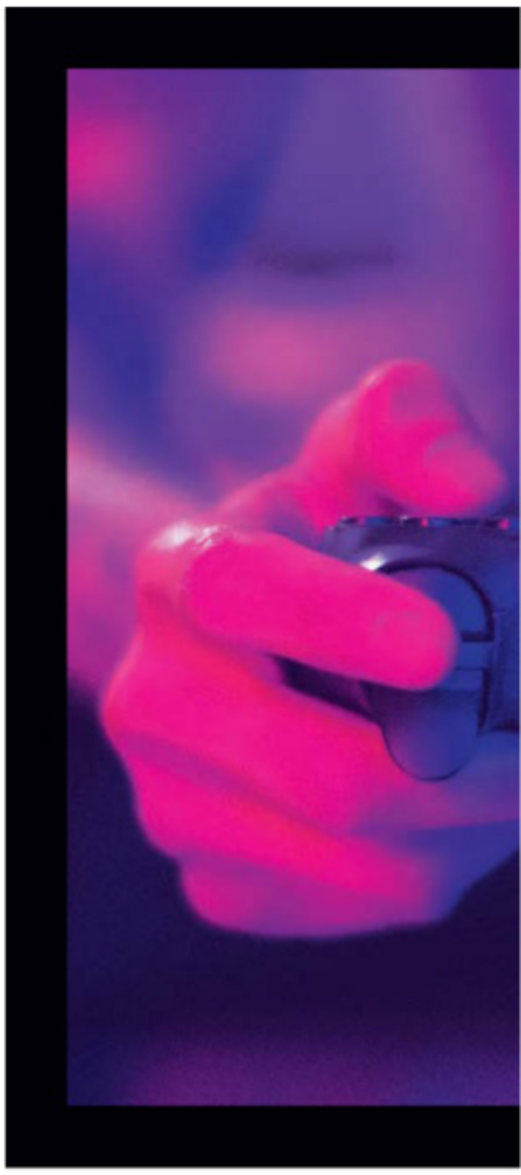
Is it really addiction?

A diagnosis that used to be for substance abuse now controversially spans all sorts of behaviours. **Moya Sarner** digs into the science



MARCO PIUNTI/GETTY

IAN used to play online video games through the night and into the next day. Over eight years, he lost his job, his home and his family. "I would have told you I loved my children more than anything – and I do love my children very dearly – but the truth is I loved the feeling of going online more," he says. "It made me feel settled, it was a way to cope and it was a physical craving."

For Ian and others like him, video games feel as addictive as a drug. In May, the World Health Organization (WHO) reached a similar conclusion, including gaming disorder in its International Classification of Diseases for the first time. Studies suggest that between 0.3 and 1 per cent of the general population might qualify for a diagnosis. In the UK, plans are under way to open the first National Health Service-funded internet addiction centre, which will initially focus on gaming disorder.

But some argue that to pathologise problematic gaming as an addiction is a mistake. In 2017, a group of 24 academics argued against attributing this behaviour to a new disorder. "Of particular concern are moral panics around the harms of video gaming," they wrote, which have been seen in the fears around games like *Fortnite*. Such hysteria, the group argued, could lead to premature or incorrect diagnoses.

Others simply claim that addiction to gaming, and to other behaviours such as sex, isn't real, and that suggesting it is trivialises the issue of addiction or lets people off the hook for their actions.

