

Number 43

unineWS

SHARING
meals

ALERTING
in case of danger

TRANSMITTING
the use of tools

**The social
life of Monkeys**

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Surrounding Professor Klaus Zuberbühler, several members from the Laboratory of Comparative Cognition with their field accessories. Standing from left to right: Noémie Lamon, Mélissa Berthet, Yaëlle Bouquet, Christèle Borgeaud
Sitting : Corinne Ackermann, Stéphanie Mercier



On the lookout for the origins of communication

Chimpanzees, bonobos, baboons, vervets, Diana and titi monkeys. Those are some of the primate species whose behaviour the University of Neuchâtel is studying. The credit goes to the Laboratory of Comparative Cognition, directed by Professor Klaus Zuberbühler. His goal? To determine the biological origins of language, as much vocal as gestural, from observation of primates in their natural environment.

Microphones and cameras in hand, no less than forty researchers are participating in this quest. In often hostile lands, going from dense and humid forests to African savannahs, over months the scientists record the acts and gestures of the primates, thus penetrating profoundly into even their most intimate daily habits.

In this UniNEws, you will discover a small part of their unheralded work, demanding discretion, patience and precision. You will see how these ingenious primates develop friendship bonds, tolerate others within their hierarchical structures, transmit to each other the use of tools, alert their fellows in case of a threat, or even seduce each other in order to reproduce.

New interdisciplinary project

All these activities present troubling resemblances with the organisation of human societies. It didn't need much more for the University of Neuchâtel to get into a new interdisciplinary project proposed by Professor of Psychology Adrian Bangerter and his primatologist colleague Klaus Zuberbühler.

Capitalising on the observations of the primatologists, this study started in the autumn of 2016. It aims to compare the aptitudes of social life and cooperation of great apes and human children. Strengthened with the support from the Swiss National Science Foundation (SNSF) of close to 600'000 francs for three years, the project will allow us to better understand the specificity of human beings in their social links and in the origin of their linguistic capacity.

To find out more:

SNSF project: *Coordinating joint action in apes and human children*, Adrian Bangerter, Université de Neuchâtel.
Calendar: 01.09.2016 - 31.08.2019. <http://p3.snf.ch/Project-166331>



Oxytocin and the young ones

Corinne Ackermann is studying the relation between the amount of oxytocin and the social interactions between young chimpanzees. “During their development they undergo an important behavioural change”, explains the young doctoral student from the University of Neuchâtel. “Even though attached to their mother and siblings through long-term relationships, they start to interact with members of their group outside the family sphere, creating new social relationships.” This research deals with determining if oxytocin is involved solely in the long-term relationships, or if it also has a leading role in the apparition of new social links. In short, to better understand the physiological bases of social behaviour.

To find out more:

Site of the Leakey Foundation, which has offered a grant of 14'000 USD to Corinne Ackermann for her research:
www.leakeyfoundation.org/grantee-spotlight-corinne-ackermann/



Sharing food creates commitment

Like getting groomed by a counterpart, sharing a meal augments the concentration of oxytocin, a hormone known to reinforce social links. Meals taken together create unwavering feelings of attachment between the chimpanzees, whether or not they belong to the same family.

The role of oxytocin in human relationships has been known for a long time: This hormone reinforces romantic social interactions, altruism, empathy, attachment, even the sense of sacrifice for others. Physiologically, oxytocin acts on the brain, reducing anxiety and fear, while reinforcing memories of social links and neuronal reward circuits.

But what about the other primates? By measuring the concentration of oxytocin from the urine of chimpanzees of the Sonso community in Uganda, Klaus Zuberbühler and his colleagues detected a sharp increase of this hormone with the individuals having already shared a meal, independently from the age of the subjects. “We mean by ‘sharing a meal’ the action of actively giving food to a congener or to let this one take possession of food without triggering an aggressive reaction”, specifies Klaus Zuberbühler.

