



Abstract booklet

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SYMPOSIA

Symposium 1: Concrete actions to improve Ethics, Diversity and Inclusivity in Primatology

Organisers: Maël Leroux & Mélissa Berthet

Awareness about the ethical issues unique to the field of primatology has increased significantly in recent years. Discussions among primatologists have played a crucial role in promoting Ethics, Diversity and Inclusivity in our community. However, raising awareness alone can fall short of fostering tangible improvements, and often, individuals lack the concrete tools necessary to establish a more ethical, diverse, and inclusive work environment.

Our symposium aims to bridge this gap by offering a series of short talks and roundtables that will provide actionable steps to move towards a paradigm shift in primatology. First, a roundtable on Diversity and Inclusivity will discuss concrete actions to reduce hardships faced by our community, especially individuals with marginalised identities that have historically been excluded from primatology. Second, two flash talks will introduce specific initiatives currently implemented to (i) actively integrate conservation into research activities and (ii) reinforce ethical considerations during the publication process. Third, a roundtable will present practical measures put in place by several field site research teams to improve ethics in the field. We hope the ideas presented and generated in this symposium will provide all actors in primatology with concrete tools to improve ethics, diversity and inclusivity within our discipline, and beyond.

Introduction talk (5 min) - Ethics, Diversity and Inclusivity in Primatology

- Maël Leroux
- Mélissa Berthet

Roundtable I (45 min) - Diversity and inclusivity in primatology (Chair: Maël Leroux)

- Kirsty Graham
- Laura Simone Lewis
- Julián León
- Shreejata Gupta (Diya)

Flash talks (20mn, 10 min each)

- Erin Wessling: Shared spaces and collaborative efforts in Pan research and conservation
- Gal Badihi: Ethical guidelines for publishers working with primatologists

Roundtable II (45 min) - Ethical primatology: the field perspective (Chair: Mélissa Berthet)

- Jo Setchell: introduction talk (5-10 min)
- Kathelijne Koops
- Catherine Hobaiter
- Aaron Sandel

Shared spaces and collaborative efforts in *Pan* research and conservation

Erin Wessling¹

¹*German Primate Center*

The biodiversity crisis poses an urgent threat to many threatened primate species. At the same time, there is a growing call within primatology to address issues of diversity, equity, and inclusion in our research activities. In this talk I discuss the ways that we as scientists can make meaningful contributions to effective conservation, using examples from my own *Pan* research and conservation policy activities, and demonstrate how these approaches often go hand-in-hand with decolonization initiatives. Rather than seeing research and conservation as separate endeavors that must be connected, we should recognize they are already interlinked within the work we do. By adjusting traditional approaches and the outlook and messaging of our work, we can leverage our research programs to have greater impact simultaneously in both conservation and DEI domains with fairly minimal realignment of our ongoing activities.

Ethical guidelines for publishers working with primatologists

Gal Badihi¹

¹*University of St Andrews*

The diversity of experimental procedures - from observations of wild groups to captive experiments - and different national and institutional requirements for the design and reporting of non-human animal research has left primate research subjects with variable safeguards. While some institutions require full ethical reviews prior to any study involving primates, others require none; research permit protocols for wild research differ between primate range countries; and most journals, even if they require an ethics statement, do not consider the different scales of protection offered by different countries and institutions, lumping any 'approval' for research as 'good enough'. Publishing is an integral part of almost all scientific research and the publication pipeline already involves a range of quality controls. Publishers can request that specific guidelines are followed for any research to be published in their journals. For example, the journal *Ethology* adopted the STRANGE framework to improve reporting standards of animal behaviour research. We propose that a similar framework should be adopted by primatology journals to ensure that equally high ethical considerations are used across studies. In this talk, I will introduce a new framework being developed by a team of primatologists with input from journal editors. It is not aimed at opposing any particular field of research but to provide a holistic consideration of the ethical standards that should be upheld in each branch of the primate research tree. By using a top-down approach, where ethical standards are ensured during the publication process, we can target a wide range of research areas and

methods thereby maximising the impact of this framework from the perspective of the primates who will benefit from it.

Symposium 2: Interacting with the wild: towards automatized behavioral testing and tracking of individuals outside the laboratory walls

Organisers: Claudia Fichtel & Daniel Huber

Studying cognition and social interactions in wild animals allows understanding how animals behave under ecologically and evolutionary relevant conditions. Traditionally, much cognitive research in populations of wild non-human primates focused on manually controlled cognitive testing devices or passive behavioral observations. More recently, video based tracking systems and new automatized closed-loop experimental approaches have been employed to study cognition in naturalistic settings. In addition, computer vision methods have been developed to automatically identify and track individuals and thus extract complex social interactions and motor actions from videos or in real time. This symposium aims at presenting a large range of current solutions and future challenges of automatized behavioral testing methods for primates in their natural habitat.

Lab cognition going wild: Implementing a new portable touchscreen system in vervet monkeys

Rachel Harrison^{1,2}, Tecla Mohr², Erica van de Waal²

¹Department of Anthropology, Durham University, ²Department of Ecology and Evolution, University of Lausanne

Touchscreen technology has provided researchers with opportunities to conduct well-controlled cognitive tests with captive animals, allowing researchers to isolate individuals, select participants based on specific traits, and control aspects of the environment. In this study, we aimed to investigate the potential utility of touchscreen technology for the study of cognition in wild vervet monkeys. We assessed the viability of touchscreen testing by comparing rates of participation between wild and sanctuary-housed vervets. Additionally, we compared performance on a simple associative learning task in order to verify that wild participants are able to engage meaningfully with a touchscreen task presented in their natural environment. We presented eight groups of vervet monkeys (four wild and four sanctuary groups, totalling 240 individuals) with a portable touchscreen device. The touchscreen displayed tasks in which food rewards could be gained by touching a stimulus displayed on the screen. We assessed individuals' likelihood of interacting with the touchscreen, their frequency of participation, and their performance on a simple associative learning task. We found that sanctuary-housed monkeys were more likely to interact with the touchscreen. Participation in wild vervet monkeys was influenced by sex and age. However, monkeys in the two contexts (sanctuary vs. wild) did not differ in their performance on a simple associative learning task. This study demonstrates that touchscreen technology can be successfully deployed in a population of wild primates. This gives us a starting point to test animal cognition under natural conditions that include varying group composition, environmental challenges and ongoing activities such as foraging, which are challenging to recreate in captivity. While rates of participation were lower than those found in captivity, reasonable sample sizes

can be achieved, and wild primates can successfully learn touchscreen tasks in a manner comparable to their captive counterparts.

A robust multi-animal tracking model for non-human primates in the wild

Richard Vogg¹, Matthias Nuske¹, Marissa A Weis¹, Timo Lüddecke¹, Elif Karakoç², Zurna Ahmed², Sofia M Pereira¹, Suchinda Malaivijitnond³, Florentin Wörgötter¹, Peter M Kappeler¹, Alexander Gail¹, Julia Ostner¹, Oliver Schülke¹, Claudia Fichtel², Alexander S Ecker¹

¹University of Göttingen, ²German Primate Center, ³Chulalongkorn University, Bangkok

In recent years, deep learning-based computer vision techniques have demonstrated remarkable results in the automated detection and classification of objects and their interactions within images. A well-performing detection and tracking model forms the foundation of automated animal behavioral studies utilizing videos. While keypoint-based methods excel in controlled lab environments with fixed backgrounds and lighting conditions, the challenges posed by wild environments need a more robust approach for effective generalization. In this talk I will introduce PrimateFairMOT, our multi-animal tracking model designed for non-human primates in the wild. By employing bounding boxes instead of keypoints, the model learns to detect and track primates and other objects of interest from labeled videos or images. This not only simplifies data annotation significantly but also enhances result robustness, requiring only a few hundred labeled frames for training. The model is both conceptually simple and highly flexible. We demonstrate how to extend its functionality for an additional classification task, applicable for individual identification or general pose estimation without relying on keypoints. To assess the model's performance, we conducted two case studies involving Assamese macaques and red-fronted lemurs in their natural habitats. We present our findings on performance regarding tracking and individual identification.

Studying coordination and cooperation using automatic cognitive testing

Nicolas Claidiere¹

¹CNRS, Laboratoire de psychologie cognitive, University of Aix-Marseille

Humans live in large groups, and this is thought to have played a key role in the success of our species because group life can bring important benefits such as hunting of large preys, defence against predators, division of labour, cooperative care of babies and infants, etc. However, group life results in a constant trade-off between group benefits resulting from coordination, cooperation and the sharing of information and increased within-group competition for food and mating resources. To increase the benefits and mitigate the costs, humans use a variety of strategies to solve collective problems. I will present results from a set of recent experiments using the automatic cognitive testing system developed by Joel Fagot in 2008 and revamped in 2018 to study social cognition. We presented our group of 18 Guinea baboons (*Papio papio*) first with a coordination problem and then with a cooperation one. We find that baboons develop systematic responses akin to human conventions with the coordination problem and use similar strategies to humans to solve

the cooperation problem. These results show that Guinea baboons, like humans, can fine tune their behaviour to the actions of their partners to solve collective problems. Our results support the idea that long-term experiments that are embedded in the environment of the participants are necessary to show the full range of behaviours non-human primates are capable of. An argument that supports the development of automatised cognitive testing in wild animals and the complementarity of wild and captive settings.

Advancing Primate Research: AI-Powered Face Recognition and Behavior Analysis in Japanese Macaques

Julien Paulet¹, Axel Molina², Théo Ardoin³, Shinya Yamamoto⁴, Cédric Sueur⁵

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⁴Kyoto University Institute for Advanced Study, ⁵Université de Strasbourg, IPHC

Recent advancements in artificial intelligence (AI) have significantly enhanced research methodologies in ecology and ethology, particularly in the study of Japanese macaques (*Macaca fuscata*). This study explores the dual application of AI in non-invasive individual identification and behaviour analysis of these primates. Utilising deep learning models, we have developed two innovative tools: a face detector for Japanese macaques using a Faster-RCNN model with 82.2% accuracy, and an individual recogniser specific to the Kōjima Island macaque population, based on a YOLOv8n model, achieving 83% accuracy. These tools streamline the identification process, overcoming the limitations of traditional, invasive tagging methods. In parallel, we have applied a cutting-edge tool, LabGym, to analyse complex primate behaviours, focusing on Japanese macaques as model subjects. Our approach involved creating a model that not only accurately detects these primates but also analyses specific behaviours, such as stone-handling-like actions, captured in video data. While our behavioural analysis model successfully recognised such behaviours, the absence of extensive quantitative data within the specified timeframe present limitations. The integration of these AI technologies represents a pioneering endeavour in primate research, laying the groundwork for future studies. Our findings highlight the potential of AI in creating non-invasive methodologies for both face detection and behaviour analysis. These preliminary results underscore the transformative impact of AI in advancing our understanding of complex social structures and behaviours in Japanese macaques. Such advancements in AI-driven research methodologies not only enhance the efficiency and effectiveness of wildlife studies but also offer a humane alternative to invasive research methods. The use of AI in ethology paves the way for broader applications in various aspects of ecological and behavioural studies, setting a new standard for the ethical and scientific exploration of animal behaviour.

Navigating in the dark: from the lab to the wild

Ali Nourizonoz¹, Claudia Fichtel², Daniel Huber¹

¹Department of Basic Neurosciences, University of Geneva, ²German Primate Center

Vision, the key sensory modality for primates, plays an important role in navigation. In the case of nocturnal primates, such as the mouse lemurs, the visual system has evolved to adapt to low-light environments. Despite the darkness, mouse lemurs navigate through dense forest by leaping across tree branches. This complex behavior heavily relies on visual guidance to estimate the distance and landing target. How mouse lemurs perform these incredible jumps in darkness, and how their ability to do so is affected by other environmental factors, remains an open question. To investigate this matter we designed a novel jumping framework for mouse lemurs using the latest version of the EthoLoop system (www.etholoop.org). EthoLoop is an optical animal tracking system designed for small animals, not only to track their spatial position (~800Hz), but also to provide continuous close-up views while freely roaming in their natural habitat. Taking advantage of the real-time position tracking we control multiple wireless feeding platforms and are able to reinforce behavior, such as jumping in a reproducible manner. This provides a rich dataset of the kinematics of individual jumps, enabling comparison across sessions with different illumination settings. In parallel, we have taken the first step to study the navigation of freely moving mouse lemurs in their natural habitat. Here we will present our preliminary result using the battery powered version of the EthoLoop system in the heart of Kirindy forest of western Madagascar.

Symposium 3: Complex communication – meaning and learning in signals and their sequences

Organisers: Catherine Crockford & Kirsty Graham

Non-human primates pose a conundrum for understanding the evolution of language: they are our closest living relatives but are thought to demonstrate extremely limited semantic or syntactic capacities with little evolutionary shift across primate phylogeny, nor plasticity or learning capability within-species. However, recent exciting studies across signaling modalities that examine natural primate communication systems challenge these assumptions. Such studies examine signaling across species, populations and ontogeny. Here, we seek to bring together both early-career and more senior scientists who have conducted some of these studies across ape and monkey species in the domains of vocal, gestural and multimodal communication. This symposium will focus on whether, and if so, how signal sequences relate to communicative complexity, and how to unpick this information using new methodological approaches. We aim to identify research gaps and commonalities in signal sequence research – a way to take stock of the field. We focus particularly on advances in identifying structural patterns and signal meanings in sequences, and discuss how these new findings can inform future directions for the study of language evolution. Symposia can sometimes benefit from the final slot being an open discussion, summarizing the commonalities and differences between systems, which we would suggest as useful for this symposium. We request a 2 hr slot for 8 speakers. Currently, 6 speakers are confirmed. If one speaker cannot attend, we will include a discussion slot.

Call combinations and compositional processing in wild chimpanzees

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Syntax, the ability to combine meaning-bearing words together into larger meaningful phrases, has often been argued to be a key feature distinguishing language from other animal communication systems. However, recent experimental evidence of syntactic-like structuring in monkeys has challenged this assumption and suggests syntax might be evolutionary more ancient. Comparable data in great apes, our closest-living relatives, are central to validating this claim and reconstructing the more recent evolutionary history of syntax. I will review recent progress we have made addressing this issue in the vocal communication system of wild chimpanzees. Firstly, through leveraging methods previously developed to identify non-random word combinations (collocation analysis)

and applying them to vocal observational data, we have built a repertoire of chimpanzee call combinations. Secondly, using playback experiments, we have probed the meaning of a candidate combination identified from collocation analyses: the “alarm-huu-waa-bark”. Chimpanzees produce “alarm-huus” when surprised and “waa-barks” when recruiting other group-members during aggression or hunting. Existing behavioural data further suggest chimpanzees combine these two calls together, specifically when encountering an unexpected threat that requires recruitment such as when exposed to a snake. To confirm these findings and verify the meaning-bearing nature of the call combination, we played back an artificial call combination and both calls produced independently to wild-living chimpanzees in the Budongo Forest, Uganda. Chimpanzees (N=6) reacted most strongly to the combination, showing longer looking responses, compared with both individual calls. These experimental results suggest the “alarm-huu-waa-bark” combination represents a compositional syntactic-like structure, where the meaning of the sequence is derived from the meaning of its parts. Our research supports previous work in monkeys and indicates the cognitive building blocks facilitating syntax were already present in our last common ancestor with chimpanzees and are perhaps even older.

Call combinations in sooty mangabeys

Auriane Le Floch^{1,2,3}, Tanit Souha Azaiez^{1,3}, Natacha Bande^{3,4}, Cédric Girard-Buttoz^{3,5,6}, Steven Moran¹, Roman Wittig^{2,3,6}, Klaus Zuberbühler^{1,7}, Catherine Crockford^{2,3,6}

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One way of studying the evolution of language, and in particular our ability to combine words into an infinite number of sentences, is to investigate the communication systems of our closest living relatives, non-human primates. Several primate species combine meaning-bearing units into vocal sequences, but most studies focus on a few sequences per species and rarely assess vocal sequences production across the entire repertoire. Such an endeavor is nevertheless crucial to assess the combinatorial abilities across species and ultimately retrace the evolutionary origins of language. Recent studies highlighted a diverse use of structured vocal sequences across ape vocal repertoires but evidence in monkeys remains scarce. Our study focuses on exploring call combinations in a forest-dwelling monkey, sooty mangabeys (*Cercocebus atys*). Given the complex vocal repertoire found in closely related species we hypothesised that adult sooty mangabeys produce a significant number of vocal sequences and that some sequences are specific to certain contexts. We studied two groups of wild sooty mangabeys in the Taï National Park, Ivory Coast for 14 months. Using a combination of individual focal follow and *ad libitum* data collection methods, we recorded their vocalisations along with the context of production. We gathered and manually annotated over 2000 recordings. Data analyses are still ongoing but preliminary explorations suggest that female sooty mangabeys produce two of their calls both individually and in combination. Interestingly, these bigrams seem to occur mainly when the caller is interacting with young infants. Males and females also seem to combine their calls with other vocal units that are rarely produced alone in

aggressive and alarm contexts. This would (1) reveal a more limited combinatorial system compared to apes and (2) confirm previous findings highlighting that monkeys and apes use call combinations primarily to negotiate social interactions and inform conspecifics of danger.

Tell me how you sing and I'll tell you who you are! Phrase combinatorics differs between sexes, status and chorus size in a singing lemur

Chiara De Gregorio¹, Anna Zanoli¹, Teresa Raimondi¹, Daria Valente¹, Filippo Carugati¹, Walter Cristiano¹, Valeria Torti¹, Olivier Friard¹, Cristina Giacoma¹, Marco Gamba¹

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Studies on the combinatorial properties of primates' songs may provide essential ecological and behavioral information about flexibility in non-human primate communication, offering insights into the mechanisms and drivers responsible for the evolutionary change of communicative traits in our and other species. The indris (*I. indri*) songs are an ideal case for the study of the variability of elements concatenation, as they can be interpreted as a string of easily identifiable phrases. We explored the song structure between sexes and statuses using two measures: the Levenshtein distance and the Jaro distance. Our dataset consisted of 599 songs recorded in the Maromizaha forest (Madagascar) from eight family groups. To investigate phrase concatenation between sexes and statuses we employed a Linear Mixed Model and a Support Vector Machine as a classification algorithm. To investigate whether the number and identity of co-singers would have an impact on the organization of phrase sequence during song emission we used a Mantel test (9999 randomization). We found that the phrase structure of songs varied between reproductive males and females: male contributions were more stereotyped than female contributions, which showed greater individual flexibility. Moreover, non-dominant individuals possess the highest degree of flexibility in phrase organization, followed by dominant females and last by dominant males. Finally, we found that parents utter less elaborate songs when co-singing with their offspring. Our results indicate that the concatenation of elements in sequences allows identifying male and female indris and recognizing dominants from non-dominant individuals. Additionally, in line with previous studies on gibbons, we suggest that parents might simplify their emissions to facilitate offspring's vocal development. Our study shows how different metrics can describe flexibility in individual indri song sequences, for which we detected remarkable variation between-sex, between-status, and between different co-singing interactions.

Potential for vocal learning of vocal sequences in wild chimpanzees

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Vocal learning is key to the acquisition of human language. Humans learn to combine phonemes into words that are themselves recombined to form an infinite number of sentences. In stark contrast, non-human primates are seen as poor vocal learners and their vocal repertoire is thought to be innate. This human uniqueness poses a conundrum as to how did the ability to learn a complex form of vocal communication such as language evolve. However, while several non-human primate species produce vocal sequences, vocal learning abilities have mostly evaluated the production of single calls. The potential for non-human primates to learn how to recombine single calls into vocal sequences has been little examined. We argue that chimpanzees, who are known to produce a large diversity of vocal sequences, are candidates for vocal sequence learning. We provide a suite of results to substantiate our view. First, the structure of certain vocal sequences varies across populations, indicating flexibility in vocal sequence production. Second, the hundreds of vocal sequences present in the adult vocal repertoire are not present from birth. Vocal sequences are acquired slowly through the first decade of life, a period that corresponds to expanding social independence in chimpanzees. Finally, we present new evidence from wild chimpanzees in Tai National Park that the vocal sequences not only expand in diversity across ontogeny, but also become more structured over time. Specifically, the position of single units within bigrams (two-unit vocal sequences) was less consistent and the transition from one unit to the next was less predictable in infants than in mature individuals. Altogether, our results challenge the view that the non-human primate vocal repertoire is fully innate and should encourage other studies to evaluate vocal learning abilities at the scale of the vocal sequences rather than single calls only.

Gesturing when it all goes wrong: persistence and elaboration in ape gesture sequences.

Catherine Hobaiter

Compositionality of wild chimpanzee gestures

Alexander Mielke¹, Gal Badihi², Kirsty Graham², Chie Hashimoto³, Alex Piel⁴, Alexandra Safryghin², Katie E. Slocombe⁵, Fiona Stewart⁶, Claudia Wilke⁵, Catherine Hobaiter²

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Recent years have produced initial evidence of combinatorial abilities in animal communication. Studies have often focused on systems where individual signals are unlikely to be meaning-bearing (such as bird or whale song) or on systems where all elements occur within the same context (such as alarm calls). Here, we test whether chimpanzee gestures, as intentional and meaning-bearing signals, show evidence of a) predictable combinations of different gesture actions, and b) changes in meaning due to combinations compared to single use of gestures. Analysing 7,749 gestures across 5,504 sequences in 5 chimpanzee communities using resampling methods, transition networks, and machine learning classifiers, we show that sequences in chimpanzees are short and often contain persistence and redundancy. Nevertheless, we find predictable first-order

transitions and combinations that accurately predict the goal of the gesture sequence beyond the individual element. We find little to no evidence that order matters for prediction - so, knowing that two specific gestures occurred reduces uncertainty about the next element in the sequence and the goal of the interaction, but knowing which of the two gestures occurred first is less important, as might be predicted for a system in which signal use is not restricted to linear production. Thus, while we find regularities in sequence use that affect meaning, we find limited evidence that combinations differ in meaning from the single signals constituting them, enabling human-like compositionality. More likely, additional signals in a sequence are used to disambiguate between multiple possible meanings of the same initial gesture, following their original classification as persistence and elaboration.

Symposium 4: Joining the dots in primate research: Integrating field and captive studies of common marmosets

Organisers: Filipa Abreu & Vedrana Šlipogor

In recent years, a growing number of non-human primate studies has set out to investigate research questions in both wild and captive settings. By integrating observational and experimental data from natural habitats with controlled experiments in captivity, researchers can gain valuable and complementary insights into various aspects of species' biology. One of the species that has received increasing attention is the common marmoset (*Callithrix jacchus*), a small-bodied neotropical primate species that has become an essential animal model in a wide range of topics due to its unique characteristics, such as its cooperative breeding system, twin births and complexity in social behaviors and communication. Thus, the primary objective of this symposium is to explore how bridging field and captive data can provide a holistic understanding of *Callithrix jacchus* behavior, ecology, genetics, and physiology. To achieve this objective, this symposium aims to 1) compare patterns observed in wild and captive settings; 2) identify best methodological practices for combining data from distinct research settings, and thus 3) generate robust conclusions across settings that will advance our understanding of this species. This symposium will bring together researchers studying common marmosets in distinct settings, sharing their expertise on crucial aspects of their behavior, welfare, social dynamics, communication patterns, genetics, and physiological responses. Through these presentations, we aim to highlight the benefits of combining field and captive studies in expanding our knowledge of this and other highly social non-human primate species.

The evolutionary history and genomics of *Callithrix jacchus* based on morphological, metagenomics, and genomic data from the field and captivity

Joanna Malukiewicz¹

¹University of Hamburg

The common marmoset (*Callithrix jacchus*) is one of only two marmoset monkeys to naturally occupy Brazil's most extreme and semi-arid biomes, the Caatinga and Cerrado. Although marmosets are already amongst the world's smallest monkeys, the very diminutive size of the common marmoset and heavy dietary exploitation of tree gums set this species apart from most other monkeys. Here, I will present research highlights and new insights from my work with morphological, metagenomic, genomics, and phylogenetic data that show how the common marmoset has taken body size and dietary strategies to a relative extreme. I will discuss these findings within the context of common marmoset evolutionary adaptations to the Caatinga/Cerrado. My research shows that the common marmoset is a relatively young species that originates in Brazil's semi-arid habitats. A close evolutionary relationship with gut *Bifidobacterium*, bacteria who functionally specialise in the metabolism and digestion of the carbohydrates that compose the bulk of tree exudates eaten by the common marmoset, likely lets this monkey thrive in semi-arid environments. Finally, I will present novel population-level genomic data of *C. jacchus* and three other marmoset species (*C. aurita*, *C. geoffroyi*, and *C. penicillata*) which

has identified several *Callithrix* candidate speciation genes. Among genes that likely influenced *C. jacchus* evolution, relative to larger and less exudivorous *Callithrix* species, are those involved in insulin signalling, fat metabolism, thermoregulation, water regulation, and growth and development. These genes include *ANO6*, which has been shown to affect body size in mice, and *SFRP5* which plays an important role in fat and glucose metabolism as well as bone development. These patterns parallel the genomic basis of adaptations found in other semi-desert and desert mammals. Thus, as these genes are related to growth, development, and metabolism, they may have facilitated speciation and the singular evolutionary trajectory of the common marmoset.

Examining communication and perception in common marmosets using the CalliFACS objective tool

Catia Correia-Caeiro^{1,2,3}, Keiko Mouri^{2,3,4}, Michael A Huffman^{2,3,4}, Duncan A Wilson⁵, Xitong Wang⁵, Takako Miyabe-Nishiwaki^{2,3}

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Facial expressions are subtle signals, central for communication and emotion in mammals. The gold standard tool, FACS (Facial Action Coding System), is used since the 70s for investigating human facial behaviour. FACS avoids assumptions of meaning by objectively measuring observed movement linked to each facial muscle, each of which is coded as an Action Units (AU). In the last 15 years, FACS was adapted for several animal taxa (available at www.animalFACS.com), and so here we followed similar methodology to develop the CalliFACS for the common marmoset. First, we determined the species facial muscular plan. Second, we analysed spontaneous facial movements on video (N=100) in a variety of behavioural contexts (e.g., grooming, play, human interaction). In the final step, we combined the anatomical and the behavioural information to document all the AUs of the common marmoset. The CalliFACS teaches how to code each AU and is a scientific tool to better understand the common marmoset's communication and emotional expression. After introducing the newly published CalliFACS, we will also report the application of this tool in two perception experiments that investigated behavioural and hormonal responses of common marmosets to visual social cues in conspecifics. In study 1, we have shown for the first time a link between exposure to valenced social cues and behavioural and hormonal responses (manuscript in review). In study 2, we performed an audio-visual expectancy violation paradigm to test how common marmosets understand emotional cues and will present preliminary results (ongoing data analysis). As the common marmoset has been hailed the new ideal laboratory model, from neuroscience to cognition, CalliFACS is an important tool to better understand this species communication and emotion cues, which in turn will allow better evaluation of marmoset welfare.

Do common marmosets follow conversational rules? New insights into turn-taking relevance and contextual use in wild family groups

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Non-human primates have been observed to adhere to temporal rules during signal exchanges akin to human conversations. This capacity has led researchers to propose that cooperative turn-taking, involving the exchange of communicative turns and governed by fundamental features, represents an ancient mechanism present across all primate branches. Common marmosets, due to their highly cooperative breeding system and complex vocal communication, have been the main model system in vocal turn-taking studies. Previous results have highlighted that marmosets engage in reciprocal exchanges of calls with gaps between 3 and 5 seconds, actively avoiding overlaps. However, most research has solely focused on the temporal aspects of turn-taking with a specific vocalization, Phees, in captive individuals, resulting in limited comparative approaches between non-human primates and humans. To bridge this gap, our study addressed two questions: (1) Do common marmosets engage in vocal turn-taking with different vocalizations? and (2) What similarities and differences can we find between these vocal interactions and human conversational turn-taking, considering the comparative turn-taking framework proposed by Pika and colleagues (2018)? Over six months, we observed four groups of wild common marmosets, recording their vocal interactions via a unidirectional microphone and a voice recorder. We had 540 hours of direct observation that resulted in 1,284 interactions with different vocalizations. Our preliminary analysis unveils an interesting pattern, demonstrating a median gap of approximately 1.2 seconds in vocal interactions, regardless of the group or vocalization pairs, and consistently longer pauses when there was no reply from the receiver, similar to what is found in humans and following Sacks et al.'s model (1974). Moreover, the results indicate that common marmosets often engage in mutual vocal exchanges, frequently responding to it with matching vocalizations and repeating the signal when there is no response. Altogether, our findings suggest a similar pattern of human conversational turn-taking.

Strengthening ties: Exploring the impact of vocal convergence on marmosets' social bonds

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Callitrichid monkeys exhibit notable communicative abilities among non-human primates, presenting several correlates with language precursors. Evidence suggests that the cooperative breeding system, a shared trait with humans, may have favored this remarkable feature. Among these features, a growing body of studies has highlighted the ability to vocally converge with conspecifics, which is thought to facilitate social

integration and therefore strengthen social bonds. In captive settings, particularly with common marmosets, vocal accommodation patterns and their impact on social interactions have been extensively explored. Furthermore, migrations offer opportunities to observe vocal convergence phenomena in different social contexts and changes in groups' social networks. However, less is known on how marmosets manifest their communicative abilities under more naturalistic situations. We aim to address this gap by exploring how the everchanging social dynamics of wild populations and vocal accommodation are intertwined. For that, we collected acoustic and behavioral data using focal animal sampling from 3 groups of wild *Callithrix jacchus*, for 12 months, encompassing 12 migration events. From this data, we expect to track changes in marmosets' acoustic and behavioral domains before and after a given event. Therefore, we analyzed contact calls (e.g. trills) and social behaviors expecting to disentangle if vocal convergence is a necessary criterion for migration or rather a consequence of environmental pressures favoring group changes. This investigation aligns with predictions tested in captive translocation experiments. Hence, if our study corroborates these experiments, we expect that successful migrations will be marked by enhanced vocal accommodation and strong social affiliation. Alternatively, vocal convergence might not manifest even in successful group formation. By bridging these two domains, we aim to enrich our understanding of callitrichid monkey communication, contributing to a broader though nuanced understanding of both their communicative abilities and our own.

Vigilance behaviour as a window into marmosets' social coordination and cognition

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Marmosets are highly vigilant, both in the wild and in captivity. Vigilance is not only interesting because of the cooperative nature of this behaviour but also because it is likely under strong selection pressures due to the small body size of these arboreal primates. At the group level, vigilance and thus safety can be optimized if it is effectively coordinated between individuals. Here, we provide converging evidence for sophisticated inter-individual coordination of vigilance in marmosets, from different contexts and methodological approaches. We collected data on captive common marmoset vigilance in two different contexts: a feeding context ($N_{\text{individuals}} = 14$, $N_{\text{groups}} = 7$) and a play context ($N_{\text{individuals}} = 11$, $N_{\text{groups}} = 5$). In both contexts the behaviours are mutually exclusive. In the feeding context, we show that marmoset pairs minimize the time when no one is vigilant, and in particular increase their vigilance level when the pair mate is feeding. This results in an anti-phase (in other words turn-taking) pattern of feeding and being vigilant. Additionally, we provide evidence for how much control over this emerging pattern of anti-phase vigilance marmosets truly exhibit by modelling marmoset pairs as coupled oscillators and show that coupling is not fixed. In the play context, preliminary results show that adult marmosets increase vigilance when infants are playing. We thus find

evidence for coordination of cooperative behaviour in two naturalistic contexts and a mathematical framework to investigate cognitive aspects of coordinated behaviours more generally. We propose that our approach of combining evidence from different contexts and using different analytical methods is particularly suited to provide robust inferences. Finally, the strong coordination abilities that include an appreciation of the current risk of group members fall well in line with their cooperative breeding system and has implications for human evolution.

