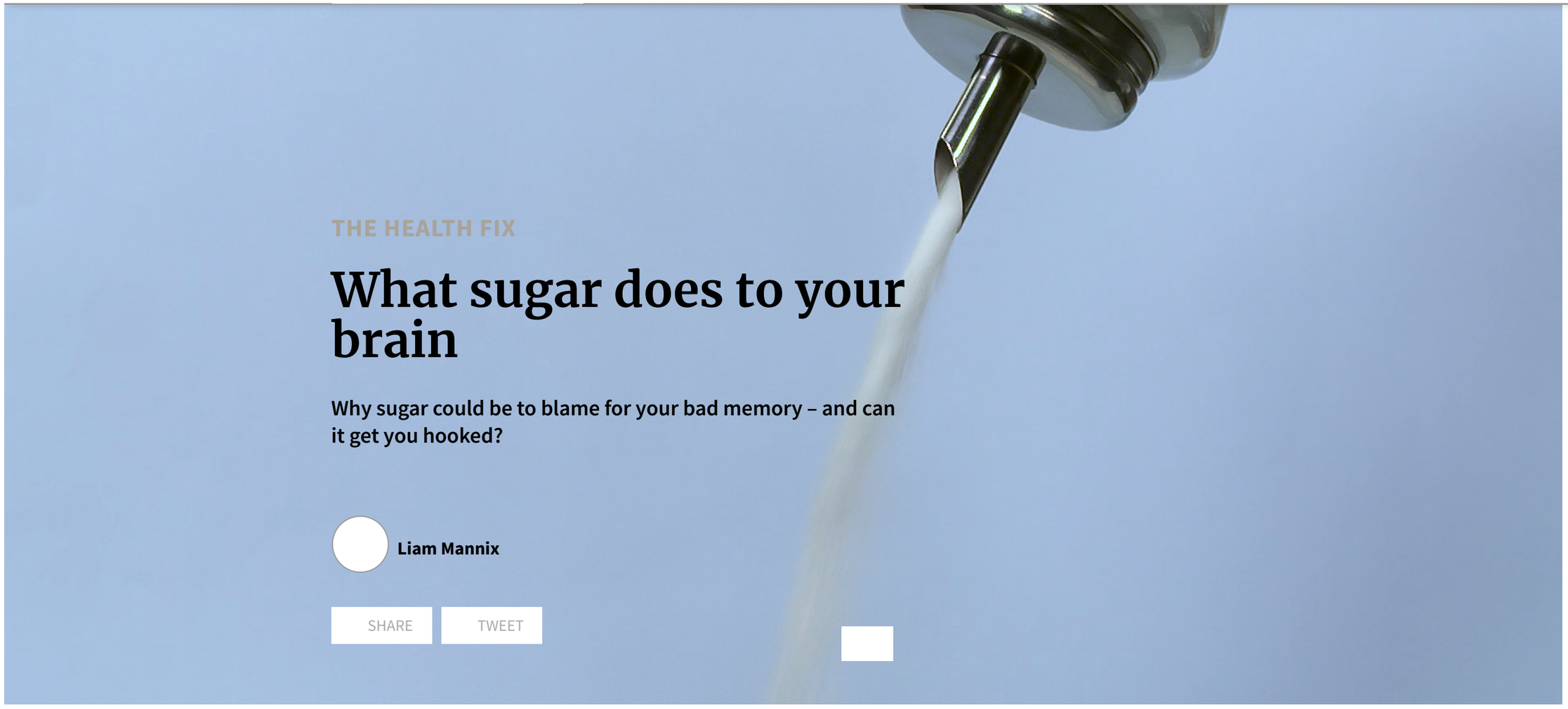


THE HEALTH FIX

What sugar does to your brain

Why sugar could be to blame for your bad memory – and can it get you hooked?

