Detractors say the always-on digital world is turning kids into screen junkies. Data says it's making them smarter

By **Tom Cheshire**

Illustration: **Josie Jammet**

Early

one morning during the school summer holidays, 52 children aged between nine and 14 are ignoring the Sun outside the classroom, and focusing intently on building spaghetti architecture. The challenge they have been given by Jill Hodges, who runs Fire Tech, a summer technology camp in London, is simple: each group must use string, masking tape and ten sticks of dry spaghetti to construct the tallest free-standing structure that can bear the weight of a marshmallow.

Hodges plays some poppy dubstep to up the tempo – the children's chatter matches it. They start building straight away. Messy, fragile structures rise and tumble. Most of the marshmallows have faces drawn on them. When time's up, there's a clear winner – a tottering, crane-like tower 54 centimetres high, tethered by string at four points, that holds its marshmallow aloft for ten seconds. The ten-minute task earns the children's undivided attention, but doing the same for the rest of the week is tougher. At the briefing

before the first session, Hodges beseeches the kids not to drift off into the digital world when they're supposed to be working: "No IMing, no texting, no *Minecraft* – there will be time for that later," she says. The children spend their free time as Hodges expected: setting up *Minecraft* servers or messaging friends who aren't at the camp. "In the morning they're pretty focused," says Hodges. "Afternoons, the focus lags."

The kids at Fire Tech are self-selectingly tech literate, but even they report feeling overwhelmed by the digital world on their screens. Zena Williams, a 13-year-old from Redbridge who wants to be the creative director of a video-game company, tells WIRED: "The suggestions pile up and you can scroll down for ten minutes." Musa Kazim, nine, says: "I literally can't hear anything when I'm on the computer. I'm just in the zone." Theo Merten Manser, a 16-year-old, says he regularly uses "ten or 12" social networks at the same time. Young people everywhere are reporting similar hyperstimulation. One 15-year-old girl told the authors of the book *Digital Youth: The Role of Media in Development*: "It's intoxicating – you simply feel great... you're the centre of attention... That's the state when everyone is writing till you can't keep up." A study led by Larry Rosen and published in the academic journal *Computers in Human Behavior* last July observed 263 middle-school, high-school and university students in the US. It found that most participants managed to focus for only six minutes on a task before switching to a technological distraction. Rosen and his coauthors suggested that the students engaged with social networks for emotional gratification, before concluding: "The

"HYPERSTIMULATION" is being reported by children everywhere

bottom line is that students want to multitask or task switch and technology encourages them to do so."

Clive Thompson, the author of the recent book *Smarter Than You Think*, says: "One of the big challenges of social media is that it triggers intermittent reinforcement, this well-known psychological mechanism by which whenever we're presented by a system that irregularly rewards us, it's really hard to pull away. Because we're always hitting that bar and hoping there will be a little pellet of food coming out... It's hard for adults. But it's really hard for young people."

