Deception with a difference

The female cuckoo adds another dimension to faking in the natural world

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Deception is essential to survival in the wild. On one hand, all animals fall into the category of predators or prey. It is hence in the interest of each one either to be concealed or to appear to be harmless, if a predator or unappetising or dangerous, if prey. On the other hand, animals and plants often depend on other animals for transport, fertilisation, shelter or nourishment. They hence need to provide services in return, or better, to look like a species that provides the service.

Jenny E York and Nicholas B Davies, from the department of zoology, University of Cambridge, writing in the journal, *Nature Ecology and Evolution*, describe an instance of a bird that simulates the predator of a sister species, to throw the sister species off her guard while the bird makes use of the sister bird's nest.

A well-documented instance of deception, or Batesian mimicry, is where species have evolved to look like other species, for protection. Caterpillars of the Heliconid butterflies of the Amazon feed on toxic leaves of the Passion Flower plant. This makes the butterflies toxic too, which is their principal protection against predators. Batesian mimics are other species of quite edible butterflies, which have evolved to look like the Heliconid, to deceive predators! Similar deception is practiced by species of harmless snakes, to look like an unrelated, but venomous snake, to keep enemies at bay.

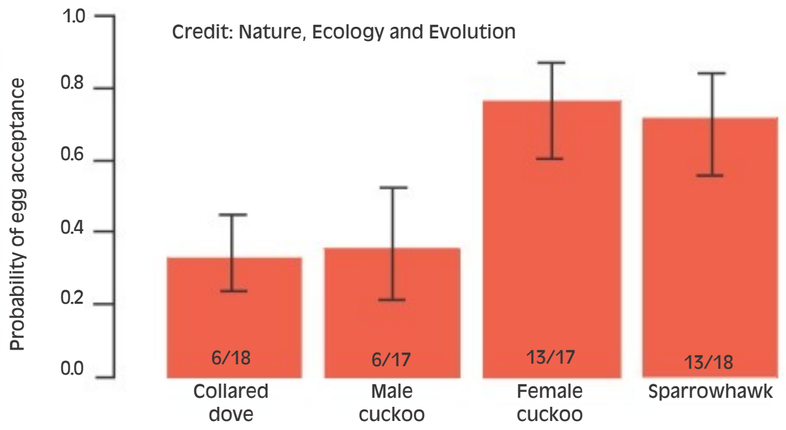
A recent publication is about a species of spider, which is in danger of being picked up by a brace of small predators. While there is no convenient model with the necessary protection, which the spider could hope to look like, the spider has evolved to mimic the dynamic actions of a species of ants, which do have defences of strong jaws and a poisonous sting. While close up resemblance at the physical dimensions of spiders and ants is not detailed, similarity of movements is more likely to cause deception. The jumping spider, which uses stealth and rapid jumps to capture prey, hence, imitates the movements of the ant, to be mistaken for one and be left alone by predators on the lookout for spiders.

In the plant kingdom, too, flowers evolve to look and smell like others, to attract pollinators. Orchids are known to mimic the colours and scents of nectar bearing flowers and even to exude the scent of female insects, to lure males to the flowers in search of a mate! Slightly apart, weeds that look like crop plants are more likely to survive.

The case of the female cuckoo, however, is different. She too relies on deception, but not to avoid predators, or even to attract helpers or sources of food. The Cuckoo mother uses deception to throw another bird off the track while the cuckoo commits trespass and passes off her own eggs as those of the unsuspecting other.

The common cuckoo, Cuculus canorus, is a "brood parasite". This means she does not lay and warm her eggs in her own nest, but lays the eggs in the nest of a host bird. The host then raises the cuckoo chicks in addition to her own. As cuckoo chicks hatch early and have marked begging behaviour, they often monopolise the nest resources, to the cost of the host bird's chicks.

While the cuckoo generally lays eggs in the host nest swiftly and with stealth, there are instances of the latter if the host birds' eggs if the hosts male cuckoo positively diverting the hosts from their nest. The cuckoo often removes one or more of the host bird's eggs while laying her own in the nest. The hosts also sometimes remove cuckoo eggs if they are able to make them out. And then, there are also instances of the cuckoo acting to destroy the host birds' should throw out the cuckoo eggs. Raising the cuckoo chicks in addition to their own is then a lesser price for hosts to pay than trying to keep the cuckoo eggs out.