Liam Mannix

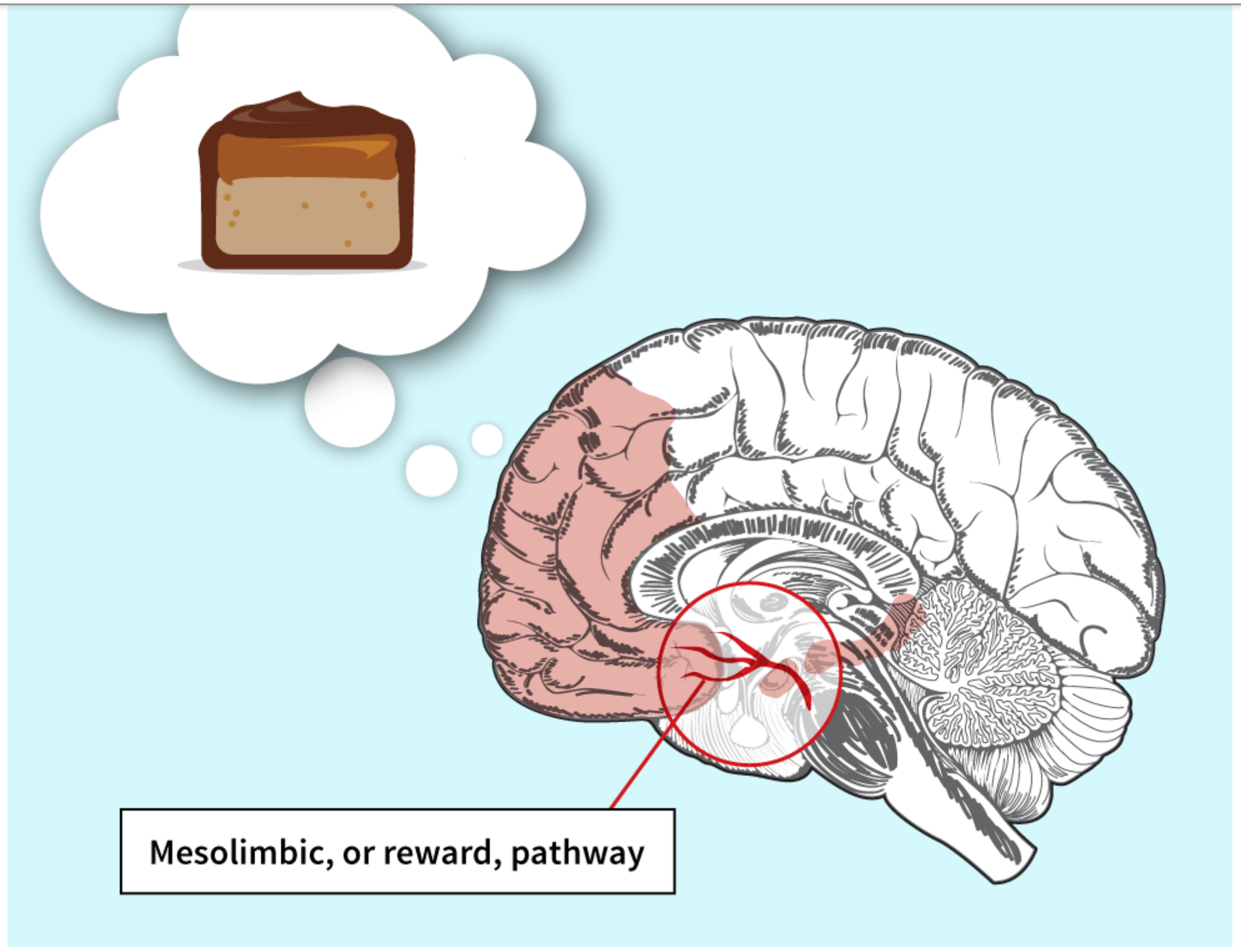
To tell the story of what sugar does to your brain, you have to start with the thought that triggers your need for a hit of sweetness.

It often happens in the afternoon when your brain, which runs on sugar, starts to get hungry.

To satiate the craving your brain activates a string of neurons, often referred to as the reward pathway, which pump the chemical dopamine into your brain.

