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Science Focus

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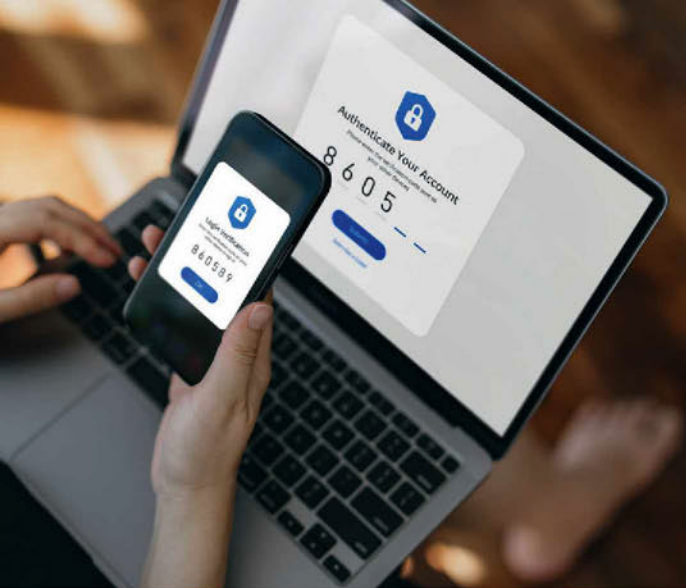
The tech uncovering the secret life of whales

E-fuels

How synthetic petrol could save the supercar

Biology

Understand the wonders of the human eye



ABOVE Two-factor authentication improves security but is by no means foolproof

→ authenticating your device. This is where biometric passkeys come in. Biometric authentication uses special sensors in your devices to measure features unique to you and uses those as a passkey.

Your fingerprint, 3D facial dimensions, iris, retina and palm vein can all be used. And today's smartphones, laptops and tablets are capable of reading fingerprints and faces, so they can perform accurate biometric authentication.

HOW DO BIOMETRIC PASSKEYS WORK?

When your device knows it's really you, then it has to send that approval securely to the application demanding authentication. Passkeys provide that mechanism. They use cryptographic security to ensure that data transferred between sender and recipient cannot be intercepted and deciphered.

Your phone stores a private cryptographic key and releases a public key to the application. This enables your phone to send a private message to the application that can only be read by that application saying: "the biometric test has been passed." All you needed to do is look at the phone or put your finger on the fingerprint reader.

AND PASSKEYS ARE BETTER BECAUSE...

Once we have biometrics and passkeys, we no longer need passwords. And this looks like the next stage in the evolution of computer security. Google has announced that it's switching from passwords to passkeys, turning off passwords and 2FA altogether for those users who wish to switch.

It's a better solution for everyone: no more passwords to remember, no codes sent to your phone that you have to type in. And should your phone be lost or stolen, it's no problem: the authentication requires your face or your fingerprint. So it won't work for anyone else.

Like all changes, it may take some getting used to. But adoption is likely to be a choice and given the alternatives, it's a big improvement.

by **DR PETER BENTLEY**

Peter is a computer scientist based at University College London and the author of 10 Short Lessons In Artificial Intelligence And Robotics.

ANALYSIS

SPACEFLIGHT: SHOULD THE FIRST CREW TO TRAVEL TO MARS BE ALL-FEMALE?

A new study carried out by the European Space Agency suggests that women may be better suited to space travel

"That's one small step for man, one giant leap for mankind". Neil Armstrong's famous declaration tellingly illustrates that the first generation of Moon landings were a male-dominated affair. Perceptions back then were that women simply did not have 'the right stuff' to make it in space. This was, of course, nonsense.

These days progress has been made and now the world's astronaut corps are much more balanced in terms of gender. But could it be the case that females have the edge when it comes to putting humans back on the Moon, or travelling to Mars and beyond?

A recent study by the European Space Agency's (ESA's) medical team, concluded that "there may be a number of operational advantages to all-female crews [for long-duration missions]." The work considered a theoretical group of astronauts and made estimations of the life support requirements and consumables that such a crew would require. They concluded, not surprisingly, that because females, on average, are smaller and lighter than males, they would need less food and oxygen over the course of a mission.

This is key, as getting stuff – spacecraft, robots, humans and everything needed to sustain them – into space takes large amounts of energy. The laws of physics demand that to orbit a planet, or to escape its gravity and fly to another one, the stuff needs to accelerate to very high speeds. The more stuff, or mass, you want to get into Earth orbit, or to the Moon or Mars, the larger the rocket you need.

So, if women are lighter, and eat less, should the first crew to fly to Mars be all-female? The ESA study was a follow-up to an earlier paper by the same researchers that considered a theoretical all-male crew.

Separating the sexes, or 'sex disaggregation', in research is a good thing, as there are biological differences between them, and understanding these differences results in better informed decisions. But as the journalist and author Angela Saini, who has researched the impacts of sex-based research, says: "There is actually no real-life 'default' male – every man is different from the next, just like every woman is. While it's great that women have been studied, the more important takeaway is that individual astronauts should obviously be considered."

