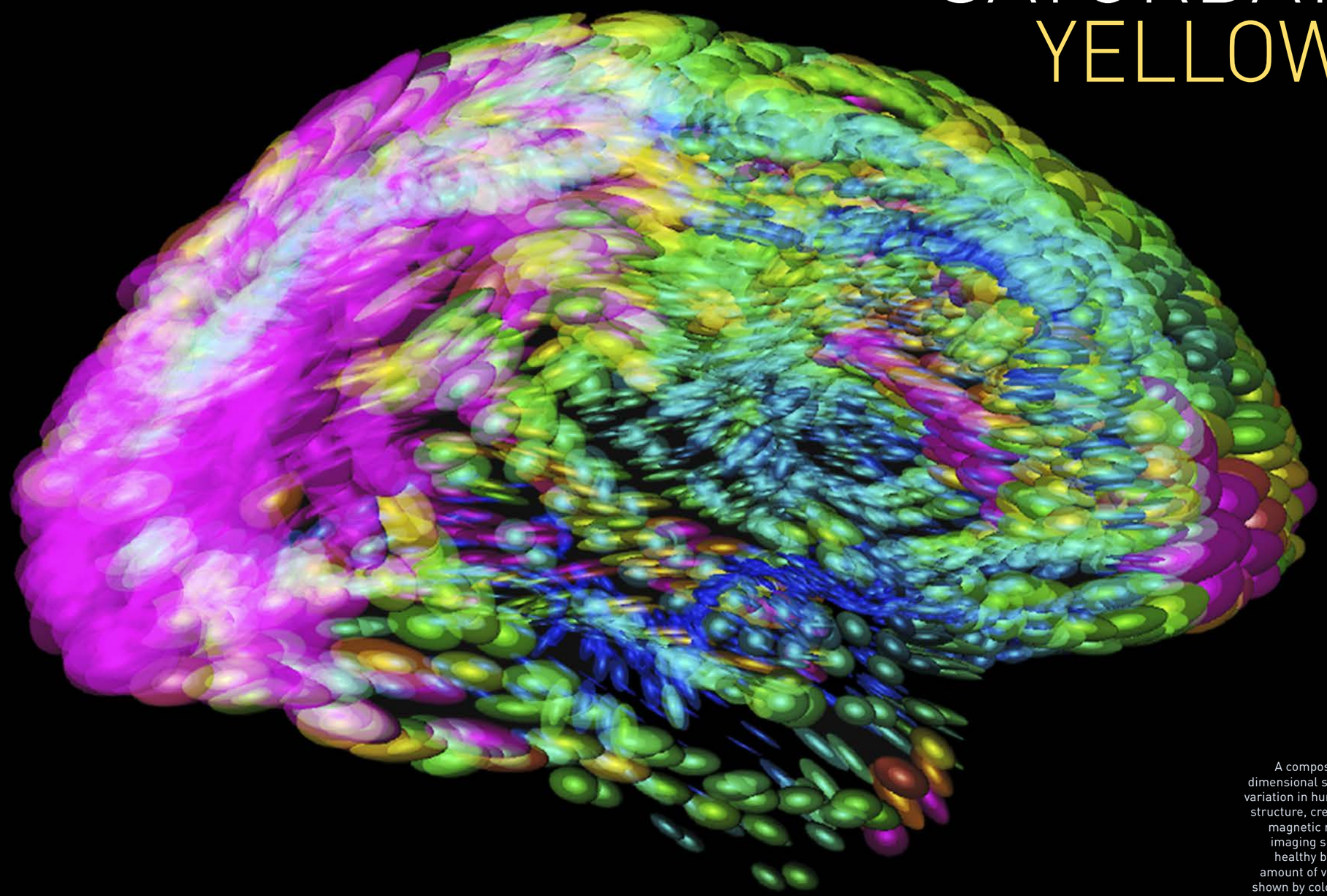
ARE YOUR SATURDAYS YELLOW?

Like Lorde and Liszt, Kate Evans has a kind of cross-wiring in the brain that has some people hearing shapes, tasting numbers or seeing time. She dives into the weird world of synaesthesia.