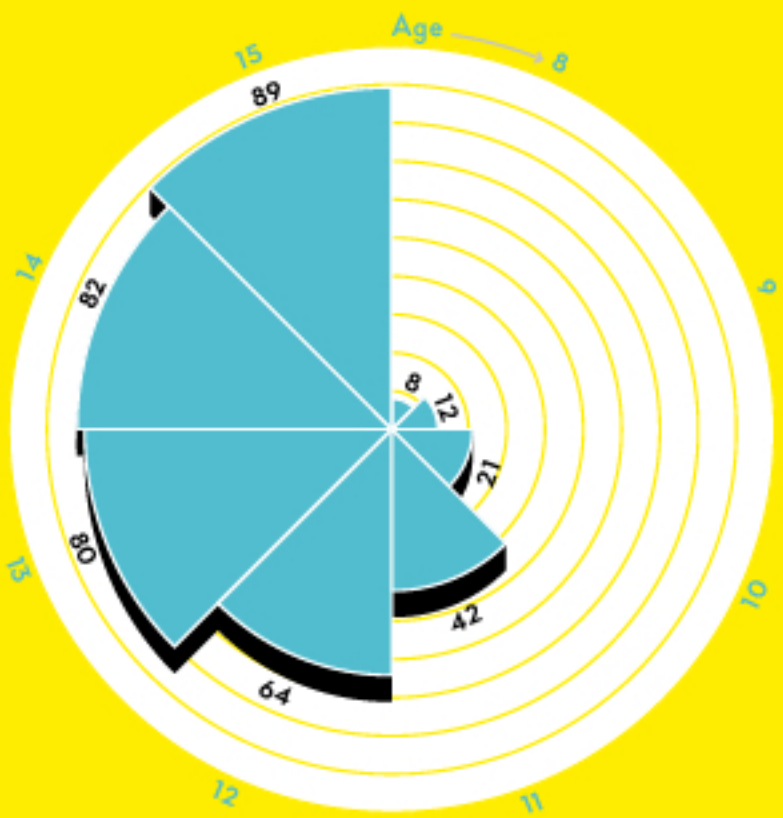
Young people have never faced so many demands on their attention. Two thirds of UK 12- to-15-year-olds now have a smartphone, according to an Ofcom report published late last year – a 50 per cent rise from 2011. More and more, children's time online is spent switching between an array of websites and apps, with new must-haves popping up every month: you've heard of *Snapchat*, what about *Keek*, *Viber* and *Phish*? And, by the time you read this, there will be another half-dozen new arrivals.

According to a Neilsen report published in May 2012, most teenagers use their phones for 18 main activities, from texting to taking photos, skipping between an average of 41 apps. But 65 per cent use their phones for social networking – more than for taking photos or playing games. On average, smartphone owners check their devices 150 times each day – about once every six minutes – according to Tomi Ahonen, who analysed Nokia data. Combine that with screens at home, and young people are packing more media into less time: according to a 2010 survey by the Kaiser Family Foundation, US teenagers

spend seven hours and 38 minutes consuming media. But as they can engage with more than one type of media at the same time – TV, IMing, browsing websites and social networks, texting – they consume ten hours and 45 minutes' worth of content in those seven hours. They also encounter digital media earlier: according to Ofcom, a third of UK three- to-four-year-olds regularly go online. They have smartphones sooner, too: the average life of a smartphone is 21 months, and old phones are handed down through the family; in the UK, a million eight-to-12-year-olds have a smartphone, according to YouGov.

What is hyperstimulation doing to the brains of these children? Surely nothing good: Manfred Spitzer,

UK CHILDREN WHO USE THE INTERNET
by age in 2012, percentage



Source: Ofcom, "Children and Parents: media uses and attitudes report", 2012

a German neuroscientist, calls it "digital dementia". According to him, a generation is voluntarily lobotomising itself with digital hyperstimulation, reposting Tumblrs until catatonia comes. This year, Susan Greenfield, a neuroscientist, sounded the alarm (again): "Already we are seeing a generation of 20-somethings still living at home, wearing onesies, perhaps playing games with simplified values of all-good or all-evil, and/or craving the constant attention of others through social-networking sites... The speed required for reaction and the reduced time for reflection might mean that those reactions and evaluations themselves are becoming increasingly superficial."

Others are more measured. Nicholas Carr, the author of *The Shallows: What the Internet is Doing to Our Brains*, says: "The problem isn't with particular services or sites... It's being sucked up into this fast-paced world, lots of stimulation, lots of information coming at you all the time, but no time to stop and think, and to develop the capacity to be attentive. The first 20 years of your life are when your brain is changing the most and forming the fundamental circuitry you're going to carry through the rest of your life. So any positive or negative effects are going to be more pronounced for younger people." Specifically, the problem is multitasking, which in fact does not exist: humans are only able to pay proper attention to one task; "multitasking" actually means rapidly switching attention between tasks, which has a cost because we spend a lot of mental effort on the switch, rather than the task itself. "By multitasking frequently, we are shaping our brain to be better prepared to rapidly toggle between tasks," says Jordan Grafman, a cognitive

neuroscientist at the US National Institutes of Health. "However, the cost is that brain processes devoted to deeper thinking and deliberation are less reinforced and thereby become less developed... If you have a young child who has an iPad, you know what I mean."

