

SCIENCE

Not bird brained

Parrots, crows, ravens, jays and magpies show intelligence comparable to chimpanzees, says s ananthanarayanan

THE nature of intelligence and communication among birds, dolphins, primates and other animals that live in groups could help understand the evolution of the human brain. Researchers in the Department of Cognitive Biology, University of Vienna, with collaboration from the Behavioral Ecology Research group in Oxford, report findings of the relative ability of parrots and crows to handle different kinds of problems. Parrots and the corvids (crows, ravens, jays, magpies) are renowned for solving problems. While crows routinely use twigs or leaves to prise food out of crevices in trees, they even fashion tools by cutting stiff leaves into the right shape. The Caledonian crow is the best studied and in one celebrated case the crow, Betty, picked up a piece of iron wire, bent it into a hook and used it to raise a container of food.

That crows drop clams from a height so that the shells break open is known to many. Less well known is that crows have learnt that a good way to break nuts that are covered with a soft shell is to leave them in the way of traffic. The cars running over the nuts crack them open and the crows wait till the lights turn red to pick up the contents while the traffic waits! Crows in Japan are said to be breaking nuts only in this manner since 1990. In the case of Western Scrub Jays, it has been documented that jays, which have indulged in pilfering food from the food hoard of other jays, make use of their wicked knowledge to protect their own repository from theft. It has even been observed that if a jay that had repeatedly stolen food was spotted in the act of burying its own store of food, it would later go back and change the hiding place when no other bird was watching. But birds that had not themselves been thieves did not behave with the same cunning.

This behaviour suggests that corvids use memory of past experience to plan ahead. It even suggests that one animal can be aware of how another animal is likely to think! The sophisticated tool-making behaviour of Caledonian Crows is unique among non-human wild animals and has been likened to technological innovations of humans. That groups of Caledonian Crow populations have each a peculiar and slightly different way of making the tools suggests some form of culture existing in the groups, a feature that has otherwise been seen with chimpanzees. Like corvids, parrots also show remarkable

intelligence. While most parrots can mimic human speech and pet parrots can anticipate their owners' actions, some African Grey Parrots have shown the ability to associate meaning with words and form sentences. Studies show that the higher intelligence is associated with living in groups. Group living, with its advantages for survival, is complex and places demands on individuals to understand processes and relationships. Socially organised species, like dolphins, chimpanzees, and humans thus hone their intelligence and develop larger brains. The size of brain, as a percentage of the animal's weight, is found to be high in the case of parrots and corvids, about the same as in the case of chimpanzees.

The Vienna-Oxford study
In the course of studying the development of intelligence in birds, the researchers pitted a group of six Kea Parrots, which are from New Zealand, against six Caledonian Crows in an experiment of problem-solving. The arrangement was a plexiglas cube, with a food reward placed on a platform inside it. The four faces of the cube presented four different ways to push the food off the platform and on to a ramp leading out of the cube. The first was a bit of string that was tied to the food, the second was a lever that opened a window, the third was a marble to be rolled through a path leading to the food and the fourth a stick-like object tool to push the food off the platform.



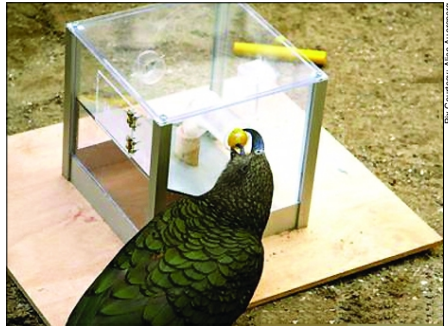
Alice Auersperg and Gyula Gaidon, who participated in the study, explain the experiment. "The animals could choose which solution they wanted to employ first. Once they had established a solution and had used it a certain number of times we blocked the entrance, forcing them to switch to another. This way we could observe not only the differences in the order of solutions that the animals established but also how quickly they were able to switch."

One animal in each group, Kermit the parrot and Uek the crow, were able to manage all four solutions. The most difficult solution for Kermit, the successful parrot, was the use of a stick-like object as a tool. This makes sense as the parrot is not a natural tool user in the wild. Moreover, manoeuvring an elongated tool with a curved beak is a complex motor task. "It is therefore all the more impressive that Kermit, the Kea Parrot, succeeded in overcoming this handicap. The strategy he used gives the strong impression that he acted in a goal directed matter," says co-author Ludwig Huber.

In the case of the crow group, the greatest challenge was to open a window by pulling a hook-shaped lever. New Caledonian Crows usually use their tools to explore scary looking objects from a safe distance -- they do not use pulling and tugging actions, which require longer body contact than pecking with the beak or the tool. "After Uek, the Caledonian Crow, managed to open the window, she would not stick her head through the entrance to directly reach for the food like the Kea did but instead she used the stick to poke it off its platform," explains Alice Auersperg.

These studies explore basic problem-solving strategies and further research may illuminate the processes and mechanisms which allow the different forms of thinking and learning. As comparatively simpler systems, not blurred by the greater stimuli and data that humans are subjected to, a study of how animal thinking works may lead to discovery of underlying commonalities.