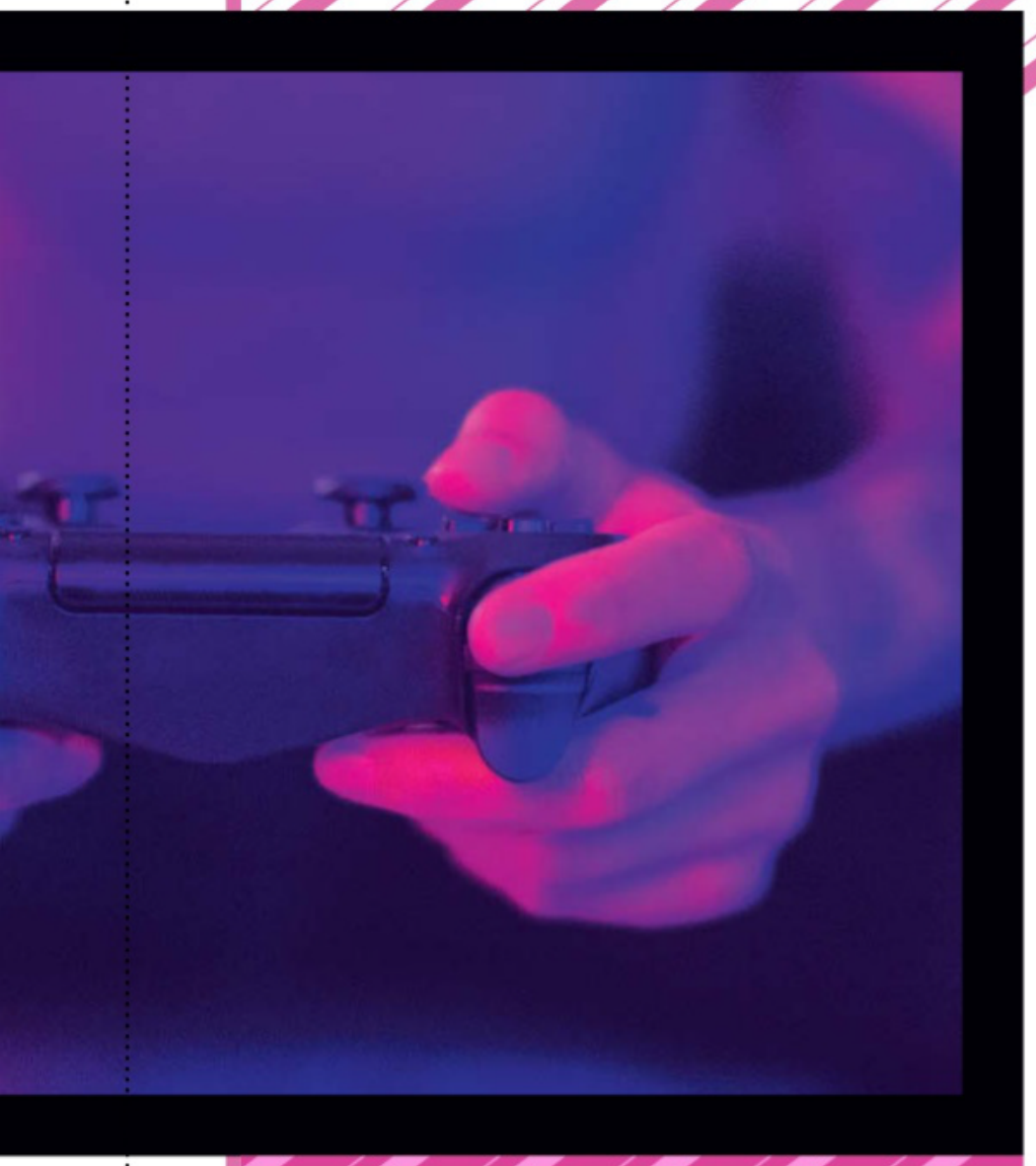
It isn't surprising that this is a complex issue when you consider that even professionals can't agree on a definition of addiction. "If you speak to 50 psychologists, we'll all give you a completely different answer," says Mark Griffiths, director of the International Gaming Research Unit at Nottingham Trent University, UK.

One way to carve up addictions is whether they relate to substances or behaviours. Take cigarettes. Louise was smoking 60 a day when she was 15 years old and she has repeatedly tried to stop. "I absolutely hate the taste and smell of cigarettes, but I still smoke," she says. For many people, nicotine takes such a strong hold over the brain that you don't even need to enjoy smoking to keep doing it.

This kind of substance addiction originally formed the basis of addiction research, which is relatively new. "There was no neuroscience of addiction 50 years ago," says Barry Everitt, a behavioural neuroscientist at the University of Cambridge. Then in the 1960s and 70s, pioneering studies identified the primary targets of addictive drugs within the brain: the dopamine system, also known as the reward pathways. The greater the surge of the neurotransmitter dopamine triggered by the substance, the more euphoric the high.

