Are you scared of sponges or seed pods? Trypophobia – a fear of holes – seems to be on the rise, but isn't based on fear at all, finds **David Adam**

# The hole truth

YVONNE RÖDER/PLAINPICTURES

WHEN Amanda was 12, her mother took her to the doctor because she was scared by the sight of Swiss cheese. Seeded bread made her sweaty and anxious. And Amanda would cry out when she saw pictures of empty honeycomb. One day, she fled in terror from the family bathroom while it was being repaired after spotting its exposed and perforated concrete walls.

The only previous clue to her discomfort had come from her fussy eating. Ever since Amanda was a toddler, she had refused to eat certain types of bread or drink raspberry juice because she hated the feel of the textures in her mouth. But by the time she saw the doctor, Amanda couldn't even look at the seeds in a strawberry without anguish.

A psychiatrist said that Amanda (not her real name) had trypophobia. There isn't much in the medical textbooks about this condition, but you can find lots of information online about how it is a fear of holes. You can follow links to pictures of sponges and the perforated heads of flowers that claim to test and diagnose you. But like much information on the web, descriptions of the condition are misleading. Trypophobia isn't really down to holes. Or fear. It might not even be a phobia, because new research suggests it is triggered by disgust. Less fear and more loathing. Reliable figures are hard to come by, but some researchers believe we will see an uptick in cases.

"It's something that will become more pervasive and we could be forced to treat it in a more serious way given the changes in our environment," says Stella Lourenco, a psychologist at Emory University in Atlanta, Georgia.

The urban environment is dominated by repetition: patterns made from tiles, bricks and other materials. "Over the last century, things have got more and more stripy," says Arnold Wilkins, a psychologist at the University of Essex, UK. "Just a lot more unnatural in terms of what we're looking at." Looking at some patterns, it turns out, can be bad for our brains. For people with trypophobia like Amanda, it can be very bad indeed.

As any pub quiz regular knows, there are dozens of phobias out there. Arachnophobia is an extreme or irrational fear of spiders, while coulrophobia (clowns), cynophobia (dogs) and haemophobia (blood) also affect significant numbers of people. Alfred Nobel had such a fear of being buried alive (taphophobia), that his will, which also established the prizes that bear his name, ends with the words: "It is my express wish that following my death, my arteries be severed, and when this has been done and competent doctors have confirmed clear signs of death, my remains be incinerated in a crematorium."

But the suffix phobia can also simply mean a strong dislike of something. The term trypophobia, for instance, isn't official. It doesn't come from the medical community or feature in the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders*, which lists mental health conditions. In fact, according to one account, the word was coined in 2005 when a woman with this phobia asked someone at the *Oxford English Dictionary* to comment on her suggested term for it, and it spread from there.

One puzzle with trypophobia, says Lourenco, is that the patterned objects and pictures that so disturb people carry no obvious threat. Phobias are often explained as a learned behaviour: being bitten as a child can induce a lifelong fear of dogs for instance. "But trypophobes are anxious about honeycomb and aerated chocolate and they're not likely to have had a bad experience with those," she says. It is true that not all phobias are learned, and some, such as haemophobia, seem more innate. But harmless scenarios and objects are still much less likely to form the basis for such an exaggerated fear.

## Evolution of fear

This is demonstrated by classic experiments with rhesus monkeys carried out by Michael Cook and his colleagues at the University of Wisconsin-Madison in the 1980s. Psychologists found that hand-reared animals had no instinctive fear of snakes – having never seen one – so pictures of snakes had no effect. That changed after they were shown video of the anxious and fearful way that wild monkeys reacted to a snake. After they saw these images, the lab monkeys learned the same response and showed the same fretful behaviour when they were shown the pictures again.

When the psychologists tried to use the same mechanism to make the lab monkeys afraid of flowers, however, they failed. No matter how many times the animals were shown footage faked to show wild monkeys react with lip-smacking panic to a flower, ›

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the hand-reared monkeys wouldn't buy it. Unlike with snakes, evolution had left the monkeys with no reason to learn to fear harmless flowers.