Personality and handedness in common marmosets: Insights from field and captive studies

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Consistent inter-individual behavioural differences or personalities are likely governed by proximate mechanisms like genetics, physiology, and brain lateralization, which is defined as the preferential use of one side of the body over the other. There is, however, mixed evidence on the link between laterality and personality, with some studies suggesting left-handed individuals being less bold and explorative and others reporting contrasting effects. Yet, these studies are usually limited to captivity, preventing generalizable findings. In this presentation, we will compare results of a captive (N=28) and a field (N=21) study linking personality and laterality in common marmosets (*Callithrix jacchus*). Personality was assessed by conducting behavioural observations in daily situations, while laterality was measured in a simple hand-reaching task in captivity, and two hand preference tests that differed in their food abundance in the wild. We assessed the links between these two variables, as well as the influence of age and sex using linear models. In captivity, marmosets displayed variation in Agreeableness, Extraversion and Neuroticism, as well as in their handedness scores. While there was no link between personality scores and hand preference or sex, older individuals were more agreeable and less extraverted. In the wild, marmosets displayed variation in both their personality traits and the direction and strength of hand preference. In conclusion, our findings show that the connection between personality and laterality is complex and can differ not only between closely related species but also within a species, based on the method of assessment as well as individuals' living habitats. Further research is needed to elucidate the intricacies of personality and its proximate mechanisms.

Foraging strategies and feeding success in free-living common marmosets (*Callithrix jacchus*): An experimental approach

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Socioecological models aim to identify the costs and benefits of primate sociality and explain how ecological factors shape social relationships. Within-group feeding competition can influence individual foraging behavior and access to resources. In scramble competition, the finder encounters and exploits a food patch before the arrival of others, obtaining a feeding advantage. In contest competition, dominant individuals direct agonism towards subordinates to obtain priority access to resources. We investigated the effects of dominance rank (based on the directedness of aggression) and changes in food availability on individual foraging strategies and feeding success in four groups of wild common marmosets inhabiting the semiarid Caatinga. We conducted field experiments simulating distinct conditions of food distribution (one or three of four reward platforms) and productivity (amount of food). We found that common marmosets did not fit the model's predictions regarding within-group feeding competition. Except for the single dominant breeding female of each group (who obtained the highest feeding success in most conditions), rank was not a strong predictor of food intake, as all other group members experienced relatively similar feeding successes. A balance of different foraging strategies related to scramble and contest competition and tolerance of co-feeders played a role in regulating within-group feeding behavior and individual feeding success. These interactions at feeding sites allowed marmosets to maintain group stability and cohesion under different conditions of food availability.

Symposium 5: Building blocks of emotion sharing in primates

Organisers: Raphaela Heesen, Zanna Clay & Mariska Kret

In nonhuman primates, the expressions and sharing of emotional states represent an essential part of social group life. A core way by which emotions can be shared is through emotion contagion, whereby one individual transmits their emotional state to another (Palagi et al., 2020). Emotion contagion involves multiple mechanisms, including motor mimicry such as yawn contagion or facial mimicry. Another, much less studied mechanism that aids emotion sharing is interactional synchrony, which refers to the matching of the timing of behaviours, postures, or actions (Yu et al., 2018). Studies in humans show that mimicry and synchrony among individuals' movements and/or physiology can promote increased affiliation among social interaction partners (Chartrand & Bargh, 1999; Hove & Risen, 2009), prosocial behaviours (van Baaren et al., 2004), sense of commitment (McEllin et al., 2022), cooperative success (Behrens & Kret, 2019; Wiltermuth & Heath, 2009), and empathy (Behrends et al., 2012). Although mimicry and synchrony have been demonstrated in nonhuman primates (Davila Ross et al., 2007; Yu & Tomonaga, 2015), evidence on how these mechanisms link with emotion sharing, as well as their effects on interactional success and relationships, remains limited. Moreover, empirical studies often focus on a singular species and rarely involve direct comparisons, despite a comparative approach being needed to make broader evolutionary conclusions. In this symposium, we address this gap by gathering new empirical evidence on emotional contagion, mimicry, and interactional synchrony in nonhuman primates. Additionally, we intend to provide a theoretical advance in relation to how these processes may be interconnected and linked to emotion sharing, and how they might have evolved. In seven diverse research talks and a synthesis talk, we ask what the evolutionary building blocks of emotion sharing are, how emotion sharing impacts social-interactional success, and how to measure these phenomena non-invasively with state-of-the-art technology.

Yawning, Facial Expressions, And...Smartphones: All Have One Thing In Common!

Elisabetta Palagi¹

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Behavioral synchronization is a common phenomenon observed in a wide range of animals, including humans. This synchronization occurs when individuals perform the same motor actions within a very narrow timeframe and are physically/sensory close to each other. Synchronizing with others offers significant advantages, leading to various benefits depending on the specific type of synchronization. During their one-on-one social interactions, both humans and non-human animals can unconsciously align their motor actions, such as facial expressions or motor activities. In line with the concept of perception-action coupling, the ability to mirror others' behaviors becomes exceptionally beneficial for animals whose survival and reproductive success depend on qualities like unity, cooperation, and social connection. Applying a comparative approach, I will explore proximate and ultimate factors of motor resonance phenomena in different behavioral domains and in response to different stimuli. In particular, I will show that yawning can

evoke a mirror response even when the visual and the vocal components are disentangled thus underlining the importance of the behavior in maintaining subject and group cohesion independently from the sensory modality of the stimulus perceived. Rapidly mimicking a facial expression of the interacting subject can have positive repercussions on the ongoing interaction, promoting, in the long-term, the formation of social bonds. Finally, I will also show data on how some manipulative actions can trigger similar responses in the receivers thus creating the scaffold for shared activities among groupmates - a first step for cultural traditions to emerge. Due to their automatic and reflexive nature, such phenomena offer a unique window on ancient and possibly phylogenetically conserved mechanisms, allowing the study of the building blocks in the evolution of human sociality through a comparative perspective.

Motor mimicry and socio-emotional implications: a comparative approach

Ivan Norscia¹, Giada Cordoni¹

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Motor replication occurs when an observed motor pattern induces the observer to do the same and includes Rapid Facial Mimicry (RFM; mirroring an observed facial expression within 1s). It is debated to what extent motor replication translates into emotional contagion, beyond inter-individual synchronisation. Here, we compare new results on presence and modulating factors of RFM spanning monkeys (e.g. three groups of *Ateles* spp.), apes (e.g. *Gorilla*, *Pan* spp.), and humans (*Homo sapiens*). Data were collected on different primate groups between 2020 and 2023 in different European zoos (Vallée des Singes, Beauval, La Palmyre in France, Mona foundation in Spain), via all occurrences sampling method and audio-video recordings on play behaviour. Our results – based on GLMMs on behavioural bouts and parametric/non-parametric tests on individual/dyadic frequencies - show that the individual and social modulation factors (e.g. social bond, kinship) may be either not evident (e.g. *Ateles* spp.) or not showing a consistent pattern (e.g. reversed effect of social bond and kinship in humans and *Pan*, respectively). Because RFM does not show a unique pattern of social modulation (it does not necessarily increase with social bond or kinship), our results suggest that - as any biological trait - RFM possesses flexible features that are the result of an adaptation to biological and environmental pressures and that are most suitable in the socio-ecological context where they are expressed.

Empathy in chimpanzees and its possible divergence from humans

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¹*Kyoto University*

Emotional matching with others, one of the core elements of empathy, is considered to be important for cooperation in group-living animals, especially in humans. Our previous works have revealed that chimpanzees help others upon request but not proactively, even when they understand the goals of others. We hypothesize that humans tend to engage in

such proactive helping more readily than chimpanzees due to a more contagious inclination of our positive as well as negative emotional valences. Previous studies have reported considerable evidence of inter-individual contagion of negative emotion in non-human animals. However, there has been much less evidence for contagion of positive emotion partly due to the difficulty in determining emotional valences in previous experimental paradigms, and thus the evolutionary origins of human empathetic traits have not yet been fully explored. Here, we are examining the emotional contagion of both positive and negative valences among chimpanzees via the judgment bias paradigm. This experimental design utilizes judgment bias, in which animals experiencing negative emotions are known to judge novel situations and stimuli more pessimistically, and on the other hand under positive emotions judge novel stimuli more optimistically. In a judgment bias task, animals are firstly trained to associate two distinct types of stimuli with positive and negative outcomes. Once training is completed, novel stimuli, which are often an intermediate version of those used during training, are then presented to the animals. Their latency in interacting with these novel stimuli are then used as a measurement of their emotional state via optimistic or pessimistic judgment bias. We have confirmed that chimpanzees' judgment is influenced by emotion-inducing stimuli, such as snake images. This will potentially establish an experimental basis for investigating emotional contagion of both positive and negative valences with this paradigm by using video stimuli of conspecifics expressing emotions, a design which can then be applied to various animal species for comparison.

Sharing emotions through bodily attunement: How to measure synchrony in primate joint actions

Raphaella Heesen¹, Alex Hoi-Hang Chan¹, Prasetia Putra¹, Zanna Clay², Fumihiro Kano¹

¹University of Konstanz, ²University of Durham

Sharing emotions is a key tool for the navigation of social life in most group-living mammals, especially in humans and other primate species. Primates express emotional states during a range of social contexts through facial, gestural, and vocal signals. One process known to facilitate emotion-sharing well documented in the literature is emotion contagion, whereby one individual transmits their emotional state to another through mechanisms such as motor mimicry of the relevant expression. Another, much less investigated mechanism is interactional synchrony, which involves the continuous matching of the timing of actions, postures and behaviours over time. One possible explanation for the relative scarcity of synchrony studies in non-human primates is the absence of suitable technologies for quantifying such fast-pasted bodily movements. Manual coding of these subtle movements, along with their concurrent timing, is not only labour-intensive but also susceptible to coding errors. In this talk, we introduce a method that employs state-of-the-art machine learning techniques to quantify changes in postures, walking synchrony, and focal points of attention in nonhuman apes during their natural behaviours (analysis ongoing). We refine existing algorithms by annotating bounding boxes and body joints in Label Studio, which will largely facilitate the automated categorization of behaviours and the precise quantification of bodily synchrony during

social interactions. We anticipate that this method will significantly contribute to future research on the comparative study of joint action in nonhuman primates.

Emotion sharing and links to emotion regulation and social integration: an observational-experimental study in chimpanzees

Giorgia Sandars¹, Raphaela Heesen², Zanna Clay¹

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Self-regulation – an umbrella term for the ability to control one’s behaviour, attention, emotions and cognition – has been well studied in primates, but mostly just within the cognitive literature. Self-regulation is closely linked to basic emotional processes, and can determine the fundamental ways in which we relate to others. In the human literature, the relationship between emotion regulation and contagious processes is unclear, as some studies suggest a negative association, yet both processes are important for successful social functioning. So far, little research has addressed how self-regulation relates to socio-emotional skills in primates. Here, we explore chimpanzee (*Pan troglodytes*) self-regulation within the context of socio-emotional functioning. We collected data on captive chimpanzees at Edinburgh Zoo (n=12), and are planning a second round of data collection at Twycross Zoo. We assessed regulation skills in a range of emotional contexts, using a delayed gratification task, a social inhibition task, and post-distress follows. We collected Post-Observation/Matched-Control observational focals, to analyse individual differences in grooming contagion, and we also collected social scan data and rank hierarchy data. Analysis is ongoing; we are studying individual differences in self-regulation through coding the chimpanzees’ emotional responses and behavioural regulation strategies across the tasks and observations. We will compare individual differences in self-regulation with the chimpanzees’ social integration and behavioural contagion patterns. We hypothesise a positive correlation between self-regulation and measures of social success (central social position and high dominance rank), and a negative correlation between self-regulation and behavioural contagion. Studying self-regulation within a socio-emotional framework should elucidate new aspects of this suite of skills, and enrich our understanding of the evolution and importance of primate socio-cognition.

Patterns of laugh expression morphology and occurrences in chimpanzee playful exchanges

Marina Davila-Ross¹

¹University of Portsmouth

Laughter is clearly an pervasive positively-grounded behaviour in humans that has multiple forms and social functions, overall helping to promote social cohesion and arguably contributing to our species being characterized as ultrasocial. As such, there is a complexity in form that accompanies a complexity in function, a relationship which seems to develop early in human ontogeny and across cultures, suggesting deep roots in biology. As phylogenetic reconstructions have shown that laughter existed already in the last

common ancestor of great apes and humans, we studied chimpanzees with the aim to better understand such potential laugh complexity in the extant taxon closest to humans. We video-recorded a total of 58 chimpanzees and coded their facial expressions during play as well as their play actions and presence of laugh vocalizations. We tested for replications in accordance to a method developed by Davila-Ross et al. (2008). We focused on rapid and exact mimicry of laugh expressions as well as on delayed replications by examining these apes from infants to mature individuals. The findings suggest that chimpanzees match expressions of their social partners in play in such various forms and across ages. We further found that the playmate characteristics, such as age and sex, has an impact on the production of such expressions in both occurrence and form. These findings contribute to understanding better the extent to which chimpanzee social laugh expressions may show a complexity in both form and function as part of their everyday positively-grounded exchange with their social partners, supporting hereby the Complexity and Continuity Hypothesis of laughter.

Synchrony, mirroring and empathy: Exploring the mechanisms of emotion sharing in primates and its ultimate basis

Zanna Clay¹

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In the last two decades, a blossoming new research field has opened up in the study of emotionality and emotion sharing in primates, as well as in other animals. In part this is thanks to the increasing acceptance that, against a backdrop of decades of behaviourism and cognitivism, animals possess rich emotional lives, and that their affective processes can be empirically investigated. This also goes hand-in-hand with an advent of exciting new technologies and experimental techniques, that can be applied non-invasively in free-ranging settings, that enable animal affective processes to be systematically studied. In this synthesis talk, I will draw together insights garnered from across this symposium along with recent other advances in comparative affective science to consider what we now know about the mechanisms and ultimate basis of emotion sharing in primates. This includes a particular focus on three core forms of emotion sharing, which we examine in this Symposium: synchrony, mirroring and empathy. Exploring the mechanisms and functions of emotion sharing in our closest relatives offers important new insights into its evolutionary basis, both at a broader phylogenetic level and within our own Hominid lineage.

Symposium 6: Long-term field studies on primates: results, lessons learned and future perspectives

Organisers: Chiara De Gregorio & Daria Valente

Without long term studies on primates it would be impossible to answer many important questions on their ecology, behaviour, development and life history. In particular, wild primates' population are particularly challenging to study: they live often in remote habitats, they require long period of habituation to human presence, they require the help of many collaborators and many physical and financial resources. The aim of this symposium is not only to share the major findings coming from many years of data collection on wild primates, but also to evidence poignant aspects (as well as difficulties, unpredictabilities, cool stories, accidents, anecdotes), and to suggest some future directions for this kind of research in such a fast-changing world where we all live in (climate crisis, social and technological development, new viruses).

How our ideas about the social system of wild Guinea baboons changed over the years: Insights into the social system of wild Guinea baboons from long-term data

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¹German Primate Center, ²CRP Simenti, Senegal

While several long-term studies of the genus *Papio* have provided fundamental insights into the social organization, social behaviour and mating patterns of different baboon species, much less was known about the West African Guinea baboons *P. papio*. We therefore established the field station "Centre de Recherche de Primatologie Simenti" in the Niokolo Koba National Park in Senegal in 2007, to study the resident Guinea baboons and settle disputes regarding their social organization. Our long-term data collected since 2010 revealed that Guinea baboons live in a multi-level society. Units consisting of one reproductively active male and one to seven females with their offspring and attached bachelor males comprise the base of the society. Around four units make up a party, and two parties typically make up a gang. However, over the years, we had to acknowledge that there was more variation than we initially suspected. While parties are indeed relatively stable ecological and social entities, gangs became more difficult to delineate over the years. It is unclear whether the greater fluidity is due to a better habituation of surrounding groups, the increasing prevalence of lions in the study area, or both. Moreover, we observed that gangs may break up and that parties may move to entirely different areas. Third, 'bachelor' males may not only bond with one specific reproductively active male, but with several males, thus contributing to the cohesion within parties. These findings underscore the fact that we may underestimate variation in observed patterns when the study duration is short compared to the lifespan of the species. We will put these findings into a broader perspective regarding our understanding of the evolution of baboons.

Estación Biológica Quebrada Blanco - lessons from a small, long-term field site

Sofya Dolotovskaya¹, Eckhard W. Heymann¹

¹*German Primate Center*

Estación Biológica Quebrada Blanco (EBQB) is a research site in north-eastern Peruvian Amazonia, embedded in a largely intact tropical rainforest. Established in 1984 by the Proyecto Peruano de Primatología, it was the place of the first field studies by researchers from the German Primate Center in 1985-86. After field research became a permanent task of the German Primate Center in 1997, EBQB was run by this institution. Engagement of the German Primate Center terminated in 2023, due to the retirement of E.W. Heymann, director of EBQB. Research at EBQB focused on the ecology and behaviour of two sympatric tamarin species, *Saguinus mystax* and *Leontocebus nigrifrons*. Specific topics were the social organization and mating system (including high levels of polyandry) of these species, and their interspecific ecological interactions (seed dispersal, mixed-species troops). Other primate species were studied intermittently, until S. Dolotovskaya initiated a large ongoing project on coppery titi monkeys, *Plecturocebus cupreus*, which provided the first detailed data on the mating system and pair-bond maintenance of this pair-living species. Researchers from other disciplines have also used EBQB, albeit less than the high biodiversity would have allowed for. While 13 primate species occur in the EBQB area, some species, particularly the larger ones, were only rarely encountered in the first 15-20 years, perhaps due to hunting in the area before and in the first years after EBQB had been founded. Involvement of locals as field assistants and sensitive communication about conservation issues have resulted in species like brown capuchin monkeys, *Sapajus apella*, and Poeppig's woolly monkeys, *Lagothrix lagothricha poeppigii*, becoming resident within the EBQB study area. Since 2023, EBQB is administered by the NGO Asociación Científica y de Turismo Comunitario Quebrada Blanco. In the absence of institutional funding, its future existence will depend on attracting research projects and to a minor degree ecotourism.

The value of long-term field studies: Benefits, opportunities and challenges for people and primates

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Primatologists are often attracted to work in the field because of their passion for a particular species and seeing their populations decline owing to human activities. This can lead to species-focused, or ecologically-orientated, approaches i.e., conserving the primate above all else. Long-term field studies have a myriad of benefits, starting from when the project is initiated through to benefits spanning decades. Benefits include a human presence to protect the area while carrying out ecological/behavioural data collection, employment, increased awareness of the area and/or primates present, a deeper understanding of the wildlife itself, the habitat and threats. Long-term benefits are positive impacts on the wildlife (hopefully), fostering collaboration, community engagement, outreach and good science. Political decisions relating to primate conservation are often acts of compromise, with ecological/conservation considerations

often “competing” against other motivations; and successful implementation of political decisions/laws will be constrained by availability of resources and expertise. Failure to consider these realities is likely to lead to failure to achieve primate conservation goals. Faced with these realities encountered in the field, the problem changes from being primarily ecological to social-political-economic in nature. Equally reliable access to long-term funding is an ongoing issue. These benefits, opportunities and challenges are illustrated well in the work of Borneo Nature Foundation in Central Kalimantan, Indonesia over the last 20 years. We have initiated intensive field research and on-the-ground conservation interventions in 3 sites. This includes development of: (1) community engagement and development activities (2) education and outreach (3) collaborative partnerships and (4) conservation actions underpinned by robust science at a landscape level. We outline these work areas and discuss potential barriers and opportunities relating to these and our associated primate conservation goals going forward.

Challenges to and success of long-term field research: lessons from the Tai Chimpanzee Project

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Long-term field research is crucial in answering many questions in ecology and evolutionary biology, e.g. life history, lifetime fitness, estimates of selection, or linkage between generations. In animals with slow life histories, it requires decades of data collection before such questions can be addressed. This is true for chimpanzees (*Pan troglodytes*), a species with a generation time of 15 - 20 years, where infants are totally dependent on the mother until the age of 4-5 years and a longevity of 60 years and over. The Tai Chimpanzee Project (TCP), Tai National Park (Côte d’Ivoire) was started by Christophe Boesch and has observed chimpanzees continuously since 1979. Four neighboring communities of chimpanzees are now observed on a daily basis by teams of local and international researchers. After an initial period of 5-7 years of habituation, we collect behavioural, demographic, and ranging data, urine and fecal samples, vocal and video recordings, as well as general climate and phenology data. These data continue to bring key detail to understanding chimpanzee life history, suggesting a prolonged juvenile dependency where: (a) mothers impact the fitness of their offspring long after weaning, (b) the development of tool use skills continues to adulthood, and (c) old males and females protect orphans or transmit knowledge. Several problems have challenged the continuation of research at TCP. Civil war, disease outbreak or funding loss are only some of them. Western chimpanzees (*P.t. verus*) are critically endangered due to bush meat, pet trade and habitat loss. The strongest predictor of chimpanzee survival is our daily presence in the forest. It is therefore crucial for the survival of the chimpanzees and data collection of the project that the scientific benefits from the research are reinvested into field site.

Long-term research on short-lived lemurs at Kirindy, Madagascar

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The general merits of long-term research have long been identified and appreciated. However, in many cases, only one group or population is chosen for this challenging endeavor, thereby neglecting potential local variation among neighboring groups or populations. Another problem arises when demographic or behavioral changes can be linked to changes in environmental factors, but these factors are typically beyond experimental control. Comparisons among multiple groups or populations of the same species and comparisons among syntopic species can help alleviate these problems by illuminating patterns of local (co-)variation. At Kirindy Forest in western Madagascar, we have been studying four sympatric lemur species since the 1990s. Several groups of Verreaux's sifakas (*Propithecus verreauxi*) and redfronted brown lemurs (*Eulemur rufifrons*) inhabit one local study area that is also home to a population of gray mouse lemurs (*Microcebus murinus*). A second gray mouse lemur population lives 3 km away, together with Madame Berthe's mouse lemurs (*M. berthae*). In this presentation, we will highlight several insights that were derived from comparisons among several groups within species, between different species in the same location and the same species in different locations. For example, syntopic groups of *P. verreauxi* exhibited micro-scale variation in ranging and activity patterns, *P. verreauxi* and *E. rufifrons* differed in female reproductive patterns in the same habitat, and gray mouse lemurs in nearby habitats showed disparate population dynamics that might be associated with the local extinction of *M. berthae*. Thus, different study units appear to maintain significant variation in behavioral and demographic traits across long-term studies.

Insight from the two longest projects on spider monkeys

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Long-term projects are challenging because of logistical, personnel and funding issues, but they provide a wealth of data that allow insights that are otherwise impossible. Here we report insights gained from the two longest continuous projects on identified individuals of any spider monkey species (*Ateles* spp.). To cope with the difficulty in funding our projects, we kept them small. We relied on infrastructure provided by national park and villages and invested in long-term local field assistants as the backbone of the projects to provide continuity. We discovered that the species' social dynamics are more complex and flexible than previously thought. We documented the absence of dominance combined with rare, targeted aggression. Through a multiplex network approach, we unveiled the differential contributions of spatial cohesion and social interactions to social structure. Our datasets provided the opportunity to document flexible adjustments to naturally

occurring extreme climatic events, such as hurricanes and droughts, and home-range changes as a function of forest regeneration. The accumulation of data on rare behaviors, such as predation, infant mortality and adoption, between-species interactions, and medicinal use of soil and plants, allow us to understand their patterns and functions. We revealed the existence of behavioral traditions across populations. As this behavioral diversity may provide critical behavioral reservoir when environmental conditions change, unique populations can be considered as important conservation units. Long-term demographic records provided details on the species' longevity and fecundity in natural conditions and, coupled with population surveys, allowed us to evaluate the long-term population viability, which has informed the conservation of other populations in the same regions.

Many years, many lemurs and a lot of rain: long term studies in the Maromizaha forest, Madagascar

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The Maromizaha New Protected Area is a 2100 ha reserve located in North-eastern Madagascar, it hosts a huge variety of endemic fauna and flora, and it is home to at least 13 species of lemur, including two Critically Endangered species only found in the reserve or its immediate surroundings. Since 2009, the Ethology lab of the University of Torino established a program for long-term training and research, biodiversity conservation, and sustainable development through the involvement of the local community, contributing to the forest protection and the long-term monitoring and study of different lemur species. Taking a quantitative approach to the study of critically endangered animals living in the forest and not manipulating them in any way often means having to wait several years to collect an adequate number of samples. Here we show the critical role of a 14-year long-term research project in providing insights into demographic, behavioral, socioecological, and environmental factors impacting different aspects of indri population such as its mating system, behavior development, and life history. Among the main findings emerging from our long-term monitoring we highlight a) a strong territorial behavior in indris, with territories that remain stable over the years, a high degree of territory exclusivity, and a crucial role of the vocal behavior in mediating inter-group spacing and dynamics. b) The presence of genetic monogamy, with a single case of extra-pair copulation documented in more than 15 years. c) A life expectancy for both sexes of 30-35 years, but high infant mortality. d) A vocal communication which is not predetermined at birth but changes during ontogeny. Moreover, our work demonstrates that long-term field studies can have an important impact on forest conservation and, therefore, on the distribution, territory, and primate group size.

Symposium 7: Medical cognition in non-human primates: Prospects and challenges
Organisers: Simone Pika & Tobias Deschner

Medical practices are deeply rooted in humans' history and culture with first evidence possibly dating back to Middle Paleolithic hominins. The diversity of organic matter used is huge, involving plants, plant material, animals and animal matter for prophylactic and therapeutic purposes. Medical practices involve self-medicative behaviors, referring to individuals ingesting or applying things that make them feel better and preventing diseases, but also cooperative, altruistic-medical behaviors, whereby helpers receive no immediate benefits and individuals helped are non-related. The latter have been implicated with complex cognitive skills such as social learning, conscious decision-making, future planning, and empathy, a cognitive tool-kit referred to as medical cognition. Although medical behaviors are widespread across other primate species, insights into involved cognitive skills are very limited and centred so far on the role of learning versus hard wired responses. This talk will represent the kick-off for the symposium on primate medical cognition to help draw attention to this fascinating research field, and to discuss and link current research and findings from research on social learning, future planning, and empathy.

Molecular assessment of a wild primate's diet at the intragroup level

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Assessing the diet of wild animals provides valuable information about their ecology and behaviour. In the research field of primatology, this is traditionally based on a variety of observation methods. However, it is difficult to obtain comprehensive observational data, as feeding habits are often difficult to observe in detail in the wild. The analysis of faecal samples using environmental DNA (eDNA)-based techniques opens further perspectives to investigate a species' diet. Recent DNA metabarcoding assays in primatology resulted in increased taxonomic resolution and coverage, i.e. revealed additional prey items and at lower taxonomic levels compared to observational data. Here, we assessed dietary variation targeting the plant and arthropod part of the diet inferred from DNA metabarcoding in an omnivorous primate, the vervet monkey (*Chlorocebus pygerythrus*). We analysed 950 faecal samples of 90 wild individuals from a social group in South Africa collected over 4 years. The attribution of samples to individuals with known life history data in our study system allows to assess the potential influence of social factors on feeding behaviour. We found a strong effect of season on variation in plant consumption. In addition, we showed that including social factors such as sex and age is valuable to further understand individuals' foraging decisions. We will discuss the potential of this method to study inter-group and small-scale variation in diet as well as group-specific behaviour, e.g., potential medicinal foraging.

Peering into the unknown: Social learning of complex food processing tasks in Chimpanzees (*Pan troglodytes*)

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When peering, animals gaze towards another individual within such a close range that detailed observation of its actions is possible. Peering behaviour is observed in multiple primate species and is validated as an indicator for social learning in orangutans (*Pongo spp.*). However, detailed data on peering behaviour of chimpanzees (*Pan troglodytes*), especially in the foraging context, is missing, as well as an understanding of its function. Here, a total of 561 feeding bouts of 8 chimpanzees in ARTIS Zoo were analysed, showing heightened peering probabilities towards chimpanzees eating novel food items, relative to familiar food items. Peering probabilities were also higher towards dominant individuals. Furthermore, a Network Based Diffusion Analyses showed that peering decreased the latency of exploring the precise act of leaf-swallowing. Our study therefore adds to the growing evidence that peering behaviour can be used as an indicator for social learning.

Socio-emotional responses as a form of palliative and restorative care in primates

Jake S Brooker¹, Christine E Webb², Zanna Clay¹

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Primates exhibit diverse social structures that appear to vary considerably regarding socio-cognitive and socio-emotional behaviours. One such capacity we appear to share with other primates is caring responses to distress, injury, and death within communities. Drawing on wild, semi-wild, and captive observations, we present a review and discussion to shed light on the nuanced ways various primates appear to demonstrate empathic tendencies towards others in need. Some primates respond to distress through offering comforting contact, assisting physically injured individuals, and protective behaviour such as scanning and alarm calling. We discuss the underlying motivations and cognitive mechanisms that may be driving such responses. Furthermore, mourning, prolonged proximity to deceased individuals, and communal behaviours indicative of grief provide insights into the deep emotional lives of primates. With particular attention on instances where group members actively respond to injured, dying, or dead individuals, we highlight the significance of the social bonds that foster such collective care in the face of injury and death. We aim to draw connections between such behaviours and their potential evolutionary adaptation, considering the consequences of impaired social care and functioning in primates, and how this may lead to reduced fitness. We conclude that comforting and assisting of injured or dying groupmates reflect deep socio-emotional

connections and propose that these behaviours may demonstrate a form of palliative and restorative care in non-human primates. Understanding the intricate and diverse nature of primate social structures contributes not only to the study of ethology but also allows us to reflect on shared emotional and social capacities between humans and our closest living relatives. We invite contemplation on the evolutionary roots of empathy and care in the primate lineage and fitness consequences of impaired socio-emotional development.

Unearthing the roots of medicinal behaviour and cognition in *Pan* species

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Medical practices in modern humans involve a complex cognitive toolkit (e.g., causal understanding, decision-making, problem solving, and future planning), cooperation and empathy (i.e., prosociality). Therefore, the question arises whether these aspects of modern human medicative practices are unique to *Homo sapiens*. To date, majority of the research within the primate lineage on nonhuman primates, have primarily been focused on one of our closest living relative, the chimpanzee (*Pan troglodytes*), and on their self-medication. For example, ingesting specific leaves to treat parasitic infections (e.g., Huffman et al., 1996; Krief et al., 2006). However, relatively little is known about treating conspecifics, the underlying cognitive skills, and the involved social dynamics of the medicative behaviours. Here, we will present a brief overview of the existing research on medical behaviours and related cognitive skills in nonhuman primates, especially *Pan* species. Subsequently, we hope to stir more research interest into this phenomenon by introducing a new collaborative project - “*Pan* prescription: medical behaviour and cognition” project - which will investigate medical behaviours (i.e., wound-tending) of *Pan* species, living in their natural environments, with a special focus on the underlying cognitive skills and involved social dynamics. The project will address five proposed medical concepts that encompass human medical cognition, cooperation and prosociality, which are (i) medical knowledge, (ii) medical effectiveness, (iii) medical navigation, (iv) medical collaboration and (v) medical altruism. Hence, considering the characteristics (age, sex, affiliation, relatedness, and rank) of individual(s) engaged in a medicative behaviour. This project also aims to bridge collaborations across multiple field sites of *Pan* species to develop an extensive dataset. Overall, the “*Pan* prescription: medical behaviour and cognition” project will provide valuable insights into the evolutionary trajectory and shared features of medical cognition, cooperation and prosociality of *Homo sapiens* with the *Pan* species.

Healthcare behaviors in the wild chimpanzees of Budongo Forest: A site-specific review

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This talk evaluates self-directed and other-directed wound care behaviors in the Sonso and Waibira chimpanzee communities of Budongo Forest using archival reports from over thirty years of observation, videos recorded by Budongo researchers, and behavioral data collected over two four-month direct observational periods. Self-directed wound care behaviors such as wound licking, finger pressing, leaf dabbing, and application of chewed organic material to wounds are described, as is a self-directed attempt at snare removal. We also document self-directed hygiene behaviors including post-coital genital wiping and self-cleansing after defecation using leaves. For the first time, we also report the presence of social-care in Budongo, including other-directed physical social assistance of snared individuals, wound licking, and post-coital hygiene behaviors. The presence of social-care behaviors between related and unrelated individuals at this site suggests that the capacity for other-directed social-care may be more widespread in chimpanzees than previously reported. Further investigation into self-care and social-care behaviors in non-human primates is needed to better understand the evolution of these behaviors in humans.