But beyond gut feeling and an ability to tickle headline writers (eg "Facebook Home could change our brains", the title of Greenfield's April 2013 article in *The Daily Telegraph*), there's little research to support such dire warnings. As yet, there are no studies linking onesie-wearing to multitasking; there has been lots of research on television and video-games, but little on always-on social networking. Peter Etchells, an experimental psychologist at the University of Bristol, says: "Anyone who does any research in neuroscience or psychology knows that everything changes the brain – that's the foundation of how we learn." (This article will change your brain.) "Saying that using Facebook is changing our brains – of course it is. It's not interesting to say that. It's interesting to go beyond that simplistic argument and say what's going on – are there good points or bad points? People like Greenfield have not produced any data on this." As Grafman says: "Clearly we need to study people exposed to devices

Multitasking has a cost because we spend a lot of mental energy on the switch, rather than the task itself

as children, controlling or measuring usage, with outcome variables concerned with real-life accomplishments. I am sure this is coming."

It is. Although the evidence is scattered and only just emerging, a number of researchers around the world might be showing the exact opposite: that technology is making children more sociable, more expressive and more creative. And, although children are certainly more digitally distracted than ever, they are much better than adults at dealing with this disturbance. Mizuko Ito, a California-based cultural anthropologist and author of *Hanging Out, Messing Around, and Geeking Out: Kids Living and Learning with New Media*, is surveying more than 1,000 children and interviewing several hundred. "Young people have had to grapple with the realities of distraction from an early age so, by necessity, they have developed strategies for coping," she says. Rebecca Eynon, a researcher at Oxford University and the author of the book *Teenagers and Technology*, published by Routledge in November 2012, says: "They are developing a lot of techniques. They're very aware of what each of those tools does for them, what it's most appropriate for and who they can reach on that particular medium. They're flexible in being able to mix those things to meet their own needs."

The evidence suggests that technology can distract them, but it also means – in the right environment and with the right techniques – it could be making them smarter. Rather than decrying kids' digital dependence (because it isn't going away, ever), a handful of researchers and thinkers are figuring out how it is altering them for the better.

Toys

fill the shelves and litter the floor in a small room in the University of Sussex. One is a large PLAYMOBIL fort, an experimental interactive version developed with the Swiss Federal Institute of Technology in Zurich. A researcher waddles a dragon around it: when the RFID chip embedded in the figure is near another, the dragon roars. She walks a king to the top of his castle and he proclaims, "I am the king!" A servant places beside the king says, "Good day, Your Majesty."

The PLAYMOBIL set is a research tool for Nicola Yuill, head of the Chat Lab, a research unit specialising in children and technology that is part of the university's psychology department. Yuill has found that the technology attached to the toy, far from being a distraction, engages children's attention and makes them more co-operative. Children were also much more creative and sophisticated in the narratives they assigned to the figures and castle. Collaboration requires successful bids for attention – and Yuill found

that technology helped this. Other research she has conducted shows that children playing picture consequences (I draw a monstrous head, fold the paper to hide it, you draw the torso, and so on) are more creative when they do so on an iPad, compared to drawing on paper. Her current research looks at how well autistic children perform joint tasks on iPad. "People fear that children are addicted, that they can't keep from being distracted," Yuill says. "I think we put that worry on to children. But they have strategies."

