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An Artificial Network Kept on The 'Edge of Chaos' Acts Much Like a Human Brain

Achievement that could be used to produce AI that acts much like the human brain

David Nield

Researchers have demonstrated how to keep a network of nanowires in a state that's right on what's known as the edge of chaos – an achievement that could be used to produce artificial intelligence (AI) that acts much like the human brain does.

The team used varying levels of electricity on a nanowire simulation, finding a balance when the electric signal was too low when the signal was too high. If the signal was too low, the network's outputs weren't complex enough to be useful; if the signal was too high, the outputs were a mess and also useless.

"We found that if you push the signal too slowly the network just does the same thing over and over without learning and developing. If we pushed it too hard and fast, the network becomes erratic and unpredictable," says physicist Joel Hochstetter from the University of Sydney and the study's lead author.

Keeping the simulations on the line between those two extremes produced the optimal results from the network, the scientists report. The findings suggest a variety of brain-like dynamics could eventually be produced using nanowire networks.

"Some theories in neuroscience suggest the human mind could operate at this edge of chaos, or what is called the critical state," says physicist Zdenka Kuncic from the University of Sydney in Australia. "Some neuroscientists think it is in this state where we achieve maximal brain performance."

For the simulations, nanowires 10 micrometers long and no thicker than 500 nanometers were arranged randomly on a two-dimensional plane. Human hairs can be up to around 100,000 nanometers wide, for comparison. In this case, the problem the network was tasked with was transforming a simple waveform into a more complex type, with the amplitude and frequency of the electrical signal adjusted to find the optimal state for solving the problem – right on the edge of chaos.

Nanowire networks combine two systems into one, managing both memory (the equivalent of computer RAM) and operations (the equivalent of a computer CPU). They can remember a history of previous signals, changing their future output in response to what's happened before, making them memristors.

"Where the wires overlap, they form an electrochemical junction, like the synapses between neurons," says Hochstetter.

Typically, algorithms train the network on where the best pathways are, but in this instance, the network did it on its own.

"We found that electrical signals put through this network automatically find the best route for transmitting information," says Hochstetter. "And this architecture allows the network to 'remember' previous pathways through the system."

That in turn could mean significantly reduced energy usage, because the networks end up training themselves using the most efficient processes. As artificial intelligence networks scale up, being able to keep them lean and as low-powered as possible will be important.

For now, the scientists have shown that nanowire networks can do their best problem solving right on the line between order and chaos, much like our brain is thought to be able to, and that puts us a step closer to AI that thinks as we do.

"What's so exciting about this result is that it suggests that these types of nanowire networks can be tuned into regimes with diverse, brain-like collective dynamics, which can be leveraged to optimise information processing," says Kuncic.

The research has been published in *Nature Communications*.

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Chestnut Compound Shows High Bioactivity against Drug-Resistant Staphylococcus aureus

Molecule from the leaves of the European chestnut tree has the power to neutralize MRSA

Methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the most serious infectious disease concerns worldwide. In 2019, the Centers for Disease Control and Prevention (CDC) labeled it as a 'serious threat.' Now, researchers from Emory University and the University of Colorado have isolated a new molecule from the leaves of the European chestnut tree (*Castanea sativa*) with the power to neutralize MRSA.

The European chestnut, also called the sweet chestnut, is a large deciduous tree belonging to the Fagaceae (beech) family.

It is native to elevated forests from Iran to the Balkans, and its fruit, the chestnut, has been eaten by humans for millennia.

The European chestnut is used by many communities around in the world in their traditional medicines.

In the Kosovar Albanian Alps, decoctions are prepared from the fruits, and they are taken internally to treat headaches and externally to treat hemorrhoids.

In the Marches region of Central-Eastern Italy, decoctions of the fruits are used as a hair wash to give light-colored hair a brown gloss, and a compress is made of the boiled fruit pulp to whiten facial skin.

In parts of Tukey, chestnut flower tea is used to treat hemorrhoids.

And going back to Pietro Andrea Mattioli's 1554 commentary on *Dioscorides's De materia medica*, chestnuts roasted with salt and pepper are attributed with aphrodisiac properties.

"We were able to isolate a molecule, new to science, that occurs only in very tiny quantities in the chestnut leaves," said Dr. Cassandra Quave, a researcher in the Center for the Study of Human Health and the Antibiotic Resistance Center at Emory University and the Department of Dermatology at the Emory University School of Medicine.

"We also showed how it disarms MRSA by knocking out the bacteria's ability to produce toxins."

Previously, Dr. Quave and colleagues found that an extract from the leaves of the European chestnut disarms even the hyper-virulent MRSA strains. Experiments also showed the extract did not disturb normal, healthy bacteria on skin cells.

The researchers also demonstrated how the extract works, by inhibiting the ability of MRSA bacteria to communicate with one another, a process known as quorum sensing.

In the new study, they isolated a novel active triterpenoid, named castaneroxy A, from the plant extract.

Tests on mouse skin infected with MRSA confirmed the molecule's efficacy at shutting down the bacteria's virulence, enabling the skin to heal more rapidly.

The scientists also characterized the crystal shape of castaneroxy A. Understanding the 3D configuration of the crystal is important for future studies to refine and optimize the molecule as a potential therapeutic.

"We're laying the groundwork for new strategies to fight bacterial infections at the clinical level," Dr. Quave said.

"Instead of being overly concerned about treating the pathogen, we're focusing on ways to better treat the patient."

"Our goal is not to kill the microbes but to find ways to weaken them so that the immune system or antibiotics are better able to clear out an infection."

A paper on the findings was published in the journal *Frontiers in Pharmacology*.

Akram M. Salam et al. Castaneroxy A from the Leaves of Castanea sativa Inhibits Virulence in Staphylococcus aureus. Front. Pharmacol, published online June 28, 2021; doi: 10.3389/fphar.2021.640179

https://bit.ly/3qZbcz4

Where did watermelons come from?

This ancient crop is NOT from the Fertile Crescent.

By Benjamin Plackett - Live Science Contributor

The iconic green and red watermelon is a sweet, refreshing summer staple. But it wasn't always so sugary or vibrantly colored. So what did watermelons originally taste and look like, and from where did they originate?

The thirst-quenching fruit isn't from the Fertile Crescent of ancient Mesopotamia, as so many other domesticated crops are, research shows. Susanne Renner, a botanist at Ludwig Maximilian University of Munich in Germany, and her colleagues carried out comprehensive genetic sequencing of the domesticated watermelon (*Citrullus lanatus*) — the kind you might find on supermarket shelves — along with six wild watermelon species.

"We found the modern genomes of the domesticated watermelon are more closely related to the Sudanese wild type than any other that we analyzed," she told Live Science. The Sudanese wild watermelon has some notable differences to the domesticated version. "The flesh is white and not very sweet, and it's mainly used as animal feed," Renner said.

Nevertheless, the genetic similarity between the two species led the researchers to conclude that the Sudanese fruit is probably a precursor to the red and sweet domesticated watermelon, according to the June 2021 study published in the journal the Proceedings of the National Academy of Sciences.

It's likely that ancient farmers cultivated non-bitter variants of the wild watermelon and consequently increased its sweetness over many generations through the domestication process. The red color is probably also thanks to artificial selection, in which farmers likely favored and selectively bred red fruit. When this happened and which civilization is responsible for it is slightly less clear, but Renner attempted to answer this question. She thinks the geographical location of the close wild type relative in Sudan is probably not a coincidence.

We already knew that the ancient Egyptian king Tutankhamun was buried with watermelon seeds 3,300 years ago, but that isn't sufficient proof of a domesticated, sweet watermelon. "The seeds may have been used as savory snacks from a wild watermelon," Renner said.

But then, she found an image of a watermelon-like fruit on an ancient Egyptian tomb painting, thought to be more than 4,300 years old. "The image was originally published back in 1912, but nobody had interpreted it as a watermelon before," Renner said. In a separate tomb, "another image shows the watermelon cut up on a tray alongside other sweet fruits, such as grapes." This realization, coupled with Renner's genetic findings, begin to paint a picture of ancient Egyptians enjoying domesticated and sweet watermelons.

That, in turn, suggests that the watermelon was most likely domesticated around that time either in Egypt or within trading distance of the ancient empire.

***The image of a watermelon-like fruit found in an ancient Egyptian tomb belonging to Chnumhotep in Saqqara.* (Image credit: Sussane Renner)**

"The ancient Nubians who lived in modern-day Sudan are often overlooked in favor of the Egyptians," Renner said. "It could have been the ancient Nubians who domesticated it and traded it with the ancient Egyptians or it could have been the Egyptians, but what my research suggests is that it was somewhere in this region that the watermelon was first domesticated, and the ancient Egyptians were eating them."

Historically speaking, that's a very significant finding, said Hanno Schaefer, a professor of plant biodiversity at the Technical University of Munich. "It's becoming clearer that we've massively

neglected the North African region. We've focused too much on the Fertile Crescent where grains and pulses [edible legume seeds] seem to have originated, but we need to invest more resources into studying the agriculture of North Africa and add those findings to the archaeological evidence," Schaefer told Live Science.

Studying the wild relatives of domesticated crops has an application beyond historical curiosity; it could prove helpful for modern-day breeders and farmers. "There are many traits of wild populations that would be useful in watermelon breeding — they're less susceptible to mold, viruses and insects than domesticated species," Renner said. Knowing more about wild watermelon DNA could help breeders take those beneficial gene variants and implant them into the modern crop without compromising the watermelon's sweet taste and red hue, which has taken so long to acquire through selective breeding.

This could potentially enable watermelon farming to weather the future challenges that climate change will bring, such as drought and higher temperatures, Schaefer said. "I'm sure the industry will be interested in studies tackling the genetics of watermelon."

https://bit.ly/2TWV6K2

3D-Printed Neural Tissue Restores Movement to Paralyzed Rats

A new strategy for 3D-printing neural tissue that mimics white matter shows that repairing spinal cord injuries is possible.

Roni Dengler, PhD

Three-dimensional (3D) printing, the process of creating a physical object from a digital model by laying down successive layers of material, is so ubiquitous that the tech shows up in settings as commonplace as classrooms and the local library. But applying 3D printing to living systems is anything but mundane. 3D printing biological tissue requires creating a stable and flexible scaffold while also keeping cells alive.

Now, researchers have 3D-printed a spinal cord-like scaffold that promoted neuron regeneration. They showed that spinal-cord injured rats recovered motion thanks to the material, demonstrating that 3D printing represents a viable strategy to aid regenerative medicine.

“There is no known effective cure for spinal cord injury,” Zhijun Zhang, a nanobiomedical engineer at the Chinese Academy of Sciences in Suzhou, who led the new research said in an email. Damaged neurons have a limited capacity to regenerate, he said, but 3D-printing biological tissue provides a new strategy for repairing spinal cord injury (SCI).

Zhang and colleagues are not the first to try to treat SCI using 3D printing. Previous efforts ran up against difficulties with keeping cells alive after printing and, if they did survive, getting stem cells to differentiate into the kinds of cells needed for regeneration.

Neural stem cells (NSCs) have the potential to differentiate into neurons, cells that communicate information across the body via electrical impulses. These cells must be in working order for the brain to tell the leg to move, for example. But in the absence of a conducive microenvironment, NSCs also differentiate into astrocytes, a type of nervous system support cell that does not produce electrical impulses.

