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PSYCHOLOGY

Keeping our heads

Fears over the effects of digital technologies on people's mental well-being are forcing social-media companies to change, even if the evidence remains sketchy.

BY SIMON MAKIN

In his 1909 short story *The Machine Stops*, E. M. Forster imagined a future in which people live in isolation underground, their needs serviced by an all-powerful 'machine'. Human activity consists mainly of remote communication — face-to-face interaction is frowned upon. Ultimately, the title of the story plays out: the machine stops, civilization collapses, and the future of humanity is left to the surface-dwellers who avoided dependency.

The story has been lauded not only for its prescient imagining of something like our hyperconnected Internet age, but also for its insights into the human impact of an all-powerful technology. We are now starting to grapple with similar questions. What do we lose when we cede autonomy to technology? Are we becoming dependent on it? And what is digital technology doing to our minds?

According to Ofcom, the UK regulatory body for telecommunications, 78% of the UK population, and 95% of those aged 16–24, own a smartphone. On average, people check their phones every 12 minutes, and one in five adults spends more than 40 hours per week online. Most of this rise in connectivity has occurred in the past decade, making it one of the fastest changes society has experienced. Smartphones, social media, video games and screen time in general have been accused of impairing memory, attention and reading, and making us less sociable, civil and empathetic. To counter growing public pressure, the corporate giants driving the revolution are moving to mitigate harm and manage addiction.

But some researchers say that any negative associations are small and that causal evidence is lacking — indeed, many studies have found positive effects. In the absence of clear evidence, battle lines are being drawn.

REASONS TO BE FEARFUL

Digital technology has been blamed for a multitude of nasty effects, from mental-health problems to a decline in cognitive faculties. Naomi Baron, who studies language at the American University in Washington DC, believes there are costs associated with the shift to reading on screens — not in ability, but in the way we approach reading. "To what extent does the medium shape our expectations of how we're supposed to read?" she asks. Some studies have found that people reading printed words are better able to recall specific details, or reconstruct the plot of a story, than those reading on a screen. The physicality and organization of printed material account for part of the difference.

Even more important, Baron argues, is the way that digital environments encourage a shallower engagement with written material. People approach digital content with a lower level of commitment than they do printed text: they skim, multitask and flit from one item to the next. "It's the amount of concentration we believe digital media warrant," Baron says. She is coordinating an international project to disseminate findings to educators and administrators, and to develop strategies to optimize reading in any medium.

Some fear that the digital environment is shortening attention spans — certainly, diagnoses of attention-deficit hyperactivity disorder (ADHD) have become more common in recent decades. It has been shown that the mere presence of a smartphone lowers performance on cognitive tasks, presumably because mental resources are tied up by the effort required to ignore the phone. The quality of

face-to-face interactions has similarly been shown to decline around digital devices.

So far, these results seem to be temporary: leave your phone in another room and it all goes away. But some researchers believe that the multitasking encouraged by digital technology might have lasting effects on attention. One study[1] compared the performance of light and heavy multitaskers in attention-control tasks. It found that heavy multitaskers were less able to filter out distractions, and fared worse on task-switching tests. This effect is open to dispute. Some subsequent studies have confirmed the finding, but others failed to reproduce it — and some even linked heavy multitasking with improvements in attention.

Larry Rosen, a psychologist at California State University Dominguez Hills in Carson, believes that ubiquitous connectivity is causing anxiety. "The typical young adult has an active presence on six sites," he says. "That takes a lot of time and effort" — and this has social costs. "We're a bit like automatons, acting like we have to respond immediately." Rosen thinks that 'phantom pocket vibration', in which people perceive non-existent notifications from their smartphones, is rooted in these stresses. In a 2014 study[2], Rosen and colleagues showed that university students prevented from using their phones for an hour experienced greater anxiety the longer they were away from their devices. The increases were larger in individuals who usually used their mobile devices for longer.

