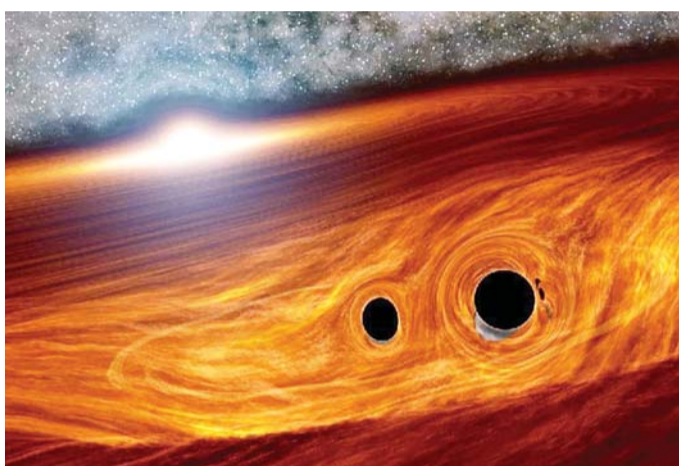


#SPACE

'Echoing' Black Holes

As a black hole pulls in gas and dust from an orbiting star, it can give off bursts of X-ray light that bounce and echo off the gas spiralling into it, briefly illuminating the black hole's surroundings.



Astronomers have discovered eight new 'echoing black hole binaries' in our galaxy with a new automated search tool that they call 'Reverberation Machine'. These are systems with a star orbiting, and sometimes being eaten away by a black hole. Previously, only two such systems in the Milky Way were known to emit 'X-ray echoes' that could be detected.

There are millions of black holes scattered across our galaxy. They are extremely strong wells of gravity that bend space and time. Nothing that falls in, even light, can escape from it. This makes them dark by definition, and difficult to detect. But as a black hole pulls in gas and dust from an orbiting star, it can give off bursts of X-ray light that



bounce and echo off the gas spiralling into it, briefly illuminating the black hole's surroundings.

Strong Wells of Gravity

By comparing these X-ray echoes across systems, the team has pieced together a general picture of how a black hole evolves during an outburst. They observed that a black hole first undergoes a 'hard' state, where it whips up a corona of high-energy photons along with a jet of relativistic particles that is then launched away at close to the speed of light.

At one point, the black hole gives off one final high-energy flash before transitioning to a 'soft', low-energy state. This flash could be a sign that the black hole's corona (region of high-energy plasma right outside a black hole's boundary) briefly expands and ejects a burst of high-energy particles before disappearing altogether.

These new findings could help scientists explain how larger, supermassive black holes at the centre of a galaxy can eject particles across vast cosmic scales to shape a galaxy's formation.

The role of black holes in galaxy evolution is an outstanding question in modern astrophysics. Interestingly, these black hole binaries appear to be 'mini' supermassive



black holes, and so by understanding the outbursts in these small, nearby systems, we can understand how similar outbursts in supermassive black holes affect the galaxies in which they reside," says Erin Kara, assistant professor of physics at MIT.

Kara and her colleagues use X-ray echoes to map a black hole's surroundings, similar to the way in which bats use echolocation to navigate their vicinity. Bats emit sounds that bounce off obstacles and return to the bat as an echo. The nocturnal animal can then calculate the distance between it and the obstacle based on the time it takes for the echo to return to them, helping them map their surroundings. Similarly, the research team is looking to map the immediate vicinity of a black hole using X-ray echoes. These echoes present time delays between two types of X-ray light emitted directly from the corona, and light from the corona that bounces off the gas and dust spiralling into the black hole.

The researchers can observe the time at which a telescope receives light from the corona and compare it to when it receives the X-ray echoes to calculate an estimate of the distance between the corona and the accretion disk (disk-like flow of plasma, gas, dust and other matter around a black hole).

Stellar Material

Observing how these time delays change over time will reveal how a black hole's corona and disk evolve as the black hole consumes stellar material. As a side project, Kara is working with MIT education and music scholars to convert these X-ray echo emissions into sound waves that can be heard by humans. You can listen to these waves in the video below.

The team identified a common theme of evolution in all systems. In the initial hard state, when the corona and high-energy particles dominate the black hole's energy, they detected time lags that were short and fast, in the order of milliseconds. This state lasts for several weeks. After that, a transition occurs over several days, in which the corona and jet sputter and die out.

Then, the soft state dominated by lower-energy X-rays from the black hole's accretion disk takes over. During this transition period, the astronomers discovered that time lags became longer for a short period in all ten systems, implying that the distance between the coronas may briefly expand outward and upward in a high-energy burst before the black hole finishes consuming a bulk of the stellar material and goes quiet.