Given that, why would a 12-year-old girl from Chile find strawberry seeds so threatening? And why do people, say, from Europe and the US take such a dislike to the appearance of the seed pods of the lotus flower – a well-known trigger thanks to its big, black eye-like seeds – which grows thousands of miles away?

To learn more, Lourenco and her colleagues showed volunteers various images. Some were known to trigger people with trypophobia – sponges and honeycombs – and some were of snakes and spiders, known to produce a fear reaction in many people. Pictures of butterflies and coffee beans were chosen as neutral control images. The scientists asked the volunteers how they felt when they saw each picture. But they were more interested in studying involuntary changes in the viewers' eyes, so they used an eye-tracker to measure the size of their pupils.

When the volunteers saw the spiders and snakes, their pupils expanded. That is expected: wide-eyed terror is well named because the sympathetic nervous system activates eye muscles that stretch the pupil open as part of the so-called fight-or-flight response.

In contrast, the trypophobic images didn't instil fear. Instead, they caused the pupils of the volunteers, who hadn't complained of trypophobia before, to shrink. This is a hallmark of a different response, known as rest-and-digest, that is driven by the separate parasympathetic nervous system and that makes muscles around the pupil contract. The parasympathetic nervous system is stimulated not by external threats, but by the feeling of disgust.

That explanation makes sense to Dylan Sessa, a psychology student at Florida Gulf Coast University, who experiences trypophobia when he sees irregular holes. "I often react as feeling uncomfortable, turning away and experiencing a skin-crawling sensation. Specifically, my face feels strange, experiencing pins and needles all over my cheeks, causing me to sometimes want to scratch at my own skin in response to the images," he says. "I believe that the idea of the root cause being disgust rather than fear would fit the particular feeling I've experienced. The sensation I get is closer to discomfort rather than fear."

Last year, Anne Schienle, a clinical psychologist at the University of Graz, Austria, invited 40 people with self-diagnosed trypophobia to her lab for tests. She agrees that disgust seems to be a strong driver. "We asked them what is the main emotion when you look at these holes and the majority said it was disgust and not fear," she says. "One interesting thing they said is that they had the urge to destroy these patterns because they look so ugly. That's atypical for phobia patients."

Psychologists already know that some phobias can be driven by disgust rather than fear. Haemophobia is one. "A blood phobic never says, 'I'm afraid to look at those red fluids'," says Schienle. Instead, the sight of blood seems to trigger some deep-seated revulsion, which could have evolved as a way to protect against the transmission of disease.

Some people with arachnophobia react in a similar way. "They say, 'I'm not afraid that the spider will do something to me'," says Schienle. "But look at the disgusting body, the disgusting eyes, look how weirdly it crawls." That is based on another subtype of disgust, of creepy-crawlies, which also probably evolved, in this case to save us from being stung and bitten.

So, disgust at both blood and spiders could have a rational, possibly evolutionary, basis.

**"The latest viral trypophobic image is the new Apple iPhone, with a cluster of camera lenses on the back"**

APPLE

But holes? Bread? Where does that come from? If rhesus monkeys can't be made to react badly to flowers then why do some people? It comes back to patterns.

Wilkins did some of the earliest research on trypophobia. In 2013, he and his colleague Geoff Cole did the first academic survey of its prevalence and suggested that about one in seven people were affected – a statistic now routinely quoted.

As an expert in the kinds of visual stimuli that can trigger epileptic fits and migraines, Wilkins thought something similar might be happening with trypophobia. Close examination of the images that brought on the disgust suggested he was correct. Mathematical analysis of the contrast between light and shade in a picture of lotus seed pods, for example, showed a particular visual signature. Specifically, the triggering images had high levels of contrast repeated at regular, but not too frequent, intervals.

The researchers were able to accurately predict which repetitive patterns would be uncomfortable to look at. They even designed some of their own. "It's usually holes, but you can get bumps to be horrid if you work at it," says Wilkins. "The reaction depends strongly on the pattern contrast. Holes have shadows even under diffuse illumination, enhancing their contrast."