Memory is also the subject of some concern, fuelled by the concept of the 'Google effect' — the idea that people are less likely to recall information if they think they can look it up later. However, this behaviour is an example of a well-known, adaptive use of mental resources called transactive memory, which is also seen in teams where people do not try to remember information that a colleague already has. A 2015 study[3] showed that saving the contents of a file improved recall for the contents of a second file, implying that offloading information frees up cognitive resources. The effect of digital technology in these cases might be to supplement memory, rather than impair it.
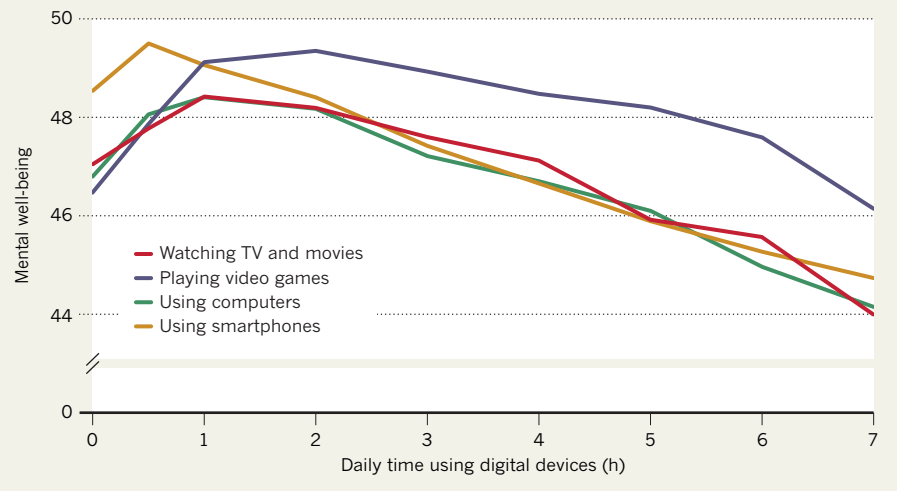
But there is one aspect of our well-being for which nearly all researchers agree that technology has a pernicious effect: sleep. Studies in sleep labs have found differences in sleep between people reading on paper and on screens before bed, says Candice Odgers, a psychologist at the University of California, Irvine. "It's pretty clear from experimental work that sleep is disrupted and displaced due to mobile-phone use," she says. "That's important for a host of reasons, especially for kids."

THE KIDS ARE ALL RIGHT
The group considered most at risk of harm from digital technology is adolescents. There has been a clear rise in the time that teenagers spend online, and their still-developing brains may make them especially vulnerable. They

EVERYTHING IN MODERATION

Moderate engagement with devices such as computers and smartphones has been found not to decrease the well-being of adolescents[5]. More than 5 hours using some devices on weekdays was associated with a decline in well-being, but the effect was small (about two points on a scale from 14 to 70). A little screen time was associated with greater well-being than none at all, but again the effect was small.

are also exquisitely sensitive to social signals, as they learn to forge connections and establish an identity. Comparing the rate of mental-health diagnoses in today's adolescents with those in previous generations is complicated by changes in definitions and a greater willingness to report mental-health problems. Even so, some differences are apparent. "You can question reports of symptoms, but it's clear there's been an increase in suicide," says Odgers. "This is particularly true for young women."

Efforts to find out whether digital technology is to blame have yielded inconclusive results. A 2017 study[4] led by Jean Twenge, a psychologist at San Diego State University in California, found correlations between increases in depressive symptoms, suicidal behaviours and suicide rates among US adolescents with increased screen time. But the effect was tiny, explaining less than 0.5% of girls' depressive symptoms, with nothing statistically significant for boys. It was also just a correlation. "Kids are spending more time online, but the association between that and negative behaviours is very small, and it's just as likely, if not more likely, that it's the other way around," says Odgers.

Odgers and her colleagues studied associations between the real-world and online experiences of thousands of adolescents, and found that online and offline behaviours often cannot be separated. "Kids who are already struggling offline are most likely to exhibit these negative associations with online usage," she says. "The online world is unlikely to be the cause." They might be online more as a way of coping with mental-health problems, for instance by connecting more with others.

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There is evidence that digitally mediated communication is beneficial. For adolescents, social media is more likely to have a positive, rather than negative, effect on how they feel. And teens who report the lowest levels of social and emotional well-being are also more likely to report that social media has a positive effect. "Kids who spend the most time connected, chatting with others, also tend to have the best relationships offline," says Odgers.

Odgers thinks the evidence suggests that concern over the health effects of digital technology is just the latest in a long line of unwarranted moral panics. "The phone is an easy target," she says. Risks might be present for those with existing vulnerabilities, she argues, "but this blanket narrative that digital devices and time online is damaging to mental health and cognition is just not supported yet."

Much of the research on the impact of digital technologies suffers from limitations or flaws, such as problems finding appropriate control groups. "It's difficult to find comparisons of kids who aren't on these devices," Odgers says.

One prominent critic of studies in this field offers a broader assessment. "A lot of the science is unreliable," says Andrew Przybylski, a psychologist at the Oxford Internet Institute, UK. Any computer code used in studies and all of the data that are collected need to be open, he says. And researchers need to avoid hypothesizing after results are already known. "This is highly problematic if you want to draw robust statistical inferences."

In 2017, Przybylski published a large study that collected data on both the time spent using digital devices and the mental well-being of about 120,000 adolescents[5]. The study took pains to address common flaws. For example, it was pre-registered — a step that stops researchers altering course midway, or changing the story once the results are in. Moreover,

Tristan Harris argues that tech companies target basic human emotions to gain people's attention.

code and data were openly shared. The study also distinguished between smartphones, computers, video games, and TV and movies, as well as between weekday and weekend time — an attempt to break away from the implausible idea that all screen time is equal, whether it is talking to your aunt on video chat or playing a game on your phone.

