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Managing salt-sensitivity

Workaround to restricting salt content in people's diet

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'If the salt have lost its savour, wherewith shall it be salted?" asks the apostle, Mathew, in the Bible. But it is this savour that may be the undoing of salt, for salt in human diet is notorious for pushing up blood pressure. A group of researchers in Boston University, however, think there is a way to salt our food and keep our cool, too.

Jesse D Moreira, Parul Chaudhary, Alissa A Frame, Franco Puleo, Kayla M Nist, Eric A Abkin, Tara L Moore, Jonique C George, Richard D Wainford describe, in the journal, *Experimental Physiology*, their work on the mechanism by which salt has this effect on the body. They note that there is a fortunate section of people, who are "resistant" to the rise of BP despite a high-salt diet, and they suggest a way for all of us to follow suit.

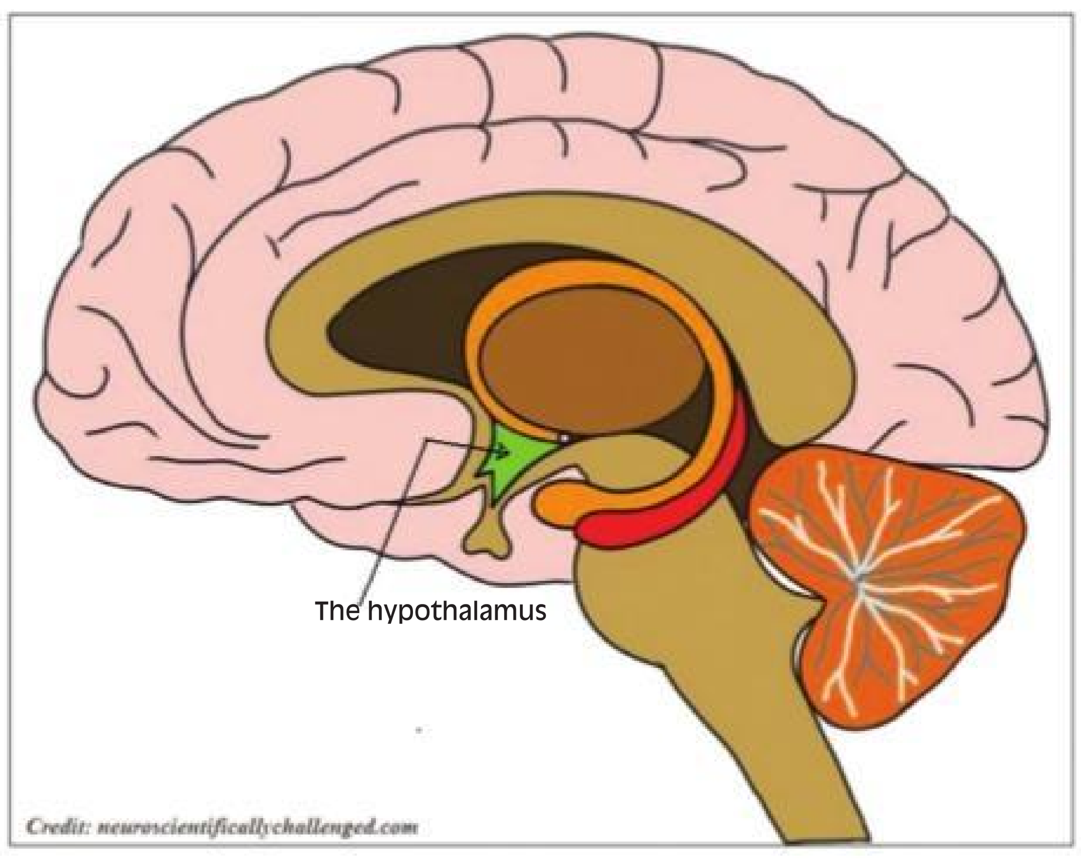
Elevated blood pressure, or hypertension, which the WHO report of 2013 calls a "silent killer and global public health crisis", affects over a billion people, or one in three adults. "It contributes to the burden of heart disease, stroke and kidney failure and premature mortality and disability," the report says, and that hypertension is responsible for nine million deaths each year.

One of the reasons for blood pressure to rise is the increase in the volume of blood in the body. Kidney malfunction, which leads to less extraction of water from the bloodstream, could be a reason. But a more frequent reason is higher salt content in the bloodstream, which leads to processes that retard the kidneys and block the extraction of water. The heightened blood pressure that results also helps to promote excretion of the higher salt content of the blood.

