Measuring dopamine

MIT neuroscientists have devised a way to measure dopamine in the brain for more than a year, which they believe will reveal much more about its role in both healthy and diseased brains.

Climate change, hurricanes and hazards of connecting dots

It may be human nature to want to assign blame for terrible events — and since climate change became part of public consciousness, it's a frequently faulted for natural disasters. Is Hurricane Florence our fault for emitting climate-changing greenhouse gases, or perhaps policy makers' fault for allowing us to do so?

The answer is the same one that applies to cancer. Environmental factors such as excessive UV radiation, secondhand smoke and certain chemical exposures increase risk, but cancer has been around since the age of the dinosaurs, and there's an element of randomness to it. It may be impossible to conclude any single risk factor was the single cause of any given case, bloomberg.com wrote.

With climate change, there is a growing body of work showing that storms will get stronger and wetter over the course of this century. Last year, in the wet wake of Hurricane Harvey, researchers told me that warming in the Arctic is making circulating winds more sluggish, and this effect may have contributed to the way Harvey stalled over Houston, where it dumped more than 50 inches of rain over a vast region.

Other researchers have shown that warming is happening in the deeper layers of the ocean, and this will give more fuel to tropical storms, allowing them to grow wetter and more powerful. Normally, cold water churned up in the path of a hurricane helps it burn out.

The National Academy of Sciences looked into the matter in 2016, with its report 'Attribution of Extreme Events in the Context of Climate Change.'

NASA/GETTY IMAGES

University of Georgia Meteorology Professor J. Marshall Shepherd, who contributed to the report, said that it's much easier to connect climate change to extreme heat spells, and the relative lack of recent cold spells.

There, the models predict these events, and there are good records from the past and a good understanding of the physics behind the phenomena. There's a good understanding of the physical mechanisms connecting more severe storms to climate change, but the models aren't yet able to say much about hurricanes specifically, and the records only go back a few decades.

Soon after the report was released, Shepherd wrote a piece for Forbes saying that "Was that caused by climate change?" is "one of the most abused questions ever".

It's abused because people use it to push different agendas. But as with cancer cases, seeking a cause is a common emotional reaction. What matters is answering it honestly.

Separating sound from noise in hot plasma fusion

In the search for abundant clean energy, scientists around the globe look to fusion power, where isotopes of hydrogen combine to form a larger particle, helium, and release large amounts of energy in the process.

For fusion power plants to be effective, however, scientists must find a way to trigger the low-to-high confinement transition, or 'L-H transition' for short, phys.org wrote.

After a L-H transition, the plasma temperature and density increase, producing more power.

Scientists observe the L-H transition is always associated with zonal flows of plasma. Theoretically, zonal flows in a plasma consist of both a stationary flow with a near-zero frequency and one that oscillates at a higher frequency called the geodesic acoustic mode (GAM), which is a global sound wave of the plasma. For the first time, researchers at Hefei University of Technology have detected GAM at two different points simultaneously within the reactor. This new experimental setup will be a useful diagnostic tool for investigating the physics of zonal flows, and their role in the L-H transition. The researchers report these findings in a new paper published in Physics of Plasmas.

Zonal flows occur anywhere there is turbulence, such as inside a fusion device or in a planet's atmosphere.

"The most famous zonal flows in nature may be the well-known Jovian belts and zones, which make Jupiter look like a colorful, multilayered cake," said Ahdi Liu, an author on the paper. In fusion plasmas, zonal flows are crucial for regulating turbulence and particle transport within the reactor.

"With the gradual improvement of diagnostic technology, zonal flows in fusion plasma has become a research hot spot in the past two decades," Liu said.

In these experiments, researchers used the Experimental Advanced Superconducting Tokamak (EAST), a magnetic fusion energy reactor in Hefei, China. They installed two Doppler reflectometers on different sides of EAST, which can detect fluctuations in turbulence and plasma density with high precision. The detected GAM had a pitch of F, five octaves above middle C.