Active wound treatment with a biologically active plant in a wild Sumatran orangutan

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Even though self-medication in non-human animals is rare, there is evidence of antiparasitic leaf ingestion, bitter pith chewing, or hair rubbing in some African apes, Bornean orangutans, capuchin monkeys, and gibbons. So far, only chimpanzees have been observed to actively treat their wounds with a substance. We observed a male Sumatran orangutan (*Pongo abelii*) who sustained a facial wound. Three days after the injury he selectively ripped off leaves of an Akar Palo liana (*Fibraurea tinctoria*), chewed on them, and then repeatedly applied the resulting juice on his facial wound. Afterwards he fully covered the wound with the chewed leaves. Akar Palo is found in the tropical forests of Southeast Asia and is known for its analgesic, antipyretic, antidote, and diuretic effects. It is used in traditional medicine to treat various diseases, such as dysentery, diabetes and malaria. Analyses of plant chemical compounds show the presence of furanoditerpenoids and protoberberine alkaloids, which are known to have antibacterial, anti-inflammatory, antifungal, antioxidant, and other biological activities. This possibly innovative behavior presents the first known case of active wound medication with a biologically active

substance in a wild animal and provides new insights into the origins of human wound care.

The interplay between cognition and instinct in the evolution of animal self-medication

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The ability to medicate exists across the animal kingdom. Animals treat themselves and sometimes others with a wide variety of bioactive compounds to protect against parasites, wounds, reproductive function, stress, and fatigue. The modes of medication are equally diverse, including passive prevention, ingestive-therapeutic treatment, topical preventative or therapeutic application of substances to skin, fur, or feathers, and fumigation of habitats. Similarities across distant taxa point to a long evolutionarily stable continuum of medicative strategies for the maintenance of health. Instinctual and cognitive processes should play an interactive role allowing an individual to access the complex and ever-changing resource base and navigate the infectious disease landscape in which it lives. Building on case studies of primates, we will show that medicative behaviors can arise from a combination of instinct, associative learning, and social interactions. When an individual experiences malaise, gustatory responses have been shown to shift and develop into a preference for limited amounts of such toxic items, resulting in medicinal benefits. Healthy primates living in multi-generational societies can learn from observing the behavior of the self-medicator about which part of a particular medicinal resource can be ingested and how, in the same way, dietary information is acquired by young and maintained in a group as a cultural tradition. Subsequently, they may learn to associate similar relief if taken when sick themselves. Having discussed specific studies in primates, we will then demonstrate that the same combination of instinct and individual and social learning can explain the evolution and emergence of medication behaviors in a wide variety of animals, from apes to ants. Learning more about the development and expression of these medicating strategies in a variety of animal species will help us to better understand the interplay between instinct and cognition and their roles in the evolution of our medicinal behavior.

Symposium 8: Prosociality in Primates

Organisers: Sacha Engelhardt, Claudia Fichtel & Jorg Massen

Prosocial behaviour, benefitting another without any apparent direct benefit to oneself, is perhaps the most important glue that holds human societies together. But, while the frequency and magnitude of prosocial behaviour may be uniquely human, the behaviour itself is not, and various forms of interactions in which an individual provides a benefit to one or more conspecifics are also found in many animal societies. In the last decades, this has triggered a whole field of research in comparative psychology and animal behaviour aimed at discovering the phylogenetic history of this behaviour. Despite numerous experimental studies of prosocial behavior in mammals and birds, however, there are as of yet no consensual explanations for its evolutionary causes. In this symposium, we aim to bring together researchers working on prosocial behaviour in non-human and human primates, as well as some other species, to showcase their latest findings and to address recent controversies and challenges in the study of prosocial behavior.

Parochialism and Neighbour Nastiness in Humans

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Like other group-living species, humans display parochial cooperation, that is they cooperate with ingroup members more than with outgroup members and strangers. Theoretically, one might assume that humans also show parochial competition, that is compete less with ingroup members than with outgroup members and strangers. However, in a direct test we observed the opposite pattern, akin to what in other species is known as the 'nasty neighbour effect'. People competed more with ingroup members in dyadic contests across 51 nations (study 1, N=12,863), in different communities in Kenya (study 2, N=552), and in an on-line sample from the United Kingdom (study 3, N=401; study 4, N=300; pre-registered replications). This 'nasty neighbour' behaviour can emerge independent of parochial cooperation and trust towards others that have the same (versus different) nationality (study 4) or are randomly assigned to in- and outgroup (study 5, N=552). Fitting field-observations in other species, within-group nastiness emerged especially among individuals concerned with within-group status-ranking and resource scarcity (study 3, 4 and 5). Results are more difficult to reconcile with prevailing (multi-level section) theory on the evolution of cooperation based on selective group extinction than with recent advances in inclusive fitness theory.

Meta-analysis of prosocial behaviour in non-human mammals and birds

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Prosocial behavior is defined as any behavior that is intended to benefit another individual. This behavior does not need to be costly. We conducted a phylogenetically

controlled meta-analysis in order to investigate how much variation in non-human mammalian and avian prosocial behavior can be explained by different experimental approaches and prosocial-choice paradigms. We examined if variation in prosocial behavior can be predicted by social organization and care systems, and their associated social tolerance. We calculated Hedge's *g* as the effect size to compare the outcome conditions for the actor and the recipient: 1) selfless (0/1) vs spiteful (0/0), 2) mutualistic (1/1) vs selfless (0/1), 3) mutualistic (1/1) vs selfish (1/0), 4) selfish (1/0) vs selfless (0/1), and 5) mutualistic (1/1) vs spiteful (0/0). We classified the experimental design according to the prosocial taxonomy (instrumental need, unmet material desire, emotional distress) and the techniques used in the experiment (GAT: helping, token exchange, or release paradigm; PCT: bar-pulling, symbol/token; group service). We included the extent of allomaternal care, the care system (cooperative breeding, communal breeding, group-living), and the sex and age classes of individuals tested. The meta-analysis included over 40 studies, 160 test effect sizes and 54 control effect sizes to investigate which factors may explain the evolution of prosocial behavior.

The love hormone in context: Oxytocin responses to social interactions in a small-scale human society

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Oxytocin (OT), known as the 'love hormone,' crucially impacts human social behaviour. Recent research suggests that OT modulates both prosocial and antisocial behaviour, suggesting a role in cooperation as well as competition. We investigated natural oxytocin responses to social behaviour in Bolivia's Tsimane society. We hypothesised increased OT levels during 1) competitive scenarios, especially when involving outgroups, and 2) in cooperative interactions, especially with partners of limited familiarity. Overall, 434 urine samples were collected in March/April 2023, and OT levels were assessed using radioimmunoassays. More precisely, 67 samples (18 women, 49 men) were obtained immediately before and after inter-group competitions such as football matches. Using Bayesian models controlling for age, sex and individual identification, we demonstrated a significant increase in oxytocin levels in males in competitive contexts, lending support to our hypothesis concerning the mediation of in-group cooperation and inter-group competition. To better understand modulators of the OT response, we incorporated additional variables, including outcomes such as winning or losing, the stakes involved in the game, the type of outgroup, self-reported satisfaction with teamwork, and perceived competitiveness of the outgroup. In addition, 91 samples (49 women, 42 men) were classified by level of familiarity in the contexts of (a) being alone, spending time with (b) close relatives, (c) extended family members, friends or neighbours, (d) people from another cluster or (e) in community-level social contexts. Each sample was assigned to one of these specific contexts using behavioural observations and personal interviews. Although analyses are ongoing, our preliminary prediction suggests that oxytocin levels increase as partner familiarity decreases, reflecting the need for updated assessments and the higher risks in less familiar cooperative relationships.

On the importance to differentiate between selfless and mutualistic prosocial behavior

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Prosocial behavior can be selfless, providing a benefit for the recipient only, or mutualistic, providing a benefit for both, the actor and recipient. Here, we show that the distinction between selfless and mutualistic prosociality is crucial to understand the evolution of prosociality. We tested cooperatively breeding common marmosets and non-cooperatively breeding ring-tailed and black-and-white ruffed lemurs in a token-choice paradigm offering, first, a choice between four outcomes (selfless-selfish-mutualistic-spiteful) and second, forced choices between two outcomes (selfless-spiteful, selfless-selfish, selfish-mutualistic). In the first experiment, all species selected the selfless token least often and common marmosets preferred selfish over mutualistic choices compared to lemurs. In the forced-choice experiments, common marmosets showed only selfless behavior when they could not optimize their own benefit. Lemurs, however, showed higher mutualistic prosociality than marmosets. Hence, selfless prosocial behavior might be more common in species that show strong interdependence in allomaternal care or collaborative foraging whereas mutualistic prosocial behavior might be crucial to promote and maintain sociality in group-living species.

Prosociality in macaques and birds; The interdependency hypothesis

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Prosocial behaviours have long been considered uniquely human, yet over the past decades, more and more evidence for prosociality in nonhuman animals has surfaced. Nevertheless, there seems to be large variation across species, and the specific selection pressures that may have caused prosocial preferences to evolve require further investigation, particularly while using consistent study designs that allow for proper comparisons across species. So far, there have been two leading hypotheses trying to explain the evolution of prosociality: the self-domestication hypothesis and the cooperative breeding hypothesis, which both suggest that tolerance at the group level may have aided in the evolution of prosociality. Building on previous work by Burkart and colleagues in primates, we used a group-service paradigm to test for prosociality in 8 different corvid- and 4 different parrot species. We found high prosocial tendencies in both cooperative breeding species and colonially nesting species, partly corroborating the findings of Burkart and colleagues in 15 primate species, and thus indeed suggesting that tolerance at the group level (or at the nest in birds) may have been one of the selection pressures in the evolution of prosociality. However, when we tested 6 different macaque species in the same paradigm, we found that the more despotic (i.e. less tolerant at the group level) species showed higher prosocial tendencies than the more egalitarian (i.e. tolerant) species. The despotic macaques were, however, very specific with regard to

whom to benefit with their prosocial behaviour. Since cooperative and colonial breeders rely heavily on group-members in general, and individuals of despotic species on particular alliances, we propose an interdependency hypothesis. I will discuss this hypothesis in light of (the specificity) of partner-choice.

Maternal styles matter! Food sharing among mother-offspring pairs in bonobos (*Pan paniscus*)

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Human society has evolved into a cooperative system founded on extended levels of prosociality. To understand the evolutionary origins of prosociality, our closest living relatives, bonobos (*Pan paniscus*), have been studied with prosocial tasks, yet leading to mixed results. Part of these inconsistencies are due to the use of different tasks with different benefits for the test subjects. In this study we measured prosociality in the Zoo Planckendael bonobo group (N=14) in Belgium by implementing two prosociality paradigms: group service paradigm (GSP); and prosocial choice task (PCT). In both tasks the bonobos could freely choose to provide food to conspecifics or not and the tasks differed in the amount of benefit the subject would obtain when providing food to a recipient (GSP < PCT). In the GSP, subjects never received a reward when providing food to a recipient. In the PCT, subjects would always obtain a high value reward for choosing any option. Analyses show that overall prosocial tendencies in bonobos were low; infants and subadult bonobos behaved more prosocially than adults; and bonobos behaved more prosocially when subjects could benefit themselves. Additionally, we ran a mother-offspring experiment where juveniles got privileged access to a food reward to investigate whether bonobo mothers would allow their offspring to eat the desired food. Data analysis is ongoing, but preliminary results show that bonobo mothers behaved selfishly by manipulating their offspring to steal the obtained food rewards. In conclusion, our studies show that the bonobos were motivated to obtain rewards for themselves but less to provide benefits for group members, including their own offspring, providing an important nuance to the existing view on the prosocial and food-sharing nature of bonobos.

Food-related interactions in socially housed chimpanzees (*Pan troglodytes*): within-species variation and ontogeny

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Food sharing is a prosocial behaviour frequently studied in chimpanzees –both in wild populations and under human care. However, studies considerably differ in both their

understanding of which food-related interactions are considered food sharing and their methods, which range from natural observations to group, dyadic or triadic experiments. Therefore, substantial differences in the results across studies are difficult to interpret. In this talk, we will present cross-sectional and longitudinal data from food-sharing tests with chimpanzees conducted between 2017 and 2023 in six zoos and one sanctuary ($N_{\text{individuals}} = 75$, age range: 1-53 yrs). All studies are based on the same concept of food sharing, defined as the voluntary and intended transfer of defendable food from one individual to another. In all tests, we applied the same method previously introduced in a study with orangutans: We provided large and compact fruits to chimpanzees in their usual social environment and continuously video-recorded all food-related interactions. In using this type of monopolisable food, the test setup resembles typical situations in which chimpanzees in their natural habitat are known to share food and, therefore, foster the comparison of food-sharing patterns across sites. The coding schemes, although differing in some details, include the same main variables operationally defined in the same way across studies. The resulting large and expandable dataset enables analysis and informed discussion of within-species variation in possessor-solicitor interactions, food-getting success, proportion of active transfers and types of request behaviour from a comparative and developmental perspective.

Prosociality beyond the dyad: interdependence, relatedness and rules of thumbs

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Species comparisons are essential to understand the evolutionary origin of prosociality and require robust and valid methods such as the group service paradigm. When applied to 26 groups of 16 primate species, inter-specific variation in prosociality is best explained by allomaternal care, which has strong implications for human evolution. These findings can be complemented by systematic patterns of intra-specific variation because it provides the substrate that evolution can act upon. We therefore leveraged data from 19 groups ($n=86$ individuals) of cooperatively breeding marmosets who like humans systematically rely on allomaternal care. First, we investigated how group composition, sex, status and rearing experience influence prosociality. In addition to intrinsic individual differences, we find strong interaction effects between age and experience: male helpers who provide more allomaternal care with increasing age and experience also increase in prosociality. Second, 14 of these groups were part of a larger project that addresses the consequence of experimentally manipulated interdependence on prosociality. First results suggest that more interdependent groups indeed increase prosociality, but further data points will be needed to test the robustness of this interim result. Finally, despite marmoset groups being composed of closely related individuals, prosociality is also present between non-related individuals. Rather than estimating relatedness and adjusting prosociality accordingly, marmosets apparently use a rule of thumb and behave prosocially towards those considered as ingroup. We thus find that (i) intra-specific variation in marmoset prosociality mirrors inter-specific variation because in both cases,

the amount of allomaternal care is key; (ii) high ecological interdependence may further increase prosociality; and (iii) genetic relatedness obviously played a role in the emergence of prosociality but is no longer used to inform helping decisions which are rather based on the rule of thumb of mere group membership. We discuss the implications for human evolution, including our strong ingroup-outgroup psychology.

Food sharing in human children from three different cultural contexts

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Existing research indicates that by the age of 8, children exhibit an aversion to inequality, whereas younger children, aged 3 to 5, often display a self-favoring tendency (Fehr et al., 2008). Sharing norms, reflective of cultural values, are likely to vary across communities (Rochat et al., 2009), yet much of the existing literature has predominantly focused on children from Western industrialized societies. To broaden our understanding of children's sharing behaviors across different cultural contexts, we conducted a comparative analysis involving children between 3 and 13 years from three distinct communities: two small-scale-societies, Bemba from rural Zambia (N=19) and ≠Akhoe Hai||om, a hunter-gatherer group in northern Namibia (N=38), as well as children from a Western industrialized urban setting in Germany (N=40). Building on previous studies (Rochat et al., 2009), we anticipated an increased tendency toward fair sharing with age and the presence of another child, irrespective of age. Following a distracter task, children were presented with six high-quality food items and given the option to take as many as they desired, with the provision to leave some for a subsequent child. The subsequent child was either present or absent during the decision-making process. Contrary to our expectations, the frequency of equal distribution responses did not increase with age. As predicted, the presence of another child increased the likelihood of fair sharing across all communities and age groups. Overall, relative to German children, Hai||om children tended to favor themselves more strongly. This result can be attributed to distinct "sharing cultures" prevalent in the respective communities. German children are socialized to avoid inequality, fostering a predisposition towards equitable sharing, while the ≠Akhoe Hai||om rarely participate in spontaneous or unelicited sharing; instead, their sharing practices are typically initiated on demand (Widlöck, 1999). Consequently, during the experiment, ≠Akhoe Hai||om children demonstrated a tendency to appropriate a greater portion of the food, influenced by the expected demands from other group members seeking their share immediately after the child completed the experiment.

Symposium 9: Using AI to decode primate communication

Organisers: Adrian Soldati & Catherine Hobaiter

Artificial Intelligence (AI) has become a driving force in modern society as well as in scientific inquiry, wielding novel and unparalleled capacity to rapidly analyse vast datasets, discern complex patterns, and is emerging as a powerful ally in animal behaviour research. The recent surge in AI applications provides an exciting new suite of tools but also a challenging new landscape to navigate for primate researchers. In this symposium, we bring together researchers working with the most recent AI tools, including machine learning, used to further our understanding of primate communication, with a focus on vocal, facial, and gestural signals. Through data-driven approaches based on natural observations, AI can be used to analyse form variants, context of usage, and sequential production of multiple signals. Ultimately, AI can overcome traditional limitations (e.g., time and resources) and facilitate the creation of large collaborative projects across sites and groups. As an example, a recent preliminary study by Jiang et al. (2023) used deep neural networks trained on human language to automatically detect and classify great ape calls from field audio recordings with great accuracy. Wiltshire et al. (2023) developed an innovative use of machine learning to track movements of great apes in their natural environments, showcasing AI's potential to automatically decode communicative behaviour from videos. This symposium will promote discussion and exploration of AI's role in advancing research on primate communication, as well as its implications for conservation and the evolution of human language. Because AI's transformative impact on the study of animal behaviour is evidently growing, this symposium will also represent a unique opportunity to address its wider significance and examine ethical concerns and limitations.

Using machine learning to decode animal communication

Christian Rutz^{1,2}

¹University of St Andrews, ²Earth Species Project (keystone partner)

In this talk, I will outline a conceptual framework for using machine-learning methods for characterizing, and functionally decoding, the communication systems of non-human animals (Rutz *et al.* 2023, *Science* 381, 152–155. <https://doi.org/10.1126/science.adg7314>). Drawing upon ongoing collaborative research on cooperatively-breeding carrion crows (*Corvus corone*) and tool-using Hawaiian crows (*C. hawaiiensis*), I will explain important aspects of data collection, data processing, and experimental validation, illustrating how workflows could be adapted for research on primates. Placing these examples into broader context, I will discuss the potential benefits of research in this fast-moving field (e.g., transformative insights; application to animal conservation and welfare) as well as some of the major challenges that lie ahead (e.g., ethics; data availability; validation). I will conclude by briefly introducing the Earth Species Project (<https://www.earthspecies.org>) – a collaborative non-profit organisation using machine-learning-assisted approaches to decoding the communication systems of a wide range of animal species.

Using large vision language models for species detection in the wild

Markus Marks¹, A. Ding¹, M. Hu¹, Kelly Ray Mannion³, Viola Komedová⁴, Liran Samuni², Erin Wessling², M. Fitzgerald⁵, Kathelijne Koops⁵, Thibaud Gruber³, Catherine Hobaiter⁴, Pietro Perona¹

¹California Institute of Technology, ²German Primate Center, ³University of Geneva,

⁴University of St Andrews, ⁵University of Zurich

Primate, anthropology, and psychology research often rely on the analysis of video data to study primate behavior in the wild. However, manually analyzing the large amounts of data collected during field trips is time-consuming and prone to error. While machine learning has helped automate some of the analysis of behavior in the lab, accurately analyzing the behaviors of primates in the wild remains a challenge. Recently, large vision language models have shown great success in generalization across multiple domains and zero-shot detection performance. Here, we demonstrate how LVLMs, specifically GroundingDINO together with Segment Anything (SAM), can be used to detect and segment primates and other species in the wild. For training and evaluation, we collected a dataset from three field sites spread across 21 locations. We evaluate zero-shot recognition performance across species, cameras, field sites, and behaviors. Furthermore, we illustrate failure cases and how few-shot learning can help overcome them. Finally, we provide a tool for the community to upload and analyze their field data fully in the cloud without requiring expert knowledge.

Machine learning-based primate vocal repertoire analysis: Who's learning

Marco Gamba¹, Daria Valente¹, Olivier Friard¹, Valeria Ferrario¹, Longondraza Miaritsoa¹, Bakri Nadhurou¹, Chiara De Gregorio¹, Walter Cristiano¹, Filippo Carugati¹, Silvia Leonetti¹, Teresa Raimondi², Valeria Torti¹, Cristina Giacoma¹

¹University of Torino, ²La Sapienza University of Rome

The application of machine learning in speech and animal vocal communication shows a critical twofold difference. Firstly, animal sounds are often recorded on an ad hoc basis for analysis, so they are more limited in number than the plethora of human signals that we can extract from multiple sources. Secondly, due to the availability and commercial interest in the human voice, we know much more about our voice compared to the variability of the voices of other primate species. In this paper, we aimed to investigate in a comparative perspective the emissions of *Eulemur fulvus*, *E. coronatus*, *E. rubriventer*, *E. flavifrons*, *E. macaco*, *E. mongoz*, *Indri indri*, *Propithecus diadema*, and *Varecia variegata*. We performed feature extraction using Mel-frequency cepstral coefficients (MFCC) and one-third octave band analysis using multiple supervised techniques such as Multi-layer Perceptrons and Random Forest Classifiers, contrasting their results against unsupervised techniques such as CLARA clustering. In our study, Random Forest Classifiers performed better than other approaches, always showing correct classification rates higher than chance, showing how MFCC can help categorize nonhuman primate calls in various species. We discuss how environmental noise often becomes one of the critical elements in selecting the variables we use in machine learning applications and how we can take precautions to avoid biased classification of the vocalizations. These precautions are

essential now, as the collection of recordings of nonhuman primate species is increasing, thanks to autonomous devices. We also discuss how using multiple approaches may be critical to highlighting different features of the same set of calls and how mining large sets may force choices regarding the numerosity of the call types and vocalizations. If we use knowledge of the data to choose the appropriate parameters for the analysis, machine learning indeed provides essential tools for the study of nonhuman primate vocalizations.

Machine learning and mathematical modeling as complementary approaches to decode primate communication: examples from marmosets

Nikhil Phaniraj¹, Kaja Wierucka², Judith M Burkart¹

¹University of Zurich, ²German Primate Center

Machine learning has emerged as a beneficial tool for animal behavior research, showcasing proficiency in data analysis and pattern recognition. Nonetheless, its interpretability diminishes as models become more biologically realistic. We explore the challenges associated with the interpretability of machine learning models for primate behavior, offering solutions using marmoset vocal behaviors as examples. Common marmosets are highly voluble group-living monkeys with a complex communication system. Their volubility presents a major challenge in determining which individual in the group vocalized. We developed an adaptive boosting-based hierarchical machine learning classifier that accurately determines the caller-identity from marmoset vocalizations. It can achieve accuracies of up to 97.8%, surpassing traditional non-hierarchical methods. While it streamlines caller-identity determination and captures inter-individual differences and temporal changes in calls, it falls short in elucidating the mechanisms underlying such changes. To resolve this, inspired by dynamical systems theory, we mathematically modeled the temporal changes in marmoset calls. Our model shows that marmosets learn certain aspects of calls from their partners, leading to vocal convergence with time. It suggests that marmosets continuously update the memory of their partner's vocalizations and modify their own vocalizations to match them, a dynamic form of vocal learning. The model provides crucial insights into the mechanisms underlying adult forms of primate vocal learning. In summary, while machine learning models excel at classification and pattern recognition, mathematical modeling aids in understanding the mechanisms underlying animal behaviors. Primatologists can maximize their understanding of primate communication by employing these two tools as complementary approaches.

Understanding great ape calls and gestures with deep pretrained neural networks

Zifan Jiang^{1,2}, Adrian Soldati^{1,2}, Catherine Hobaiter³, Steven Moran^{2,4}

¹University of Zurich, ²University of Neuchâtel, ³University of St Andrews, ⁴University of Miami

Recent developments in artificial intelligence have made remarkable progress in comprehending human language, speech, and visual perception through extensive

datasets and deep pretrained neural networks. However, the application of these technologies in animal communication research faces challenges due to the lack of reliable and interpretable open-source data. Our study investigates the transferability of cutting-edge technologies developed for human language data to the domain of animal communication systems. Specifically, we use deep pretrained neural networks to model and understand the calls and gestures of great apes, our closest biological relatives. Our exploration starts with an attempt to automatically detect and classify various call types of orangutans, chimpanzees, and bonobos, from noisy field research recordings. We find that the wav2vec 2.0 model –pretrained on a large corpus of human speech –generalizes surprisingly well as an audio feature extractor for great ape calls without additional fine-tuning. Next, we expand our approach into the vision domain by leveraging contrastive learning –inspired by the CLIP model –on The Great Ape Dictionary dataset. Aligning texts and videos of great apes in a common latent vector space facilitates applications such as identity recognition and gesture recognition. Given the typically prohibitive cost of video understanding networks, an alternative strategy involves estimating the skeletal key points of animals from raw videos. Human pose estimation technology such as Mediapipe Holistic is mature, but less is known about its application to animals. Therefore, we plan to also apply the DeepWild model which tracks the movement of great apes in video data for better video understanding. In this talk, we report on these results from both the vocalization (published) and the gestural (in progress) domains.

Using of audio-visual action recognition to study communication

David Schofield¹

¹*University of Oxford*

Recent advancements in computer vision and deep learning have opened up new frontiers in the study of primate behaviour and communication. Previous approaches have utilised deep convolutional neural networks (CNNs) to detect, track and classify individual primates to a high degree of accuracy, and the output of this approach can be used to generate social networks. Multi-modal 3D spatio-temporal CNNs, which utilise both visual and audio signatures of behaviour, can be used to classify individual actions across time and space - for example to track percussive behaviours such as tool use or communicative actions such as buttress drumming. I review these methods to examine how they can be used to study communication in West African chimpanzees (*Pan troglodytes verus*), and how these approaches can be layered with other models (e.g gaze direction and pose estimation) to more comprehensively quantify social interaction and communication between individuals in the wild. I introduce an open-source tool kit for detection, tracking and recognition more accessible to researchers to reproduce this framework on their own species and datasets.

Application of the pose estimation tool DeepLabCut for behaviour tracking in wild chimpanzees and bonobos

Charlotte Wiltshire¹, James Lewis-Cheetham², Viola Komedová¹, Tetsuro Matsuzawa^{3,4,5}, Kirsty E Graham¹, Catherine Hobaiter¹

¹University of St Andrews, ²Cardiff University, ³California Institute of Technology, ⁴Chubu Gakuin University, ⁵Northwest University

Studying animal communication allows us to understand how different species and individuals navigate their social worlds. Video coding of communicative behaviour is considered a gold standard: allowing researchers to extract rich nuanced behavioural datasets, validate their reliability, and for research to be replicated. However, in practice, videos are only useful if data can be efficiently extracted. Manually locating relevant footage in tens of thousands of hours is extremely time-consuming, as is the manual coding of animal communication, which requires extensive training to achieve reliability. Machine learning approaches can be used to automate the recognition of patterns within data, considerably reducing the time taken to extract data and improving reliability. However, tracking visual information to recognise nuanced behaviour is a challenging problem and, to date, the tracking and pose-estimation tools used to detect behaviour are typically applied where the visual environment is highly controlled. Animal behaviour researchers are interested in applying these tools to the study of wild animals, but it is not clear to what extent doing so is currently possible. We provide a worked demonstration of the use of machine learning to track movement in video data of wild apes and make our base models available for use. We use a pose-estimation tool, DeepLabCut, to demonstrate successful training of an extremely challenging pose estimation and tracking problem: multi-animal videos of wild forest-living chimpanzees and bonobos across behavioural contexts from hand-held footage. With DeepWild we show that, without requiring specific expertise in machine learning, pose estimation and movement tracking of wild primates in visually complex environments is an attainable goal for behavioural researchers. We hope, in the future, that DeepWild can be used to recognise and locate examples of communication in large databases.

What can an AI-trained language software tell us about chimpanzee calls?

Adrian Soldati¹, Josep Call², Klaus Zuberbühler^{2,3}, Catherine Hobaiter²

¹University of Zürich, ²University of St Andrews, ³University of Neuchâtel

Artificial Intelligence (AI) has emerged as a powerful and popular tool for rapid processing and analysis of large datasets and enabling discernment of multi-dimensional patterns. With the transformative impact that AI applications like ChatGPT had on human language, decoding non-human primate communication using similar AI applications represents a compelling avenue of exploration. While acknowledging the linguistic differences between human and non-human vocal systems, this study investigates the potential in employing automatic speech recognition to explore the mapping of the acoustic properties of chimpanzee calls, characterized by diverse pitches, durations, and rhythms, into words. Beyond sound-meaning association, a prominent feature of human speech is the

association with non-acoustic attributes such as affect. Critically, chimpanzee vocal production also varies with context and affect. Our aim was to explore whether context of call production correlates with the affective states of words transcribed from chimpanzee calls. We used Whisper, an open-source neural net software for automatic speech recognition developed by OpenAI, to transcribe 50 high-quality recordings of wild chimpanzee pant-hoots. Each recording was transcribed using the language database of 7 major families: Arabic, Chinese, Indonesian, Spanish, Swahili, Tamil, Turkish, as well as the largest dataset available (English). After translation of transcriptions to English using Google Translate, we computed combined sentiment scores for each “pant-hoot translation”, investigating correlations with the context of production (feeding, traveling, resting). While Whisper cannot translate chimpanzee calls, our preliminary findings reveal that chimpanzee vocalizations tend to be transcribed into words associated with positive affective states, but with some differences between language families. Furthermore, we observed variation in the number of transcribed words across language families, potentially influenced by the size and accuracy of the available dataset. Our research underscores the potential-and challenges-of using AI to unravel intricacies of primate communication, offering valuable insights into cross-species vocal patterns.

REGULAR TALKS

SESSION A: Ecology & Fitness (Wednesday, 16:00-18:00)

Testing the Sexual Selection Hypothesis

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¹*University of Otago*

Hrdy's (1974) Sexual Selection Hypothesis (SSH) to explain the evolutionary advantage of infanticide in primates has been met, despite some controversy, with near universal acceptance by primatologists. Consequently, it is invoked to explain infant killings, losses, or disappearances in a wide range of species even when, as is oftentimes the case, there is little corroborating evidence to substantiate such assertions. The key prediction of the SSH is that the inter-birth interval (IBI) *must* be reduced for infanticide to have a selective advantage. Given that most studies invoking the SSH do not measure IBI, we conducted a meta-analysis of 1,120 published papers on primates reporting IBIs and/or purporting to have evidence of infanticide. Of the 668 weighted cases with IBIs, 53.5% were obtained from wild troops, 17.2% were from provisioned groups, and 29.3% were based on observations of captive animals. We show that infanticide significantly reduces IBIs by an average of 34%. However, this effect is moderated by several variables, being more pronounced in non-seasonal breeders than seasonal breeders, and in wild populations compared to provisioned or captive populations. Mothers losing infants due to causes other than infanticide are likely to have their IBIs foreshortened to a greater extent than those losing infants to infanticide. Furthermore, the IBI of mothers losing a male infant to infanticide is reduced more than those losing female infants. The early loss of an infant is likely to reduce the IBI to a greater extent than the late loss of an infant. In conclusion, our meta-analysis provides strong evidence supporting the critical, yet typically unreported, component of the SSH needed to demonstrate a selective advantage of infanticide to male perpetrators, but more research is needed to decipher the effects of infanticide on fertility from the perspective of females.

Social determinants of offspring mortality in wild mandrills

Berta Roura-Torres^{1,2,3}, Nikolaos Smit⁴, Marie Charpentier³

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Offspring death imposes significant costs on female reproductive success. These costs are particularly high in primates where infants remain dependent for long periods and maternal investment in time and energy is massive. During early stages of life, primates depend on their mothers for lactation, protection and social development, and are highly vulnerable. In this ongoing study, we perform survival analysis on the outcome of 210 pregnancies and survival of 140 infants in a wild group of mandrills (*Mandrillus sphinx*).