The way this reaction to high salt content comes about is by the action of a part of the brain called the hypothalamus. This almond-sized organ, just above the brain stem, is responsible for a number of automatic responses of the body. One of these is to sense the salt content in the blood. When the hypothalamus senses high levels of salt, it stimulates secretion of a hormone that slows down the action of the kidneys. The high salt level in the bloodstream also draws water out from body cells. The body then feels thirsty and drinks water. All this dilutes the blood, but the volume of the bloodstream increases.

Another, important action of the hypothalamus is to turn on the emergency system of the body in the face of danger or different kinds of stress. This includes hormones that increase the heart rate and constrict the blood vessels. These effects are also seen to chip in when the stress is a high salt content in the blood.

While there are several reasons for a person to be hypertensive, by far the most prevalent is a high salt intake. The diet of primitive humans was largely meat from animals that they hunted, and the meat was eaten raw within hours of the animal being killed. There was almost no salt intake and there is evidence that rising blood pressure was non-existent. It is when agriculture was developed that salt intake grew, with rising incidence of hypertension.



Credit: neuroscientificallychallenged.com

Lewis Dahl, who demonstrated the strong link of high salt intake with hypertension in the 1960s, records that the diet of people living in northern Japan included about 30g of salt in a day and there was almost 40 per cent prevalence of hypertension. Whereas Alaskan natives consumed less than five g of salt in a day and the prevalence of hypertension was almost zero. Initiatives taken in Japan in recent decades have reduced salt intake nation-wide and Japan now has one of the lowest incidences of hypertension.

Dahl also found that of a population of rats fed a high salt diet, three-fourths became hypertensive, but not the remainder. There was hence a genetic element and Dahl was able to breed salt-sensitive and salt-resistant strains. Among humans also, blood pressure tends to rise or fall with salt content in the diet, a condition called salt-sensitivity. But, there is also a salt-resistant group, which gets rid of the salt efficiently and has no rise in blood pressure with a high salt diet.

The group working in Boston notes that while the central mechanisms that lead to salt sensitivity have still not been understood, it could be promising to study the factors at play in "salt-resistance". The group hence carried out trials on experimental mice that had been fitted with a device to wirelessly transmit the blood pressure in the arteries of the animal to observers.

The group refers to previous research, which suggests the role of a specific protein that acts to suppress the body reaction to high salt levels in salt-resistant mice. The protein, and a substance that suppresses the response to the protein were hence administered to the experimental mice over a period of seven days and the behaviour of the blood pressure, and other parameters, was observed. The paper reports that role of the protein in preventing inflammation in the part of the hypothalamus that is associated with salt-sensitivity has been made out.

"Our findings have implications for the development of personalised anti-hypertensive therapeutics designed to target the pathway involved in changing cells to bring about salt-resistance in the body," one of the authors of the study is reported to say, in a press release.

The current approach to managing hypertension is with the use of agents that promote kidney action and urine production or by suppressing the production of hormones that push up the blood pressure as a reaction to stress. The effective way of diet control does not appear to be immediately practicable, one reason being the use of salt as a preservative. Medication has proved useful in the developed world, but uncontrolled hypertension remains a scourge in many countries. Extending the capacity to not become hypertensive even with a salt-rich diet represents a new approach that may eliminate the disease at its root.

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Bound by context

Here's why memories come flooding back when you visit places from your past

ADAM OSTH

We all know our memories get worse as time goes on — your recollection of what you did yesterday is probably a lot better than for the same day three years ago.

And yet we often have moments where old and seemingly forgotten memories pop back into mind. Perhaps you have visited your childhood home, walked into your old bedroom, and been hit with a wave of nostalgia. What triggers this rush of memories, and how can you suddenly remember things you may not have thought about for decades?