All of a sudden you need a chocolate bar or that sweet pastry you saw at lunchtime.

If you act on that craving, the reward pathway then switches mode, pumping chemicals such as beta-endorphins into your brain, generating feelings of pleasure.



The part of the brain that senses hunger is also integrated into the rewards system.

Your brain thanks you for the sugar hit by making the chocolate bar literally taste sweeter, says Dr Zane Andrews, a scientist at Monash University who studies how our brains regulate control of our diets.

But if you respond to the brain's need for sugar too often, the reward pathway can develop tolerance to the stimulus.

"That means we need to eat more to get the same feeling. That's a classic feature of addiction," says Dr Andrews.

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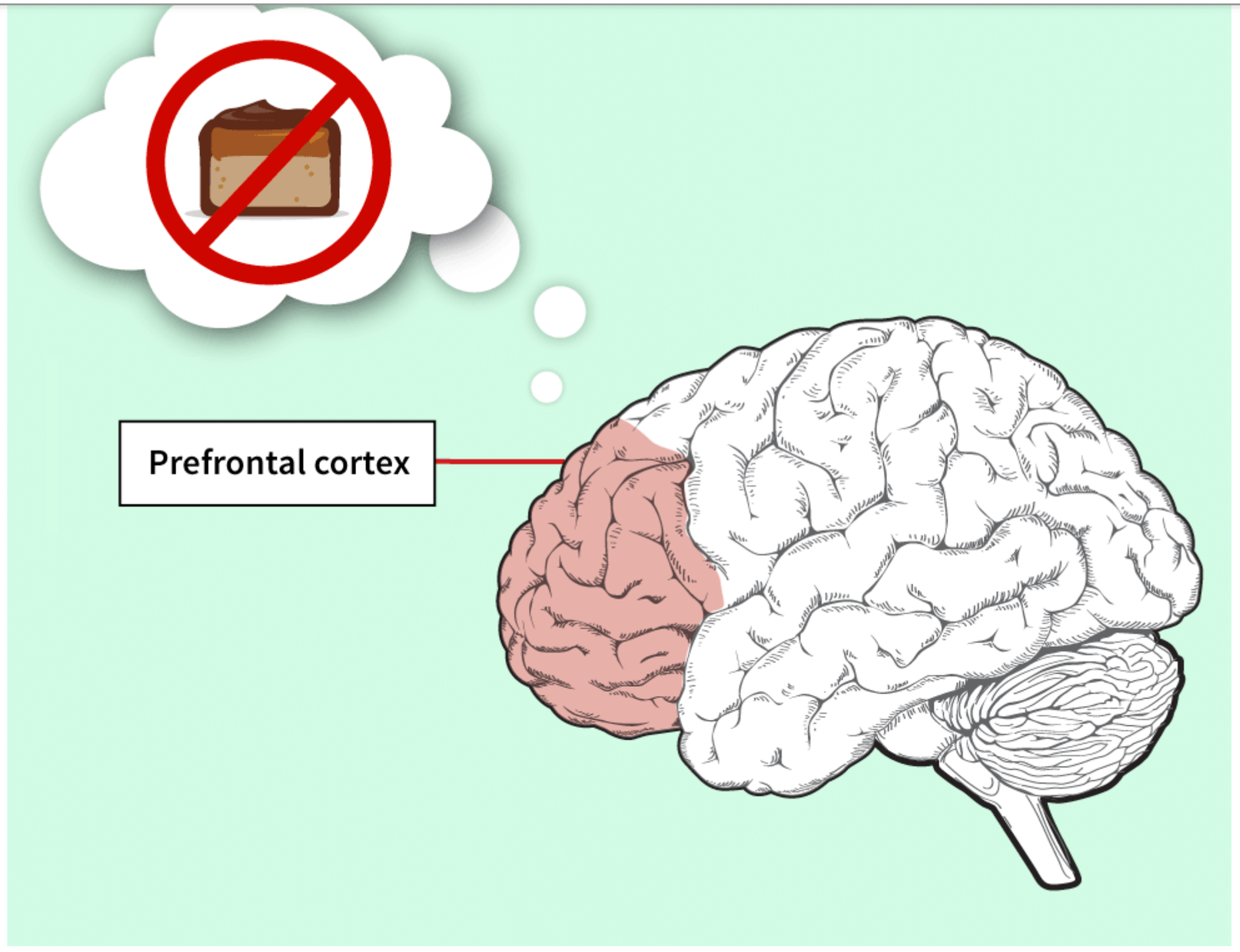


