

Wolves Understand Cause and Effect Better than Dogs

Men's best friends seem to have lost some cognitive abilities when they were domesticated



Children learn the principle of cause and effect early on: if you touch a hot stove, you'll get burned. But animals such as wolves understand causal relationships, too – and as a study has shown, they are even better at it than dogs. A research team that includes Juliane Bräuer from the Max Planck Institute for the Science of Human History investigated the behavior of dogs and of wolves that are used to people. To do this, the researchers hid food and tested whether the animals understood cues indicating the food's location. Both dogs and wolves understood communicative signals such as eye movements,

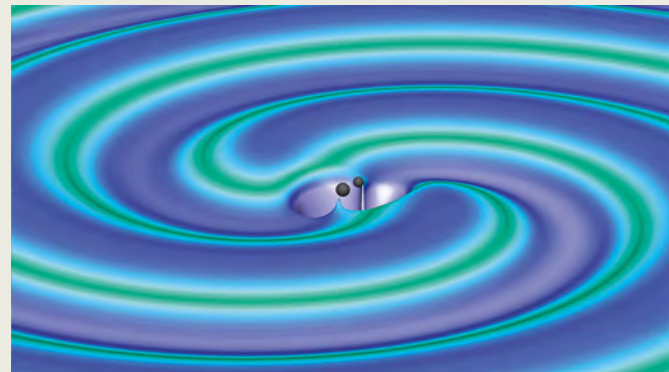
pointing fingers and nodding, as well as gestures directed toward the location in question. When the animals were expected to recognize that a can containing food makes a noise when shaken, while an empty can doesn't, only the wolves reached the correct conclusion. "This suggests that domestication affected the cognitive abilities of today's pet dogs," says Bräuer. "However, it can't be ruled out that the differences could be due to wolves being more persistent in exploring than dogs. Dogs are conditioned to receive food from us, whereas wolves have to find food themselves in nature". (www.mpg.de/11477998)

A telling glance: Wolves can interpret human eye movements and gestures correctly when it comes to finding hidden food.

All Good Things Come in Threes

Gravitational waves from two black holes caught also by Italian Virgo detector

The observation of gravitational waves is gradually becoming a routine occurrence: once again, researchers have recorded the space-time ripples that Albert Einstein predicted a hundred years ago. This time, however, in addition to the two Advanced LIGO observatories in the US that detected all three gravitational waves recorded thus far, the Italian Virgo detector was also involved. On August 14, all three detectors observed the GW170814 signal produced by the merger of two black holes. These cosmic monsters measured 31 and 25 solar masses. The signal reached the LIGO detector in Livingston around 8 milliseconds before it reached Hanford and about 14 milliseconds before it reached Virgo in Tuscany. The direction to the source could be inferred by combining these differences in arrival time. In this way, GW170814 could be localized to an area of 60 square degrees between the Eridanus and Horologium constellations in the southern celestial hemisphere. Comparing the measured waveform with predictions from the general theory of relativity, in turn, yielded a distance of about 1.8 billion light-years. This time, scientists from the Max Planck Institute for Gravitational Physics in Potsdam and Hannover were also involved in the discovery and data analysis. (www.mpg.de/11492342)



Signal from space: Two black holes with 31 and 25 solar masses merge and emit gravitational waves. The colors characterize the strength of the field.



Over the energy wall or through it? Classical particles can overcome energy barriers only if energy is expended to lift them above it. Quantum particles, however, have the possibility to cross the wall even if they don't actually have sufficient energy: they can tunnel through the obstacle.

Measuring Time in a Tunnel

In the quantum tunneling effect, particles overcome an energy barrier in a few attoseconds

Harry Potter can do a lot of things that we can't, including walking through walls: to reach platform 9 $\frac{3}{4}$ where the train to Hogwarts School of Witchcraft and Wizardry stops, he and his classmates slip through a wall between platforms nine and ten. Impossible in real life, this feat is normal in the crazy world of quantum physics. Particles such as electrons are able to penetrate energy barriers that are actually insuperable. Physicists call this the quantum tunneling effect. Now researchers at the Max Planck Institute for Nuclear Physics in Heidelberg have shown for the first time that it takes electrons a finite amount of time to tunnel. To investigate this,

the researchers used the electromagnetic field of a laser to rotate the potential well, which forms the electrical field of an atom and confines its electrons. Then they observed an electron as it tunneled out of the potential well. Due to the rotation, the particle's trajectory was shifted slightly, indicating that the electron had spent a few attoseconds – billionths of a billionth of a second – in the quantum tunnel. Although the tunnel effect has been known for nearly a hundred years, it was previously unclear whether a particle tunnels through a barrier in a finite amount of time or whether it instantaneously appears at the tunnel exit. (www.mpg.de/11419700)