We test for the influence of maternal life history (age, parity, dominance rank) and social (matriline size and bonding with males and other females) traits, along with the demographic setting of the population and environmental conditions, on the probability of miscarriage and infant's survival. Infants had a higher probability of death when born to primiparous females or when their mother died soon after birth. The probability of miscarriage was higher for young and old females, than for mid-aged females. Intriguingly, while the presence of the maternal grandmother improves the probability of infant's survival, the size of the matriline has an unexpected negative impact. Our study adds to previous evidence suggesting that maternal condition and social environment have a strong impact on female reproductive success.

The energy-saving strategy of the frugivorous primate *Eulemur fulvus*, in Mayotte: field metabolic rate and the effects of thermal conditions

Bruno Simmen^{1,2,3}, Benoît Quintard⁴, Brice Lefaux⁴, Laurent Tarnaud^{1,2,3}, Guillaume Correa-Pimpao², Romane Ibanez², Stéphane Blanc⁵, Alexandre Zahariev^{5,6}

¹CNRS Eco-anthropology, ²MNHN, ³Université de Paris, ⁴Parc Zoologique et Botanique de Mulhouse, ⁵IPHC Strasbourg CNRS, ⁶Institut Pluridisciplinaire Hubert Curien

Recent comparative studies on placental mammals, including primates, indicate that daily energy expenditure (DEE) varies positively with species body mass. However, it has been claimed that the DEE of a species does not vary considerably, but rather fluctuates within a narrow physiological range. To date, we lack the measurements on wild primates confronted with variable environmental conditions in terms of climate and food supply to test this hypothesis. In the present study, we provide quantitative results on the DEE and body composition of a cathemeral primate, *Eulemur fulvus*, living on the island of Mayotte, and analyse whether its DEE varies as a function of abiotic (temperature, rainfall, night-time illumination) and morphometric (body mass, fat mass, free fat mass, body proportions) factors. The study took place from March to July 2022 in a wooded agricultural area consisting mainly of cultivated and native trees dedicated to growing fruit trees. We captured a total of 17 lemurs during two anaesthesia sessions, corresponding to wet and dry months respectively. From this set of focal lemurs, 12 (belonging to 3 contiguous groups) were tested for DEE for durations of 3 to 5 days. Using doubly-labelled water and behavioural and accelerometric methods (after approval from the French Ministry of Research), we show that the field metabolic rate of these frugivorous lemurs is one of the lowest recorded to date among primates and eutherians in general. Multiple regression models showed that total energy expenditure increased with temperature (but not with rainfall), suggesting that thermoregulatory costs are important in this species. For a long time, it was thought that frugivorous primates exhibit high energy input/high energy foraging costs strategies, linked to the search for high-quality resources that are dispersed in space and time. The present data suggest that this view should be reconsidered.

Evidence for deceptive fertility in a wild primate

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Primate sexual swellings have long generated debate about their function –do they reliably indicate female fertility or deceptively blur it? Here, we provide evidence that female primates can manipulate sexual swellings to outwardly indicate fertility while inwardly failing to conceive. Geladas (*Theropithecus gelada*) exhibit extreme sexual conflict as sexually selected infanticide. When new males take over a group, they often kill dependent infants –a high cost for lactating females. Using 14 years of demographic and hormone data from a population of geladas in Ethiopia, we demonstrate that after takeovers: lactating females immediately resumed external signs of fertility (e.g., sexual swellings); these swellings were far less likely to lead to conception; and all lactating females exhibited a surge in estrogens mediating both fertile (“true”) and non-fertile (“false”) swellings. Critically, lactating females that exhibited post-takeover sexual swellings were less likely to lose their infants to infanticide compared to those that failed to. We propose a strategy whereby sexual swellings of lactating females range from *probably deceptive* (when infants are highly dependent) to *probably honest* (when infants could be weaned successfully). These results strongly support that sexual swellings can deceptively blur fertility as a counterstrategy to sexual conflict.

Investigating the Relationship Between Sociality and Reproductive Success in Wild Female Crested Macaques, *Macaca nigra*

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Studying the link between sociality and fitness is valuable to understand the costs and benefits of sociality. In many species, sociality is positively linked to fitness: having more, stronger, more equitable or predictable affiliative relationships leads to higher reproductive success, greater survival, or longevity, at least in females. We tested this sociality-fitness link in wild, female, crested macaques, *Macaca nigra*, in Tangkoko, North Sulawesi, Indonesia. Over 15 years, we studied six groups and collected behavioral, ecological, and demographic data on 140 females. We modeled the annual probability that

females gave birth as a function of grooming rate with other females, adjusting for a number of control variables. We found no evidence for an overall association between grooming and the probability of giving birth. Further exploration of the results revealed large uncertainties in the model estimates and substantial idiosyncratic variation within and between females, and to a lesser extent, years and groups. This may have to do with constraints imposed on grooming, on reproduction, or on both. Further investigations into the significance and sources of this variation will help to disentangle the pathways by which social interactions with other group members relate to fitness outcomes.

Are hunters hunks? Meat sharing and reproductive success in the nested multi-level society of Guinea baboons

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The ability to hunt animals and share meat is a signal of male quality in human hunter-gatherer populations, and has been linked to greater reproductive success for those males that hunt most successfully. A similar relationship between meat sharing and high social status has been shown in one of our closest living relatives, the chimpanzee. However, the extent to which meat acquisition and sharing plays a role in the perceived quality of males in more distantly related primates remains largely unknown. Similar to human hunter-gatherers, Guinea baboons (*Papio papio*) live in nested multi-level societies, and female access to meat predominantly comes through their primary male. They therefore offer an intriguing study system in which to explore the evolutionary origins of meat acquisition and sharing as quality signals. Units composed of a primary male and associated females form the base of the Guinea baboon society. We investigated whether males who more frequently acquired meat had more associated females and whether females stayed longer with males who more frequently shared meat with them. We combined data from video records of 109 meat-eating events collected between 2014 and 2023 at our field site in Senegal with unit composition data collected over the same period. These meat-eating events involved 47 males who acquired meat 118 times (1-12 times per male) and transferred meat to females 72 times (1-20 times per male). Unit size ranged from 0 to 7 females per male over the same period. Detailed analyses are still ongoing; the results and their implications will be discussed.

Evaluating the eco-evolutionary correlates of sexual coercion in nonhuman primates

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Sexual coercion is a widespread, heterogeneous phenomenon in both humans and nonhuman animals. Evolutionary, model-based and qualitative approaches have proposed several demographic, socio-ecologic, life history and reproductive factors that facilitate or impeded sexual coercion. We extend and test these hypotheses using a comparative data set of extant, nonhuman primates while controlling for phylogeny. First, if sexual coercion is an expression of sexual conflict, we expect that sexual coercion is associated with male-biased operational sex ratio, sexual dimorphism and male reproductive skew. Second, we distinguish *access sexual coercion* that increases a male's mating access to females from *exclusivity sexual coercion* that may reflect attempts to control mates and to reduce their promiscuity. Access and exclusivity sexual coercion likely emerge in different contexts. On the one hand, we expect access sexual coercion where males cannot exclude other males from mating access, i.e., in mating systems with potential for sperm competition and dispersed social organization where females are spatially isolated and lack social allies. On the other hand, we predict exclusivity sexual coercion in contest-based mating systems where male monopolization potential is high, rivals may be in proximity and females do not form coalitions. We conducted a systematic literature search on intersexual aggression that qualifies as either access or exclusivity sexual coercion, in 376 extant primate species. So far, we obtained documentation in 102 species, 66 with reports of sexual coercion and 36 where coercion seems absent. We will evaluate these predicted pathways between the evolution of mating and social systems and sexual coercion using Bayesian phylogenetically controlled analyses to draw the eco-evolutionary framework of sexual coercion quantitatively. Having established such a framework in nonhuman primates will allow us to better understand why sexual coercion is such a common expression of conflict between the sexes.

Social predictors of fitness in mountain gorillas

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There is strong evidence linking aspects of sociality with different components of fitness across a wide range of species. An individual's fitness can be influenced by the social environment they experience at the group-level e.g. the size of their social group, as well as at the individual-level e.g. their level of social integration within that group. However, individual and group-level aspects of the social environment have rarely been studied in

combination, and little is known about how these different elements of sociality combine to influence fitness. In this ongoing study we are using two decades of detailed social, health and demographic data collected on more than 150 adult mountain gorillas across 15 social groups to examine how aspects of the social environment at both the individual and group level, influence gorillas' health, reproduction and survival. We hypothesize that the influence of individual-level aspects of sociality (network centrality, strength of top relationships and stability of top relationships) on fitness, will vary based on traits of the wider social group. For example, having strong, reliable relationships may have greater impact on reproductive success in groups where infants are at higher risk of infanticide, such as those that share more of their home range with neighboring gorilla groups. By examining the relationship between multiple aspects of the social environment and fitness, we aim to deepen our understanding of the mechanisms by which sociality impacts fitness and the potential trade-offs individuals face in developing optimal social environments. These findings may shed light on how the wide variety of social phenotypes observed within species have evolved and are maintained.

SESSION B: Communication 1 (Wednesday, 16:00-18:00)

Individual differences and plasticity in the communicative behaviour of captive and semi-wild chimpanzees

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Human communication requires immense behavioural plasticity, given that we adjust our language use flexibly to context and interaction partner. The evolutionary roots of this plasticity may be found in the flexible communication systems of great apes, our closest living relatives. This is a hypothesis that remains to be tested, as most comparative work on non-human primate communication to date has focused on population- or species-level variation, while individual variation has been largely ignored. However, consistent individual differences in social behaviour have been shown to have fitness consequences, so the biological relevance of individual variation is increasingly recognised. Behavioural variability can be partitioned into environmental, between-individual (individual differences in the average expression of behaviour) and within-individual components (e.g. responsiveness of individuals to environmental changes). Such a “behavioural reaction norm” approach has been applied in several studies, but little is known about individual differences in primates' communicative behaviour. Adopting a multimodal approach including gestures, vocalizations and facial expressions, this study aimed at investigating the extent of individual variation and plasticity in communicative behaviour in chimpanzees (*Pan troglodytes*). To do so, we analysed both repertoire and use of communicative signals in eighty-six adult individuals from three captive and two semi-wild social groups. The results showed no group (i.e. social environment) differences in repertoire size but low repertoire similarity, among individual chimpanzees, both between and within social groups. Moreover, within-individual variation in repertoire use

(assessed through the multimodal use of signals and persistence) was found across social contexts (e.g. feeding or resting) for several communicative functions (e.g. affiliation or play initiation). In sum, this study provides evidence for extensive between- and within-individual variation in chimpanzee communicative behaviour. We highlight further research avenues for exploring the extent of such variation as well as how communicative plasticity may have impacted language evolution.

Maternal vocal behaviour changes with offspring age during chimpanzee nesting events

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¹*University of Neuchâtel*

Primate mothers can influence offspring development in various ways, but the extent to which this also concerns vocal behaviour is less clear. In our study, we looked at the dynamics of maternal chimpanzee vocal behaviour in the presence of dependent offspring during nesting in Budongo Forest, Uganda. Nest building is technically complex, socially challenging and, in adults, typically accompanied by specific calls. Here, we tested two hypotheses concerning the function of this behaviour, i.e., that maternal call production serves to influence offspring vocal development or to coordinate with offspring during nest building. To address this, we investigated the effect of offspring age on maternal vocal behaviour and found that, overall, mothers called in 70% of nesting events (N=60). More specifically, using a general linear mixed model, mothers were more vocal once offspring started to make their own nests, suggesting that calls function mainly to coordinate with their offspring rather than to influence their vocal development. As younger infants are often in the company of older siblings, learning may primarily take place by observing mother-juvenile dyad rather than active teaching by the mother.

Nonlinear phenomena in the vocal communication of bonobos: vocal ontogeny and emotional context of production

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We propose to investigate the importance of nonlinear phenomena (NLP) in the vocal communication of bonobos in different social contexts and at different ages. Mechanistically, NLP result from perturbations in the typical rhythmic vibration of the vocal folds that cause deviations from regular, tonal voice production. This can result in frequency jumps, subharmonics, biphonation, and deterministic chaos, giving the voice a perceived quality of harshness, roughness or instability. It is increasingly recognized that NLP are not a simply by-product of vocal production, but have the potential to convey important information about the emotional state of the caller. To our knowledge, NLP have been overlooked in great ape vocalizations. Here, we describe the occurrence of the different types of NLP in relation to their production contexts, and investigate the potential vocal ontogeny of NLP in the bonobo repertoire. Almost 3000 vocalizations were

analyzed from three captive social groups (26 adult bonobos) and we found that 29% of their vocalizations contain NLP. NLP are found throughout their vocal repertoire, but are much more common in calls produced in high arousal contexts. Interestingly, the role of the individual during a conflict seems to influence their occurrence, with calls from victims containing more NLP than those from aggressors. The effect of age individuals on the production of NLP is still ongoing. Due to some mechanical and functional characteristics of vocal production, we predict that young individuals produce more NLP than adults. In conclusion, NLP can signal levels of arousal, stress or aggression, and because of their diversity, NLP should be excellent candidates for encoding and reflecting nuances in the social relationship dynamics between individuals.

Automatic discrimination of voiced and unvoiced facial gestures in lemurs and gibbons using deep learning

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The current knowledge of animal facial gestures heavily relies on labour-intensive, frame-by-frame, manual inspection methods, which pose significant challenges in analysing extensive datasets. However, applying deep learning algorithms in visual tasks has shown promising results, potentially revolutionizing the study of animal behaviour by efficiently describing postural and locomotor sequences in various species. Our study employs pose estimation algorithms to describe primate facial gestures, focusing on distinguishing expressions associated with vocalizations from those unrelated to phonation events. To ensure our approach applies to multiple species, we extracted and labelled 2355 frames of *Indri indri* and 5200 frames of *Propithecus diadema* from videos recorded in the wild and 7180 frames of *Nomascus* sp. recorded in captivity. We then trained three deep-learning models to identify a custom set of 13 key points to mark critical primate oro-facial configuration areas. We computed the distances between those points to summarise variation across each facial configuration. We submitted dimensionally reduced datasets to three competitive machine learning classification algorithms (multi-layer perception, support vector machine, random forest classifier), reaching higher-than-chance correct classification rates of vocalized and non-vocalized frames exceeding 90%. Our findings show an innovative application of pose estimation systems and consolidate the extent to which deep learning may be employed to map quantitative variations of primate facial gestures, facilitating the intra-specific investigation of facial repertoire across different behavioural contexts and paving the way for broader comparative research in primate communication.

Acquisition of snake predator knowledge in sooty mangabeys

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How do non-human primates learn to communicate? According to the influential –but largely untested– model proposed by Seyfarth & Cheney in the 1980s, non-human primates go through a pruning process, guided by social learning, during which they increasingly restrict alarm calling from initially broad ranges of animals to few dangerous predators. We tested this model by conducting a field experiment with free-ranging sooty mangabeys, *Cercocebus atys*, in the Tai Forest, Côte d'Ivoire. We systematically exposed different age groups to models of dangerous vipers and not-venomous colubrid snakes. We found that young juveniles perceived all snakes as dangerous and indiscriminately alarm called, although they had the longest response latencies. In contrast, adults responded faster to vipers than colubrids but never alarm called to the latter, unlike juveniles. Finally, all young and some older juveniles engaged in social referencing, suggesting that social learning mostly occurred during the first two years of life. Our study provides a first systematic, empirical demonstration that predator learning in non-human primates starts with over-generalisation followed by subsequent refinement via social learning.

Chimpanzee communities in East and West Africa drum with different rhythms

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Chimpanzees drum with hands and feet on the buttress roots of trees producing low frequency sounds that can travel over a kilometer. Buttress drumming consists in bouts of beats and is often accompanied by pant hoots, the species-typical long-distance vocalization. Previous studies have shown that, when they travel, chimpanzees drum with individually distinctive styles that can aid fission-fusion dynamics. However, whether chimpanzees drum with regionally distinctive styles is still uncertain. We investigated the presence of regional variation in chimpanzee buttress drumming by exploring the temporal and rhythmic properties of drumming bouts of 11 communities across six populations and two subspecies in East and West Africa. Additionally we explored whether chimpanzees in different regions differ in the way they integrate drumming

bouts and pant-hoots. We found that chimpanzee communities living in forest habitats in East Africa and in forest and savannah habitats in West Africa have different drumming styles. More specifically, we found that chimpanzee communities in West Africa drum with less structured inter-beat intervals than communities in East Africa, where drumming bouts tend to consist of alternated short and long inter-beat intervals. Moreover, populations in West Africa start drumming earlier in the pant-hoot than in East Africa. Our study suggests stable subspecies differences in the rhythm of chimpanzee buttress drumming despite striking ecological variation between populations. Our work deepens our understanding of rhythmic percussive behaviour in one of our closest living relatives and of the use of nonvocal acoustic signals in non-human primate long-distance communication.

Phylogeny and ontogeny of primate vocal rhythms

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All human cultures produce music. Differences abound, but a few features are universal to all musical systems. One of these universals is the production of periodic rhythms characterised by temporal intervals that show very simple relationships among them (small-integer ratios). This shared phenomenon begs the question: is there a biological root for *small-integer ratios*? This work presents our main findings in this regard, obtained through integrating two main approaches. The first is the comparative perspective, aimed at finding common rhythmic traits between human musicality and the vocalisations of other primates to understand the ultimate causes of rhythm, or in other words, when (*phylogeny*) and why (*function*) rhythmicity evolved during primate evolution. The second is investigating the development of rhythmic capacities in those same species to identify, with a bottom-up approach, the proximate causes that allow rhythm at different life stages (*mechanism* and *ontogeny*). We analysed sound recordings from six primate species with an increasing gradient of phylogenetic distance from humans: the Bornean orangutan (*Pongo pygmaeus wurmbii*), four gibbon species (*Hylobates lar*, *Nomascus gabriellae*, *N. leucogenys*, *N. siki*) and one species of lemur (*Indri indri*). Using an established methodological approach, the inter-onset intervals of their spontaneous vocalisations were extracted. The ratios between successive inter-onset intervals, their distribution, and clustering around small-integer ratios give insights into similar-to-humans categorical rhythms in other primate vocalisations. Our results show that periodicity, in its simplest form (*isochrony*, i.e. the 1:1 small-integer ratio, when all inter-onset intervals have equal durations), is a shared feature between the vocalisations of the six different primate species and at different developmental stages. This evidence supports partially shared evolutionary roots between rhythm in human musicality and non-human primates' vocalisations.

Common marmoset (*Callithrix jacchus*) volubility across different contexts

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Callitrichid monkeys have an extensive vocal repertoire among primates and have long been described as highly voluble, a feature next to cooperative breeding that makes them similar to humans. Although presumably true, this characterization has never been systematically quantified and explored in terms of variability between sex-status classes and context dependency. We therefore examined these aspects by recording a large number of common marmosets (n = 45) in various social contexts. We recorded all possible dyads within 14 groups (9 families, 5 pairs), resulting in different sex-status combinations. Animals were exposed to 6 different contexts - visual contact with the dyadic partner, visual isolation, access to food, and presentation of an ambiguous stimulus to both subjects at different time points (only one subject having access to food/could interact with ambiguous stimulus at a time). We recorded all occurring vocalizations from both subjects throughout the test sessions and annotated them in real-time. Furthermore, we specified all single elements by call type for each individual and context, resulting in ca. 60.000 calls in total. We can observe high variability in call rates between groups and helpers exhibiting higher volubility than breeders across contexts. This pattern remains when examining specific vocalization classes, such as contact-seeking and danger-indicating calls. These results suggest that despite high variability between groups, further factors such as status and, thus, age and experience might also play a role in determining volubility. The large number of calls produced by the animals confirms that they are indeed highly voluble primates. Additional aspects we are examining are the communication dynamics within dyads. Adding data on social tolerance for each dyad, we predict that more socially tolerant dyads also vocally interact more with each other when separated, seeking to establish and remain in contact.

SESSION C: Sociality (Thursday, 15:00 – 16:30)

Primate Childhoods: development of mother infant relationships in bonobos (*Pan paniscus*) and chimpanzees (*Pan troglodytes schweinfurthii*)

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Human development is a gradual process in which individuals acquire crucial motor, communicative and social skills, rendering them dependent and in need of extended care throughout their rather long periods of infancy and childhood. Parallels of extended development are also present in our two closest living relatives, bonobos (*Pan paniscus*) and chimpanzees (*Pan troglodytes*). These species show clear differences with regards to their social dynamics and specific behaviours (e.g., dominance patterns, tool usage, aggressions and socio-sexual behaviours). It also has been proposed that they differ

concerning development, but existing studies have been biased towards chimpanzees and direct systematic comparisons are non-existent. Moreover, the few qualitative comparisons provided mixed results. While several studies showed that bonobos have accelerated physical maturation, no consensus exists concerning developmental behavioural differences between the two *Pan* species. For instance, while some authors highlight bonobos' increased social activity and longer maternal riding, others suggest species differences concerning proximity patterns and gaining independence. Hence, the present study aims to provide a systematic, quantitative comparison of behavioural development in bonobos and chimpanzees living in their natural environments. We specifically investigated the following question: Do bonobos and chimpanzees show similarities or differences in development with regards to (i) general behavioural patterns, (ii) gaining independence, and (iii) social activity. To investigate this question, we collected observational data of 44 individuals (m: 21; f: 23) aged 0-5.5 years from five different groups living in two different *Pan* communities: the Ngogo chimpanzee community, Kibale National Park, Uganda (N=22, two groups), and the Kokolopori bonobo community, Kokolopori Bonobo Reserve, Democratic Republic of Congo (N=22, three groups). At the time of submission, data analysis is in progress. Results will be discussed in relation to similarities and differences in the developmental trajectories of *Pan* species, thereby enabling further insights to reconstruct the process of human evolution.

Tolerant macaque species are less impulsive and reactive

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Inhibitory control, the inhibition of impulsive behaviours and emotions, is believed to be key in navigating a complex social environment. To date, little is known about the selective forces that favour the evolution of inhibitory control. Species characterised by higher social tolerance, living in more complex groups, with more diverse relationships, face higher uncertainty regarding the outcome of social interactions and, therefore, would benefit from employing more inhibitory strategies. In this study, we compared inhibitory control skills in three closely related macaque species which differ in their social tolerance style. We tested 66 macaques from two institutions (28 *Macaca mulatta*, 19 *M. fascicularis* and 18 *M. tonkeana*) in a battery of touchscreen tasks assessing three main components of inhibitory control: inhibition of a distraction (using a Distraction task with pictures of conspecifics), inhibition of an impulsive action (using a Go/No-go task) and inhibition of a cognitive set (using a Reversal learning task). Overall, higher social tolerance was associated with enhanced inhibitory control performances. More tolerant species were less impulsive and less distracted by pictures of unknown conspecifics. We did not find evidence that social tolerance degree was associated with performance in reversal learning though. Overall, our results support the hypothesis that evolution has promoted

the development of socio-cognitive skills to cope with the demands related to the complexity of the social environment.

A longitudinal approach to the comparative study of mother-infant relationships: new insights from WEIRD humans and captive small and great apes

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Mothers play a crucial role for the survival and socio-cognitive development of their offspring, yet little is known about variation in the developmental trajectories of mother-infant relationships. Here, we used a comparative and developmental approach to study maternal style during the first year of infants' development, in 48 mother-infant dyads belonging to ten different primate species (i.e., *Homo sapiens*, *Hylobates lar*, *H. moloch*, *H. pileatus*, *Nomascus gabriellae*, *N. leucogenys*, *N. siki*, *Pan paniscus*, *P. troglodytes*, *Symphalangus syndactylus*). Our study showed variation in maternal behaviour within and across ape genera. Some aspects of maternal behaviour differed between WEIRD humans and other species, but differences between great and small apes were not as clear-cut. For some behaviours, differences across genera were consistent through development (e.g., touching was more likely in humans than in other genera, whereas grooming was common in all genera but Homo). Similarly, WEIRD humans were the only ones engaging in object stimulation, and they were less likely to engage in body contact and restrain than other genera throughout development, although rejection was low in all study species. Face-to-face interactions were also more common in WEIRD humans than in other species, but they overall increased when mothers and infants spent less time in physical contact, and when infants became older. Finally, other maternal behaviours followed different developmental patterns across genera (e.g., nursing more quickly decreased in Homo than in other species, whereas human mothers became relatively less likely to approach infants, and infants more likely to leave mothers, but later than other genera). We highlight the important limitations of our study and discuss our results as a first exploratory comparison of longitudinal variation in small and great ape maternal styles, sketching possible future lines of research.

Patterns of organized attachment: An analysis of mother-offspring bonding in wild Western chimpanzees (*Pan troglodytes verus*)

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Mother-offspring attachment is a crucial biological mechanism aiding offspring's fitness. Humans feature three organized attachment types—secure, insecure-avoidant, insecure-resistant—serving as adaptive strategies to ensure offspring's survival through responsiveness variation from mothers, and one disorganized attachment. Evidence of

attachment to caregivers and variation in maternal styles has been observed across several non-human primates, suggesting the existence of distinct attachment types. Given the shared cognitive and physiological characteristics between humans and chimpanzees, we hypothesize distinct mother-offspring attachment types in wild chimpanzees. In our study, we focused on offspring reaction to natural threat analogous to the 'strange situation' used to test attachment types in humans. We observed 309 behavioural reactions of 18 individuals across ages (1.5 –6 years) belonging to three chimpanzee communities (*Pan troglodytes verus*) living in the Taï National Park (Ivory Coast) when exposed to external threat. Also, over 16 months, we recorded 1232 hours of focal observations on offspring behaviour and mother-offspring proximity. We analysed the data using dimension reduction methods, cluster analysis and Bayesian models and controlled for age and sex. Preliminary results show that wild chimpanzees exhibited organized attachment patterns, with parallels to human. When faced with indirect threats, certain offspring sought closeness and reassurance from their mothers, using them as a source of safety, resulting in varying distress responses, akin to the secure attachment found in humans. Conversely, others exhibited greater independence, without relying on their mother during dangers and exploring away from maternal proximity in social contexts, similar to the insecure-avoidant attachment. Contrary to humans, disorganized attachment was absent, suggesting it may not be an adapted survival strategy for wild chimpanzees. This study provides evidence of distinct attachment patterns in wild chimpanzees, emphasizing the adaptability of attachment strategies across species and increasing our knowledge on the key role attachment plays in social evolution.

Not all mothers are the same: Individual variation and plasticity in Sumatran orangutan maternal investment

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Primate studies have long shown that mothers vary in their post-natal investment (here, the probability of mothers showing a caretaking behavior towards their offspring), which is affected by several factors, most notably offspring age. However, studies often do not control for these factors before quantifying maternal variation. Besides, most studies have focused mainly on between-individual but not within-individual behavioral variation. In our study, we quantified between- and within-individual variation among mothers in six

offspring-directed maternal behaviors in Sumatran orangutans (*Pongo abelii*), while controlling for offspring age, using behavioral reaction norms. This method involves the use of repeated observations of mothers to partition the observed behavioral variance into its within-individual, between-individual, and environmental gradient (here, offspring age) components using generalized linear mixed models. Our analyses included 1360 focals of 15 mother-offspring pairs collected from 2007-2002 in the Suaq Balimbing research area in the Gunung Leuser National Park in South Aceh, Indonesia. Our results showed that Sumatran orangutan mothers significantly differed in their maternal investment (i.e., between-individual variation in investment) in five behaviors, namely contact initiation, proximity initiation, proximity termination, feeding in proximity, and carrying, even after controlling for offspring age. Additionally, mothers showed significant plasticity (i.e., within-individual variation in investment in response to offspring age) and significantly differed in their plasticity (i.e., between-individual variation in plasticity in response to offspring age) in these behaviors. We conclude that Sumatran orangutan mothers do not just differ in their maternal investment but also show individual trajectories of investment over their offspring's development. We add to the existing studies on maternal behavioral variation, laying the foundation for addressing its causes and fitness consequences for mothers and their offspring.

The functional role of infantile facial features in rhesus macaques

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Infants across species are thought to exhibit specific facial features, known as the 'baby schema.' These features are thought to serve an adaptive function, eliciting caregiving behavior from adults. There is abundant empirical evidence supporting the existence and adaptive functions of the baby schema in humans, but its function in non-human animals has not been scientifically demonstrated. We examined if and how facial immaturity of individuals impacts actual behavioural outcomes in captive group-living rhesus macaques (*Macaca mulatta*). First, we analyzed the facial appearance morphology of rhesus macaques across age classes to illustrate how it changes over their lifetime. We delineated 81 landmarks on each face and analysed the landmark configuration by geometric morphometrics. We observed a dramatic change in face morphology during early development, suggesting that faces may be an effective cue of age information in early infancy (compared to other factors such as body size). Second, we calculated the relative face immaturity, specifically assessing how an individual's face immaturity deviated from a face predicted by its age ("Infant Face Index") for each infant under 14 weeks old. We examined the relationship between the Infant Face Index and maternal behaviours from focal sampling observations. Our analysis is still ongoing. We predicted that infant macaques exhibiting high infantile face morphology may receive more parental care and/or tolerance from their mothers.

SESSION D: Physiology (Thursday, 15:00 – 16:30)

Mandrills and Microbes: Characterising the mandrill scent-gland microbiome and its potential role in olfactory communication

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Olfactory communication uses the release and reception of semiochemicals to convey information about the releasing individual's state such as sexual maturity, dominance rank and group membership. The effects of chemical signals on receiver behaviour have implications for reproduction, by influencing mate choice (sexual selection). Primates harbour a diverse array of microorganisms both on and in their bodies, many of which have co-evolved with the host to facilitate metabolic pathways that the host alone would be unable to use. For example, the fermentation hypothesis holds that microbes inhabiting scent-glands digest secretions, producing odour signals. Mandrills (*Mandrillus sphinx*) are one of the few catarrhine species to possess scent-glands, which produce odour that differs with age, sex, male dominance rank, group membership, and possibly individual identity. We aimed to determine the composition of the mandrill scent-gland microbiome and investigate how composition differs with the same traits as odour does, as well as with glandular activity. We collected 120 skin swab samples from the scent-glands of mandrills living in a large, semi-free ranging mandrill colony in Franceville, Gabon. We isolated genomic DNA from these samples, then used 16S rRNA amplicon sequencing and bioinformatic analyses with QIIME2 to determine bacterial composition and diversity measures. At the time of writing analysis is ongoing. Across subjects the mandrill scent-gland is dominated by four phyla: Firmicutes (47.6%), Bacteroidota (16.5%), Actinobacteriota (12.9%) and Proteobacteria (11.9%). We also identified multiple genera present in the scent-glands of other mammalian species including *Staphylococcus* (9.8%), *Prevotella* (9.1%), *Lactobacillus* (3.4%), *Corynebacterium* (0.4%), *Fusobacterium* (0.3%) and *Anaerococcus* (0.1%). This first description of the mandrill glandular microbiome tests the potential for microbiota to mediate signals used in sexual selection, the capacity for hosts to control the composition of their microbiome, and the co-evolutionary consequences of this symbiosis in relation to signalling theory.

The bonobo bacterial book: Extensive gut microbiome analyses of wild and zoo-housed bonobo populations

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The primate gut teems with bacteria, which play an important role in the health and physiology of their host. Communities of these bacteria are shaped by intrinsic individual characteristics such as sex and age, but also depend on lifestyle factors such as diet, health

status, and the social environment. In humans, catalogues of gut microbiome variation are readily available in both industrialized and non-industrialized populations, allowing the identification of factors determining microbial variation. However, such extensive datasets are lacking for other great ape species, although these could help us understand the uniqueness and function of the human gut microbiome. Here, we conducted an extensive analysis of the gut microbiome and its associated factors within the entire European population of zoo-housed bonobos (*Pan paniscus*) (11 zoos in 5 countries) and in two communities of wild habituated bonobos (LuiKotale, Democratic Republic of the Congo). We collected 707 fresh faecal samples from 212 individuals in a longitudinal fashion. Samples were analysed for microbial content using 16S amplicon sequencing and extensive metadata were collected using observations, questionnaires, and historical records. Preliminary analyses indicate clear-cut differences in gut microbiome composition between wild and zoo-housed bonobos. Regardless of environment, *Prevotella* was the most abundant and prevalent genus, being found in 98% of the bonobo gut microbial samples. *Blautia_A* and an unnamed genus in the *Lachnospiraceae* family were also abundantly found in both wild and zoo-housed bonobos, hinting to the possible existence of a core bonobo microbiome. Further analyses will focus on identifying the factors that determine gut microbiome variation, including sex, age, diet, health status, medicine use, kinship, and social behaviour. This in-depth analysis of the bonobo gut microbiome across ecological conditions will provide further insight into the function and composition of gut microbiome in humans and non-human primates.