Some of those strategies tend towards multitasking, which children are learning ever younger. Lydia Plowman is a professor in education and technology at the University of Edinburgh. Earlier this year, she studied how pre-school children interact with dual screens such as an iPad and a TV. "Based on our very small sample, we had the feeling that operationally children can do this kind of flipping. My guess is teens would be able to do it more rapidly and intuitively than these young children, but the adults not used to multitasking would not find it any easier." As part of a large study of how children learn with technology and toys at home, Plowman spent time with more than 50 three- and four-year-olds with their families, getting to know them well. "At three years old, Colin was already a proficient photographer when we visited his family. With help from his mother, he was learning to store and retrieve digital photos and, with his five-year-old sister, was communicating with relatives in Australia by sending them photographs and messages containing emoticons (as neither child could write at this stage) and using a webcam for video calls." Colin was communi-

cating with relatives he had never physically met, before he had mastered the technical demands of written language. He is better connected, and more sociable, than any generation before him. Plowman notes: "With support, digital media can... provide new possibilities for the development of children's communicative skills. This suggests that, used thoughtfully, technology can enhance rather than hinder social interaction."

'Kids prefer text-messaging to phone calls because it is easier to text when it's in the background of conducting other activities'

What happens when technology is not used thoughtfully, when children – especially teenagers, left to their own (smartphone) devices – do not get the right support? As Carr puts it, "The screen homogenises life." Michael Rich, a paediatrician at Harvard Medical School's Center on Media and Child Health, says that "Screens override natural attention spans: screens are able to keep regrabbing attention. What it doesn't do is give kids the abilityto look at something, figure it out at their own pace and synthesise what's going on."

The research to date suggests human beings are not good at dealing with data bombardment. A key 2009 study by Stanford researchers Eyal Ophir, Clifford Nass and Anthony Wagner found that those who are heavy media multitaskers – which, according to other studies, necessarily includes teenagers

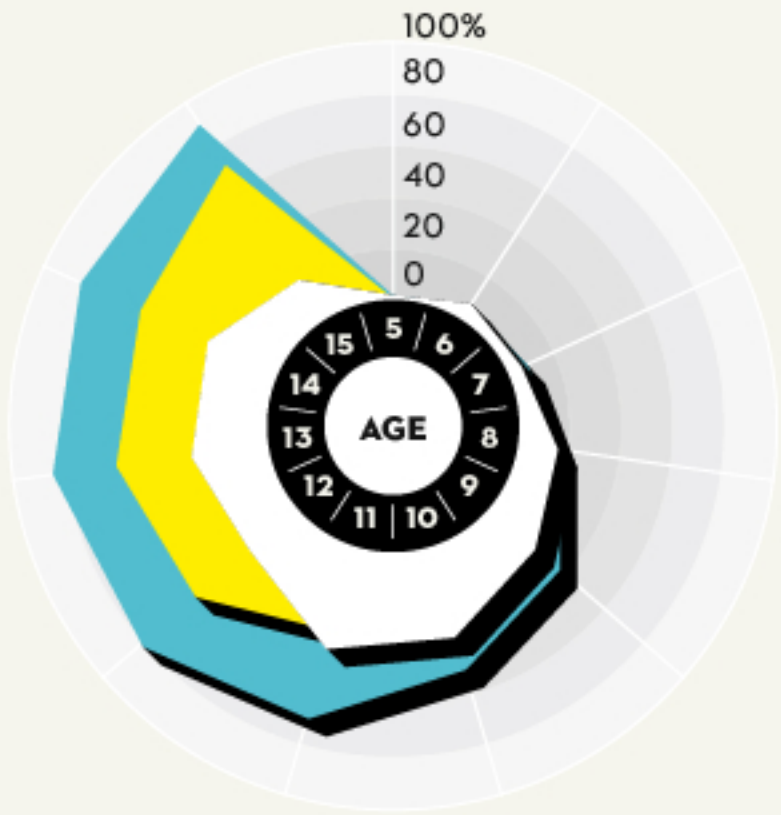
– "are distracted by the multiple streams of media they are consuming". Those who multitasked a lot were not only worse at maintaining focus, they were worse at multitasking, too. Heavy multitaskers weren't good at "exploiting" information, instead having a bias towards "exploratory information processing". Other studies have shown that multitaskers make more mistakes and are worse at remembering information learned during multitasking. Dimitri Christakis, director of the Center for Child Health, Behavior and Development at Seattle Children's Hospital, last year studied what happens to mice bombarded by media. His hyperstimulated mice suffered "deficits in cognition and attention" – the first study to show this direct link. The question is, as Jay Giedd, a neuroscientist at the US National Institute for Mental Health, in the *Journal of Adolescent Health* in August 2012, put it: "Will the availability of technologies that can persistently keep dopamine levels so high raise the threshold for what our brains deem rewarding in terms of relationships, studying, or working toward other long-term goals that may not have immediate reinforcements?" Another 2012 study by Harvard researchers found that disclosing information about oneself activates the same sensation of pleasure as the brain experiences from eating food or having sex; some participants even forwent money for the chance to talk about themselves. According to the paper, more than 80 per cent of social media consists of announcements about oneself (compared to 30-40 per cent of human speech): teenagers – those renowned narcissists – don't stand a chance.