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“Because females, on average, are smaller and lighter than males, they would need less food and oxygen over the course of a mission”

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Getting humans to Mars and back safely is a huge challenge. A round trip would take around two years, with the crew having to endure a harsh radiation environment, as they're bombarded by solar wind. Also, as they got further from Earth, communication delays would increase, with messages taking minutes to travel one way, rendering normal conversations with anyone back on Earth impossible.

Once on the Red Planet, after nine months in transit and living in a weightless environment, the crew would have to be physically and mentally capable of living on the surface of Mars before making the return trip home. Solving the challenges of keeping astronauts safe and well will require a staggering number of considerations.

ABOVE Kristina Koch is part of the crew that will be making humanity's next flight to the Moon

The ESA studies showed that, just as on Earth, the resources needed to sustain a crew when they exercise are higher than at rest. But exercise is vital to ensure that astronauts' bones and muscles are strong enough for them to function when they land.

HIFIm is a new exercise device invented by John Kennett, director of Physical Mind London, that might hold the answer. Smaller and lighter than current exercise equipment, HIFIm workouts are carried out on the bench-like device and are based around jumping movements, rather than running or cycling, and could revolutionise in-space exercise programmes.

Kennett says: "ESA has proven jumping just four to six minutes a day mitigates the effects of being in microgravity. This means that HIFIm could reduce the →



ABOVE Astronauts need a wide range of skills, including the ability to work well as part of a team

→ time astronauts need to exercise by over 80 per cent.” So using the new device could also reduce the resources the astronauts need and lessen the payload any rocket would have to carry.

As well as staying fit and healthy individually, any crew must also function well collectively. While humans haven’t yet travelled to Mars, research has been carried out into how people function in confined, isolated environments for long periods of time and it shows that a diverse crew is key to success.

Susan Charlesworth, director of Oxford Human Performance, and a specialist in human factors for space missions, says: “Men and women often have different, complementary leadership and conflict management styles that temper one another, leading to better cohesion over extended periods. A crew that is diverse in many characteristics maximises its likelihood of successful teamworking.”

Overcoming these extreme environments and challenges is also part of why human spaceflight can be inspirational to so many people, and the first mission to Mars will surely captivate imaginations. In order for it to reach the widest possible audience, however, inclusivity is vital.

Saini says: “One of the mistakes of earlier eras was to assume that all women were incapable of going into space. It would be just as damaging to assume that all men were unsuitable. I would hate for young boys to feel they couldn’t dream of being astronauts, just as I hate that young girls were ever made to feel that way.”

Space agencies spend a lot of time and effort selecting their astronauts, finding people with the right mix of skill and personality needed to thrive in space. These astronauts are then carefully combined into crews, taking account of the specific demands of any given mission.

The first journey to Mars will be risky, arduous and daunting. The crew that take that step will be painstakingly chosen and will most certainly have the right stuff to undertake what will be a monumental leap for humankind, whatever their gender.

by **LIBBY JACKSON** (@LibbyJackson_)
Libby is an expert on spaceflight and author of Space Explorers: 25 Extraordinary Stories Of Space Exploration And Adventure

COMMENT

ONE MEAL A DAY: COULD IT WORK FOR WEIGHT LOSS?

Is eating just once a day the secret to staying trim or is it just restrictive eating?

Society has an ongoing fascination with the constantly shifting trends in celebrity diets. The one meal a day (or OMAD) diet is one such trend, reportedly championed by the likes of Bruce Springsteen, Coldplay frontman Chris Martin, football pundit Gary Lineker and even the prime minister, Rishi Sunak. But does the science back up the claims?

OMAD is an extreme fasting diet. As the name suggests it involves eating just one big meal a day, with fasting, or very minimal eating, in between. The key focus of this kind of diet is weight control and simplicity.

There are many celebrity anecdotes surrounding OMAD and from an evolutionary point of view, it can seem reasonable to suggest that human biology is better suited to less frequent meals. This theory is based on our ancestors often experiencing cycles of feasting and fasting rather than the relatively modern construct of three meals a day. But while fasting itself isn’t new, the research on its health impacts is still in its infancy and there are very few studies on OMAD and the evidence supporting other more periodic types of fasting can’t necessarily be extrapolated into extreme fasting.

One trial exists on OMAD, where participants ate either one meal a day or three meals per day, with their calorie intakes tailored to theoretically maintain their current weight. When on one meal per day they reduced body weight and fat levels, and displayed features of “metabolic flexibility” (changes in measures of how fats and carbohydrates are metabolised). But participants also experienced a loss of muscle and bone mass. This highlights that a focus on weight loss alone can miss the potential downsides of this kind of diet.

Importantly, the results of this study can’t be applied to everyone. Only relatively healthy people were included and no one with obesity, cardiovascular disease, diabetes, mental disorders, eating disorders or other metabolic conditions was allowed to participate. Furthermore, the trial was small and short, with just 11 participants following the diet for 11 days.

One of the claims made by supporters of OMAD and other fasting diets is that you can eat whatever