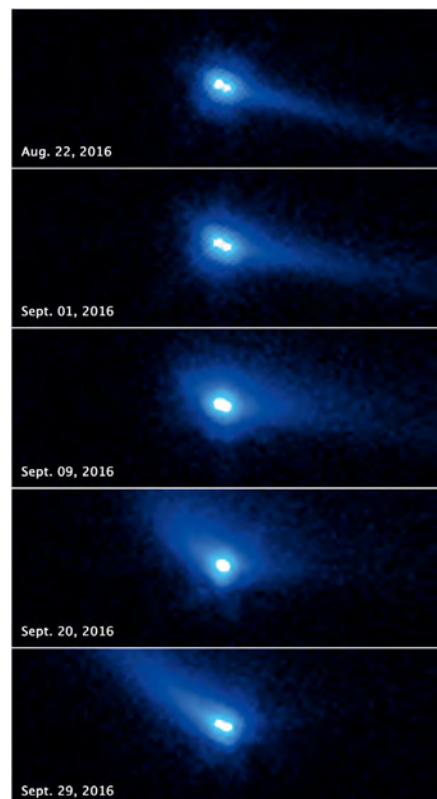
The Double Asteroid

An object with the name 288P is the only known active binary planetoid

Body 288P, which orbits the Sun in the asteroid belt between the orbits of Mars and Jupiter, is unique. For one thing, it belongs to the group of unusual asteroids that discharge dust and gas into space – thus behaving more like comets, which traverse the solar system as lone wolves. For another, Hubble Space Telescope data analyzed by a team of scientists under the leadership of the Max Planck Institute for Solar System Research suggests that it also comprises two separate components rotating about a common center of gravity. This makes 288P the first known active binary asteroid. It probably broke into two pieces under the force of its own rotation no more than 5,000

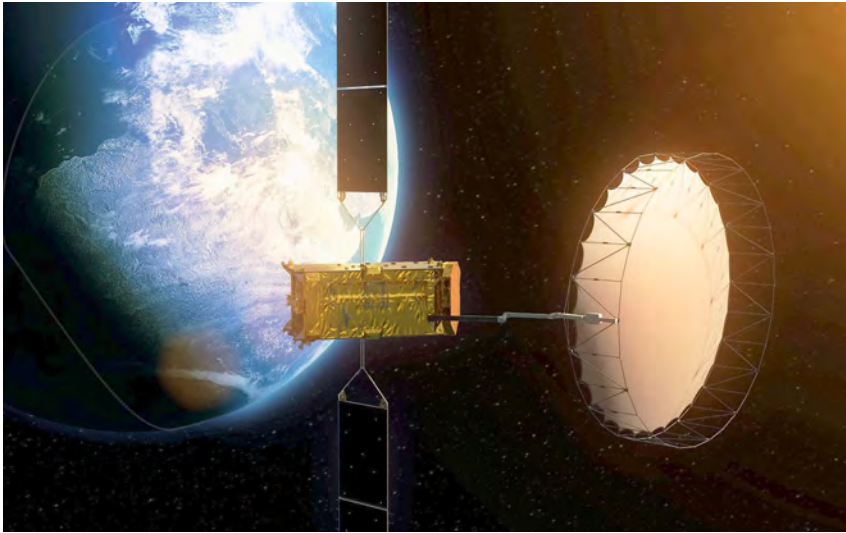
years ago. These two pieces each have a diameter of about one kilometer. Simulations show that they circle each other at a distance of around 100 kilometers on a highly elliptical orbit. Similar to a comet, the asteroid always becomes active when its orbit approaches the Sun. This is apparently due to gases that are then exposed and sublime. (www.mpg.de/11481624)

Not one, but two: This series of images from the Hubble Space Telescope show that the binary asteroid 288P comprises two parts that orbit each other and exhibit comet-like features. These include the coma – a thin gas envelope – and the long tail of dust.