This discovery spurred a number of possible explanations of addiction. Some researchers ›

"The worse life got, the more I would retreat into that online world"



HOOKED ON video games

Half-Life **was the game-changer for Ian*. He had played video games since he was a child, but he had always been able to stop until he was in his 20s. That was when he went to a colleague's house after work and first tried *Half-Life*, a first-person shooter game, played online against other people. "I felt an instant attraction to it, and I fell in love with these sorts of games," he says.**

He started playing for a few hours at home every night after work, staying up later and later. Within the month, he was playing 7 hours every evening during the week, and through the night on weekends. "It started interfering with my family life. I had a child, another one on the way and I wasn't spending any time with my partner," he says. "It must have been horrible for my son to see me sitting in front of the PC not moving. But when I was in the zone, in the game, I didn't think about it."

As a result of his gaming, he started turning up late for work or not at all, and was eventually fired. After that, he says, "I just played pretty much constantly, taking naps from time to time. When I wasn't playing, I was irritable, restless and unhappy, thinking only about getting back online."

He lost not just his job, but his family and his home. "All that happened over the course of eight painful years. Gaming was a massive escape for me, an adrenaline rush, and the worse my life got, the more I would retreat into that online world," he says.

After trying to limit his gaming first by himself and then with the help of a new partner, he decided to get professional help. He spent 28 days in a private rehab clinic run by UK Addiction Treatment Centres, working on trauma he endured in early life. "I had to look at what I was running away from," he says.

He relapsed a few years ago, and spent two months playing all night, but hasn't played a game since. "My life is really quite nice today. I have my partner, my kids, I have a job – I'm free. I'm not chained to that addiction any more."

