

## Issue 30: Easter 2014

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# The Human Machine

UNDERSTANDING HOW OUR BRAIN WORKS is one of the most complex puzzles of our time. Just last year the president of the United States, Barack Obama, unveiled a \$100 million initiative to “unlock the enormous mystery of the human brain”. Formed by a hundred billion nerve cells, and united through a hundred trillion interconnections, our brain is what defines us as a species and as individuals. It is in charge of all we feel, think and do. In Issue 30 we have taken human cognition as our main theme.



How many times have you made a choice between restaurants or political candidates? How certain are you that you're making objective decisions? In our focus article we review some cognitive biases in human decision making and account for the effects they can have upon our daily lives. In a second article we refer to another type of bias, the psychology behind racial discrimination, unfolding how it is rooted in us. Although it may feel frightening to know the extent of this bias, it is only through awareness that we can overcome it. Finally, we discuss another aspect of human cognition: the tricks our mind can play on us through optical illusions.

Many other subjects also draw our attention on this Issue. We explain why parasites can have a different effect on people according to their blood type, review the recent outbreak of a virus that has unsettled the Middle East, account for the evidence behind the popular belief that vegetables in our diet have positive effects upon our health and describe how hundreds of animals use body movements to communicate. We also refer to some of the front-line technology that is revolutionising the world we're living in: we explain how quantum computing works, and discuss the possible outreach of stem cells therapies.

We also celebrate the lives of two extraordinary figures that have shaped the modern world: The British biochemist who taught us how to read the code of life, Frederick Sanger, and the South African philanthropist Nelson Mandela. Both men were born in 1918 and died late in 2013.

This Issue is the product of the joint effort of dozens of people. Both authors and editors have very different academic backgrounds. It is thanks to this diversity that we find a great mixture of topics and perspectives across the Issue. If you would like to be one of the people contributing to this magazine we're always looking for people to get involved in *BlueSci*.

Omela De Gasperin Quintero

Omela De Gasperin Quintero  
Issue 30 Editor

## Wolves and relatives have species-specific howls, extensive study finds

Organisms living in groups have means of communicating with one another, which can be visual, acoustic and/or olfactory. Even though groups may use the same communication system (e.g. acoustic cues), even among closely related species communication (i.e. language) may differ.

**FRIDAY, 19 FEBRUARY 2016**

This is true for the acoustic communication of humans as well as other animals, including songbirds, whales and monkeys. Now, a multinational study involving scientists from Cambridge University shows that canids, a diverse genus of top predators including wolves, jackals, coyotes and domestic dogs, also have distinct vocal calls within species and subspecies.

In order to analyse canid calls, the researchers collected over 2000 howls of 13 distinct species and subspecies. Then they used machine-learning algorithms to sort these calls into discrete types. They found that each species and subspecies used very different howl types. This suggests that canid howls are not arbitrary, but instead encode species-specific information. This is the most comprehensive study of canid communication calls to date, and the first one to use machine-learning in this research area.

How human language evolved and what drove the diversity of languages we have today are questions that remain unanswered. Because our closest relatives, the chimpanzees, have relatively simple vocal communication systems, it is difficult to compare our language to theirs.

Lead researcher Arik Kershenbaum and collaborators think that understanding how animals living in complex societies communicate with one another could grant us insight into the evolution of our own language. Furthermore, the scientists note that their findings might help in the planning and management of canid conservation programs.

DOI: [10.1016/j.beproc.2016.01.006](https://doi.org/10.1016/j.beproc.2016.01.006)

Image by [Fool4myCanon](#)

Written by Ornela De Gasperin.



Even subspecies of canids able to interbreed are distinguished by their 'dialects'.

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## Cultural shocks enhance cognitive performance

Do you think a 'cultural shock' can't

**WEDNESDAY, 2 DECEMBER 2015**

affect how likely it is that you will to buy something, or your output

in a reasoning test? Think again. This is the main conclusion found in a

series of experiments recently published at the Journal *Social Cognition*.

In this study lead author Daphna

Oyserman and colleagues exposed people to different situations, some of

which were culturally common, and some of which were not. For example,

people were either shown 'normal' wedding pictures (bride in a white

dress, groom in a black tuxedo, a tiered cake), or pictures of a

'strange' wedding (bride wearing green, groom in a purple tuxedo, a cake

decorated with gears). Surprisingly, what type of pictures people had

seen strongly influenced their performance on a reasoning task taken

afterwards.

Those who saw normal pictures were more

likely to choose an intuitive but wrong answer on this task. They were

also more prone to buy random items than those who saw the strange

pictures.

Furthermore, the researchers found


similar results across independent experiments, which were performed in

different countries, with subjects of different ages, and carried out in

different social contexts. The results are consistent: cultural shocks

affect our reasoning.

How can this be? There seems to be a



The pictures influenced people's reasoning

dichotomy in the way our brain thinks and processes information. This dual-process theory was first proposed in the late 1800s, and has received lots of experimental support ever since. The idea is that there are two distinct systems underlying reasoning. System one is fast, automatic and intuitive. It is happy to give quick answers to problems, and will most likely stay in control as long as the situation is pleasant and at ease. Unlike system one, system two is slow, analytical and logical. Difficult cognitive tasks can only be performed by system two. But because system two demands lots of cognitive capacity, it is also lazy. So it will only take charge when really needed. These results suggest that cultural fluency (seeing everything as expected) keeps system one happy and in charge, whereas a cultural shock serves as an alarm call for our lazy system two to wake up, take charge, and pay attention to details. This is one of many studies showing the great advantages that cultural diversity can have.

The pictures influenced people's reasoning

DOI: [10.1521/soco.2015.33.4.308](https://doi.org/10.1521/soco.2015.33.4.308)

More information on dual-process theory and cognitive biases can be found in Daniel Kahneman's book *Thinking Fast and Slow*.

Written by Ornela De Gasperin.

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### Month of birth linked to natal and adult differences, study suggests

An adult's behaviour, morphology and physiology develops throughout its life, and their development depends on the interaction between the genes it has and the environment in which it grows. Pre-natal conditions can have long-lasting effects on all of these traits, even beyond the age of sexual maturity. Recently, researchers from the University of Cambridge (UK) have found links between the month when a baby is born and several post-natal traits.

**TUESDAY, 20 OCTOBER 2015**

The study, lead by Dr. Perry from the Medical Research Council (MRC) Epidemiology Unit, used a long-term data-set from the *UK Biobank Study*, a major national health resource, to analyse how different traits relate to the month when a baby is born. Using information from 500,000 people the group found that individuals born between June and August had a larger weight at birth and developed into taller adults than those born in other months.

Babies born in December showed the exact opposite pattern. Furthermore, they also found a relationship between the birth month and the likelihood of studying beyond the age of 16. This effect was particularly strong between August and September: Babies born in the later were much more likely to study beyond the age 16 than babies born in the former. These correlations (non-causal relationships) remained significant even when statistically controlling for important factors, like socio-economic rank, smoking and educational attainment of the parents.

What could be driving this effect remains unknown, but one possibility is that it depends on how much vitamin D the mother gets during pregnancy. Mothers giving birth in the summer receive more sunlight (and hence a higher vitamin D exposure) in the second trimester of their pregnancies, at least in the UK, where the data came from. However, this idea remains to be properly tested by future work.

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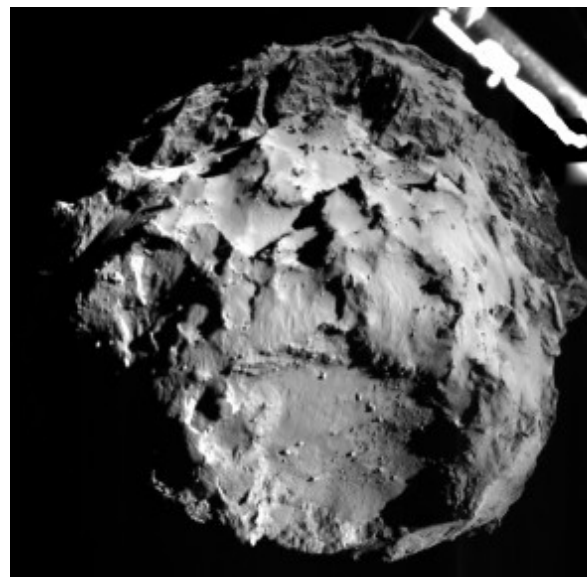
### Probe successfully lands on comet for the first time in history

On the 12th of November at 16.00 GMT hours a mission launched by The European Space Agency succeeded on landing on a comet. Comets are remnants from the formation of the solar system. Investigating a comet's composition can shed light into how our solar system was formed and how water arrived on Earth. Yet, no spacecraft had been able to land on them, until now.