even ones who watch YouTube videos all day long, are not children, though. There is little research that has been conducted on exactly how technology is affecting teenagers' attention. More recent studies suggest it isn't as bad as commentators such as Susan Greenfield thought. And it could even be good.

First off, even in a multitasking, always-on, digitally demented world, it actually looks as if children are getting smarter: not just at short-form, creative exercises, but more rigorous academic thought. Andrea Lunsford, a researcher at Stanford University, has compared essays written by first-year university students in 2006 with their equivalents in 1986, 1930 and 1917. The number of spelling and grammar mistakes made by students didn't change over nearly a century. But Lunsford found that students' writing had grown much more sophisticated, "tackling issues that require investigation as well as reflection." This wasn't in spite of pervasive digital media and demands

on their attention – it was because of it. Lunsford found 40 per cent of all writing today happens outside the classroom. Teenagers write more than any generation before – on text, IM and Twitter. A report published late last year by Common Sense Media found 71 per cent of 685 US teachers surveyed thought pupils' attentions spans had been "mainly hurt" by digital media. In the same report, though, more teachers than not said students were getting better at maths, science, reading and verbal communication. Digital tools also let kids nurture specific skills earlier, as Thompson argues in *Smarter Than You Think*. Before computers, it was very rare for teenagers to become a chess grandmaster: when Bobby Fischer did

UK MOBILE-PHONE OWNERSHIP
by age in 2012



Source: Ofcom, "Children and Parents: media uses and attitudes report", 2012

it in 1958, he was a wonder of the world. It took until 1991 for Fischer's record to be beaten. Since then, with affordable computing and networked players, that record has fallen 20 times. Thompson tells WIRED: "If there are ways to help them learn, iterate and think, you can open these quite remarkable flourishings of critical thought at much younger ages than would have been possible when I was young."

There's hope for multitasking too. The 2009 Ophir paper ended with a caveat: "It remains possible that future tests of high-order cognition will uncover benefits, other than cognitive control, of heavy media multitasking," it stated – and others are uncovering them. A 2010 paper found some people can multitask effectively: about two per cent of the UK's population have no problem simultaneously talking on the phone and driving. The authors called them "supertaskers".

Last year Kelvin Lui, a psychologist at the Chinese University of Hong Kong, set out to find if there were any benefits to multitasking. Previous studies had used multiple streams of similar information. Lui deployed audio and visual information sources and found that heavy multitaskers were better at dealing with this multisensory information: "Situations like this may be more representative of what happens in real life," he wrote. Lui is trying to develop a new measurement that can differentiate types of multitasking: "I would like to include some qualitative questions in the measurement... The multitaskers' frequency of switching between media, whether they pay 'active attention' to the media, etc," he says. Lui thinks that multitaskers who have to switch frequently between tasks will be at a disadvantage. "However, if the situation requires

people to distribute their attention to all tasks concurrently, media multitaskers may be superior due to their breadth-biased cognitive control."