A composite three-dimensional scan of the variation in human brain structure, created from magnetic resonance imaging scans of 20 healthy brains. The amount of variation is shown by colour-coded ovals that range from pink (greatest), through green, to blue.

GETTY

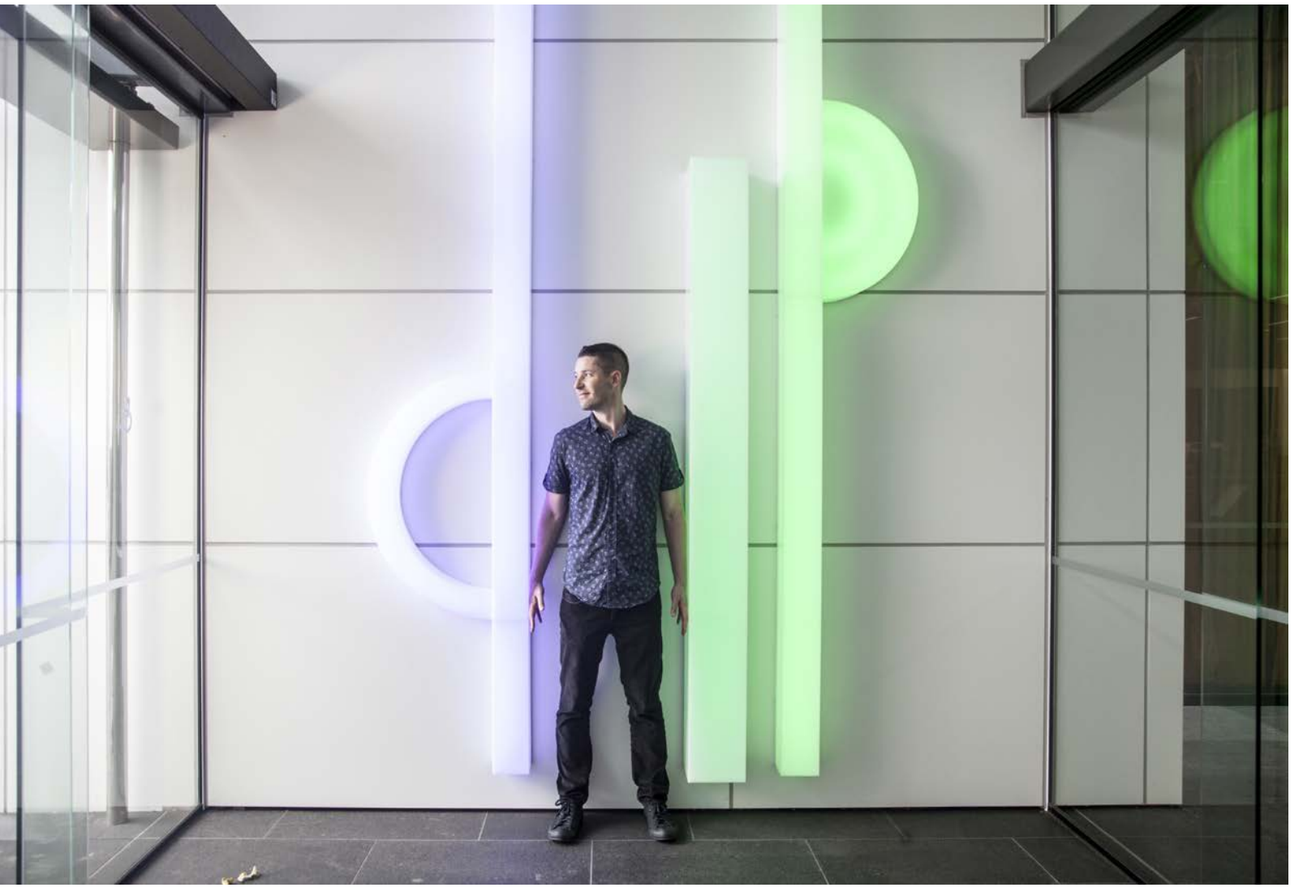
When Shannon Novak was seven, his primary school class was told to go outside and draw what they saw. This was rural Taranaki in the 1980s, and most kids came back with pictures of trees and flowers.

