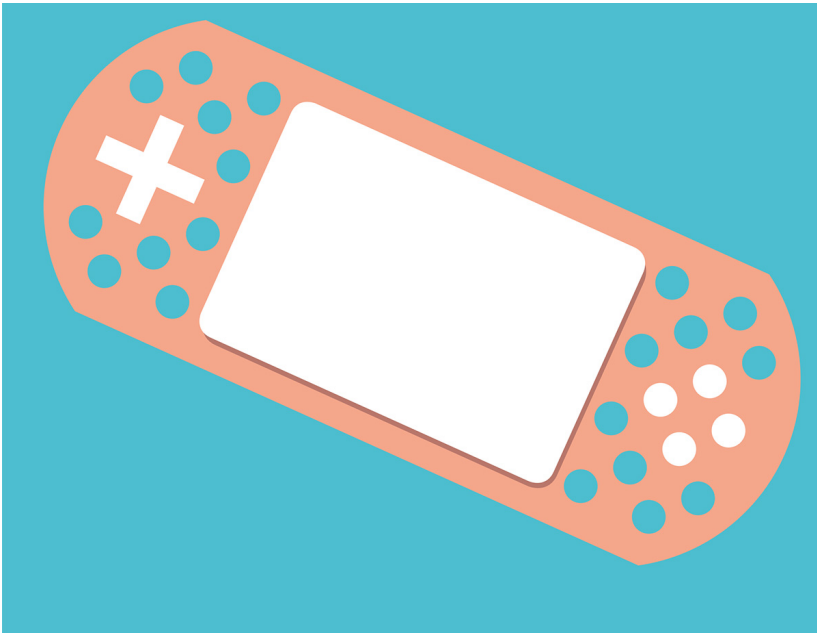## Obsession engineers: Mind control the Candy Crush way

29 May 2014 by Douglas Heaven

Why are we addicted to games? (Image: Patrick George)

How do you design a hit video game? Psychologists are diagnosing what gets us addicted – a recipe for obsession that could hurt or heal us

IN APRIL, a landfill in New Mexico disgorged proof of a decades-old rumour.

The story goes back to 1983, when James Heller was given an unusual job. His bosses at video-game maker Atari wanted him to drive out to the desert with 750,000 copies of their latest game, and bury them there. Over decades the story acquired the status of urban legend, an illustration of the quality of the game in question, ET: The Extraterrestrial. Despite a $21 million outlay, Atari's expected blockbuster was an unmitigated flop, and was later dubbed "The worst game of all time.

Now consider Flappy Bird, a game that, despite having been created by a single developer in a couple of days, became an accidental global obsession. At its peak earlier this year, Flappy Bird was being played by so many people on their phones that Dong Nguyen was making $50,000 a day. "Flappy Bird was designed to play in a few minutes when you are relaxed," he said at the time. But things took a dark turn. People became so obsessed with the game that they showered Nguyen with angry abuse online. In the end it was too much for him. Nguyen withdrew Flappy Bird from public circulation.

It has never been possible to know ahead of time whether your painstakingly crafted game will soar to the heights of Flappy Bird or require desert burial. Game designers relied on a combination of intuition, sheer luck and years of toil - and have often been taken by surprise by the runaway success of their own games. But that's all about to change. Although game science is in its infancy, it is already feeding insights from psychology back into design to produce what looks like very much like a recipe for obsession. It has attracted the attention of interests beyond the gaming industry.

Will they use it to hurt us - or help us?

We have been aware of some basic ingredients of habit-forming games since at least the 1990s. That could explain the similarity of so many popular puzzle games like Tetris, Bejeweled and Puyo Puyo: random shapes appear on a screen that the player must match up with complementary shapes to clear the board and score points.

Rearranging these shapes is undeniably, deeply, satisfying.

But why? The psychological underpinnings have only recently begun to be examined in any detail. Many researchers have suggested that a love of matching patterns taps into a basic human compulsion, giving the same fix we get as an infant pushing shaped blocks into their corresponding holes. "It's hard-wired in our brain to organise things," says Angelica Ortiz de Gortari at Nottingham Trent University, UK.

Perhaps no game has harnessed psychology as deftly as Candy Crush Saga. Its basic construction is familiar: presented with a grid full of colourful "candies", you line up at least three matching sets in a row to meet different targets and progress to subsequent levels. Unlike some other puzzle games, Candy Crush has become an instant, unstoppable juggernaut and a pop culture phenomenon.

Since its introduction two years ago, the game has become the focus of obsessive analysis and sordid confessions. Journalists have openly declared themselves addicts, with more than a few admitting they have paid extravagant sums to play.