The prefrontal cortex acts as the brain's “brakes” but it's weakened by too much sugar (and fat).

You do possess the ability to resist cravings - it's called willpower.

That ability to stop yourself comes in part from a network of neurons called inhibitory neural circuits. These circuits occur throughout your brain, but are particularly concentrated in the parts involved in decision-making, impulse control and delaying gratification.

"They are kind of like the brain's brakes," explains RMIT sugar scientist Dr Amy Reichelt.

But if you find you can't resist that craving for a chocolate bar don't be ashamed – you may be able to blame it on the sugar.

In world-first research using rats, Dr Reichelt has shown that high-sugar diets can alter decision-making and the ability to control behaviour.

Her studies revealed that rats fed on high-sugar diets suffered a loss of those willpower neurons.

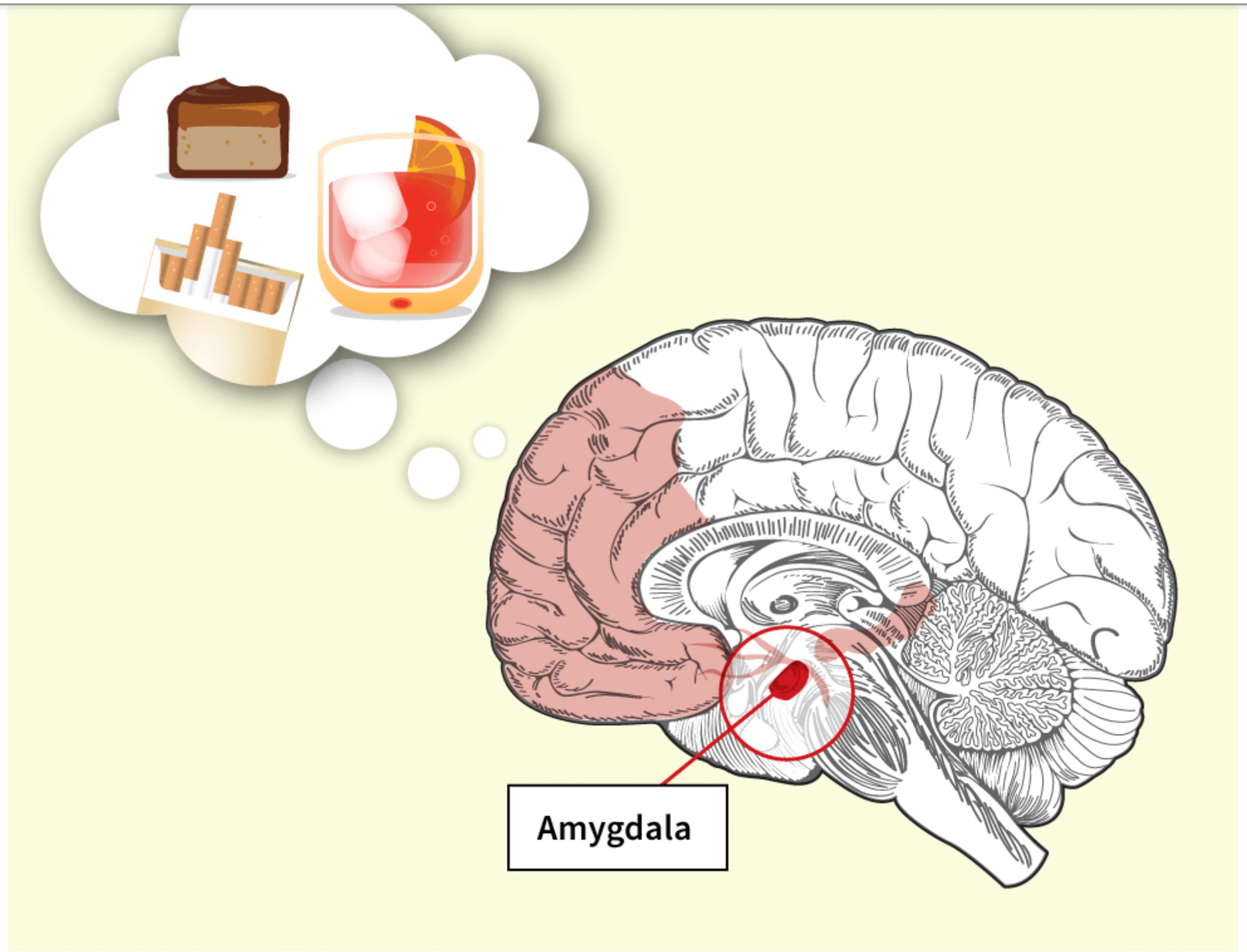
"When you're consuming these high-sugar diets and you're told to stop consuming them, you've made alterations to your behavioural control – and that can lead to your diet falling apart," she says. "You're literally unable to resist that cake."