This is how teenagers tend to encounter the digital world: not switching between tasks, but as chefs keeping pots cooking on a hob, checking each one as and when. They use the internet in an exploratory way. It's also easy to imagine that teenagers, multitasking from an early age, are more likely to be supertaskers – though, of course, not all are. But even if not supertaskers, those who have grown up with the web seem to have developed strategies to order demands on their attention in a hierarchical flux. Teenagers are great at constantly ranking their priorities because the asynchronous technologies they like – texting, Tumblr – let them. "My son will be playing an online game with a book in his lap," Izuko explains. "He switches attention to the book while the game is in a lull or loading a new game, and then he will switch his attention back to the screen when the game starts back up. This kind of attention switching is very different from being interrupted by, for example, a phone call... Since it isn't under his control, it interrupts his focus. One reason why kids prefer text messaging to phone calls is that it is easier to text in the background of other activities and to manage multiple attention streams."

What's important is not that teenagers use smartphones, but how they use them. Over the last four years Marion Underwood, a researcher at Texas University, has collected every IM, text and email sent by 175 teenagers (around 500,000 messages per month). She is sifting the data, but told *Forbes* that so far she can see no correlation between the number of

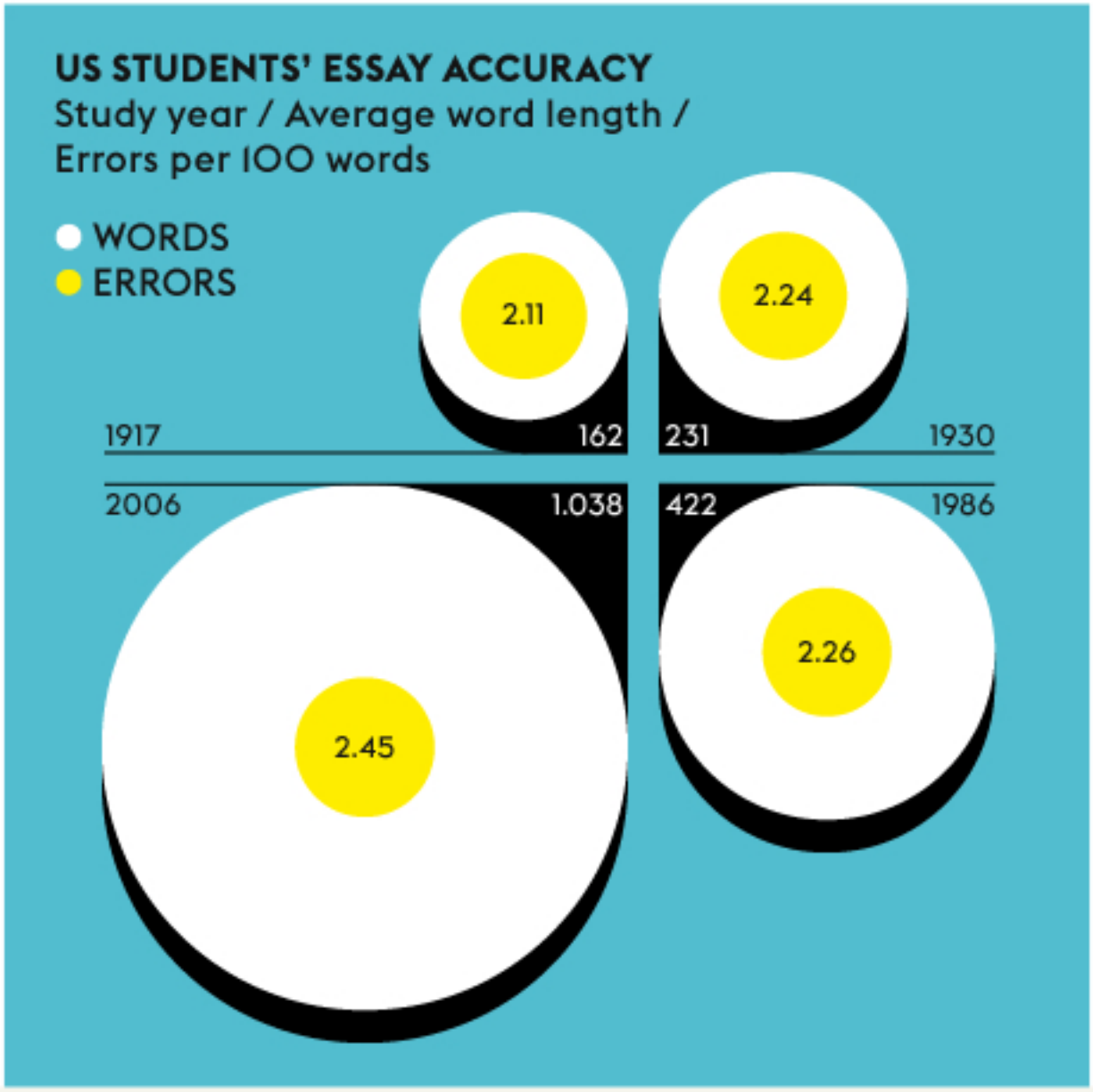
messages a teenager sends and behavioural problems; what matters is the content of the message. A study – now under review – by Reynol Junco, a psychologist at the Youth and Media lab at Harvard University, found that, although first-year college students' academic performance deteriorated when multitasking on social networks, the same was not true for second-years and above: "They're developing skills to deal with that," he says. Danah Boyd, a researcher at Microsoft, identifies "super log-offs" – where teenagers deactivate their Facebook account instead of just logging off, and whitewalling, where users delete a Facebook comment or post after they've read it – as strategies for managing networked life.