The results showed that spending only a few hours a day using digital devices was associated with slightly better well-being than none at all. Only after longer periods was well-being diminished, and even this difference was small (see 'Everything in moderation'). The findings fit with Przybylski's 'Goldilocks' hypothesis that 'just right' amounts of screen time might in fact be beneficial in today's wired world.

But these are still just correlations. "There are things that are very different about a kid who spends one hour a day online and seven hours," Odgers says.

The question of whether digital technology is altering neural development has been hard to answer because relevant brain-imaging data are sparse. But the Adolescent Brain Cognitive Development (ABCD) study will change that. Involving 21 research sites across the United States, it is the largest ever longitudinal study of adolescent brain development and health to use brain imaging, recruiting some 11,500 children aged 9–10. Researchers will track their development over ten years, assessing their physical and mental health, cognition and behaviour, including digital-media habits. The study protocols and all the data will be openly available.

An initial analysis has suggested a mix of positive and negative associations between screen time and development. Social media emerged as being better for well-being than general Internet use, TV and gaming. Brain imaging will be conducted every two years, so any links between the use of digital technology and brain development over time remain to be revealed.

THE TECH GIANTS AWAKE

In December 2017, in response to public concern about Facebook's impact on well-being, the company launched features that allow users to temporarily hide a person, page or group, or to 'take a break' from recent exes. A month later, Facebook announced changes to the news feed that were meant to promote friends, family and groups at the expense of content from brands and media, on the basis of research suggesting that passive scrolling is bad for us, whereas connecting is good. Facebook then announced that it had invested US$10 million to foster better communities and improve security. And this August, it announced 'digital well-being' tools that allow users to monitor time spent and set limits, and make it easier to mute push notifications.

Apple and Google have since made similar moves, rolling out dashboards for their iOS and Android operating systems that let individuals monitor the time they spend on devices. Users can see how often they pick up their phone, how long they use different apps for, and the number of notifications they receive from each app. There are options to set time limits, and enhanced features for hiding notifications, for example at night. These are certainly welcome moves to some, but it is not clear whether they will improve well-being. "None of this stuff has any empirical evidence behind it," Przybylski says. "They're just doing it because they need to do something, because everybody's making noise."

When Facebook founder Mark Zuckerberg announced the changes to the news feed, he stated a desire to "make sure that Facebook is time well spent". These words were borrowed from a movement started two years earlier by Tristan Harris, a design ethicist at Google who left to form advocacy group Time Well Spent. In a 2017 TED talk that has since amassed more than 2 million views, Harris makes the case that the advertising-based business models of several big tech companies require them to fight to bring people to their platforms as often, and for as long, as possible. He describes this as driving a "race to the bottom of the brain stem" in which the algorithms used by a handful of companies target the most basic human emotions, such as outrage, to gain and hold people's attention.

"The media systems we trust to guide our thoughts and behaviours deliver us ubiquitous, instantaneous rewards, which creates new challenges of self-regulation," says James Williams, a philosopher at the Oxford Internet Institute and a co-founder of Time Well Spent. "The goal of much design is not to

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Williams is ambivalent about the tech giants' recent moves to promote well-being. "It's just a bandage, not the systemic surgery that's ultimately needed," he says. "If the bandage leads to the surgery, fine, but it seems likelier to make the surgery seem unnecessary." He acknowledges the lack of evidence about the effects of digital technology, and is not optimistic that this will change soon. Technology is developing faster than our ability to understand its impacts, he says. But he does not think the lack of evidence should stop us taking action. "It's akin to demanding proof that the adversarial army marching towards you does, in fact, have bullets in their guns before you take some self-preservatory action," he says.

HERE BE DRAGONS

As the debate rages, Odgers is afraid that the focus on the potential for digital devices to harm mental health could lead to more pressing threats from the digital realm being overlooked. "Few meaningful protections are in place to guard children's privacy, and algorithms are increasingly shaping the online world in ways that are unlikely to be helpful for kids," Odgers says. But "there is no solid evidence" that they damage mental health, she adds.

Przybylski also maintains that robust evidence is needed to inform any policy action. He points to the 'Scroll-free September' campaign organized by the Royal Society for Public Health in London to encourage people to take a break from social media. "If you take it seriously, it's a medical intervention, and it's completely untested," he says.

He is working with colleagues on three studies aimed at different issues that plague the field. One is similar to the Goldilocks study but looks at changes over time; another addresses the unreliability of self-reported measures; and the third tackles causality. "Each paper addresses a separate dragon that needs slaying," Przybylski says. Acting prematurely, before the evidence is in, robs us of the opportunity to learn how to properly study the effects of new technologies on our health, he argues. "The next technology is going to come along, and it might actually be dangerous," he says. "So how can we build incremental knowledge that will be informative when the technological floor under us shifts?" ∎

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