Much of the research, though, on sugar's impact on the brain has yet to be replicated in people.

In another study conducted last year, a team led by Professor Richard Stevenson from Macquarie University asked a group of volunteers to rate how much they wanted to eat several snack foods when they were feeling hungry versus when they were sated.

They found that the volunteers who regularly ate a high-fat, high-sugar diet were much more likely to crave snack foods even when they weren't hungry.

The scientists suggest the high-sugar and fat diet was actually impairing the ability of the brain to block food cravings.



Nicotine, alcohol, sugar – the desire for them is also linked to the part of the brain that registers fear and stress.

Can you get hooked on sugar?

Let’s say you manage to use your willpower to get on top of your craving for that chocolate bar. But the feeling does not go away.

Your mouth runs dry. You can taste the first bite. Your work performance

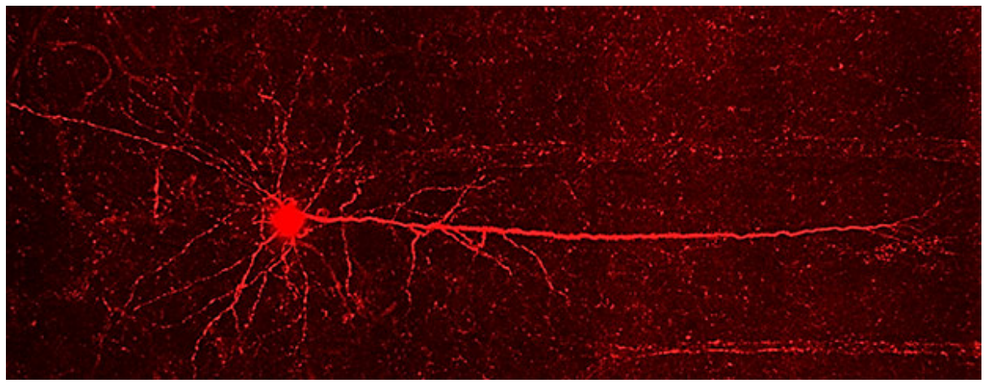
> “We’re all prone to try to excuse our behaviour by claiming we’re addicted. Which is rubbish.”
>
> **Professor Margaret Morris**

Maybe the similarities run deeper than that.