Novak drew an abstract, grid-like tessellated shape, all straight lines and block colours. He wasn't being cheeky – he had drawn exactly what he saw, he explained. His teacher and parents were confused, but he seemed otherwise normal, so his unusual perception was dismissed as a quirk. Novak kept quiet about it after that – but it didn't go away.

When he looked at a cloud, a tree, a building, even another person, he sometimes heard percussive beats inside his head, and felt a clear impression of colour and shape – circles and semicircles, bright triangles and block lines. It wasn't until he was a teenager that he learned the name for what he was experiencing: synaesthesia.

"I just stumbled on the term online," he says. "I was literally typing things in like 'trees making sounds'. It was a relief to know I was actually pretty normal."

KATE EVANS IS A *NORTH & SOUTH* CONTRIBUTING WRITER.
PHOTOGRAPHY BY KEN DOWNIE.



Artist Shannon Novak was a teenager when he learned the name for his synaesthetic experience. "I just stumbled on the term online. I was literally typing things in like 'trees making sounds'."

Drum beats emanating from trees might not seem all that normal to most people, but it's estimated one in 23 of us have some form of synaesthesia – a kind of cross-wiring in the brain that causes a blending of sensation, perception and emotion. There are dozens – perhaps even hundreds – of different kinds.

For some people, each number or letter of the alphabet has an innate colour, regardless of the ink it's printed in. Some associate letters with personality: one synaesthete told researchers that A is "bright-to-medium yellow, female, very feminine, always in dresses", while D is "deep charcoal, male, dashing, a bit of a joker".

There's also "coloured hearing", made famous by a handful of artists and musicians: Liszt instructed his orchestra to "play a little bluer", Kandinsky painted music, and Lorde and Billy Joel have said they see the colours of songs. Pharrell Williams recently described his hit tune "Happy" as made up of yellows and mustards, with "slight slivers of orange and a tinge of brown in the verses", and "a bright sherbet orange" in the chorus.

There are synaesthetes who experience specific tastes when they say or read certain words – the word "peace" might taste of tomato soup. For others, touching particular textures triggers intense emotions.

Or, as for Novak, objects can elicit sounds, colours and abstract shapes.

WE MEET IN BRITOMART, and have coffee at the kind of fancy place that provides sparkling water free with your flat white. This particular glass of water makes a noise, Novak explains – "a loud staccato-type sound" – and evokes an abstract shape in addition to its physical form: "If I were to focus on it, it would be like a blue line with a blue semicircle going up the side of it."

There's music playing in the cafe, waves of conversation reaching us from the surrounding tables, banging and hissing and roasted-bean smells coming from the coffee machine. I can't imagine how overwhelming it would be to sense extra colours, shapes and "internal" sounds on top of all the other information coming in through my senses.

It doesn't quite work that way, Novak says. Just as I can shut out the chatter from the table next door to concentrate on what he's saying, he isn't constantly bombarded with kaleidoscopic scenes. To appreciate the sounds and shapes provoked by the glass, he usually needs to "tune in" to it – although occasionally an object can unexpectedly jump out at him, ringing with noise and colour.

It happens in reverse, too. Novak describes going to a concert at the Auckland Town Hall: "When I got home, I had to draw it up on a piece of paper. It was definitely this massive pink semicircle.

"The sound and the emotion and the building and the people – it was like an interpretation of the energy of the complete environment boiled down into this one shape and colour. It's never hazy or iffy – it's very clear what it is."

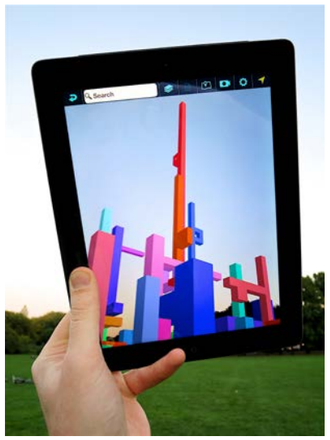
Novak always wanted to be an artist, but was encouraged to "get a real job". He went to art school in his 30s and although he still works in a bank, he now devotes every spare minute to his art. This year, he has exhibitions of digital prints, installations and sculptures planned for Auckland, Hamilton, Wellington and Dunedin. They're all strongly influenced by his synaesthesia. "It's kind of like transcribing my experiences into art," he says.