**MONDAY, 17 NOVEMBER 2014**

This mission has been in planning for the last 20 years, and it cost £1 billion. The mother ship '*Rosetta*' travelled 6 billion km for the last 10 years until it finally reached *67P*, a comet the size of Mont-Blanc that orbits the Sun at about 135,000km/hour. *Rosetta* orbited this comet for weeks to generate a map of its surface so that the mission controllers back on Earth could choose a landing site. The surface was difficult- full of cliffs and hills. The *Philae* lander that was released from *Rosetta* had to touch down on a one kilometre square spot, and it only had a 75% probability of landing. Yet, it succeeded, making this the first time in history that a probe has managed to orbit and land on the surface of a comet.

Unfortunately, on the 15<sup>th</sup> of November, the probe's batteries ran out and it shut down. *Philae* had a battery that lasted for 60 hours, and it was equipped with solar panels which would allow it to keep working on solar energy. However, it didn't manage to get enough sunlight to recharge. It sent its last data and went into hibernation. Scientists hope that by August 2015, when the comet gets closer to the Sun, *Philae* will revive and continue sending data to Earth.



The mission has been in planning for the last 20 years, and it cost £1 billion.

Written by Ornella De Gasperin.

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## Communities of ferns communicate to decide an individual's sex

Sex-determination, the process by which organisms develop into males, females, or hermaphrodites, happens in many different ways across nature. In...

**FRIDAY, 14 NOVEMBER 2014**

Sex-determination, the process by which organisms develop into males, females, or hermaphrodites, happens in many different ways across nature. In many species, including humans, insects and birds, it's determined by genetics. In reptiles, sex is determined by the temperature, allowing mothers to change the sex of their offspring by laying their eggs in different places, or by burying them more or less shallowly. Therefore, in some species the environment plays a crucial role in determining an individual's sex. However, a recent study published in *Nature* has found that in ferns, not only parents, but the whole community has a say in determining an individual's sex.

The study was carried out by a group of molecular biologists at Nagoya University. Plants, unlike animals, have two alternating generations: one diploid state called 'sporophyte' and a haploid state called 'gametophyte'. During cell division, the sporophyte produces spores, which then germinate and grow into the gametophyte, which can either be male, female, or hermaphrodite. Some plants produce spores of different sizes, and small spores grow as males and large ones grow as females. Ferns however produce spores of the same size, each with the potential to become either sex or hermaphrodite.

Leading author Makoto Matsuoka and his team has shown that in Japanese ferns this decision is influenced by communicating chemical signals emitted by older ferns in the community. When there are no gametophytes around, then the spores germinate as a hermaphrodite. This way they can ensure reproduction, but with the potential cost of inbreeding through self-fertilization.

When older gametophytes mature as females, they emit signals to induce the younger gametophytes to germinate as males, therefore balancing the sex-ratio in the population and ensuring cross-fertilisation, which avoids inbreeding and maintains genetic diversity. Scientists around the world are now trying to understand how widespread this process is among fern species, and whether it could occur in other plant species, too.

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Written by Ornela De Gasperin

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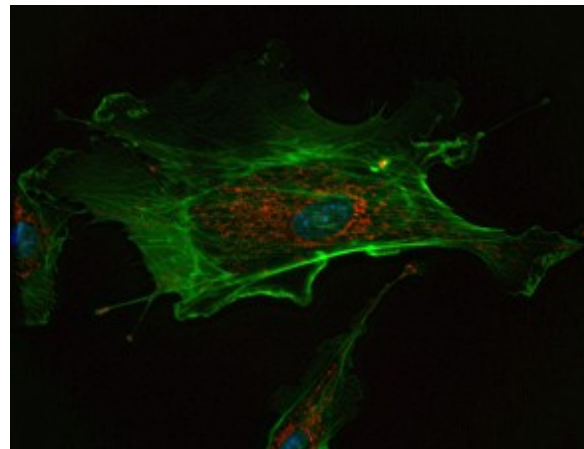
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### New software allows to live-track cells

Since the discovery of the cell by Robert Hook in the 1665, biologists have been studying cells under microscopes. Currently scientists investigating cell biology have to watch time-lapse images of cell division and annotate by hand when a cell divides, a time-consuming and sometimes inaccurate task. Now, a group of engineers in Drexel University in Philadelphia have developed a program that allows scientists to live-track cells.

**FRIDAY, 17 OCTOBER 2014**

The newly developed software is called LEVER, short for Lineage Editing and Validation Program. This software uses sequences of microscopic time-lapses, and can be used interactively in the computer while observing cells. It allows scientists to delineate cells and track them while they move and divide. Furthermore, an enhanced version of the program called LEVER 3-D creates multi-layered microscopic images, which produces a 3-D vision of the cell. This program can be run in a computer with video-games' graphics, and by putting a pair of 3-D lenses on scientists can observe inside the microscopic cross-section. They can zoom in and rotate, therefore seeing angles of the cell that have never been observed before.



LEVER is currently being used for stem-cell research

Leading researcher Dr. Andrew Cohen wants to make this software available for all by making it an open-source. It is currently being used for stem-cell research, and it could eventually become a tool used by most cell-biology labs in the world.

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Written by Ornela De Gasperin.

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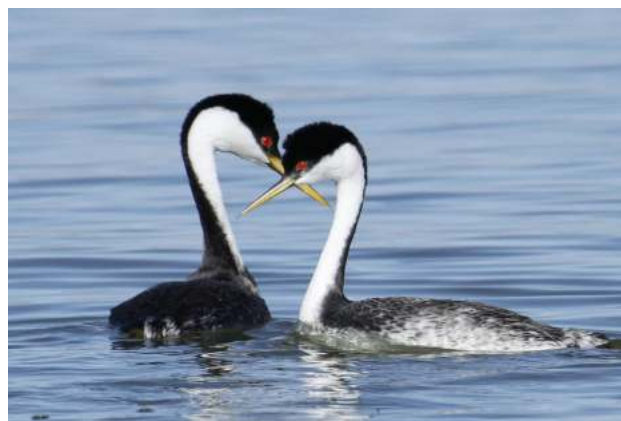


## Feature: Homosexuality in the animal kingdom

Ornela De Gasperin Quintero describes the wealth of homosexual behaviour in the animal kingdom

**SUNDAY, 6 JULY 2014**

Same-sex sexual behaviours are widespread in humans. In the US alone, close to 10 per cent of the population has had sexual encounters with a member of their own sex, and throughout our history numerous examples of homosexual behaviour have been documented. The oldest record of homosexual behaviour dates back to 2400 BC, in ancient Egypt. Indeed, just last year the British Museum launched a book called "A Little Gay History", that depicts the expression of homosexuality in all cultures across our history. But it turns out that we are not the only animals to experience same-sex sexual encounters.



Since the 1700s naturalists have been describing sexual interactions between individuals of the same sex across different animal species. Scientists like George Edwards speculated that these behaviours were 'abnormalities', and suggested that they violated the 'law of procreation'. Around the late 1800s researchers ventured into finding a cause for these phenomena, suggesting that perhaps a lack of members of the opposite sex triggered them. And in the 1980s efforts were concentrated in understanding the physiological bases of this 'disordered' condition. Same sex sexual encounters were considered maladaptive, since natural selection should favour individuals that are able to pass on more copies of their genes. But as the years passed, the number of species observed to engage in same-sex sexual behaviours increased, and around the 1990s researchers began to question whether these behaviours might have an evolutionary advantage.

Nowadays we know that thousands of animal species have sexual interactions with individuals of their own sex. The extent of these behaviours varies considerably: from courtship displays and sexual encounters to the formation of long-term couples. In some cases the extent of same-sex sexual behaviours is so large that it exceeds that of opposite sex interactions. Examples have been described in animals as different as bugs and apes, and in all types of vertebrates.

Among mammals, bottlenose dolphins have the highest rate of homosexual behaviour known, and both males and females interact with members of the same sex. Many apes also engage in same-sex sexual interactions. For example, bonobos spend a long time massaging the genitals of members of their own sex, and these encounters can produce female orgasm. Among fish, guppies in lab conditions show courtship displays towards other males, and this tendency persists even when females are re-introduced into male-only tanks. Amphibians and reptiles are no exception; some males of the garter snake, nicknamed 'she-males', mimic females and other males court them when there are no females around.

Birds show the most remarkable examples of same-sex sexual behaviours, as members of the same sex can form long-term pairs. Two striking examples are the Laysan albatross and Zebra finch. Female Laysan albatrosses in Hawaii form pairs with other females when they can't access a male partner. They fertilize their eggs by copulating with males of the colony, and then together incubate the eggs and raise their chicks. Throughout the breeding season they perform courtship displays and copulatory behaviours towards one another, and spend time grooming each other. In the Zebra finch both males and females form long-term pair bonds.

Same-sex sexual behaviours are common among invertebrates as well. A particularly interesting example occurs in marine snails of the species *Crepidula fornicata*, as members of this species can change their sex. All individuals start off as males, and if they pair up with another male then one of them simply switches into being a female. These are just a few examples of the thousands of same-sex sexual interactions known to occur in the animal kingdom.

