

Bricklaying in speech composition

Songbirds and babies learning to speak are found to acquire skills in the same way, says s ananthanarayanan

BIRDSONG has been shown to have the structured ordering of different tones which is akin to the grammatical form of sentences in human language. This is to say that birdcall has syntax, as opposed to the use of animal cries, including birdcall, merely as signals of danger or food, or to keep the flock in communication. Furthermore, birdsong, which is learnt by fledglings from an older bird, has even been shown to have a musical quality in evoking, in other birds, a neural response similar to that in humans.

Dina Lipkind, Gary F Marcus, Douglas K Bemis, Kazutoshi Sasahara, Nori Jacoby, Miki Takahashi, Kenta Suzuki, Olga Fehér, Primoz Ravbar, Kazuo Okanoya and Ofer

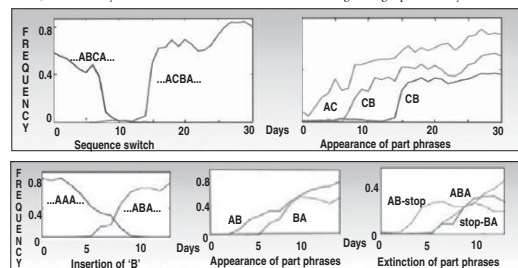


Ofer Tchernichovski, Gary F Marcus, Dina Lipkind and Kazuo Okanoya.

speech.

The zebra finch

The study of zebra finches was of how they progressed from a sequence of syllables to another where the syllables were swapped, and then where some syllables were inserted into an existing string. Young zebra finches were exposed to a simple song and the ones that could imitate the song within just over two months of hatching were then exposed to a variation of the song. A song represented by



Tchernichovski, working at institutes in New York, Japan and Israel, have presented in the journal *Nature* a study of the process of songbirds and human infants acquiring the skills of ordering tones in different patterns.

The team traced the course of the learning with the help of experiments with the zebra finch and an analysis of records of the vocal progress of the Bengalese finch and human infants. The zebra finch is common to central Australia and a loud and boisterous songbird. Its song consists of sequences made up of four different tones, usually starting with a short series of "beeps", followed by other sounds, to create a rhythmic pattern. The Bengalese finch is a domesticated songbird that has a more complex repertoire than the zebra finch. Apart from a linear sequence of tones, the Bengalese finch creates "branches", or switches from one sequence to another.

The human infant is able to switch from a many-syllable sequence to others, soon to master the great variety that we find in human

the sequence "ABC", was replaced by the variation "ACB".

The whole progress, from singing the first sequence, which they had learnt well, to learning the new sequence, and forgetting the first, was examined using statistical methods to decide when the switch had taken place. It was found that at the end of 17 days (statistically) the new song abruptly appeared. The old song disappeared at once or within a few days.

To identify the intermediate stages of the new song appearing, the team studied when the new part phrases, viz, "AC", "CB" and "BA" appeared and got more frequent, till the whole new song took over and the old song was forgotten. It was found that the new combinations started appearing in about 10 days, a new combination being repeated thousands of times, while other combinations also began to appear. There were features in this progression, of the newly learnt combinations being attached at either end of

old sequences, with faster attachment of subsequent new combinations learnt.

The other task that zebra finches were set was to introduce a syllable within a sequence, like inserting "B" into a string of "As", moving from "AAAAA..." to "ABABA...". Here, there was a feature of learning two new sequences, "AB" and "BA", and these new sequences appeared first, before the "ABAB" pattern took over, and the intermediates were forgotten.

In this case, of learning "AB" and "BA", it would be expected that till "BA" was learnt, "AB" could appear only at the end of a string of "As", and then stop, as "BA" had not been learnt. This was found to be the case, the syllable "B" appearing only at one or the other end of a string of "As". But the sequence "ABABA" appeared abruptly as soon as the complementary sequence was learnt. The abrupt appearance of the new skill, in both cases, indicated the progress of step-wise acquisition followed by expression of the complete skill when the steps had been taken.