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Kermit solves puzzle with ball twine



Uek, the crow, welds stick to get carrot

From diagnosis to cure

Of the many theories prevalent regarding the nature and causes of scarlet fever, tapan kumar maitra expounds the one most favoured by scientists

SCARLET fever has long been known as a widespread disease but its aetiology has not yet been ascertained. Four different theories have been proposed: streptococcal, allergic, viral, and combined (viral-streptococcal). Most scientists and medical practitioners favour the streptococcal theory.

The streptococcal aetiology of scarlet fever is supported by the following arguments: a) all people suffering from the disease are found to harbour in their throats haemolytic streptococci which are agglutinated by the sera of convalescents; b) a subcutaneous injection of the scarlet fever toxin into susceptible people (volunteers) in some cases is followed by the appearance of a characteristic skin rash, vomiting, fever, tonsillitis and other scarlatinal symptoms; c) an intra-cutaneous injection of the toxin into susceptible children produces a local erythematous and oedematous reaction (the toxin produces no reaction in children who had previously suffered from scarlet fever and were immune to the disease); d) 0.1 ml of antitoxic anti-streptococcal serum or convalescent serum is introduced into the skin of a patient in the area of the rash, the latter turns pale (is "extinguished"); e) hyper-immunisation of animals with the toxin leads to the production of antitoxins and a neutralisation reaction takes place between the toxin and antitoxins; and f) therapy with antitoxic sera and prophylaxis with combined vaccines consisting of the toxin and haemolytic streptococcal cells result in the appearance of less

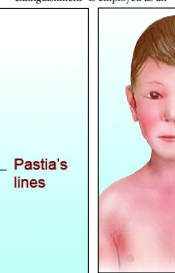
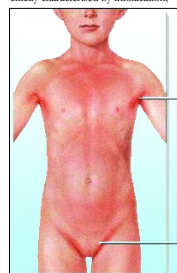
severe cases and decrease in morbidity and mortality.

At present many investigators accept the streptococcal theory in scarlet fever aetiology. In post-war years, this theory has been confirmed by a number of investigations. Arguments against the streptococcal theory are as follows: a) people inoculated with streptococci or their toxins do not always display the characteristic symptoms of the disease; e.g. there is no peeling, only rarely are there instances of tonsillitis and phlegmon, sepsis and erysipelas occasionally develop; b) in severe hypertoxic forms the anti-toxic serum has little effect, while the serum of convalescents gives better results; c) the skin toxin test (Obersteiner's) sometimes gives a negative reaction in susceptible children and produces a positive reaction in those who are immune; and d) immunity acquired after the disease is very stable and of long duration, while that acquired after other streptococcal diseases is unstable, of short duration, and is frequently accompanied by an increased susceptibility to streptococci.

It is assumed that the disease is caused by the group A beta-haemolytic streptococci which possess M-antigen and produce erythrogenic exotoxin. People become infected by the air droplet route. Sick people, convalescents and carriers of the causative agent of the disease are all sources of infection. The fever is most commonly encountered in children from one to eight years of age. The causative agent sometimes enters the body through wounds on

the skin and mucous membranes of the genitalia. This form of scarlet fever is known as extra-buccal or extra-pharyngeal (traumatic, combustion, surgical and puerperal). Certain objects (eg utensils, toys, books, etc.) as well as foodstuffs (eg milk) contaminated by adult carriers may also be sources of infection. Of great importance in the epidemiology of scarlet fever are patients with atypical, unrecognisable forms of the disease. In its initial stage, scarlet fever is chiefly characterised by intoxication,

years are most susceptible. The disease is recognised mainly by its clinical course and on epidemiological grounds. Laboratory diagnosis for the detection of haemolytic streptococci and their typing is employed only in certain cases. This method is of no practical value since haemolytic streptococci are often isolated from people with various diseases and frequently from healthy individuals. The phenomenon of rash "extinguishment" is employed as an



The first signs of the disease.

while in the second stage it is accompanied by septic and allergic conditions. The disease produces a relatively stable immunity. Reinfections are very rare. They have increased in number in the last few years as a result of wide use of antibiotics, which reduce the immunogenic activity of the pathogen and its toxin. Data concerning the correlation between a positive Dick test and susceptibility to scarlet fever provide evidence of the anti-toxic nature of immunity acquired after scarlet fever. Children from one to five

auxiliary diagnostic method. In the case of scarlet fever, the rash at the site of injection disappear within 12-20 hours and the skin turns pale. Certain physicians apply the Dick test with the thermolabile fraction of the toxin. The diagnosis is verified to a certain extent if on a second injection of the toxin a positive Dick test reverts to a negative reaction. Scarlet fever may also be diagnosed by detecting precipitins in the urine -- urine precipitation test. A layer of type-specific streptococcal sera or convalescent serum is transferred

onto freshly-filtered urine of patients in the first days of the disease. The appearance of a greyish-white ring at the interface of the two fluids designates a positive reaction.