The foreign egg in the reed warbler's nest appears easy to make out. The probability that the foreign egg be accepted is hence low and stays low when the relatively non-threatening calls of the collared dove or a male cuckoo are sounded. The call of a female cuckoo or of a real threat, a sparrowhawk, however, distracts the host birds and they accept the foreign egg almost 80 percent of the time


Common Cuckoo

For all this, the cuckoo cannot just march up to a host bird's nest and lay her eggs there. The host birds would also attack and "mob" cuckoos found in the vicinity of their nests. The cuckoo has hence, perforce, to be secretive and use stealth to plant her eggs in hosts' nests. Given the need for stealth, however, it is surprising that soon after she lays the eggs in the host's nest, the female cuckoo often breaks out into a "chuckle" call, which should draw attention to herself!

This is the feature of the female cuckoo's behaviour that York and Davies from Cambridge made their subject of study. The duo notes that the female cuckoo's call is not just a "chuckle" but is "hawk-like". The chuckle is thus calculated to put the host birds on the alert, to watch out for the serious peril of a hawk, and ignore trifles like a female cuckoo messing about with the nest!

"Prey are sensitive to even subtle cues of predation risk, which provides the evolutionary potential for parasites to exploit host risk perception. In our field experiments, reed warbler (Acrocephalus scirpaceus) hosts paid no more attention to the 'cuckoo' call of the male common cuckoo than the call of a harmless dove. However, the chuckle call of the female cuckoo had the same effect as the call of a predatory hawk in distracting the warblers' attention and reducing rejection of a foreign egg. Our results show that the female cuckoo enhances her success by manipulating a fundamental trade-off in host defences between clutch and self-protection," the authors say in the paper.


Jumping spider

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PLUS POINTS

It's right here

Scientists have spotted a huge black hole lurking at the middle of our own galaxy. The supermassive black hole is sitting in the middle of the Milky Way and if confirmed would be the second biggest ever seen in our own neighbourhood. The discovery could help solve some of the central mysteries of black holes, giving us an unprecedented look at how such strange things form.

The object was spotted by scientists looking at a huge, toxic gas cloud that is swirling around near the middle of the galaxy. By looking at that, they saw a strange movement of gases that indicated a huge "compact object" was at its centre — which they say must have been a black hole.

Scientists have long agreed that extremely large galaxies like our own contain huge black holes that can be many billion times bigger than the sun, but they haven't been able to work out how that actually happens. But by managing to look at one right in our own solar system, astronomers hope to find out why.

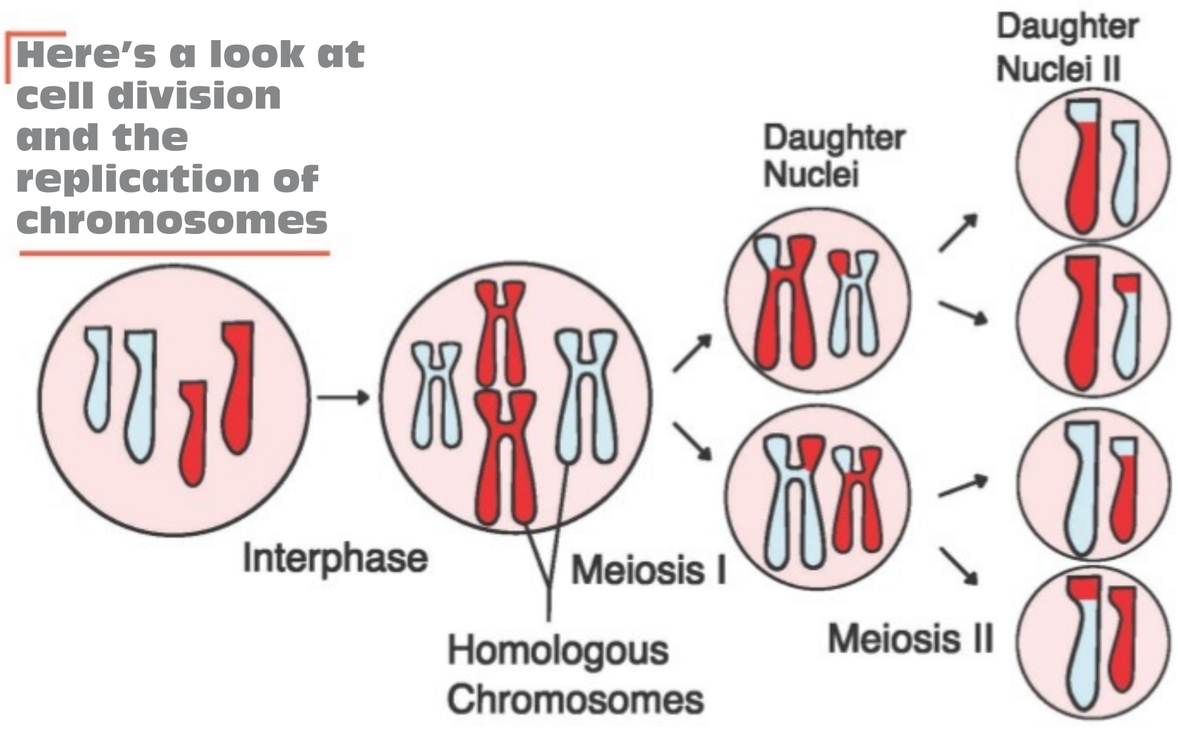
Such large black holes — known as intermediate-mass black holes — are thought to form when smaller black holes move together into bigger ones, which then in turn join up to create supermassive ones. But this is the first time that evidence of those middle, bigger ones have been found.