Previously, researchers at ASDEX-U, the fusion research device at the Max Plank Institute of Plasma Physics, used a similar system to detect GAM, but they measured the plasma at a single location, which makes the setup prone to interference. "This disadvantage is the main motivation for using two sets of Doppler reflectometers," Liu said.

"We could 'purify' the GAM information by comparing the two location's measurements."

The measurements taken at the two points did not entirely agree, showing that each reflectometer also picked up information from nonzonal flows.

"It is completely necessary to extract accurate zonal flows information from multipoint measurement," Liu said.

Using both measurements, they could clearly show that GAM interacted with the ambient turbulence. Going forward, the researchers will further investigate the role of zonal flows in turbulence and turbulent transport within EAST.

Iranian computer scientists bag four medals at IOI 2018

Iran's brightest young computer scientists took home four medals at the 2018 International Olympiad in Informatics in Japan.

The 30th International Olympiad in Informatics (IOI) was held in Tsukuba, Japan, from September 1 to September 8. Over 900 participants from 85 countries took part in the event, Mehr News Agency reported.

Iran's team of four finished the competitions with four medals. Mohammad Mahdavi snatched the gold medal of the event, while Keivan Rezaei and Mehrdad Saberi bagged silver each. Mahdi Sadegh Shobeiri settled for the bronze medal.

The International Olympiad in Informatics (IOI), the second largest olympiad after International Mathematical Olympiad, is an annual competitive programming competition for secondary school students.

Iran hosted the previous edition of the event during which the Iranian team finished fourth after Japan, China and Russia with one gold medal and three silver medals.

The IOI 2019 will be held in the Republic of Azerbaijan.

mehrnews.com

Single gene mutation may have helped humans become optimal long-distance runners

Two to three million years ago, the functional loss of a single gene triggered a series of significant changes in what would eventually become the modern human species, altering everything from fertility rates to increasing cancer risk from eating red meat.

In a new paper, published in issue of the Proceedings of the Royal Society B, researchers at University of California San Diego School of Medicine report on studies of mice engineered to lack the same gene, called CMAH, and resulting data that suggest the lost gene may also have contributed to humanity's well-documented claim to be among the best long-distance runners in the animal kingdom, phys.org reported.

At roughly the same time as the CMAH mutation took hold, human ancestors were transitioning from forest dwellers to life primarily upon the arid savannahs of Africa. While they were already walking upright, the bodies and abilities of these early hominids were evolving dramatically, in particular major changes in skeletal biomechanics and physiology that resulted in long, springy legs, big feet, powerful gluteal muscles and an expansive system of sweat glands able to dissipate heat much more effectively than other larger mammals.

Such changes, say scientists, helped fuel the emergence of the human ability to run long distances relatively tirelessly, allowing ancestors to hunt in the heat of the day when other carnivores were resting and to pursue prey to their point of exhaustion, a technique called persistence hunting.

"We discovered this first clear genetic difference between humans and our closest living evolutionary relatives, the chimpanzees, more than 20 years ago," said senior author Ajit Varki, MD, distinguished professor of medicine and cellular and molecular medicine at UC San Diego School of Medicine and co-director of the UC San Diego/Salk Center for Academic Research and Training in Anthropogeny.

Given the approximate timing of the mutation and its documented impact on fertility in a mouse model with the same mutation, Varki and Pascal Gagneux, PhD, professor of anthropology and pathology, began investigating how the genetic difference might have contributed to the origin of Homo, the genus that includes modern Homo sapiens and extinct species like Homo habilis and Homo erectus.

MICHAEL STEELE/GETTY IMAGES

"Since the mice were also more prone to muscle dystrophy, I had a hunch that there was a connection to the increased long distance running and endurance of Homo," said Varki, "but I had no expertise on the issue and could not convince anyone in my lab to organize this long-shot experiment."