For several years, researchers have known that oxytocin played a role during breastfeeding, contributing to reinforce social links between parents and children. The influence of the hormone extends to the sharing of meals in general and between individuals, which are not necessarily related, even though chimpanzees favour family meals. Indeed, only a quarter of feasts take place between unrelated males.

Rare moments

“Moments of food-sharing are still however rare”, clarifies Klaus Zuberbühler. “We listed 42 of them in one year. Meat (in 46% of cases) is in first place of shared food products, followed by fruits (30%), rotten tree trunk hearts (18%) and honey (6%).” To be sure, chimpanzees are not immune from naughty motivations. It is not excluded that a small pittance be given in exchange for sexual favours. This happens in less than 10% of the cases though!

In these moments of sharing, the individuals occupying a high social rank will more often give than receive. The principal reason why is the increase of oxytocin, the researchers believe, and not the insistent requests from the receivers, as was often supposed in the past.

This discovery comes in the wake of another result on the part of the team: the augmentation of oxytocin after being groomed, a practice known for its importance in the creation of social links. Yet, after sharing a meal, the concentration of the hormone is even more marked than after being groomed. Oxytocin acts thus directly on the social memory system. It could therefore play a key role in conserving the trace of social interactions between multiple individuals over time.



New tools: a family affair!

Using moss instead of leaves to make sponges: This innovation has been adopted by some chimpanzees from the Sonso community in Uganda, at first to draw clayey water rich in minerals. During her doctorate, Noémie Lamon demonstrated that this particular knowledge was transmitted above all within the family. Even though, some who could be qualified as close friends could also profit from it.

The recourse to tools is relatively common with the chimpanzees, such as plants used for sponges. “It’s very practical for drawing water from a pond, or even from the hollow of a tree”, explains Noémie Lamon. “These sponges are most often made with leaves that the chimpanzees fold and chew.” But in 2011, researchers noticed that eight individuals of the Sonso community used moss instead of leaves and that the behaviour was transmitted socially. Indeed, to be able to thereafter make sponges with that material, an individual had to observe his counterparts do it.

The site where this behaviour developed is distinctive: Two holes situated in a clayey earth rich in mineral salts, which chimpanzees often frequent. But when the new doctoral student arrived on the spot in 2012, no individuals seemed to use moss as sponges any more. She then wondered if this knowledge persisted in a latent state.

To check it, Noémie Lamon carried out an experiment in 2014. She positioned, in the trees located around the holes, small quantities of moss collected a bit further away, hoping to stimulate the fabrication of moss sponges by the monkeys

To find out more:

T. Gruber, K. Zuberbühler, C. Neumann (2016) *Travel fosters tool use in wild chimpanzees*, eLife, 5(JULY), [e16371]. DOI : 10.7554/eLife.16371

who had learned it between 2011 and 2014. Indeed, she noted that that behaviour propagated to seventeen other individuals. The fact that an alpha male was the first to take the moss and make sponges out of it must have also played a key role in the popularisation of this technique.



“We found that the transmission of this knowledge took place above all through the family”, noticed Noémie Lamon. “This case is all the more interesting because the transmission wasn’t necessarily handed down from the mother to the children, but very probably from the children to the mother. It is very hard to make congeners change their habits, because chimpanzees are very reticent to any innovation.” The researcher nevertheless noted that individuals, who often spent time with counterparts, were good at making moss sponges and show their preference for this material. “This allows me to think that if we come back in five years, as long as moss stays in sufficient quantities on the site, the whole community of about 70 individuals will use moss as sponges”, predicts Noémie Lamon.



Motivated by... tiredness

Using a stick to take out the honey from a log is a technique developed by several groups of chimpanzees. Thibaud Gruber, former researcher from the University of Neuchâtel, also observed behaviours of the Sonso community during seven years. In his experiments, chimpanzees had to try to retrieve honey from the inside of a log (called the honey-trap experiment).

The chimpanzees only really took interest in the log if there was a lack of fruits in the forest and if they had travelled far to get the food. But between these two factors, it is really the fact of having travelled far that motivated them the most to resort to tools.