Many different hypotheses have been proposed and tested to explain the advantages of these behaviours. Most studies of homosexual behaviours have been performed in the wild, and outstanding advantages have been linked to them. With such a vast number of examples of animals showing same-sex sexual behaviours, it shouldn't be surprising that their function greatly varies across different species according to its particular social and mating system.

Among animals that live in social groups, like dolphins, woodpeckers and many apes, same-sex sexual behaviours are usually used to express affection and affiliation towards members of the group, and to reinforce long-term relationships. They can also help mark dominance ranks among individuals, reduce social tension, and reconcile members of the group after disputes. A remarkable study carried out in 1990 in the olive baboon showed that same-sex sexual behaviours are correlated with the reproductive success of the individuals expressing them. In this species, males form social groups and have a high rate of sexual behaviours towards one another. They embrace and 'mount' each other, and touch and handle each other's genitals. Researchers quantified the frequency of these behaviours across different social groups and compared this rate with the success of the group. They found that groups in which males mounted and manipulated each other's genitals more frequently formed the most cohesive groups, and these groups were the most successful when fighting-off rival groups.

On the other hand, rather than living in groups, many animal species form long-term pair bonds. Frequently, having a partner increases the chances that an individual will survive and/or reproduce, as a pair can synchronize its foraging schedule and help each other when fighting predators or competitors off. Social partnership has been proposed as an explanation for the formation of same sex long-term pair bonds, as shown by albatrosses and zebra finches. In zebra finches a skew in the proportion of males or females in a population shifts the number of same-sex pairs, and both males and females form same-sex bonds. These unions are as selective and stable as male-female pairs, and they are unlikely to be disrupted even if members of the opposite sex are again abundant.

In the case of the garter snake, the benefits of male-male courtship behaviours are very different. In the spring, thousands of snakes emerge after eight months of hibernation in Manitoba, Canada. Snakes are weak and slow after hibernating, and are vulnerable to predator attack. In order to raise their bodies' temperature, they produce a pheromone that mimics the scent of females. This attracts courting males, who strongly press their bodies against the newly emerged 'she-males', raising their body temperature, and protecting them from potential predators.

Homosexual interactions can also increase how sexually attractive an individual looks to members of the opposite sex. In a recent study carried out in 2013 on the fish *Poecilia mexicana*, researcher David Bierbach and colleagues presented females with videos of males courting males or females, and found that females showed higher attraction towards males that were performing higher intensity courtship displays, regardless of whether they were courting males or females.

For a long time, same sex sexual behaviours seemed maladaptive because we thought that the only way of leaving copies of our genes, which are the units of natural selection, was by having offspring, and that same-sex sexual interactions reduced the amount of offspring produced by an individual. Now we know that not only are these encounters incredibly common across the animal kingdom, but that they are the product of their evolutionary history and can have substantial effects on the reproductive success of individuals.

So, how many times have you seen birds taking turns to feed their chicks? Next time, keep in mind; they may be same-sex lovers.

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**Focus: Decision making and cognitive biases**

BlueSci explores biases in human cognition, from their evolutionary background to their socio-political implications

**FRIDAY, 16 MAY 2014**

Humans, and organisms in general, are faced with different possibilities and trade-offs in every aspect of their lives. When to reproduce or divide? When to fight or flee? Which political party to elect? Rationality is held by many people as intrinsic to human behaviour. We assume that rational decision-making underlies our cognition, and that we make decisions by finely weighing options and thoughtfully calculating outcomes. However, decision-making processes in human and non-human animals are pervaded with biases. In this article we discuss some of the most striking cognitive biases known in human decision-making, focusing on the economic, social and political implications that they can have. We then contrast these processes with less-biased decision-making programs in computers, and

close the article by discussing the potential evolutionary explanations behind cognitive biases: why are they there?

According to economists, if humans are 'rational' and free to make choices then they should behave according to the 'Rational Choice Theory' (RCT), which states that people should make decisions by determining the value of a potential outcome, how likely this outcome is, and multiplying these factors. Daniel Kahneman and Amos Tversky were two of the first social psychologists to empirically prove that this is frequently not the case, and that decision-making processes have many biases. After their first work in the 1970s, the list of known cognitive biases has increased greatly, and their work set out a paradigm in psychology and economics of humans as irrational decision-making agents.

Let's start by describing a bias in an everyday situation. We may think that the opinion we have of somebody depends on a deep scrutiny of what we know about them, but in reality this is not the case. We tend to have limited information about people, and we extrapolate this information to other aspects of their personality or abilities. This phenomenon, known as the 'halo effect', was first described by Edward Thorndike in 1920 after he asked commanding officers to evaluate their soldiers according to the physical qualities and intellectual capabilities they possessed. He found that whenever a soldier scored well in one category, he would rank well in all categories. Basically we assume that because someone is good in task A, then he or she will also be good in task B. The halo effect has been studied in different scenarios with remarkable results being found. For instance, students have been shown to rank essays as better written if they think the author is attractive than if they perceive the author as unattractive. Another study carried out in 1975 found a correlation between the attractiveness of criminals and the harshness of the sentence they would receive: the more attractive the criminal, the less likely they were to be convicted, or the lighter the sentence that they would receive.

Political campaigns too can be influenced by the halo effect. A study carried out by Melissa Surawski and Elizabeth Ossoff in 2006 confirmed this by asking participants to rate the political skills of candidates after showing them photographs and playing audio clips of them. They found that physical appearance predicted the candidate's competency better than voice. A recent study on US congressional elections also showed that winning was strongly affected by inferences of abilities based on facial appearance.



Another cognitive bias that can have profound socio-political implications is the 'bandwagon effect', where individuals support the opinion of the majority of their peers. This effect is particularly relevant in politics, where voters may alter their decision to match the majority view and hence be on the winner's side. For example, in the 1992 US presidential election, Vicki Morwitz and Carol Pluzinski conducted a study in which they exposed a group of voters to national poll results indicating that Bill Clinton was in the lead, while keeping another group unaware. They found that a number of voters in the former group who intended to vote for George W. Bush changed their preference after seeing these results, while the latter group didn't change their decision. Studies have also looked at a counter-acting bias known as the 'underdog preference', a rarer phenomenon than the bandwagon effect, wherein some people may support the less-favoured candidate or sports team in a match to feel fair.

How about when we have to decide between two options? If we were to make a rational decision when comparing two alternative options then the relative proportion of choices made between them should be the same regardless of whether they are presented to us on their own, or whether a less-preferred, third option is presented alongside. Nevertheless, this less-preferred third option can make us change our opinion about the other two, better options. This is the 'decoy effect', and it happens when a preference between two options changes when shown a third option that is asymmetrically-dominated, meaning it is inferior in some way and superior in another to one option but inferior in all aspects to the other option. To illustrate this, imagine trying to decide between two train tickets to London, which vary in price and duration of the journey:

	Ticket B
	£30
	40 min

It may be difficult to decide between these two, and some people may decide for ticket A and some for ticket B depending on their priorities. But what would happen if we included a third option that was more expensive than both A and B, but took longer than A?

Ticket B	Ticket C
£30	£45
40 min	35 min

In this case, the asymmetrical decoy (Ticket C), would make option A more appealing than option B. Interestingly, the decoy effect has also been described in non-human animals. For instance, Melissa Bateman

and her colleagues studied the foraging behaviour of hummingbirds by placing birds in two different scenarios. In one scenario the birds had to choose between two alternative artificial flowers, and in the other scenario they had to choose between the same two flowers and an asymmetrical decoy:

A	Scenario B	
	Quantity	Conc
0%	15 µl	40%
0%	45 µl	30%
t	10 µl	35%

The target flower offered less food but a higher sucrose concentration than the competitor. The asymmetrical decoy in scenario B was worse than the target in both aspects and better than the competitor in terms of sucrose concentration, but not in the total amount of food that it provided. Birds that were exposed to the decoy option showed a higher preference for the target flower than birds that did not have access to the decoy.

The decoy effect has been studied in many different circumstances with remarkable effects being found. For instance, Joel Huber, a marketing professor at Duke University, showed how it can affect our preference for restaurants. He asked people if they would prefer to have dinner in a five-star restaurant that was farther away or in a closer three- star restaurant. With these alternatives some people would prefer the five-star restaurant and some the three-star restaurant. But once he included a third option, a four-star restaurant that was farther away than the first two restaurants, then more people preferred the five-star restaurant over the three-star one.

A well-known scenario where biases blur our choice is when we are confronted with risky decisions. Let's imagine that flooding in a city prompted the council to announce two emergency schemes to limit the damage from the flooding: we could either pile up sandbags everywhere, which would save about a quarter of the city from flooding, or we could invest in an experimental and risky flood barrier, which has a twenty five per cent chance of saving the entire city and a seventy five per cent chance of failing and saving nothing. Which solution would you choose? Now imagine that an updated risk assessment comes in about these two solutions. It turns out that piling up sandbags is actually

going to cause three quarters of the city to be flooded, while the flood barrier has a seventy five per cent chance of causing the whole city to be flooded, and a twenty five per cent chance of preventing the flooding completely. Which solution would you choose this time?