**Names have been changed to preserve the anonymity of the individuals featured in the case studies in this article.*

CASE STUDY

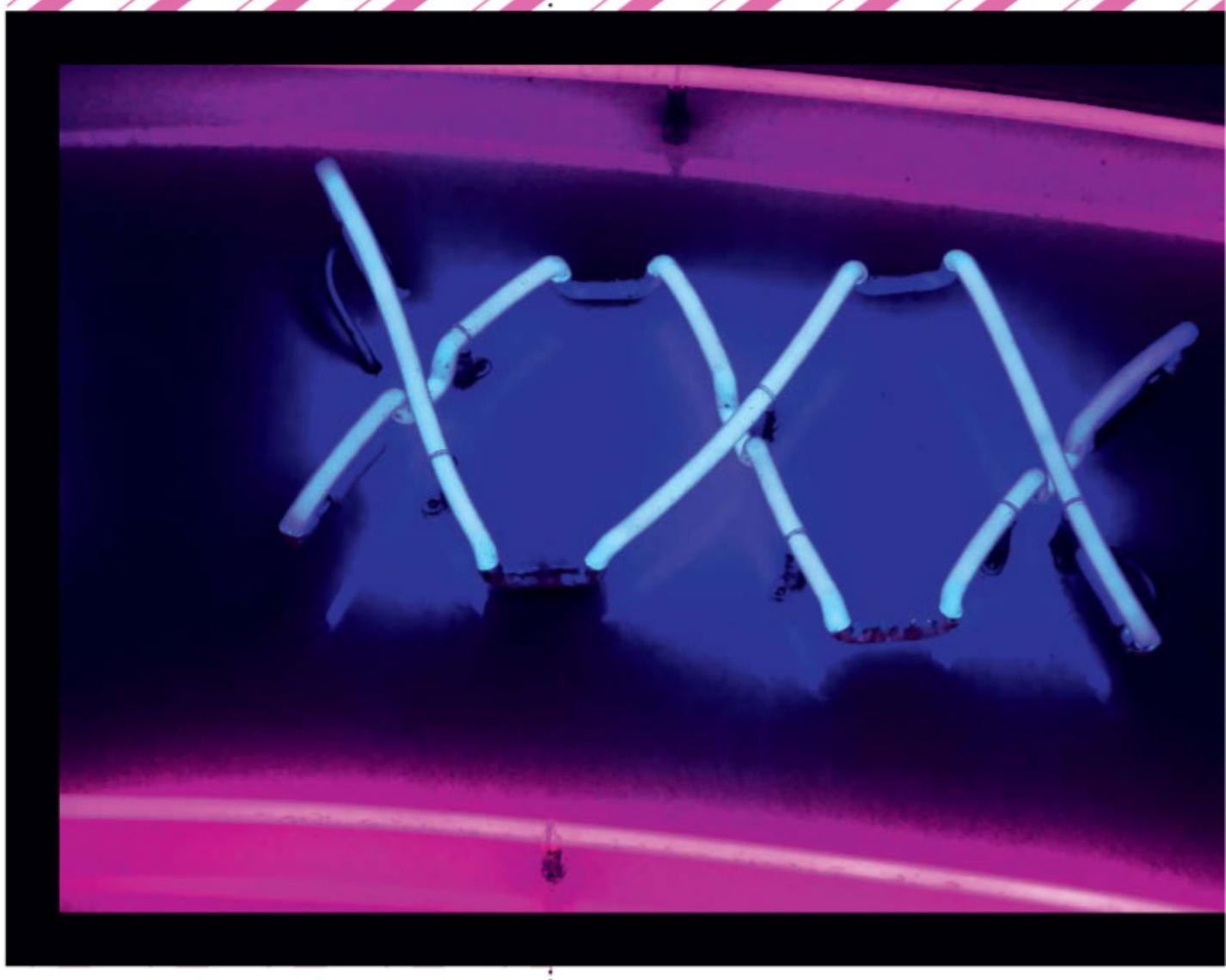
Addicted to pornography

Sam, a successful stockbroker and married father of two, has a life that looks perfect. "From the outside, everybody thinks I'm 'that guy'. I'm always exceeding my targets, winning awards and helping people. But on the inside, I have this shadow that nobody knows about, that I'm so ashamed of. I hate myself. It's a part of me that I cannot resist or control," he says.

Sam can remember the beginnings of obsessive thoughts and behaviours around pornography developing at the age of 12. But it was only in his 20s, when he met his wife and his career took off, that they became problematic. "I remember staying late at the office saying I had work to do, but really I was watching porn on my work computer until midnight, a couple of times a week. Stress, uncertainty and fear at work would be massive triggers for me to reach out to my drug, which was porn," he says.

He soon began "using" four times a week. "I'd wake up next to my wife with anxiety at midnight, sneak downstairs, then binge until 6 am, before getting an hour's sleep and going to work," he recalls. Sometimes he would start shaking at work, "like a drug addict or an alcoholic", he says. Without pornography, he couldn't think or function.

His marriage deteriorated. At times, Sam felt suicidal. About a year ago, his wife found him watching porn in his office, and that was the trigger for Sam to get help. He is now having therapy for pornography addiction at the Laurel Centre in the UK, and is starting to understand the impact that two experiences of sexual assault in his teenage years had on him. "I understand this as a mental illness now," he says. "I know it's not yet considered an addiction, but it most definitely is – no two ways about it – and it is only a matter of time until it is treated like one."



TONY BAGGETT/GETTY

"I have this shadow that nobody knows about, that I'm ashamed of"

believed people became hooked on the pleasurable, rewarding dopamine rush. Others observed that for addicts like Ian and Louise (see case studies on pages 43 and 45), there is little pleasure left. Instead, it could be that regularly hitting up the dopamine system left lasting changes in brain function, so the drug became necessary for a user to feel normal.

It wasn't until the 1990s, with the rise of molecular imaging, known as PET scans, that we could see the impact of drugs on the human brain in real time and watch what happens to the dopamine system.

One major finding was that the prefrontal cortex, where decisions are made, is far quieter in the brains of people who are addicted than in those who aren't. This suggests that their brain function had changed as a result of drug use, says Everitt, leaving them less able to control their own behaviour. Whether an addict uses drugs to attain pleasure or avoid misery, continued use will ultimately depend on the extent to which they are able to control their impulses.