Wilkins and Cole suggested why this visual signature might make someone react to an everyday object or a non-threatening picture. It has the same properties, they said, as patterns and markings on the skin, scales and shells of some of the world's most poisonous and venomous animals, including the blue-ringed octopus, Brazilian wandering spider and poison dart frog (pictured, above). Perhaps trypophobia was caused by the brain seeing soap bubbles and reacting like it was seeing a deadly marbled cone snail or a deathstalker scorpion. Non-venomous species of the same animal type didn't display the same patterns, they said.

There are two objections to this explanation. The first is that plenty of venomous creatures lack such patterns. The other is that, like all ideas for modern behaviour rooted in the distant evolutionary past, it is impossible to check. Would early humans really have benefited from developing instinctive protection against an octopus?

More recently, Tom Kupfer, now at Vrije University in Amsterdam, the Netherlands, and An Le, then at the University of Essex, have refined the idea. The disgust response in trypophobia isn't directed at dangerous animals, they said, but nasty diseases and

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Lotus seed pods can trigger a strong response in people with fear of holes

**"It's usually holes, but you can get bumps to be horrid if you work at it"**

parasites, which are known to have exerted strong selection pressure during human evolution. Many of the most unpleasant diseases – leprosy, smallpox and typhus among them – produce circular shapes on the skin or irregular clusters of pustules. It makes sense that early humans would have benefited if they avoided people with those marks.

## How disgusting!

To test this, Kupfer and Le showed images to people with self-diagnosed trypophobia and to a control group of non-affected people. The images were divided into two batches: disease-relevant, such as body parts with a rash, and disease-irrelevant, which showed similar patterns on objects, such as drilled holes in a brick wall. A third group of images showed the same background object but without patterns – a man's chest with no rash, say, or a smooth wall with no holes.

Nobody was bothered by the pattern-free images, while both groups found the disease-relevant pictures disturbing. As would be expected, most said the problem there was feelings of disgust rather than fear. When it came to the disease-irrelevant patterned pictures, those with trypophobia found them disgusting. But so too – albeit to a lesser extent – did the others. Kupfer and Le said that the results indicate that humans have developed a rational aversion to some types of holes and clusters because they could pose a disease risk. In trypophobia, however, this mechanism becomes exaggerated and spills over into an unnecessary overreaction to harmless patterns.

Wilkins says this could make sense, although he points out that patterns on human skin often show relatively low visual contrast. Many of the trypophobic images that circulate on the internet are unrealistic patterns photoshopped onto skin, he says.

Schienle also questions how useful such deliberately provocative online images are to gauging the true nature and scale of trypophobia. None of the 40 people with self-diagnosed trypophobia she tested and spoke with in 2018 met the full clinical criteria for phobia. They didn't go out of their way to avoid such patterns and there was no impairment to their daily life. She now uses the term trypophobia-prone to describe such individuals. "I don't exclude that there are some people out there who have a clinically relevant phobia of clusters of holes. But it's not really prevalent," she says.

Unfortunately for people with trypophobia, there seems to be no easy fix. Fears and anxieties can be treated with drugs or cognitive behaviour therapy; disgust responses are harder to shift. In Amanda's case, nine weeks of medication and therapy relieved some of her anxiety and sleeplessness. But she was also diagnosed with general anxiety disorder, which makes her situation more complicated.

True phobia or not, an overactive disgust response to certain patterns is a problem for many people, says Wilkins. And that is something architects and designers need to take on board. A survey in China this year suggested that trypophobia is more common among young city dwellers. Wilkins isn't surprised: "Most of our visual environment is much more stressful now than in the past."

Proving his point, on the day *New Scientist* spoke with Wilkins, the internet exploded with the latest viral trypophobic image to drive disgust around the world – nothing more threatening than the new Apple iPhone, which features a cluster of three circular camera lenses on the back. Adverts showed the devices stacked, so exaggerating the effect. "The devices themselves aren't as bad as the adverts," says Wilkins.

A simple solution, he says, would be for Apple to make the surround of the lenses black, to reduce the contrast. But then artists and designers deliberately use contrast to provoke. "They like to catch the eye," says Wilkins. "And when they do, they hit the head." ▮

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