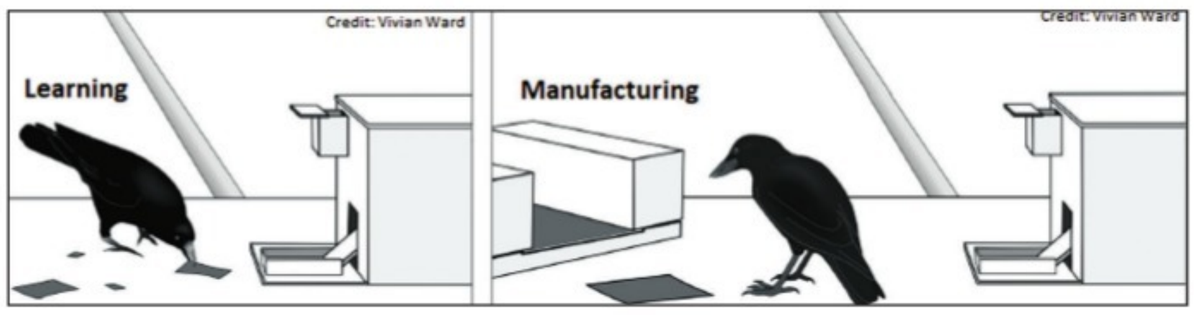
The end rather than the means

The New Caledonian crow's style of learning may resemble the one followed by primitive humans



S ANANTHANARAYANAN

A characteristic of social evolution in humans is that we build on past learning and accumulate skills. Animals also show impressive capacity to learn but do they build on what they learn and pass on to the higher skill?

SA Jelbert, RJ Hosking, AH Taylor and RD Gray from the Universities of Cambridge, Auckland, the Australian National University, Canberra and the Max Planck Institute for the Science of Human History, Germany, write in the *Nature* group journal, *Scientific Reports,* that the New Caledonian crow is able to recall a mental template and fashion a copy, which may be the mechanism for a form of cumulative social learning.

Quite apart from the trainability of many animal species, which are conditioned responses and involve no aspects of cognition, many species have been found to learn skills from others of the same species. One example is of macaque monkeys that learn from others to wash potatoes in the sea before they eat them. Another was when piercing the caps of milk bottles to get the cream, spread, by imitation, through flocks of the blue tit in the UK. There is, however, little evidence that such practices in animals have evolved and accumulated improvements over time, the paper says.

In human populations, in contrast, there is obvious preservation and evolution of skills. There is archeological evidence of additive, or cumulative improvement of technology since 1.6 million years ago, the paper says. This capacity of humans is generally believed to come from the many adaptations that humans have made, including teaching, language and imitation.

Social learning, however, is not just the copying of actions but consists of learning that is influenced by watching and interacting, not only with others but also with the final products or results of what others do.

There are those who consider that emulative learning or learning from end products, rather than imitation of the process, can only lead to approximate copies of the products and not cultural change or cumulative growth.

Copying end products, however, could also be an effective avenue to cultural evolution in some cases. The paper cites studies where it has been shown that children and adults are able to replicate and progress to improve on the design of things even when they are presented only with end products, and not the manufacturing process, which they could have imitated.

Different animal species display remarkable intelligence and problem solving ability. The crow is legendary, even Aesop speaks of the one that dropped pebbles into a jar to raise the water level. In Japan they report that crows see cars split walnuts open when the run over them. Hence, crows strew walnuts, which they cannot open themselves, on the freeway for cars to run over.

The authors of the paper in *Scientific Reports* note that the New Caledonian crow is known to fashion hooked stick tools and barbed tools using leaves of plants. The tools, which appear to be adaptive improvements over a basic design, have persisted over many generations, at least since 2000. "Thus, New Caledonian crows may possess a material culture that has incorporated incremental changes over time," the paper says.

The evidence, however, does not suggest that the tool-making skill is culturally transmitted in crows. That is because crows display none of the social learning mechanisms that it would call for. They do not display imitative behaviour and in trials of retrieving food from a puzzle box, the presence of other, trained birds, that were proficient, did not seem to improve their performance. Imitation and teaching-learning are thus unlikely means of transmission of the tool-making skill. An alternative that has been suggested, the paper says, is end-product emulation, termed mental template matching.

In this process, younger crows see and possibly use tools fashioned by parents or others. The birds then form a mental picture — a mould or template — of the shape and properties of the tool they have seen, and they reproduce that. The paper suggests that the process is similar to the way young birds learn birdsong in some species. The fledgling bird begins by hearing the song of others of its species and acquires a song template. The bird then trims its own vocalisation to match the memorised song structure.

In the same way, the young crow has a mental picture of the tool and is able create another on its own. More importantly, the paper says, any improvements that the crow makes would stay in the templates that she would pass on to the next generation.

To test this suggestion, the team designed an experiment where New Caledonian crows would need to remember shapes and generate them when needed. A group of eight New Caledonian crows were trained to drop pieces of card into a slot machine to obtain rewards of food. It was done by placing eight large and eight small pieces of card and allowing the crows to drop them into the machine till all the cards that resulted in reward were used. This training continued till the crows consistently dropped in only the cards that produced rewards.

