and young adulthood, resulting from when synaptic connections are critically low. In early childhood, onset can occur from abnormally high pruning (McGlashan & Hoffman, 2000). As previously discussed, technology use can reduce these synapses, thus at a time where the brain is rapidly developing, excessive technology use could potentially cause the synaptic connections to be critically low. This would account for the Generation Z cohort to be experiencing more mental distress, as negative effects could result in other disorders.

The connection between mental illness development and excessive technology use seems to be supported by existing research, but correlation does not infer causation, so more research is

needed to make a just conclusion on technological effects on different types of mental disorders and the potential severity.

Conclusion

The negative effects of handheld internet capable devices on mental health has been minimally researched, yet its importance should be noted. Through interpretive flexibility, the ways in which Generation Z and millennials utilize the technology and its respective effects on their brains can infer how the technology affects their mental health. Since this technology is both utilized differently and affects the brain differently between the two groups, stabilization has not yet been reached. It will take an additional generation of adolescents to grow up using the technology to compare against Generation Z and potentially reach stabilization. Even then, technology is rapidly advancing, so any major developments may impact a new generation differently. In any case, researchers still need to focus on the current and future effects so that if the effects are significantly detrimental, society is aware of the implications. An extensive scientific approach could impact the way society views the technology and result in its use being changed. Specifically, it could result in parents limiting the time and ways their children spend using handheld internet devices. It could also impact the education system, which has been changing to incorporate more technology into learning. This does not seem likely though, as companies who profit from educational tools do not have mental health in mind, and there is no clear link on classroom technologies negatively impacting the brain. So does this really all come down to the parent enforcing good habits? Like educational tools, companies selling gaming systems and other internet-capable devices are incentivized by profit, not mental health. Unless these technologies develop to create usage limits or ways to encourage users to take breaks, too

much responsibility will be forced onto the user. The connection between worsening mental health in younger generations and the increased utilization of handheld internet capable devices is a growing concern, and it should not be ignored by any stakeholder.

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