In other words, the more the chimpanzees had strolled around the week preceding their interaction with the log, the higher chances there were that they would use a tool to draw out the sought-after honey. This suggests that there is direct energetic cost for moving, which the ape can compensate for with the use of tools. This energetic compensation is somewhat reminiscent of the apparition of bipedalism, which was adopted for a similar purpose throughout evolution.

One cry says it all!

Chimpanzees are champions of information synthesis. In only one call, they communicate their identity, their age, their social rank and the context in which they are. Analysis of this call enabled situating exactly when each of these pieces of information are distilled and learning more about the social links that chimpanzees hold with their counterparts.

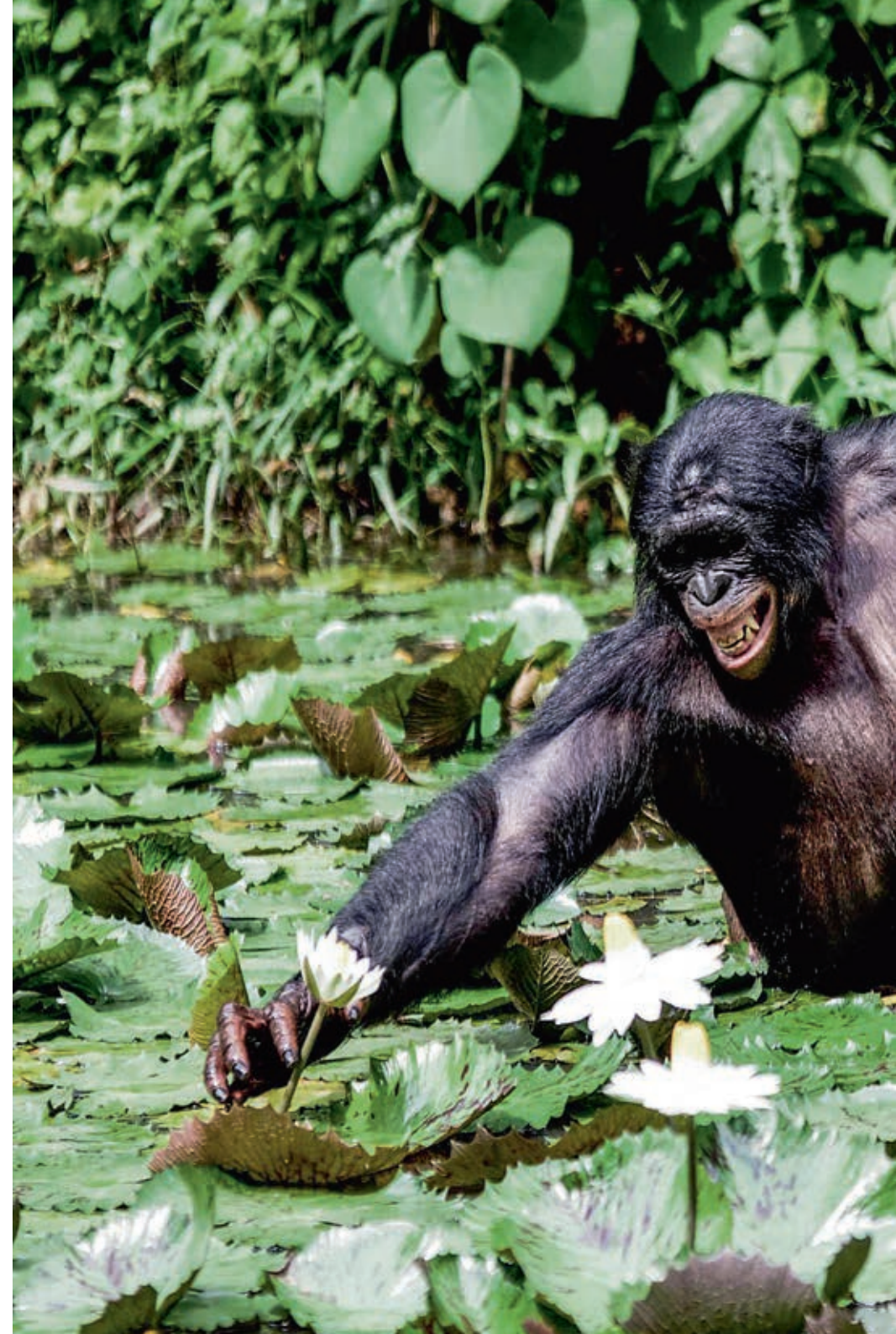
Unconsciously, we all have in mind this characteristic chimpanzee call, which generally starts with “hoo hoo hoo”. Called “pant hoot” by primatologists, this utterance was the object of a detailed computerized analysis at the University of Neuchâtel by Pawel Fedurek and Christoph Dahl. It has been studied within males living in the Budongo forest in Uganda.