Quantum Communication with a Satellite

Transmitting information from orbit will enable secure global data exchange



A versatile satellite: A part of the Alphasat I-XL was actually developed to demonstrate data transmission between Earth observation satellites and the Earth, but it is also suitable for transmitting quantum states.

Quantum cryptography: What started out as exotic research in physics laboratories could soon change global communication of sensitive data. The most recent work in this field, which a team headed by Christoph Marquardt and Gerd Leuchs at the Max Planck Institute for the Science of

Light in Erlangen has now presented, is set to further heighten the rapidly growing interest in this technology, and not just on the part of telecommunications companies, banks and governmental institutions. In collaboration with the company Tesat-Spacecom and the German Aerospace Center, the physicists have now created one of the conditions for using quantum cryptography to communicate even over great distances without any risk of interception. They measured the quantum states of light signals that were transmitted from a geostationary communication satellite 38,000 kilometers away from Earth. The physicists are therefore confident that a global interception-proof communications network based on established satellite technology could be set up within no more than a few years. (www.mpg.de/11389946)

Parasites and an Early Warning System

Dodder helps host plants inform other plants about hungry insects

Plants can communicate with each other by means of gaseous substances and underground fungal networks. A team of scientists from the Kunming Institute of Botany in China and the Max Planck Institute for Chemical Ecology in Jena has discovered that parasites, too, can function as mediators. Dodder, a parasitic vine, transmits information between its host plants about infestations of other parasites. This plant of the genus *Cuscuta* has no roots of its own. Instead, it forms haustoria with which it can extract nutrients from its hosts. Dodder attacks multiple plants simultaneously and creates a network between them. The scientists analyzed all the active

genes in the leaves of the dodder-connected plants and determined that insect-infested plants transmit signals via dodder bridges to neighboring plants – even to different plant species. This enables the recipients to boost the production of defense genes and arm themselves against an attack. Further studies are planned to determine whether dodder is acting completely altruistically in this mediator role. (www.mpg.de/11410164)

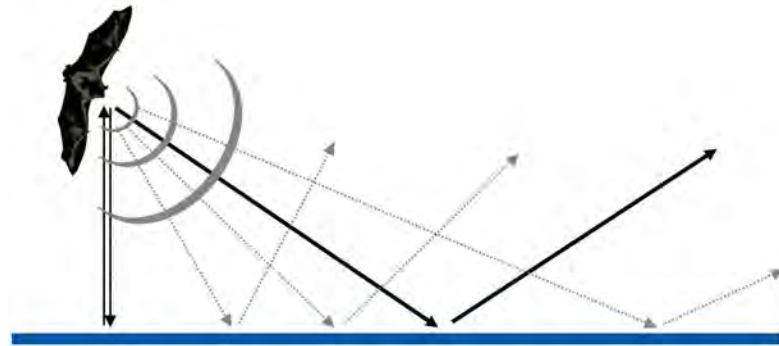
Dodder causes considerable economic damage in pasture farming with alfalfa, clover and soybeans.



Glass Facades Are Traps for Bats

Bats rely largely on their echolocation calls to orient themselves in the dark. However, if their calls strike smooth horizontal surfaces – such as water – at an oblique angle, they are reflected away from the bats. The surfaces of lakes, ponds and rivers thus act like acoustic mirrors to them, from which they receive hardly any echo signals. Artificial smooth horizontal surfaces have the same effect: the animals mistake them for water. A similar thing occurs with smooth vertical surfaces – sometimes with fatal consequences: scientists at the Max Planck Institute for Ornithology in Seewiesen found that bats usually don't recognize a smooth vertical sur-

face until it's too late, initially perceiving it as a hole to fly through. Such surfaces are inaudible for the animals and thus essentially invisible. The scientists used infrared cameras and microphones to analyze the flight and echolocation behavior of greater mouse-eared bats (*Myotis myotis*). In a darkened flight room, 19 out of the 21 animals involved collided with a smooth panel on the wall within a short time. When the researchers put the panel on the floor, there wasn't a single collision, but 13 animals tried to drink from it. The researchers are now calling for measures to prevent collisions of bats with glass facades. (www.mpg.de/11465022)



When a bat flies toward a smooth surface, its echolocation calls are initially reflected away from it. Only when it is directly next to the smooth surface (image) are echoes reflected back to it.