To overcome these hurdles, Zhang and colleagues developed a novel bioink. Made of chitosan (a sugar found in the outer skeleton of shellfish), different hyaluronic acids (lubricants produced by the body and found in many cosmetic moisturizers), and Matrigel, the bioink gels together in seconds at body temperature. The researchers added NSCs isolated from rat brains to the ink and printed them into 3D scaffolds that mimic the structure of white matter in the spinal cord.

“The 3D bioprinted scaffolds maintained high NSC viability—about 95%—and offered the benign microenvironment that

facilitated cell-material interactions and neuronal differentiation," Zhang said.

To find out whether the NSC-laden scaffolds could heal SCI, the researchers implanted them into the spines of paraplegic rats. The 3D neural scaffolds promoted neuron regeneration and enabled the rats to regain control over their hind legs.

Over 12 weeks, the researchers did not see any movement in the hindlimbs of animals that did not receive a transplant. But rats implanted with NSC-loaded scaffolds moved their hips, knees, and ankles, and kicked at a pressure sensor with remarkable strength, Zhang reported in Biomaterials.[1]

Given the success so far, Zhang wants to apply the approach to spinal cord injuries in humans. Ultimately, he sees bringing 3D bioprinting to the surgical table and is exploring the feasibility of fabricating NSC-laden constructs directly in patients.

"The 3D bioprinting strategy we developed may represent a general and versatile strategy for rapid and precise engineering of the central nervous system and other neuronal tissues for regenerative medicine," he said.

[1]. *X. Liu et al., "3D bioprinted neural tissue constructs for spinal cord injury repair," Biomaterials, 272:120771, 2021.*

https://bit.ly/3hRuZfI

Beautiful Bone Carving From 51,000 Years Ago Is Changing Our View of Neanderthals

Evidence suggests traits we assume are unique to modern humans, may once have been present in our hominin cousins

Conor Feehly

As humans, we like to think we have some pretty unique traits in the animal kingdom. Language enables us to communicate efficiently with one another. Culture preserves and accumulates knowledge through generations. Technology and tools help us solve problems. Symbols and art reveal clues about our complex experiences. A growing body of evidence suggests the traits we tend to assume are unique to modern humans, may once have been present in our hominin cousins, too.

Scientists have now announced the discovery of a 51,000-year-old engraved giant deer bone which was produced by Neanderthals in the Harz Mountains, now northern Germany. The carvings on the deer bone are precisely and artistically arranged into chevron patterns.

***Engraved giant deer phalanx*. (V. Minkus/Leder et al., Nat. Ecol. Evol., 2021)**

Previous evidence of symbolic and artistic traits in Neanderthals has been scarce, but the new findings raise exciting questions about how complex Neanderthal behavior might truly have been. The findings add to previous research already pointing to Neanderthals having complex behavioral traits, such as their capacity to produce and hear the speech sounds of modern humans, their production of tools and technology, and their mourning of the dead.

Archaeologists Dirk Leder, Thomas Terberger and their colleagues carbon dated the deer bone, placing it at 51,000 years old. Microscopic analysis and experimental replication suggests the bone was actually boiled to soften before the engraving took place.

Up until now, Neanderthal artistic evidence amounted to minimalistic motifs and hand stencils on cave walls at three Spanish sites - La Pasiega, Maltravieso, and Ardales.

The authors of the new study believe the engraving of individual lines in the chevron design combined with the fact that these giant deer (*Megaloceros giganteus*) were rare north of the alps at that time, strengthens the idea that the engravings have symbolic meaning and show evidence for conceptual imagination in Neanderthals.

"Archaeological finds of artist engravings are rare and, in some

cases, ambiguous. Evidence of artistic decorations would suggest production or modification of objects for symbolic reasons beyond mere functionality, adding a new dimension to the complex cognitive capability of Neanderthals," writes Silvia Bello from the Natural History Museum in London, in an accompanying News & Views article published in *Nature*. "The choice of material, its preparation before carving and the skillful technique used for the engraving are all indicative of sophisticated expertise and great ability in bone working," adds Bello.

A question at the heart of this research is whether these Neanderthals were influenced by ancient *H. sapiens* contemporaries in the production of this type of carved bone.

Leder, who works at the State Service for Cultural Heritage Lower Saxony, and colleagues believe that Neanderthals had the manual and intellectual capabilities to produce the artifact independently of any modern human influence. They support their hypothesis with archaeological evidence that suggests *H. sapiens* arrived in Central Europe several millennia after the engraved bone was dated.

However, given recent evidence for the exchanging of genes between Neanderthals and modern humans over 50,000 years ago, Bello thinks we can't rule out the possibility *H. sapiens* had some influence on Neanderthals producing these types of artifacts.

"Given this early exchange of genes, we cannot exclude a similarly early exchange of knowledge between modern human and Neanderthal populations," she writes.

"The possibility of an acquired knowledge from modern humans doesn't undervalue, in my opinion, the cognitive abilities of Neanderthals. On the contrary, the capacity to learn, integrate innovation into one's own culture and adapt to new technologies and abstract concepts should be recognized as an element of behavioral complexity."

The research was published in *Nature Ecology and Evolution*.

https://go.nature.com/3jXCJiU

Beetles make 'Teflon' to grease their knees

The protein-based substance found in the leg joints of beetles and at least one other insect is a superb lubricant.

The leg joints of beetles are lubricated with a versatile substance that is as hard-wearing as Teflon.

Until now, scientists have had little understanding of how insects' joints reduce friction and are protected from wear and tear. Vertebrates have enclosed joints that are bathed in a liquid lubricant, which minimizes friction and helps to protect the surfaces of bones where they meet. But insects have an external skeleton, and their joints are open to the air.

Konstantin Nadein at the Christian-Albrechts University of Kiel in Germany and his colleagues used a scanning electron microscope to image the 'knee' joint of the darkling beetle (*Zophobas morio*). They found that the joint's surfaces are covered in pores through which a protein-based substance oozes. Chemical analysis found that this is made up of proteins and fatty acids.

When the authors compared this grease to other lubricants experimentally, they found that the substance reduced friction to a similar degree as the chemical coating Teflon. They also found pores and lubricant in the joints of several other species of beetle and a wood roach. *Proc. R. Soc. B* (2021)

https://bit.ly/2UxW13G

How the pelvis, and not bipedalism, gave humans their narrow hips

The anatomy of our pelvis is a result of an evolutionary trade-off, but perhaps it's not the one we thought

Darcy Shapiro

Giving birth is generally a difficult process for humans, often requiring long hours of labor and help from other people, but this doesn't seem to be the case for our closest living relatives, the

African apes. The obvious explanation is that we give birth to relatively large, big-brained babies through a pretty narrow pelvic opening, while the opposite is true for our ape cousins. But *why* we ended up in this painful evolutionary predicament is still an open question, one that anthropologists recently teamed up with an engineer to try to answer. It turns out, we might've been focusing on the wrong reason for that narrow pelvis all along.

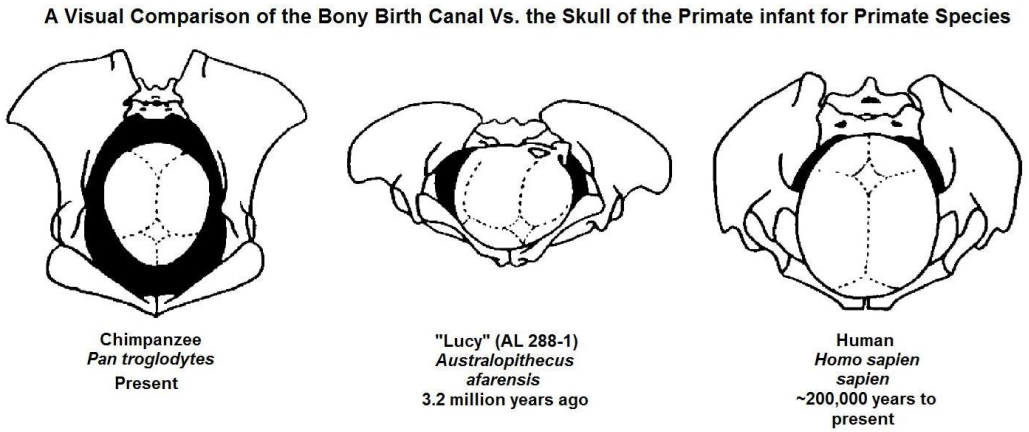
For decades, the conventional wisdom among anthropologists was that the anatomy of the female pelvis is an evolutionary compromise between the demands of our unique style of locomotion, bipedalism, and the demands of giving birth to big babies. A narrower pelvis was thought to make walking and running more energy-efficient, while a wider pelvis would allow for a larger birth canal. This trade-off is often called the "obstetrical dilemma."

The supposed dilemma has been challenged recently, in part because the fields of paleoanthropology and human evolutionary biology are becoming more diverse, with a greater variety of lived experiences being brought to bear on key questions about our evolution. Anthropologists have now experimentally demonstrated that a person's sex doesn't make a difference to their running or walking efficiency and that effective bipedal locomotion isn't impaired by a wider pelvis, for example. Additionally, human birth canals aren't uniform in size and shape around the world; if this trade-off was so critical, we would expect less variability.

So, if locomotion isn't the main pressure driving selection for a narrow pelvis, what is? A paper published this year in *PNAS* suggests that pelvic floor function might actually be behind it, instead.

The pelvic floor is the set of muscles and connective tissue that forms the base of the pelvic canal; if the bones of your pelvis are the sides of a bowl, the pelvic floor is its bottom. The pelvic floor plays a really important role in supporting our internal organs and the weight of a large fetus and maintaining continence (your ability to control your bowels and bladder).

The size and shape of a person's bony pelvis dictates the size and shape of their pelvic floor, and there seems to be a bit of a Goldilocks situation happening here – it can't be too big or too small. The pelvic floor needs to be strong enough to support the weight placed on it and deal with changes in pressure within the abdomen caused by normal activities like coughing, while also being stretchy enough to allow for birth. The size and thickness of the pelvic floor is where the trade-off between strength and stretchiness happens.



***Human infants have much larger skulls, and must pass through a much narrower pelvis, than other apes or hominids*. ArchaeoMouse on Wikimedia Commons**

This study serves as a reminder that there's a lot more to our evolutionary history than bones alone can tell us

The new study came to this conclusion by testing the "pelvic floor hypothesis" using a series of mathematical models informed by experimental data from MRIs. The modeling technique allowed the researchers to vary the size and thickness of a hypothetical pelvic floor, and measure how much stretch and stress it experienced at

different sizes and thicknesses. They found that the pelvic floor bent out of shape more, and the tissue experienced greater stresses and stretches, as its size increased. Increasing the thickness of the pelvic floor only partially compensated for this and came with its own downsides, like the fact that a thicker pelvic floor would require much higher abdominal pressure for giving birth and possibly also for pooping.

These results support the "pelvic floor hypothesis" and complicate the previous idea that the main evolutionary trade-off driving human pelvic evolution was between a narrower pelvis for efficient locomotion and a wider pelvis for a more spacious birth canal. Instead, it looks like a major pressure driving selection for a narrower pelvis was actually the task of suspending a sufficiently supportive pelvic floor – one still allows for birth, but prevents rupture and prolapse.

Ultimately, this study serves as a reminder that there's a lot more to our evolutionary history than bones alone can tell us, and that it will only continue to come into greater focus when people with new, different perspectives can weigh in on the stories previous researchers have told about our shared human past.

https://bit.ly/3yFMXsi

Poop Transplants Have Been Linked to Improved COVID-19 in Two Patients in Poland

Scientists will soon begin proper clinical trials to see if poop transplants really can help people recover from COVID-19.