Exploring Nocturnal-Diurnal Behavioral Dynamics in Captive Chimpanzees

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This study examines how nocturnal activities influence daytime behaviors in sanctuary-housed chimpanzees. By integrating audio recording techniques to monitor nocturnal chimpanzee activities and employing multifocal sampling methods to observe diurnal activities, this research provides an innovative understanding of captive chimpanzee behavior. The main findings of this research highlight the relation between the frequency and intensity of nocturnal disturbances and the subsequent behavioral patterns exhibited by the chimpanzees during the next day. Specifically, nocturnal activity seems to have a significant effect on inactivity, abnormal and self-directed behaviors, as well as on affiliative behaviors and social proximity in the following daytime period. Furthermore, we investigated the effect of abiotic nocturnal conditions on nocturnal activity, seeing an increase in chimpanzee activity during hot, dry nights. These insights highlight the importance of the influence of nocturnal activities on chimpanzee well-being and on their diurnal behavior in captivity. The use of affordable and non-invasive audio recordings as a means to monitor nocturnal activity opens new possibilities for effective welfare monitoring. This research project is currently entering in its second phase, increasing in detail, information gain and efficiency, allowing us to better understand the impact of nocturnal activity on diurnal behavior as well as the impact of abiotic factors from both indoor and outdoor climatic conditions. This research not only contributes to the field of

chimpanzee welfare knowledge but also has important implications for the management and care of captive chimpanzee populations.

Male service variation in vervet monkeys cannot be predicted by testosterone-immunity trade-offs

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Sexual competition and mate choice are powerful forces that shape animals' behaviour, and physiology. One way male primates might showcase themselves to females is by providing services, i.e., cooperative behaviours that benefit the rest of the group, such as vigilance, territorial defence, and leading group progressions. The immunocompetence handicap hypothesis (ICHH) offers a framework to understand this phenomenon, suggesting that testosterone, while potentially enhancing reproductive success through such behavioural displays, simultaneously compromises the immune system. This trade-off is proposed to serve as an honest signal of male quality, as only the fittest males can afford the immunological cost of high testosterone levels. Our study aims to examine this hypothesis in free-ranging vervet monkeys, a primate species where males seem to present variation in service provisioning. We investigated the possible testosterone-immunocompetence trade-off by studying the relationship between behavioural displays, reported in a male service index, hair hormonal levels (including testosterone) using HPLC technology, and leukocyte profiles in blood smears. Contrary to the expectations of the ICHH, our findings reveal no significant correlation between testosterone levels and male service provision. Furthermore, neither male service index nor testosterone levels were linked to leukocyte counts. These results suggest that in the case of this study population, the variation in male service provisioning is not governed by testosterone's immunocompetence trade-off as proposed by the ICHH. The absence of the hypothesised relationships indicates that alternative life-history traits, such as potential paternity (implying male services as paternal care) or the maintenance of social rank, are more influential in shaping these service displays. This study adds to the understanding of male service provisioning in primates, suggesting that factors other than a direct trade-off between reproductive effort and immune function may drive behavioural variation observed in this species.

Habitat utilisation, leaping performance and hind limb functional morphology in callitrichid primates

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Callitrichidae utilize habitats in different ways, form mixed-species groups, and exhibit a range of locomotor adaptations. Some species specialize in vertical clinging and leaping between trunks. Studies into such adaptations that integrate different biologically relevant 'levels' of ecology, behaviour and morphology are rare due to the methodological challenges in study design. We present a multi-level analysis that combines the findings from habitat utilisation, leaping performance, hind limb muscle architecture and limb bone morphology in seven species of callitrichids and shows possible correlations with regard to two different types of leaping (trunk-to-trunk leaping vs. horizontal leaping). We found significant differences in support use and leaping performance. The two species of a sympatric tamarin group we studied in the field each showed a preference for a leaping type, even when faced with a lack of preferred supports outside their preferred forest layer. This result indicated that the leaping behaviour of these tamarins is not determined by the most frequently available supports in each layer suggesting that postcranial anatomy should reflect behavioural specialization in these species. The result provided the basis for further investigation of the morphology and performance of closely related species. According to our performance and habitat utilisation data, we expected the greatest potential for joint torque generation and stress resistance during longer leaps on vertical supports. Surprisingly, we found that the link between these different 'levels' was rather loose. In contrast to our assumption, behavioural differences were not clearly reflected in convergent morphology of trunk-to-trunk leaping specialists. Rather, our results underscore the presence of many-to-one mapping, a phenomenon that results in similar function despite different morphological 'solutions'. This study demonstrates that the relation of behavioural and morphological 'levels' studied in our project is complex and cautions against oversimplification of ecological profiles to draw adaptive conclusions.

Exaggerated Sexual Swellings, Ovulation Probabilities and Consortship Behaviour in Wild Chacma Baboons

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¹*Institute of Evolutionary Anthropology, University of Zurich*, ²*Nottingham Trent University*

A striking feature of female baboons are their sexual swellings. Sexual swellings have been proposed to serve as a signal that attracts the best male during peak swelling and attracts other group males when ovulation is less likely, to reduce the risk of infanticide by males (the 'graded signal' hypothesis). We investigated the graded signalling hypothesis through an examination of swelling size in relation to ovulation probability in a population of wild chacma baboons living on the Swebeswebe Wildlife Estate, Limpopo, South Africa. We precisely measured swelling size using a new laser measurement technique that combines digital photographs with laser distance measurements. Timing of ovulation was assessed using faecal oestrogen metabolite (fEM) and faecal progesterone metabolite (fPM) levels. In addition to fEM and fPM levels, we also investigated the possible effects of temperature and resource abundance (NDVI) on female swelling size. Data were collected from 19 cycles of seven female baboons, over a period of six months. The new measurement method proved to be highly accurate, demonstrating its potential for broader application in wildlife research. Swelling size consistently increased up to the day before rapid

deturgescence occurred. Males predominantly consorted with females on days towards the end of the female's swelling phase and consorted more in conceptive cycles. Because males consorted for several days around the period when ovulation was most likely, consorting males are expected to have a perceived high paternity certainty. Females mated with other group males when they were not at maximum swelling size and were mostly likely non-conceptive. Swelling size was strongly related to fEM levels and was notably larger in conceptive cycles. Neither temperature nor resource abundance were significantly associated with swelling size. Together our results support the graded signal hypothesis.

SESSION E: Ecology & Social Structure (Thursday, 15:00 – 16:30)

Fruitful connections: a multi-site exploration of the impact of fruit availability and age-sex class on orangutan (*Pongo spp.*) sociality

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Living in social groups incurs a significant cost: indirect competition for food sources, known as scramble competition. As food availability fluctuates across time and space, the intensity of this competition varies. In response, individuals may adjust their group size to reduce the costs of scramble competition. Orangutans, who are primarily solitary but occasionally form temporary associations called parties, provide an intriguing case for studying this phenomenon: their arboreal lifestyle results in high travel costs and they often experience fruit scarcity. While prior research at some sites, but not others, hinted at a relationship between fruit availability and time spent in social proximity, a comprehensive multi-site study remains absent. Our study combines daily focal follow data from three Sumatran sites (Ketambe, Sikundur, Suaq Balimbing) and aims to include data from four Bornean sites (Danum Valley, Gunung Palung, Sebangau, Tuanan). If increases in fruit availability reduce the costs of associating, we expect (1) a positive correlation within sites between fruit availability and both probability of party formation and party size, and (2) we expect to observe a higher probability of party formation and a higher average party size for sites with on average higher fruit availability. Additionally, we aim to explore whether differences in social behaviour across age-sex classes remain consistent across sites or show variation. Initial analysis of daily party size data for the Sumatran data with zero-altered mixed gamma regression suggests a positive correlation between fruit availability and probability of party formation in Ketambe and Sikundur, but not in Suaq Balimbing. Moreover, while we find evidence for within-site variations in sociality between age-sex classes, these differences seem to vary across sites too. These preliminary findings imply that orangutans at certain sites adapt their social behaviour in

response to local fruit availability, suggesting a nuanced relationship between resource abundance and sociality.

Social determinants of competition in female gorillas

Nikolaos Smit¹, Martha M Robbins¹

Max Planck Institute for Evolutionary Anthropology¹

Most organisms compete over fitness-determining resources, including food and mates, and competition is expected to increase with the 'competitor-to-resource ratio'. Here, we use a behavioural dataset spanning over 24 years to test if female gorillas from five groups of both species compete over food, mates and/or protectors. Although female western gorillas (*Gorilla gorilla gorilla*) experience higher monopolization potential of food and lower abundance of food and males than female mountain gorillas (*Gorilla beringei beringei*), they did not show higher rates of aggression. However, certain factors influenced female aggression in both species. Group size had a quadratic (reverse-U-shaped) relationship with female aggression, suggesting that the benefits of larger group sizes might counterbalance the costs of within-group competition and/or a perpetual increase of aggression might be too costly for females. Importantly, females of both species were more aggressive in groups with more females but less males, that is, when the sex ratio (or operational sex ratio) was higher. Combined, these results highlight the caution needed when interpreting the effect of group size on social interactions, as this might entangle the potentially contrasting effects of females and males. In our analysis, we also controlled for fruit-feeding rate and verified previous results that fruit-feeding impacts aggressive interactions in these species. Therefore, our results suggest that aggressive behaviours in female gorillas are driven by competition over both food and males. Our study contributes to the understanding of the evolution of *competitive behaviour* in other animals and humans whose ancestral states likely resemble those of gorillas.

Long-term field studies to understand animal societies: A focus of the complex but exciting relationships between parasites and the social structure of a wild primate

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The Mandrillus Project aims at studying the socio-ecology of the only habituated population of mandrills (*Mandrillus sphinx*) worldwide, using daily behavioral observations and long-term data collection. Throughout the years, we have obtained striking results shedding a new light on social relationships in mammals. In particular, we have shown that these social interactions depended on various classic factors, such as dominance relationships, but also on more intriguing determinants such as individual parasite status. The structure of social behaviors but also ranging patterns are strongly shaped by gut parasites. Indeed, mandrills avoid contagious groupmates using an olfactory mechanism. In addition, they also avoid to forage in areas contaminated by environmentally-transmitted parasites. Taken together, these results suggest both social

and possibly foraging costs to parasitism. Individuals' daily life, particularly the social relationships that individuals form over the course of their lives are thus not random but are rather highly differentiated and respond to biological rules and individual needs.

Social structure resilience: the effect of group-member loss in wild spider monkeys through multiplex network analysis

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The social structure of animal groups is generally resilient to perturbations due to changes in group size and membership. To explore how such resilience is achieved and the role played by key individuals, we evaluated the effect of group-member loss on spatial cohesion and social structure of a group of wild spider monkeys using social network analysis on a 17-year dataset. We constructed networks of group members' spatial associations to model spatial cohesion, and multiplex networks incorporating different social interaction types within interconnected layers to model social structure. To investigate network resilience, we applied site-percolation models that simulate node removal. The social structure withstands ordinary perturbations such as the random removal of group members as the networks did not display abrupt structural transitions from a connected to a disconnected state, similar to the networks of spatial cohesion. Nevertheless, we found the propagation of removal effects from the network of one type of social interaction to another makes the multi-layered networks of social structure less robust to perturbations than single-layered networks of spatial cohesion. Even a small number of targeted removals (i.e., removal of group members with high network centrality scores) resulted in a more rapid fragmentation of the social structure, whereas this effect was either absent or milder for spatial cohesion. Our results highlight the importance of considering the impact of group-member loss on social structure rather than only on spatial cohesion, as its disregard may result in an overestimation of resilience. They also indicate that specific group members play a key role in maintaining the social structure's connectedness over several consecutive years. The study contributes to our understanding of the resilience of animal societies, offering valuable insights into the effects of group-member loss and the potential implications for anthropogenic activities that may cause such loss.

Flexibility in dispersal strategies: insights from GPS and accelerometer data in wild vervet monkeys

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Dispersal is one of the most prominent and spatially significant movement an organism may undertake during its lifetime. Consequently, it exerts strong influences on the genetic structure and both spatial and social organization of populations. The study of dispersal has long been impaired by limited technological and analytical resources, which often led to oversimplified assumptions portraying dispersal strategies as unconditional or fixed processes rather than recognizing them as flexible and contingent upon both environmental variables and an individual's internal state. In the last decade, the advent in bio-logging technologies and analytical methods has provided scientist with new opportunities to unveil the complexity of animal movement in the wild. In light of these advancements, this study delved into the socio-ecological determinants of dispersal trajectories within a wild population of vervet monkeys by harnessing GPS and tri-axial accelerometer data from 30 adult males collected over an 18-month period. First, we applied a machine learning-based framework using tri-axial acceleration to continuously identify individuals' behaviours throughout the study duration. Subsequently, we investigated the interplay between behaviours and environment covariables associated with their distribution in time and space. Our findings revealed unexpected long and complex dispersal trajectories, pushing the boundaries of existing knowledge within our studied species. Finally, we discuss how animal movement decisions scale up to shape group and population-level processes within a spatially and socially structured population.

Factors influencing Grauer's gorillas (*Gorilla beringei graueri*) habituation in the upland sector of Kahuzi-Biega National Park, DRC

Marcel Karume¹

¹Primate Expertise

Deepening and extending knowledge on Grauer's gorillas' (*Gorilla beringei graueri*) behavior require the use of several methods such as habituation. This study is fundamental, as it is the first to discuss the methods, stages and requirements necessary to Grauer's gorilla habituation. To do this, from May 2021 to December 2022 Grauer's gorillas were regularly monitored in Kahuzi-Biega National Park and each time we met the group, we mentioned our presence by growling and clapping our hands, while remaining standing upright. The formal habituation phase began in June, during which an ethogram of most of the behaviors collected during the prospection phase was drawn up. During this period, observations were collected by scan and focal sampling of individuals, using the one-zero method for each behavior during one hour at 5 minute intervals. We then found that the individuals gave several reactions at our first meeting which varied depending on

the habitat types. Similarly, behaviors expressed by males influenced the family's daily activities and movements. We compared results between two groups (Mpungwe and Nabirembo) to understand if factors including the group size, the daily observation time, the presence of another groups in the area or ecological factors can influence the complete habituation process. It also remains essential to increase regular contact with individuals by maximizing daily observation time, especially for males which led to reduction of the charges number giving way to curiosity rather than fear of the observers. This enabled us to determine the predominant activities of the individuals and the habituation steps. We found that males take much longer to be habituated than females. So, in view of the results found during the habituation process, this study becomes a gateway to in-depth studies and other notions not yet tackled on Grauer's gorillas at Kahuzi-Biega.

SESSION F: Causal Reasoning (Thursday, 15:00 – 16:30)

Guinea baboons (*Papio papio*) show a preference for agents in chasing interactions

Floor Meewis¹, Joël Fagot¹, Nicolas Claidière¹, Isabelle Dautriche¹

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Languages tend to describe who is doing what to whom by placing agents before patients. This preference for agents is reflected in cognition: agents are recognized faster and capture more attention than patients in both human adults and infants. We investigated whether this agent bias is uniquely human or shared with non-human animals. Chasing animations in which one object (the chaser/agent) chases another that flees away (the chasee/patient), have been previously used to look into the processing of events and event roles. During a chasing event, human adults and infants show an attentional preference for the chaser/agent. In the current, pre-registered study we presented Guinea baboons (*Papio papio*) with a change detection paradigm with simple 2D chasing animations. The baboons were trained to respond to a colour change which was applied to either the chaser (agent) or the chasee (patient). The baboons (N = 13) were faster to detect a change to the chaser than to the chasee in the chasing interaction. This faster response cannot be explained by a preference for low-level features such as the chaser's motion pattern or the fact that the chaser moved behind the chasee, as we did not observe this bias in our control conditions. Our study thus suggests that Guinea baboons are sensitive to the event roles of agent and patient in chasing interactions and that they show an attentional preference for the agent. This points to similar event processing in Guinea baboons as has been previously shown for human adults and infants. Event parsing with an agent preference may be an evolutionarily old mechanism that is shared between humans and other non-human primates, which could have become externalised in human language as a tendency to place the subject first.

Do snake pictures capture macaques' attention more than other predators?

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Detecting and identifying predators quickly is key to survival. According to the Snake Detection Theory (SDT), snakes have been a substantive threat to primates for millions of years, so that dedicated visual skills were tuned to detect snakes in early primates. Past experiments confronted the SDT by measuring how fast primate subjects detected snake pictures among non-dangerous distractors such as flowers but did not include pictures of primates' other predators, such as carnivorans, raptors, and crocodilians. Here, we examined the detection abilities of 19 Tonkean macaques (*Macaca tonkeana*) and 6 rhesus macaques (*Macaca mulatta*) to spot different types of predators. By implementing an oddity task protocol, we recorded success rates and reaction times to locate a deviant picture among four pictures over more than 400,000 test trials. Pictures depicted a predator, a non-predator animal, or a simple geometric shape. The first task consisted of detecting a deviant picture among identical distractor pictures (discrimination) and the second task was designed to evaluate the detection abilities of a deviant picture among different distractor pictures (categorization). The macaques detected pictures of geometric shapes better and faster than pictures of animals and were better and faster at discriminating than categorizing. The macaques did not detect snakes better or faster than other animal categories. Overall, these results suggest that pictures of snakes do not capture visual attention more than other predators, questioning previous findings in favor of the SDT. This work highlights how much more effort is needed to understand the evolution of specific anti-predator traits.

The influence of social tolerance on innovative problem-solving processes in groups of non-human primates

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Culture can be defined as distinct behaviors shared by multiple individuals and transferred via social learning mechanisms. Social tolerance as an element of social dynamics within a society is highly intertwined with social learning with more tolerant groups allowing for a faster and more reliable exchange of information. Yet, despite an enormous effort to understand the mechanisms involved in innovative processes the influence of social tolerance has been hitherto overlooked. The main objective of this study is to elucidate the relationship between social tolerance and the initial innovative process. Here we measure and compare social tolerance and innovativeness in two species of

capuchin monkeys, namely white-faced capuchins (*Cebus capucinus*) and tufted capuchins (*Sapajus apella*). Both species show remarkable behavioral flexibility and exhibit cultural behaviors, yet they differ in the extent of their cultural repertoires and their social structure. We examine the social tolerance and innovativeness of multiple groups of each species and provide an intra- and inter-specific comparison. First, we measured social tolerance using co-feeding experiments examining whether individuals will tolerate each other around valuable food items. Additionally, we examined structural social tolerance using focal observations to measure dominance hierarchies and the covariation of multiple tolerant, aggressive, and affiliative behaviors. Lastly, we measured innovativeness by presenting novel food puzzles in a group setting. We used different puzzles varying in the manipulation steps required to solve the puzzle. Inter-specific comparisons indicate that white-faced capuchins showed higher frequencies of agonistic and affiliative interactions than tufted capuchins, whereas the latter showed higher levels of tolerance during the co-feeding experiment. Our results show that tufted capuchins solved the provided problems more frequently than the white-faced capuchins. Ultimately, our results suggest that co-feeding social tolerance can facilitate individual innovativeness and emphasize the importance of distinguishing between contexts of social tolerance measurements.

Cognitive performance during a discrimination learning task: effect of the emotional valence of stimuli in a lemur species

Eugénie Mortessagne¹, Dalila Bovet², Camille Nozières¹, Emmanuelle Pouydebat¹, Fabien Pifferi¹

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In human, emotions influence thoughts, memories, perceptions, reactions to a given situation and social interactions. Considerable attention has been devoted to the study of emotions in human and specially their interaction with cognition. In non-human primates, as well as many other animal species, emotion also plays a central role and an increasing number of studies has investigated the relation between emotions and cognition. However, they are carried on a limited diversity of primates' species making comparative studies difficult. In that context, we aimed to explore and compare the emotion –cognition interaction in primates. For that, we first explored this link in a lemur species, as no studies to date has been carried on this topic with lemuriforms. We evaluated the performance of 48 grey mouse lemurs (*Microcebus murinus*) in a discrimination learning task using visual emotional stimuli. We tested whether the type of visual stimulus (positive, negative or neutral) influenced the cognitive performance of mouse lemurs. Individuals had to learn to discriminate between two platforms according to the associated visual stimuli and to jump to the target platform (leading to a reward). Our main finding was that emotional stimuli, whether positive or negative in valence, impaired cognitive performance when used as a target. Specifically, the lowest success rate occurred when the target was associated with the emotional stimuli, and the highest success rate occurred when it was associated with the neutral stimuli. Our results highlight the importance of studying the emotion-cognition interaction in a wider number of

phylogenetically representative primate species and introduce a larger comparative project.

Ape Research Index (ARI): Quantifying the effect of previous experience in research tasks on cognitive skills in captive chimpanzees.

Siddharth Girish¹, Ulrich Maloueki^{1,2}, Bekeli Nseu Mbomba², Sofia Forss¹, Elisa Bandini¹
¹University of Zurich, ²University of Kinshasa

Chimpanzees are the primary comparative models for tracing the evolutionary roots of human behaviour and cognition. To assess cognitive abilities, researchers often test captive chimpanzees. These studies are primarily conducted at a handful of zoological and/or research institutions, resulting in some individuals building up a huge amount of experience in research tasks during their lifetimes. However, the effect of this large body of research experience on subsequent task performance is often unaccounted for. The Ape Research Index (ARI) project aims to address this gap of knowledge by quantifying the effect of previous experience on current captive chimpanzee cognition and performance. In order to do so, we have collected and categorized all reports of captive chimpanzee research participation world-wide within our (soon to be) freely accessible database. This comprehensive documentation of past research experiences enables us to explore hypotheses, such as the potential relationship between increased chimpanzee research experience and higher task performance. In this talk, we will present the preliminary findings from the analysis of our database on the distribution of research participation globally across captive chimpanzee institutions. Furthermore, we will discuss predictions on the effects of different levels of research experience on task performance across domains, which we will be testing in upcoming experiments.

Primate brain size evolution revisited: the role of sensorimotor complexity

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For decades, comparative studies have searched for the selective pressures on primate brain size, with a major debate concerning the relative importance of ecological or social pressures. A recent study on birds (Song et al., in prep) found that morphological features (especially of bills) and amount of sensory inputs (eye size) predicted brain size far better than social and ecological variables, suggesting that the cognitive aspects of ecology and social life did not undergo direct selection but were subsumed under the selection for sensorimotor complexity. Here we repeat this analysis for primates, using eye size and manipulative abilities as key measures of sensorimotor complexity as well as a range of social and ecological variables thought to reflect cognitive challenges. Our primate results largely mirror the bird findings. Although primate brain size is a very good predictor of cognitive performance and survival, it apparently was not the result of direct selection on specific socio-or eco-cognitive abilities.

SESSION G: Social Learning & Foraging (Thursday, 17:00 – 18:30)

Peering behaviour and social learning in the acquisition of foraging skills in wild chimpanzees.

Oscar Nodé-Langlois^{1,2}, Eléonore Rolland^{1,2,3}, Cédric Girard-Buttoz^{3,4}, Pier Francesco Ferrari², Roman M. Wittig^{2,3}, Catherine Crockford^{2,3}

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Social learning significantly influences the development of human cognitive skills and has played a critical role in human evolution. Opportunities to learn socially are theoretically constrained by features of social structures and dynamics, notably by the size of the group and the presence of tolerant role models. However, empirical evidence regarding the impact of these factors on the utilization of social learning remains scarce. Wild chimpanzees offer a model of choice to study the influence of these parameters on social learning. They evolve in large fission fusion groups, receive a prolonged maternal investment and need to learn various foraging skills, which can include the use of tools, during their development. We studied peering behaviour, a form of social attention found to be associated with social learning in orangutans, in 34 immature chimpanzees from the national parc of Tai. We tested: 1) If peering behaviour was produced in contexts where social learning was expected. 2) If party size influenced the frequency of social learning. 3) If role model choices were influenced by the complexity of the task. We found that: 1) Peering behaviour peaked during development and was positively correlated with processing complexity and monopolizability of food resources. 2) Party size was positively correlated with the frequency of peering events. 3) The proportion of peering events directed at the mother compared to other individuals gradually decreased with age and was positively correlated to the complexity of the foraging task. Our study supports a function of peering behaviour in social learning in chimpanzees and suggest that group size enhance observational social learning opportunities. Moreover, it supports that the acquisition of complex skills might be more dependant on role model's tolerance than simpler ones.

The role of observational social learning in chimpanzee skill acquisition

Nora Slania^{1,2}, Cat Hobaiter³, Klaus Zuberbühler², Caroline Schuppli¹

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The composition and geographic distribution of behavioral repertoires of wild chimpanzees indicate reliance on social learning for skill acquisition. Studies on the ontogeny of learning-intensive skills, like tool-use behaviors, find evidence for observational and interactive forms of social learning. However, the everyday use of social learning throughout chimpanzee development remains understudied and debated. We investigated whether wild chimpanzees use peering (close-range attentive observation of conspecifics)

as a means to social learning. Data are being collected on a community of wild chimpanzees (*pan troglodytes schweinfurthii*) at the Budongo Forest Reserve, Uganda since January 2022, currently comprising 240 peering events during 700 follow hours on 25 focal individuals. Data collection is scheduled until February 2024. We found several lines of evidence that chimpanzees use peering to learn from conspecifics. First, peering rates are highest during immaturity when most learning is expected, compared to little to no peering in adult chimpanzees. Second, young individuals frequently peer at behaviors that play central roles in chimpanzees' everyday lives, such as feeding and grooming. Third, chimpanzees selectively peer in learning intense contexts. We find a significant increase in peering with increasing number of pre-ingestive processing steps involved in a feeding technique. Further, this heightened attention to learning intense behaviors is particularly pronounced in juveniles, indicating that peering coincides with times of skill acquisition. Lastly, whereas infant chimpanzees primarily peer at their mother, juveniles increasingly select other conspecifics as role models, broadening their access to social information. Our results suggest that immature chimpanzees use peering for the acquisition of a wide range of skills. Chimpanzees seemingly maximize learning outcomes by peering selectively in different contexts and at different role models. These findings add to the increasing evidence that social learning pervades primate ontogenetic development.

Population interconnectivity and the origins of chimpanzee cumulative culture

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The factors enhancing the emergence of cumulative culture in the common ancestor of humans and chimpanzees, and limiting complexification in chimpanzees, are yet to be fully explained. In our study, we investigated networks of cultural transmission and similarity among 35 populations across the four chimpanzee subspecies, and compared these to between-population networks based on genetic markers of recent migration. We classified chimpanzee foraging behaviors into increasing levels of complexity and investigated the effects of recent population connectivity on shared cultural knowledge. We show that limited levels of interconnectivity predict increased levels of sharing of complex cultural traits compared to more simple behaviors and might have promoted the emergence of a few instances of cumulative culture in chimpanzees. The progression of cultural complexification, much like in humans, likely occurred in steps, with transmission between populations promoting incremental changes and repurposing of technologies. We propose that the shift in social patterns resulted in greater inter-group mobility in *Homo*

compared to *Pan*, leading to irreversible dependence on cultural exchange and complexification in our lineage.

Quantifying the effects of social learning during feeding repertoire development in wild Sumatran orangutans.

Elliot Howard-Spink¹, Tatang Mira Setia², Caroline Schuppli¹

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Wild adult orangutans consume a vast array of different food items. Due to their semi-solitary lifestyle - unlike in other apes - independent immature and adult individuals cannot rely on the knowledge of other group members but must be able to recognize food items by themselves. By the time immature orangutans reach independence from their mothers (at around eight years old), they possess adult-like feeding repertoires, suggesting that the majority of repertoire development occurs prior to this milestone. However, to date, the extent to which social and asocial learning contribute to feeding-repertoire development could not be quantified. During the dependency phase, orangutans encounter frequent opportunities for social learning from their mothers and likely make use of several different social-learning mechanisms, including local and stimulus enhancement, as well as observational and interactive social learning. Yet, whether these social learning mechanisms expedite feeding-repertoire development, and to what extent, are exceptionally challenging questions to answer using observational data alone. Using an agent-based model that is calibrated to long-term feeding data collected from wild Sumatran orangutans (*Pongo abelii*) at Suaq Balimbing (Indonesia, N = 22 immatures observed during approximately 1300 focal follows), we present data from an *in-silico* experiment that simulates developmental trajectories of feeding repertoires when different forms of social learning are available to agents. We evaluate the relative importance of different forms of social learning for orangutan feeding-repertoire development by comparing simulated repertoire development to the repertoire development observed in wild individuals. Our results are discussed in the context of ongoing debate surrounding the existence of culture across great-apes, with specific consideration of subsistence behaviours which do not require elaborate tool-use. We also discuss how agent-based models represent a generalized tool for estimating the importance of social learning strategies across behaviours and species, including other primates and beyond.

Wild capuchin monkeys extract underground spiders using stones and sticks

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Primate tool use repertoire for foraging include stones, sticks, and leaves. Among Platyrrhini, the customary use of stick probe tools and digging stone tools is restricted to one population of capuchin monkeys living in Serra da Capivara National Park (SCaNP). In

this study, we describe and compare the four techniques used by bearded capuchin monkeys in Ubajara National Park (UNP) to extract underground trapdoor spiders from their nests: digging using hands-only, digging with stone tools, probing with stick tools, and using stones and sticks tools sequentially. We followed a group of 31 monkeys during 1778.6 h contact hours recording All Occurrences of digging and probing trapdoor spiders. We observed 66 trapdoor spider extraction episodes. Females preferred hands-only technique, using stone tools in just 6% of their digging episodes and not using sticks. Males preferred the stick technique (51%) in comparison to stones (23%), stone-stick (12%) and hands-only (14%) techniques. When digging, males and females had similar success rates in obtaining this food resource. Males had lower success rates when using sticks (42%) and stones (40%) in comparison to hand (83%) and stone-stick (83%) techniques. Our data supports the hypothesis that females may be more sensitive to food rewards, not using tools when they do not provide increased success. Alternatively, males may take advantage of these tools where the soil is tough and stony, consequently having access to spiders on more hard-to-dig terrain. At SCaNP the stick and the stone-stick techniques were never observed being used on the ground, even though this population uses stones to dig for trapdoor spiders. These may constitute a cultural variation between these populations and add a newly described behavior variety in primate tool use repertoire. Grants: The Leakey Foundation; FAPESP #2018/01292-9; NGS-64133R-19; CAPES (#88887.511836/2020-00); The Animal Behavior Society.

Mushrooms in a Mosaic: Fungi consumption in a primate community within the Issa valley, western Tanzania

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Human have consumed mushrooms for centuries, with well-known culinary and nutrition (selenium, vitamin D, and vitamin B6) benefits. Mushrooms have been described as a key forest food for Neanderthals based on dental calculus remains and their presence in contemporary African grasslands suggests that mushrooms may have been available for early hominins and played a role in the evolution of cognition and language as far back as two mya by *Australopithecus*. Despite the global importance and even reliance on mushrooms by some humans, and their suggested role in hominin dietary ecology, there has been minimal description into the role of mushrooms in wild primates. For over 5 years (2018-2023), we observed consumption by sympatric chimpanzees, baboons, and red-tailed monkeys living in a savanna mosaic habitat in the Issa valley, western Tanzania. In addition, for 24 months (2022-2024), we investigated mushroom availability. Preliminary findings reveal an enormous diversity of mushrooms (> 30 genera) in terms of availability that are spatiotemporal variable. Individuals of all three primate species consume mushrooms, although we cannot yet be sure which (mushroom) species. Primate mushroom consumption was limited by their overall availability, which was restricted to the wet season (November - May). Individuals consumed mushrooms over several months, with proportion of their diet varying (i.e. *Pan*: Dec - 2 %, Jan - 23 %, Feb - 1 %, Mar - 1 %, Apr - 1 %, May - 1 %, Jun - 1 %, Jul - 1 %, Aug - 1 %, Sep - 1 %, Oct - 1 %, Nov - 1 %).