This helps to explain how habits come to form a big part of addiction. For instance,

Compulsive sexual behaviour is now considered a medical disorder

someone may be able to resist their cravings until they visit a place where they normally take a drug or meet a person with whom they do it. "Certain cues and stressors elicit very, very strongly engendered habits and people lapse into compulsive use because they have lost control," says Everitt.

But what about behaviours? The notion that people could become addicted to these found scientific recognition in 1980 when what is now called gambling disorder was first recognised by the Diagnostic and Statistical Manual of Mental Disorders, an influential guide to psychiatric disorders. In 2008, the NHS's only specialist service dealing with this issue opened, the National Problem Gambling Clinic, which sees between 750 and 900 people every year.

Then, in around 2012, the first studies were conducted using PET imaging to look at the dopamine system in people with a gambling addiction. Luke Clark, who is now director of the University of British Columbia's Centre for Gambling Research, and his colleagues found that although drugs have a much more powerful effect on dopamine than gambling, there is some overlap in the surge of this chemical in the brains of those addicted to substances and those addicted to the behaviour.

Clark asked himself what it is about gambling that might allow this behaviour to hijack the brain's reward system in a comparable way to how drugs do it. One answer, he thinks, could be uncertainty.

A reward delivered unpredictably has a far greater effect on the dopamine system than one the brain knows in advance that it will receive. If you know you are about to win £5, when you do, there is little change in the system. But if you know that one in every three goes on a slot machine will win you £5, but you aren't sure which, "the dopamine system goes wild", says Clark.

In both gambling disorder and gaming disorder, the first two behavioural addictions recognised by the WHO, "it's the uncertain nature of the rewards that allows those behaviours to spiral", he says. Near misses amplify that uncertainty – and therefore could make a game particularly addictive.

More recent research into gambling and gaming addiction suggest other factors are at play too. One is the idea of immersion, the heady experience of entering "the zone", a hyper-focused state of flow not unlike a drugs high, where you don't notice time passing and troubling thoughts are kept at bay.

Investigating this phenomenon for one recent study, Clark's team asked psychology students and regular gamblers to play on slot machines in his "casino laboratory" – carpeted and with low lighting and comfortable stools (but no cocktail bar). Participants were told that some white circles and red squares would appear on screens either side of the slot machine while they played. They should ignore the white circles, but press a button whenever they saw a red square.

In the zone

After 30 minutes, participants filled out questionnaires designed to measure their state of immersion by asking them how much they agreed with statements such as "I felt completely absorbed" and "I felt I lost track of time". Those who had previously showed signs of problem gambling were not only more likely to describe themselves as being "in a trance" while playing, but were also worse at reacting to the red squares. The more addicted the players, as measured by the researchers, the less aware they were of their surroundings, and the more immersed in the game they ›

Addicted to cigarettes

The first time Louise smoked a cigarette, she was 10 years old. By the time she was 15, she was up to 60 a day. When she couldn't smoke, she felt agitated and stressed, unable to think of anything else. "I quit school because you weren't allowed to smoke there," she says. "At that time, cigarettes were the most important thing in my life."

The only time she has been unable to smoke was when she was in hospital. "I kept everyone awake on the entire ward, causing chaos. Even though I struggled to walk, I got to the nurses' station and turned the lights on and off, screaming and shouting, until they finally let me out at 5 am. It was ridiculous, disgraceful behaviour, all for a cigarette," she says.

Now aged 26, she still smokes. She doesn't enjoy it, and never has. "I've tried stopping several times. I've never liked cigarettes, nothing appeals to me about them. And now I work in public health, I look like a hypocrite when I smoke. It is against everything I believe in, but I still do it." However, despite her determination to quit, she can't get below 10 cigarettes a day.