“It is the most charismatic call of the chimpanzees”, enthuses Klaus Zuberbühler. The complex call decomposes into four distinct parts: the introduction, the build-up, the climax and the let-down. Each of these parts corresponds to information about the individual. His identity is presented in the four phases, but more strongly in the introduction and the climax. His age is deduced from the introduction and the build-up, his social rank from the climax, whereas the activity that the individual is doing (the context) is communicated in the let-down phase.

“The communication of these characteristics probably doesn’t come from a deliberate choice”, comments Klaus Zuberbühler. “As to the age determination, this must be linked to differences in size and hormones.” The social rank distinction is related to self-confidence, greater in dominant males, which translates itself by a louder sound. Researchers notice a correlation between the initial frequency peak of the signal and an increased production of testosterone, which, in chimpanzees, reflects the social rank, as well as the potential virility of the male.

To find out more:

P. Fedurek, K. Zuberbühler, C. Dahl (2016) *Sequential information in a great ape utterance*, Scientific Reports. DOI : 10.1038/srep38226





Bonobos

Long time, no see!

We now know that bonobos can recognise the voices of old friends, even after years of separation — a trait we once thought was confined to our own species. We owe this observation to Sumir Keenan, doctoral researcher at the University of St. Andrews (UK). Her research, co-supervised by Klaus Zuberbühler, took place at various zoos across Europe.

“Ours is the first study to show that bonobos are capable of long-term social recognition — as it happens, even after five years of separation,” says Sumir Keenan. To prove this, the researcher and her colleagues recorded the calls of a group of bonobos, and played them to a second group, who had already met the first.

The researchers took advantage of the fact that certain bonobos had lived in lots of zoos across Europe, giving them time to build close links with their counterparts in different places. To mimic the arrival of old friends, well-camouflaged speakers were used to broadcast the calls.

When the recorded voice sounded familiar, the bonobos became excited, actively looking for the individual whom they evidently recognised. On the other hand, the calls of an unknown bonobo hardly created any reaction at all among the primates.

“It’s fascinating to discover this long-term ability to recognise familiar voices”, enthuses Sumir Keenan. This is attributable to the fact that, like other primates such as humans, bonobos form complex social networks, where knowing “who’s who” is highly prized.

To find out more:

S. Keenan, N. Mathevon, J.M.G. Stevens, J.P. Guéry, K. Zuberbühler, F. Levréro (2016) *Enduring voice recognition in bonobos*, Scientific Reports. DOI: 10.1038/srep22046

Changing tactics according to the interlocutor

Bonobos adapt their modes of communication according to the human interlocutor from whom they want to get food. They can take into account the knowledge they have in common with their counterparts. With this discovery, post-doctoral student Emilie Genty has revealed a further facet, which brings primates closer to human beings.

“Until now, there was no evidence that animals could take knowledge shared with an interlocutor into account, and adapt their communication as a result,” observes Emilie Genty. “This ability is essential to the development of shared conventions and common references. It remains a primordial characteristic of human social interactions, and a prerequisite for language.”