Most people would have chosen the sandbags the first time, and the flood barrier the second. But as some of you may have noticed, the options were identical in both cases. All that changed was the framing: describing the positive effects of the measures the first time, and the negative effects the second. This 'framing effect' is related to our instinctive loss aversion. We hate losing out on something we already have, and will take riskier decisions (the uncertain flood barrier) to try and maintain it. On the other hand, when it comes to gains, we prefer a decision with a certain and reliable outcome (the sand bags). This causes our behaviour to change, in identical circumstances, depending on whether an outcome is presented as a potential loss or a potential gain. These are just some examples of dozens of known, named and heavily researched systematic biases that exist in human decision-making. But is there a way of making un-biased decisions?



Thanks to the work of Kahneman and Tversky, computer-based decision-making has come to replace human decision-making in many walks of life, reducing the biases in some choices. Think of Moneyball, the story of the team that revolutionized baseball by ditching the tips of talent spotters in favour of statistical analysis in order to buy undervalued players and turn their prospects around. These techniques, once employed only by statistically-gifted mavericks, have become commonplace in courtrooms and hospitals, where a failure to recognise biases can have drastic consequences. A popular way of getting computers to do this relies on a branch of maths called 'Bayesian inference'.



Generally, theories can predict how experiments should work, but real data is often messy and experiments frequently go wrong. Scientists need to work backwards from the experiments to decide which theories are best, and to modify these theories to fit better with the observed results.

The mathematical principle behind how scientists do this is termed Bayesian inference: what should we believe, and how confident of it should we be, given the data? It's basically a method of updating probabilities when new information is acquired. Bayesian inference requires 'priors', or information of how likely a theory is before starting an experiment. Priors used in Bayesian inference

can be based on previous experience or general knowledge of the world. Not expecting a particular result more than any other can be the best choice in some cases.

A common human bias is that of ignoring 'statistical priors' when evaluating new information. For instance, in one of Kahneman and Tversky's experiments they gave subjects descriptions of several people's personalities, and asked them to guess if they were engineers or lawyers. The descriptions gave no occupation-specific information, but one group of subjects were told that the people came from a population with seventy per cent lawyers and thirty per cent engineers. The other group were told that the percentages were reversed. Bayesian inference states that if there are more engineers present, we should guess that more of the people described are engineers. However, in the experiment the two groups entirely ignored the information on the population as a whole and gave the same responses, no matter how vague the description was. Only if no personality description was given did the two groups give predictions that resembled the population divide.

Bayesian theory is often used as the basis of machine-learning, where computers predict or discover things about the world from large data-sets. For instance, naïve Bayesian classifiers are used to infer whether people who have been arrested are likely to commit crimes again if released on bail. To do this, first a program is trained with existing data on people previously released on bail, and information on whether or not they committed crimes before the trial was over. The program then establishes relationships between certain variables, or risk-factors, such as criminal records, social and economic situation, and reoffending rates. Afterwards the program can be used to predict the outcome of releasing criminals, with the first set of learnt relationships used as priors. When comparing the output of the program with decisions made by judges, it transpired that judges' subjective decisions had been completely misguided. Between their personal biases, and the fact that some people could not afford to post bail, the judges effectively released people at higher risk of re-offending while on bail.

The outstanding prevalence of biases in decision-making processes begs the question of why we, and animals in general, have these biases to begin with? Could there be an advantage to them or are they just an evolutionary solution to compensate for our limited cognitive ability?

Every individual, from the smallest virus to the largest whale, faces trade-offs during its lifetime. Resources are limited, and individuals are selected to maximise their lifetime reproductive success: getting the highest benefits with the lowest costs, according to the resources available. This is the basic principle of natural selection, the main driving force of evolution. Cognition is no exception. Our brain has been moulded by natural selection throughout our evolutionary history to adapt to the environment under which it evolved. Under this perspective the mind is 'adaptively rational', comprising a set of tools designed by natural selection to deal with situations our ancestors encountered. This concept has led to the idea of 'ecological rationality', which suggests that cognitive biases are a result of adaptive solutions to the decision-making problems of our evolutionary past, that maximised the ratio between the benefits and costs of decision-making.



Two of the strongest arguments linked to ecological rationality are 'heuristics' and 'error management'. Heuristics are efficient solutions to problems when information, time, or processing capabilities are constrained, while error management suggests that natural selection favours biases towards the least-costly error. An experiment that illustrates the idea behind heuristics was done by Andreas Wilke in 2006; he studied the foraging behaviour of people—when they would decide to leave their current resource patch and move onto a new patch—under different resource-distribution situations: random, evenly-aggregated or evenly- dispersed. He found that humans used the same set of rules to change resource patches independently of the distribution of food, always using rules that were particularly useful for aggregated resources. Although this result seems irrational, if we consider how resources are distributed in nature it becomes less puzzling; aggregated patches are more common in nature because species are not independent of one another—they tend to attract or repel each other. Using a straightforward rule that is useful in most patches can be a more efficient solution than carefully calculating the amount of food in each patch and deciding when to leave afterwards.

The idea of error management comes from the theory that eliminating all possible errors when making decisions may be impossible, so there may be selection to reduce the most-costly errors. For instance, being able to identify poisonous animals like snakes requires observation and identification of the object. There are two possible outcomes to this: a person could properly examine a potential threat and correctly classifying it as a snake, or could walk away without the certainty that it was in fact a snake. Either way, an error is likely to occur, so it may be more advantageous to have a bias that makes people run away from things that resemble snakes, even if sometimes they run away from lifeless objects, than to get close to the object to decide if it is actually a snake or not. In this second case, the likelihood of being bitten will be larger, as is the cost of the error. Error management may increase the overall rate of making errors, but minimises the overall costs of the errors made.

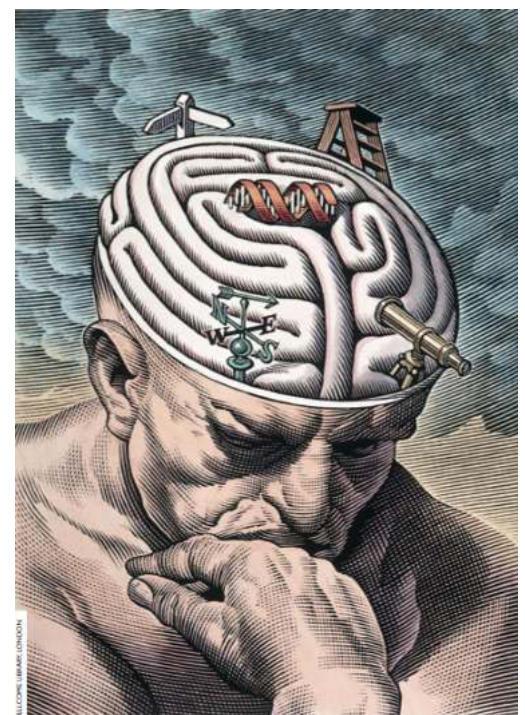
Ecological rationality leaves us with two ideas. One is that our brain has an optimal design that maximised the benefit-to-cost ratio of cognition during our evolutionary history. An optimal design need not necessarily be a 'perfect design', since the costs associated with producing and maintaining it could be too high, but another hypothesis that emerges is that, under some circumstances, biases could have a selective advantage. Whatever the reason behind our cognitive biases, one thing is certain: the study of how our brain works and how it evolved is a topic that has brought together the minds of economists, psychologists, philosophers, physicists, engineers, neuroscientists, medics, mathematicians and biologists. It is perhaps one of the most interdisciplinary lines of research, and one of the most interesting mysteries of our time.

*Alex O'Bryan Tear is a 2nd year PhD student at the Department of Psychiatry*

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**Editorial: Issue 30 - Easter 2014**

UNDERSTANDING HOW OUR BRAIN WORKS is one of the most complex puzzles of our time. Just last year the president...

**TUESDAY, 13 MAY 2014**

## The Human Machine

UNDERSTANDING HOW OUR BRAIN WORKS is one of the most complex puzzles of our time. Just last year the president of the United States, Barack Obama, unveiled a \$100 million initiative to “unlock the enormous mystery of the human brain”. Formed by a hundred billion nerve cells, and united through a hundred trillion interconnections, our brain is what defines us as a species and as individuals. It is in charge of all we feel, think and do. In Issue 30 we have taken human cognition as our main theme.

How many times have you made a choice between restaurants or political candidates? How certain are you that you're making objective decisions? In our focus article we review some cognitive biases in human decision making and account for the effects they can have upon our daily lives. In a second article we refer to another type of bias, the psychology behind racial discrimination, unfolding how it is rooted in us. Although it may feel frightening to know the extent of this bias, it is only through awareness that we can overcome it. Finally, we discuss another aspect of human cognition: the tricks our mind can play on us through optical illusions.