Extra Years at No Extra Cost

People who don't smoke, aren't obese and consume alcohol moderately can expect to live seven years longer than the average population. In addition, they can expect to spend most of those extra years in good health. These were the findings of a study conducted by Mikko Myrskylä, Director at the Max Planck Institute for Demographic Research, and Neil Mehta from the University of Michigan. The researchers analyzed data from more than 14,000 US citizens and found that people who have smoked a total of no more than 100 cigarettes and have a body mass index of less than 30 live four to five years longer than the average population and with far fewer physical impairments. The results of their analysis also showed that people with moderate alcohol consumption live, on average, seven years longer than the general population, surpassing even the average life expectancy in Japan, a country whose inhabitants are generally considered to have particularly long lifespans. (www.mpg.de/11407661)



Surprising origins: Researchers found numerous women from distant regions in Bavarian graves from the Bronze Age. They were buried just like the native population.

Women from Far Away

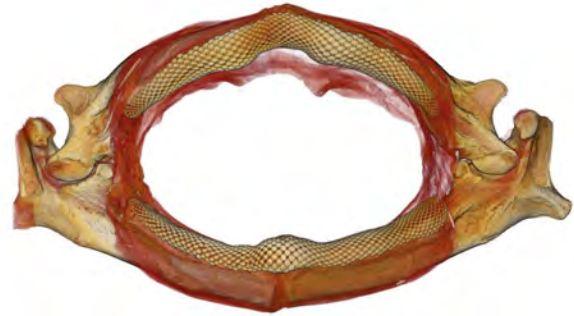
Four thousand years ago, many brides came to the Lech Valley from Bohemia and Central Germany

At the end of the Stone Age and in the early Bronze Age, families were established in a surprising manner in the Lech Valley south of Augsburg, Germany: many women came from outside the area, probably from Bohemia or Central Germany, while men were usually from the region. And this wasn't a temporary phenomenon, but persisted over a period of 800 years. These findings are the result of archaeological analyses conducted in a research collaboration in which Johannes Krause from the Max Planck Institute for the Science of Human History is involved. The researchers examined the human remains of 84 individuals using genetic and isotope analyses in conjunction with archaeological evaluations. The individuals were buried between 2500 and 1650 BCE in burial grounds that belonged to individual homesteads. Genetic and dental analyses showed that the majority of the women did not originate from the region. However, they were buried just like the native population, indicating that they were integrated into the local community. (www.mpg.de/11463384)

Deceptive Teeth

Although the jaws of the wedgefish are designed only to crush shellfish, it also eats stingrays

Some animals have a different diet than the shape of their teeth would suggest, as shown by a recent study on the jaw of the wedgefish conducted by a team headed by Mason Dean, a scientist at the Max Planck Institute of Colloids and Interfaces in Potsdam-Golm. Although these rays have wide teeth and normally eat mussels and shrimps, fragments of tail spines in their jaws reveal that they also hunt stingrays. Previously, zoologists and paleontologists based their work on the principle of “show me your teeth and I’ll tell you what you eat.” As the current findings show, they should begin looking harder for evidence of animals’ dietary and living habits that aren’t immediately apparent. For the re-



A sharp aftertaste: A CT scan of the jaw of a wedgefish provides unmistakable evidence of previously unknown feeding behavior: it clearly shows stingray spines in the jaw of this cartilaginous fish.

searchers in Potsdam, another reason the results of the jaw analysis were surprising was because the wedgefish had enveloped the spine tip fragments in bone tissue, which is very rare in cartilaginous fish, a group of which rays are a member. (www.mpg.de/11478384)

Intestinal Flora Can Trigger Multiple Sclerosis

Microorganisms from the intestines of MS patients set off encephalitis in genetically modified mice



Escherichia coli is one of around 1,000 types of bacteria in the human intestine.

modified mice that had no intestinal flora of their own with microorganisms from the intestines of MS patients. With their findings, the researchers confirmed for the first time that components of the human gut flora play an active role in activating errant T-cells in the immune system. The researchers further analyzed how the microorganisms differ in the intestines of diseased and healthy humans. Pairs of twins in which only one twin had developed multiple sclerosis are particularly well suited for this because, as monozygotic twins are genetically identical, any differences can’t be explained by genes. The researchers recruited more than 50 such pairs of twins and found some subtle differences in the intestinal flora of diseased and healthy siblings. It isn’t yet possible to say whether these findings will one day lead to new diagnostic procedures or treatments. (www.mpg.de/11471726)