Experiments were carried out on ten individuals accommodated in semi-free conditions at the Lola Ya Bonobo Sanctuary near Kinshasa, in the Democratic Republic of the Congo. The results indicate that when bonobos fail to get the food they want, they adapt their communication strategy. “If the person is known, the bonobos insist on repeating the signals that have succeeded in previous interactions with that partner. But if the experimenter is unknown, the subjects quickly change strategy, and use new signals,” the researcher explains.

“It is highly likely that bonobos have learned how certain signals help persuade their caregivers to feed them, and that they can understand that these signals are meaningless to someone with whom they have not yet interacted,” Emilie Genty notes.

Then, the bonobos adapt their communicative signals to overcome this lack of understanding. These results are similar to those seen in two-year-olds when they try to correct misunderstandings with parents or strangers.





Invitation by gesture

Among other amazing features when it comes to communication, there is a hand gesture that bonobos perform to invite a partner to copulate, a little out of the way. “This gesture has the same form — and function — as the human gesture inviting an approach,” says Emilie Genty. It is produced intentionally; the signal-receiving bonobos then respond by approaching the transmitter, and following to the desired location.

“This type of gesture — termed referential — indicates not just the direction but also the path to follow. It had never been seen in communication between great apes, except those raised by humans or trained in sign language. In the case of our study, the gesture reveals the ability to represent an action and a direction in space.”

Referential gestures, which each have a unique meaning, are the closest things to human words. By way of sustained interactions with their parents, human children begin to integrate referential gestures into their communication at around twelve months. But they cannot understand the relationship between the form of the sign and what it refers to until around twenty-six months, which is when they learn words for the corresponding gestures.

Baboons



Seduction: the feminine touch

In periods of fertility, female baboons show signs that leave little to the imagination, like their buttocks swelling to excite the males around them. But it is the particular calls they produce just after mating that are at the heart of Yaëlle Bouquet's research. The aim? To work out the link between these vocalisations and the relationships that they create with the males of the group.

In a forest in Uganda, a female baboon saunters along, an imposing male by her side. Suddenly, she raises her posterior and, in the blink of an eye, her companion responds to her desires. The act itself lasts only a few seconds. Then, the female runs away, so fast that it might seem that coitus has been interrupted. But no: that lady baboon has indeed, the PhD candidate in primatology Yaëlle Bouquet will affirm, received his affection.

But the majority of the action seen on screen is elsewhere: the handful of grunts that the primate produces just after mating has a function, which researchers are still trying to determine. According to the study in Uganda, the female seemingly intends to use these calls to multiply her acts of coitus, and at a very high frequency, regardless of the social rank of her partners. No surprise, then, that she is quick to find other potential future dads once she is satisfied. "We think these vocalisations tend towards what we call sperm competition," comments Yaëlle Bouquet. "The female multiplies the number of different seeds harvested, so the best possible sperm can fertilize the egg."

Different competitions

Even if sperm competition is at the forefront of the observations, it is not the only possible meaning of the vocalisations. "We've also tested two other hypotheses that have been verified, although less frequently," says Yaëlle Bouquet. The first of these is to encourage competition between the other males of the group, inviting them to challenge the partner who is most favoured at that moment. "This is to seduce the highest-ranking male. So hierarchy clearly comes into play in this scenario."

The second hypothesis, on the other hand, suggests the opposite. The female wishes to signify her attachment to the male who "has her back" and who pleases her, inviting him to increase his vigilance, so that no pretenders will muscle in on the newly formed couple. It should be noted that only the very beginning and end of the fertility period are accessible to juvenile males. Here again, however, the most favourable interval for fertilisation is reserved for adult males — that is, for partners in full possession of their reproductive capacity.

"We are a long way away from the theories that saw females as mere passive creatures, subject to the authority of males," Yaëlle Bouquet sums up. For baboons, it is the females who do the heavy lifting, when it comes to the continuation of their line.



Warning: males rely on females!