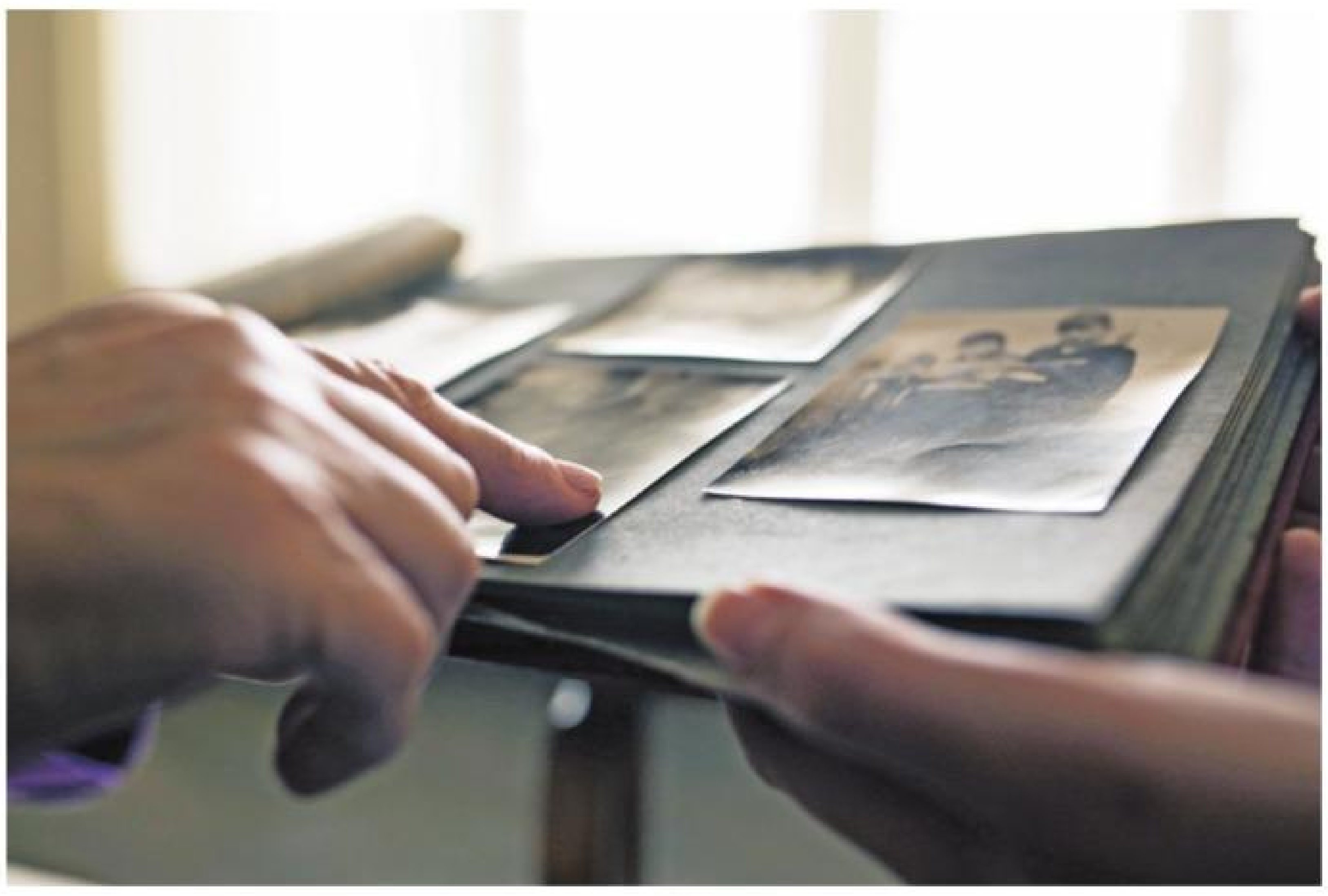
Researchers are realising that the context in which memories are created is crucially important in remembering them later. This idea is known as "contextual-binding theory", and it boils down to three components — context learning, context change, and memory search.

Let's start with learning. It is well established that learning in the brain happens by a process of association. If A and B occur together, they become associated. Contextual-binding theory goes a step further — A and B are associated not just with one other, but also with the context in which they occurred.

What is context? It's not just your physical location — it's a mental state that also comprises the thoughts, emotions, and other mental activity you're experiencing at a given moment. Even as you read this, changes in your thoughts and mental activity are causing your mental context to change.

As a consequence, each memory is associated with different states of context. However, some context states will be similar to each other — perhaps because they share the same location, or mood, or have some other factor in common.

This similarity between contexts is important when it comes to retrieving memories. Your brain's memory search process is rather like a *Google* search, in that you're more likely to find what you're looking for if your search terms closely match the source content. During memory search, your current mental context is your set of search terms. In any given situation, your brain is rapidly rifling through your memories for ones that most closely resemble your current state of context.



Simple but deep

These mechanisms are simple, but the implications are profound. According to the theory, you're most likely to remember memories from contexts that are similar to the context you're in now. Because your mental context is always changing, your mental context will be most similar to recently experienced memories. This explains why it's harder to remember older events.

But, of course, older memories aren't permanently forgotten. If you can change your context to resemble those from seemingly long-forgotten memories, you should be able to remember them. This is why those old memories come flooding back when you step into your childhood bedroom or walk past your old school.

Context-dependent memory was confirmed by an ingenious 1975 experiment in which divers memorised lists of words and were then tested both on land and underwater. On land, their recall was best for the words they had learned on land, whereas underwater they were better at remembering the word lists they learned underwater.

This phenomenon isn't limited to physical locations. You may have noticed that when you're sad about something, you tend to remember other sad events from your life. This is because your mood and emotions also comprise your mental context. Experiments have confirmed that memory is enhanced when your current mood matches the mood in which you learned the information.

More than a century's worth of studies have confirmed we are also better at remembering things if we experience them at different times, rather than repeatedly in quick session. This is one of the main reasons why, when preparing for exams, a regular study routine is more effective than cramming.