Carly Cassella

The decision was spurred on by curious results from two recent hospital patients in Poland - an 80-year-old man with pneumonia, and an immunosuppressed 19-year-old man - who both received fecal transplants for severe *C. difficile* infections.

Unbeknownst at the time, these patients also had COVID-19. Its symptoms began to show up shortly after the two received their poop transplant, and yet even though both individuals were particularly vulnerable to SARS-CoV-2, their cases were only mild and their fevers cleared up within just a couple days.

There's no way to know how either would have coped without the poop transplant, so it's hard to pin down their fast recovery to any one source. That said, the coincidence is intriguing enough for scientists to investigate further.

After all, this isn't the first time experts have proposed using poop transplants to treat COVID-19. A person's gut microbiota is closely linked to their immune system, and COVID-19 can cause distinct disturbances in the gastrointestinal tract.

Some other initial reports suggest poop transplants can somewhat restore the balance of gut bacteria after COVID-19, but nobody has yet done any hard investigations on whether the treatment is useful clinically or even safe.

Poop transplants are carefully screened for infections when used as treatment, but there's always the chance some dangerous pathogen sneaks through, and in a global pandemic that prospect is even riskier.

Nevertheless, researchers think the two rapid recoveries in Poland are promising enough to merit further exploration. Most patients who develop COVID-19 show evidence of the virus in their feces for roughly 28 days, but in these two recent cases, the viral matter disappeared from stool samples much faster.

The 19-year-old, despite having a compromised immune system, wasn't even treated for the SARS-CoV-2 infection; he simply got better on his own within a day.

Meanwhile, the 80-year-old patient was given a cutting edge treatment that usually takes about 10 days to kick in. Two days after receiving a poop transplant, his fever broke and never recurred again.

"Our main conclusion from these cases is that a fecal microbiota

transplant appears safe and of comparable efficacy in treating recurrent *C. difficile* infection in patients with coexisting COVID-19," the researchers write in a letter describing the case.

"A further more speculative question is whether a fecal microbiota transplant may impact the clinical course of COVID-19."

It's possible, for instance, that poop transplants could boost the immune system in those with COVID-19, triggering a cascade of molecular changes from the presence of certain bacteria.

Some research even suggests the gut's microbiome can impact the respiratory system; in turn, this could boost the lungs' resistance to COVID-19.

We still know surprisingly little about how the gut impacts the immune system, or how poop transplants ultimately may contribute to the process, but it's worth investigating if this treatment really can help us clear severe viral infections. The authors of the current letter intend to begin recruiting for their clinical trials shortly.

The case study was published in *Gut*.

https://bit.ly/3hrAXVE

Iceland Ran a 4-Year Experiment on Shorter Working Weeks. The Results Are Great

For four years between 2015 and 2019, roughly 2,500 Icelanders were involved in two major experiments to see how a shorter working week would affect productivity.

David Nield

Now the results are in – and the experiments seem to have been a resounding success.

Some key points: reducing a 40-hour working week to 35 or 36 hours didn't lead to any drop in productivity or the provision of services, while worker wellbeing improved substantially across a range of metrics, including perceived stress and burnout.

Since the trials were carried out, around 86 percent of the entire workforce in Iceland has moved to a shorter working week, and there's hope from the researchers behind the tests that these ideas could be applied in other countries as well.

"Across both trials, many workers expressed that after starting to work fewer hours they felt better, more energized, and less stressed, resulting in them having more energy for other activities, such as exercise, friends and hobbies," states the published report. "This then had a positive effect on their work."

A wide range of workplaces were involved in the four-year period covered by the trials, from hospitals to offices, and over 1 percent of the entire working population of Iceland took part. Employees were kept on the same pay even though their hours were cut.

And the hours really were cut – the results published by the Association for Sustainability and Democracy (Alda) in Iceland, and the UK think-tank Autonomy, showed that there was no noticeable rise in overtime for the majority of staff. Shorter meetings, shift changes and the cutting out of unnecessary tasks all helped workers stick to their new regime.

Working four or five fewer hours per week actually forced people to get creative with how they did their jobs – and while some participants in the trials said they initially struggled to adapt, most of those involved soon got used to a new way of working.

"Instead of doing things the same, usual routine as before, people re-evaluated how to do things and suddenly people are doing things very differently from before, and people also co-operated in this," said one of the participants in the trials.

On the wellbeing side, those involved reported less stress at work and a better work-life balance on the whole. In follow-up interviews, participants mentioned benefits including having more time to do errands and home duties, having more time to themselves, and being able to do more exercise.

The published report declares the trials in Iceland "a major success", with both managers and staff managing to spend less time at work

without actually affecting the amount and quality of the work they do – something we've seen in previous research.

Perhaps most tellingly, the majority of participants were keen to carry on with the new way of working – something to consider as workplaces around the world readjust to the ongoing impact of the coronavirus pandemic.

"It has become more and more clear that few wish to return to pre-pandemic working conditions: a desire for a reduced working week is set to define 'the new normal'," concludes the report.

You can read the report in full on the Alda website here.

https://bit.ly/3r0uDHB

New Modeling Study Points toward Biological Origin of Enceladus' Methane

Probability that biotic methane production might explain the escape rates of molecular hydrogen and methane in Enceladus's plume, as measured by Cassini.

Observations from NASA's Cassini spacecraft established that Enceladus, the sixth-largest of Saturn's moons, has a **global subsurface ocean**. An analysis of a plume of ice grains and water vapor ejected into space **suggested** that hydrothermal vents are present on the moon's seafloor. On Earth, such deep-sea vents harbor ecosystems rich in methane-producing microorganisms. Now, planetary researchers in the United States and France have constructed mathematical models to calculate the probability that a process called methanogenesis (biotic methane production) might explain the escape rates of molecular hydrogen and methane in Enceladus's plume, as measured by Cassini.

Enceladus' tiger stripes are known to be spewing ice from the moon's icy interior into space, creating a cloud of fine ice particles over the moon's south pole and creating Saturn's mysterious E-ring. Evidence for this has come from NASA's Cassini spacecraft that orbited Saturn from 2004 to 2017. Pictured here, a high resolution image of Enceladus is shown from a close flyby. Tiger stripes are visible in false-color blue. Image credit: NASA / ESA / JPL / SSI / Cassini Imaging Team.

"We wanted to know: could Earthlike microbes that eat the dihydrogen and produce methane explain the surprisingly large amount of methane detected by Cassini?" said Dr. Regis Ferriere, a researcher in the Institut de Biologie de l'École Normale Supérieure, the University of Arizona and iGLOBES,

"Searching for such microbes, known as methanogens, at Enceladus' seafloor would require extremely challenging deep-dive missions that are not in sight for several decades."

In the new study, Dr. Ferriere and colleagues constructed mathematical models to calculate the probability that different processes, including biological methanogenesis, might explain the Cassini plume data.

They applied new mathematical models that combine geochemistry and microbial ecology to analyze the Cassini data and model the possible processes that would best explain the observations.

Their results suggest that even the highest possible estimate of abiotic methane production based on known hydrothermal chemistry is far from sufficient to explain the methane concentration measured in the plumes.

Adding biological methanogenesis to the mix, however, could produce enough methane to match Cassini's observations.

"Obviously, we are not concluding that life exists in Enceladus' ocean," Dr. Ferriere said.

"Rather, we wanted to understand how likely it would be that Enceladus' hydrothermal vents could be habitable to Earthlike microorganisms. Very likely, the Cassini data tell us, according to our models. And biological methanogenesis appears to be compatible with the data. In other words, we can't discard the 'life hypothesis' as highly improbable. To reject the life hypothesis, we

need more data from future missions."

The researchers hope their results provide guidance for studies aimed at better understanding the observations made by Cassini and that they encourage research to elucidate the abiotic processes that could produce enough methane to explain the data.

"For example, methane could come from the chemical breakdown of primordial organic matter that may be present in Enceladus' core and that could be partially turned into dihydrogen, methane and carbon dioxide through the hydrothermal process," Dr. Ferriere said. "This hypothesis is very plausible if it turns out that Enceladus formed through the accretion of organic-rich material supplied by comets."

The findings were published in the journal *Nature Astronomy*.

A. Affholder et al. *Bayesian analysis of Enceladus's plume data to assess methanogenesis.* Nat Astron, *published online June 7, 2021; doi: 10.1038/s41550-021-01372-6*

https://bit.ly/3k17MKz

Dark wings supercharge seabird flight

Dark feathers absorb more heat, which improves flight efficiency

By Mennatalla Ibrahim

Most birds that swoop over ocean waters have one thing in common: dark wings. Now scientists think they know why. Dark feathers absorb more heat, which improves flight efficiency, allowing these birds to fly faster and longer than those with lighter-colored wings.

Researchers had investigated this mystery before. Whereas most scientists have focused on the typical functions of colors, such as how birds' feathers can help them with mating, hiding from predators, or finding food, others have looked at how darker feathers might improve flight efficiency. These experiments, which included 3D printed wings, led to conflicting results, however.

So in the new study, researchers tried to better replicate the real world. Evolutionary biologists at Ghent University examined museum specimens of 324 species of seabirds, including ospreys, northern gannets, and great black-backed gulls. When they compared the wing coloration of these birds with what is known about their flight performance, they found that darker-winged birds tended to be better flyers.

The team then stuffed two real northern gannet wings with cotton and propped them up in a wind tunnel. One wing was white with black tips, the other was dark all over. The scientists altered wind speeds and wing position; they also simulated various Sun intensities with infrared light bulbs. The dark wing heated up more, as expected. But this hotter wing was also more efficient, experiencing up to 20% less drag than the lighter wing, the team reports this week in the *Journal of the Royal Society Interface*.

Unlike birds that live on land, seabirds fly for long periods of time in extreme heat and wind, notes co-author Matthew Shawkey, also at Ghent University. Similar adaptions may also be used by other species that fly long distances, such as butterflies, he says.

The findings of this "great project" could also be used to improve drone technology and the aviation industry, says Mostafa Hassanalian, a mechanical engineer and biomimicry researcher at the New Mexico Institute of Mining and Technology who was not involved with the work. "This is actually going to be the future of science, where the combination of two different areas like this helps us to come up with new studies."

https://bit.ly/3wxSNdV

Glass catalysis screening study prompts reactionware rethink

Glass can accelerate various base-catalysed reactions as well as the degradation of base-labile biomolecules, new research shows.

By Eleanor Clifford

The team used a high-throughput system capable of screening thousands of reaction conditions per hour to test how various base-

catalysed chemical reactions, including elimination, solvolysis, imine formation, Katritzky reaction and Knoevenagel condensation, are affected by the addition of glass microspheres

Glass can accelerate various base-catalysed reactions as well as the degradation of base-labile biomolecules, new research shows. The work serves as a reminder for chemists to carefully select what containers they use to store chemicals and perform reactions in.

Last year, Yangjie Li and colleagues in Graham Cooks' lab at Purdue University, US, reported how glass surfaces can accelerate the Katritzky transamination reaction. Doubting that they'd been lucky enough to 'spot the only one reaction that can be accelerated by glass, I thought maybe we should try all the important organic reactions,' explains Li.

The group has now used a high throughput system to screen the rates of various reactions in the presence and absence of glass microspheres. To their surprise, they found that all the base-catalysed reactions, including elimination, solvolysis, condensation and oxidation reactions, were accelerated by glass. They attribute this to strongly basic silanolate groups on the glass surface, which can participate in the reaction directly, or indirectly, by converting protic solvents into their conjugate bases. The acceleration effects were larger at lower concentrations, as a greater proportion of the material was at the glass surface.

