Conducting the dolphin choir

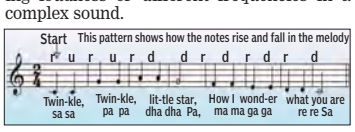
SOFTWARE THAT DETECTS MUSICAL MELODIES HAS BEEN USED TO IDENTIFY THEIR WHISTLES, SAYS **S ANANTHANARAYAN**

The question of whether animals have a language that can compare with that of humans has been an intriguing question. That animals communicate is obvious. Dogs bark to warn an intruder and flocks and herds stay in contact with the help of sounds. Bees are known to use signals based on movement and ants leave a trail of scent to point the way to food. But is this language in the sense that humans use sounds?

The distinction is that the human baby learns not just sounds and words, but also grasps very early the rules of grammar, which enable the baby to form and understand sentences that have not been heard before and are being used for the first time. It is language that has made it possible for there to be a Shakespeare or a Milton, and also a Newton or Einstein. Seeing similarities in the structure of almost all human languages, there are suggestions that there exists a universal grammar , which is inborn in humans, in their very genetic make-up. And there is research to discover if there are signs of grammar in animal conmmunication in birdsong, for instance.

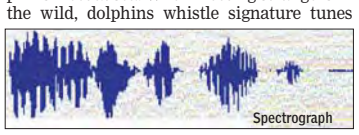
A serious contender for language ability status is the dolphin. Long studied as a mammal with very high intelligence and, hence, highly trainable, groups of dolphins have also displayed remarkable communication activity and the nature of their cries, or whistles, has been of great interest. But scientists have considered the whistles mainly as sounds, and analyses have been made on patterns of frequency and amplitude, which are the scientist words for pitch and loudness. The dolphin s whistle is, thus, been analysed with complex instruments, and is represented by a *spectrograph*, or a visual display of the varying loudness of different frequencies in a complex sound.


Vincent Janik, Leela Sayigh, Arik Kershenbaum and Stephanie King



The dolphin, on its part, has displayed more and more interesting features of the way it communicates. Scientists Stephanie L King and Vincent M Janik from the University of St Andrews in Scotland recently reported that dolphins develop their own, individual, signature whistles, which they use to identify themselves and which can be imitated by other dolphins, apparently to address one another! That animals can use specific sound signals when presented with a specific object or a class of objects has been known and the Bottlenose dolphin is capable of learning to make specific sounds to report that an object is there, or even that it is not there. But what King and Janik found was that there were features in the whistle that coded the individual s identity, independent of voice features.

Dr Janik had earlier reported that often whales used this signature whistle in big group settings, like when several pods of dolphins meet at sea. When meeting strangers in the wild, dolphins whistle signature tunes that may be the animal equivalent of Hello, my name is There is evidence that dolphins can recollect these specific whistles of individual dolphins after a long lapse of time, even 20 years!



The method King and Janik used for their studies was to record the whistles of dolphins and to play them back to other dolphins or the same dolphins in different situations. These studies showed that one dolphin s whistle was clearly its own, and it could be identified by its whistle or be addressed by that whistle, too.

Melodic pattern

But analysis of whistles or of the different sound signals with spectrographs has been scarcely possible as large sampling is needed and the method is time- consuming. This is where the journal, *Public Library of Science-One*, reports an important advance in the analysis of dolphin whistles. Researchers Arik Kershenbaum, a postdoctoral fellow at the National Institute for Mathematical and Biological Synthesis, University of Tennessee; Leela S Sayligh; and Vincent M Janik have applied a method used to automate the identification of musical melodies to dolphin whistles and they find that the signature cries of individual dolphins have distinct melodic patterns.

Melody consists of a series of sounds of different pitch and duration set to a given rhythm. The notes of different pitch are represented in Western music by markings on a grid of five parallel lines, with each higher line or space indicating a sound of higher pitch. In Indian music, the notes have individual names, like sa, re, ga, by which their relative pitch can be made out. In representing sound in this way, it is a relationship of a series of sounds that is shown, and not the actual frequency, and loudness at every instant, as in the spectrograph. The coding in a given melody was further simplified in what is known as *Parson s Code*, where what is recorded is only whether each note is at the higher, lower or same pitch, as the previous one. The picture shows the notes in the song, *Twinkle, twinkle, little star,* a song familiar to many, with the rising and then falling pairs of notes, in Western and Indian notation. Also indicated is Parson s Code, where the letter r means same pitch , u means higher pitch and d means lower pitch .