Apr –16%). Furthermore, across the three primate species the mushroom consumption peaked at a different month (*Pan*: January –23 %, *Papio*: April –45 %, *Cercopithecus*: March –19 %), which may prevent food competition among the species. We argue that mushrooms represent a crucial, yet underexplored, resource for non-human primates in western Tanzania. The accessibility and consumption of mushrooms among the primates in Issa unveils dietary adaptability and likely micro-niche partitioning.

SESSION H: Conservation (Thursday, 17:00 – 18:30)

One-Health approach applied to a primate conservation project in Brazil

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Brazilian biomes hold the highest primate diversity in the world, with many species living in forest fragments close to humans. However, how habitat fragmentation interacts with social connectivity to predict the emergence and spread of infectious diseases is barely known. Our project aims at understanding how infectious diseases emerge in animal populations and how they are regulated through socio-ecological processes. This project focuses on the endangered golden lion tamarins (*Leontopithecus rosalia*) as the flagship species –which had a 30% population decline due to the recent emergence of yellow fever in SE Brazil. We will present how this outbreak affected the ecology and behaviour of the species, how the population recovered, and which conservation efforts were implemented to mitigate further impacts. This research relies on long-term data (>20 years) on life history, behaviour, and ecology of primates and on-field experiments and advanced mathematical modelling (e.g., network analysis, individual-based modelling). By combining these different approaches, we are able to design appropriate actions for the prevention of epidemics and to assess humans' exposition to emerging zoonotic diseases.

Local ecological knowledge about pest control services provided by the Aye-aye offers substantial new conservation perspectives

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The Aye-aye's (*Daubentonia madagascariensis*) unique morphological features such as the large ears, elongated middle fingers, and rodent-like incisors enable it to access elusive food resources. Simultaneously the odd appearance is the basis of negative folklore that considers the Aye-aye a bad omen which causes the killing of animals. This threatens

populations of the world's largest nocturnal primate species. Although this narrative is frequently echoed in scientific and mainstream publications, systematic research on Human-Aye-aye-coexistence is still missing. Local ecological knowledge has proved to be a crucial tool in social conservation science, especially regarding elusive species. Drawing on a preliminary study by Randimbiharirinirina et al. in 2021, this collaborative research project by the Universities of Antananarivo (Madagascar) and Hildesheim (Germany) is the first to provide a detailed assessment of local communities' knowledge about the Aye-aye. 392 semi structured interviews and 6 guideline-based expert interviews were conducted to examine benefit-related and general knowledge about the Aye-aye in 21 communities in northeastern Madagascar as part of an evaluation study of educational approaches. Consulting local perspectives revealed a surprising positive interaction. Aye-ayes were perceived to control pests (Larvae of the clove leaf miner, *Chrysotus mabillanum*, locally known as Andretra) on clove trees by 47% of respondents. Through its unique foraging strategy, the Aye-aye is able to extract larvae from the wooden tissue, while causing minimum harm to the tree, thus substantially benefiting local livelihoods. General knowledge levels were found to be diverse and varied between communities and sociodemographic subgroups. The interplay between knowledge and attitudes, intracommunal knowledge transfer and the interregional transferability of findings are subject to our ongoing research efforts. Our results represent a milestone and bear the potential to advance Aye-aye conservation from contesting horror stories to developing community-based approaches that focus mutual benefits.

Leprosy surveillance of unhabituated chimpanzees in central Cantanhez National Park, Guinea-Bissau

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For the first time in any wild primate, we recently identified leprosy, a chronic infectious disease mainly caused by the bacterial pathogen *Mycobacterium leprae*, in the critically endangered western chimpanzee (*Pan troglodytes verus*) in Cantanhez National Park

(CNP), Guinea-Bissau. To estimate leprosy prevalence in two neighbouring chimpanzee communities, Caiquene-Cadique and Lautchande, where leprosy was confirmed, we non-invasively collected a total of 451 chimpanzee faecal samples between May and July 2021. Firstly, we screened each sample for *M. leprae* DNA using two complementary nested PCR systems targeting the repetitive element RLEP and the 18-kDa antigen gene. 27 samples (19 in Caiquene-Cadique and 8 in Lautchande) were positive in one or more assays. Secondly, chimpanzee DNA was amplified at 12 autosomal microsatellite loci and one sexing marker to infer the number and sex of the individuals. 424 samples were successfully genotyped and from these, 100 unique genotypes were identified (47 in Caiquene-Cadique and 53 in Lautchande). When combining the results, 16 individuals (12 in Caiquene-Cadique and 4 in Lautchande) tested positive in one or more samples, with an overall prevalence of *M. leprae* of 16%. To support these findings, molecular data were compared with camera trap footage of individually identified chimpanzees obtained during the same study period. Only two adult females in Caiquene-Cadique, and one adult male and one adult female in Lautchande showed clinical signs of leprosy. Longitudinal observations from camera trap footage obtained since 2015 showed progression of symptoms with manifestations similar to those described in humans. We discuss the usefulness but also the limitations of combining non-invasive methods to study infectious diseases in unhabituated great apes. This study provides valuable information on leprosy occurrence and suggests an active transmission of *M. leprae* between individuals in CNP.

Chimpanzee surveys in forest-agriculture mosaics: testing methods to inform effective monitoring across West Africa

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Surveys are critical for identifying important biodiversity areas, estimating and determining factors affecting species abundance and distribution, and monitoring population trends to inform conservation strategies. Critically Endangered western chimpanzees (*Pan troglodytes verus*) in West Africa rely heavily on heterogeneous forest-savannah-agricultural landscape mosaics (hereafter 'forest-agriculture mosaics') for survival. Despite this, these vital habitats are underrepresented in the current survey database. For example, robust national population estimates of chimpanzees in Guinea-Bissau are lacking. The challenges of surveying forest-agriculture mosaics, including the complexities of stratified sampling in highly heterogeneous anthropogenic landscapes, have contributed to the scarcity of studies in these areas. Considering the predicted agricultural expansions across West Africa, our study aims to inform the development of effective, standardized approaches for monitoring chimpanzee populations across diverse landscape types. We employed different survey approaches across an anthropogenic, forest-agriculture mosaic in Guinea-Bissau, namely Cantanhez National Park (1067 km²). Our methods included standardised marked nest counts on 64 line transects, camera trap surveys, and a grid-based rapid nest count survey. We employed Bayesian models

accounting for spatial dependencies using a SPDE-INLA approach. Our methods provided density maps and identified environmental and anthropogenic predictors of chimpanzee distribution and space use, abundance, and suitable nesting habitat. Camera traps proved more reliable than repeated transect surveys, and our grid-based approach allowed for broader coverage, enabling the collection of finer-resolution data on chimpanzee presence and the validation of model predictions. A challenge we encountered involved estimating the age and decay rates of nests in oil palms (*Elaeis guineensis*), a preferred nesting plant for chimpanzees in this region. These nests decay differently compared to those in other tree species. We are currently developing a protocol to overcome this issue. Our findings will contribute to the development of a nationwide survey strategy for accurate estimates of the chimpanzee population in Guinea-Bissau.

The Gorillas (*Gorilla Gorilla Ssp.*) Of The Ebo Forest, Littoral Region, Cameroon: Ecology, Anthropic Pressures And Community Conservation Strategy

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The relict population of Ebo gorillas in the Littoral Region of Cameroon is taxonomically still unknown and the least studied today. The study aimed to clarify the distribution of the gorilla population in the Ebo forest, their nesting and feeding behaviours, the anthropogenic pressures within their habitat, and finally the local population's opinions about the conservation efforts displayed by community-based associations. Ecological and biological data were collected across the study area (39 km²) from January 2013 to November 2017 along recces and on plots of 40x20 m²; while socio-economic data were obtained during a semi-structured household interview in 2013 and 2017. As results, the distribution range of gorillas in the Ebo forest extends over a 22 km² mosaic vegetation area. The abundance index of gorilla is 0.16 nest groups per kilometer. The grassland (3 % coverage of the area) seemed to be the preferred habitat for gorillas. Gorillas exclusively use plants to build nests (more than 281 species). Hunting was the most common anthropogenic activities in the area. However, it appeared that community-based organizations baptized '*Club des Amis des Gorilles*' not only contributed to wildlife conservation in the locality but also improved living conditions of local populations. The study recommends further research on the ecology, demography and taxonomy of this elusive gorilla population. Sustainable livelihood activities and promoting local leadership through community conservation will efficiently foster conservation of this gorilla population.

Between tradition and conservation: local perceptions and attitudes toward of great apes in the Dja biosphere reserve, Cameroon

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Within the northern part of the Dja Biosphere Reserve, a community conservation area managed by the NGO Tropical Forest and its partners for nearly 13 years, local populations coexist with endangered gorillas and chimpanzees, both threatened by poaching and logging. As part of a study on the interactions between great apes, human communities, and habitats in this socio-ecosystem, we delve into the perceptions and attitudes of local populations toward great apes, shedding light on traditional aspects, observed changes, and motivations for conservation. Through a structured questionnaire, 297 participants were surveyed between December 2023 and January 2024. Preliminary results reveal an intriguing paradox: while 63% perceive great apes as "meat provided by God," surprisingly, 86% express a strong desire to protect this resource. This willingness does not stem from its ecological or economic value but rather from the hope of allowing future generations to savor this meat. The decline in the great ape population, attributed to poaching by 42% of participants, along with NGO initiatives in economic alternatives, education, and awareness, seem to catalyze this collective awareness. These findings underscore the imperative to deepen our understanding of local dynamics, integrating cultural aspects and perceived changes. Thus, this research sheds crucial light on the complexities of interactions between local populations and great apes in an iconic ecosystem.

SESSION I: Social Cognition (Thursday, 17:00 – 18:30)

Between sex bonds in multi-male multi-female primate groups: a deductive framework

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Bonds, good and differentiated relationships, among group members have fitness benefits, also bonds among non-kin males and females. Here we explore from a deductive framework in what circumstances Between Sex Bonds (BSB) can be expected in multi-male multi-female primate group. BSB are considered a way to access sources of power that are subject to leverage, in particular to sources of leverage provided by the other sex, and differs yet complements power obtained through force. While females exert leverage

over fertilizations, both sexes exert leverage over the services protection, tolerance, and support. We predict that leverage will be higher, 1) when the receiver benefits on average more than the provider, 2) when receivers cannot share the resource, and/or 3) when the resource is rare and valuable. We expect BSB to be found, 4) when long-term targeting of the same partner yields benefits. We argue that females' main source of leverage is fertilizable eggs, whereas males mainly have leverage over protection of females and offspring. BSB are more likely in three settings: 1) most importantly through the combination of female mate choice with male protection and care; 2) less female cohesion in combination with setting 1; and 3) potentially, but not yet documented, secondary female dispersal in combination with setting 1. Systematic testing of these proposals is not yet possible due to a drawer effect, yet found patterns conform to our predictions. The investment in shared offspring may result in interdependency between male and female strategies, but the different services provided by females and males indicate that affiliative exchanges associated with bonds between the sexes will be typically asymmetric and variable over time. Thus, bonds between the sexes are expected in a limited number of circumstances that provide both females and males leverage over sex-specific resources.

Playmate's impact on the production of laugh faces' morphological variants in two nonhuman great apes

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Among primates, facial expressions play a crucial role in communication, and such a role is especially important in risky situations. Playful interactions can potentially to unwanted consequences, particularly during rough bouts or when a substantial discrepancy in the players' size/strength is present. In these contexts, laugh faces may arguably signal playfulness, but despite our knowledge about their general function, very little is known about the role of their variations with dependence on the playmate's features. Indeed, the facial muscles typical of laugh faces could be more extensively activated either in the weaker individuals or in the potentially more threatening individuals, depending on the direction of the message. Additionally, facial muscles' activations could also depend on the intensity of the play and reflect levels of arousal. In this study, we examined 14 orangutans (4-17 years old) and 17 chimpanzees (1-36 years old) of both sexes, for a total of 624 laugh faces of dyadic play that we analysed with OrangFACS and ChimFACS, respectively. By focusing principally on the degree of mouth opening and teeth exposure, we tested if such variations were affected by the individuals' age difference, their social bond, the playmate's sex and the intensity of the play. Interestingly, our results partially support all three hypotheses, with orangutans showing more facial muscles when interacting with weaker playmates, and chimpanzees activating them more often towards stronger individuals and in more intense interactions. These findings further highlight nonhuman apes' facial expressions flexibility and complexity, and possibly shed some light on the origin of the extremely broad facial repertoire of our species.

Social evaluation of skillfulness in Tonkean macaques (*Macaca tonkeana*) and brown capuchins (*Sapajus apella*)

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Evaluating others is crucial to inform decisions on who to interact with, trust, learn from, or compare to. To date, research on social evaluation of competence in nonhuman primates has mainly focused on forming impressions about others' prosocial tendencies. The current study aimed to investigate the ability of Tonkean macaques (*Macaca tonkeana*, n = 10) and brown capuchins (*Sapajus apella*, n = 9) to evaluate others' skills in solving a particular task. Subjects sampled information about the skillfulness of two human actors to open containers, during 24 observation opportunities. One actor succeeded reliably while the other actor failed repeatedly. Subsequently, subjects chose between those actors who manipulated a container to make food available for them. We compared choices for the skillful actor before and after the observation phase. We also compared anticipatory behaviors (i.e., looking, proximity, begging) of the subjects before and after the observation and choice phases. Preliminary analyses show that preference for the skillful actor increased in both species following the experimental manipulation. Anticipatory behaviors did not change after observing or co-acting with the actors. Our findings indicate that both species can form impressions of others' skillfulness and use it to choose or avoid a partner as needed given the context at hand. These results extend our knowledge on social evaluation abilities of capuchins, who have previously already demonstrated a preference for prosocial over unhelpful human actors. In addition, the results provide a first glimpse into social evaluation skills of Tonkean macaques, who have not previously been tested with a similar paradigm. Future research will tell if nonhuman primates can also overcome competing social preferences to select conspecific partners in flexible context-specific ways.

Presenting a novel Common Pool Resource dilemma to captive chimpanzees

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Though social animals reap significant benefits from group living, it is inevitable that groups will encounter social dilemmas, where the conflicting interests of different group members must be resolved. However, most behavioural economics work in non-human great apes focuses on dyadic interactions, and very few attempt to capture group-level dynamics. This represents a significant gap in our knowledge of what facilitates and constrains group cooperation in primates. In general, these dyadic studies find that dominance dynamics, low feeding tolerance of dominant individuals, and asymmetrical payoffs are key to finding a resolution (Koomen and Herrmann, 2018; Melis et al., 2009,

Sánchez-Amaro et al., 2019). However, there is evidence that these solutions become less important as group size increases (Schneider et al., 2012). This study examines the role of group size, dominance, and their interaction in social dilemma resolution. We presented a novel Common Pool Resource Dilemma to dyads and quartets of captive chimpanzees. Coordination should be more challenging with more players and, if the chimpanzees rely on dominance relationships to resolve the dilemma, the ability of the highest-ranking ape to monopolise the resource should be reduced in the larger group size. We therefore hypothesised that the quartets would be less able to sustain the fragile resource. Our preliminary findings suggest the opposite, with the quartets succeeding in achieving higher latencies until collapse and a greater difference between the test and the no-dilemma control condition. This indicates that group cooperation in chimpanzees cannot be neatly summarised as “the larger the group, the less it will further common interests” (Olson, 1971). Further analysis will focus on the effect of dominance ranking heterogeneity on success, its interacting effect with group size, and the importance of payoff equality, in order to gain a fuller understanding of what can help and hinder group cooperation in chimpanzees.

Live or Lifeless? Chimpanzee Preferences in Viewing Images of Live and Dead Animals: Untangling the Animacy Bias.

André Gonçalves¹

¹*Kyoto University*

Humans and many non-human animals divide their world into agents and non-agents. Agents usually have clear morphological/biomechanical features associated with animacy used to categorize them as such. According to the *animate monitoring hypothesis*, animate entities attract more attention than inanimates due to their potential role as predators or prey in ancestral human environments. Studies show that humans quickly detect both upright lions and impalas in comparison to their reclining counterparts. Detecting animacy is a problem many animals face, likely widespread in nature. The perception of dead animals poses an interesting question since they share both animate and inanimate attributes. Visual-defining features of death include inertia, injury, and decay. Using a two-competing stimuli task with eye-tracking, we measured chimpanzees' attention toward images depicting both live and dead animals in realistic backgrounds to explore if they exhibited preferential-looking patterns towards live versus death-related stimuli. In experiment 1, the stimuli consisted of image-pairs of live and dead animals. Experiment 2 had image-pairs of dead and live infant-carrying behavior in non-human primates. Lastly, experiment 3 consisted of image-pairs of sleeping and dead mammals. Our results suggest a similar animacy bias towards upright live animals versus dead reclining animals in experiment 1; the chimpanzees detected live animals quicker and looked at them significantly longer. Experiment 2 showed this bias carried through infant primates; chimpanzees looked longer at live primate infants in comparison to dead ones. Finally, in experiment 3, there was no such difference in latency or looking durations; sleeping and dead animals were perceived similarly in this experiment. The results suggest that indeed chimpanzees show an animacy bias towards life-like stimuli; however, while we remain

agnostic as to whether chimpanzees distinguish sleeping from dead animals in experimental settings, our sleeping-dead stimuli may be too perceptually similar for such detection in this task.

Joint commitment in monkeys: the role of mutual gaze

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Among human and non-human social animals, only hominin species seem to engage in joint actions where interacting subjects exchange signals to form, maintain, and seal joint commitments. To see whether mutual gaze (*mg*) could be used also in monkeys to reach shared engagement and intentionality, we explored the exchange of *mg* anticipating and closing naturally occurring joint play fighting (n=954 interactions) in a large group of rhesus macaques (n=122, among which 63 young subjects). We found that *mg* between macaques anticipated 72% of playful interactions and concluded 32% of them. Importantly, the presence of *mg* contributed to successful joint play and was specifically used to close play compared to control conditions, highlighting the specific role of *mg* in joint action and its possible link to joint commitment. Then, we found for the first time an association between *mg* and the rapid mimicry of positively valent facial expressions (RFM of play faces) during play. More in detail, *mg* opening joint play led to events of RFM more often punctuating the interaction; the presence of RFM, in turn, enhanced the likelihood of *mg* concluding joint play. This importantly suggests that RFM might have a role in the maintenance and reaffirmation of joint commitment during the main body of interactions. Overall, our results suggest that joint commitment as a process may be more ancestral than previously thought, shedding light on the role of low-demanding *mg* in establishing and dissolving joint commitment in monkeys. Moreover, this present and further studies will contribute to better understand the evolution of the primate social/interacting mind.

SESSION J: Communication 2 (Thursday, 17:00 – 18:30)

What expression do you replicate? Play face and full play face rapid mimicry in chimpanzees

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In non-human primates, Play face (PF) and Full Play Face (FPF) - homologous to human smile and laughter - are signals that contribute to prolong the playful session and avoid escalation into real fight. PF and FPF are typically conflated into a single communicative signal, but in many primate species evolution has maintained and favored these two expressions as distinct. Also studies on Rapid Facial Mimicry (i.e. RFM; the fast - <1 sec - replication of a perceived facial expression) collapsed PF and FPF into a single category. In this study, we aim at investigating in chimpanzees (*Pan troglodytes*) the possible occurrence, modulation and function(s) of RFM for either PF or FPF. From 2019 to 2023, we collected video data on playful interactions ($N_{\text{sessions}}=1400$) in four chimpanzee colonies ($N_{\text{tot}}=44$) housed at La Palmyre, ZooParc de Beauval, Vallée des Singes (France) and Fundación Mona (Spain). Although analyses are still in progress, preliminary results show for the first time the occurrence of RFM of either PF or FPF, taken separately. Furthermore, the RFM of FPF - but not of PF - tended to be more frequent between unrelated individuals, suggesting its play facilitation between individuals that were less bonded with one another and possibly limiting the risk of context misunderstanding. Hence, in chimpanzees PF and FPF and their rapid replication might have different meaning and serve different functions depending on playmate identities and social dynamics.

Homologues of human conversation in chimpanzee gestural communication

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Natural conversations across the diversity of human languages and cultures follow surprisingly similar structures, requiring the combination of cognitively demanding abilities such as rapid turn-taking and joint-attention. The speed between conversational turns is faster than the time required for humans to process a sentence –we ‘finish each other’s sentences’ as we respond. Great ape gestural communication shares many characteristics with human language and has been proposed as a foundation from which language could evolve. Ape gestural communication has been shown to follow sequential

contingencies akin to conversational turn-taking in which a signaller's gesture is rapidly followed by a behavioural response from the recipient. However, one key property of human conversation is that both signallers and recipients produce signals (words or signs). These exchanges of signals scaffold longer conversations that may be used to negotiate toward a shared goal, make compromises, or ask for clarification, ultimately facilitating cooperation between interactants. We present the first analysis of chimpanzee gesture exchanges, where both participants produce gestures in sequential turns. Using the largest gestural dataset to date, spanning five communities of wild East African chimpanzees, we found that 14% of chimpanzee gestural communication included a gestural exchange and, as in human conversation, latency between turns was consistent across communities. The average latency (~120ms; range -1500ms to 8640ms) was within the range of human latencies (-500ms to 1500ms) and close to the human average (~200ms); negative latencies within these ranges highlight occasional interruptions/turn overlap in conversations and gestural exchanges. We argue that these forms of fast-paced signal exchange may represent precursors to negotiation and compromise that are essential for cooperative species, such as humans and chimpanzees, to coordinate joint behaviour.

A holistic investigation of the syntactic capacities of wild bonobos

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Compositional syntax is the capacity to use rules to combine elements into larger structures whose meaning depends on that of the elements. In human language, it is illustrated by the combination of meaningful units into words (e.g., water + proof) or words into sentences (e.g. I + love + dogs). Animals often produce meaningful signals, and a handful of species have been shown to possess compositional syntactic capacities. However, evidence remains scarce, and is mostly restricted to one call type (typically, alarm calls) or one type of meaning (e.g., reference or imperative). In this study, we use linguistic methods to investigate to what extent our closest relatives, bonobos (*Pan paniscus*), possess compositional syntactic capacities. We collected data on wild bonobos at the Kokolopori Bonobo Research Project, DRC. Over 9 months, we conducted 15-min focal recordings on 24 adults (total: 150h of focal), during which we recorded every vocalization produced by the focal individual (N = 1174 utterances). We then implemented a collocation analysis, an approach borrowed from computational linguistics, to identify what two-call combinations occurred more than expected by chance. We found that bonobos regularly combine calls into at least 17 different combinations. We also conducted ad libitum recordings for over 6 months, and for each vocal utterance (N = 992), we live-coded the holistic ongoing context. We then adapted a method from distributional semantics to investigate the meaning at the call and combination level, i.e.

identify what set of contextual variables is statistically associated with the emission of a call type or combination. Through quantifying the extent of combinatoriality in bonobos and systematically investigating the meaning of their calls and combinations, this study can help shed light on the evolutionary progression of language, specifically the latent syntactic capacities present in our ancestors living 6-8 million years ago.

Adopting comparative behavioural methods to document the forms, functions, and meanings of pre-speech gestures in 12- to 15-months olds

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While speaking, we always gesture. These gestures add semantic information to speech, such as referential (e.g., pointing) or symbolic gestures (e.g. “thumb up” meaning ‘okay’); they also coordinate social interactions (e.g. beat gestures). While a substantial body of research addresses the co-speech gesture categories in adults, their ontogenic origin remains poorly studied. To fulfill this gap, we adopted an ethological method established in non-human primate gesture research (Hobaiter & Byrne 2014) to document the gestural repertoire (forms, functions, and meanings) of six infants aged 12- to 15-months. We manually annotated videos of spontaneous infant-caregiver interactions (26 hours) available on the CHILDES platform (PhonBank French-Paris, Leroy et al 2009 & French-Lyon, Demuth & Tremblay 2008). We identified 63 unique gesture forms, constituting of the four main functions, also identified in adult co-speech gestures: referential deictic (46.03%), referential iconic (7.54%), non-referential (41.47%) and symbolic (4.96%). On average, referential gestures meanings are most versatile across age (spanning 10 of the 11 identified meanings), signifying a range of intentions, such as, to ‘acquire object’ (27.78%), to ‘share attention’ (25.82%), to ‘describe action’ (43.93%), among others. 87.73% of the non-referential gestures were used to ‘express emotion’, while symbolic gestures are most used to ‘respond to question’ (53.96%) or to ‘share attention’ (40.42%). Our findings provide the first evidence of a functional overlap between infant pre-speech gestures and adult co-speech gesture categories. This result also suggests that adult co-speech gesture meanings are perhaps speech independent, as manifest in the pre-speech gestures of infants. We are currently examining whether and how specific pre-speech gesture categories might lay the developmental foundations of their corresponding counterparts in adult co-speech gestures.

Social play in common marmosets (*Callithrix jacchus*): function of signals to initiate and modify play

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Social play requires various mechanisms to ensure success. For instance, communicating the playful intent of a physical encounter is important to avoid potentially costly misinterpretation. Primates show the most play of all mammals, and though they use various bodily expressions to regulate social life, the precise function of these expressions as mechanisms for social play is unknown. In particular, we do not know whether such expressions function to initiate and/or modify play. Common marmosets are a cooperatively breeding species and, therefore, an appealing model species to investigate collaborative actions such as social play. We recorded play within three captive family groups (total of 450 min), using multiple Go Pro's simultaneously to capture the fast-paced marmoset behaviors. Three distinct signals (supine, hide, stalk) and six distinct play types (wrestle, chase, pounce, touch, catch, pull) were identified. We used modern statistical methods to model the transitions between behavioural states: our multi-state (i.e. signal, play, rest/nothing) time-to-event model takes a data-driven approach to account for uncertainty in the duration of play bouts, avoiding arbitrary bout intervals by using probabilistic classification. The resulting classified bouts (total 117) allowed us to assess the social function of signals by comparing the resulting play behaviour to a resting state baseline. We find that the presence of a signal (vs. rest) increases the probability to play, and, moreover, doubles the duration of a play bout. Other results regarding signals as referential communication, and who takes on the role of signalling versus initiating play, will be presented at the conference. Overall, social play and its signals are proposed as important elements in the evolution of communication, and our research contributes to its further understanding.

ChimpLASG: a form-based approach to the classification of chimpanzee gestures

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The classification of primate gestures is traditionally achieved through top-down approaches, i.e. the categorization of gesture types based on the assignment of each gesture to a pre-described category. Being based on researchers' intuition, these classifications may lack consistency in the applied criteria. For example, the gesture *poke* is characterized by its stretched fingers handshape, while other gestures with the same basic movement are all classified as *touch*, regardless of whether the hand, knuckle, or foot

is used. Despite these limitations being acknowledged and occasionally addressed, there is still to date no coding scheme that formally describes primate gestures without relying on pre-established categories. This study aimed to fill this gap by developing an annotation system that describes chimpanzee gestures primarily through formal parameters, and only subsequently applies them to the identification of gesture types. To ensure we focused on formal features that may be relevant for meaning, we applied and adapted to chimpanzees an existing linguistic annotation system for co-speech gestures in humans, known as LASG (Bresse et al., 2013). The resulting coding scheme, ChimpLASG, comprises 13 formal parameters: it firstly subdivides gestures into phases, identifying their smallest unit, the stroke; then, of each stroke, it describes the shape (hand-wrist-elbow configuration, orientation, and position), the form of movement (movement descriptor, direction, trajectory, quality, and motor pattern), and type of touch (touch quality, body part touching, body part touched). Currently, ChimpLASG is fully developed and undergoing its first application for video coding in ELAN on a dataset of semi-wild chimpanzees in Chimfunshi, Zambia. Form-based approaches like ChimpLASG overcome current biases in primate gesture classifications and enable further investigations on gestural units, compositionality, and co-variation of gesture formal parameters with demographic, social, and ecological factors.

SESSION K: Welfare & Neuro (Friday, 11:00 – 13:00)

Welfare impact of new diet in captive chimpanzees: changes in behaviour, microbiome and blood parameters linked with obesity, prediabetes and cardiovascular disease

Dietmar Crailsheim¹, Nicky Staes², Jonas Torfs², Leen Verbist³, Olga Feliu¹, Sarah Depauw³
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Both in free-ranging and captive-housed animals, food availability and quality has been repeatedly identified as an important factor influencing animal's survival chances, physical health and wellbeing. Yet even today, the importance of providing captive animals with adequate diets is often being overlooked or underestimated. In this study, we evaluated the impact of improving the diets of two chimpanzee groups (N=13) housed at the primate sanctuary Fundació MONA. Here, their diet has been corrected for nutritional imbalances and adapted to the chimpanzees' increasing age, i.e., reducing sugar, increasing fibre while also increasing the food volume. To evaluate the impact of the new diet, we analysed 2 years of behavioural data as well as data on body weight and body condition. Furthermore, before and after the diet change, faecal samples for microbiome analyses and opportunistic blood samples (N=4) for blood analysis were collected. As expected, our preliminary results already indicate a desired impact on the animal's behaviour and physical health. Specifically, overweight chimpanzees lost weight, while lean animals maintained their body condition. Behaviours, such as aggression, vigilance, abnormal and self-directed behaviour decreased while alimentation and relaxed resting activities increased. The gut microbiome showed a significant change in beta- but not alpha-diversity, indicating a shift in composition of the bacterial communities, rather than

overall diversity. Moreover, blood parameters related to commonly problematic health issues in great apes, such as cardiovascular diseases, diabetes and/or obesity improved. Specifically, we found blood triglycerides and the blood sugar level (HbA1C) to decrease, whereas the cholesterol ratio greatly improved. Finally, in initially overweight chimpanzees, leptin concentrations noticeably decreased. Our results highlight the importance of providing captive-housed chimpanzees with an adequate and well-balanced diet, as well as demonstrate the clear positive impact on the chimpanzee's health, behaviour and general welfare.

Greater variability in rhesus macaque (*Macaca mulatta*) endocranial volume among males than females

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The greater male variability (GMV) hypothesis proposes that traits are more variable among males than females, and is supported by numerous empirical studies. Interestingly, GMV is also observed for human brain size and internal brain structure, a pattern which may have implications for sex-biased neurological and psychiatric conditions. A better understanding of neuroanatomical variability in non-human primates may illuminate whether certain species are appropriate models for these conditions. Here, we tested for sex differences in the variability of endocranial volume (ECV, a proxy for brain size) in a sample of 542 rhesus macaques (*Macaca mulatta*) from a large pedigreed free-ranging population. We also examined the components of phenotypic variance (additive genetic and residual variance) to tease apart the potential drivers of sex differences in variability. Our results suggest that males exhibit more variable ECVs, and that this pattern reflects either balancing/disruptive selection on male behaviour (associated with alternative male mating strategies) or sex chromosome effects (associated with mosaic patterns of X chromosome gene expression in females), rather than extended neurodevelopment among males. This represents evidence of GMV for brain size in a non-human primate species and highlights the potential of rhesus macaques as a model for sex-biased brain-based disorders.

Assessing the welfare of laboratory macaques: towards an ethical and responsible research

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Macaque species, specifically *Macaca mulatta* and *M. fascicularis*, play a pivotal role in neuroscience and biomedical research. Inadequate housing conditions and husbandry practices can lead to physiological and behavioral alterations, reflecting poor welfare, and can have an impact on the validity of results. However, despite the existence in the scientific literature of numerous studies examining welfare indicators for laboratory-

housed macaques, few field studies have been carried to develop a species-specific welfare assessment tool for macaques and test its validity. This is the goal of this project. This study was conducted on 169 macaques housed in eight research laboratories in France. We aimed to investigate their welfare through a welfare assessment tool. This latter is based on pre-existing frameworks on the matter, such as AWIN (Animal Welfare INdicators) protocol for farm animals, but specifically adapted to macaques in laboratory settings. Behavioral data were collected by two observers on each subject with 10-min of focal sampling, totaling 110 hours of observations. The interrater reliability score was calculated using intraclass correlation coefficient (ICC). In addition, a wide range of animal-based and environmental-based measures were collected through a survey which includes over a hundred questions divided into 4 categories: housing, nutrition, health, and behavior. The ongoing data analysis, including Generalized Linear Mixed Models, investigate the potential impact of various housing conditions and husbandry practices on the behaviors exhibited by macaques. Preliminary results suggest that single housing conditions and water restriction influence the proportions of abnormal behaviors exhibited by macaques, in line with previous studies reported for other species. Through this work, our aim is to guarantee an objective and standardized assessment of the welfare of primates in the laboratory, to make recommendations for improving husbandry practices and to help raise awareness of the welfare of laboratory animals, for ethical and responsible research.