They also found that glass accelerates the degradation of phospholipids. Yu Xia, a bioanalytical chemist at Tsinghua University in China, says the lipidomics community should take note because lipids are often stored in glass containers to avoid plastic contamination. 'This new finding clearly prompts caution on the use of methanol or other protic organic solvents for lipid storage in glass containers, as this effect can lead to both false identification and inaccurate quantification in lipid analysis.'

Cooks hopes the work encourages chemists to think carefully about which containers they store chemicals and perform reactions in, 'especially if you're going to be working at very low concentrations, which is increasingly the case, as that's where these effects come in.'

While they might alarm organic and analytical chemists, the findings also highlight the potential of glass as a green heterogeneous catalyst. 'You can just simply rinse it and the whole catalytic power is recovered,' says Li. 'It's a good way of avoiding corrosive chemicals.' Li and colleagues achieved reactions rates that were up to 1000 times faster using glass. As the acceleration is dependent on the glass's surface area, there is potential to increase these even rates even further.

References This article is open access Y Li et al, Chem. Sci., *2021*, *DOI: 10.1039/d1sc02708e*

https://bit.ly/3xyTQvq

Handwriting beats typing and watching videos for learning to read

New study finds we shouldn't be so quick to throw away the pencils and paper

Though writing by hand is increasingly being eclipsed by the ease of computers, a new study finds we shouldn't be so quick to throw away the pencils and paper: handwriting helps people learn certain skills surprisingly faster and significantly better than learning the same material through typing or watching videos.

"The question out there for parents and educators is why should our kids spend any time doing handwriting," says senior author Brenda Rapp, a Johns Hopkins University professor of cognitive science. "Obviously, you're going to be a better hand-writer if you practice it. But since people are handwriting less then maybe who cares? The real question is: Are there other benefits to handwriting that have to do with reading and spelling and understanding? We find there most definitely are."

The work appears in the journal *Psychological Science*.

Rapp and lead author Robert Wiley, a former Johns Hopkins University Ph.D. student who is now a professor at the University of North Carolina, Greensboro, conducted an experiment in which 42 people were taught the Arabic alphabet, split into three groups of learners: writers, typers and video watchers.

Everyone learned the letters one at a time by watching videos of them being written along with hearing names and sounds. After being introduced to each letter, the three groups would attempt to learn what they just saw and heard in different ways. The video group got an on-screen flash of a letter and had to say if it was the same letter they'd just seen. The typers would have to find the letter on the keyboard. The writers had to copy the letter with pen and paper.

At the end, after as many as six sessions, everyone could recognize the letters and made few mistakes when tested. But the writing group reached this level of proficiency faster than the other groups - a few of them in just two sessions.

Next the researchers wanted to determine to what extent, if at all, the groups could generalize this new knowledge. In other words, they could all recognize the letters, but could anyone really use them like a pro, by writing with them, using them to spell new words and using them to read unfamiliar words?

The writing group was better - decisively - in all of those things.

"The main lesson is that even though they were all good at recognizing letters, the writing training was the best at every other measure. And they required less time to get there," Wiley said.

The writing group ended up with more of the skills needed for expert adult-level reading and spelling. Wiley and Rapp say it's because handwriting reinforces the visual and aural lessons. The advantage has nothing to do with penmanship - it's that the simple act of writing by hand provides a perceptual-motor experience that unifies what is being learned about the letters (their shapes, their sounds, and their motor plans), which in turn creates richer knowledge and fuller, true learning, the team says.

"With writing, you're getting a stronger representation in your mind that lets you scaffold toward these other types of tasks that don't in any way involve handwriting," Wiley said.

Although the participants in the study were adults, Wiley and Rapp expect they'd see the same results in children. The findings have implications for classrooms, where pencils and notebooks have taken a backseat in recent years to tablets and laptops, and teaching cursive handwriting is all but extinct.

The findings also suggest that adults trying to learn a language with a different alphabet should supplement what they're learning through apps or tapes with good old-fashioned paperwork.

Wiley, for one, is making sure the kids in his life are stocked up on writing supplies.

"I have three nieces and a nephew right now and my siblings ask me should we get them crayons and pens? I say yes, let them just play with the letters and start writing them and write them all the time. I bought them all finger paint for Christmas and told them let's do letters."

The work was supported by the Science of Learning Institute at Johns Hopkins University, and the Dingwall Foundation Dissertation Fellowship in the Cognitive, Clinical, and Neural Foundations of Language.

https://bit.ly/3e5uxcv

Stroke treatment may backfire when kidneys don't work well

Excessive blood pressure reduction for acute intracerebral hemorrhage is risky in people with lowered kidney function

Researchers at the National Cerebral and Cardiovascular Center in Japan show that excessive blood pressure reduction for acute intracerebral hemorrhage is risky in people with decreased kidney

function

Suita, Japan -- Stroke and chronic kidney disease are both difficult to handle in their own rights, but having a stroke when your kidneys are already poor is more than just double the trouble. A new study led by Kazunori Toyoda at the National Cerebral and Cardiovascular Center (NCVC) in Japan shows that excessive blood pressure reduction for acute intracerebral hemorrhage can have dire consequences when kidney function is low. The study was published in the scientific journal *Neurology*®.

Intracerebral hemorrhage is a disease for which effective treatment is expected to be established. Abnormally high blood pressure is usually observed in the acute phase of intracerebral hemorrhage. Previous clinical studies have shown that intense blood pressure reduction in acute intracerebral hemorrhage patients can improve the clinical outcome. However, excessive blood pressure reduction can damage the kidneys, especially in people who already have chronic kidney disease. "Without a clear understanding of how kidney function affects the overall outcome when controlling blood pressure in these situations, doctors cannot make the best decisions for immediate stroke treatment," senior co-author Masatoshi Koga explains.

Kidney function is typically assessed using the estimated glomerular filtration rate (eGFR), which evaluates how well your kidneys are filtering out toxins from the blood. To determine if kidney function can affect the outcome after intracerebral hemorrhage, the researchers looked at data from an NIH-funded clinical trial, the Antihypertensive Treatment of Acute Cerebral Hemorrhage II (ATACH-2), led by Professor Adnan I. Qureshi, a co-author of this article. In ATACH-2, patients within 4.5 hours of onset of intracerebral hemorrhage were randomly assigned to the intensive antihypertensive group (systolic blood pressure 110-139 mmHg) or the standard antihypertensive group (140-179 mmHg) and maintained in the target blood pressure range for 24 hours. The primary endpoint of the study was the rate of death or severe functional disability at 3 months.

In the current study, researchers divided patients into three categories based on their eGFR at the time of admission, which correspond to normal function, mild loss of function, and decreased kidney function.

The researchers found that the rate of death or disability after stroke was almost 50% in patients with decreased kidney function, compared with about 32% in patients with normal kidney function. They next looked at what happened when patients were treated with an intensive blood pressure-lowering regimen. They found that compared with the standard treatment, the effect of this intense treatment changed depending on the eGFR levels at admission. Among patients with decreased kidney function, the odds of death or disability were higher in patients treated with intensive blood pressure-lowering compared with those with standard blood pressure control. In contrast, the treatment effect (intensive vs. standard) was similar among the other two groups.

First author Mayumi Fukuda-Doi thinks that these findings have important implications. "Although intense lowering of blood pressure can reduce the risk of hematoma expansion and prevent brain damage after stroke, we found that it can harm those with eGFR values less than 60, who have decreased kidney function," she says. "Detailed mechanisms of the effects of excessively lowering of blood pressure in acute intracerebral hemorrhage patients, as well as the appropriate target blood pressure for those with kidney dysfunction, need to be studied. At present, renal function should be considered when deciding the optimal blood pressure range for each patient."

The article, "Impact of renal impairment on intensive blood pressure-lowering therapy and outcomes in intracerebral hemorrhage: Results from ATACH-2," was published in the July 1, 2021 issue of Neurology®, the medical journal of the American Academy of

Neurology at DOI: http:doi.org/10.1212/WNL.0000000000012442.

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Tooth loss associated with increased cognitive impairment, dementia

Good oral health, including dentures, may protect against cognitive decline

Tooth loss is a risk factor for cognitive impairment and dementia--and with each tooth lost, the risk of cognitive decline grows, according to a new analysis led by researchers at NYU Rory Meyers College of Nursing and published in *JAMDA: The Journal of Post-Acute and Long-Term Care Medicine*. However, this risk was not significant among older adults with dentures, suggesting that timely treatment with dentures may protect against cognitive decline.

About one in six adults aged 65 or older have lost all of their teeth, according to the Centers for Disease Control and Prevention. Prior studies show a connection between tooth loss and diminished cognitive function, with researchers offering a range of possible explanations for this link. For one, missing teeth can lead to difficulty chewing, which may contribute to nutritional deficiencies or promote changes in the brain. A growing body of research also points to a connection between gum disease--a leading cause of tooth loss--and cognitive decline. In addition, tooth loss may reflect life-long socioeconomic disadvantages that are also risk factors for cognitive decline.

"Given the staggering number of people diagnosed with Alzheimer's disease and dementia each year, and the opportunity to improve oral health across the lifespan, it's important to gain a deeper understanding of the connection between poor oral health and cognitive decline," said Bei Wu, PhD, Dean's Professor in Global Health at NYU Rory Meyers College of Nursing and co-director of the NYU Aging Incubator, as well as the study's senior author.

Wu and her colleagues conducted a meta-analysis using longitudinal studies of tooth loss and cognitive impairment. The 14 studies included in their analysis involved a total of 34,074 adults and 4,689 cases of people with diminished cognitive function.

The researchers found that adults with more tooth loss had a 1.48 times higher risk of developing cognitive impairment and 1.28 times higher risk of being diagnosed with dementia, even after controlling for other factors.

However, adults missing teeth were more likely to have cognitive impairment if they did not have dentures (23.8 percent) compared to those with dentures (16.9 percent); a further analysis revealed that the association between tooth loss and cognitive impairment was not significant when participants had dentures.

The researchers also conducted an analysis using a subset of eight studies to determine if there was a "dose-response" association between tooth loss and cognitive impairment--in other words, if a greater number of missing teeth was linked to a higher risk for cognitive decline. Their findings confirmed this relationship: each additional missing tooth was associated with a 1.4 percent increased risk of cognitive impairment and 1.1 percent increased risk of being diagnosed with dementia.

"This 'dose-response' relationship between the number of missing teeth and risk of diminished cognitive function substantially strengthens the evidence linking tooth loss to cognitive impairment, and provides some evidence that tooth loss may predict cognitive decline," said Xiang Qi, a doctoral candidate from NYU Meyers.

"Our findings underscore the importance of maintaining good oral health and its role in helping to preserve cognitive function," said Wu.

In addition to Wu and Qi, study authors include Zheng Zhu of Fudan University and Brenda L. Plassman of Duke University. This research is partially supported by the National Institutes of Health (1R56AG067619 and U01DE027512).

https://wb.md/3qZ6Vf3

Stress May Turn Hair Gray, but Calm May Reverse It

Researchers say they can measure what is happening when hair grays, and show early evidence that it could possibly be reversed

Sofia Bening

Gray hair, jokingly referred to as stress highlights, is a visible sign of aging that has long been tied to personal pressure, but the theory is difficult to prove. Now, researchers say they can measure what is happening when hair grays, and provide early evidence that it can sometimes be reversed.

Hair color is lost, and strands turn gray as melanin — a pigment found in the skin, eyes, and hair — declines. Before hairs emerge from the scalp, they grow under the skin in follicles that receive chemical and electrical signals, including stress hormones, from the body. Once they emerge, hairs harden, and their molecular structure is preserved and reflected in their pigmentation.