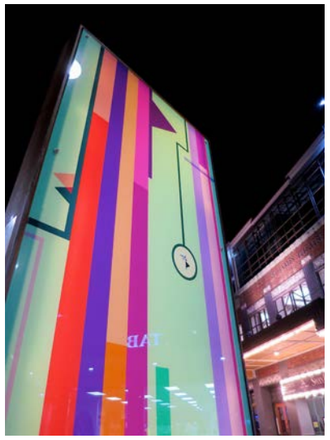
A series of very abstract-looking portraits exhibited at the New Zealand Portrait Gallery in Wellington last year was, for him, a realistic depiction of what he perceived looking at his subjects. "If you think about musicians writing music for people they love or places they've been, it's kind of the same for me. I'll create an artwork for a person, for a place, for an object – it's like creating a piece of visual music."

Novak's latest show, a series of eight light boxes currently lining Wellington's Courtenay Place, is a direct response to the surrounding environment. He sat in the street, sketching the sounds and shapes he perceived, and then turned them into digital panels. An "augmented reality" app also allows visitors to peek inside Novak's head. When a mobile phone is held up to circle motifs on some of the panels, the app reveals additional shapes, colours and dramatic piano chords – the impressions Novak gets when he looks at the artwork.

"It is kind of meta," he admits. "It's like a layer upon a layer – a next-level abstraction – but it's as close as I can get at this point in time to giving people a window into what I'm experiencing."

Synaesthesia has only recently become acceptable as a legitimate subject for scientific study. Francis Galton published a series of papers in *Nature* on the phenomenon in the 1880s, but for much of the 20th century, synaesthetes tended to be dismissed either as crazy artists or attention-seeking fabulists.





Above: One of 16 panels in Novak's Wellington interactive installation *Modulation*. Top: An "augmented reality" app allows visitors to peek inside the artist's head.

> Shannon Novak describes going to a concert at the Auckland Town Hall: "When I got home, I had to draw it up on a piece of paper. It was definitely this massive pink semicircle."

Psychology was in the grip of behaviouralism, which held that consciousness was an illusion, and regarded the subjective experience of individuals as forbidden territory. It took an outsider American neurologist, willing to follow his nose and risk professional disdain, to bring synaesthesia back into the limelight.

In 1979, Richard Cytowic was having dinner at a neighbour's house. The host, Michael Watson, apologised that he'd cooked the wrong shape, and there weren't "enough points on the chicken".

"For the neurologist, the odd remark is a gold mine," Cytowic told me over Skype. "Instead of dismissing it, and saying 'Oh, Michael, what are you smoking?' like all his friends did, I thought, isn't that an odd thing to say?"

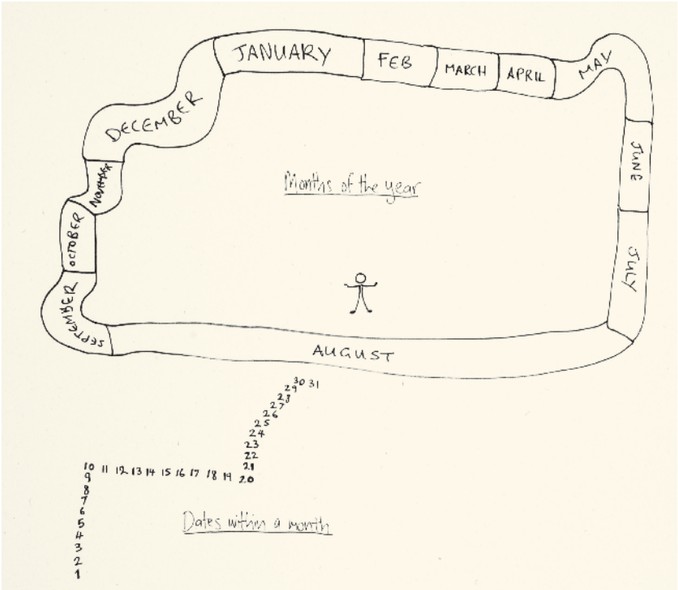
Watson explained that when he tasted something, he also felt texture. With intense flavours, sensation swept down his arm, and he felt weight, shape and temperature as well, as though he was actually grasping something. "Of course, it was like catnip to me, because here was something that wasn't supposed to exist," says Cytowic.