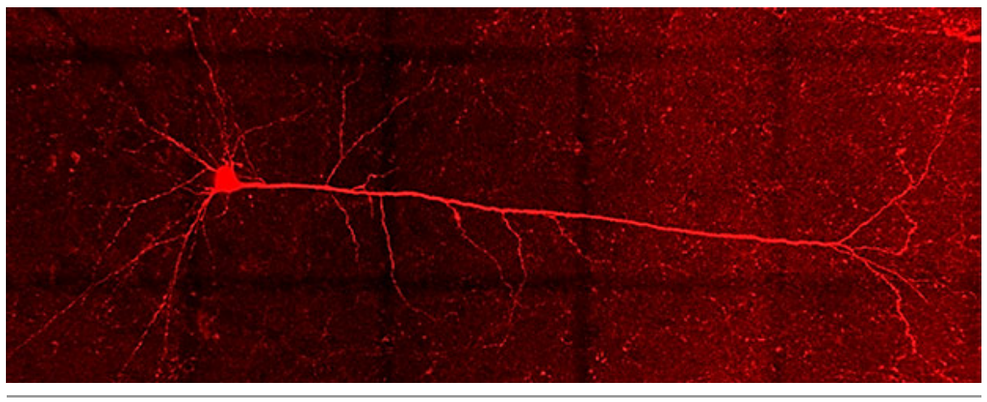
In world-first research, Queensland University of Technology neuroscientist Professor Selena Bartlett claims to have found evidence that high-sugar diets act on the brain in very similar ways to tobacco, alcohol or other physically addictive substances.

Her work targets the basolateral amygdala, a small region in the brain that is linked to fear and stress, and the prefrontal cortex, which sits at the front of the brain.

She found that mice who had binged on sugar had far fewer links between the neurons in these regions and looked a lot like animals addicted to alcohol.



A pyramidal neuron in the brain of a rat fed a normal diet. Photo: Courtesy Dr Arnauld Belmer, QUT



A pyramidal neuron in the brain of a rat that has been bingeing on sugar for 10 weeks. Photo: Courtesy

More remarkably, when her researchers gave mice a medication used to treat nicotine addiction, they stopped eating as much sugar.

“What we discovered in the last five years is that sugar is as addictive as alcohol. We nailed a very specific set of circuits in the brain that alcohol and nicotine bind to,” Professor Bartlett says.

“We showed sugar using the same protocols could change the brain in exactly the same way as alcohol and nicotine do, which labels it into the addictive pathway.”

In a hotly contested field, claims about sugar’s addictive qualities are among the most fraught.