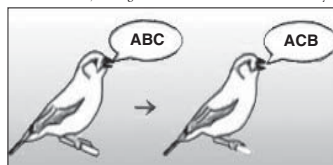
In the case of zebra finches, the results were from the contrived training of the birds and the results could arise from bias. A control experiment was with Bengalese finches, which grow to be able to

later. The group identified cases of birds which did bidirectional transitions and traced their past history of performing the two end combinations ("AB" or "BA"). It was found to be the case that one combination had been learnt well before the other. In the case of unidirectional transition in the song, viz, "A to B", again, it was found that the transitions appeared as soon as the components for the transitions were learnt. This discounts the explanation of early chance events and points to skill appearance along with acquisition of components.

The progress of human infants was studied using the records of the *Child Language Data Exchange System*, a freely available repository of transcripts, audio and video recordings in over 20 languages. The instance used was the recordings of nine US infants, every two weeks, from the age of nine months to 28 months. Babbling utterances were separated into syllables and occurrences were analysed statistically.

A first finding was that newly acquired syllables tended to be repeated, but the frequency of repetition dropped as the variety of syllables increased with new learning. The expectation, from the lesson learnt from songbirds, was that new syllables should appear at the ends of utterances. This was found to be entirely the case, with new syllable types appearing at the edges of utterances, well above the expectation by chance. And the constant acquisition of new syllable types seemingly affected the increase in the number of combinations of syllables that were tried out.

The findings, which are common to the three species studied, indicate a gradual, step-wise progress during the early stages of development. The skill learnt is of a combination of syllables, with the pruning of



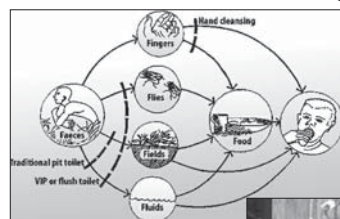
transitions that are not required. The study then proposes possible connections between neurons in the brain, which correspond to different syllable combinations. The gradual development in infants could explain why they, for all their grasp of grammar and syntax, are slow to keep up with vocalising. But the way songbirds can use simple components to put together complex song patterns mirrors the observation that songbirds and infants use the change from syllable to syllable, in pairs, to transfer from one multi-syllable string to another.

The writer can be contacted at simplices@gmail.com

with diarrhoeal disease who stayed at home received Oral Rehydration Salts—an affordable and effective treatment. To supplement these interventions, rotavirus vaccines offer a significant, targeted hope for protecting children from this terrible disease.

This is where India has an advantage. Its strong scientific community can innovate new technologies very quickly and our vaccine manufacturers are capable of producing quality medication for the world. We have already developed an indigenous rotavirus vaccine—designated 116G—which has been shown to be safe and immunogenic in Indian infants. Bharat Biotech, based in Hyderabad, with the Department of Biotechnology, developed this vaccine in a uniquely designed private-public partnership model and the results are evident.

India is at a critical juncture. It has been more than two years since our last case of polio, which highlights the success we can have if strong partnerships are formed between multiple stakeholders. However, with diarrhoeal diseases still a major child killer, this is no



—and provides new insight on the causes and impact of these diseases.

The study found that the incidence of moderate to severe diarrhoea in India was the highest of the seven countries studied. It estimated that there were roughly 90 episodes of moderate to severe diarrhoea among every 100 infants aged 0-11 each year. Rotavirus under the age of two in the slums of Kolkata and, on its own, caused an episode of Musculoskeletal disorders in approximately one of every four infants each year.

To reduce the burden of diarrhoea in India, we will need to deliver a comprehensive package of proven interventions. This includes access to oral rehydration therapy, zinc supplementation, encouraging exclusive breastfeeding for the first six months of a child's life and improvements in hygiene, sanitation and drinking water. Previously published Gens data found that less than 30 per cent of children



Saving children

To reduce the burden of diarrhoea in India, we will need to deliver a comprehensive package of proven interventions, says dipika sur

A NEW global study published recently in *The Lancet* has confirmed rotavirus as a leading cause of diarrhoeal disease in children in India and across the world. With more than 100,000 children dying of rotavirus every year in India, this research must catalyse all stakeholders into action to protect their health and wellbeing.

