

ON THE
PODCAST

Treating INSOMNIA

Find it hard to drift off to sleep? It could be that your brain is built differently to those who are happily snoring away says **Moheb Costandi**

You lie in bed, tossing and turning, eventually finding sleep in the small hours, only to wake up the next day feeling like you've hardly slept at all. Sound familiar? It's a common problem: according to NHS statistics, one third of people in the UK have suffered from insomnia.

Bouts of insomnia, characterised by prolonged problems with sleeping or staying asleep in the absence of a mental

or physiological disorder, can last for months or even years.

The condition often worsens with age, and usually affects the sufferer's ability to function properly in the daytime. Insomniacs frequently complain of lapses in attention, and sleep deprivation has been shown to affect memory (see 'Sleep and memory', p40). Yet little is known about insomnia's causes, and it's difficult to measure its effects objectively. But

recent research is beginning to reveal what insomnia can do to your brain, and it seems that the insomniac's brain physiology is different from those who sleep well.

Dr Ellemarije Altena of the University of Cambridge and colleagues at the Netherlands Institute for Neuroscience, recruited 25 elderly insomniacs and 13 healthy control subjects, and had both groups perform two vigilance tasks. In ►

► one experiment, participants were asked to press a button every time they saw an asterisk appear on a screen. In a second, more complex, task the letters 'p' and 'd' were shown at random, and people had to press only when they saw the letter 'p'.

Using reaction times to assess performance, the researchers found that the control subjects out-performed the insomniacs on the 'p or d' task. Although they made the same number of errors, the controls responded a fraction of a second faster than the insomniacs whenever the letter 'p' appeared. Surprisingly though, the insomniacs performed better on the simpler, 'asterisk' task. The

participants were asked to repeat both tasks about six weeks later. However, in the intervening time, to improve their sleep quality, half of the insomniac group received a combination of treatments, such as cognitive behavioural therapy (CBT) to help them change dysfunctional thoughts about sleep, exposure to bright light for two 30-minute intervals every day, and a number of simple lifestyle changes (see 'Beat insomnia', right).

The combined therapy effectively returned the insomniacs' performance on the tasks to normal levels. Those who received it became significantly slower on the simple task and faster on the complex task when tested later. This outcome



Science is trying to get to the bottom of what makes for a good night's sleep

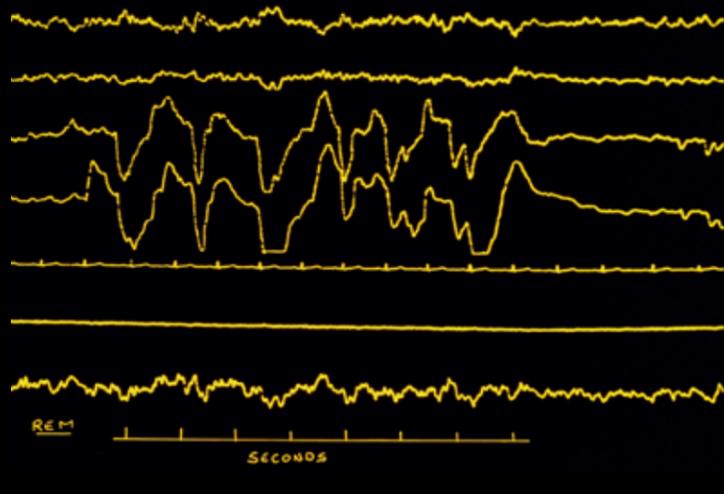
SLEEP AND MEMORY

Don't forget: a good night's sleep is important

Quintilian, a famous first-century Roman teacher of rhetoric, noted the "curious fact that the interval of a single night will greatly increase the strength of memory". And it's now well established that sleep enhances memory consolidation, the process by which newly acquired information is transferred to long-term storage in the brain.

Researchers from the University of Haifa in Jordan have shown that a daytime nap enhances memory recall, and that even a short nap lasting just six minutes is sufficient to aid the processing of memories. The slow brainwave oscillations that occur during short-wave sleep are thought to mark the integration of new information with pre-existing knowledge. Also, changes in the pattern of how genes are switched on or off during rapid-eye-movement (REM) sleep may promote the strengthening of neuronal connectivity that is widely believed to underlie memory formation.

One recent study, led by Susanne Diekelmann of the University of Lübeck in Germany found that sleep deprivation promotes the generation of false memories. This has implications for interrogators, who often use sleep deprivation techniques when questioning suspects.



"Insomniacs suffer from a condition that's best described as a light form of stress"

suggests that insomniac's brains work differently to others, and that some of the cognitive changes associated with insomnia are at least partly reversible.