The discovery might one day allow for proof of generational relativity, a change that the scientists note would "make a considerable contribution to the progress of modern physics".

The independent

Growing in phases

Here's a look at cell division and the replication of chromosomes



TAPAN KUMAR MAITRA

After meiosis I has been completed, a brief interphase may intervene before meiosis II begins. However, this interphase is not accompanied by DNA replication because each chromosome already consists of a pair of replicated, sister chromatids that had been generated by DNA synthesis during the interphase preceding meiosis I. So DNA is replicated only one time, and that is prior to the first meiotic division. The purpose of meiosis II, like that of a typical mitotic division, is to parcel the sister chromatids created by this initial round of DNA replication into two newly forming cells. As a result, meiosis II is sometimes referred to as the separation division of meiosis.

On the other hand, prophase II is very brief. If detectable at all, it is much like a mitotic prophase. Metaphase II also resembles the equivalent stage in mitosis, except that only half as many chromosomes are present at the spindle equator. The kinetochores of sister chromatids now face in opposite directions, allowing the sister chromatids to separate and move (as new daughter chromosomes) to opposite spindle poles during anaphase II. The remaining phases of the second meiotic division resemble the comparable stages of mitosis. The final result is the formation of four daughter cells, each containing a haploid set of chromosomes. Because the two members of each homologous chromosome pair were randomly distributed to the two cells produced by meiosis I, each of the haploid daughter cells produced by meiosis II contains a random mixture of maternal and paternal chromosomes. Moreover, each of these chromosomes is composed of a mixture of maternal and paternal DNA sequences created by crossing over during prophase I.

While each of the cells produced by meiosis normally contains a complete, haploid set of chromosomes, a rare malfunction called nondisjunction can produce cells that either lack a particular chromosome or contain an extra chromosome. Nondisjunction refers to the failure of homologous chromosomes (during anaphase I) or sister chromatids (during anaphase II) to separate from each other at the metaphase-anaphase transition. Instead, both chromosomes or chromatids, remain together and move into one of the two daughter cells, thereby generating one cell containing both copies of the chromosome and one cell containing neither copy. The resulting gametes have an incorrect number of chromosomes and tend to produce defective embryos that die before birth. However, a few such gametes can participate in the formation of embryos that do survive. For example, if an abnormal human sperm containing two copies of chromosome 21 fertilises a normal egg containing one copy of chromosome 21, the resulting embryo, possessing three copies of chromosome 21, can develop fully and lead to the birth of a live child. But this child will exhibit a series of developmental abnormalities -including short stature, broad hands, folds over the eyes, and low intelligence - that together constitute Down syndrome.

The amount of DNA present at various stages is indicated using the C value, which corresponds to the amount of DNA present in a single (haploid) set of chromosomes. In a diploid cell prior to S phase, the chromosome number is 2n and the DNA content is 2C because two sets of chromosomes are present. When DNA undergoes replication during S phase, the DNA content is doubled to 4C because each chromosome now consists of two chromatids. In meiosis I, segregation of homologous chromosomes into different daughter cells reduces the chromosome number and the DNA content from 4C to 2C. Sister chromatid separation during meiosis II then reduces the DNA content from 2C to 1C while the chromosome number remains constant. In contrast, a normal mitosis reduces the DNA content from 4C to 2C (by sister chromatid separation) while the chromosome number remains at 2n.