Using high-resolution scanners, scientists can now detect small color changes in single strands of human hair.

Researchers measured color loss in single strands of human hair from 14 volunteers who kept diaries to document the weekly levels of stress they experienced. The results were striking: As the volunteers experienced more stress, their hair lost pigment. But as the stress eased, their hair regained color, says Martin Picard, PhD, associate professor of behavioral medicine at Columbia University Vagelos College of Physicians and Surgeons in New York City, who led the research.

The method they used to capture images of hair fragments so tiny they represent 1 hour's growth, which allowed the researchers to assess pigment loss, was developed by Ayelet Rosenberg, a research assistant in Picard's laboratory, who is first author on the study. And when hair color changed, the team saw variations in 300 proteins.

They developed a mathematical model to predict what might happen to human hair over time and suggest there is a point in a person's life when stress can temporarily induce loss of color, but that can be reversed if tensions ease.

These findings add to a growing body of evidence indicating that aging is not a linear, fixed biologic process; it can be halted or even temporarily reversed.

With a better understanding of the biologic basis of pigmentation loss, it's possible that gray hair could one day be reversed with a visit to the doctor's office instead of the hair salon.

The research was funded by grants from the Wharton Fund and the National Institutes of Health.

Sources *eLife: "Quantitative mapping of human hair greying and reversal in relation to life stress." 2021;10:e67437.*

Martin Picard, PhD, associate professor of behavioral medicine, Columbia University Vagelos College of Physicians and Surgeons, New York City

Ayelet Rosenberg, Columbia University Vagelos College of Physicians and Surgeons, New York City

https://go.nature.com/3qZ7VzP

Quarter-dose of Moderna COVID vaccine still rouses a big immune response

Results hint that dose stretching could help to address the world's acute vaccine shortage.'

A little bit of coronavirus vaccine goes a long way towards generating lasting immunity.

Two jabs that each contained only one-quarter of the standard dose of the Moderna COVID vaccine gave rise to long-lasting protective antibodies and virus-fighting T cells, according to tests in nearly three dozen people[1]. The results hint at the possibility of administering fractional doses to stretch limited vaccine supplies and accelerate the global immunization effort.

Since 2016, such a dose-reduction strategy has successfully vaccinated millions of people in Africa and South America against yellow fever[2]. But no similar approach has been tried in response to

COVID-19, despite vaccine shortages in much of the global south.

"There's a huge status quo bias, and it's killing people," says Alex Tabarrok, an economist at George Mason University in Fairfax, Virginia. "Had we done this starting in January, we could have vaccinated tens, perhaps hundreds, of millions more people."

The just-right dose?

In the earliest trial of Moderna's mRNA-based vaccine, study participants received one of three dose levels: 25, 100 or 250 micrograms[3]. The top dose proved too toxic. The low dose elicited the weakest immune response. The middle dose seemed to offer the best balance: it triggered strong immunity and had acceptable side effects.

That 100-microgram dose ultimately became the one authorized for mass use in dozens of countries. But Moderna scientists later showed that a half-dose seemed to be just as good as the standard dose at stimulating immune protection[4].

To find out whether a low dose might offer protection, scientists analysed blood from 35 participants in the original trial. Each had received two 25-microgram jabs of vaccine 28 days apart.

Six months after the second shot, nearly all of the 35 participants had 'neutralizing' antibodies, which block the virus from infecting cells, the researchers reported in a preprint published on 5 July[1]. Participants' blood also contained an armada of different T cells, both 'killer' cells that can destroy infected cells and a variety of 'helper' cells that aid in general immune defence.

Levels of both antibodies and T cells were comparable to those found in people who have recovered from COVID-19.

"It is quite remarkable — and quite promising — that you can easily detect responses for that long a time," says Daniela Weiskopf, an immunologist at the La Jolla Institute for Immunology (LJI) in California and a co-author of the study, which has not yet been peer reviewed.

Corine Geurts van Kessel, a clinical virologist at the Erasmus University Medical Center in Rotterdam, the Netherlands, who was not involved in the study, agrees. "It's rather good news," she says. "Even with a low dose, you can prime your own immune system in quite a nice way."

Weiskopf and her study co-author Shane Crotty, also at LJI, are among the scientists who would prefer carefully planned trials to confirm the efficacy of reduced vaccine doses before any such regimen is widely deployed. One such trial is ongoing: a study in Belgium is comparing a lower-dose version of the vaccine from Pfizer–BioNTech against the standard dose.

But Sarah Cobey, an infectious-disease researcher at the University of Chicago in Illinois and a co-author of a 5 July *Nature Medicine* commentary[5] supporting dose 'fractionation', disagrees about the need for time-consuming data collection.

"We shouldn't wait that long," she says. "People are dying, and we have historical precedent for making very well-reasoned guesses that we think are going to save lives."

Less is more

Even if the immune responses spurred by the low-dose strategy are only moderately effective at keeping SARS-CoV-2 at bay, it could still be worth giving quarter doses to speed up the pace of vaccination around the world, argues Tabarrok.

According to a modelling study published by Tabarrok and other economists, such an approach would reduce infections and COVID-linked deaths more than current policies[6]. The study has not yet been peer reviewed.

A half-dose now is more useful to an unvaccinated person than a full dose a year from now, Tabarrok says, which means that dose-stretching "is a way of promoting vaccine equity."

doi: https://doi.org/10.1038/d41586-021-01893-0

References

1. Mateus, J. et al. Preprint at medRxiv https://doi.org/10.1101/2021.06.30.21259787

(2021).
2. Casey, R. M. et al. N. Engl. J. Med. ***381****, 444–454 (2019).* PubMed Article Google Scholar
3. Jackson, L. A. et al. N. Engl. J. Med. ***383****, 1920–1931 (2020).* PubMed Article Google Scholar
4. Chu, L. et al. Vaccine ***39****, 2791–2799 (2021).* PubMed Article Google Scholar
5. Cowling, B. J. et al. Nature Med. https://doi.org/10.1038/s41591-021-01440-4 (2021). PubMed Article Google Scholar
6. Więcek, W. et al. Preprint at SSRN https://doi.org/10.2139/ssrn.3864485 (2021).
Download references

https://bit.ly/3hWmJen

One Vaccine Dose No Match Against Delta Variant, New Study Suggests

Although vaccines work well against the Delta variant, the level of protection they offer seems to depend largely on whether you've completed your vaccination course.

Aria Bendix, Business Insider

A study published Thursday in the journal *Nature* found that just a single dose of Pfizer's or AstraZeneca's vaccines – both of which require two shots – was either weakly or not at all effective against Delta.

The researchers performed laboratory experiments on blood samples from people who had received one of those shots. After a single dose, just 10 percent of those samples had developed antibodies that neutralized the Delta variant – a sign that those individuals would be protected from a symptomatic infection. After two doses, however, 95 percent of samples had developed neutralizing antibodies against Delta.

The researchers concluded that the Delta variant "partially but significantly escapes" immune protection from vaccines.

While the results of laboratory experiments like these don't necessarily translate directly to the real world, other studies have similarly shown that Delta resists protection from one vaccine dose.

A UK analysis in May found that a single dose of either Pfizer's or AstraZeneca's vaccine was just 33 percent effective against symptomatic COVID-19 caused by Delta. After two doses, that efficacy rose to 88 percent for Pfizer's vaccine and 60 percent for AstraZeneca's.

Two doses of Pfizer's vaccine were also 96 percent effective at preventing hospitalizations from Delta cases, while two doses of AstraZeneca's vaccine were around 92 percent effective by the same standard.

Meanwhile, a Canadian study that's still awaiting peer review found that a single dose of Pfizer's shot was 56 percent effective at preventing symptomatic infections caused by Delta after two weeks. That rate was 67 percent for AstraZeneca's shot and 72 percent for Moderna's.

When it came to preventing Delta-related hospitalizations, that efficacy rose to 78 percent for Pfizer, 88 percent for AstraZeneca, and 96 percent for Moderna.

The same study suggested that after two doses, Pfizer's vaccine was 87 percent effective against symptomatic infections caused by Delta. But the researchers didn't have enough data for AstraZeneca or Moderna.

Taken together, the studies suggest that partially vaccinated people may be more vulnerable to symptomatic COVID-19 cases now than in months past, since Delta has become the dominant strain in many countries, including the UK and US. Around 48 percent of the US population is fully vaccinated, while 55 percent has received at least one dose.

But in some states, the gap between people who've gotten one shot and those who've completed the course is wider than the national average. Arkansas' state health director, Dr. José Romero, told Insider that 15 percent of people there who had received their first dose of either Pfizer's or Moderna's vaccine hadn't returned for their second as of two weeks ago.

In many cases, Romero said, people were deterred by the initial side effects.

"We have a significant proportion of individuals that receive one dose of a two-dose series but don't go back for the second dose within the window, or within 42 days after that vaccine," he said. "They don't have the full protection that they should have."

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Tetanus toxin fragment may treat depression, Parkinson's disease and ALS

Non-toxic derivative of the tetanus neurotoxin improved depression symptoms in rat animal models

Depression has been treated traditionally with inhibitors of serotonin reuptake in the central nervous system. These drugs do not come without side effects, such as lack of immediate therapeutic action, the need for daily doses and the danger of becoming addicted to some of these drugs. That is why scientists continue to work on new therapies to treat depression.

In 2019, an international group of researchers co-led by Dr Yousef Tizabe from the Howard University College of Medicine in Washington, D.C., and Professor José Aguilera from the Department of Biochemistry and Molecular Biology and the Institut de Neurociències at the Universitat Autònoma de Barcelona (UAB), observed that a non-toxic derivative of the tetanus neurotoxin (which causes tetanus infections) improved depression symptoms in rat animal models. "One intramuscular dosis of Hc-TeTx made depression symptoms disappear in less than 24 hours, and its effects lasted two weeks", explains Aguilera. Based on these findings, scientists began to work on discovering the mechanism through which this substance produces these effects.

In a recent study coordinated by Professor Aguilera and conducted in collaboration with the research group led by Dr Thomas Scior of the Benemérita Universidad Autónoma de Puebla (BUAP) in Mexico, researchers demonstrated that Hc-TeTx is capable of inhibiting the transport of serotonin within the central nervous system, by binding to neurotrophin receptors, proteins that induce the survival of neurons. These results, published in the journal *Molecules*, suggest that the drug may not only serve in treating depression, but also be useful in treating neurodegenerative diseases, such as Parkinson's disease or amyotrophic lateral sclerosis (ALS).

According to researchers, the advantages of introducing Hc-TeTx as a new drug are evident. A biweekly or monthly dosis would allow medical professionals to control the progress. Since it is a recombinant product, there would be no problems with drug safety, production or high costs. Furthermore, in neurodegenerative cases, Hc-TeTx would stop the development of the pathology and at the same time eliminate any disease-related depressions.

Researchers recently patented the therapeutic use of Hc-TeTx for the treatment of depression, Parkinson's disease and amyotrophic lateral sclerosis, and are now looking for investors to be able to conduct clinical trials on humans. "This is an important advance in science, and even more so now when in addition to the high incidence in depression and alterations in behaviours, we see mental alterations as a result of COVID-19 and the negative environments of stress, self-isolation or fear", Aguilera concludes.