Thompson reports a conversation with a teenager: "He said, 'We've all started disabling the constant alerts on our phones and computers, so that we're trying to say we enjoy using these forms of awareness and connection, but we don't want them pecking at us all day.' And that's exactly the sort of healthy adaptation that comes from realising you're overloaded." And the tools most popular with teenagers – *Snapchat*, *Instagram*, *Vine* – require a degree of thoughtfulness, expression and creativity less apparent in the services they're shying away from, such as Facebook.

"If I'm doing something really important, I'll put myself offline everywhere," Zena Williams tells WIRED. "Then I'll speak later. It's just a means of communication." Eleven-year-old Alexander Leonce Weekes says, "I don't normally get distracted. If I'm on my computer and I'm doing something and someone Skypes me, I'll normally log off straight away." They're aware of where their attention is. "We have

an ability to go between things and, I dunno, that's where it's going to go in the future," says Marley Gibbons-Balfour, 16. "But too much of it is a bad thing – you've got to step back sometimes and think about how much time you're spending on it."

"Older people, I'm not trying to say I don't get them, but because they've been in their own time and they don't have this stuff, they don't get us," says Jamie Holloway, a 12-year-old who lives in south London. "Everyone's saying that kids can't concentrate at school because they spend half the night on Facebook or stuff like chatting on the internet with friends. But I don't think so. If the world is just going to stay like this, what's going to happen in the future? The world's



Source: Andrea Lunsford, Stanford, 2006

going to become more like this. It's not going to back into Victorian times and have wooden cars and stuff."

This attention-switching, well suited to now, will be even better suited to the future. A report by the Pew Internet Project in February last year asked 1,021 (adult) technology experts and critics how suited the younger generation would be to the world in 2020. "The essential skills will be those of rapidly searching, browsing and assessing the vast quantities of information," responded Jonathan Grudin at Microsoft Research. "The ability to read one thing and think hard about it for hours will not be of no consequence, but it will be of far less consequence for most." The workplace increasingly rewards those with a bottom-up exploratory attention and the rapid attention switching performed by teens in particular.