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No mere coincidence

Experts say that Hurricanes Irma, Harvey and Jose appearing at the same time shows climate change is real and getting worse

ANDREW GRIFFIN

The horrifying weather that has swept over the Atlantic is just a light example of things to come, according to researchers. The Americas have been hit by three destructive hurricanes in recent weeks — Harvey, Irma and then Jose. That is not simply a coincidence, say climate experts — instead, it is a demonstration of global warming in action.

Scientists have already warned that the response to the recent hurricanes shows how terrifyingly unprepared the world is for the kind of extreme weather events that will become more common as the Earth gets hotter. But they warn also that the combination of the hurricanes is a particular warning about the damage being done to the environment. What's more, the weather effects that usually slowed the damage caused by such a run of hurricanes is likely to stop — meaning not simply that we will get more dangerous hurricanes, but they are more likely than ever to chain together in this way.

"Perhaps Harvey was happenstance and Irma could be coincidence," said Philip Williamson, NERC Science Coordinator at University of East Anglia. "But Jose following close behind has to be climate change in action. Damaging hurricanes, cyclones and typhoons occur in tropical parts of the world, at the time of year when the sea is warmest. So if the world gets warmer still, the risk increases — it's as simple as that.

"In particular, when one follows much the same track as another, soon afterwards, the second or third is usually likely to be weaker — since the surface will have been cooled by the initial mixing (bringing deeper, lower-temperature water to the surface). But that effect won't happen, or will be much less, if there's warm water at depth as well as in the uppermost layers. Here we see there has been some overlap of the 'flight paths' of Harvey, Irma and Jose, yet without resulting in any substantive reduction in their strengths, all being at least category 4."

Climate experts are clear that the hurricanes themselves weren't necessarily the result of climate change, and that while the combination of them is rare it could occur naturally. But environmental changes are making the strength and energy of such hurricanes far stronger, and allowing them to do far more damage.

"Climate change may not have caused Hurricane Irma but it is making its impacts a whole lot worse," said Dave Reay, professor of carbon management at the University of Edinburgh. "Rising sea levels and a warmer, wetter atmosphere are combining to intensify flood risks all around the world. President Trump said he withdrew the US from the Paris Climate Agreement to protect jobs and businesses. For many folk in Texas and Florida that decision must now be looking pretty short-sighted."

As before, researchers have warned that the world is simply not equipped for the kinds of extreme weather that will come with changes in the environment. In particular, if the effects of such damage are spread differently across the world, meaning that people in poorer countries are far more likely to die, for instance.

"The reach of extreme weather is spreading and its punch is getting stronger due to climate change," said Jeffrey S Kargel from the department of hydrology and atmospheric sciences at the University of Arizona. "No individual meteorological event is attributable exclusively to shifting climate, but human alteration of the atmosphere is having a major role in causing more costly and more frequent extreme weather events.

"Poor nations pay mostly in bodies, and wealthier, more developed nations pay more in damaged stuff but there comes a point when no amount of weatherproofing can protect people."

The independent

Sibling rivalry

A bacteria that is a leading cause of death worldwide from hospital acquired infections following antibiotic treatment looks set to be brought down through its own sibling rivalry.

Different strains of Clostridium difficile (C diff) use tiny weapons to kill each other, and scientists from the UK and US have discovered how these work, enabling them to be engineered into an antimicrobial agent with the potential to prevent or cure C diff infection.

The team of scientists from the University of Sheffield, the California-based biotech company, AvidBiotics Corp, and the University of Glasgow also found that, when C diff develops a resistance to these weapons, the bacteria can no longer cause infection, making them harmless. The research has been published in *Science Translational Medicine*.

C diff lives in the human gut - usually in small numbers — but when people take antibiotics, this kills off many of their protective gut bacteria, allowing C diff to get a stronger foothold. It then grows very quickly, releasing toxins that cause diarrhoea and inflammation, which can be fatal.

Like many bacteria, C diff can make a weapon that is able to identify and kill competing C diff strains. This weapon attaches to the surface of other C diff cells and fires a harpoon-type needle through their membrane, causing the cell to die.

AvidBiotics Corp teamed up with Robert Fagan from the University of Sheffield's department of molecular biology and biotechnology, who is an expert in the crystalline outer layer of C diff, known as the S-layer. The team realised that the answer seemed to be linked to different types of S-layer — C diff strains produce one of 14 possible different types.

Dr Gillian Douce at the University of Glasgow was able to show that while these resistant C diff could still survive and multiply in the gut, they became harmless and no longer caused disease.

The research has so far only been carried out in the laboratory and in animal studies, so further work will be needed before the treatment can be made available in the clinic.