Parson s Code, where only higher or lower, not even how much higher or lower, is considered, is not really a way to record or reproduce the sounds but it is a simple and still a unique pattern of practically all tunes. In the task of detecting a song with the same tune, in a data base of thousands of songs, Parson s Code helps carry out the search in seconds, using a computer. One purpose could be to find a specific recording from a jumbled collection, or it could be to detect if a snatch of tune has been pirated and used anywhere else, even worldwide.

Parson s Code becomes a handy tool for the analysis of dolphin sounds. Each snatch of whistle can be readily broken into its series of rising, falling or level components and Parson s Code of different sounds is then a matter of comparing text! The Parson s Code is a robust way to compare dolphins signature whistles because it is able to home in on the variation in frequency that actually matters. It discards the information that isn t useful for the analysis, says the paper s lead author, Arik Kershenbaum.

With mounting evidence that dolphins calls represent sophisticated communication, analysis of their content would be crucial to classifying them and to study how they appear in the course of social behaviour of the animals.

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PLUS POINTS

Birds of a feather

All pet owners will happily wax on about their dog or cat s character traits probably in far more detail than you ever wanted to know. But the idea of animal personality is not one that s been formally studied all that much.


Collared Flycatcher

A new study has classed a species of bird into groups of more and less aggressive males. Researchers gauged the response of male collared flycatchers to female birds, to a strange object, and to other males. They found that each type of individual displayed consistent behaviour in each of these situations.

However, they also found that the birds more likely to take risks also were the ones most likely to be trapped and thus studied further raising important questions about the skewed sample set presented when researchers base their findings on animals caught in traps. It s kind of like when talk show hosts say 95 percent of 13-year-olds (who responded to our online survey) are smoking pot! leaving out the part about it really being 95 per cent of *the particular 20 teenagers who felt like responding to our survey.*

Not so cheeky

Scientists have discovered that the conversations of marmoset monkeys are far more ordered and polite than anyone might have thought, paving the way for a new theory of an alternative evolutionary route for our own speech patterns. When separated from one another by a curtain, marmosets involved in the research took turns to call, waiting for an interval of around five seconds before responding.


Marmosets have developed their own version of polite conversation.

The findings, published in the *Current Biology* journal, have implications for our understanding of how humans evolved to take turns before speaking a practice which (bad manners excepted) is universal throughout the world and across all languages. And it could provide the foundation for further research into how and why the patterns of our conversations sometimes break down.

Princeton University s Dr Asif Ghazanfar set out to find evidence of a vocal equivalent to this evolutionary route, and chose marmosets because they, unlike chimps, are very chatty indeed. He said it was one of two main characteristics the monkeys shared with humans. They re (also) cooperative breeders so they help one another take care of their offspring. That s an important characteristic because it leads to greater pro-sociality (meaning the animals, like us, carry out behaviours that are intended to benefit others).

ADAM WITHNALL/THE INDEPENDENT

Impurrfect vision

New research into feline vision has revealed the stark differences between cat and human eyesight. A series of images created by Nickolay Lamm show that cats have much better eyesight in some instances compared to humans.

The pictures make an accurate hypothesis of what feline eyesight could look like. Cats have a visual field of 200 degrees compared to only 180 degrees in humans, meaning felines can see more in general. However, humans have better long distance vision, which means that a cat would have to stand 20 feet away to see something that a person can see clearly from a distance of 100-200 feet.

According to the research, humans see a wider spectrum of colours because of the shape of our retinas, so we can see a vibrant range colours during the day. A colourblind person would be able to see a similar range of colours as a cat. While the shape of our retinas enhances our ability to see different colours during the day, it limits our vision in dim light, unlike cats whose sight excels under these conditions. In fact, cats can see six to eight times better in dim light than humans because of the shape of the retinas, their elliptical pupils and large cornea.


The same scene as viewed through the eyes of a human and a cat and the contrast is surprising.