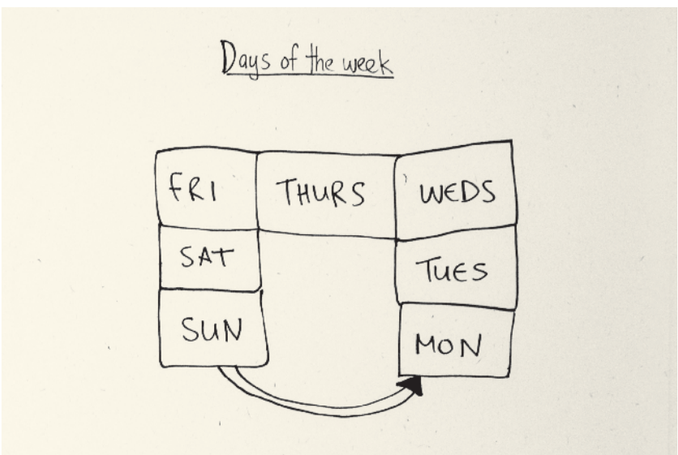
When he mentioned it to colleagues, they rolled their eyes, insisting it was too weird and New Age and would ruin his career. Cytowic ignored them, and went on to publish a number of books on synaesthesia, inspiring numerous other studies. He says it dawned on him only recently that part of the reason the subject appealed so strongly to him was because of his experiences growing up gay in the 1960s.

"As a 10-year-old in New Jersey, my father's medical profession said I was sick, the state said I was a criminal, and the church said I was doomed to hell – and I hadn't done anything! So this notion that something wasn't supposed to be is what rang alarm bells in me. I said, 'Let's have a look at this, and maybe I'll show you.' And of course I did."

I'D ALWAYS BEEN vaguely jealous of synaesthetes like Novak. Those worlds of colour sounded magical and psychedelic, adding a rainbow richness to life. My monochrome brain seemed boring

KEN DOWNIE





Calendar synaesthetes Kate Evans (left) and her sister Monica. Below: Kate draws the days, weeks and months as she sees them in her mind's eye.

I can't think about history without my brain placing events onto a complex, zig-zagged (and, frankly, nonsensical) line for decades, centuries and millennia. World War II is below my waist.

by comparison. But a few months ago, I discovered I actually do have a form of synaesthesia, an unusual way of seeing the world that to me felt so normal I barely paid it any attention. In fact – and this is a common experience for synaesthetes – I thought everyone saw time like me.

When I think of the months of the year, they are arranged in a lopsided clockwise oval in front of me, with January at the top. August sits horizontally along the bottom, and takes up more space than the other months – not because it's cold and rainy and interminable, but perhaps because it feels at though it's closest to me, near my chest.

I can see the year as a circular whole, or "zoom in" to each month in order to see the dates clearly. Dates within each month take the same left-to-right zigzag that all numbers do for me. The first to the 10th run vertically upwards, then it turns horizontal at the 11th, and vertical again at the 21st. Days of the week, meanwhile, flow anticlockwise, with Monday at the bottom right corner and Friday at the top left.

I also can't think about history without my brain placing events onto a complex, zig-zagged (and, frankly, nonsensical) line for decades, centuries and millennia. World War II is below my waist and slightly to my left. Imperial Rome is lower again and much further left, and the Neolithic curves behind my back to the right. The future is above me, and extends rightwards.

I know it sounds nuts, and when I try to draw these forms (it never comes out quite right), it's abundantly clear how odd they are. But I couldn't change them if I wanted to – the shapes have stayed constant as long as I can remember. If I think of November, or Tuesday, or 1000 AD, an awareness of its place in space is automatically triggered. It doesn't feel like a conscious process – it's just the way I perceive time.