India has experienced impressive improvements in economic status and population health over the past few decades but the country still lags behind in child survival. The mortality rate for children aged five and younger currently stands at 61 per 1,000 live births and this is higher than many countries of similar per capita gross domestic product.

Diarrhoeal diseases are significant contributors to this high child mortality rate. Despite being largely preventable and treatable, diarrhoeal diseases are the second leading cause of death among children under five years of age globally, followed by pneumonia. In 2010, experts estimated that almost 1.7 million children of under five years of age died in India and it has been shown that 18 per cent of these deaths occurred because of diarrhoeal diseases.

The illness is caused by many different bacteria, viruses and other pathogens. The challenge—without clear data on which pathogens account for the most severe illness and death—has been how to prioritise resources and research to reduce the burden of these diseases. The release of new findings from the Global Enteric Multicentre Study reveals critical information that can help us target our approach and finally reduce this burden. Gens is the largest and most in-depth study on diarrhoeal diseases to date—conducted in four sites in sub-Saharan Africa and three in South Asia, including Kolkata, India

Girl or boy, it's up to you

There are many legends and myths about how parents can produce a child of the desired sex. Actually, it's entirely a matter of chance, writes tapan kumar maitra

A CHROMOSOME is considered a component endowed with a special organisation, individuality and function. It is capable of self-replication or reproduction and of maintaining morphologic properties through successive cell division. On the other hand, chromosomes have been considered a physical basis of heredity. They occur in all living cells but with specific number and organisation and usually fall into three categories:



viral chromosome; prokaryotic chromosome; and eukaryotic chromosome. On a different angle, they are also divided into two categories: somatic chromosome; and sex chromosome.

Sex is determined as soon as the egg is fertilised by sperm and that depends on the gametes. Chromosomes that are different in their visible morphology and in their influence upon sex are termed sex chromosomes. The rest of the normal chromosomes in the body-cell are termed autosomes or somatic chromosomes. These sex chromosomes are designated as X and Y. The majority of the diploid (2n) sexual organisms have a pair of these sex chromosomes. Females have two similar chromosomes (XX), while males possess one X and one Y. Here, the female produces only one type of egg, whereas the male produces two types of sperm. Thus, the female producing gametes of one type is termed the homogametic sex; whereas the male, forming two types of gametes, with or without the X chromosomes, is termed the heterogametic sex.

Humans also follow the same XX-XY method of sex determination. Here, the egg carries the usual autosomes (22) and an X chromosome. The sperm, on the other hand carries the same autosomic number (22) and either an X or a Y.

The union of eggs with Y-chromosome sperm develops into a male, while those uniting with X-chromosome sperm develop into a female.

Girl or boy? There are many legends and myths about how parents can produce a child of the desired sex. It has been said that if a mother eats large amounts of sugar during pregnancy, she will have a girl, but if she eats a great deal of meat, she will have a boy. Others have believed that the month of the year in which the child is conceived determines its sex; but actually this is entirely a matter of chance.

The chances are slightly more favourable to the male sex than to the female sex. There are between 105 and 106 boys born for every 100 girls. To date, no one can give reasons why this is so. The sex of a child is determined by the type of sex chromosomes in the spermatozoon. One-half of all mature spermatozoa carry the X-chromosome; the other half carries the Y chromosome. By contrast, all mature ova carry the X-chromosome. In any fertilised ovum, there is always an X-chromosome from the ovum, and either an X or a Y chromosome from the spermatozoon. If two Xs combine, the child will be female. If, on the other hand, an X and a Y combine, the child will be male.

The writer is associate professor and head, Department of Botany, Ananda Mohan College, Kolkata

time to rest. The true legacy of polio eradication in India could fade if the government does not invest in innovations and new vaccines to fight diseases that cause the maximum number of child deaths. Not only would it provide tremendous social and economic returns, we would be making great strides towards a more equitable country where all children achieve their right to survival, good health and holistic development.

The writer is principal investigator, Global Enteric Multicentre Study, and deputy director and senior head, National Institute of Cholera and Enteric Disease Epidemiology