In another study, Altema and her colleagues found that insomniacs out-perform good sleepers on a verbal fluency task. Test subjects had to press a button whenever a word belonging to a specified category was presented. Again, the performance of the insomniacs who received sleep therapy for six weeks was comparable to that of the healthy control subjects when they were tested again.

"Insomniacs suffer from a physiological condition best described as a light form of stress, which can be measured in higher brain activation when trying to fall asleep," Altema explains. "This hyper-arousal may underlie some of the high-performance levels we observed. It may serve as a compensatory mechanism of the brain to function relatively well during the day, despite the sleeping difficulties."

Structural differences

Altema's group has found that insomniacs' brains are structurally different to those of good sleepers. They used a brain-scanning technique called 'voxel-based morphometry' to measure and compare the volumes of various brain structures in 24 chronic insomniacs and 13 healthy control subjects.

The insomniacs showed reduced volume of grey matter in three different

regions of the brain. Furthermore, the reduced volume of one area, the orbito-frontal cortex, was strongly related to the severity of the insomnia: the more severe a volunteer's complaints, the greater the volume reduction.

The results fit well with the functions of the orbito-frontal cortex, which is known to be involved in decision-making and problem-solving, both of which are significantly impaired following sleep deprivation. But it's unclear whether

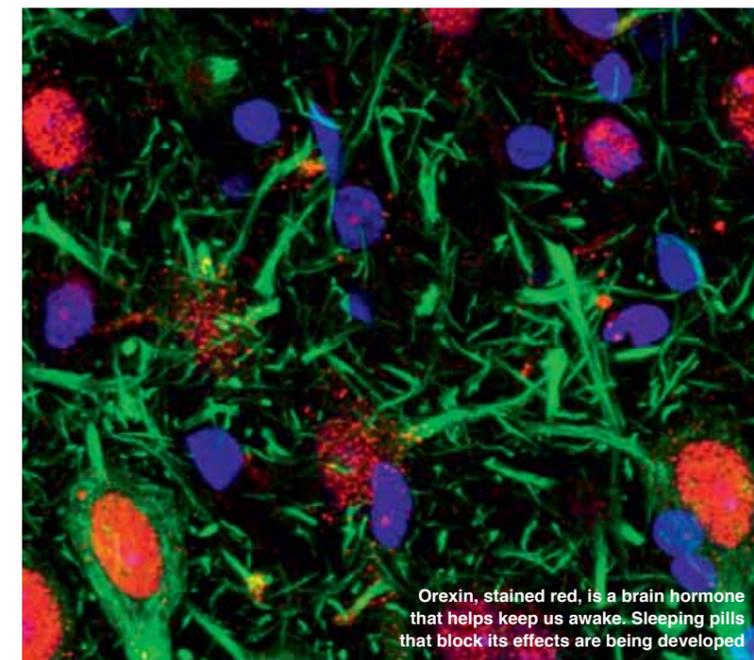
these structural changes cause the insomnia or come after it, although the observation that they were not related to the duration of insomnia suggests that they come first.

"To draw conclusions about the neural mechanisms underlying insomnia we need to investigate which of these effects contribute to the condition and which are consequences of it," says Altema. "Larger studies involving different age groups may show that insomnia can be divided into different sub-types, each of which may have its own cause."

New treatment methods

While the causes of insomnia are unclear, the condition can be treated, and although CBT is effective, access to the treatment could be improved if it was computerised and made available on home computers. This approach to CBT treatments has been shown to effectively treat common mental disorders such as depression, but getting patients to start and then stick to it can be difficult.

A newly launched project aims to develop the first computerised CBT treatment for insomnia, and to improve how patients interact with



Orexin, stained red, is a brain hormone that helps keep us awake. Sleeping pills that block its effects are being developed

BEAT INSOMNIA

ESTABLISH A ROUTINE
Adopting good sleeping habits can help you overcome insomnia and sleeping difficulties. Go to bed and wake up at around the same time every day, and don't try to force yourself to drop off if you aren't feeling sleepy.



RELAX BEFORE BED

Take a nice hot bath an hour or two before going to bed – this will relax you and promote both sleep onset and prolong the duration of deep sleep, because of the effects on body temperature. You should also avoid exposure to bright light in the evening, as this can unsettle the circadian rhythms that regulate sleep.

EAT AND DRINK RIGHT

Caffeine is a stimulant that will disrupt your sleep, so avoid drinking tea and coffee for at least four hours before going to bed. Eating spicy food in the evening can disturb sleep too, although some people find that a small snack before bedtime aids a good night's sleep.