Will Run Again... Will Live Again

Sumathi Kumar

The first plane journey in first-class luxury is cause for great excitement for most. Hillary Allen would not necessarily agree; then again, she is not likely to forget hers anytime soon.

At the top of her game, ranked No.1 on the sky running circuit, the American trail runner had lined up at the Tromsø Skyrace. The course covered some of the most scenic yet treacherous landscapes of Norway. While negotiating a technical section along a ridge line, Allen slipped and fell, plummeting 150ft. By the end of it, she was on a long-haul flight back home to Colorado, US, in first-class comfort, but strapped to a bed with 14 broken bones, on a diet of painkillers and blood thinners.

Doctors sounded the death knell for her running career. The early days were despondent but through the turmoil, Allen rediscovered her love for running. And things about herself that make her the champion that she is. The story about bouncing back on the trails and in life makes her latest book, Out And Back, published by Blue Star Press last month, an inspiring read for anyone who has struggled to find their way up after hitting rock bottom.

Way of Life

In a previous avatar, Allen was a student of neuroscience, physiology and structural biology. This was the time when she discovered running, as a change from life indoors. Though just two years away from a PhD, she decided to pursue a teaching career instead. It would give her enough time to chase her new found passion and she was soon making waves on the international circuit. The prize money and endorsements helped her make a living but it was evident that running was more than just a job. And then, she woke up



one day to realise she couldn't even step out, what to say of going for a run.

"Running was a way of life, a way for me to feel connected to the world. So to have it suddenly taken away from me was like experiencing a death. I felt extreme grief and sadness, a loss of identity," Allen says.

The first round of surgeries was on the right foot and wrists. The cracked vertebrae and ribs needed healing. As she lay in bed, struggling with basic movement, there were times she wondered just why she had survived. She missed the freedom of setting out in the wilderness, watching vistas unfold as she gained height, hopping daintily over stones and tearing down trails to test the limits of her ability. The lack of independence while attempting just about anything gnawed at her.

While the medals in her closet reminded her of epic wins and indefatigable battles, at times with her own self, she now had recurring dreams of falling through space, bracing for impact and what fate had in store for her. Her support system helped her pull through the initial months of recovery but it

A devastating accident – words of the doctors who told her that she could never run again. For someone else, this could have been the end of her dreams. But not for Hillary Allen, an American sky runner and the author of the book 'Out and Back', who refused to give up her love for running just because she had fallen down some 150ft and broken about 14 bones.

"The accident in Tromsø had made me realise that I was stronger than I thought I was. I was brave and had the courage to face my fears and keep moving forward," Allen says.

Accepting Initiations

Once she had recovered, Allen decided to take on things that scared her. This would culminate in a return to the Tromsø Skyrace. She went to the Cortina Trail 48k in June 2019 to test out her ankle and though slower than the previous year, still won the race. The following month, she decided to run on snow for the first time since slipping and shattering her ankle. Just the thought of it scared her. It took a mighty effort to just get to the race venue in Gran Paradiso, Italy. She cried during testing moments, uncertain of the snow underfoot after all she had suffered. The doubts crept in but she pushed on, focusing on speed up hills, making the descents nimbly and consciously.

"I have great respect for the power of mountains. Risk is constant in the mountains and I feel comfortable accepting it after the

game. Five months after the accident, she took on her first run. "I remembered how scared I was. And how confused I was about being scared, since I was only running on a flat gravel path! But those first steps really ignited my hopes," Allen recalls.

Allen started focusing on the run, the many wonders of the terrain and the joy it brought, instead of the daily targets and results. A few weeks on, she decided to take on her first event. Though this was no race, the competitive spirit was back as she ran alongside others. There was the burning desire to storm past them like she could once. But her body simply wouldn't permit it. She broke down by the side of the trail, until her friend asked her to simply enjoy the run. By the end of it, she had logged 20 miles. It was the most since her return-and a start that made her believe.

Soon after, a broken screw in her foot needed surgery again. She made a full recovery and even won a few races in 2018. As she geared up for a promising 2019 season, disaster struck again. A slip on ice left her with a broken ankle that needed another surgery. Despite the sinking feeling, she embraced the situation with a sense of calm, not allowing it to control her.



hours spent practising. What has changed is how I check in with my initiation and if I feel good going into the mountains that day. There's a physical and a mental side to it now," she says. "After the accident, I have changed how I train and constantly take care of my body with physical therapy and stretching. But what's changed the most is how grateful I am to be running and how much I love the process of going after big goals and pushing myself."