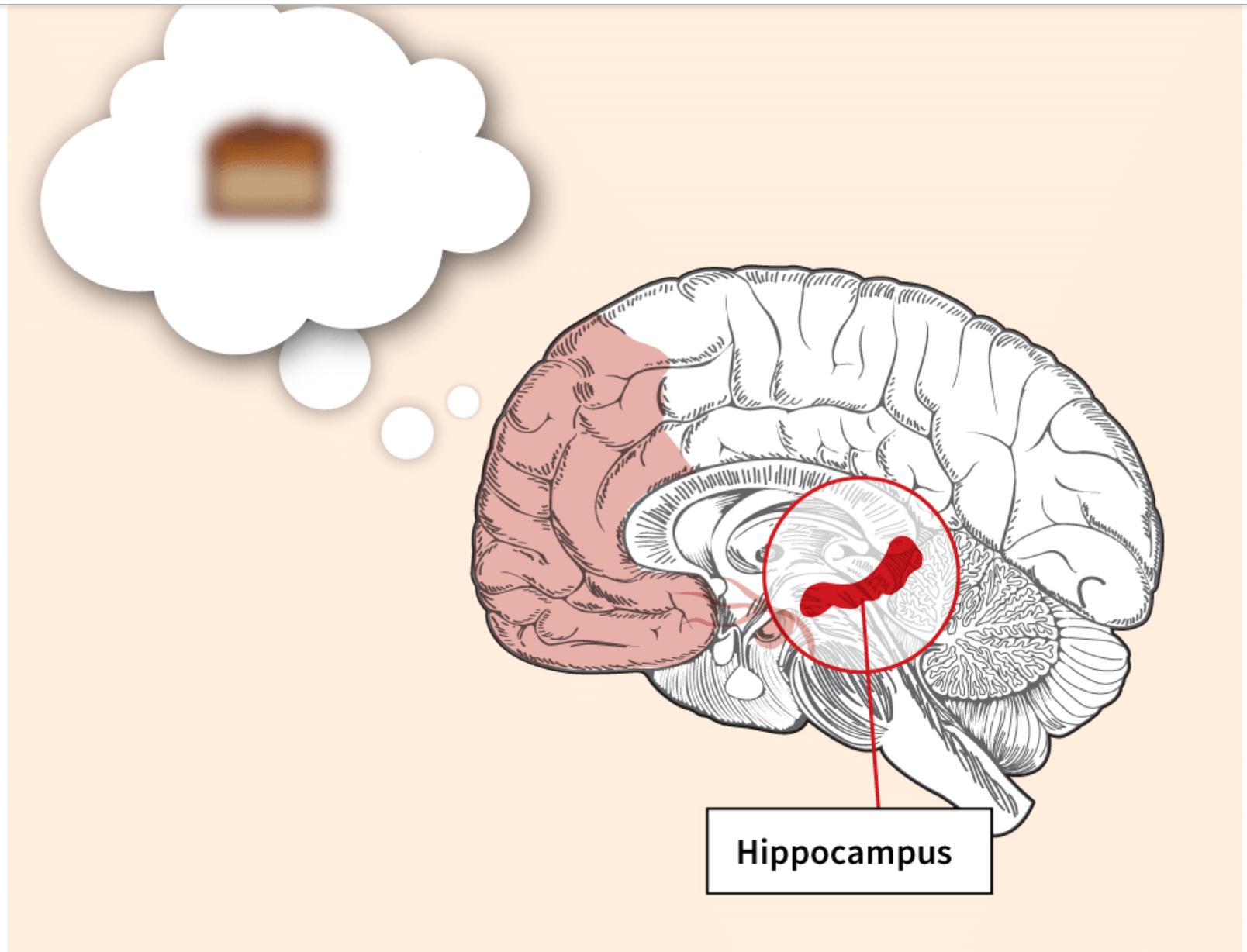
“When we look at obesity, we’re not finding those addictive qualities at all. Where’s the evidence for that?,” says Professor John Dixon, a researcher with the Baker Heart and Diabetes Institute.

“More than any other disease, people believe they know what causes obesity. They don’t.”

Even University of NSW Professor Margaret Morris, one of the leading proponents of the theory that sugar can damage the brain, says the evidence for actual addiction is weak.

“We did a review of the evidence and we had to conclude, on the balance of evidence, that there was no strong evidence for sugar addiction in humans.

“We’re all prone to try to excuse our behaviour by claiming we’re addicted. Which is rubbish.”



In animals, and men and women, a high-sugar diet seems to impair the hippocampus, which controls memory.

I can’t forget but I don’t remember what

Most research on sugar’s impact focuses on a small horseshoe-shaped region in the middle of the brain, about level with your ear, called the hippocampus. It is responsible for memory formation and navigation; to do that, it needs to be continually building new neurons or rewiring

> “Sugar seems to adversely impact the hippocampus and longer-term brain structures that are involved in decision-making and pleasure.”

This role makes it vulnerable to external stresses – potentially such as diets high in sugar.

In animals, the research is fairly clear: sugar damages their ability to make new memories.

The first person to confirm that effect in humans was Professor Richard Stevenson, leading a team at Macquarie University, earlier this year.

He had volunteers spend a week eating a high-fat, high-sugar breakfast. After just four days, their performance on memory tests fell dramatically.

“Sugar seems to adversely impact the hippocampus and longer-term brain structures that are involved in decision-making and pleasure,” he says.

The University of Sydney’s Dr Kieron Rooney once did a quick study – largely for a lark – on a small group of people who signed up to a popular quit sugar diet. He was surprised to find that their memories had significantly improved by the end of the diet.