Many other subjects also draw our attention on this Issue. We explain why parasites can have a different effect on people according to their blood type, review the recent outbreak of a virus that has unsettled the Middle East, account for the evidence behind the popular belief that vegetables in our diet have positive effects upon our health and describe how hundreds of animals use body movements to communicate. We also refer to some of the front-line technology that is revolutionising the world we're living in: we explain how quantum computing works, and discuss the possible outreach of stem cells therapies.

We also celebrate the lives of two extraordinary figures that have shaped the modern world: The British biochemist who taught us how to read the code of life, Frederick Sanger, and the South African philanthropist Nelson Mandela. Both men were born in 1918 and died late in 2013.

This Issue is the product of the joint effort of dozens of people. Both authors and editors have very different academic backgrounds. It is thanks to this diversity that we find a great mixture of topics and perspectives across the Issue. If you would like to be one of the people contributing to this magazine we're always looking for people to get involved in BlueSci.. *Ornela De Gasperin Quintero*

## Issue 30: Easter 2014

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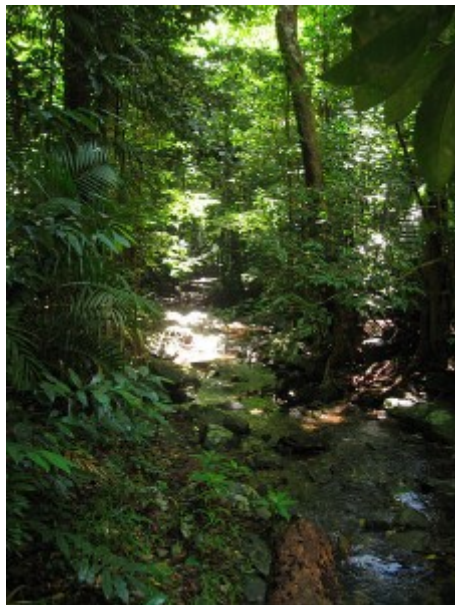
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## New metal-eating plant discovered in the Philippines

Researchers from the University of the Philippines, Los Banos, have discovered a new plant species that accumulates enormous amounts of nickel. Hyperaccumulators are plants capable of growing in soils with high concentrations of metals, extracting these metals through their roots and storing them in their tissues without being poisoned.

**TUESDAY, 13 MAY 2014**



Hyperaccumulators can be used to extract metals from contaminated soils

Hyperaccumulators are of great value as they can be used to extract metals from contaminated soils, a process known as phytoremediation, and collect commercially valuable metals, or Phytomining.

Nonetheless, of the 450,000 species of vascular plants known, only 450 are hyperaccumulators, and of these only 1% can accumulate the concentrations that the newly discovered species, *Rinorea niccolifera*, can. This species can store up to 18,000 ppm by weight, making their dried leaves almost 2% nickel, reports leading author Edwino Fernando in *PhytoKeys*.

The researchers hope that the discovery of this species may encourage future research into applications of hyperaccumulators for soil purification.

**doi:** [10.3897/phytokeys.37.713](https://doi.org/10.3897/phytokeys.37.713)

Written by Ornela De Gasperin Quintero.

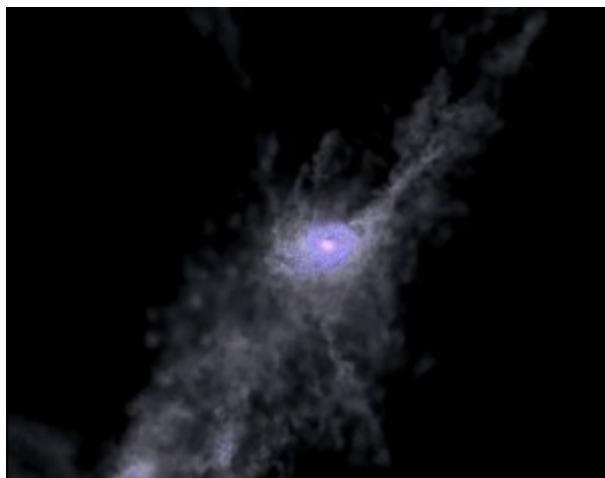
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## Probable hydrogen river observed flowing through space

Astronomers from West Virginia University have spotted what could be a hydrogen river floating through space. Galaxies have different shapes, and more than half of the known galaxies have a spiral form. In fact, the Milky Way has a barred spiral shape, which means it has a central bar-shaped structure composed of stars. Spiral galaxies tend to keep a steady pace of star formation, which can be slow or active.

**THURSDAY, 6 FEBRUARY 2014**



Scientists have wondered what fuels this star formation process, and one of the most important theories is that hydrogen rivers, also known as cold flows, provide the energy for continuous star formation. These cold flows come from intergalactic space and have never been heated to extreme temperatures. Hydrogen rivers however have not been observed so far.

Using the Robert C. Byrd Green Bank Telescope (GBT), the world's largest fully steerable telescope, astronomer D. J. Pisano observed what could indeed be a hydrogen river located near the NGC 6946 galaxy, around 22 million light years away from Earth. Other telescopes lacked the needed resolution to observe such a tenuous light. Future studies and observations may discard alternative explanation for this phenomenon, and

may share light to the role that cold flows may play upon the transformation of galaxies.

DOI: 10.1088/0004-6256/147/3/48

Written by Ornela De Gasperin.

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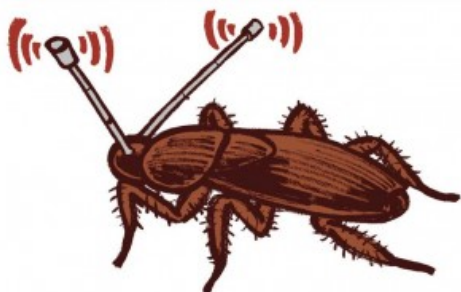
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## Issue 29: Weird and Wonderful

A selection of the wackiest research in the world of science

TUESDAY, 4 FEBRUARY 2014

### Help, I need a cockroach!



Remote-controlled cockroaches might sound like a cartoon super-villain plan, but far-fetched as it seems, the technology is real. Developed by a team at North Carolina State University, it uses motion-sensing Microsoft Kinect system, originally developed for Xbox. So what's the purpose behind these cyborg cockroaches? Well, other than trying to freak out your grandmother or make the first invertebrate chorus line, the researchers hope to use them to map unknown environments where GPS technology cannot be used, such as collapsed buildings. Cockroaches are ideal for this because

their movement is essentially random. The wired-up cockroaches (known as biobots) would be let loose at the scene, and allowed to wander. Radio- signals would be sent to the researchers every time two biobots got close to each other. By commanding them to find and follow walls, go back to random movement, and repeat, an algorithm can be used to translate the biobot data into a rough map of the environment. Chemical and radiation sensors could also be attached to help inform of possible hazards. Who knows? Biobots could soon become the next emergency service. *Nathan Smith*

### The Mpemba effect

Hot water freezes faster than cold water. Although this phenomenon has been observed for centuries, researchers have finally explained why. The so-called “Mpemba effect” was first described by Aristotle in the 4th century BC, and later by Francis Bacon and Rene Descartes. It is named after the Tanzanian student, Erasto Mpemba who, in 1969, published the observation that ice cream mix freezes faster when it's warm. Why this phenomenon occurs has long been a conundrum but recent work from Xi Zhang's team

at the Nanyang Technological University in Singapore seems to suggest the secret lies in the water's molecular interactions. Each water molecule is formed by two atoms of hydrogen and one of oxygen united via strong covalent bonds. Water molecules interact with each other via weak attractive forces called hydrogen bonds. Zhang's idea is that hydrogen bonds generate repulsive forces between water molecules by pulling them close together. This stretches the covalent bonds between atoms and makes them store energy. As water warms up, the hydrogen bonds loosen up, allowing the covalent bonds to shrink and release the stored energy—a process equivalent to cooling. When warm water is exposed to freezing temperatures, this extra cooling mechanism acts in addition to the conventional one, causing a faster rate of freezing. *Ornela De Gasperin Quintero*



### Left wag, right wag

A new study from two Italian universities indicates dogs can tell the difference between left and right. It has long been known that the direction of a tail wag can provide important information, with rightward saying “come and play”, and leftward warning “I want to bite you”. However, whether or not such gestures are used for communication between our canine friends was not shown until last November. Scientists measured the heart rates of 43 pooches in response to wagging video clips, and found that they were significantly higher for leftward wags. This indicates an ability to detect aggression from tail wag direction alone. The implications of this research go beyond making it that little bit more embarrassing if you are someone who confuses left and right, as it provides supporting evidence for the fundamental asymmetry of canine brains. The left side, which instructs muscles on the right, is thought to be more associated with “approach” behaviours, while the right controls the left side of the body and is linked to “withdrawal”. The extension of this theory to behaviours triggered by social cues, such as exhibiting stress reactions when watching a nasty

leftwagger, seems to suggest that the need for communication played an important role in the evolution of brain lateralisation. *Elly Smith*