They played on the train, at work, at weddings, while driving and during bathroom breaks (according to one anonymous web confessor, when she finally got off the toilet after 4 hours of play, her legs collapsed beneath her).

This is no niche market; no group seems immune to its charms. So what did Candy Crush get so right?

Its designers appear to have hit upon a formula that's beginning to emerge from the academic discipline of game studies as the "ludic loop". Ludic loops are tight, pleasurable feedback loops that stimulate repetitive, if not compulsive, behaviour. "It definitely takes us back to behaviourist psychology," says Natasha Dow Schüll at the Massachusetts Institute of Technology, whose research on games anthropology led her to study this phenomenon in popular gaming.

Her formulation has come largely from her studies of slot machines and their allure to addicts. Slot machines perfectly illustrate the concept of the ludic loop. They lure people into short cycles of repeated actions using tricks familiar to behavioural psychologists: you do something, the machine responds with lights, jingling sounds and occasionally cash rewards. You do it again. And again, and again.

Our affinity for this kind of activity is typically ascribed to dopamine, a brain signalling chemical that has been the source of much confusion about the links between addiction, reward, gambling and gaming. Dopamine was long thought to be a simple reward or pleasure chemical, but the last decade has brought evidence that its action in the brain is in fact much more subtle. It is linked to the compulsion to repeat an activity, whether or not that activity is pleasurable (Behavioral Neuroscience, vol 119, p 5).

That would explain the appeal of slot machines, which beget compulsive behaviour despite offering virtually no chance of a tangible long-term reward. Beneath the obvious blinking lights, Schüll thinks, the real draw of the slot machine - and all ludic loops - is a constant, repetitive switching between certainty and uncertainty. A moment of uncertainty opens up as the symbols whir inexorably toward resolution. When it resolves, "that moment is shut down immediately", Schüll says. "But then you want it again. It's open, close, open, close. Uncertainty and then closure." Pull someone into this pattern and you can keep them repeating small actions over and over, with neither reward nor end in sight.

"There's no goal here, just the pleasure of being in the zone created by this machine," says Schüll. The ludic loop is its own reward.

Granted, makers of slot machines would never admit to soliciting licensed

psychologists to help them make the machines more addictive. Similarly, Candy Crush's developer, King Digital Entertainment of Dublin, Ireland, is more likely to have relied on the expert intuition of game designers and the exhaustive testing of prototypes on sample players. "I doubt any of these designers are sitting around reading behaviourist psychology," says Schüll. "Intentionally or not, "they've hit upon this formula."

So what's Schüll's recipe for a ludic loop? The first ingredient is engineered randomness. Aaron Steed, an independent game developer who has studied Candy Crush closely, thinks that if the algorithm that decides what shapes to drop were truly random we would see more matches than we do. That suggests the game's "randomness" has been fine-tuned to a sweet spot between pure chance and the illusion of control. "You think surely because it's random there'll be something I can solve there. It's what makes gambling games popular in general."

Then there's the jackpot moment. The most satisfying thing that can happen in Candy Crush is when you think you're matching up a single row of sweets, but trigger an unexpected cascade of further matches. "It makes the game freak out," says Jamie Madigan, a psychologist based in St Louis, Missouri, who specialises in games.

Candy crush nation

Like pattern-matching, our response to unexpected rewards is hard-wired. Psychologists have long understood that random windfalls are better at making us compulsively repeat a certain behaviour than predictable ones. This effect, known as the variable-ratio schedule of reinforcement, was demonstrated in the 1950s by behavioural psychologist B. F. Skinner. When his lab rats received unpredictable and occasional rewards for pressing a lever, they would continue pressing that lever long after the rewards stopped coming, says Luke Clark of the University of Cambridge, who specialises in gambling disorders. "Once it's been set up, the conditioning is incredibly persistent."

There's another reason we find variable rewards so compelling: they make us think we are mastering the game. Psychologists have long understood that a sense of mastery at some venture seems to be a powerful motivator, even when we're not actually getting any better at it. Even a fleeting illusion of control puts us in mind of efforts characterised by setbacks and improvements, like tennis or golf. And, Clark says, the cognitive distortion caused by the fuzzy line between skill and luck in Candy Crush is key to engineering this illusion. "You're not really sure if you've caused it," he says.

Stitch together what appear to be random rewards with the illusion that we're somehow earning them, and we're hooked.

Whether or not this precise winning formula was hit upon by accident, Schüll says, it won't stay accidental for much longer, now that it's clear what's to be gained from deliberately engaging the psychology of compulsive play.

King has crushed its competition. At least 500 million people - equivalent to two-thirds of the population of Europe - have downloaded Candy Crush, and 7 million of them play every day. Enough of them pay for the privilege that King's revenue is estimated at about $900,000 per day. But the formula isn't easily copied. Even King hasn't been able to replicate Candy Crush's success.