Lining up at the start line of the Tromsø Skyrace again and crossing the finish post with a big smile on her face was redemption at its finest. By her side was Manu Par, a fellow runner who had rushed to her side after witnessing the acci-



Out And Back by Hillary Allen.

The scars on her body are a constant reminder of what the human spirit is capable of. "To me, scars represent resilience-visible, tangible evidence of the experiences I have endured," says Allen. "I have healed and become stronger, and am grateful for the experiences."



dent. She hiked with him to the spot where she had taken a fall and relived the incident through him, as he described what he had seen that day. There was fear before the race about how things would pan out; this gradually transformed into a sense of anticipation to tackle everything that the run would throw at her. It brought closure for Allen.

The scars on her body are a constant reminder of what the human spirit is capable of. "To me, scars represent resilience-visible, tangible evidence of the experiences I have endured," says Allen. "I have healed and become stronger and am grateful for the experiences."

World Ego Awareness Day

We all know someone who we would say has an incredibly inflated ego, and while we all have a very good idea of what 'Ego' is, we seem to lack an understanding of just how damaging that this phenomenon can be. World Ego Awareness Day is our opportunity to spend some time in self-reflection exploring our ego, and our experiences with those around us to determine how much of their perceived ego is our own coming into conflict with others.

#DRUG-FACTS

Marijuana has a significantly adverse effect on the cardiovascular system. Studies of human cells and mice clearly outline how THC exposure initiates a damaging molecular cascade in the blood vessels. It's not a benign drug.



Marijuana's use and heart attack risks were correlated in a large human study, researchers report. A molecule in soybeans may counteract these effects.

The study also shows that the psychoactive component of the drug, known as THC causes inflammation in endothelial cells that line the interior of blood vessels as well as atherosclerosis in laboratory mice.

The inflammation and atherosclerosis can be blocked by a small molecule called genistein that occurs naturally in soy and fava beans, the researchers found. Genistein has limited brain penetration, it doesn't inhibit THC's ability to stimulate appetite, dull pain, and tamp down nausea-characteristics vital to medicinal marijuana users.

"As more states legalize the recreational use of marijuana, users need to be aware that it could have cardiovascular side effects," says Joseph Wu, professor of cardiovascular medicine and director of the Stanford Cardiovascular Institute. "But genistein works quite well to mitigate marijuana-induced damage of the endothelial vessels without blocking the effects marijuana smokers on the central nervous system, and it could be a way for medical marijuana users to protect themselves from a cardiovascular standpoint."

Long-Term Exposure

In part because THC, or tetrahydrocannabinol, is a controlled substance in the United States and therefore strictly regulated in medical research, the investigators cautioned that the long-term health effects of regular use remain largely unclear.

"Marijuana has a significantly adverse effect on the cardiovascular system," says instructor of medicine Mark Chandy. "As more states legalize marijuana use, I expect we will begin to see a rise in heart attacks and strokes in the coming years. Our studies of human cells and mice clearly outline how THC exposure initiates a damaging molecular cascade in the blood vessels. It's not a benign drug."

Wu is the senior author of the study which appears in the journal Cell. Chandy shares lead authorship with former postdoctoral scholar Tzu-Tang Wei and instructor Masataka Nishiga.

Marijuana Users

The researchers analysed the genetic and medical data of about 500,000 people ages 40-69. The data was from the UK Biobank. Nearly 35,000 participants reported smoking cannabis; of those, about 11,000 smoked more than once a month. The more-than-monthly smokers

Heart Attack More Likely Among Pot Users



treated human endothelial cells or gave it to the THC-injected mice with high cholesterol, they found genistein blocked the drug's deleterious effects and did not block the psychoactive effects of THC on the brain.

"We didn't see any blocking of the normal painkilling or sedating effects of THC in the mice that contribute to marijuana's potentially useful medicinal properties," Chandy says. "So genistein is potentially a safer drug than previous CB1 antagonists. It is already used as a nutritional supplement, and 99% of it stays outside the brain, so it shouldn't cause these particular adverse side effects."

Conclusion

The researchers hope to conduct clinical trials to learn whether genistein can reduce the risk of cardiovascular disease in marijuana users. They'd also like to extend their studies to include CBD-another cannabinoids in marijuana that does not have the psychoactive effects of THC. "There's a growing public perception that marijuana is harmless or even beneficial," Wu says, comparing the legalization of marijuana use to vaping which was first marketed as a safe way to stop smoking but has since been shown to cause lung damage and lead to increased tobacco use. "Marijuana clearly has important medicinal uses, but recreational users should think carefully about excessive use."