Among Diana monkeys, the males rely more on the warning signals of their female counterparts than on their own perceptions. Claudia Stephan, a post-doctoral researcher at the University of Neuchâtel, is the first to demonstrate that, among monkeys, predator warnings follow different rules according to the individual's sex.

Diana monkeys are unique in making warning calls whose vocal structure varies according to the individual's sex. Claudia Stephan has shown that males and females raise alerts according to different patterns. Whilst females react directly to the presence of predators, males only call out in response to females.

The experiments were carried out at the *Centre Suisse de Recherches Scientifiques* in Côte d'Ivoire, under the supervision of Professor Klaus Zuberbühler. They started by simulating the presence of a predator — an eagle or a leopard — broadcasting the call of the animal concerned and then recording the monkeys' vocalisations, in the knowledge that each predator triggers a highly specific vocalisation.

"The first surprise: the males were waiting for the females to give a warning call before relaying the signal," notes Claudia Stephan. "And once the males start calling, the females stop their vocalisations."

Blind trust

But even more surprising is the male monkeys' reactions when the experimenters follow a leopard's call with a false warning signal from the female Diana monkey, meaning "warning: eagle". The males systematically relay the female's signal: in this case, "warning: eagle".

And this is the case even when the males hear that the real threat is a leopard. Males invariably follow females' judgments, in spite of their own perceptions. The same logic is followed when an eagle's call is followed by a "warning: leopard" signal.

To find out more:

C. Stephan, K. Zuberbühler (2016), *Persistent females and compliant males coordinate alarm calling in Diana monkeys*, *Current Biology*. DOI: 10.1016/j.cub.2016.08.033

As for the females, whose calls were also recorded as part of the same experiments, their vocalisations are invariable: the signals they send out always refer to the simulated predator, even if they hear different warning signals from their male counterparts.

A call to arms

Claudia Stephan explains these gender-related differences: "The females' calls are intended to protect the family by summoning the males to come to the rescue". The males, on the other hand, perceive the females' calls as "a call to arms". They then display the same physical behaviour as they would in the face of a predator, playing the role of protector for the group of monkeys, including females and the young.

With this behaviour, the males reassure the females who have given the warning, showing that they can take on the task of protecting of the group. And when the males are not vocal in doing this, the females continue to give the warning signal until the males respond appropriately. These results show that males and females not only depend on one another when faced with a predator, but also try to manipulate their partners' behaviour to their own benefit.

For now, these observations are only valid for Diana monkeys. "I imagine, however, that these differentiated vocalisations are much more widespread," Claudia Stephan suggests. "It needs to be verified among other primates whose social structures follow a similar harem pattern (one reproductive male for various females)."



Diana monkeys



A flea for a favour

As is true for most primates, grooming plays a central role in the relationships between vervet monkeys, who live in groups governed by female hierarchies. The doctoral student Christèle Borgeaud has shown that this activity might reduce displays of authority, leading dominant members to tolerate subordinates eating nearby, for example.