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**News: Issue 29**

Babies suppress own immune system

**MONDAY, 3 FEBRUARY 2014**

A new study has suggested that the immune system of a newborn baby regulates itself to allow the colonisation of beneficial bacteria. When foetuses are developing inside their mother's womb they are in a sterile environment. When they are born, however, they immediately become colonised by bacteria and fungi. The immune system of infants has a very weak response to infections, and it has been assumed that this was due to a lack of maturity. A group of researchers at Cincinnati Children's Hospital in Ohio has challenged this view by comparing the immunosuppressive properties of newborn and adult mice. Surprisingly, baby mice had a higher concentration of CD71+ cells. These cells generate an enzyme called arginase-2, which actively suppresses their immune response. To understand this, Sing Sing Way and his team experimentally knocked

these cells out by providing baby mice with antibodies. Afterwards they infected them with *Listeria monocytogenes*, a bacterium that can cause severe infections, and found that their immune system successfully resisted the attack. But there was a trade-off; as the colonisation of commensal microorganism in the baby's intestinal cells produced an inflammatory reaction, a process that would have otherwise happened smoothly. The challenge now is to understand if a similar process happens in humans. If so, treatments that allow a temporal reduction of CD71+ cells could strengthen the immune system of newborns. This may allow health workers to vaccinate sooner, which could save many lives in developing countries. *Ornela De Gasperin Quintero*

**Giant channels beneath Antarctic ice**

Antarctica is covered in a vast ice sheet that holds close to 90 per cent of the Earth's freshwater reserves. However, climate change means that the potential threat of melting Antarctic ice mass to the globe's ocean levels has become a growing concern. The Antarctic ice sheet is a dynamic system where glaciers continuously push towards the sea. As they move into the ocean, they form ice shelves that float on the water whilst maintaining their connection to the mainland ice sheet. Scientists have used satellite imagery and radar measurements to gain crucial new insights into meltwater flow beneath Antarctica's ice sheets. They showed that large channels run underneath a major ice shelf and that these are extensions of channelised meltwater flow underneath the 'grounded' ice sheet that rests on the land. These findings differ from previous models that suggested water flows in a thin layer beneath the ice sheet. Analysis of the architecture of floating ice shelves could provide key information on the organisation and stability of the water system beneath the ice mass on the continent's mainland. Dr Anne Le Brocq from the University of Exeter stated: "The information gained from these newly discovered channels will enable us to understand more fully how the water system works and, hence, how the ice sheet will behave in the future." The findings will help improve existing models as environmental conditions continue to change. *Nele Dieckmann*

**Getting drunk without the hangover**

Imagine getting drunk at a party and then being able to drive home the same



night, and with no hangover the next day. This may sound like science fiction, but scientists are developing a drug that may do just that. David Nutt, from Imperial College London, has identified five potential compounds which could provide a synthetic alcohol substitute that mimics the positive effects of alcohol without the health risks, danger of addiction or hangover. Alcohol is known to mimic GABA, an inhibitory chemical produced in the brain. The brain contains multiple GABA receptor types, each with different functions. Alcohol non selectively binds to GABA receptors, causing many side effects such as memory impairment and loss of coordination. Unlike alcohol, the new drug selectively targets GABA receptor subtypes responsible for the pleasurable and relaxing effects of alcohol. What's more, it would also come with an antagonist that can rapidly reverse its effects,

thus allowing revellers to sober up quickly. Alcohol addiction and alcohol-related health problems, violence, and accidents are collectively responsible for 2.5 million deaths worldwide each year, so a new safer alternative to the drug is surely to be welcomed. Professor Nutt is looking for investors to develop the drug, but it is unlikely it will be on the market any time soon, considering the regulatory challenges facing new pharmaceuticals. It remains to be seen whether popping a pill could ever replace the ritual of enjoying a drink with friends. *Camilla d'Angelo*

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### Mice can transmit fear to their offspring through sperm

A study has shown that mice can transfer fear to specific odours through their sperm to their offspring and grand...

**WEDNESDAY, 18 DECEMBER 2013**

A study has shown that mice can transfer fear to specific odours through their sperm to their offspring and grand offspring. Epigenetics are changes in the expression of DNA which are not caused by changes in the DNA sequence. Through epigenetics parents can transmit useful information of the environment to their offspring. Researchers Brian Dias and Kerry Ressler from the Emory University School of Medicine in Atlanta, Georgia, tested whether fears can be transmitted to offspring in mice through non-genetic inheritance.



New generations of trained mice showed a 200 per cent stronger response than the offspring of untrained mice

The researchers trained male mice to associate a cherry blossom odour to shocks. Then they allowed these males to mate and tested the response of their offspring and grand offspring to this odour.

The new generations of mice showed a 200 per cent stronger response than the offspring of untrained mice, even though they have never been exposed to it before. To understand what triggered this fear the team investigated changes in a gene that influences the smell to cherry blossom.

Although the genetic code of this gene remained unchanged, it had epigenetic marks that affected its behaviour, triggering it to express more. The challenge now is to understand how widespread this phenomenon is, and if a similar intergenerational transmission influences the expression of phobias and anxieties in humans.

doi:10.1038/nn.3594

Written by Ornela De Gasperin Quintero.

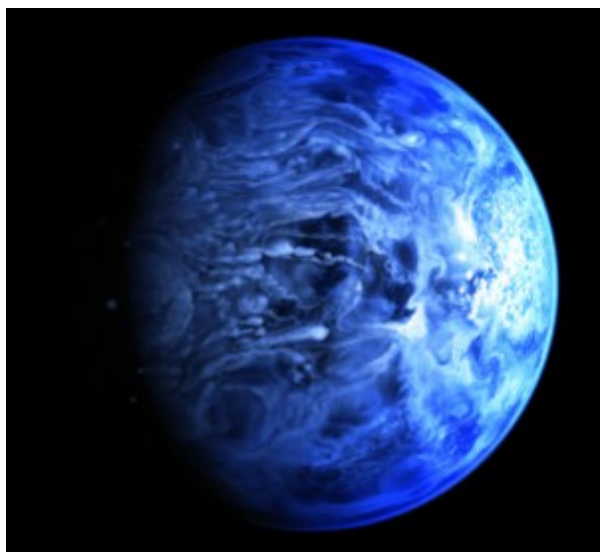


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**News: Issue 28**

Azure Planet Spotted by Hubble

**MONDAY, 25 NOVEMBER 2013**

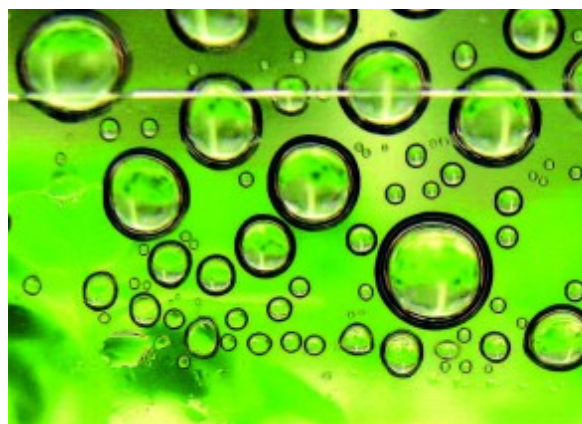
In 1990, the Pale Blue Dot image made headlines as Earth was photographed by Voyager 1 from a record distance of six billion kilometres. Thanks to astronomers from Oxford and Exeter, we now know of another blue dot, orbiting another star. Forget pale though —this planet is deep azure. Since 2005 the star HD 189733b was known to harbour a “hot Jupiter”, a massive planet on a very short orbit. Subsequent studies found that its surface temperature is close to 1000°C and that the planet is tidally locked to the host star, featuring the same orbital and rotational periods. This means that the same planet side faces the star at all times and the huge temperature gradients resulting from uneven heating are thought to stir up 7000 kilometre per hour winds. The researchers have used the Hubble Space Telescope to monitor the intensity of visible light coming from the system during the passage of the planet behind the face of the star. They observed a drop in the blue part of the light spectrum by 0.01 per cent, but

no similar effect in green or red. The tiny missing amount is the light normally reflected by the planet—a hue of blue much deeper than that of Earth, Neptune or Uranus. This extraordinary colour is not due to the presence of liquid water, but rather is believed to be evidence of a hazy and turbulent atmosphere filled with silicate particles. This makes HD 189733b a place where it can rain glass. Sideways. *Maciej Hermanowicz*