Once the birds had learnt the size of card that led to rewards, they were presented with a large sheet of card, too large to insert into the machine. No templates were visible and the birds were allowed to rip the sheet of card with feet and beak to insert into the machine. This time, there was no template available and the insertions were rewarded at random, regardless of the size of the card. The result of the test was remarkable, the birds, despite there being no reward for doing so, consistently ripped the card into the size that they had learnt would result in the reward.

The conclusion, the authors note, is that New Caledonian crows have the capacity to manufacture articles from a mental template. This, then, could be the mechanism for cumulative cultural transmission of tool-making skills, despite there being no record of communication, teaching-learning or imitation behaviour.

The idea that emulation of a finished product, in place of imitation of a process, may not be effective for cumulative evolution, the authors, say, may be because known examples in the human context, like Stone Age tools, are "cognitively opaque". This is to say that the final form does not suggest how it may have been arrived at. This, however, is not generally true, as the tools that New Caledonian crows make with leaves have tears along the ribs, which can be inferred.

The capacity to reproduce simple articles through emulation may be the one of the bare necessities for cumulative cultural evolution, the authors say. They suggest that before the appearance of complex tools in the hands of primitive humans, end product emulation may have been the means of cultural transmission and evolution.

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Why neurosurgery transcends medical care

Patients' stories, their circumstances and their will do not always align with the plans of healers

ABDUL KAREEM AHMED

'Dad, hold still."

As we entered the hospital room that morning, our patient's daughter was attempting to give him a shave. He was bed bound after his operation and had grown a salt-and-pepper stubble.

A week earlier, his wife had brought him to the emergency room. He was behaving oddly, mumbling nonsensical sentences and stumbling through the house. Sixty-two years old, male, Caucasian, new and profound neurological symptoms. An MRI of his brain seemed redundant but confirmed the diagnosis — a four centimetre malignant tumour was invading his right frontal cortex, the seat of his personality, where "Dad" lived.

I'm drawn to the human brain, its unforgiving and protean nature. Just five minutes without oxygen and the brain loses function. The occipital cortex processes visual information and allows us to see faces, trees and the stars. However, in a young child who becomes blind, as with Helen Keller, this same cortex can be repurposed for entirely distinct functions, like language processing.

Early astronomers looked to the heavens for answers. But in the human brain — a three pound ball of fat — there resides enough mystery and potential to have satisfied Galileo, Kepler and Brahe.

And so I found myself, on what had now been a four year foray towards a career in neurosurgery, helping care for this patient. I was the sub-intern at a hospital away from home for the month. It was my first week on the job.

The resident and I stood around his bed in our cerulean scrubs and white coats and watched him smiling. His daughter looked towards me, the only other man in the room, and paused, razor in hand. "Would you like me to help?" I offered.

"Oh, would you?" she said, looking relieved. She quickly handed me a foam cup filled with hot water and shaving cream, along with the razor. I chuckled to myself as I got to work, shaving his face. It was makeshift but familiar. The defiant angles, going against the grain here, giving in there, and that upper lip, the hardest part. The first European surgeons were barbers; what a homage.

I dried his face with a towel. His daughter thanked me. Even with a brain tumour, and the obligatory exams, tests, and treatments that ensue in a hospital, everyday life goes on. He needed a shave because he always has. In the hallway, I caught up with the resident. "He's always smiling," I said.

"Why do you think that is?" she asked knowingly. I had an inkling before but it was obvious now. He was smiling because he had no choice. The tumour, or maybe the surgery he had undergone to remove it, had robbed him of his expression.

He might feel despair, elation, anger or fright, but now he could only ever smile. It seemed somehow cruel.

We visited the patient later that day, now with the attending neurosurgeon. The patient had been refusing to eat for the past few days, and his laboratory results belied his smiling face — low potassium and albumin levels, suggesting starvation. What was he feeling right now? And how could I know? In all likelihood, I presumed, he was severely depressed. Maybe he was electing to stay mute.

The attending neurosurgeon pleaded with him to eat. He just smiled. He refused to open his mouth, even after multiple attempts at feeding him. The neurosurgeon nodded to the resident, who quickly left. I followed her into the hall.

She was getting a nasogastric tube, a thin plastic device we could thread through the nostril and into the throat until it reaches the stomach. The patient needed nutrition if he was to recover. Feeding him through this tube was the best option for keeping him going. I offered to place it.

Once we were back in the room, we explained to him and his family the need for the tube. It was worlds better than placing a tube into his stomach surgically, we told them. He nodded and it seemed he understood, smiling.

I attempted to place the tip of the tube into his nostril, and he struggled. He used his hands to swat me away. The resident held his left arm and I held his right. If we could not place this tube, he would only suffer more, we reasoned. I tried again, but he was strong, straining his neck and avoiding the tip. Our eyes met. I wondered what he saw. Did he see the person who had earned his trust earlier that morning? Did he see betrayal?