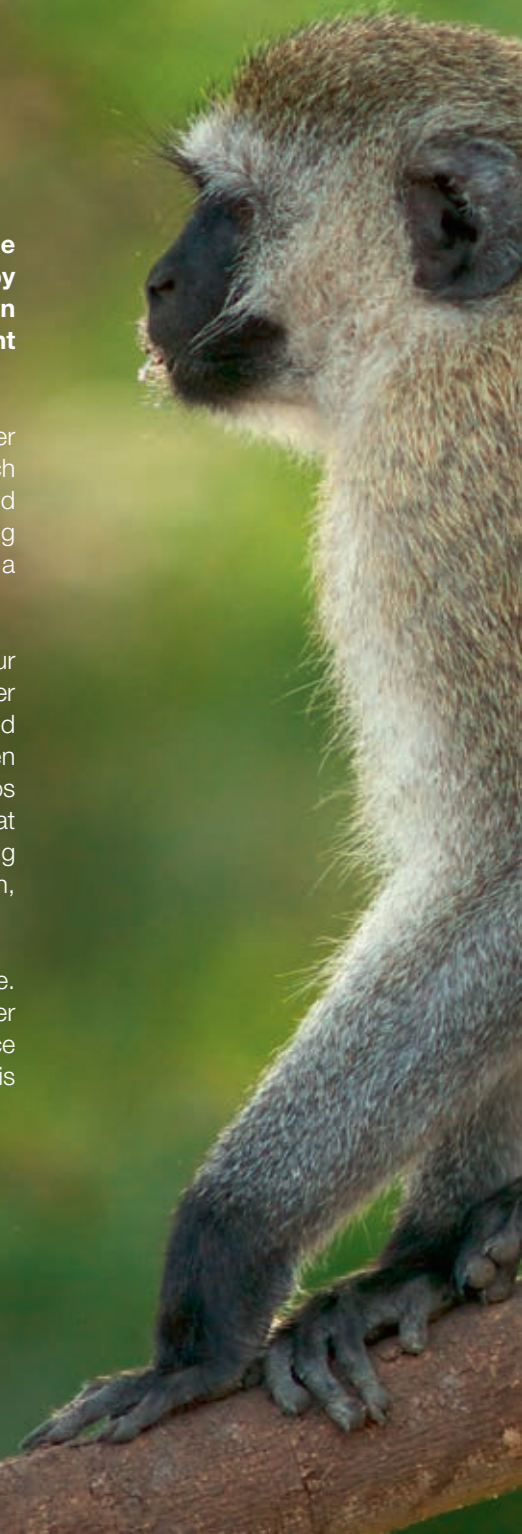
“In this hierarchical system,” explains Christèle Borgeaud, “the dominant member theoretically has all the rights when it comes to feeding, including stealing food which was found by subordinates, without any risk of negative reactions. If dominated members try the same behaviour, they will be violently attacked. But everything can change when two individuals have had a grooming session, which serves as a bargaining chip for other commodities.”

So, when two females of different rank engage in grooming less than an hour before food is distributed, the dominant female shows tolerance towards her subordinate, allowing her to eat nearby, where normally she would have prevented her subordinate from eating. “We already knew that repeated grooming between individuals of different rank creates privileged relationships, similar to friendships between humans,” notes the scientist. “The discovery here is not only that grooming has a very rapid soothing effect. More importantly, the effect of grooming is as strong as that of friendship: a resulting short-term tolerance is always seen, regardless of whether the two females were friends or enemies before.”

A second important consideration observed in grooming is that of assistance. “When there is a conflict with another vervet, a female who has groomed one of her peers can count on her support,” explains Christèle Borgeaud. “But this alliance only works if the common enemy is lower down in the hierarchy. In vervets, it is impossible to join forces against a higher-ranking individual.”

To find out more:

Christèle Borgeaud, *Comportements sociaux stratégiques chez des singes vervets sauvages*, Ma thèse en 180 secondes (2016). Video (in French): www.youtube.com/watch?v=05qj3PLyUXI





Parallel hierarchies

Females spend their entire lives in the groups into which they were born, each usually composed of 30 to 40 individuals. Their position in the hierarchy is inherited from the mother. This is not the case for males who, on reaching adulthood, leave their birth group for another. There, they can eventually challenge other often dominant males, to assert their authority among their new peers.

However, there are also displays of tolerance between males. In her doctorate, Stéphanie Mercier studies the greeting calls, which vervet monkeys make to reduce the aggression levels of dominant males. Her thesis reveals that, in response, dominant males express tolerance by raising their tails to reveal their brightly coloured genitals.

“This is a sign of extreme confidence, as dominant males go so far as to let their subordinates feel, touch or groom their blue testicles and their red penis,” Stéphanie Mercier details. In addition, like the beneficial effects of grooming, the ritualistic behaviour of greetings helps vervet monkeys to secure the social support of males when they are in imminent danger. This can be seen, for example, on the banks of rivers, where the risk of encountering snakes is high.