DOI: 10.1088/2041-8205/772/2/L16

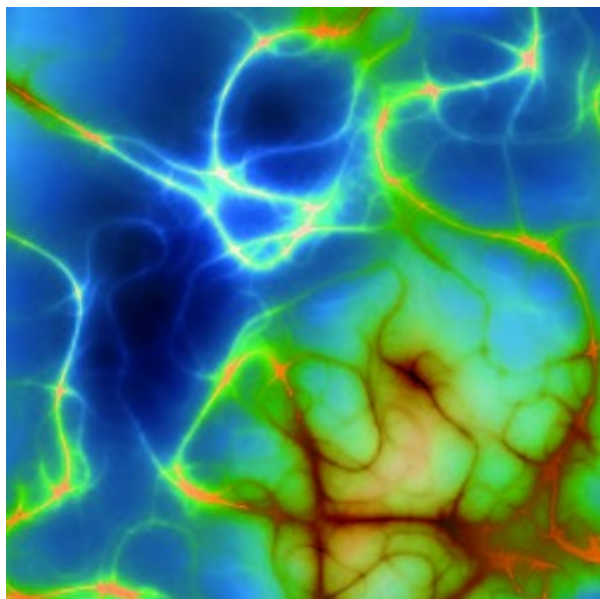
**Bacteria Make Biofuel Precursor**

Researchers at the Wyss Institute for Biologically Inspired Engineering and Harvard Medical School have engineered a bacterium that can produce a key biofuel precursor. Biofuels are alternative energy sources to petrol, diesel and aircraft fuel. Research on biofuels is critical as burning gasoline shrinks the world’s limited oil supply and releases huge amounts of carbon dioxide to the atmosphere. However, existing biofuels do not produce as much energy as gasoline; ethanol for instance packs only two-thirds the energy of gasoline. Pamela Silver and her team have been pursuing new ways of synthesising gasoline precursors called fatty acids. These energy-packed molecules contain chains of carbon atoms flanked by hydrogen and can easily be transformed into fuel. The chains must have a length of four to twelve carbons; shorter chains do not store enough energy, whereas longer chains are too waxy. The researchers succeeded in genetically modifying *E. coli* so that the bacterium produces large quantities of octanoate, an eightcarbon fatty acid which can be converted into octane, just by ingesting carbon-rich sugars. Their results are reported in *Proceedings of the National Academy of Sciences*. Silver and her team are now seeking to engineer *E. coli* to convert octanoate and other fatty acids into alcohols, which are just one chemical step away from octane and can themselves be used as biofuels. *Ornela De Gasperin Quintero*



DOI:10.1073/pnas.1307129110

## Neurodegeneration: How Important is Taking Out the Trash?



Clearing proteins and cellular waste products is a crucial process, ensuring that tissues and organs function properly. The lymphatic system is a circulatory network of organs and vessels, which runs in parallel with the blood vascular system and is the principal way in which tissues eliminate fluid and proteins. However, the lymphatic system does not extend to the brain, so how does the brain manage its waste? Using a new imaging technique called two photon microscopy, researchers at the University of Rochester Medical Center have discovered a network analogous to the lymphatic system termed the 'glymphatic system'. The brain is bathed in cerebrospinal fluid which flows into the interior of the brain at high speed sweeping excess proteins and debris away. These are then transported down the spine to the lymphatic system, and ultimately to the liver where they are degraded. So why is this important? Many degenerative diseases are caused by the build up of toxic proteins, leading to the death of brain cells. In Alzheimer's disease for instance, the protein beta-amyloid accumulates,

giving rise to the characteristic plaques found in the brains of patients. Now that we know about the glymphatic system, it will be critical to determine its role in disease. For example, does the glymphatic system slow down with age, explaining why the risk of developing neurodegenerative diseases increases as we get older? Ultimately, it may be possible to develop novel therapies that enhance waste removal in the brain, which can then be used to treat people with conditions such as Alzheimer's disease. *Laura Pearce*

DOI: [10.1126/science.1240514](https://doi.org/10.1126/science.1240514)

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## Birds pay attention to speed limits, study shows

European birds decide how soon to fly away from a car according to the speed limit of the road, a recent study shows. Animals living near humans may change their behaviour in order to survive. For instance, some birds living in urban areas sing with higher frequency as a response to noise pollution.

**FRIDAY, 8 NOVEMBER 2013**



Pierre Legagneux and Simon Ducatez from the University of Quebec and from the university of McGill, respectively, wondered whether birds could use the speed limit from highways as a cue to decide how soon to fly away from a vehicle.

To answer this question they performed an experiment in France by driving at different speeds (either at the speed limit, over, or under the speed limit) in roads that varied in their speed limits of (20, 50, 90 and 110 km/h).

Whenever a bird flew away from the approaching car the researchers recorded the time from the moment the bird started to fly until the car reached the spot where the bird had been, and calculated the distance at which the bird initiated the flight. They found that birds fly away from the car sooner in roads with higher speed limits.

Surprisingly, the actual speed of the vehicle did not affect their flying distance. The challenge now is to understand how different aspects of the biology of birds, like their mobility or

territoriality, may affect how they respond to speed limits.

doi:10.1098/rsbl.2013.0417

Written by Ornela De Gasperin.

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### Drinking impairs healing of broken bones

A study performed in Loyola University Medical Center has shown that alcohol abuse impairs the healing of broken bones. Alcohol-related accidents are widespread. In Great Britain alone, 9,990 reported accidents in 2011 occurred as a result of drinking over the legal alcohol limit. The new study shows that in addition to causing accidents, alcohol could also impair recovery from injury.

**MONDAY, 21 OCTOBER 2013**

John Callaci and his team performed an experiment on mice to understand whether drinking affects bone recovery after a fracture. They compared the healing process of two groups of mice; one exposed to alcohol levels equivalent to three times the drinking limit, and a second to saline water.

They found that the alcohol exposed group had less bone forming in the callus, a hard tissue that forms around the edges of fractured bones. This group also had higher levels of oxidative stress, a process that weakens cellular functions. Roman Natoli presented their findings during the 2013 Annual Meeting of the American Society for Bone and Mineral Research on the 6th of October.

When a fracture occurs, the body sends stem cells to the injured bone, where they become bone cells. Stem cells are immature cells which can differentiate into any cell type. In two future studies the researchers will try two different treatments. In one experiment they will inject stem cells directly into the fracture, and in another one they will introduce an antioxidant that fights oxidative stress. If successful, these treatments could improve the healing process in alcohol abusers and in non alcohol abusers.



More information can be found at: <http://www.loyolamedicine.org/newswire/news/study-shows-how-binge-drinking-impairs-healing-broken-bones>

Written by Ornela De Gasperin.

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### Extensive glacial retreat in the Mount Everest region

Researchers from the University of Milan have found that glaciers in the Mount Everest region are shrinking. Glaciers are large thickened ice masses made up from fallen snow after many years. Glaciers retreat or advance periodically, and these movements are usually very slow and only evident after a long period of time. However, retreat of glaciers can occur rapidly over a few months or years.

**FRIDAY, 24 MAY 2013**

A study led by PhD student Sudeep Thakuri integrates satellite images and topographic maps to reconstruct the glacial history and analyse the extent of glacial change in the Sagarmatha National Park. They found that the glacier in this region has shrunk by 13% in the last 50 years, and the snowline shifted upward by 180 meters. The team has yet to establish what the causes of this phenomenon are, but they suspect it is caused by human-generated greenhouse gases which alter global climate.



The Himalayan glaciers and ice caps are a source of water supply and storage for Asia. Downstream populations depend on melt water for agriculture, power production and drinking, Thakuri reports. With future research the team plans to understand the behaviour of the hydrological cycle to predict future water availability in the region.

Written by Ornela De Gasperin Quintero.

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VII

**CULTURA / OAXACA (/OAXACA) / CAPITAL**

Ornela DE GASPERIN QUINTERO (<https://www.nvinoticias.com>)

/ Jue, 08/19/2021 - 10:16

# ¿Cómo se determina el sexo en el árbol de la vida?

CIENCIA A LA MANO



En el 2019, la corte más alta de deportes internacionales dictaminó que mujeres con altos niveles naturales de testosterona deben reducir estos niveles para competir como 'mujeres'. Esta decisión abrió una tormenta de preguntas sobre cómo, y por qué, definimos quién es 'mujer' u 'hombre'. Así como es altamente

difícil, sino imposible, definir quiénes son hombres o mujeres en humanos, a través del árbol de la vida hay muchísimos procesos que influyen en qué organismos se desarrollan como 'machos' o como 'hembras'.

La mayoría de los organismos multicelulares, como las plantas y animales, se reproducen sexualmente, produciendo células especiales llamadas 'gametos', como los óvulos y espermatozoides. Los gametos tienen la mitad del número de genes típicos de los organismos de una especie, y deben unirse con otro gameto para formar un nuevo organismo. Históricamente, en la ciencia hemos clasificado como 'hembras' a quienes producen gametos grandes, y como 'machos' a los que producen gametos pequeños (aunque no todos los organismos producen gametos de distintos tamaños). Y muchísimos factores, incluidos genes, cromosomas (grupos de genes), y factores medioambientales, afectan si un organismo produce gametos chicos o grandes.