Lamm carried out his research with the help of Kerry L Ketring, Dr DJ Haeussler of The Animal Eye Institute and the ophthalmology group at Penn Vet.

FLUIDITY AND ASYMMETRY

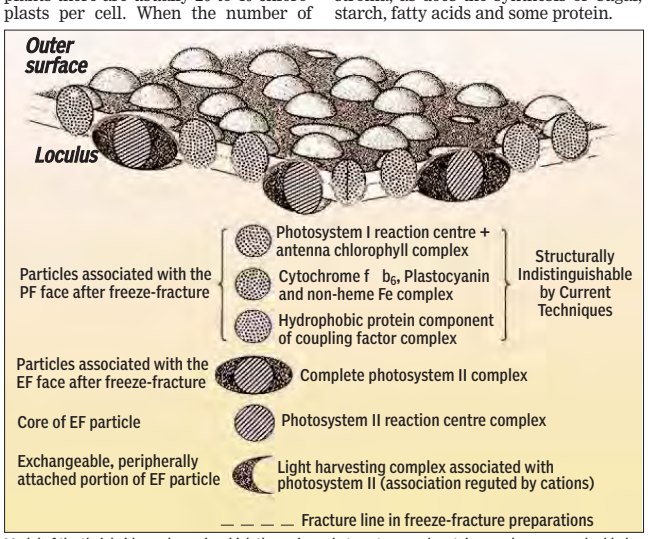
TAPAN KUMAR MAITRA EXPLAINS CHLOROPLAST STRUCTURE AND MOLECULAR ORGANISATION

The shape and size of chloroplasts vary in different cells and species. In higher plants, they are generally disc-shaped and sometimes have a colourless centre due to the presence of starch granules; in general, chloroplasts of plants grown in the shade are larger and contain more chlorophyll than those of plants grown in sunlight.

The number of chloroplasts is relatively constant in different plants. Algae such as Chlamydomonas often contain a single huge chloroplast, while in higher plants there are usually 20 to 40 chloroplasts per cell. When the number of chloroplasts is insufficient, it is increased by division (ie, elongation and constriction at the central portion); when it is excessive, it is reduced by degeneration.

Chloroplasts exhibit both passive and active movements. Changes in shape and volume caused by the presence of light have been observed in chloroplasts isolated from spinach. The volume decreases considerably after the chloroplasts are struck by light and photophosphorylation is initiated; this effect is reversible.

With the light microscope it is possible to distinguish many structural features of the chloroplast, although, of course, the electron microscope has revealed its components in much greater detail. The envelope is a double limiting membrane that lacks chlorophyll and cytochromes, and across which all molecular interchanges between the cytosol and chloroplast take place. The stroma or matrix is a kind of gel-fluid phase enclosed within the envelope. It contains about 50 per cent of the chloroplast proteins, mostly of the soluble type; it also has ribosomes, DNA and the machinery for protein synthesis. We will see that the fixation of $C0_2$ occurs in the stroma, as does the synthesis of sugar, starch, fatty acids and some protein.



Model of the thylakoid membrane in which the various photosystems and protein complexes are embedded in a lipid bilayer. The diagram shows the cleavage plane of the freeze-fracturing and the relative number, position, and size of the particles in the outer surface and the loculus.

The thylakoids are flattened vesicles arranged as a membranous network within the stroma. The outer surface of the thylakoid is in contact with the stroma and its inner surface encloses an intra-thy-lakoid space. Thylakoids may be stacked like a pile of coins, forming the *grana* or they may be unstacked (stroma thylakoids), forming a system of tubules that are joined to the grana thylakoids. The number of thylakoids per granum may vary from a few to 50 or more. Thylakoids contain about 50 per cent of the chloroplast protein and all the components involved in the essential steps of photosynthesis.

The lipid-protein mosaic model, now accepted for the plasma and mitochondrial membranes, has been accepted for thylakoids as well. The main characteristics of this model are: (a) fluidity, allowing the free lateral movement of molecular components; (b) asymmetry with regard to the composition of the two lipid half-leaflets, thus preventing lipids and proteins from moving from one leaflet to the other; and (c) economy, meaning that since the membrane is extremely thin, random movements of its molecular components are only possible in two dimensions.