According to the theory, rapidly repeated material is associated with a single state of context, whereas material repeated across different times and events is associated with several different states of context. This pays off later, when you're sitting in the exam hall desperately trying to recall the chemical formula for potassium permanganate, because your current state of context will be more likely to match one of the many states of context in which you so diligently did your chemistry revision.

Context in the brain

Contextual-binding theory can potentially explain a host of other phenomena, such as the effects of brain damage on memory. People with damage to a region in the centre of the brain called the hippocampus are often unable to form new memories. We suspect this is where context-binding actually occurs, especially given that the hippocampus receives inputs from virtually all other brain regions, enabling associations between different sights, smells, physical sensations, and emotions.

A competing theory, known as systems consolidation theory, instead proposes that memories are initially stored in the hippocampus but are gradually transferred and strengthened in other brain regions over time.

This theory is supported by the fact that memory for new material is better when you rest after learning. Time spent resting may give the brain a chance to consolidate new memories.

However, contextual-binding theory can also potentially explain this benefit. Resting immediately after learning, as opposed to carrying on shovelling facts into your brain, means fewer memories share the same context, making them easier to distinguish when you revisit that context later.

This also explains why rest is also beneficial before learning, as well as after. And it underpins the tried and tested advice for hardworking students everywhere — don't forget to get lots of sleep!

The writer is senior lecturer, University of Melbourne, Australia. This article first appeared on www.theconversation.com

PLUS POINTS

Low power chips

Researchers from the Indian Institute of Technology, Hyderabad, have developed low power chips that can be used in Artificial Intelligence-powered devices. They have made magnetic quantum-dot cellular automata-based nano-magnetic logic architectural design methodology of approximate arithmetic circuits. The researchers are working towards a vision of realising resource constrained magnetic chips for ultra low power portable artificial intelligent applications.

Many modern systems such as speech and face recognition systems and IoT-enabled devices for remote health monitoring require highly computationally and energy-intensive neural networks. Hence, it is not practically affordable to perform these computations in the portable hand-held devices. With these major limitations, all the machine learning algorithms used in these Artificial Intelligent applications runs on remote systems.

The IIT-Hyderabad researchers from the Advanced Embedded Systems and IC Design Laboratory, department of electrical engineering, have conducted extensive research in this area and as a proof of concept demonstration, they have shown "Dipole coupled MQCA based efficient approximate nanomagnetic subtractor and adder design approach."

The research was undertaken by a team comprising Santhosh Sivasubramani, PhD scholar, Advanced Embedded Systems and IC Design Laboratory, department of electrical engineering, IIT Hyderabad, Amit Acharyya, associate professor, department of electrical engineering, IIT Hyderabad, and Chandrajit Pal, post-doctoral research fellow, IIT Hyderabad. The research has been published in the peer-reviewed journal, *Nanotechnology*.

Speaking about the outcomes and benefits of this research, Acharyya said, "We have computationally modelled, designed and implemented an arithmetic adder, subtractor and add/sub using nanomagnets, which are the basic building blocks of performing AI computing. We are aware that the emerging edge computing devices are handy in size as well as requiring low-power computation and are also tolerant to feeble decrease in precision. The reported work of ours' targets such devices, where there is a significant investment in the research towards making it low power without compromising on accuracy too much. Performing AI computing on edge with approximate nanomagnetic logic deployed on the magnetic ICs is an attempt towards the futuristic computations. I hope this work paves the way towards achieving such a vision."

Changing 'accents'

Marmoset monkeys rapidly adapt their dialects when they move to new territories — changing their "accents" in just a few weeks, a new study shows. Adapting their calls could be a way to signal their interest in the new group and increase the chance of meeting a partner, according to the paper published in *Plos One*.

Like humans, marmosets raise their offspring with the help of the entire group, which could be another reason why they need "language skills", according to scientists from the University of Zurich. Senior author Judith Burkart told *The Independent*, "It's rather like what you in England call accents. All the calls are high pitched so for the human ear it's hard to hear these differences but using acoustic analysis we could locate these calls to distinct areas. The ear of the marmoset is much more in tune to these calls so the differences are clearly audible to them."

Scientists already knew marmoset calls varied from one region to the next but they didn't know why. They thought it could be caused by genetic differences, environmental factors or learnt through social learning. To answer this, they analysed the calls of common marmosets — which normally travel around in groups of between three and 15 individuals — before and after they moved to a new colony. They looked at captive marmosets in three colonies in Spain, Italy and Switzerland. Each group did not have direct contact with the new group but they still adapted their calls in as little as a few weeks.

Scientists say the study shows the common marmoset is an important model system to understand the origins of language.

The Independent