KEEP SLEEP SEPARATE

Your sleeping environment is also important – wear earplugs to block out excessive background noise, and use heavy curtains to reduce the amount of light entering through the window. Finally, your bed is for sleeping, so don't use it for other activities such as watching TV or reading.

such treatments by investigating how people use social media websites such as Facebook and Twitter.

"The way people engage with Facebook very closely mirrors the way in which we want them to engage with computerised CBT treatment," says Dr Shaun Lawson, a computer scientist at the University of Lincoln and principle investigator on the ENACT (Exploiting Social Networks to Augment Cognitive Behavioural Therapy) project.

"A typical Facebook user logs in to the site for up to 30 minutes, but they'll do that several times a day, every day," says Lawson. "They'll also engage in different activities such as playing games, looking at what their friends have posted and updating their own status."

Lawson also notes that people are more willing to disclose personal information on social-networking sites than in real life, and that online games, such as *Farmville*, use rewards and ►

PROF JIM HORNE



Director of Loughborough University's sleep research centre



Do we get enough sleep?

We are obsessed with the amount of sleep we get nowadays, and whether we get enough. Some say that we slept longer in the past, but most people had awful sleeping conditions until about 100 years ago. Circumstances today are much better, and most of us actually sleep very well. Between seven and eight hours a night is probably optimal.

Are current sleeping patterns 'normal'?

Actually, confining sleep to one block in the night is probably not normal. Two sleeping periods a day was a very common practice throughout much of the world, and still is. People in Mediterranean countries have siestas which last several hours, so they only need to sleep four to five hours in the night and can stay up later. Medieval Europeans had what was called a 'fyrste sleep' at about six o' clock in the evening, for about an hour, so they'd feel refreshed for any social activities taking place later on.

Can an afternoon nap be beneficial?

It can be useful, but only under the right circumstances. If you're fully alert, a nap is pointless, but if you're feeling sleepy, it can overcome that and be very refreshing. A nap should be kept short – no more than 20 minutes – otherwise it could develop into full-blown sleep, and you'll feel groggy when you wake up, like you're suffering from jet lag.

What is 'sleep debt'?

It's a term that implies that we have something to pay off. You can make up for lost sleep very quickly, with only a small return of what you've lost. If you normally sleep for seven hours, and miss a night, 10 hours the next night should do the trick. You only need to make up the deep sleep you've lost – light sleep and REM sleep can be forfeited.

What has brain-scanning technology taught us about sleep?

Functional MRI has shown us a bit about what parts of the brain are involved in sleep, but these techniques only get down to a resolution of about one cubic millimetre, or roughly 10,000 neurones. To really understand sleep, we need to get down to the cellular level. 'Neuroglial cells' probably have a lot to do with it, but we still don't know much about them.



► other incentives to ensure that players return to play regularly.

A better understanding of why these activities are so engaging could therefore make computerised CBT treatments even more effective. "Embedding treatments into websites like Facebook might reduce the barrier of maintaining adherence to computerised CBT."

Deeper problems

Insomnia often coincides with depression, but the link is poorly understood, and recent work has led some researchers to argue that insomnia can actually cause mental illness.

In one study, Matt Walker of the University of California, Berkeley, scanned the brains of mentally healthy participants while they viewed a series of emotion-laden and neutral photographs. Compared to those who were not sleep deprived, people who had stayed awake for 36 hours beforehand showed greater brain activity in the amygdala, a small brain structure that processes emotion.

The sleep-deprived group also exhibited reduced connectivity between neurones in the amygdala and the medial prefrontal cortex (MPFC), which normally curtails the emotional response from the amygdala to produce an appropriate reasoned reaction.

Walker and his colleagues concluded that sleep may 'reset' the MPFC-amygdala circuit – maintaining its functional integrity – to prepare for the following day's emotional challenges. They suggest the findings could mean that there's a causal link sleep disruption could cause mood disorder.

But this conclusion is highly speculative, and many sleep researchers aren't convinced. "There's no evidence whatsoever that insomnia causes mental illness," says Prof Jim Horne, director of the Sleep Research Centre at Loughborough University. "It may be true that insomnia and some mental illnesses have common underlying factors. Sleep is affected in people who are depressed, for example, but giving them sleeping tablets won't cure their mental health problems. Pills may help, but they won't get to the underlying cause." Insomnia, it seems, remains somewhat of a mystery. ■

Moheb Costandi is a neuroscientist and science writer

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<http://j.mp/SleepCentre>
Sleep Research Centre at Loughborough University

<http://j.mp/insomniaNHS>
Information about insomnia from the NHS