Professor Morris has spent more than 20 years putting rats on high-sugar diets. She says the results are consistent and repeatable. “Weight gain and a cognitive decline - it’s quite a large effect,” she says.

Obesity is characterised by low-grade inflammation throughout the body. The theory, says Professor Morris, is that with excess sugar and fat in the diet inflammation also appears to affect the hippocampus, impairing its function.

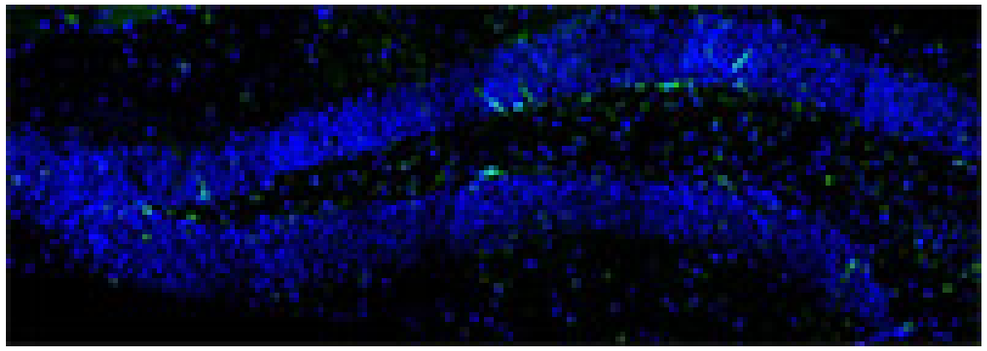
High-sugar diets also reduce the levels of a chemical needed for new neuron formation - which is crucially important to the hippocampus’s job of creating new memories.

The most prominent and studied impact of sugar on the hippocampus is navigation. We use the hippocampus to build an internal map of our surroundings.

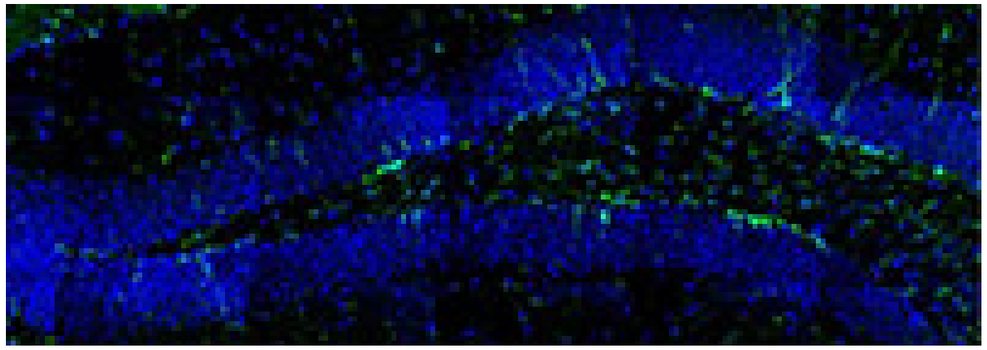
Professor Morris found that navigation for rats fed a high-sugar diet is significantly impaired.

react is not definite.

“It’s probable but it’s far from confirmed,” sums up Professor Morris.



The green flecks are new immature neurons in the hippocampus of a mouse but their number has been reduced by chronic sugar consumption. Photo: Courtesy Dr Arnauld Belmer, QUT



The amount of newborn neurons (green) is much higher in the brain of a mouse fed a normal diet. Photo: Courtesy Dr Arnauld Belmer, QUT

What can we do?

So, what can you do to protect your brain from sugar?

Beyond trying to eat less of it, not much, experts say.

To deal with the addictive powers of sugar, Professor Selena Bartlett suggests meditation exercises to build focus and willpower.

Omega-3s, the fats contained in fish oil, have shown potential neuro-

But ultimately, says Professor Morris, the only magic pill is exercise and following the Australian Dietary Guidelines, which recommend limiting your intake of added sugars.

“There is no question that there is some ability of the system to reset. If people adopt a healthy diet, that could go some way to reversing the effect.”

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