PLAINPICTURE/RALF GROSSEK

You can hate the taste of cigarettes and still struggle to kick the habit

The addiction lottery

Somewhere between 15 and 20 per cent of us would develop an addiction if we were exposed to addictive drugs, according to research. "It's a huge minority – one large enough to create one of the greatest public health issues we have on this planet – but it's still a minority," says Markus Heilig at Linköping University in Sweden.

To find out why some people get hooked and others don't, Heilig and his team trained rats to press a lever in return for a reward. They then gave the rats a choice: either press a lever that delivers a few drops of alcohol or one that delivers a sweet solution. About 15 per cent chose alcohol. Rats cannot be labelled as addicted, because it is a complex disorder, perhaps with uniquely human aspects. But they do show behaviours that closely mimic some of the key features of clinical addiction, and the team theorised that the 15 per cent would continue to choose alcohol, even if it led to negative consequences. In the next experiment, every time such a rat pressed the lever delivering alcohol, it received an electric shock. Did it stay hooked to the alcohol despite the painful zap? "The answer, to our delight, was a crystal clear yes," says Heilig, "and that's a first."

Having shown addiction-like behaviours in rats, Heilig wanted to know whether there were differences between the brains of the "hooked" rats and the others, and discovered a striking difference in the amygdala, a key part of the brain for dealing with emotions. Rats that behaved like people with alcohol addiction had an excess of the neurotransmitter GABA there. That, in turn, was probably due to a lack of a chemical called GAT-3, which normally clears out excess GABA.

To see whether a shortage of GAT-3 really could cause addiction, Heilig's team took rats that showed no addiction-like behaviours and lowered the amount of the chemical in their amygdala to the level found in the "hooked" rats. Suddenly, those rats that had previously chosen the sweet solution now compulsively pressed the lever for alcohol, even when given an electric shock.

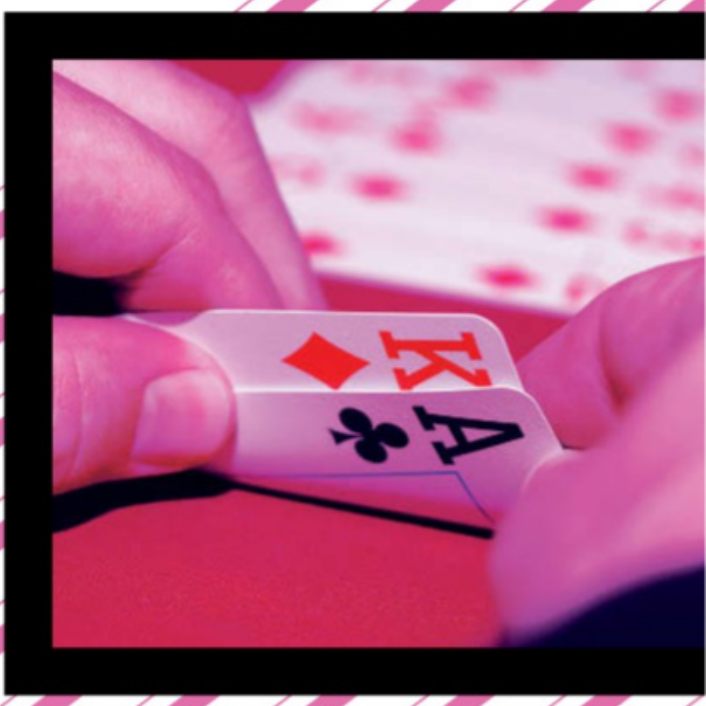
Turning to brains donated by people who had been addicted to alcohol, the team again looked at GAT-3 levels in the amygdala. "It turns out that the picture in human brains is just unbelievably similar to the rats," says Heilig. "We were blown away."

This was a pioneering study in pinpointing why some people are more vulnerable to alcoholism than others, but there are still unanswered questions, including how exactly GABA and the amygdala relate to addiction. And explaining this link is likely to be just one part of the puzzle, says Heilig.

ROLL OF THE DICE

Other factors include genetics and personality. A variant of the *DRD2* gene "is implicated in nearly all addictive behaviour I can think of", says Mark Griffiths at Nottingham Trent University in the UK. "But we also know that people who have this don't necessarily go on to become an addict, and there are also some people who are addicted who do not have it. So genetics and biology only play a contributory part to begin with."