The thylakoid membrane contains half of the lipids in the chloroplast and interspersed among them are important molecules such as chlorophyll, carotenoids and plastoquinone, which are involved in photosynthesis.

Chlorophyll is an asymmetrical molecule with a hydrophilic head made of four pyrrole rings bound to each other to form a porphyrin ring. This part of the molecule is similar to some animal pigments such as haemoglobin and the cytochromes. In chlorophyll, however, there is a Mg atom forming a complex with the four rings. (In animal pigments, the Mg is replaced by Fe.) Chlorophyll has a long hydrophobic chain attached to one of the rings.

In higher plants, there are two types of chlorophyll, a and b. In chlorophyll b, there is a CHO group in place of the CH_3 group. Pigments that belong to the group called *carotenoids* are masked by the green colour of chlorophyll. In autumn, the amount of chlorophyll decreases and the other pigments become visible. These are the carotenes and the xanthophyUs, which are both related to vitamin A.

Chlorophyll molecules are disposed within the thylakoid membrane in close association with integral proteins, forming several complexes that have important functions in photosynthesis.

Chloroplasts contain a coupling factor, CF1, that is similar to the F1 particle of mitochondria and is involved in the photophosphorylation of ADP to ATP. The electron microscope has shown that the CF1 particles are localised in the outer surface of the thylakoid membrane, especially in the region of the stroma thylakoids, and are excluded from the stacked regions or grana thylakoids. The CF1 particles are attached to the membrane by way of the CF0 segment, which represents a proton channel made of hydrophobic proteins.

Not only does the photophosphorylating system have a vectorial disposition across the membrane, the components of the photosystems are asymmetric as well.

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Social media for dummies

YOU MAY NOT UNDERSTAND A WORD OF WHAT FOLLOWS SO IT MAY HELP TO HAVE A TEENAGER AT HAND, BUT **STEFANO HATFIELD** ADVISES YOU TAKE NOTE BECAUSE VIRTUAL SHARING IS HERE TO STAY

If you have neither caught the buzz about Buzzfeed this week, nor tweeted your opinion of Sir Roy Hodgson s bad monkey joke; if you haven t liked anything on Facebook or endorsed anyone on Linked In, then you are on the outside of a world that may seem as mysterious as the Freemasons.

I still have friends who resist all social media but they are now firmly in the minority. Even some who swore they would never are now on Twitter. The current consensus is that Facebook is starting to wane, especially among teens. They are embracing not just Twitter, but Instagram (now owned by Facebook) and Snapchat, the site that helps you send images of yourself with squiggly writing over them that will disappear into the ether within seconds.

Well, that s the theory. Where teens lead on social media, we follow.

You may have caught recent headlines about Buzzfeed, which has tripled in size in a year. It brought us listicles articles divided up by linked bullet point headlines, often featuring pictures of cute kittens. Its founder, Jonah Peretti, was on the *Today* show earlier this week, explaining the Internet to John Humphreys. It felt like a Sex Pistols-Bill Grundy moment (Google it!).

Then there s the Instagram photo-sharing site, increasingly the preferred way of teens (and celebrities) letting others get a self-edited glimpse of their lives. Facebook recognised this, which is why it bought Instagram for $1 billion last year. And, Instagram itself hasn t stood still, introducing a 15-second video share service. Why? Perhaps because Twitter has its own new six-second video clip product, Vine.

Still with me? Then take note of Snapchat, the site that boomed on the back of teens allegedly sexting each other sending intimate photos of themselves that will disappear in seconds.

Like it or not, what Twitter, Instagram and now Snapchat have is that they are even simpler to use than Facebook, without the complexity of the latter s privacy policies. Does this simplicity matter? Does keeping up with change? Look to Bebo and MySpace (who?) as a warning. No 13 year-old will stay on Facebook if their only friend is Aunty Sarah.

Some of you reading will feel smug that you haven t plunged in. Some will hate the over-sharing wow, you had sushi! Others will wish they would all just go away, and we can go back to letters, phone calls, even face-to-face conversations. Well, they are not going to go away. They may evolve incredibly quickly but virtual sharing is here to stay. And, is it really any worse than sitting next to Aunty Mary to go through her photo albums?

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