Salivary cortisol and IgA in zoo-housed bonobos: Diurnal patterns and responses to an environmental stressor

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Various physiological markers can be used to assess affective states in animals and evaluate their welfare. Glucocorticoids (GCs) are widely used as stress biomarkers, and by extension animal welfare. However, GCs primarily provide insights into physiological arousal, but fail to distinguish between positive and negative arousal. More recently, salivary immunoglobulin A (IgA) has been suggested as a potential biomarker that could inform animal welfare assessment due to its sensitivity to stress, and the combined measurement of GCs and IgA is gaining prominence for a more holistic evaluation of individual stress responses. Despite these advances, species seem to differ in the diurnal pattern observed in salivary IgA measures. Some studies report a morning peak with subsequent decline in humans, other studies mention an increase in the afternoon in other species. If and how patterns of the two markers are correlated is still unclear. Especially in non-human primates, fundamental knowledge about IgA diurnal patterns, inter-individual variation, and its responses to stressors remains understudied. Therefore, this study has two primary objectives. First, we aimed to investigate the diurnal patterns of associations between salivary cortisol and IgA in ten zoo-housed bonobos (5 females, 5 males). Second,

we explored how salivary cortisol and IgA levels changed in response to an environmental stressor (i.e. heavy machine maintenance). Bonobos were trained for voluntary saliva sampling, with samples collected hourly between 7:30 and 17:30 across six days. Utilizing microtiter plate enzyme immunoassay (EIA), 405 cortisol samples and 410 IgA samples were deemed suitable for data analysis. Preliminary results confirm the expected diurnal decline in cortisol, which was also mirrored in IgA. Regarding responses to the environmental stressor, we anticipate finding elevated levels of cortisol and IgA compared to control days. The outcomes of this study will contribute to further validating salivary IgA as a physiological welfare marker in great apes.

Behavioral, physiological, and genetic drivers of coping in a non-human primate

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Human and non-human animals are repeatedly confronted with environmental and social stressors. The mechanism of coping enables them to face a stressor and to deal with challenging situations in a behavioural and physiological manner. In humans and non-human primates, considerable inter-individual differences in coping behaviour have been observed. Yet, little is known about how behavioral, physiological, and genetic drivers regulate coping and contribute to such variation. We introduce a multidisciplinary framework to study coping behavior in a non-human primate, the long-tailed macaque (*Macaca fascicularis*). We conducted ecologically relevant predator exposure experiments repeatedly to assess coping styles ($n=30$) in three captive groups of long-tailed macaques. Personalities were assessed using a comprehensive multi-method 'bottom-up' approach of repetitive behavioural observations and experiments ($n=32$). An infrared thermal imaging method was employed to detect emotional arousal during predator exposure ($n=12$). In addition, we tested whether underlying genotype associates with copying. We targeted and identified the human equivalent *COMT* (Catechol-O-methyltransferase) Val/Met polymorphism in long-tailed macaques ($n=26$). *COMT* Val/Met is well known for its role in human stress regulation but received only little attention in non-human primate studies so far. Our findings indicate that personality traits and the human equivalent *COMT* Val/Met polymorphism are associated with "nonaggression-based" and "aggression-based" coping styles in long-tailed macaques. Behavioral coping styles align consistently with emotional arousal. Our study elucidates the multifaceted mechanisms of coping and encourages further research on non-human animals to deepen our understanding of the proximate drivers of coping and its evolution.

Subcortical Correlates Of Macaques' Social Tolerance Scale

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Relying on years of ethological studies, 23 species of the *Macaca* genus have been ordered on a 4-grade social tolerance scale. Based on 18 covariant behavioural traits such as counter-aggression or reconciliation rates, each species are ordered from low (Grade 1, e.g. *M. mulatta*) to high social tolerance (Grade 4, e.g. *M. tonkeana*). To date, the neuroanatomical correlates of interspecific variability in macaques' social behaviours are unknown. To explore this potential link, we have established a collection of 46 *post-mortem* samples from 12 species of macaques scanned in Strasbourg (7T MRI) or gathered from databases (PRIMate Data Exchange, Japan Monkey Centre, Oxford University). We studied the subcortical anatomy (SARM atlas) of these acquisitions in light of recent knowledge about primates' social brain. In previous studies on *M. mulatta*, the volume of subcortical regions (e.g. amygdala, striatum) is correlated to socio-demographic variables (e.g. individual's hierarchical rank or group size). We thus hypothesize that volumetric variations of subcortical regions belonging to the social brain, should reflect the level of tolerance of the species studied. Results show the relative amygdala's volume, a region with a prevalent role in social cognition and behaviours regulation, is the best predictor of macaques' social grades, with Grade 4 (tolerant) monkeys having bigger nuclei than Grade 1 (intolerant). To tackle the innate vs acquired dimensions of this finding, we then considered the effect of the subject's age on the volume of amygdala across social grades. We observed a significant and reversed difference between social Grade 1 and 4 macaques. The least tolerant species showed a small amygdala in their youth, which gradually increased in size over their lifespan, while the Grade 4 species exhibited the opposite trend. These results represent the first insights about the cross-species neuroanatomical correlates of social behaviours variations in primates and pave the way for further investigations related to the evolution of primates' social brain.

Brain ontogeny and behavioral development in cooperatively breeding and independently breeding primates

Paola Cerrito¹, Judith Burkart¹

¹University of Zurich

Brain development in primates, and especially in humans, is experience-dependent: it is affected by the stimuli received during a critical period. In early ontogeny, these stimuli differ significantly between independently and cooperatively breeding species. In cooperative breeders infants interact with multiple caregivers right from birth, and therefore must adapt to a richer and more varied social environment. Here, we examine white and gray matter ontogenetic trajectories of the cooperatively breeding (*Homo*

sapiens, *Callithrix jacchus*) and independently breeding (*Pan paniscus*, *Macaca mulatta*) primates, and relate them to behavioral and life-history milestones. We find that: (i) cooperatively breeding species share similar relative brain ontogenetic timing; (ii) maximum gray matter volume is achieved before weaning in cooperative breeders but before weaning in independent breeders; (iii) in cooperative breeders the volumetric reduction to adult size coincides with the period of frequent negotiations between infants and caregivers over food, the arrival of the next set of siblings, and the change of role from being a recipient of care to becoming a helper. Overall, we find that the neuro-ontogenetic trajectory coincides with fundamental social milestones and tasks in marmosets and humans, but not in other primates. The rich social environment in which infants of cooperative breeders are raised during a critical period of brain ontogeny appears fundamental for the emergence of the particularly strong prosociality and socio-cognitive skills that we see in cooperatively breeding species. Since humans are also cooperative breeders with prolonged brain development, our comparative findings have significant implications for the evolution of human social cognition.

Bonobo biometrics: Tracing markers of stress through behavior, genes and microbes

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Stress in primates is commonly assessed by observing behavior and measuring physiological indicators such as fecal cortisol levels. Elevated stress is linked to heightened self-directed behaviors (SDBs), such as increased self-scratching, along with elevated circulating cortisol. Yet, for numerous primate species, our understanding of stress remains limited, particularly regarding lesser-explored biological markers like variation in stress-related genes and distinctive gut microbial signatures. Here, we report on stress biometrics in a large population of zoo-housed bonobos (*Pan paniscus*). We collected behavior, fecal and DNA samples for 70 adult bonobos housed in 6 European zoological institutes. We initially quantified the distinct types of self-directed behaviors (SDB) that increase following a social stressor, specifically an aggressive interaction. The results revealed a significant increase solely in rough self-scratching, with no notable changes observed in other self-directed behaviors like gentle self-scratching, nose wiping, and autogrooming. Next, we assessed gut microbial composition from fecal samples using 16S rRNA sequencing. Bonobos with elevated levels of rough self-scratching showed lower gut microbial alpha diversity and alterations in its composition. In the last phase, we will assess individual genotypes for four serotonergic genes linked to stress-susceptibility in other species (namely, *HTR1A*, *SLC6A4* and *TPH1/TPH2*) and explore the degree of alignment with behavioral and gut microbial stress markers.

FLASH TALKS

Wednesday 15:00-15:30

Emotional Responses and Agency in Chimpanzees

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The ability to attribute agency is an important capacity for social primates; it allows for reasoning about others' actions, and prevents inappropriate and redundant behaviour towards non-agentive objects. Human infants identify novel entities as agentive if they show internal control over their actions, or possess physical features (e.g. faces, limbs, hair) that tend to be associated with animals. The planned study (which, by the conference, will be in the data collection stage) aims to investigate whether chimpanzees (*Pan troglodytes*) use any of the same mechanisms as humans to identify agents. For this purpose, I will use a novel outcome measure and experimental paradigm: emotional responses in virtual reality. In a recent experiment in which chimpanzees used a touchscreen to collect virtual prey in exchange for fruit rewards, I observed several subjects responding emotionally to virtual animal avatars that stole prey from them. These responses included vocalisations, spitting, and gestures directed towards the virtual competitors. This demonstrates that the chimpanzees viewed the avatars as agents who were deliberately stealing from them—in previous touchscreen tasks that lacked agentive competitors but featured similarly frustrating target losses, the same subjects never vocalised or gestured towards onscreen objects. The upcoming study will feature four virtual competitors varying in terms of self-propulsion and the presence of animalian features: a moving animal, a stationary animal, a moving non-animal shape, and a stationary shape. When subjects lose prey to these competitors, I will use the frequency of their emotional responses as a proxy of agency attribution. In this way, I seek to identify which of these two variables—if either—is most associated with agency from chimpanzees' perspective. This would represent a first step towards elucidating how chimpanzees categorise agents, and the extent to which the pathway to this ability is evolutionarily shared among the great apes.

Are Tonkean Macaques able to make intuitive statistical inferences?

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In a changing environment, making predictions about probabilistic events from few observational facts has ecological relevance for many species. Recent research has shown that preverbal infants, great apes, and capuchins were able to reason about proportions to predict the nature of single-item randomly sampled from two populations. Recent studies with Afro-Eurasian monkeys (*Macaca fascicularis*, Plací *et al.*, 2018; *Macaca mulatta*, De

Petrillo and Rosati, 2019) brought contradictory results about whether macaques relied on proportions or other choice heuristics to solve this kind of task. To provide additional information on the evolutionary origins of this skill and overcome methodological concerns from previous studies, we assessed the ability of Tonkean macaques (*Macaca tonkeana*) to consider proportions in intuitive statistical inferences. In a series of eight experimental conditions, 13 Tonkean macaques had to infer from which of two jars that differed in their relative distribution of a preferred and non-preferred food item, they could get more chance to obtain the preferred item. During each test, the experimenter simultaneously drew an item from each option, and presented them (hidden in the hand) to the subject for his choice. The results showed that Tonkean macaques as a group, relied on proportions to predict the drawing outcome. Interestingly, when there was a major difference in food quantity between the two options, monkeys' decision was also influenced by the quantity of preferred food items. More detailed analyses revealed the existence of a substantial inter-individual variability in their decision-making strategies. While some individuals reasoned exclusively about proportions, others also considered the quantities of their preferred food items in their decisional framework. Our results support that the cognitive ability to produce intuitive statistical inference is shared amongst primates. However, its high cognitive demands might motivate the use of simpler heuristics in animals' daily decisions.

Experimental evidence of tool use in Bugoma Forest chimpanzees

Kelly Ray Mannion¹, Stephen Kugonza², Michael Ndora², Thibaud Gruber¹

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This study presents experimental evidence for tool use behaviors in a newly habituated community of wild chimpanzees, *Pan troglodytes schweinfurthii*, in Bugoma Forest, Uganda. The honey-trap experiment is a field method used to simulate natural contexts, e.g. a bee hive, and provides an ecological opportunity for tool use. The honey-trap experiment was set up using a log with a hole drilled into it with honey placed in the bottom so the chimps cannot reach it with their fingers. The honey-trap experiment was previously implemented in Ugandan chimpanzee communities in Budongo and Kibale forests. Chimpanzees at Kibale used stick tools to extract the honey from the log, while Budongo chimpanzees used leaf sponges. Starting in 2021, more than 14 experiments have been conducted in Bugoma Forest to examine the tool use repertoires of the newly studied Mwera community. Remarkably, both leaf and stick tool use evidence occurred during the experiments. Following the use of a honeycomb to extract honey, two adult female chimpanzees manufactured leaf-sponges to dip into the log, a typical behavior in this community to collect water. In a separate experiment, one adult male used a branch to dip into the log and then, detached leaves from it and continued with a stick to reach the honey. This study highlights the diversity of tool use strategies to reach the same goal within the Mwera community and raises ecological and social questions in comparison to the earlier findings in Budongo and Kibale.

Comparing chimpanzee (*Pan troglodytes verus*) and sooty mangabey (*Cercocebus atys*) crab-fishing behaviour in the Nimba Mountains, Guinea

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Aquatic faunivory, and specifically feeding on crabs, is rare among primates. As crabs are mobile, armed, and are often not visible due to burrowing, crab consumption entails repeated behavioural sequences and attending to information not immediately related to the goal. Crab consumption therefore provides insights into primate cognition. There are only three habitual cases of wild primate crab consumption: long-tailed macaques (*Macaca fascicularis*), a vervet (*Cercopithecus aethiops*) group, and a community of western chimpanzees (*Pan troglodytes verus*) in the Nimba Mountains, Guinea. Here, we report the fourth case of habitual crab consumption by sooty mangabeys (*Cercocebus atys*), also in the Nimba Mountains. Sooty mangabeys were observed to prey on the same freshwater crab species (*Liberonectes latidactylus* and *L. rubigimanus*) as the sympatric chimpanzees, and to use a similar approach: 'crab-fishing'. Crab-fishing comprises repeated sequences of manual disturbance of the waterbed, attending to visual cues of disturbed crabs, and movement decision making, i.e., deciding when to optimally abandon a patch of waterbed. Here, we compare the two species' crab-fishing behavioural in detail. We collected behavioural data from motion-triggered camera footage of adult chimpanzees (2019-2024) and mangabeys (2023-2024). Age-sex profiles of crab-fishing adults differ between the two species: in chimpanzees, females with dependent offspring are overrepresented in crab-fishing parties, whereas there is no difference between age-sex categories in mangabeys. This may indicate that crabs serve different functions in the two species' diets. In on-going analyses, we compare frequencies of component behaviours of each crab-fishing sequence between the species. We also compare movement decision-making: do the species attend to different cues (e.g., decline in fishing success rate, neighbour's success rate, or other cues)? We will comment on the implications of our results for the possibility of interspecific social learning, chimpanzee-mangabey competition, and comparative primate cognition.

Vervet monkeys do not establish male-female social relationships based on the raising the stakes model

Josefien Tankink¹, Maria Granell Ruiz¹, Redouan Bshary¹, Carel van Schaik²

¹University of Neuchâtel, ²University of Zurich

Cooperation among unrelated individuals has been extensively studied in behavioural ecology and game theory, but often models fall short in explaining observed levels of cooperation in natural settings. Traditional models are usually based on some version of the prisoner's dilemma, which suggests that cooperative investment is stable. The "raising-the-stakes" (RTS) model challenges this statement and introduces variable cooperative investment, where individuals adjust their contribution based on prior interactions. This predicts cautious initial investments, which can be increased only upon

reciprocation. Despite theoretical stability, RTS lacks empirical testing in wild populations. This study investigated male-female grooming reciprocity of wild-living vervet monkeys as a potential example for the RTS logic. Adult males disperse approximately every two years, allowing for the opportunity to study their cooperative behaviour and investment in new social settings. We found that immigrant males initially do not reciprocate grooming from adult females, but increase their investment over time until it matches females' investment, after approximately a year of residency. Adult females groom both immigrant and resident males for the same duration – although immigrant males less often – leading to imbalanced reciprocity. Thus, each sex exhibits distinct cooperative patterns that do not seem to follow the dynamics suggested by RTS. Future modelling should explore factors that may affect the development of cooperative exchanges in settings in which strangers enter an established community, as is the case in social species with a sex-biased dispersal.

Insights of human-vervet monkeys conflicts in a new Urban Vervet Project

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Alongside an increase of urbanisation, there is also an increase in interest to study urban ecology. The interaction between humans and vervet monkeys (*Chlorocebus pygerythrus*) in South Africa has become a complex and challenging issue, raising concerns for both the peacefulness of citizens and the health of monkeys. The Urban Vervet Project started in November 2022 in Simbithi Eco-Estate, near Durban, South Africa, to study the impact of human activities on vervet monkeys' behaviours, as well as to help mitigating the existing human-wildlife conflicts. Using a citizen science approach (questionnaires conducted on 100 residents), we investigated the interactions between residents and vervet monkeys in a semi-urban environment, and examined which factors attract and/or repel monkeys to intrude houses. While neither personal data (such as age, sex or nationality of residents), nor accommodation data (such as being the owner or the presence of kids/pets) influenced monkeys' perception by the local community, residents disliked the monkeys the most when these latter ones raided their bins/houses in a weekly basis. We also found that while having bird feeders and fruiting trees in the garden might attract the monkeys to a residence, it also decreases the risk of them intruding. However, contrary to expectations, the presence of a dog did not repel the monkeys, but instead, increased the likelihood of monkeys raiding properties. Understanding the underlying causes of the monkeys' attraction or aversion to residential areas might help implementing targeted preventive measures that will enhance cohabitation between vervet monkeys and residents.

Thursday 10:00-10:30

The Impact of Snaring on Present and Future Budongo Chimpanzee Survival

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Against a backdrop of climate change driven food instability in the Masindi district, rising costs of living, and increasing encroachment on the forest edge by international oil companies, anthropogenic influences pose the greatest current challenge to the conservation of Budongo chimpanzees (*Pan troglodytes schwinfurthii*). This has culminated in an apparent increase in the amount of snare traps laid by those living at the forest edge as they seek alternative means of subsistence or supplementary income. Our aim here is to provide a quantitative picture into the present and future survival of Budongo chimpanzees in relation to illegal snaring. We present a historical analysis of spikes in illegal snaring activity according to data collected by the Budongo Snare Patrol team between 2002 and 2022. To gain insight into the impact of this pattern, we examined the outcomes of snare injuries and their relation to population demographics. In our sample, juveniles were disproportionately affected, accounting for 50% of injuries, despite making up just 10% of the overall population. We found that snared chimpanzees are significantly more likely to go permanently missing from the community than those who were not. Surprisingly, survival between snared and unsnared chimpanzees does not begin to significantly diverge until around 25 years of age. As snaring is continuing to increase in Budongo forest, our results imply that the chimpanzee populations are becoming increasingly vulnerable. The skew in demographic composition of snare victims towards juveniles in tandem with the long-term nature of the impact on survival suggests that current snaring may create demographic gaps in the future chimpanzee population that may prove problematic to the stability of Budongo chimpanzee communities.

**Conservation and population management of non-human primate species:
Parentage identification through STR multiplexing**

Natasja G de Groot¹, Annemiek JM de Vos-Rouweler¹, Jesse Bruijnesteijn¹, Annet Louwse², Jan AM Langermans^{2,3}, Lena S Pflüger⁴, Ronald E Bontrop^{1,5}

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The destruction of habitats and the decreasing availability of natural resources are causing fragmentation of wild living primate populations. This fragmentation can have significant repercussions for population size, genetic diversity, and overall fitness. Conversely, non-human primates kept in captivity often live in small groups, which may increase the likelihood of inbreeding. To address these challenges, the implementation of genetic

conservation and population management tools become imperative, allowing the monitoring of diversity and the development of intervention strategies, which aim to prevent the potential extinction of specific primate species. Here, we present a microsatellite-based multiplex assay comprising a unique set of 23 polymorphic STR markers distributed across various chromosomes. This assay is routinely applied to determine the parentage in our rhesus and cynomolgus macaque breeding colonies. Furthermore, it has also proven to be applicable to great apes and other Old World monkey species. The assay can be performed using DNA isolated from both invasive and non-invasive derived material (e.g. feces, hair follicles, saliva) and may benefit future prospects for colony management of various captive and free-ranging populations of primate species.

Can chimpanzees and orangutans infer when a hidden breadstick is intact or broken?

Michèle N. Schubiger^{1,2,3}, Claudia Fichtel^{1,2}, Nicholas J Mulcahy⁴

¹German Primate Centre (DPZ), ²Leibniz Science Campus Primate Cognition, ³University of Zurich, ⁴World Ape Fund

Evidence suggesting non-human primates infer the hidden functional properties of tools is equivocal. One possibility is that task demands in previous studies were too high or distracting because subjects had to reason about two factors: the tools' functional properties and the out-of-reach reward. We designed a novel inference task without tools, in which subjects only had to reason about one factor: 'food functionality'. Subjects were given a choice between two breadsticks: one was intact and functional in that subjects could consume the full breadstick if they chose it, and one was broken at its middle and less functional in that subjects could only consume half if they chose it. Importantly, opaque covers were placed over the breadsticks' middle sections that hid their functional properties and only let their ends protrude. The breadsticks now looked identical but it was inferable which one was functional by watching the experimenter move one end of each breadstick. Doing so moved both ends of the intact breadstick but not the unattached end of the broken breadstick. We tested chimpanzees (*Pan troglodytes verus*) and orangutans (*Pongo abelii*) and found that only one of twelve subjects chose the intact breadstick significantly above chance. In a series of follow-up experiments, we investigated if procedural modifications would improve the subjects' performance. Although some experiments resulted in more subjects being successful, learning during the test procedures could not be ruled out. Therefore, we tested subjects with novel types of breadstick configurations and most subjects passed these transfer tests. This suggests chimpanzees and orangutans can infer food functionality. An advantage of our simplified task setup is that it does not involve tools, which makes it suitable to test and compare the inferential reasoning abilities of a wide range of non-tool using species.

Living apart together – The social adaption of a semi-free ranging population of Japanese macaques (*Macaca fuscata*) post fission

Roy Hammer¹, Pia Böhm¹, Mathieu Stribos², Angela Stojan¹, Bernard Wallner¹, Michael Huffman³, Lena Pflueger¹

¹University of Vienna, ²University of Utrecht, ³Kyoto University

Fission, which is the self-initiated separation of a socially coherent group into two independent groups, is a social process experienced by many primate species. A species in which this process is especially well documented is the Japanese macaque (*Macaca fuscata*). Studies on fissions in this species concluded that this process is finished when one of the newly formed groups leaves the habitat. The possibility to depart thus seems to be a requirement for Japanese macaques to complete fissions, which suggests that captive populations lack the opportunity to fully separate due to their confined living space. This might cause Japanese macaques that do undergo fission in captivity to display unique social adaptation mechanisms in order for two independent groups to co-exist in the same habitat. In this ongoing study, we aim to describe such adaptations by studying a semi-free-ranging population of ~180 Japanese macaques. This population, housed at Affenberg Landskron, Austria, has been under constant observation ever since the occurrence of fission in 2020 through continuous focal sampling and repeated scan sampling. Currently, the three years of data on the social dynamics of this group are being analysed. Our preliminary results show that this population indeed showed a unique social adaptation process as the previously separated groups partially merged to form interconnected, yet independent social clusters. Over time, these clusters change in size as many individuals switch their cluster associations. The next steps in this study are to further describe the interactions between these clusters, the individual social dynamics, and the role of kinship and rank in these processes. This study thereby describes previously undocumented social dynamics of Japanese macaques and the extent to which this species can adapt to a unique social environment.

Impacts on anthropogenic stressors on the movement ecology of Terai Gray Langur in Shivalik Hills, Outer Himalayas

Divya Dwivedi¹

¹Wildlife Institute of India

Animals exhibit numerical and behavioural responses to changes in their habitats, particularly those induced by anthropogenic factors such as habitat degradation, fragmentation, and urbanization. This study focuses on the socio-ecological impacts of human disturbance on Terai Gray langurs in the Shivalik landscape of Outer Himalayas in India. By comparing langur troops in protected areas of Rajaji National Park and disturbed habitats of Shivalik Forest Division, the study aims to elucidate the movement ecology. Four comparable-sized langur troops, two in each habitat, were examined. Behavioural differences were evident in canopy usage, with disturbed troops using lower canopies (38%) and ground (32%), while undisturbed troops used middle (34%) and lower canopies (32%). Disturbed troops also exhibited more ground movement (57%),

contrasting with the canopy-focused movement of undisturbed troops (65%). Daily travel distances varied, with disturbed troops covering more ground (1.45 ± 0.07 km in winter, 2.48 ± 0.14 km in spring) compared to undisturbed troops (0.9 ± 0.1 km in winter, 1.35 ± 0.12 km in spring). Home range sizes followed a similar trend, with disturbed troops having larger ranges (2.98 km² and 3.42 km²) compared to undisturbed troops (2.25 km² and 1.37 km²). In conclusion, anthropogenic disturbances significantly influence the socio-ecology of Terai Gray langurs. The observed movement behaviour highlights the resilience of these primates in response to human-induced changes in their environment. Understanding such dynamics is crucial for conservation efforts aimed at mitigating the impacts of habitat alterations on primate populations.

Friday 10:00-10:30

Human's ability to decode affective information in human, chimpanzee and bonobo vocalizations: insights from a new paradigm

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Humans have a good ability to decode affective information expressed through the voice by other humans (Sauter et al., 2010). On the other hand, the performance for chimpanzee and bonobo vocalizations had until then been quite clearly dissociated. While a performance above chance for chimpanzee vocalizations was shown, a bias inducing a tendency to over-estimate the level of joy or distress in bonobo vocalizations was highlighted, thus underestimating the potentially threatening nature of the latter (Debracque et al., 2023; Kelly et al., 2017). However, this observation may have been induced by a paradigm presenting only one vocalization at a time, thus accentuating the focus on the interspecific variability of the vocalizations. In our research, the human ability to decode affective states of joy, fear and anger in the voices of humans, chimpanzees and bonobos was tested using a new experimental paradigm presenting three vocalizations at each item. This new paradigm aimed, through the possibility of comparing three vocalizations of the same species in each item, to redirect the attention of participants on the intraspecific variability of the affective vocalizations. The purpose was to neutralize the bias induced by the previous paradigms and to investigate the human ability to decode affective information in the voice in a new paradigm free of this bias. 141 participants took part in this study. They showed above chance performance to detect joy, fear and anger in human vocalizations, and ditto for chimpanzee and bonobo vocalizations, with the exception of anger which was most often misclassified by selecting fear vocalization instead. These results show that the performance dissociation previously shown for chimpanzee and bonobo vocalizations seems more nuanced than initially thought: performance for bonobos could be better, and the one for chimpanzees poorer than imagined.

The importance of eye contact in macaques: comparison between tolerant and intolerant species

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In primates, an eye contact can be followed by an affiliative or an agonistic interaction, which the severity depends on the social structure of the observed species. In macaques, intolerant species (e.g. *Macaca mulatta*) are more likely to suffer injury during conflicts than tolerant species (e.g. *M. tonkeana*). Consequently, eye contact could be perceived as more dangerous in intolerant macaques than in more tolerant ones. To test this hypothesis, we (1) evaluated the spatio-temporal dynamics of grooming in 18 rhesus and 23 Tonkean semi-free ranging macaque monkeys over a three years period. We considered the time spent in social grooming, the level of reciprocity, the body parts groomed and the relative position of the macaques. We further evaluate the probability of eye contact occurring between partners during these grooming sessions. In addition, we (2) measured visual exploration of social stimuli in 4 rhesus macaques and 8 Tonkean macaques, via the novel digit-tracking method where subjects, on a touch screen, locally revealed beneath their finger a blurred image of a conspecific. Our results show that (1) Tonkean macaques exhibit a spatio-temporal grooming dynamic more conducive to the occurrence of eye contact than rhesus monkeys; (2) subjects are particularly inclined to reveal the faces vs other body parts of their conspecifics. Ongoing data analysis will test the effect of socio-demographic factors (affiliative relationship, dominance, sex, age) and species tolerance level on the exploration of conspecifics face and body. This is the first-time that spatiotemporal dynamic of different species of macaque monkeys are compared within the same study and that digit-tracking experiments are used on group-living primates. Our results support the idea that differences in social cognition and attention enable macaques to cope with the social challenges influenced by their group social structure and past relationships.

Understanding primate distribution, behaviour and human-primate interactions through group interviews inside and outside protected areas in Guinea-Bissau

Chloe Chesney¹, Elena Bersacola², Kimberley Hockings², Tânia Minhós¹, Amélia Frazão Moreira¹

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With wildlife populations plummeting and continued habitat loss, research investigating local ecological knowledge and how it could be incorporated into typical approaches to wildlife conservation is increasingly vital. Research outside protected areas is important because the majority of primates inhabit areas under no formal protection including over 80% of Critically Endangered western chimpanzees (*Pan troglodytes verus*). This is the first project, to our knowledge, to investigate primate distribution through focus-group interviews and to compare data from the same locations over an 18-year period both inside and outside formally protected areas in southern Guinea-Bissau. Semi-structured,

focus- group interviews with photo elicitation exercises were used to collect data in more than 160 villages including over 2500 participants. The data from 2006-2009 and 2022-2024 show reported socio-ecological changes over time that are affecting the presence, distribution, behaviour and interactions with humans of ten primate species including western chimpanzees, western red colobus, king colobus and Guinea baboons. Qualitative data were assigned codes and inferentially transformed to expose variables and their relations. Reported spatial distribution data were mapped using GIS. Results include higher reported diversity of primates inside protected areas with less adaptive primate species (such as colobines) reported as absent outside, and more 'negative' reports of human-primate interactions inside protected areas than outside. Our results highlight the need to address human-primate negative interactions within protected areas and develop culturally appropriate community-led conservation initiatives outside protected areas that are based on local ecological knowledge and needs.

Language brain evolution: Revisiting the Arcuate Fascicle in Chimpanzees

Yannick Becker¹, Cornelius Eichner¹, Michael Paquette¹, Carsten Jaeger¹, Christian Bock², Cédric Girard-Buttoz³, Tobias Gräßle⁴, Tobias Deschner^{5,6}, Philipp Gunz⁷, Roman Wittig³, Catherine Crockford³, Angela Friederici¹, Alfred Anwander¹

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Language is at the core of what makes us a species. Many authors have argued that the difference between humans NHP may lie in the different neural connectivity between primate species. The main connection for language processing and articulation is the Arcuate Fascicle (AF). It arches dorsally around the sylvian fissure, connecting frontal with temporal language areas in the STG and MTG. It is possible that a major morphological transformation occurred in the AF. Studying the evolution of the AF, through comparative studies between primate species, can shed light into the evolution of language. Previously, continuities and discontinuities of the AF structures between humans and NHP were identified. Importantly, available datasets addressing these questions in our closest living relative, the chimpanzee, have been limited to captive adult subjects and low-resolution data. Therefore, uncertainties about the morphology of the AF (dis)continuities in chimpanzees, which in turn influence our understanding of its evolution, might be related to data resolution and subjects' living conditions. Now, in a consortium, the Evolution of Brain Connectivity, we first examine a developmental sample of chimpanzee brains from naturally deceased animals collected from African wildlife field-sites, sanctuaries, and European zoos. We optimised the diffusion MRI acquisition for post-mortem measurements on a preclinical MRI system and archived excellent data quality up to 80 times more detailed than previously analysed chimpanzee data. Combined with advanced fibre crossing tractography, we were able to study the fine details of the AF at an extremely increased precession than previously possible; and updating the crucial questions about the evolution of the language fiber tract, that makes us human.