Scarlet fever patients are treated with penicillin, tetracycline, sulphamonomides (norsulphazol, etc.) and gamma-globulin from human blood. The wide use of antibiotics has led to a significant decrease in the morbidity and mortality rate of scarlet fever and to a milder course of the disease. This fact also confirms the definite role played by haemolytic streptococci in the aetiology and pathogenesis of the disease, since it is known that these organisms are extremely sensitive to penicillin and other antibiotics.

The diagnosis consists of early diagnosis, isolation of patients and



hospitalisation in the presence of epidemiological and clinical indications. Extremely hygienic cleaning and ventilation and observation of correct hospital regimen are also necessary. If cases of scarlet fever occur in children's institutions, the children concerned must be isolated. Debilitated children must be injected with 1.5-3 ml of human serum gamma-globulin.

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'The sky at night stops me from sleeping'

Tom Bogdan heads the world's only civilian operation to forecast solar storms and he's a worried man. Steve Connor reports

HE doesn't strike you as the nervous type but there is one thing that does keep Tom Bogdan awake at night. His insomnia is caused by a 14-year-old satellite sitting between the earth and the sun some 1.5 million km away which, he fears, may one day suddenly die, thus leaving the world without a vital early-warning system against a devastating solar storm.

Dr Bogdan is head of the US Space Weather Prediction Centre, the only civilian operation in the world dedicated to forecasting the size and timing of solar storms on a 24/7 basis. The satellite disturbing his sleep, the Advanced Composition Explorer, was designed with a lifetime of just two years -- which is why, 14 years after its launch, he gets worried. Last week, earth was bombarded by millions of tons of solar particles travelling at a million miles an hour.

Fortunately, this solar storm was a relatively minor affair. Dr Bogdan's centre gave it Category One status, the lowest of the five solar-storm categories. But there is always the risk that one day earth will be hit by a Category Five storm, which in space weather terms amounts to a cosmic hurricane capable of knocking out GPS satellites, power grids and critical telecommunications. The sun is now emerging from the lowest period of inactivity since the space age took off 50 years ago. Last week's event is almost certain to be just the start of a cycle that is expected to peak in 2013. It is during this rising activity that we can expect earth to be buffeted by some devastating solar storms.

Britain has now teamed up with the USA to create a second solar weather prediction centre, like its counterpart in Boulder, will operate 24/7 to make forecasts about an "imminent coronal mass ejection" -- when the sun spews out a billion or so tons of energetically charged particles travelling at a million miles an hour that can interact with electronic and magnetic devices, from satellites to electrical transformers.

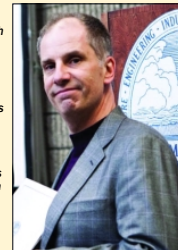
Dr Bogdan freely admits space weather prediction is still in its infancy. "Today, unfortunately, space weather is where meteorology was at the end of the 1950s." His book-lined office overlooks the Rocky Mountains and is situated within the Boulder Laboratories of the US National Oceanic and Atmospheric Administration, which is responsible for predicting terrestrial hurricanes, among other things. He is a mathematician by training and first got interested in the sun when he met his academic supervisor, a scientist called Eugene Parker, who predicted the existence of the solar wind before it was discovered.

One of Dr Bogdan's undoubted skills is what, in America, is called "public outreach". In other words, in his verbal description of what actually happens when the sun starts to get active. "It usually starts with a solar flare, which is composed of a lot of ultraviolet and shortwave radiation travelling at the speed of light, so it takes eight minutes to get to us from the sun," he says. "Down here at ground level we never see it or experience it but it gets absorbed in the atmosphere overhead by the ozone protective layer. It leads to an overactive ionosphere and that impacts people who operate GPS and any high-frequency radio communications. Ten to 30 minutes later, if we are well connected to the flare site of the sun where the event occurred, energetic particles will start bombarding the atmosphere."

This is when it gets dangerous for astronauts to be out there in space as these particles can penetrate their protective suits and damage their DNA. They can also cause "bit flips" in electronic devices controlled by computer. "In the past we've had satellites rendered inoperable because of severe radiation storms," says Dr Bogdan. "However, the big impacts we are concerned about are power grids, because those long wires connected to transformers can pick up currents that can cause power outages." The biggest coronal solar storm occurred in 1859 and was documented by British astronomer Richard Carrington, after whom the event is now known. More recently, in 2003, a solar storm caused the loss of an air navigation system across the USA that relied on GPS satellites.

"Advanced technology has crept into just about everything we do. GPS has entered into many parts of our lives," he says. But this dependence creates vulnerability, which is why one needs a cool head to be the man who will warn the world of a Category 5 storm to rival the infamous Carrington Event of 1859. "We know the sun is capable of an 1859 event. It would be shortsighted to say that that's the worst the sun could ever do. It can probably do worse than 1859," he says.

The Independent, London



Tom Bogdan says our increasing reliance on GPS systems has left us all more vulnerable to solar storms.