Instead, some people may have an unfortunate combination of genetics and a certain personality type, such as sensation seeking, which together make them susceptible. Findings like these are leading to new approaches for treatments. Heilig's group is working on medications that reduce the production of GABA released by nerve cells in the amygdala. So far this seems to work in the rats.



felt – all of which chimes with Ian's descriptions of gaming. The image of an addict's world shrinking is not just a metaphor; their field of vision literally narrows, until their addiction is all they can see.

Before gambling and gaming disorder were accepted as behavioural addictions by the WHO, they were included under a different category, impulse control disorders. Last June, a new impulse control disorder was added to the list: compulsive sexual behaviour. According to Valerie Voon, a psychiatrist and neuroscientist at the University of Cambridge who researches sex addiction, it is just a matter of time before there is enough evidence for its inclusion in the behavioural addiction category.

She and her colleagues designed a study to see what happens in the brains of possible sex addicts when they watch pornography. Nineteen heterosexual men with a diagnosis of compulsive sexual behaviour and 19 men with no history of addiction were shown pornographic and less sexually arousing videos while having their brain activity scanned using functional MRI.

In earlier studies, when people addicted to substances were exposed to the cue for their addiction, be it cigarettes, alcohol or drugs, brain scans showed activity in three specific regions: the amygdala, the ventral striatum and the anterior cingulate cortex, areas associated with the reward system.

In the study Voon led, there was an increase in activity in those same three regions in the brains of the participants with signs of addiction to sex when they watched the pornographic videos and not in those of the

LEFT: PLAINPICTURE/LIQUID; MIDDLE: PASHAPIXEL/GETTY; RIGHT: PLAINPICTURE/LOHFINK

"Their field of vision literally narrows until their addiction is all they can see"

control group. Other labs have since found similar results.

Sam says he is an addict, and pornography is his drug (see "Addicted to pornography", page 44). And it turns out that substance addictions and would-be behavioural addictions don't just feel similar, they look similar in the brain too.

Griffiths believes that behavioural addictions don't just include gambling, sex and gaming. "Any behaviour could be. I don't care what the behaviour is," he says. The good news is that very few people would be classed as a genuine addict, he says. "The key difference between an excessive healthy enthusiasm and an addiction is that healthy enthusiasms add to life and addictions take away from it."

Significantly, time spent on the behaviour is not a criterion for addiction, he says. One of his most highly cited studies compared two cases, both men who were gaming for up to 14 hours each day. The first was married with three children and a career before he lost everything as a result of his playing. The second had just left university, had no partner or children and went on to meet his wife playing *World of Warcraft*. His time spent gaming decreased as a result, and he now works in the video-game industry. "Computer games were the most important thing in his life, but when he got his first job, the gaming stopped just like that," says Griffiths. "It was quite clearly nothing to do with loss of control or addiction."

Griffiths regularly receives emails from parents who are shocked and worried by the amount of time their children spend playing computer games or on social media. This is the "technological generation gap", he says. If their children still go to school, see friends and have other hobbies, he says, they aren't addicted.

We know that only 15 per cent of people who are exposed to an addictive substance will end up hooked, and what determines whether or not they do is one of the burning questions of addiction research. One suggestion is that it is down to differences in the brain's molecular machinery (see "The addiction lottery", page 46), although genetics and personality also play a part.

And while some people manage to cut out addictive substances from their lives, that isn't always possible for certain behaviours. This is why abstinence isn't always the answer, says psychologist Richard Graham, head of the tech addiction service at Nightingale Hospital in London. He encourages those worried that they are veering towards unhealthy tech habits to use the American Academy of Pediatrics' family media plan, which involves establishing "clean" tech-free zones in the home and technology-free periods every day.

For the individuals affected, the clinicians who treat them and the scientists who study them, addictions are as real as heart disease, just far less understood. And the more we know about them, the more we can do to treat them. "My addiction has taught me that life is very precious," says Ian. "I destroyed a lot of people, including myself." ▮

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