Co-authors of the study are from Stanford, National Taiwan University, the University of Copenhagen, Academia Sinica, the University of Colorado School of Medicine, and UC San Francisco.



Finally, laboratory mice bred to have high cholesterol levels and fed a high-fat diet developed significantly larger atherosclerosis plaques when injected with THC at levels comparable to smoking one marijuana cigarette per day than did control animals.

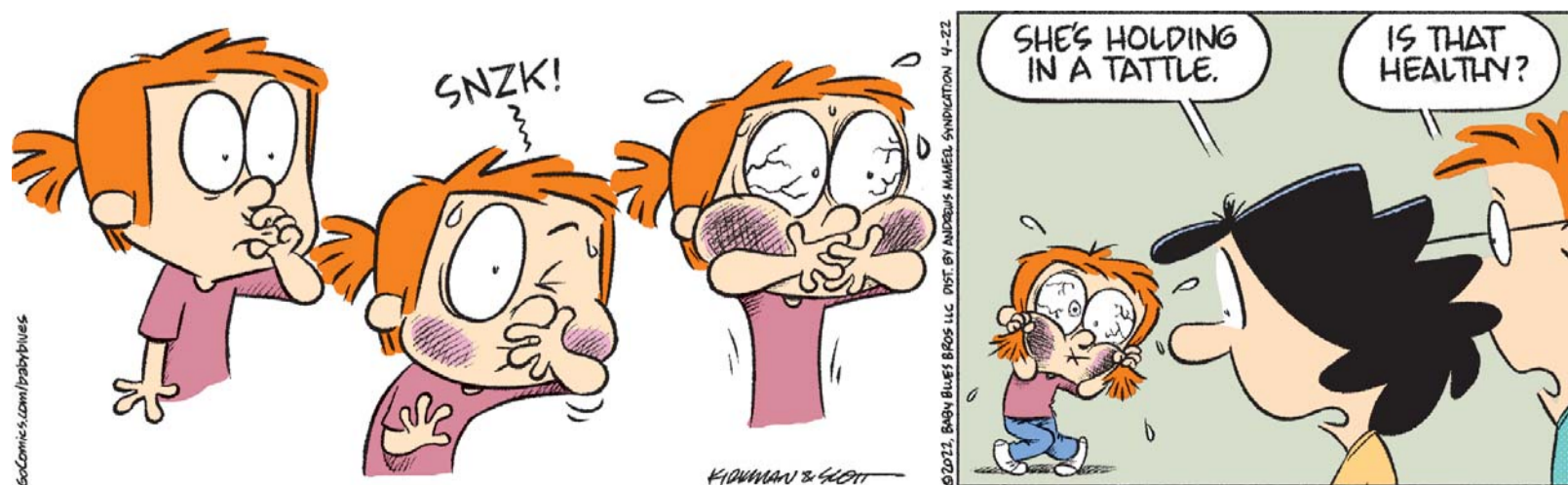
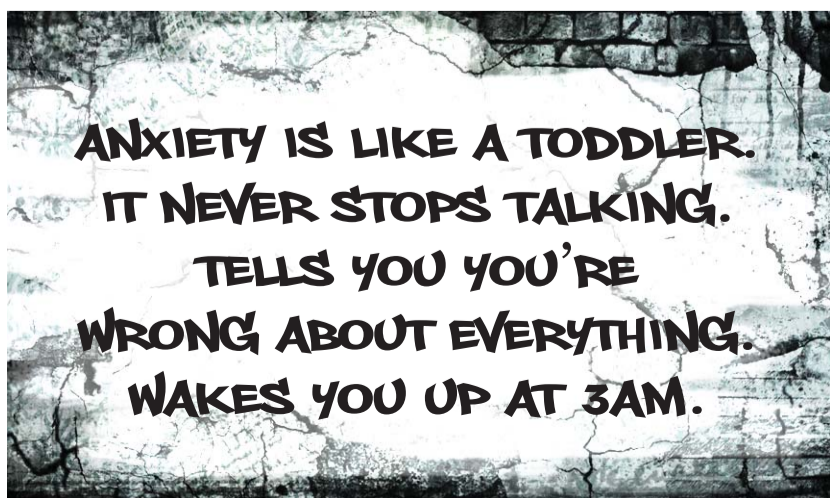
Genistein and Heart Attack Risk

THC binds to a receptor called CB1 on cells in the human brain, heart, and vasculature system. The receptor recognizes naturally occurring cannabinoids, or

BABY BLUES

By Rick Kirkman & Jerry Scott

THE WALL



ZITS

By Jerry Scott & Jim Borgman