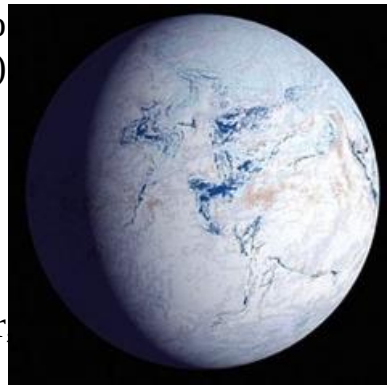
https://bit.ly/3yJxE1J

Changes in Our Planet's Orbit May Have Allowed Life to Survive during 'Snowball Earth' Glaciations

Rocks provide compelling evidence that Earth was completely covered in an icy shell

A team of researchers led by Chinese Academy of Sciences' Professor Ross Mitchell has studied a succession of rocks laid down when most of Earth's surface was covered in ice during severe

'snowball Earth' glaciations, about 720 to 635 million years ago (Cryogenian period) Professor Mitchell and colleagues ventured into the South Australian outback where they targeted kilometer-thick units of glacial rocks formed about 700 million years ago. At this time, Australia was located closer to the equator known today for its tropical climates.



An artist's impression of a 'snowball Earth.' **Image credit: NASA.**

The rocks the scientists studied, however, show unequivocal evidence that ice sheets extended as far as the equator at this time, providing compelling evidence that Earth was completely covered in an icy shell.

They focused their attention on 'banded iron formations,' sedimentary rocks consisting of alternating layers of iron-rich and silica-rich material. These rocks were deposited in the ice-covered ocean near colossal ice sheets. During the snowball glaciation, the frozen ocean would have been entirely cut off from the atmosphere. Without the normal exchange between the sea and air, many variations in climate that normally occur simply wouldn't have.

"This was called the 'sedimentary challenge' to the snowball hypothesis," Professor Mitchell said. "The highly variable rock layers appeared to show cycles that looked a lot like climate cycles associated with the advance and retreat of ice sheets."

"Such variability was thought to be at odds with a static snowball Earth entombing the whole ocean in ice."

"The iron comes from hydrothermal vents on the seafloor," said Dr. Thomas Gernon, a researcher at the University of Southampton.

"Normally, the atmosphere oxidizes any iron immediately, so banded iron formations typically do not accumulate."

"But during the snowball glaciations, with the ocean cut off from the air, iron was able to accumulate enough for them to form."

Using magnetic susceptibility, a measure of the extent to which the rocks become magnetized when exposed to a magnetic field, the authors made the discovery that the layered rock archives preserve evidence for nearly all orbital cycles.

Earth's orbit around the Sun changes its shape and the tilt and wobble of the planet's spin axis also undergo cyclic changes.

Known as Milankovitch cycles, these astronomical cycles change the amount of incoming solar radiation that reaches Earth's surface and, in doing so, they control climate.

"Even though Earth's climate system behaved very differently during the snowball, Earth's orbital variations would have been blissfully unaware and just continued to do their thing," Professor Mitchell said. The team concluded that changes in Earth's orbit allowed the waxing and waning of ice sheets, enabling periodic ice-free regions to develop on snowball Earth.

"This finding resolves one of the major contentions with the snowball Earth hypothesis: the long-standing observation of significant sedimentary variability during the snowball Earth glaciations appeared at odds with such an extreme reduction of the hydrological cycle," Professor Mitchell said.

The results help explain the enigmatic presence of sedimentary rocks of this age that show evidence for flowing water at Earth's surface when this water should have been locked up in ice sheets.

"This observation is important, because complex multicellular life is now known to have originated during this period of climate crisis, but previously we could not explain why," Dr. Gernon said.

"Our study points to the existence of ice-free oases in the snowball ocean that provided a sanctuary for animal life to survive arguably the most extreme climate event in Earth history."

The findings were published in the journal *Nature Communications*.

R.N. Mitchell et al. 2021. Orbital forcing of ice sheets during snowball Earth. Nat Commun 12, 4187; doi: 10.1038/s41467-021-24439-4

https://bit.ly/3idBDNF

An opioid made in the brain is crucial for remembering other people

Without enkephalin, a neuropeptide, mice were unable to recognize other mice they'd already met

Czarina Ramos

It would be inconvenient if we couldn't remember the people we have or haven't met before. Social recognition, the ability to differentiate familiar or novel individuals of the same species is part of a larger process of social memory that allows groups within a species to build and maintain stable networks or relationships, like what we know as friend groups or communities.

The hippocampus, known for its role in memory, is divided into subregions that contribute to different memory processes, and one called CA2 is particularly important for social memory. Scientists have found one particular neurochemical to be important in social recognition. Enkephalin, a neuropeptide that interacts with opioid receptors, is needed in CA2 to recognize new people.

Enkephalins belong to a class of opioids produced by the brain which are often associated with stress response and pain relief. The researchers found that in CA2, these compounds are released by specific type of neuron, boosting information transfer to the CA2, thus enabling our brains to form social memories.

Scientists studied the effects of enkephalin through a social memory test in mice. They introduced one mouse to a space with two others, and the subject mouse was allowed to interact with each mouse for five minutes. The subject mouse was removed, then returned half an hour later, this time with one of the mice from the last entry and one mouse it had not met before. The typical response for mice in this case is to pay attention to the new mouse for longer. The scientists observed that, while mice with regular enkephalin levels sniffed out the new mouse for a longer amount of time, mice without enkephalin spent the same amount of time between both mice, as if they had not previously encountered one of them.

A better understanding of social memory can help demystify related diseases. Schizophrenia, a condition in which social memory is impaired, is treated with drugs affecting opioid receptors, for example. The results of this study shed light on how these treatments work.

https://bit.ly/3r4qLfO

Modestly Tilted Planets More Capable of Evolving Complex Life, Study Suggests

A planet's tilted axis helps to promote oxygen production by doubling the output of photosynthesis

Earth's sphere tilts on its axis at an angle of 23.5 degrees; this gives us our seasons, with parts of the planet receiving more direct sunlight in summer than in winter. However, not all solar system planets are tilted like the Earth: Uranus is tilted at 98 degrees, whereas Mercury is not tilted at all. According to new research led by Purdue University, a planet with a tilted axis helps to promote oxygen production by doubling the output of photosynthesis.

"There are several factors to consider in looking for life on another planet," said lead author Dr. Stephanie Olson, a planetary scientist in the Department of Earth, Atmospheric, and Planetary Science at Purdue University.

"The planet needs to be the right distance from its star to allow liquid water and have the chemical ingredients for the origin of life." "But not all oceans will be great hosts for life as we know it, and an even smaller subset will have suitable habitats for life to progress towards animal-grade complexity."

"Small tilts or extreme seasonality on planets with Uranus-like tilts

may limit the proliferation of life, but modest tilt of a planet on its axis may increase the likelihood that it develops oxygenated atmospheres that could serve as beacons of microbial life and fuel the metabolisms of large organisms." "The bottom line is that worlds that are modestly tilted on their axes may be more likely to evolve complex life." "This helps us narrow the search for complex, perhaps even intelligent life in the Universe."

In the study, Dr. Olson and colleagues produced a sophisticated model of the conditions required for life on Earth to be able to produce oxygen The model allowed the team to input different parameters, to show how changing conditions on a planet might change the amount of oxygen produced by photosynthetic life.

"The model allows us to change things such as day length, the amount of atmosphere, or the distribution of land to see how marine environments and the oxygen-producing life in the oceans respond," Dr. Olson said.

The researchers found that increasing day length, higher surface pressure, and the emergence of continents all influence ocean circulation patterns and associated nutrient transport in ways that may increase oxygen production.

They believe that these relationships may have contributed to Earth's oxygenation by favoring oxygen transfer to the atmosphere as Earth's rotation has slowed, its continents have grown, and surface pressure has increased through time.

"The most interesting result came when we modeled 'orbital obliquity' — in other words how the planet tilts as it circles around its star," said Megan Barnett, a Ph.D. student in the Department of Geophysical Sciences at the University of Chicago.

"Greater tilting increased photosynthetic oxygen production in the ocean in our model, in part by increasing the efficiency with which biological ingredients are recycled." "The effect was similar to doubling the amount of nutrients that sustain life."

The scientists presented their findings this week at the *2021 Goldschmidt Geochemistry Conference*.

Stephanie Olson et al. Ocean Dynamics and the Oxygenation of Habitable Worlds. Goldschmidt 2021, paper # 7332

https://bit.ly/3xzNGuT

Early Earth was bombarded by series of city-sized asteroids

Analysis suggests the number of these impacts may have been 10 times higher than previously thought

Scientists know that the Earth was bombarded by huge impactors in distant time, but a new analysis suggests that the number of these impacts may have been 10 times higher than previously thought. This translates into a barrage of collisions—similar in scale to that of the asteroid strike that wiped out the dinosaurs—on average every 15 million years between 2.5 and 3.5 billion years ago. Some of these individual impacts may have been much bigger, possibly ranging from city-sized to small province sized. Researchers are also considering what effect the impacts may have had on the Earth's evolving near-surface chemistry. This work is presented at the Goldschmidt Geochemistry Conference.

Earth's early years were unimaginably violent in comparison to today. Scientists believe that Earth was struck by a significant number of large asteroids (greater than 10 km in diameter), and this would have had significant effect on the Earth's near-surface chemistry and ability to support life. The effect of just one such collision was shown comparatively recently by the Chicxulub impact 66 million years ago, which led to the extinction of the dinosaurs. The early Earth, however, was very different to the Earth at the time of the Chicxulub impact, and so were the effects of collisions.

Impact craters from similar collisions can be seen on the Moon and other rocky planets, but atmospheric weathering and plate tectonics

have tended to mask any direct evidence for ancient impact craters on Earth. However, echoes of these distant impacts can be seen in the presence of "spherules" found in ancient rocks; the huge impacts threw up molten particles and vapors which then cooled and fell to Earth to be embedded in rock as small spherical glassy particles. The greater the impact, the more these particles would have spread from the impact site, so global distribution of a thick spherule layer shows a huge impact.

Researcher Dr. Simone Marchi, of the Southwest Research Institute (Boulder, CO, U.S.) said, "We have developed a new impact flux model and compared with a statistical analysis of ancient spherule layer data. With this approach, we found that current models of Earth's early bombardment severely underestimate the number of known impacts, as recorded by spherule layers. The true impact flux could have been up to a factor of 10 times higher than previously thought in the period between 3.5 and 2.5 billion years ago. This means that in that early period, we were probably being hit by a Chicxulub-sized impact on average every 15 million years. Quite a spectacle.

"As we deepen our understanding of the early Earth, we find that cosmic collisions are like the proverbial elephant in the room. They are often neglected as we lack a detailed knowledge of their number and magnitude, but it is likely these energetic events fundamentally altered the Earth's surface and atmospheric evolution.

"For example, one outcome we are looking at is to try to understand if these impacts may have affected the evolution of atmospheric oxygen. We find that oxygen levels would have drastically fluctuated in the period of intense impacts. Given the importance of oxygen to the Earth's development, and indeed to the development of life, its possible connection with collisions is intriguing and deserved further investigation. This is the next stage of our work."

Commenting, Dr. Rosalie Tostevin, of the University of Cape Town, said, "These large impacts would certainly have caused some disruption. Unfortunately, few rocks from this far back in time survive, so direct evidence for impacts, and their ecological consequences, is patchy. The model put forward by Dr. Marchi helps us to get a better feel for the number and size of collisions on the early Earth.

"Some chemical markers suggest there were 'whiffs' of oxygen in the early atmosphere, before a permanent rise around 2.5 billion years ago. But there is considerable debate surrounding the significance of these 'whiffs,' or indeed, whether they occurred at all. We tend to focus on the Earth's interior and the evolution of life as controls on Earth's oxygen balance, but bombardment with rocks from space provides an intriguing alternative."

