

How and why do seasonal changes affect our mood?

Isabella Coxon (she/her)

At university, the winter months are always tricky. The days become shorter, exams are around the corner and, if you're like me, the heating stays off until the last possible minute. Generally, people report experiencing more positive mood during the spring and summer months, and more depressive symptoms in autumn and winter. In more severe cases individuals can struggle with Seasonal Affective Disorder (SAD), which is particularly prevalent in temperate climates (areas whose coldest months average between 0 and 18 degrees Celsius). So, what is the science behind seasonality and mood?

The diagnostic criteria for (Winter) Seasonal Affective Disorder is: (1) a syndrome in which depression developed during autumn or winter and remitted the following spring or summer for at least 2 successive years, (2) meets criteria for a major depressive or bipolar disorder, and (3) has no other psychosocial explanation for mood. Common symptoms of SAD include changes in appetite, decreased energy, hypersomnia, irritability and avoidance of social

situations. More severe symptoms include apathy, feelings of blameworthiness and hopelessness, and suicide ideation. Full understanding of the causes of the relationship between mood seasonality are unknown, but multiple theories have been put forward, generally theorising that there is atypical variation in the brain.

The role of Serotonin:

Serotonin is a chemical in the brain that contributes to feelings of well-being, and is associated with mood, emotion, sleep and appetite. It's derived from a substance called L-tryptophan. Tryptophan supplements have produced positive effects in individuals for whom light therapy hasn't been helpful. Lower levels of serotonin neurotransmission has therefore been correlated with feelings of low mood. Furthermore, molecular genetic research has identified possible associations between certain genes and SAD. Serotonin levels in the brain vary with the seasons, and is at its lowest between December and January. In line with this, medications like SSRIs, that increase serotonin

levels, have been effective in treating SAD.

Sleep cycles and biological clock:

One theory suggests that SAD is correlated with a phase-shift delay and an irregular circadian rhythm. The circadian rhythm refers to the body's internal time-keeping system in a structure within the hypothalamus, which persists without external stimuli. With relevance to SAD, it is involved in regulating: sleep/wake cycles, hormone release, body temperature, and appetite.

Changes to external stimuli, particularly the amount of exposure to daylight we experience, can disrupt our internal rhythm. Such disruption can impact the body's regulation, contributing to symptoms of SAD. This theory led to the development of light therapy as a treatment, which has been found to correct disrupted or shifted

rhythms and improve mood symptoms. Phototherapy (the use of UV rays) has also been shown to reduce symptoms in individuals with SAD, but showed no effect on non-seasonal depression. It is unclear whether individuals with SAD have atypical circadian rhythms or are more susceptible to changes in circadian rhythm. Light therapy is a symptomatic treatment, meaning it addresses the symptoms of the disorder, rather than the underlying cause. While effective in some cases, this demonstrates the current lack of understanding of the disorder.

What can you do to alleviate symptoms of low mood during the colder months?

SAD affects a small percentage of the population (one in 20). Nonetheless, treatment methods for it can be beneficial to everyone when it comes to feeling better during winter. In a UK study Individuals with SAD most frequently reported that getting outside and

socialising were their most used method of alleviating symptoms. Others also mentioned that 'keeping busy' with indoor activities and an SAD lamp was also helpful. The efficacy of methods is dependent on individual characteristics, so it's important to try out different methods until you find the right one for you.

Individuals likely to be struggling with SAD are normally prescribed with light therapy, and antidepressants if symptoms still persist. If you are struggling, you should reach out to your local GP or a support group.

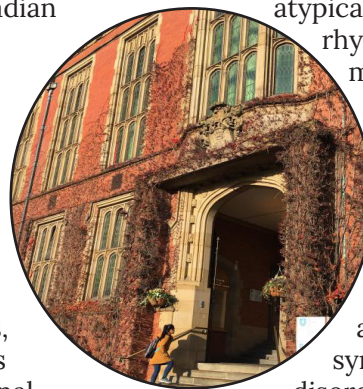
Support groups/services in Sheffield and the UK:

Rethink Mental Illness - <https://www.rethink.org/help-in-your-area/groups-in-your-area/>

Campaign against Living Miserably (CALM) - <https://www.thecalmzone.net/>

Seasonal Affective Disorder Association (SADA) - <https://www.sada.org.uk/>

Image credit: The University of Sheffield



Discovery of new prime number blows mathematical records out of the water

Matthew Rowe (he/him)

Recently, both the largest Mersenne prime and the largest prime in general was found; this is a very important discovery in the mathematical area of number theory. This was the 52nd Mersenne prime ever found, and between the 51st and 52nd, it took mathematicians using specialist software 7 years.

A Mersenne prime is a prime number of the form $2^p - 1$, where p is a pre-existing prime number. To start with, these numbers are small, the first three being 3, 7, and 31 but very quickly ramp up, with the

10th Mersenne prime already reaching 27 digits. In 1995, in an effort to find these huge numbers, the Great Internet Mersenne Prime Search (GIMPS) was set up to corroborate efforts by several mathematicians as well as releasing free software for the sole purpose of finding Mersennes. Unexpectedly, the mathematician who found its latest discovery only joined the search in October 2023.

Luke Durant, an ex-NVIDIA employee turned researcher, was the person responsible

for the discovery; he did this by creating a "cloud supercomputer" of GPUs globally, all simultaneously using the GIMPS software.

This resulted in the discovery of a prime number 16 million digits larger than the 51st Mersenne prime, resulting in a 41 million digit number I can't even begin to imagine. But in the form mentioned earlier, this is represented as $2^{136,279,841} - 1$.

New prime numbers are a very relevant concept with applications within mathematics and computer science. After the searching

process, these numbers need to be checked since the Fermat probable prime test used in the preliminary test is relatively simple and these calculations have many stages where it can go wrong. For example, the 49th Mersenne prime, $2^{74,207,281} - 1$, took roughly 34 quadrillion steps. Checking these primes helps consolidate otherwise hard to verify algorithms as well as being a great test for hardware.

In mathematics, and specifically number theory, primes have always been an area of great interest. Mersenne primes have a particular link to perfect numbers; these are numbers

where the number itself is equal to the sum of all its divisors. This tells us that if $2^p - 1$ is a prime, then $2^{p-1}(2^p - 1)$ is a perfect number. There aren't many real life applications of this but it's important to understand how these groups of numbers interact.

Durant received \$3000 for this discovery but is choosing to donate his prize towards the Alabama School of Math and Science, giving funds back to the institution originally behind the search.

Image credit: Dhiraj Singh/ Bloomberg via Getty Images