Fantastic father figures

A rare phenomenon among mammals, the youngest member of a family of titi monkeys is cared for exclusively by the male. It is he who carries the infant on his back, gathering its food, and spending much of his time playing with it. “A male’s ability to care for his offspring is a determining factor for females when choosing their partners.”

Even if from time to time their fidelity lapses, these black-faced monkeys are known for their monogamous lifestyles, taking the same partner throughout their lives. They regularly proclaim their monogamy by vocalising in pairs, a reminder that they are on their own territory.

Each couple raises between one and three youngsters. Family members display attachment in the true sense of the word, happily intertwining their tails as they sleep in the trees — a practice which also develops balance and safe posture on branches. This is of little help to researchers, as individuals are difficult to distinguish when nestled up against one another.

A sense of sequence

The Titi monkeys of Brazil are unique in emitting two types of call, which they arrange in sequences. When danger arises, an individual sends out a sequence, in which the type — and order — of calls communicates the kind of predator encountered, and its location. But do the monkeys who hear these sequences understand their meaning? This is the question that Mélissa Berthet asks in her doctoral thesis.

The researcher has just returned from a year and a half of study in a Brazilian reserve at Caraça. As tropical latitudes demand, the climate is humid and heavy: but as the site happens to be 1,300 meters above sea level, it freezes in winter, making it a far cry from the hot, sun-kissed seashores stereotypical of Brazil. And in this mountainous region live about thirty wild titi monkeys.

“These primates are used to a human presence,” Mélissa Berthet remarks. “But we never interact with them directly: we don’t feed them, we don’t touch them. If they have health problems, we have no right to treat them. So they can still be considered to live in the wild.”

The experiments, which the young doctoral student carried out, started by installing lures, in the form of stuffed predators, within sight of one of the apes. Represented among these were local species of eagles, cats and a tayra, similar to the martens found at more familiar latitudes.

Six combinations of factors were set out: two locations (on the ground or on the branch of a tree) for each of the three types of predator. Biologists then recorded the monkey’s vocalisations, according to the type and position of the lure.



The records obtained were used in the second part of the experiment. Loudspeakers were used to broadcast the calls within earshot of a receiver; the scientists then watched for reactions, especially visual. “If the sequence relates to a predator in the air, the monkey immediately looks up at the sky,” explains Mélissa Berthet. “If it is on the ground, the monkey will lower its head very quickly.”

The young researcher is still analysing the images from an angle so far little explored when it comes to titi monkeys: verifying whether the coded vocalisations can be understood by other members of the species.

Master in Cognitive Science

Offering students an individually tailored curriculum, this Master's programme covers the broad range of disciplines at the intersection of the biological sciences and the humanities. It consists of modules in ethology, evolutionary biology, philosophy of mind, linguistics, cognitive and developmental psychology. Specific areas of study are: belief acquisition and social representation in human development, verbal and nonverbal communication, discourse used to understand and manage the mind, the dissemination of ideas and rumours, the construction of social interactions, the mechanisms that underlie cooperative behaviour, and communication and cognition of nonhuman primates and animals in general.

<http://www.unine.ch/cognition/home.html>

Master in Biology

This Master's programme permits students to select their area of specialization and acquire a diverse range of transferable skills. It begins with core courses covering key topics in biology, with particular emphasis on methodological and quantitative aspects. It then divides into seven specializations representing the Institute of Biology's main areas of research, e.g. Animal Behaviour. This specialization studies the ultimate causes and the proximal (physiological and cognitive) mechanisms in the evolution of animal behaviour. It studies the emergence and evolution of a wide range of animal behaviours, such as cooperation, the establishing of social hierarchies, the resolution of social conflicts, sexual behaviour, and parental behaviour. The focus is on vertebrates, in particular primates, tropical fish and birds.

<http://www.unine.ch/unine/home/formation/masters/sciences/biologie/master-in-biology.html>

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