Mice can contract an MS-like encephalitis when they receive the intestinal flora of patients with multiple sclerosis. This is the result of a study conducted by an international research team including scientists from the Max Planck Institutes of Neurobiology, Biochemistry, and Immunobiology and Epigenetics. In the study, the scientists inoculated genetically

Oil as a Source of Energy for Marine Animals

In the Gulf of Mexico, at a depth of around 3,000 meters, oil and asphalt seep out of the ocean floor and form bizarre structures reminiscent of cooled lava. They are known as asphalt volcanoes, and a thriving biological community of various organisms has formed there. Today, 15 years after this community was discovered, it still holds many surprises, as researchers at the Max Planck Institute in Bremen have now shown. Since higher organisms such as sponges and mussels can’t eat asphalt and oil, and since there is hardly any other source of food in the deep sea, some of them have joined forces with bacteria: the researchers have discovered mussels and sponges that live in a symbiotic relationship with bacteria at these volcanoes. The microorganisms can extract both energy and vital carbon from the oil. The microbes have specialized in the oil’s easily degradable compounds – so-called short-chain alkanes such as butane, ethane and propane – and are members of the group of free-living, oil-degrading bacteria that play a key role in degrading oil in the oceans. Unlike their free-living relatives, those that live inside sponges and mussels are unable to utilize the persistent oil compounds, so-called polycyclic aromatic hydrocarbons. (www.mpg.de/11353055)

Creating 3-D Animation with a Simple Camera

Smartphone or webcam images can be used to reconstruct the movements of a person in a three-dimensional model

Portraying people and their movements three-dimensionally in virtual reality in real-time is set to become much easier. Researchers at the Max Planck Institute for Informatics in Saarbrücken have developed a method called VNect that creates digital 3-D models using only images from simple cameras like those in a smartphone. Demand is constantly growing for these kinds of models of people and their movements, for applications ranging from the animation of virtual figures in computer games to movement analysis in sports to medical examinations. The researchers in Saarbrücken used machine learning to translate human poses into a digital model in real-time: they trained a neural network, which imitates the function of the human brain, to recognize any pose by feeding it more than 10,000 images of various body postures taken with simple cameras. Previously, this was possible only with expensive camera systems. (www.mpg.de/11386365)



Srinath Sridhar demonstrates how well VNect calculates a three-dimensional model of the researcher's body poses in real-time based on images captured with an inexpensive webcam.

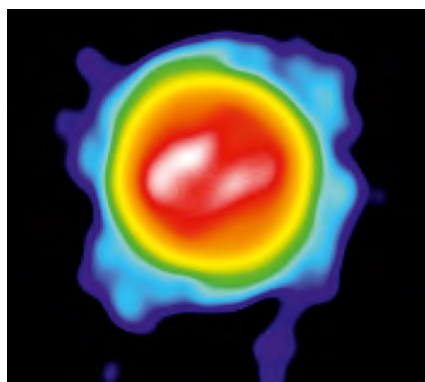
A Star's Turbulent Twilight Years

Researchers map the atmosphere of Antares, a red supergiant

On a clear summer night in central European latitudes, Antares, in the Scorpius constellation, shines brightly above the southern horizon. Astrophysicists know that this enormous star – which is almost 700 times larg-

er than our Sun and, in the Sun's position, would extend past the orbit of Mars – is nearing the end of its life. Located nearly 600 light-years from Earth, Antares has expended much of its fuel, has reached the red supergiant stage and is gradually losing matter. An international team that includes scientists from the Max Planck Institute for Radio Astronomy in Bonn is investigating what exactly is taking place. To this end, the astrophysicists captured a snapshot of the turbulent

motions in Antares' atmosphere. They measured both the radiation intensity, which is a measure of the gas distribution, and the gas velocity across its entire surface. This is the first time researchers have succeeded in obtaining such measurements for a star other than the Sun. To compile the surface map, the researchers had to combine no fewer than three telescopes at the European Southern Observatory ESO to create an interferometer. (www.mpg.de/11456828)



Zooming in on Antares: The first relatively detailed image of the red supergiant star shows the stellar disk (yellow) with two brighter regions (white) and the star's extended atmosphere (green and blue). Its irregular shape with several bulges and the variable distribution of gas indicate that the star is losing matter in turbulent currents, but only in some regions.