I'm not alone. Some studies have found that "time-space", "calendar" or "spatial-sequence" synaesthesia is one of the most common forms, perhaps affecting one in every 100 people. Although it's not technically a coupling of the senses, Cytowic says it still counts as synaesthesia: the concept of a sequence triggers an automatic experience of location in three-dimensional space.

One reason I thought it was normal to think like this is that my sister, Monica, and a close friend from childhood, Sophie Gladwell, also see time as space. One evening, we met up to draw our internal calendars, and debate where exactly September is.

Monica drew her weeks and months sloping down from left to right. They're coloured, too – January is red, for example, and Wednesday green. Other months are a little more vague: "I'm starting to think it probably influences the way that I plan things," she says. "If someone suggests doing the project on Friday, I'm like, what colour is that, and what feelings do I have associated with that colour?"

Sophie's months also slope down to the right, over a series of steps, and they slot into a wider three-dimensional pattern for the decades – the years stacking up on top of each other as she lives them. "You can zoom into it for more detail," she says. "It's like a Google map of time."

They're both struggling to understand this is even a "thing" – Monica is sure her calendar is much less weird than mine, and Sophie can't quite believe it's anything unusual. "I don't understand how you could not do this!" she says. "Everything would be in a big jumble. How do you remember 1995 if you can't navigate to it?"

Interestingly, given that synaesthesia runs in families, Monica's and Sophie's forms are most alike. Whereas my calendars are more two dimensional, and exist in relationship to my body, they both see the past and future as a kind of landscape they travel through, and can store their memories in.

ALAMY

V.S. Ramachandran – "the Marco Polo of neuroscience" – is a professor in the Department of Psychology at the University of California, San Diego. "Synaesthesia – it's terra incognita. It's a window into enigmatic aspects of brain function."

"It's like this tapestry that's populated with the whole of history, every memory you've ever had, everything you've ever been told or read," Sophie says. "For the purposes of remembering things, I can project myself back – it was 1991, and I'm on the flat, on the edge of the mound and about to go down."

For Monica, areas of the time-scape have specific colours, often connected to the fabric of clothes she wore at the time. "Everything down there in the 80s is like the colour of old photos, and that funny green of the curtains in our house back then." For her, 1988 – when she was three – has the feeling of brown corduroy. When she thinks about 1992, Monica realises she can even remember the outfit Sophie wore on her first morning at Leigh Primary School, the day they met.

Some studies have found synaesthetes do have enhanced powers of recollection, and both Sophie and Monica agree their synaesthesia is most useful as a memory tool. It's almost like the "memory palace" technique some people use to recall a speech or a deck of cards, Sophie says, except that the palace already exists organically in her brain.

By the end of the night, we've largely agreed on what it feels like to have an internal calendar, that the future is above us, and that October is an unclear, murky month. The calendars we have drawn, however, are totally unique.

Scientists say this idiosyncrasy is a key feature of synaesthesia. No two synaesthetes experience the same calendar form, or the same set of colours for the alphabet. That can be seen as proof that synaesthesia is a real phenomenon – if two sisters can have such divergent ideas, we're unlikely to have simply been influenced by a calendar we saw as children.

I DISCOVERED the name for what we experience at the end of last year, when I came across a short article on new research by V.S. Ramachandran at the University of California, San Diego. Ramachandran has been called "the Marco Polo of neuroscience", and his interests are as varied as phantom limbs, autism, metaphor, OCD, and the origins of language – anything that can shed light on how the brain works, and what

makes us human. "Many phenomena that seem abnormal or strange, when you bring them into the mainstream they actually change your thinking about how the brain works – and synaesthesia is a prime example," he tells me.

Since Cytowic rediscovered synaesthesia in the 1980s, most studies have focused on the common grapheme-colour variety (coloured letters and numbers). Ramachandran noticed comparatively little attention had been paid to calendar synaesthesia.

Francis Galton first identified the variant back in 1883. "It is a common peculiarity that the months do not occupy equal spaces," he wrote. But no one had since even proved it was real.

Ramachandran set out to do just that, and last year carried out a number of experiments that, he says, provide the first "clear, unambiguous proof" that it's a genuine sensory experience.