That could explain why psychologists are at the centre of an industry now springing up to formalise their understanding into design at very early stages of game development. Feeding psychological research back into game development will take the guesswork out of design and yield recipes for making games more compulsive, says Richard Ryan at the University of Rochester, New York. Ryan co-founded Immersyve, a consultancy that advises game studios on how to make their games more engaging, in 2003. "We have developed a lot of metrics so we can measure whether games are hitting a psychological satisfaction mark in people," he says.

They're not the only ones. "You're going to see games companies of all kinds increasingly adding scientists to their teams," says Ramin Shokrizade, an economist at games studio Wargaming America in Austin, Texas, who advises game designers.

What happens when this industry matures? Like Candy Crush, it will probably compel an ever wider net of casual gamers to pay for a game that they could play for nothing - something that has until recently been the purview of specialist gambling apps.

Candy Crush is free, but it requires small payments if you want to extend your stay in the ludic loop. For example, you get five free lives, but each lost life takes half an hour to refresh. Lose five lives in quick succession and you have to wait two-and-a-half hours till you're back with your full complement of lives. Unless... you're willing to pay a small fee, or give up some data through social media. "When you're already immersed, you don't stop and say 'Wait, this dollar would be better spent somewhere else,'" says Shokrizade. As our understanding of the function and motivation of ludic loops has grown, we are seeing more games work this way to squeeze cash out of us. "When games get more effective - and trust me, they're going to get much more effective - we won't be converting just some of the population," he says. "We could be converting 90 per cent."

In light of that, it's not surprising that ludic loops have caught the attention of industries beyond gaming. Bite-size loops can turn dreary tasks into activities many of us will happily snack on whenever we have a spare minute. In 2006 Google hit upon the idea of turning manual image-tagging into a quick-fire game where your input - a word to describe the content of a given image - was quickly

followed by feedback telling you whether it matched the input of a random online collaborator.

Ludic loop mechanisms are also apparent in the success of projects like EyeWire, a collaborative online brain-mapping effort. EyeWire recruits players around the world to do the painstaking work of colour-coding the brain, neuron by neuron. The ludic loop is engaged with frequent feedback. Colour in an area and you immediately learn whether you answered with the majority.

Both EyeWire and Google image-tagging involve tasks that would normally be outsourced to paid workers. But suck your workers into a ludic loop and the labour is free.

That's also appealing to the makers of healthcare self-tracking apps, who have tried desperately to find ways to make logging food intake or other arduous self-monitoring appealing and compulsive. "Often they point to Candy Crush as something good to imitate," says Schüll.

She is concerned that too many people are jumping on a bandwagon that nobody fully understands. "Every time I give a talk, I get dozens of people coming up to me afterwards and asking for these secrets for their particular industry." She has noticed an slight upturn in the number of people who refer to themselves as "behaviour designers", which she says feels a little creepy.

If this is all beginning to sound a bit dystopian, it's not all bad news. Plenty of people are trying to hijack our compulsive tendencies for our own good.

Digital healing

Engaging the ludic loop with interactive media, for example, could make it easier for students to learn. Engaging compulsive mechanisms causes information to get encoded on a deeper level, says Berni Good of Cyber Psychologist, a consultancy in Birmingham, UK, specialising in games psychology. "It goes into long-term memory more readily," she says. The extremely popular game Minecraft - which has also inspired musings about compulsion - has even been used as a teaching aid for subjects as diverse as quantum physics, geology and etiquette.

We might even use the ludic loop to heal, or prevent, psychological damage. Playing Tetris after viewing a traumatic film, for example, was found to reduce the likelihood of flashbacks. The researchers who did the study suggest games that engage compulsive behaviours could be used as a "cognitive vaccine" for post-traumatic stress disorder (PLoS One, vol 5, p e13706).

It's not just people with PTSD who need soothing, though. Shokrizade thinks we all do. "As society gets more stressful, we need more entertainment, in any place, at any time."

Schüll thinks smartphone apps designed around ludic loops act as digital pacifiers, damping down stress. "They turn our phones into mood modulators, little self-medicating devices," she says. She remains unconvinced that turning people into game-addicted zombies is ever justified. When people ask for her help in making their product as compelling as Candy Crush, she tries to encourage them to avoid the baser manipulations of the ludic loop. "Just because these things work doesn't mean you want to imitate them," she says.

But her words are likely to fall on deaf ears: game developers would prefer not have to bury the bodies of their failed games in the desert. And if the ludic loop is a bit of a Pandora's box, it's full of great tricks.

See how video games get you hooked in our gallery: "Eye candy: Video game visuals that hijack your brain"

Douglas Heaven is a feature editor at New Scientist