With one final attempt, the tube slipped into his nostril and down into his throat. I quickly threaded it into his stomach and taped it in place to hold it steady. We restrained his arms with the harnesses that dangle from hospital beds for such situations. Given any chance, we figured, he'd pull the tube out.

As I left for the final time that day, I tried to say goodbye. His smiling expression was the same as always, but I felt he was looking at me differently this time. I said goodbye to his wife and daughter as well. They were perturbed, but grateful nonetheless, circumstances being what they were.

And the days passed. I heard that the patient was moved to a different ward to convalesce. With different surgeries and tending to other patients, time was limited.

I passed through the ward every night before I left for home, hoping to catch up with the patient and his family. One night, I found him asleep and could not bear to wake him. I could make out his huddled shoulders under his blanket, his face to the window.

Later I heard he'd been discharged, and I would not see him again. But his case makes me reflect on the patient encounter.

In one or two meetings, doctors take a cross section of an intricate life, arrive at a diagnosis and provide treatment. For this patient, our goal was to place the tube, to take care of his body. But it did little to address his feelings, or his probable depression.

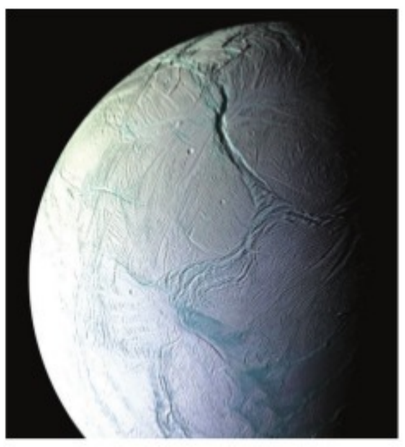
Patients' stories, their circumstances and their will do not always align with our plans as healers. I need to recognise that more. I need to see.

I'd like to think that the patient regained his appetite for life. I need to believe that.

Courtesy The New York Times/
The Independent

PLUS POINTS

Elusive 'water world'



Large organic molecules blasted into space from deep-sea vents on one of Saturn's moons show that it contains "all of the basic requirements for life as we know it".

Plumes of material from cracks in Enceladus' icy surface were sampled by Nasa spacecraft Cassini, shortly before it plunged to its death in Saturn's atmosphere.

A study of this data by an international team of researchers has found evidence of carbon-rich substances formed in the heart of the moon. The scientists said they were "blown away" by the discovery.

"Complex organic molecules do not necessarily provide a habitable environment, but on the other hand they are a necessary precursor for life," Frank Postberg from the University of Heidelberg, who led the research, told *The Independent,* "Previously it was unknown whether complex organic chemistry happens on Enceladus — and now we know."

Christopher Glein, a space scientist specialising in extraterrestrial chemical oceanography, said the new findings mean the distant moon is the only body besides Earth known to "simultaneously satisfy all of the basic requirements for life as we know it". He said, "We are, yet again, blown away by Enceladus. Previously we'd only identified the simplest organic molecules containing a few carbon atoms, but even that was very intriguing."

The new discovery is the culmination of years of data gleaned by Cassini as it flew close by Saturn's moons, collecting information as it went.

The news comes shortly after Nasa's announcement that "ingredients for life" had been found on Mars, a discovery welcomed by scientists as some of the best evidence yet for aliens.

Data collected on the red planet was far more detailed than Cassini's Enceladus findings but the discoveries made in the past 12 to 15 months have singled out the distant moon as one of the most likely places to support life in our solar system.

Postberg said the case for alien life on Enceladus is mounting but as it stands there are no follow up Cassini missions planned. However, the technology to test for such life exists, and he predicts a decision will be made in the next five years about future alien-hunting missions to this elusive "water world".

The independent

Novel plaster

A plaster, which sticks to the inside of one's mouth is revolutionising the treatment of painful recurring ulcers.

Scientists from the University of Sheffield's School of Clinical Dentistry, working in close collaboration with Dermtreat A/S from Copenhagen, have developed a unique patch using special polymers that are able to stick to moist surfaces. The patch successfully administers steroids directly to oral ulcers or lesions whilst also creating a protective barrier around the affected area, accelerating the healing process.

The novel plaster is a breakthrough therapy for the treatment of mucosal conditions such as oral lichen planus and recurrent aphthous stomatitis, which are diseases that cause painful lesions and affect one to two per cent of the population.

Until now, ulcers and lesions inside the mouth have been treated using either creams or mouthwashes, which are used in the whole mouth rather than targeting the specific area, making them less effective. Craig Murdoch, reader in Oral Bioscience School of Clinical Dentistry and lead author of the research, said, "Patients who have trialled the patch found it to be very comfortable to wear and they were really pleased with the length of adhesion, which makes it particularly effective and efficient."

The findings of the research are published in the journal *Biomaterials.* To view the full paper, visit *https://doi.org/10.1016/j.biomaterials.2018.06.009*