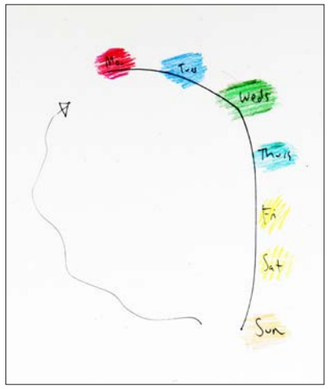
His main subject was a 20-year-old student he calls ML, who sees the year laid out in an asymmetrical V-shape in front of her, the name of each month appearing in Helvetica font. On three occasions over a month, Ramachandran's team asked her to draw it on a screen. The shape remained remarkably consistent. She was then asked to name the months backwards, starting at an arbitrary point, and skipping one or two months each time. Non-synaesthetes find this task rather challenging; ML simply read off the calendar she could see in her mind, and performed much better than control subjects.

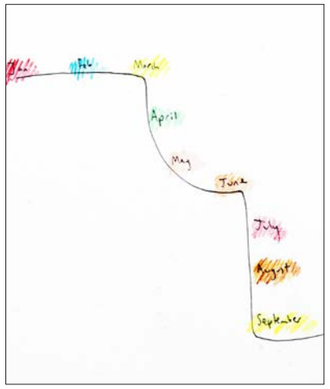
That shows the calendar isn't some "vague figment of her imagination", Ramachandran says – it's vivid enough to actually enhance her performance.

He believes that studying this kind of synaesthesia can help shed light on how everyone perceives time. "People have taken the calendar for granted – and yet calendars are a vital part of our lives. You anchor yourself in the world using a calendar," he says. "We believe there may be brain structures involved in this sense of a calendar, and they may be enhanced in some people with synaesthesia."

So how does the brain represent a calendar? We don't know for sure, yet, says Ramachandran, but his hunch is that it involves a chunk of grey matter called the left angular gyrus, a feature only found in the human brain.

"If it's damaged, you lose the ability for spelling, writing, reading, left and right distinction, arithmetic, metaphor – an astonishing array of subtle but striking deficits," he says. "These patients have problems with sequencing too; they have a confused calendar. So this gave me the hint that the angular gyrus is involved in sequence."





Monica Evans' colour-coded days and months slope from left to right.

A set of specialised cells in another brain area, the hippocampus, are responsible for our sense of location in space – "the brain's own GPS", he says. "We were struck by the fact that there's a very obvious band of fibres that goes from the angular gyrus – anatomically you can trace it – to this very location in the hippocampus."

So what's different about my brain that produces such a detailed calendar-in-space?

The theory Ramachandran favours is that synaesthesia results from the expression of a gene that causes the "defective pruning" of neural connections as the brain is maturing. Fetuses and newborns have many more linkages within and between brain areas than adults do – in fact, recent studies have suggested that all infants may be synaesthetic to some extent.

Over time, those pathways are pruned back, but in synaesthetes, perhaps, the process is imperfectly completed, leading to enhanced connections between brain areas – in my case, between the angular gyrus and the hippocampus. It's important to note that a "synaesthesia gene" has not yet been discovered, and researchers in the field still have many more questions than answers.