Ultimately, a graduate student named Jon Okerblom took up the task, building mouse running wheels and borrowing a mouse treadmill.

"We evaluated the exercise capacity (of mice lacking the CMAH gene), and noted an increased performance during treadmill testing and after 15 days of voluntary wheel running," said Okerblom, the study's first author.

The researchers then consulted Ellen Breen, PhD, a research scientist in the division of physiology, part of the Department of Medicine in the UC San Diego School of Medicine, who added observations that the mice displayed greater resistance to fatigue, increased mitochondrial respiration and hind-limb muscle, with more capillaries to increase blood and oxygen supply.

Taken together, Varki said the data suggest CMAH loss contributed to improved skeletal muscle capacity for oxygen utilization.

"And if the findings translate to humans, they may have provided early hominids with a selective advantage in their move from trees to becoming permanent hunter-gatherers on the open range."

When the CMAH gene mutated in the genus Homo two to three million years ago, perhaps in response to evolutionary pressures caused by an ancient pathogen, it altered how subsequent hominids and modern humans used sialic acids — a family of sugar molecules that coat the surfaces of all animal cells, where they serve as vital contact points for interaction with other cells and with the surrounding environment.

The human mutation causes loss of a sialic acid called N-glycolylneuraminic acid (Neu5Gc), and accumulation of its precursor, called N-acetylneuraminic acid or Neu5Ac, which differs by only a single oxygen atom.

This seemingly minor difference affects almost every cell type in the human body — and has proved to be a mixed blessing. Varki and others have linked the loss of the CMAH gene and sialic acids to not just improved long-distance running ability, but also enhanced innate immunity in early hominids. Sialic acids may also be a biomarker for cancer risk.

Conversely, they have also reported that certain sialic acids are associated with increased risk of type 2 diabetes; may contribute to elevated cancer risk associated with red meat consumption; and trigger inflammation.

"They are a double-edged sword," said Varki. "The consequence of a single lost gene and a small molecular change that appears to have profoundly altered human biology and abilities going back to our origins."

Going green could make the Sahara Desert…go green

The world's largest hot desert — with a scant population, strong winds and unobstructed exposure to the sun — is an idyllic landscape for generating renewable energy, according to new research.

Scientists have been studying how to effectively turn this potentially endless generator into a global port of power for some time now. The Sahara Solar Breeder Project, for example, is hoping to power half the world by 2050 with solar panel farms from the desert, foxnews.com reported.

Although wind and solar farms are known to affect a region's heat and humidity, the environmental impact that such projects would have on the desert itself have been largely overlooked. But a new study published in the journal Sciencereveals that not only could these plants literally run the world, they could also transform the Sahara for the better.

Researchers developed climate models based on the temperature, precipitation and vegetation changes that would occur if the entirety of the Sahara — 3,500,000 square miles — was covered with solar and wind farms. A project this size could create up to 79 terawatts of electrical power — four times the 18 terawatts the world used in 2017, according to the study.

Published by foxnews.com

"We found that the large-scale installation of solar and wind farms can bring more rainfall and promote vegetation growth in these regions," Eugenia Kalnay, one of the coauthors of the paper, told the University of Illinois. Specifically, it could double the Sahara's, and neighboring Sahel's, precipitation and help increase vegetation by 20 percent, research showed.

"The rainfall increase is a consequence of complex land-atmosphere interactions that occur because solar panels and wind turbines create rougher and darker land surfaces," said Kalnay.

Wind turbines would pull warmer air down to the surface while the solar panels help to reduce surface reflectiveness, both of which are known to increase rainfall, the study explained, turning the arid landscape into a global mean, green, renewable machine.

"The increase in rainfall and vegetation, combined with clean electricity as a result of solar and wind energy, could help agriculture, economic development and social well-being in the Sahara, Sahel, Middle East and other nearby regions," Safa Motesharrei, another one of the study's coauthors, told the University of Illinois.