Dr. Tostevin was not involved in this work.

https://bit.ly/3AR5weX

Vocal music boosts the recovery of language functions after stroke

Listening to music can support other rehabilitation

Research has shown that listening to music daily improves language recovery in patients who have experienced a stroke. However, the neural mechanisms underlying the phenomenon have so far remained unknown.

A study conducted at the University of Helsinki and the Turku University Hospital Neurocenter compared the effect of listening to vocal music, instrumental music and audiobooks on the structural and functional recovery of the language network of patients who had suffered an acute stroke. In addition, the study investigated the links between such changes and language recovery during a three-month follow-up period. The study was published in the *eNeuro* journal.

Based on the findings, listening to vocal music improved the recovery of the structural connectivity of the language network in

the left frontal lobe compared to listening to audiobooks. These structural changes correlated with the recovery of language skills.

"For the first time, we were able to demonstrate that the positive effects of vocal music are related to the structural and functional plasticity of the language network. This expands our understanding of the mechanisms of action of music-based neurological rehabilitation methods," says Postdoctoral Researcher Aleksi Sihvonen.

Listening to music supports other rehabilitation

Aphasia, a language impairment resulting from a stroke, causes considerable suffering to patients and their families. Current therapies help in the rehabilitation of language impairments, but the results vary and the necessary rehabilitation is often not available to a sufficient degree and early enough.

"Listening to vocal music can be considered a measure that enhances conventional forms of rehabilitation in healthcare. Such activity can be easily, safely and efficiently arranged even in the early stages of rehabilitation," Sihvonen says.

According to Sihvonen, listening to music could be used as a cost-efficient boost to normal rehabilitation, or for rehabilitating patients with mild speech disorders when other rehabilitation options are scarce.

After a disturbance of the cerebral circulation, the brain needs stimulation to recover as well as possible. This is the goal of conventional rehabilitation methods as well.

"Unfortunately, a lot of the time spent in hospital is not stimulating. At these times, listening to music could serve as an additional and sensible rehabilitation measure that can have a positive effect on recovery, improving the prognosis," Sihvonen adds.

https://wb.md/3hyfb2q

As Delta Cases Surge, FDA Pressured to Fully Approve COVID Vaccines

It might jump-start the stalled national vaccination program and slow down the surge of the Delta variant

Ralph Ellis

More and more experts are urging the FDA to grant full approval to the Pfizer and Moderna COVID-19 vaccines because it might jump-start the stalled national vaccination program and slow down the surge of the Delta variant infection.

The FDA granted emergency use authorization in December to those two vaccines, which are based on mRNA technology. Both companies have applied for full approval but it's unclear when the FDA will act.

Eric Topol, a professor of molecular medicine at Scripps Research, and editor-in-chief of WebMD's sister site, Medscape, is one scientist urging full approval soon.

In a guest essay in *The New York Times*, he wrote that people taking a wait-and-see attitude toward the vaccine might get a shot if the FDA granted full approval. Also, people might take the step if required by their employers.

"Some people who understand that the 'E' in 'EUA' stands for 'emergency' are waiting for full FDA approval before they receive a shot," Topol wrote. "Others may not get immunized unless their employers require it, and many organizations — including, reportedly, the military — are waiting for the vaccines to be fully approved before instituting such mandates."

Topol said the rapid spread of the Delta variant is one reason for the FDA to move more quickly.

"The agency should make full approval its number one priority, and its leadership should communicate its plans to the public," he wrote.

The CDC says 183 million doses of the Pfizer vaccine and 135

million doses of the Modern vaccine have been administered in the United States since December. Infections, hospitalizations, and deaths have dropped sharply since.

"That's as good as it gets when it comes to having data on safety and efficacy," said Céline Gounder, MD, an epidemiologist at New York's Bellevue Hospital, according to Politico. "We have it in real life — what more can people ask for?"

But vaccine hesitancy remains. The CDC says only 55.2% of the total U.S. population has gotten at least one dose and 47.7% is fully vaccinated. The Delta variant has been recognized as the dominant strain in the United States.

In a comment to Politico, FDA spokesperson Abby Capobianco declined to offer a timeline for when the agency might grant full approval of the Pfizer and Moderna vaccines.

"Although an authorization is not an FDA approval, the FDA conducted a thorough scientific evaluation of each of the authorized vaccines and can assure the public and medical community that the vaccines meet FDA's rigorous standards for safety, effectiveness, and manufacturing quality," she said.

Politico said Pfizer and Moderna requested priority review, meaning the agency's goal would be to make a decision within 6 months of receiving the application.

Some scientists want the FDA to go slow. A group of them lodged a "Citizen Petition" with the FDA asking the agency to delay full approval, according to a blog on the website of the *BMJ*, formerly known as the *British Medical Journal*.

"The message of our petition is 'slow down and get the science right — there is no legitimate reason to hurry to grant a license to a coronavirus vaccine.' We believe the existing evidence base — both pre- and post-authorization — is simply not mature enough at this point to adequately judge whether clinical benefits outweigh the risks in all populations," the *BMJ* reported.

The one-shot Johnson & Johnson vaccine received emergency authorization in February, but the company has not applied for full approval yet. That vaccine does not use mRNA technology.

Delta Variant Grows Quickly Inside People, Study Says

Meanwhile, two studies showed the dangers the Delta variant poses. Researchers at the Guangdong Provincial Center for Disease Control and Prevention in China say the Delta variant is not just highly transmissible. It also grows faster inside an infected person than other strains, according to NPR.

The scientists determined that "people infected with the Delta variant had about 1,000 times more copies of the virus in their respiratory tracts than those infected with the original strain of the coronavirus," NPR said.

The Delta variant also makes a person sicker faster, taking around 4 days to reach detectable levels inside a person, compared to 6 days with the original COVID-19 strain, NPR said.

A second study, out of France, highlighted the importance of getting two shots of two-dose vaccines like Moderna and Pfizer.

The study said one dose "barely inhibited" infection by the Delta variant, whereas two doses provided a 95% neutralizing response. The study, published in *Nature*, echoes previous research about how much protection vaccines offer against the Delta variant.

LA County COVID Cases Jump 165% in a Week

COVID-19 is making a comeback in Los Angeles County, also because of the Delta variant.

Los Angeles County Public Health said in a news release that there were 839 new COVID-19 cases this week, a 165% increase over last week.

The daily average case rate is now 3.5 cases per 100,000 people, compared to 1.74 cases a week ago. The daily test positivity rate on Thursday was 2.5%, up from 1.2% last week.

"Overall COVID-19 trends are going in the wrong direction for

everyone, and are particularly concerning given the proliferation of the Delta variant," said Barbara Ferrer, director of public health.

The department said the Delta variant has been the most commonly sequenced variant in L.A. County since the beginning of June and "now accounts for the majority of variants of concern identified by labs."

Sources

The New York Times: "It's Time for the F.D.A. to Fully Approve the mRNA Vaccines."
Politico: "Calls mount on FDA to formally endorse Covid vaccines as Delta surges."
BMJ. "Why we petitioned the FDA to refrain from fully approving any covid-19 vaccine this year."
Virological: "Viral infection and transmission in a large well-traced outbreak caused by the Delta SARS-CoV-2 variant."
NPR: "The Delta Variant Isn't Just Hyper-Contagious. It Also Grows More Rapidly Inside You."
Nature: "Reduced sensitivity of SARS-CoV-2 variant Delta to antibody neutralization"
L.A. County Department of Public Health: "L.A. County Sees Increased Spread of COVID-19 and Delta Variant Cases; Fully Vaccinated People Remain Well Protected - 11 New Deaths and 839 New Confirmed Cases of COVID-19 in Los Angeles County."

https://bit.ly/3hyx01y

How Scientific Detective Work Pinned Down the Oldest Known Shark Attack

But mysteries about the 3,000-year-old bones from Japan remain.

by Hannah Seo

In Okayama Prefecture, near the coast of the Seto Inland Sea, which sits between three of Japan's islands, is a shell-mound cemetery called Tsukumo. There, preserved in layers of soil and shells, archaeologists had uncovered the remains of more than 170 prehistoric Japanese fisher-hunter-gatherers dating to more than 3,000 years ago. Among them was the remains of a man, designated No. 24, that had scientists baffled.

No. 24 was missing his right leg and left hand. His bones were covered in lacerations, scratches, and gouges. J. Alyssa White, an archaeologist at the University of Oxford, was bewildered by the sheer number of injuries he appeared to have sustained. "We were like, 'There's another one, and another one, and another one,'" she says of her first examination of the remains, which had originally been excavated around 1920 by Japanese archaeologist Kenji Kiyono.

White and her team initially thought they had found an example of the phenomenon known as "overkill," when remains are ritually altered, such as a body shot full of arrows after death. But no human-wielded weapon seemed to fit the bill. "We were just quite flummoxed and perplexed," she says.

Radiocarbon dating placed No. 24 somewhere between 1370 to 1010 B.C., during the late Jomon Period, when sea level was higher than today and Tsukumo was closer to the shore, says Masato Nakatsukasa, an anthropologist at Kyoto University and coauthor of a study of the remains, recently published in the *Journal of Archeological Science: Reports*. It would have been a great place for a settlement. "Land mammals such as deer, boars, rabbits were abundant, and this area was dominated by broadleaf evergreen forests," he says.

White and her team continued examining the remains in ever greater detail, but still couldn't pin down a cause for the skeletal damage, or a cause of death. "I just kept on getting more and more confused," she says. She corresponded with her supervisor and colleagues, and slowly but surely went through a process of elimination. The wounds looked like injuries that could be caused by metal weapons, but the people of Japan hadn't used those at that time. The late Jomon people had hunting weapons made of stone. None of No. 24's lesions matched that kind of weapon, and there were no other marks to hint at another cause of death. So they ruled out human conflict.

White and her colleagues then thought that a terrestrial carnivore may have killed or scavenged the remains of No. 24, but there aren't many large, predatory mammals on the Japanese archipelago

(just bears, really, but the injuries didn't resemble a bear attack). Plus, microscopic analysis showed that whatever had damaged the bones was serrated. That took land predators off the list of suspects. Isotope analysis on the remains revealed that No. 24 was a seafood eater. It's known that the Jomon people were fishers, and even wore shark teeth or vertebrae as accessories. No. 24 probably fished or went diving in the Seto Inland Sea regularly, as modern inhabitants of the area still do.

Working off of a hunch that the culprit might be in the sea, the team reached out to George Burgess, director emeritus of the Florida Program for Shark Research at the Florida Museum of Natural History. "They sent me wonderful pictures of a variety of elements of the body and I immediately could see that, yes, these were absolutely shark bites, very much similar to what we see in modern victims," says Burgess, who has reviewed thousands of shark attack cases around the world, and helped pin down the oldest known shark attack in the Americas.

Using data such as theoretical water temperatures at the time, current distribution of shark species, and possible animal size based on the bites, Burgess deduced two possible candidates for the attack: the tiger shark and the great white shark.

If Kazuhiro Nakaya had to bet, he'd put his money on a great white. Nakaya is a marine biologist at Hokkaido University who has studied the sharks of Japan extensively. While tiger sharks are not unheard of in the Seto Inland Sea, he says, historically they've been much more common toward the southwestern tip of the Japanese archipelago. Seto is great white territory. The last several shark attacks in the area, in the 1990s, were all by great white sharks.