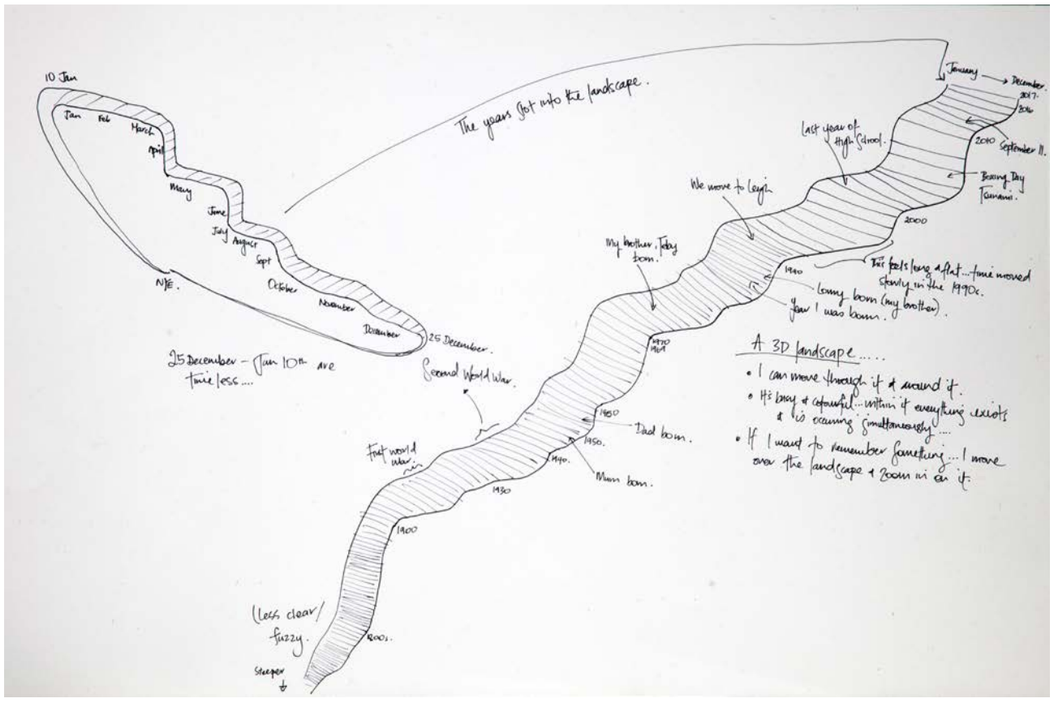
"Defective pruning and excess connections help explain a lot of what we see," says Ramachandran. "But then you hear a synaesthete say, 'The number five is a fat man with a beard,' and you see it sufficiently often that you know they're not making it up. So how do you account for that in the brain? Is there a map for personality and a map for numbers and they get cross-wired? It stretches your imagination a bit. But that's the exciting thing about synaesthesia – it's terra incognita. It's a window into enigmatic aspects of brain function."

SYNAESTHESIA IS in the realms of mainstream science and, with celebrities like Lorde and Kanye West beginning to talk about their experiences of the condition, it's also making its way into popular culture.

Still, most of the friends and family members I spoke to while writing this story had no idea what I was talking about – although once I explained it, a few synaesthetes came out of the woodwork. Most had rarely discussed their experiences with anyone. And that's something New Zealand researcher Patrick Shepherd wants to change.

Shepherd is a composer, musician, and arts education lecturer at the University of Canterbury. A decade ago, he visited Antarctica as an arts fellow, with the aim of composing music inspired by the landscape. It was more difficult than he expected, and, struggling to musically represent the stark colours of the continent, he came across the idea of synaesthesia.

While he doesn't have it himself, he became fascinated with the condition, and is currently researching New Zealanders' experiences of synaesthesia. Some shared memories of school, where their unusual perceptions were dismissed or ridiculed, so he's also trying to raise awareness of it among teachers and the general public.



Sophie Gladwell's landscape view of time, which she describes as a "tapestry" of all her knowledge and memories. "I can't add colour to it because it's like life, it's all colours."

Cytowic suggests the study of synaesthesia has caused two paradigm shifts.

American neurologist Richard Cytowic began writing about synaesthesia in the 80s, despite colleagues insisting it was too weird and "New Age" and would ruin his career.

The first was overturning the scientific orthodoxy that the senses don't mix. The second is its vivid illustration of the fact that reality is deeply subjective. "Synaesthesia is a great example of how two people can have totally different points of view, because their whole experience, the context they bring to it, is different."

The existence of synaesthesia means we have to accept others don't see things the way we do, he says. It's also enabling scientists to rethink long-held ideas about how brains are organised.

"Nature reveals herself through her exceptions. So far from being a mere curiosity, or a weird abnormality, synaesthesia has turned out to be a porthole onto an enormous expanse of both the brain and the mind." +

• *Shannon Novak's interactive installation* Modulation *is in Courtenay Place, Wellington until April 4. His exhibition* The Expanded Gallery *opens on April 8 at the Dunedin Public Art Gallery (www.dunedin.art.museum).*