### **TAMBIEN PUEDE INTERESARTE**

- [La Puerta Abierta presenta Lucía y Julio... nada más \(/nota/194104/la-puerta-abierta-presenta-lucia-y-julio-nada-mas\)](#)
- [Evitó capa de ozono mayor calentamiento del planeta \(/nota/194072/evito-capa-de-ozono-mayor-calentamiento-del-planeta\)](#)
- [Amenazan incendios a fauna silvestre \(/nota/194071/amenazan-incendios-fauna-silvestre\)](#)

Por ejemplo, los mamíferos y las aves tenemos cromosomas sexuales, los cuales evolucionaron de manera independiente hace más de 200 millones de años. En mamíferos, las hembras tenemos cromosomas XX, mientras que en las aves las hembras llevan cromosomas WZ (equivalente a XY, que en mamíferos determina machos). Para muchos organismos, es el medioambiente, y no sus genes, quien determina su sexo. Por ejemplo, la temperatura determina el sexo de los cocodrilos y las tortugas. Algunos helechos jóvenes detecten cuántas hembras y machos hay en su comunidad a través de sustancias químicas, y se desarrollan hacia el sexo limitante (¡menos competencia al aparearse!). Y muchos peces son hermafroditas, empezando como hembras (o machos), y transformándose en machos (o hembras) conforme avanza su vida.

Quizás sorprende más cuando es la mamá de un organismo la que determina su sexo. Esto ocurre en cerca del 12 % de los animales, y es común en insectos que viven en sociedades (como las abejas, hormigas y avispas). En estas especies, las 'reinas' se aparean una vez al comienzo de sus vidas, y guardan los espermatozoides por meses o años (las hormigas reinas más longevas pueden vivir 28 años). Las reinas deciden cuando fertilizar sus óvulos. Si lo hacen, éste se desarrollará como hembra, y si no, como macho.



En el árbol de la vida, hay una diversidad inmensa de procesos que influyen en qué tan probable es que un organismo se desarrolle como macho o hembra. La comunidad científica sigue tratando de entender cómo funcionan estos procesos, y, sobre todo, por qué hay tantas maneras tan distintas de determinar el sexo de un organismo.

## MEMENTO

19 de agosto de 1812: El Generalísimo José María Morelos adopta su bandera de guerra.

29 de agosto de 1940: Muere asesinado León Trotsky, precursor de la Revolución Rusa y jefe del Ejército Rojo.

21 de agosto de 1842: Muere Leona Vicario, Madre de la Patria, heroína de la Independencia, quien apoyó la lucha aportando dinero para la causa.

23 de agosto de 1928: Nace Heberto Castillo, ingeniero, político y luchador social.

24 de agosto de 1821: Se firman los Tratados de Córdoba, con los que se acuerda la Independencia de México.

## TE PUEDE INTERESAR



[\(/nota/194010/esto-no-es-una-nota-roja-es-un-libro-absurda-noveleta-negra\)](/nota/194010/esto-no-es-una-nota-roja-es-un-libro-absurda-noveleta-negra)

[Esto no es una nota roja, es un libro "Absurda noveleta negra"](/nota/194010/esto-no-es-una-nota-roja-es-un-libro-absurda-noveleta-negra)  
(/nota/194010/esto-no-es-una-nota-roja-es-un-libro-absurda-noveleta-negra).



[\(/nota/193966/defiende-goldin-su-gestion-en-la-direccion-de-la-biblioteca-vasconcelos\)](/nota/193966/defiende-goldin-su-gestion-en-la-direccion-de-la-biblioteca-vasconcelos)

[Defiende Goldin su gestión en la dirección de la Biblioteca Vasconcelos](/nota/193966/defiende-goldin-su-gestion-en-la-direccion-de-la-biblioteca-vasconcelos)  
(/nota/193966/defiende-goldin-su-gestion-en-la-direccion-de-la-biblioteca-vasconcelos)



[\(/nota/193871/seattle-invita-](/nota/193871/seattle-invita)

[Seattle invita a conocer su oferta urbana y cultural](/nota/193871/seattle-invita-conocer-su-oferta-urbana-y-cultural)  
(/nota/193871/seattle-invita-conocer-su-oferta-urbana-y-cultural)



[\(/nota/193870/llega-moda-los-museos\)](#)

[Llega moda a los museos \(/nota/193870/llega-moda-los-museos\)](#)

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[\(/nota/193867/pandemia-ha-provocado-acercamientos-mas-directos-entre-los-artistas-y-los-espectadores\)](#)

[Pandemia ha provocado acercamientos más directos entre los artistas y los espectadores \(/nota/193867/pandemia-ha-provocado-acercamientos-mas-directos-entre-los-artistas-y-los-espectadores\)](#)

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[\(/nota/193796/la-casa-escuela-de-tradiciones-espacio-de-vida-cultural-en-el-ex-convento-de-santo\)](#)

[La Casa Escuela de Tradiciones, espacio de vida cultural en el Ex Convento de Santo Domingo \(/nota/193796/la-casa-escuela-de-tradiciones-espacio-de-vida-cultural-en-el-ex-convento-de-santo\)](#)

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## LO MÁS VISTO

- [1 Piden justicia por homicidio de mujer de 82 años, fue asesinada a puñaladas en Mazatlán Villa de Flores \(/nota/193978/piden-justicia-por-homicidio-de-mujer-](#)
  - [2 Violento sujeto ingresa a sucursal bancaria con un machete con el cual amedrentó a empleados \(/nota/194045/violento-sujeto-ingresa-sucursal-bancaria-con-un-](#)
  - [3 Deja accidente 14 personas heridas, entre ellas el ex edil de San Pedro Jicayán, Oaxaca \(/nota/193944/deja-accidente-14-personas-heridas-entre-ellas-el-ex-](#)
  - [4 Choque por alcance deja 6 lesionados en Chenalhó \(/nota/194109/choque-por-alcance-deja-6-lesionados-en-chenalho\)](#)
  - [5 Con diversas lesiones resultó un motociclista al chocar contra un auto compacto \(/nota/193979/con-diversas-lesiones-resulto-un-motociclista-al-chocar-contra-](#)
  - [6 Juegos Nacionales Populares con sede en San Cristóbal \(/nota/194031/juegos-nacionales-populares-con-sede-en-san-cristobal\)](#)
  - [7 PJE0 ha brindado atención a cinco mil 188 personas a través de plataformas digitales \(/nota/193949/pje0-ha-brindado-atencion-cinco-mil-188-personas-](#)
-

8 [Los tratados de Córdoba \(/nota/194066/los-tratados-de-cordoba\)](/nota/194066/los-tratados-de-cordoba)

9 [Oaxaqueños participarán por México en el torneo internacional Flatland Contest 2021 \(/nota/193993/oaxaqueños-participaran-por-mexico-en-el-torneo-](/nota/193993/oaxaqueños-participaran-por-mexico-en-el-torneo-internacional-flatland-contest-2021)

10 [Suspenden función de box de este viernes a causa del Covid en Tuxtla Gutiérrez \(/nota/194106/suspenden-funcion-de-box-de-este-viernes-causa-del-covid-](/nota/194106/suspenden-funcion-de-box-de-este-viernes-causa-del-covid-en-tuxtla-gutiérrez)

NO TE LO PIERDAS

(/cultura)



[Los tratados de Córdoba \(/nota/194066/los-tratados-de-cordoba\)](/nota/194066/los-tratados-de-cordoba) firman

(/cultura)

[¿Cómo se determina el sexo en el árbol de la vida? \(/nota/194065/como-se-determina-el-sexo-en-el-arbol-de-la-vida\)](#)

(/cultura)



["La noche de plata", una novela reciente de la autora española Elia Barceló \(/nota/193967/la-noche-de-plata-una-novela-reciente-de-la-autora-espanola-elia-barcelo\)](#)

(/cultura)



[Defiende Goldin su gestión en la dirección de la Biblioteca Vasconcelos \(/nota/193966/defiende-goldin-su-gestion-en-la-direccion-de-la-biblioteca-vasconcelos\)](#)

(/cultura)



[Vigente el sueño de Toledo por preservar las lenguas originarias \(/nota/193865/vigente-el-sueno-de-toledo-por-preservar-las-lenguas-originarias\)](#)

(/cultura)



[Festivales de cine mexicanos si van a realizarse en la virtualidad \(/nota/193866/festivales-de-cine-mexicanos-si-van-realizarse-en-la-virtualidad\)](#)

(/cultura)



[“Eugenio Polgovsky: La poética de lo real” llega a librerías \(/nota/193759/eugenio-polgovsky-la-poetica-de-lo-real-llega-librerias\)](#)

(/cultura)



[Merle Barbieri, diseñadora de moda y artista plástica \(/nota/193761/merle-barbieri-disenadora-de-moda-y-artista-plastica\)](#)

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