A culprit appears to be found, but there are still unanswered questions. For someone who was attacked by a shark, No. 24's bones are surprisingly intact. Based on the bite patterns, Nakaya thinks that the shark must have been around 10 feet long, and a shark that big is likely to have broken bones. "There are so many scars, and the body parts are very complete," he says. "So I wonder, if one huge shark attacked him, why are his other parts not also broken severely? I cannot understand that."

White guesses that it's a sign that No. 24 spent just enough time in the water for the shark to get in a lot of bites, but then was promptly pulled out. If his body was retrieved and then buried in the shell mound fairly quickly, it might explain why the bones remained more intact and were so well preserved.

If the culprit seems apparent in retrospect, it's important to remember just how astonishingly rare evidence of an ancient shark attack like this is—the odds are stacked against you at every step. There are very, very few shark attacks a year across the globe, and there were a lot fewer people in the water back then. Given just how much damage No. 24 sustained—the research team counted at least 790 lesions, visible in a 3D model the team created—the chances that his body wasn't consumed entirely and was retrieved more or less intact seem rather low. Then, White adds, the soil in the region destroys most burials. It was only because he was buried in a shell mound that his bones were preserved for 3,000 years. Lastly, says White, what are the odds that archaeologists would find and excavate those remains at all?

https://bit.ly/36uxxLr

Flu jab protects against some of the severe effects of COVID-19, including

ICU admissions, sepsis and strokes, largest study of its kind suggests

The flu vaccine may provide vital protection against COVID-19, new research being presented at the European Congress of Clinical Microbiology & Infectious Diseases (ECCMID), held online this year, concludes.

An analysis of patient data from around the world strongly suggests

that the annual flu shot reduces the risk of stroke, sepsis and DVT in patients with COVID-19. Patients with COVID-19 who had been vaccinated against flu were also less likely to visit the emergency department and be admitted to the intensive care unit (ICU).

Immunising the world against COVID-19 is a daunting challenge and, although production and distribution of vaccines increases daily, some countries are not expected to vaccinate large numbers of their population until the start of 2023.

Recently, several modestly-sized studies suggested that the flu vaccine may provide protection against COVID-19 - meaning it could be a valuable weapon in the fight to halt the pandemic.

Ms Susan Taghioff, of the University of Miami Miller School of Medicine, Miami, USA, and colleagues carried out a retrospective analysis of data on tens of thousands of patients from around the world to find out more.

In the largest study of its kind, the team screened de-identified electronic health records held on the TriNetX research database of more than 70 million patients to identify two groups of 37,377 patients.

The two groups were matched for factors that could affect their risk of severe COVID-19, including age, gender, ethnicity, smoking and health problems such as diabetes, obesity and chronic obstructive pulmonary disease.

Members of the first group had received the flu vaccine between two weeks and six months before being diagnosed with COVID-19. Those in the second group also had COVID-19 but were not vaccinated against flu. The study was conducted using patients from countries including the US, UK, Germany, Italy, Israel and Singapore.

The incidence of 15 adverse outcomes (sepsis; strokes; deep vein thrombosis or DVT; pulmonary embolism; acute respiratory failure; acute respiratory distress syndrome; arthralgia or joint pain; renal failure; anorexia; heart attack; pneumonia; emergency department visits; hospital admission; ICU admission; and death) within 120 days of testing positive for COVID-19 was then compared between the two groups. The analysis revealed that those who had not had the flu jab were significantly more likely (up to 20% more likely) to have been admitted to ICU.

They were also significantly more likely to visit the Emergency Department (up to 58% more likely), to develop sepsis (up to 45% more likely), to have a stroke (up to 58% more likely) and a DVT (up to 40% more likely). The risk of death was not reduced.

It isn't known exactly how the flu jab provides protection against COVID-19 but most theories centre around it boosting the innate immune system - "general" defences we are born with that are not tailored to any particular illness.

The study authors say their results strongly suggest that the flu vaccine protects against several severe effects of COVID-19. They add that more research is needed to prove and better understand the possible link but, in the future, the flu shot could be used to help provide increased protection in countries where the COVID-19 vaccine is in short supply.

Dr Devinder Singh, the study's senior author and a professor of plastic surgery at the University of Miami Miller School of Medicine, says: "Only a small fraction of the world has been fully vaccinated against COVID-19 to date and, with all the devastation that has occurred due to the pandemic, the global community still needs to find solutions to reduce morbidity and mortality.

"Having access to real-time data of millions of patients is a powerful research tool. Together with asking important questions it has allowed my team to observe an association between the flu vaccine and lower morbidity in COVID-19 patients.

"This finding is particularly significant because the pandemic is straining resources in many parts of the world. Therefore, our

research - if validated by prospective randomised clinical trials - has the potential to reduce the worldwide burden of disease."

Ms Taghioff adds: "Influenza vaccination may even benefit individuals hesitant to receive a COVID-19 vaccine due to the newness of the technology.

"Despite this, the influenza vaccine is by no means a replacement for the COVID-19 vaccine and we advocate for everyone to receive their COVID-19 vaccine if able to.

"Continued promotion of the influenza vaccine also has the potential help the global population avoid a possible 'twindemic' - a simultaneous outbreak of both influenza and coronavirus.

"Regardless of the degree of protection afforded by the influenza vaccine against adverse outcomes associated with COVID-19, simply being able to conserve global healthcare resources by keeping the number of influenza cases under control is reason enough to champion continued efforts to promote influenza vaccination."

https://bit.ly/2TUuIAO

Hepatitis C vaccine could be rolled out within five years, says Nobel Prize winner who discovered virus

No doubt that a vaccine is required to help the world reach its ambitious target of reducing new hepatitis C infections by 90%

A vaccine to protect against infection with hepatitis C could be in use within 5 years, says Professor Sir Michael Houghton, who won the Nobel Prize for Medicine and Physiology along with three other scientists for discovering the hepatitis C virus (HCV) in 1989. Sir Michael will discuss the development of a vaccine in a special presentation at this year's European Congress of Clinical Microbiology and Infectious Diseases (ECCMID), held online this year.

Up to 2 million new HCV infections occur every year around the world, with an estimated 70 million carriers of the virus globally, most of whom are not diagnosed. The virus is estimated to cause some 400,000 deaths annually. Many infected with the virus go on to develop liver cirrhosis and liver cancer.

"While the advent of directly acting antivirals (DAAs) to cure hepatitis C has given us a huge weapon to turn the tide on this pandemic, there is no doubt that a vaccine is required to help the world reach its ambitious target of reducing new hepatitis C infections by 90% and mortality rates by 65% by 2030," explains Sir Michael, who is currently based at the Li Ka Shing Applied Virology Institute, University of Alberta, Canada.

He will discuss that, while countries like Egypt have managed to enact huge control programs for hepatitis C (50 million screened and 4 million treated and cured using DAAs since 2014), they have only been able to do so thanks to mass production of generic drugs ($US84 per patient). However, the cost per patient in high-income countries is some $US20,000 per patient.

He will explain how the scientific community has learnt what immune responses protect against HCV infection, and many technologies including the new RNA technology (used in Pfizer and Moderna COVID-19 vaccines) and adenovirus-based technologies (developed by Oxford University and AstraZeneca, and Johnson & Johnson) are able to reproduce these protective immune responses through vaccination.

Sir Michael and colleagues at the Li Ka Shing Applied Virology Institute are currently developing an adjuvanted recombinant vaccine, which is expected to induce production of antibodies to multiple cross-neutralising epitopes, making it harder for the virus to escape the humoral immune response. Put another way, there are many different antibodies likely to be produced by this vaccine that can prevent HCV infection, making it very hard for the virus to evade them by mutation and thus protecting the vaccine recipient from hepatitis C infection.

Sir Michael will discuss how the COVID-19 pandemic has pushed back many areas of medical research, including work on hepatitis C vaccines. But he anticipates phase 1 trials in 2022 using different adjuvants followed by phase 2 human efficacy trials from 2023-2026, either in an at-risk population such as people who inject drugs, or via human vaccine challenge trials.

He says: "If safety and efficacy are proven, roll-out of vaccine to the high-risk people-who-inject-drugs population could begin in 2026/2027. Following phase 3 trials, the hepatitis C vaccine could then be rolled out to other high-risk groups in or around 2029, such as men who have sex with men, healthcare workers, and babies born to mothers with hepatitis C, in all countries of the world."

Using Canada as an example, Sir Michael points out the huge cost savings that could be generated by a successful vaccine - it is estimated that treating people who inject drugs with DAAs over a decade would incur drug costs of around C$1 billion (US$0.8 billion), compared to $20 million (US$16 million) estimated for vaccine costs to protect the same population.

https://bit.ly/2Ta8o5O

High-tech toilets could spread antibiotic-resistant superbugs in hospitals, Japanese study suggests

Water-jet nozzles in electric toilets be reservoirs for multidrug-resistant Pseudomonas aeruginosa

Water-jet nozzles in electric toilets--commonly used in Japan and other parts of Asia--may be reservoirs for multidrug-resistant Pseudomonas aeruginosa (MDRP) in hospitals, increasing the risk of dangerous germ transmission among patients, according to new research being presented at the European Congress of Clinical Microbiology & Infectious Diseases (ECCMID) held online this year.

"This is the first report of hospital transmissions associated with electric toilets and could have major implications for infection control," says Dr Itaru Nakamura from Tokyo Medical University Hospital in Japan who led the research. "If water-jet nozzles are a source of hospital superbug cross-contamination, additional interventions - such as modified hand hygiene practices and toilet disinfection protocols - may be needed to stem the risk of transmission among healthcare providers and patients alike."

More than 80% Japanese households use electric toilets with an integrated bidet, which flush automatically [2]. The main feature is a nozzle the size of a pencil that comes out from underneath the toilet seat and squirts water to wash the bottom and clean the toilet. The nozzle is also self-cleaning and cleans itself before and after every operation.

P. aeruginosa naturally occurs in soil and freshwater, but it can also thrive on the moist surfaces in hospitals, leading to opportunistic infections in weakened and ill patients that could develop into life-threatening conditions like pneumonia or sepsis.

Because of the overuse of antibiotics, these bacteria have evolved the ability to withstand attempts to treat infections with drugs that once killed them. And infections caused by MDRP bacteria are becoming more common in both the community and hospitals. Mortality rates among people infected with these superbug strains are double those of people infected with strains that are susceptible to treatment [1].

In this study, researchers investigated the presence of multidrug-resistant bacteria recovered from the waterjet-nozzles of electric toilets in a haematology ward of Tokyo Medical University Hospital between September 2020 and January 2021.

The team made more than 10 visits to take samples from water-jet nozzles in electric toilets used by three patients with MDRP infections, including two patients with severe sepsis. MDRP strains were defined as those with resistance to at least two antibiotics such as imipenem, meropenem, amikacin and ciprofloxacin.

Using genetic fingerprinting techniques, they looked to see whether the strains of MDRP from the three infected patients were the same as the environmental MDRP strain sampled from the toilet nozzles. They found the samples matched, with strain 'ST235' dominating in all the samples--suggesting that transfers to and from patients were happening.

"In short, our findings imply that multidrug-resistant P. aeruginosa bacteria were being transmitted within the patient community, and critically that the infection may be spread within hospitals via contaminated electric toilet nozzles", says Dr Nakamura. "With good hospital hygiene, which includes handwashing and environmental cleaning, we can control the spread of these pathogens, especially within in settings where patients' immune systems are compromised."

The authors point out that this was only a small study in a single hospital ward. They also highlighted several limitations including that the genetic analysis was not able to distinguish the direction of transfer, whether it is from the patient to the water-jet nozzles, or from those nozzles to the patients.