Different situations have always called for different types of attention: compare driving to reading a book, both of which require very specific types of attention. The modern default calls for fast attention switching. "I don't think having one's attention in multiple places is necessarily a bad thing," says Howard Rheingold, a former editor of the *Whole Earth Review*, visiting lecturer in communications at Stanford University and the author of *Net Smart: How To Thrive Online*. "I think it's somewhat of an adaptation to the world we live in. If you think about your great grandparents, they probably didn't have to worry about getting run over by automobiles, and people now have to pay attention in traffic. So, as the world changes, our attentional needs change... Young people are good at switching. But being facile at moving doesn't tell you when to move and what to move to."

Here's

where adults come in: helping with those moves. "It means figuring out how to encourage kids to spend time Facebooking and texting and everything, but also making sure you have that time when you're not gazing at a screen – you're practising those more attentive forms of thinking," Carr says.

People like Rheingold, Rich, Yuill, Rosen and Plowman are all trying. Rich is leading a study of 800 adolescents' multitasking and how it affects impulse control and attention. Each subject carries a smartphone and is pinged with questions: where are you? What are you doing? What are you paying the most attention to? The teenager then shoots a 360° panorama on HD video "to pick up things they're not even conscious of", says Rich, who also has some routines that can improve teenage mindfulness: no-screen meal times, parents putting away their own phones and letting teenagers fill up 24-hour plans of their activity, to teach prioritisation more actively. "We're not saying

pitch them out the window," says Rich. "Let's make mindful choices about what we're going to use and when." Larry Rosen says that his lab is focusing "on understanding what this constant drive to task-switch does to the brain and helping people recognise the limitations and learn skills to help them focus better." Alex Soojung-Kim Pang, the author of *The Distraction Addiction*, calls this "contemplative computing".

Rheingold has been trialling mindfulness or metacognition techniques on his students. "Fifteen- to 16-year-olds share different habits with their technology," he says. "We could use that to their advantage by helping them be more aware of what they're doing. Metacognition is about being aware of all the tools in your mental toolbox, and using the appropriate one at the right moment." Ito agrees: "We should focus on ways of helping kids develop strategies to manage attention." It wouldn't be hard to do, either. "This is something that schools should teach," Thompson says. "You could easily put this in the curriculum. Learning to deal with social media – they're chasing it out of schools, but that's exactly where they should have kids interacting with social media."

We need to stop scaremongering about technology, not just because it's wrong, but because it's harmful. In another 2013 study, published in *Computers in Human Behavior*, Reynol Junco found that young people in the US overestimated the time they spent online by a factor of five: on average, they spent 26 minutes a day on Facebook, but reported spending 145 minutes. "Society is telling them it's bad, and they're accepting it. That's not how to raise a generation. We're making youth feel bad about a normal part of their lives."

We shouldn't. Nor should kids have to come up with attention strategies on their own. Instead, we need to help children develop those skills. Thompson mentions Heidi Siwak, who is a primary-school teacher in Ontario. She gets her class involved in day-long Twitter projects, where, for example, they'll debate a book on the Holocaust with people around the world. "You can only do it if your school lets you use Facebook and Twitter in school," says Thompson. "What Heidi is doing is superb and a model for how you can do this. There's inertia at an institutional level. But there are a thousand flowers blooming at a classroom level. And that's the fun stuff to watch."

'There is inertia at an institutional level, but flowers are blooming in classrooms'

Put digital technologies at the heart of education in ways that fit how children use digital media, so that they understand how to use them best. Sound research needs to support this. Hyperstimulation is changing kids' development: we need to find out how, and how we can use it to supercharge them. With their plastic, adaptive brains and a digitally immersed upbringing, they could be the smartest, most creative, best-connected generation yet. Let's help.

Tom Cheshire wrote about Thomas Heatherwick in WIRED *10.13. His first book,* The Explorer Gene *(Short Books), is out now*