How do urban primates use human food sources? Dietary diversity among semi-urban vervet monkeys

Adrian McConnell¹, Stéphanie Mercier¹, Sofia Forss²

¹University of Lausanne, ²University of Zürich

Urbanization represents both a common and an extreme form of environmental change for many species, confronting wild animals with habitat transformations presenting both evolutionary new foraging challenges and opportunities. Some species drastically decline due to urbanization, whilst other species, like vervet monkeys (*Chlorocebus pygerythrus*), thrive in these environments. Despite challenging, urban environments also provide generalist species with advantages such as the availability to forage on anthropogenic food sources, which are unlikely to be affected by seasonal fluctuations and are high in calories. In this project, we study the dietary composition of a population of monkeys with daily access to human food sources at the Simbithi Eco-Estate, Ballito, KwaZulu-Natal in South Africa. Using both *ad libitum* data and focal follows at the individual level from two different troops (Acacia N=26 & Savanna N=25) varying in their raiding activities, we compare the percentage of natural versus human food sources consumed across the two troops. Preliminary results suggest that the diet of this semi-urban population is mainly composed of natural food items such as fruits, leaves, and insects, with occasional opportunistic access to anthropogenic food sources. Given the nutritional high value of such opportunities, we furthermore determine whether hierarchical rank, sex or age plays a significant role in access to anthropogenic food sources and describe interindividual differences in foraging behaviour.

Blueprints of language: Features of mother-infant interactions across development in chimpanzees (*Pan troglodytes*) in the wild

Bas van Boekholt¹, Simone Pika¹

¹Osnabrück University

Despite decades of research on primate communication, the majority of studies have been focusing on signallers or receivers while still relatively little is known about communicative interactions and the role of development. Here, we aimed to contribute to filling this gap by investigating communicative interactions of one of our closest living relatives, the chimpanzee (*Pan troglodytes schweinfurthii*), with a special focus on mother-infant interactions and linkage to development. We addressed the following two research questions: 1) Which features characterize mother-infant communicative interactions? 2) What is the impact of age, sex, interactant role and context on communicative exchange? To answer these questions, we recorded communicative interactions in 17 mother-infant dyads (infant ages: 4-62 months) living in two groups of the Ngogo community, Kibale National Park, Uganda. Data were collected between February 2021 and February 2023 resulting in a total of 1,295 observation hours (34-140 hrs/dyad). We collected communicative interactions in the following contexts: food sharing, nursing, grooming and joint-travel. The results showed that communicative interactions were characterized by equal distributions of signals and actions, quick response times (<3 seconds), and high

frequencies of directed gaze and body direction. Age, sex and interactant role had little to no effect on these features, but there was a strong impact of context, with lower frequencies of signal production, directed gaze, and directed body direction, and faster response times in the joint-travel context. These results will be discussed in relation to communicative development, interaction and general development in primates, and will enable a better understanding of precursors and ancient mechanisms of human social action during conversations.

Friday 14:45-15:15

Raise awareness to act

Hantanirina Rasamimanana¹

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Ever since 1986, Environmental Education has been added into the Madagascar school curriculum and has found its place in teacher preparation and in all educational settings. The environment is now firmly anchored in the school curriculum and is addressed at primary, secondary, and university levels. Environmental Education provides the intellectual tools and learning strategies necessary to acquire the knowledge needed for being operational and productive. Despite four decades of environmental education, people are not able to act to preserve nature for lemurs and even for themselves because the Malagasy educational system fails in properly applying it. How should it be applied? During these last twenty years, about 60 students from Ecole Normale Supérieure of Antananarivo University had been conducting some 19 lemur species studies in a dozen different Malagasy ecosystems for two months each year. All began by censusing *Lemur catta*, *Propithecus verreauxi* and *Eulemur rufifrons* in the private reserve of Berenty, in the south of Madagascar. Later, to have their High School Life and Earth Sciences teacher diploma, 40% of them did their Master thesis on 10 different lemur species. Ninety percent now teach High School of whom 10% are currently writing a PhD thesis on lemur ecology in diverse forests. One PhD subject aims to train some local young people around Berenty Reserve to become research assistants at its newly built research center. Scientific training is one important component to acquiring data and better understanding biodiversity issues in Madagascar. The idea of preserving nature for lemurs is long overdue. Environmental education is of long duration because it should develop physical, intellectual and moral qualities to support fieldwork, to analyze the environment that involves complex problems with multiple interacting links, and to model self-denial, concern and solidarity.

Individual mental representation of dominance hierarchies in Tonkean macaque

Sébastien Ballesta¹, Jamie Whitehouse², Romain Ligneul³, H el ene Meunier¹

¹University of Strasbourg, ²Nottingham Trent University, ³Centre de Recherche en Neurosciences de Lyon

Past studies suggest that non-human primates (NHP) represent the structure of their own group (e.g. Kawai, 1958; Dasser 1988; Bergman et al., 2003, Whitehouse and Meunier, 2020). However, these mental representations are typically considered at the group level and little is known regarding how individuals differ in their representation of these third-party social relations. In this study, semi-free ranging Tonkean macaques (*Macaca tonkeana*) performed, using autonomous testing devices (MALT), a cognitive task to describe individual representation of the dominance hierarchy of their own group. In the training phase, subjects were rewarded for selecting amongst a dyad of pictures representing a peer, the more dominant one. Test trials depicted dyads of individuals that were not involved in the training phase and both responses were rewarded. We analyzed 1.4 million trials in 21 subjects and found that subjects' answers were overall consistent with the hierarchy measured using ethological observations. Moreover, we found that subject's performances were affected by socio-demographic factors suggesting different social skills and knowledge. Using a continuous assessment of the dominance hierarchy of the group across time (see Ballesta et al., 2021), we were able to test the best correspondence between monkeys' answers to the task and the temporal variation in social structure of their own group. We found that some individuals' (mostly young males) mental representation of the hierarchy matched the current state of the group, while others' (mostly old females) matched the hierarchy of the group months or even years ago. To the best of our knowledge, this is the first study quantifying individual variation of social knowledge, our findings support that social representation must be conceptualized as a subjective truth that must be deciphered at the individual level.

Violence towards conspecifics in primates

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Violent behaviour ranges from mild aggression, involving displays without physical contact, to killing. Violence is ubiquitous in primates, and varies in intensity, function, as well as in the number and characteristics of individuals involved. Most previous comparative studies in primates have either focused on one particular type of violence (e.g., infanticide), or treated it as a single, monolithic trait. In this study, we quantify the evolutionary association between five distinct types of violence in group-living primates: i) within- and ii) between-group mild aggression, iii) within- and iv) between-group adulticide, and v) infanticide. We extracted information from the literature and unpublished data on wild, non-provisioned populations. The resulting dataset comprised 104 species and sub-species, belonging to 11 primate families. Phylogenetic mixed-models

revealed a strong, positive association among the three types of lethal violence (i.e., within- and between-group adulticide, and infanticide). Conversely, we only found a weak association between the three types of lethal violence and mild aggression, and between within- and between-group mild aggression. Our findings suggest that species that display higher frequencies of mild aggression are not more likely to kill conspecifics. Violence cannot be considered to constitute a single behavioural trait.

Primate social organization evolved from a flexible pair-living ancestor

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Explaining the evolution of primate social organization has been fundamental to understand human sociality and social evolution more broadly. It has often been suggested that the ancestor of all primates was solitary and that other forms of social organization evolved later, with transitions being driven by various life history traits and ecological factors. However, recent research showed that many understudied primate species previously assumed to be solitary actually live in pairs, and intraspecific variation in social organization is common. We built a detailed database from primary field studies quantifying the number of social units expressing different social organizations in each population. We used Bayesian phylogenetic models to infer the probability of each social organization, conditional on several socioecological and life history predictors. Here, we show that when intraspecific variation is accounted for, the ancestral social organization of primates was inferred to be variable, with the most common social organization being pair-living but with approximately 10 to 20% of social units of the ancestral population deviating from this pattern by being solitary living. Body size and activity patterns had large effects on transitions between types of social organizations. As in other mammalian clades, pair-living is closely linked to small body size and likely more common in ancestral species. Our results challenge the assumption that ancestral primates were solitary and that pair-living evolved afterward emphasizing the importance of focusing on field data and accounting for intraspecific variation, providing a flexible statistical framework for doing so.

Flexible grouping patterns in a western and eastern chimpanzee community

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Primate social organizations, or grouping patterns, vary significantly across species. Behavioural strategies that allow for flexibility in grouping patterns offer a means to reduce the costs of group living. Chimpanzees (*Pan troglodytes*) have a fission-fusion social system in which temporary sub-groups ('parties') change in composition because of local socio-ecological conditions. Notably, western chimpanzees (*P. t. verus*) are described as showing a higher degree of bisexual bonding and association than eastern chimpanzees, and eastern female chimpanzees (*P. t. schweinfurthii*) are thought to be more solitary than western female chimpanzees. However, reported comparisons in sociality currently depend on a small number of study groups, particularly in western chimpanzees, and variation in methods. The inclusion of additional communities and direct comparison using the same methods are essential to assess whether reported subspecies differences in sociality hold in this behaviourally heterogeneous species. We explored whether sociality differs between two communities of chimpanzees using the same motion-triggered camera technology and definitions of social measures. We compare party size and composition (party type, sex ratio) between the western Gahtoy community in the Nimba Mountains (Guinea) and the eastern Waibira community in the Budongo Forest (Uganda). Once potential competition for resources such as food and mating opportunities were controlled for, subspecies did not substantially influence the number of individuals in a party. We found a higher sex-ratio, indicating more males in a party, in Waibira; this pattern was driven by a greater likelihood in Gahtoy to be in all-female parties. This finding is the opposite of what was expected for eastern chimpanzees, where female-only parties are predicted to be more common. Our results highlight the flexibility in chimpanzee sociality, and caution against subspecies level generalizations.

Early stone tools and apes – the role of human enculturation

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Early stone tools (manufactured sharp tools) are often regarded as an important milestone in human evolution. However, it is still debated which factors led to their production and use ca. three million years ago. Lacking a time machine, learning experiments today are informative –especially when they are performed on close relatives of the original makers of early stone tools (i.e. humans or apes). Here we report on three new studies that specifically tested apes for social learning of early stone tool making and use. None of the chimpanzees (two groups) or gorillas we tested successfully made sharp stone tools following human demonstrations. Despite similar methods, our new studies' outcomes contrast with the earliest studies of this kind, performed on an enculturated orangutan and enculturated bonobos (most famously, Kanzi) –where in those studies apes did make and use sharp stone tools following human demonstration. In the light of this contrast and relevant other recent findings, we discuss the currently most likely mechanism for ape early stone tool making and using performances: human enculturation.

POSTERS

Poster 1

Decisions under risk in Tonkean and Rhesus macaques

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Economic decision-making under risk has been extensively investigated in humans, revealing cognitive biases that lead to deviations from rational behaviour. For instance, humans display differences in decision-making strategy in the loss or gain domains. Humans also show probability distortion with an overestimation of low probabilities and underestimation of high ones. To unravel the evolutionary origins of these cognitive biases in economic decision-making, studying it in non-human primates is of utmost relevance. Interestingly, similar asymmetry in loss/gain processing as well as probability distortion has been recently shown in non-human primates, including *Macaca tonkeana* and *M. mulatta*. Despite their close genetic relatedness, these two species exhibit differences in social behaviours. While *M. mulatta* lives in despotic societies, *M. tonkeana* displays greater social tolerance. These differing social structures may influence the economic decision-making strategies of these species. Our current study aims to highlight potential disparities in gambling behaviour among monkey species. Preliminary results suggest similar decisional strategies used by these two species of non-human primates. However, a closer analysis of response times suggests that *M. mulatta* displays more discrepancies in response time between loss and gain tasks than *M. tonkeana*. These discrepancies can be explained by different cognitive treatments of losses and might suggest variances in employed strategies for economic decision-making under risk between the two closely related species. Overall, this approach will produce new insights regarding the evolutionary origin of cognitive biases during economic decision-making.

Poster 2

Changing attitudes towards the aye aye (*Daubentonia madagascariensis*) through educational approaches

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Misconceptions about certain species of wildlife can lead to human-wildlife conflicts. The Malagasy Aye-aye (*Daubentonia madagascariensis*) is an example of such a species, as many people believe it is a harbinger of death. The rare sightings are explained with superstitious narratives rather than ecological explanations. Comparative and

experimental testing of educational approaches to overcome misconceptions is lacking, but promoting human tolerance towards the non-threatening Aye aye is necessary. As part of a collaborative research project from the Universities of Antananarivo and Hildesheim, we implemented three different educational approaches in 21 villages around Makira Natural Park in northeastern Madagascar. We conducted a pre-survey before the implementation and a post-survey one year after with 392 people to evaluate the effectiveness of these interventions in improving attitudes and knowledge about the Aye-aye. The interventions were designed according to two educational theories: the Theory of Conceptual Change by Strike & Posner in 1992 (A) and the Theory of Planned Behavior by Ajzen in 1991 (B). Also, a combination of both (A + B) and a control treatment were implemented. Our study revealed that attitudes towards the Aye-aye were surprisingly positive, even though ambivalence of general, emotional, and cognitive components occurred frequently. All experimental treatments improved attitudes better than the control group. The cognitive attitudes, particularly risk perception and knowledge parameters, improved under treatment A. While treatment B did not outperform the other treatments, the combined approach was more effective in enhancing positive emotions than experience or knowledge treatments alone. These results will improve interventions for Aye aye conservation in Madagascar and comparable settings worldwide.

Poster 3

Reconciliation during Male Introduction and Integration in Social Groups of Rhesus Macaques

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Primates live in complex social groups. Although group living has benefits, conflicts can lead to stress and damaged social bonds. Reconciling conflicts may minimise these costs and is found in numerous primate species. However, the specific function of reconciliation remains unclear. The two most used hypotheses state that reconciliation may 1) restore valuable relationships, and 2) reduce uncertainty over an individual's position in the group. This study investigates reconciliation behaviour in rhesus macaques (*Macaca mulatta*) during the introduction and integration of new males in multi-generational groups. Conflicts are associated with increased stress levels in this species, and although they are known to occasionally reconcile conflicts, it is not fully understood what determines how conflicts are resolved. Subjects were four adult males, who were individually introduced into a different all-female group housed at the Biomedical Primate Research Centre, Rijswijk, The Netherlands. Focal data, including social interactions with females, were collected during and after new male introduction. PC –MC comparisons were used to determine whether conflicts between the new male and resident females were reconciled. Post-conflict anxiety was monitored through self-directed behaviours. The analysis focused on changes in reconciliation rates and post-conflict anxiety over time, as well as the effects of the social bond with the conflict partner on reconciliation probability and post-conflict anxiety. If reconciliation functions to maintain social bonds, reconciliation rates were expected to increase as the introduction progresses, when the

male established relationships with the resident females. In contrast, if the male reconciled to reduce anxiety, reconciliation rates should decrease during the introduction, when he becomes more secure about his role in the group and post-conflict anxiety decreases. With this study, we hope to gain a better understanding of the mechanisms behind reconciliation in primate groups.

Poster 4

Does human proximity and pressure influence the demographic and territorial parameters of the Barbary Macaque (the example in the High Atlas, Morocco)?

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Located in the peripheral area of the Toubkal National Park in the watershed of the Ourika River, western High Atlas, the village of Setti-Fatma is a village known for its famous waterfalls, its economy based on agriculture, fruit trees and tourism. At the same time, the Setti-Fatma area and its surroundings count to nearly 150 individuals of Barbary Macaques (*Macaca sylvanus*), divided into three groups which have distinct levels of habituation to humans. Among these groups, one of them lives in the mountains, far from humans, and just occasionally enters the crops to feed; and another one lives exclusively near humans : individuals sleep near restaurants and feed on recent orchards which provide more palatable fruits. This change in home range is caused by drought, deforestation and overgrazing, forcing this group to go down in the valley. Ecological and behavioral research carried out on both groups of Macaques highlighted (i) that the groups show different frequency of behaviors (vigilance, resting, grooming and foraging) and uses of space with distinct home range according to level of habituation to humans; (ii) that the three groups show difference in population dynamic stability: the more the monkeys evolve in a highly degraded natural environment, the more the sex ratio is unbalanced and a decreasing growth rate; (iii) consequently, the hypothesis of a compromise has been found between the quality of the habitat and the human pressure on the demographics of the different groups. All these results show us that, in addition to being a species classified as "Endangered" according to the IUCN, the environment in which Barbary Macaques live increases the modification of their behavior and accentuating the threats on the species in the Ourika valley (lost of habitats and food resources, diseases, stress).

Poster 5

Genomic patterns of kinship and identity-by-descent in a wild baboon population

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Kinship is a major determinant of mating behavior, social affiliation, and cooperative behavior in primates and other social mammals. The availability of genome-scale sequencing data now makes it possible to investigate patterns of kinship in wild primates in unprecedented detail. For example, by identifying near-identical DNA fragments shared between individuals (i.e., regions identical-by-descent: IBD), it is possible to both assign unclassified dyads to specific kin categories and produce highly accurate estimates of genetic relatedness within kin categories. Here, we report our progress on analyzing genome-wide IBD in a population sample of 433 wild baboons from the intensively studied Amboseli population in Kenya. We combine low-coverage genome resequencing data (~1x coverage) with genotype imputation up to ~15 million biallelic SNPs and a modified version of the *ancIBD* pipeline for IBD inference in low coverage ancient DNA samples. We then compare relatedness coefficients and IBD segment length distribution for dyads in the sample against existing pedigree data available for the Amboseli baboons. Finally, we investigate the potential for IBD inference to reveal how immigrant males may be connected to the known pedigree. Together, our findings provide a first glimpse into the possibility of inferring relatedness structure using low-coverage genome resequencing data in wild primates, with potential applications to understanding kin recognition, population demography, and evolutionary history.

Poster 6

Protect Great Apes from Disease: from assessing visitor compliance and developing education materials to next steps

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Great ape tourism and research occur in most great ape range countries in Africa despite the well documented risks of disease transmission from human to nonhuman great apes. The IUCN has clear guidelines on how to mitigate these disease risks; however, barriers to effective communication of rules and enforcement by guides, authorities, and tourists persist. Based on an international sample of past (N = 420) and potential future visitors (N = 569) to wild great ape tourism sites in Africa, we used an online questionnaire to characterise visitors' practices, assess expectations (e.g. about proximity to great apes) and identify key factors related to potential compliance with disease mitigation measures.

Visitors expressed less willingness to wear a facemask during trekking (although willing when viewing the apes) and quarantine after international travel before visiting great apes. Expectations about the visitor experience and perceived effectiveness of specific measures were important factors explaining variation in potential compliance across multiple behaviours. This understanding of what fosters compliance with disease mitigation measures, facilitated our evidence-based, freely available, suite of education materials, including posters, a booklet and videos: www.protectgreatapesfromdisease.com.

Poster 7

What predicts association patterns in female western and mountain gorillas?

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Association patterns are a hallmark of social relationships in gregarious mammals but the drivers of variation remains to be investigated. Gorillas are a taxa that exhibits secondary female dispersal and provide an interesting counterpoint to female philopatric species to examine the factors influencing variation in association patterns. We examined demographic and social factors that may predict association patterns of female western (*Gorilla gorilla gorilla*; Loango, Gabon) and mountain gorillas (*Gorilla beringei beringei*; Bwindi, Uganda). We looked at dyadic and individual level strength scores of social proximity data obtained via scan sampling (total scans = 1,219,329). For individual female gorillas' high dominance rank increased association scores and being a newly emigrated female decreased association scores. While at the dyadic level, higher and similar dominance rank positions as well as both partners having a dependant infant increased the association score, whereas association scores were negatively impacted if one or both partners had recently emigrated. Overall, gorilla female association patterns show flexibility in partner choice based on real time necessities and contingencies, namely social and demographic traits. Our results suggest that social relationships in species with female secondary dispersal are governed by homophily like that of modern humans. Furthermore, by understanding female gorilla social structure we can enhance our knowledge of the evolutionary origins of social relationships.

Poster 8

Nipple manipulation and subsequent self-suckling in a group of orphaned chimpanzees (*Pan troglodytes verus*) in a sanctuary environment

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Non-human female mammals primarily use their nipples to suckle young although self-suckling (individuals place their nipple in their mouth and suckle) has been reported in goats (*Capra hircus*), cows (*Bos taurus*), Barbary macaques (*Macaca sylvanus*) and chimpanzees (*Pan troglodytes*). Whilst such behaviour is rarely reported self-suckling and

nipple manipulation (individuals rub a nipple between two digits) is frequently seen in captive great apes, according to anecdotal evidence, where it is thought to self-soothe individuals. As such behaviour has been reported in wild chimpanzees in Mahale, Tanzania it is questionable whether such behaviour is a result of captivity although this may influence its prevalence through intensive social learning, stress, boredom, or other factors. During a nine-month study of rescued, orphaned chimpanzees (*Pan troglodytes verus*) at Tacugama Chimpanzee Sanctuary, Sierra Leone (July 2022–Apr 2023) both self-suckling and nipple manipulation were observed. Forty-four instances of nipple manipulation were observed throughout the study, although not every occurrence led to self-suckling. Six chimpanzees in the study group of 13 (March 2022, 14) performed nipple manipulation, four chimpanzees also self-suckled following nipple manipulation by themselves or another individual. Self-suckling was witnessed in three sub-adult females, two nursing mothers and one who experienced a stillbirth the previous year. Two sub-adults, male and female, were seen to manipulate the nipples of the highest-ranking nursing mother and drink her milk or allow her to drink post-manipulation. They were not seen to manipulate their own nipples and milk extraction appeared to be their focus. Milk was not always the result of nipple manipulation within the group although long-term research is required on the nursing mothers who self-suckled to see if there is any impact on infant development. The prevalence of such behaviour in the group appears to be due to intensive social learning.

Poster 9

Savannah chimpanzee (*Pan troglodytes verus*) nesting behavior in the unprotected area of Tikankali near to a mining exploitation and the Niokolo Koba National Park in Senegal

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This work focuses on the nesting behavior of the West African chimpanzee (*Pan troglodytes verus*) in the anthropized habitats of the village of Tikankali and its surroundings. Studies on chimpanzee nesting behavior are carried out at several sites of Senegal but never in Tikankaly. Thus, proximity with the Niokolo Koba National Park and the presence of a gold mining industry mean that data on chimpanzee nesting behavior and anthropogenic disturbance in their habitats for decisions-making about chimpanzee conservation in this area. We recorded a total of 213 chimpanzee nests during two surveys over a distance of 47.81 km (i.e., 47.81 km x 2). Data were collected in October 2020 and October 2021. The majority of nests (63%) were found in wooded savannah, 19% in bamboo savannah, 09% in gallery forest and 07% in open forest. The results showed that 22 plant species belonging to 08 families are used for chimpanzee nests in and around Tikankali. However, half of the nests were in *Pterocarpus erinaceus* (53%); followed by *Hexalobus monopetalus* (8%); *Diospyros mespiliformis* (6%), *Piliostigma thonningii* (6%), *Lannea acida* (6%); and *Grewia bicolor* (4%). The average height of trees used as chimpanzee nest supports was 9.88 m (SD=3.60) and the average height of nests was 7.46 m (SD=3.23). Linear regression analysis ($r=0.84$; $N=213$; $p< 0.05$) suggested a preference for nesting at a particular height but also that nest height is a function of the supporting

tree's height. The current study contributes to the knowledge of chimpanzee nesting behavior in Tikankali, the anthropogenic disruption and will help in the implementation of a good chimpanzee management and conservation strategy in Senegal.

Poster 10

Daily Activities And Feeding Strategies Of Sooty Mangabey (*Cercocebus atys*), Abidjan National Zoo (Ivory Coast)

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The adaptive function of cheek pouches in the subfamily of primates Cercopithecinae, remains still unresolved. Based on previous studies, cheek pouches would be used to decrease vulnerability to predation, to increase feed efficiency by reducing intraspecific competition, and to facilitate seed predigestion with salivary amylases. In order to test the hypothesis of intraspecific competition, we conducted a behavioral study on a primate group including five individuals of the species *Cercocebus atys* in captivity at the National Zoo of Abidjan from September 3 to October 21, 2018, to determine (i) the daily activities of sooty monkeys and (ii) their feeding strategies. We collected 216 hours of instant observation on individuals. The results showed that (i) diet (46%) and rest (26%) are the major activities of sooty mangabey, (ii) the strategies used by individuals to maximize their food gain are: the use of cheeks (65%), the establishment of a privileged relationship with a high-ranking individual, via coalitions (13%) and grooming (6%), as well as the monopolization of food through aggressive interactions (4%) of cheek pouches use therefore seems to increase food efficiency in the mangabey by reducing intraspecific competition.

Poster 11

Using non-traditional stable isotopes ($\delta^{44}\text{Ca}$, $\delta^{66}\text{Zn}$, $\delta^{88}\text{Sr}$) to study primates diet and weaning practices

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Studying the breastfeeding and weaning behaviors of ancient human populations and fossil hominids is essential to the understanding of human evolution. Indeed, knowing the weaning age of a species or a population provides information on the care given to infants, the diet of the population, and can give an estimate of the time interval between births. However, this information is difficult to retrieve from fossil remains. The geochemical analysis of bones and teeth is an essential tool to do so, as the isotopic signature of these tissues depends partly on the individual's diet. Isotopic systems of calcium ($\delta^{44/42}\text{Ca}$), zinc ($\delta^{66/64}\text{Zn}$) and stable strontium ($\delta^{88/86}\text{Sr}$) are already used to characterize differences in diet and trophic level. Moreover, the isotopic signature of calcium in milk is very different from the one of the adult diet (meat and plants), suggesting that milk consumption could be recorded in the isotopic signature of calcium in teeth, since these are formed during the individual's first years. To test this hypothesis, we conducted isotopic analysis of calcium,

strontium, and zinc in modern chimpanzee and gorilla teeth. The results confirm the link between the calcium isotopic signature in teeth and breastfeeding and highlight differences in weaning practices between these two species and early *Homo sapiens*.

Poster 12

Movement ecology of foraging bonobos (*Pan paniscus*) at Wamba, Democratic Republic of the Congo

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Social frugivores such as bonobos and chimpanzees risk within-group competition during foraging given the patchy and ephemeral nature of ripe fruit. While group fission-fusion is thought to reduce competition, bonobo foraging groups are stable and cohesive compared to chimpanzees in similar habitats. Therefore, this study investigated another potential bonobo foraging behavior that could reduce competition: selective movement toward fruits with ecological characteristics that facilitate group feeding. As a proxy for such selectivity, we analyzed the linearity of movements between food patches (straight-line distance between patches divided by distance traveled), of the 'E1' bonobo community at Wamba, DR Congo, using feeding observations and GPS tracklogs for 12 months, December 2021 to November 2022. We calculated fruit ecological characteristics from bi-monthly phenology surveys and a botanical survey across the E1 home range. We separated the movement dataset into periods of fast 'extensive' search and slow 'intensive' search using the partial sum method for area-restricted search analysis. Generalized Linear Mixed Models (GLMMs) analyzed the effects of each of five fruit characteristics on linearity: fruit ID, clumping, fruits/patch, ripeness duration and fruiting synchrony separately for the intensive and extensive datasets. GLMMs were compared to null models with likelihood ratio tests (LRT). In the model testing the effect of fruit ID on linearity for 'extensive' movements, of the 15 fruits with significant positive effects on linearity, most are widely considered favorite bonobo foods. The only significant ecological characteristic model (LRT, $p < 0.001$) found a significant negative effect of 'ripeness duration' on linearity for 'extensive' movements (GLMM, $p < 0.05$). Despite data limitations, this study found rapid linear movement towards certain favorite and short-lasting foods, supporting bonobo selectivity in foraging. Such spatially-targeted group mobility indicates a foraging strategy that could potentially help explain the stable social cohesiveness of foraging bonobo groups.

Poster 13

Generation ChimpanZee: implications of technological enculturation for our understanding of great ape cognition

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Human history is marked out by the transition between generations that differ in terms of their beliefs, values, knowledge, and skills. The most recent variation on this theme is what has been termed the generation of ‘digital natives’ –those who have grown immersed in a technological world which enculturates new ways of thinking suited to navigating the digital landscape. Similarly, many captive primate populations are immersed in an environment that is technologically enriched, with eye-trackers and touchscreens, and at the same time is comparatively ecologically deprived. It is important to understand what impact this has both for grasping what it tells us about primate cognition as well as what primate cognition research is telling us. In this study, we analysed the participation and performance of 3 great ape species (Chimpanzees: *Pan troglodytes verus*; Gorillas: *Gorilla gorilla gorilla*; Orangutans: *Pongo abelii*) in technological vs non-technologically based studies at Basel Zoo, Switzerland. We found that there was a significant negative relationship between the number of studies subjects participated in and age. When broken down into technological vs non-technological studies, we found there was also a significant negative relationship between participation and age for technologically based studies (i.e. eye-trackers, touch-screens), but not for non-technological studies. We will also present data on generational differences in cognitive performance in technological tasks. Currently, our findings suggest a generation difference in great ape cognition, wherein young apes raised in a technologically enriched environment are better equipped at navigating technologically mediated situations and raises the important question of what technologically mediated studies of captive subjects tell us about great ape cognition more generally.

Poster 14

The Perspectives Collective: Introducing a New Platform for Inclusive Primatology

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Local knowledge is the backbone of field primatology, yet the voices of local knowledge remain relatively quiet in primatology. This represents an enormous barrier to primate conservation, owing to both the resultant blind-spots in our knowledge of wild primates, and the fundamental social inequity that is ultimately responsible for this gap. This talk will introduce a new free-format and mixed media journal platform committed to providing a venue for local knowledge in field primatology. This project, which is currently on-going at Budongo Conservation Field Station, will re-imagine the publication process to provide a new means by which field staff can share their knowledge and experiences in the field. We will share examples from our first issue that exemplify the range of methods used, including short video segments, audio-recorded discussions, and written articles, which reveal a side of primatology hidden within the scientific literature and which showcase the lifeworld into which field primatology is embedded. We will end with a brief discussion of how this project can be scaled to include other fieldsites with a view to enabling a wider inclusion of local knowledge in primatology.

Poster 15

Social or individual learning in socially housed long tailed macaques: the influence of two trained role models in a learning experiment

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To learn new behaviours, e.g. to open fruits, one needs practice. When learning is influenced by observing or interacting with another individual, it is social learning. There are doubts whether monkeys are capable of imitating, when they copy others' movements, or emulating, when they find their own way to reach the same result. There are questions about the determinants of favourite role models, what it makes an animal most likely to copy. Alternatively, individuals can learn individually to open the fruit. We explored the characteristics of the role model in long-tailed macaques. We will consider the mode of opening the artificial fruit and take the influence of age, dominance hierarchy, relationship quality and tolerance into account, in a behavioural experiment where five captive multigenerational groups of long-tailed macaques, conform previous experiments by Van de Waal et al. The artificial fruits are boxes that are easy to open, to allow every individual to get access to a food reward by trial-and-error learning. The boxes can be opened in two different ways: by pulling or pushing. We assume that when it is not necessary to observe a demonstrator to open the box, in the two naïve control groups spontaneous learning processes will occur. In three other groups there will be two trained demonstrators, the alpha male and an adult high ranked female, each with a preference for its own technique. If the presence of a role model has an influence, we expect differences in the spreading of the learning behaviours in both groups. The analyses of video recorded attempts and successes are ongoing. The presentation will address tests of our predictions.

Poster 16

Social Learning in wild red-fronted lemurs (*Eulemur rufifrons*)

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Inferring the expertise of others from observed actions enables individuals to decide from whom to learn because the information provided by others can be either useful or maladaptive. Here, we conducted a field-based open-diffusion experiment with four groups of wild red-fronted lemurs (*Eulemur rufifrons*) in Kirindy Forest, Western Madagascar. We offered redfronted lemurs an artificial feeding box that could be opened by two different techniques, either pushing or lifting a lid to get access to a food reward. Out of the 24 individuals, 16 learned the task successfully. Half of the individuals developed a preference for either technique (N=3 pushing, N=5 lifting), whereas the other half of the individuals learned to open the box using both techniques. The probability of learning the task was predicted by the proportion of time spent manipulating the boxes, watching others, and scrounging. Individuals scrounged, independent of whether they learned the task or not, suggesting that scrounging is rather opportunistic. The latency to open the boxes did not differ between techniques, suggesting that they were equally easy

to open. Hence, redfronted lemurs integrate social and individual information to learn a new foraging technique.

Poster 17

Long-term impact of past trauma on pet and entertainment chimpanzees in a sanctuary in Spain: are chimpanzees traumatised?

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While human fascination for chimpanzees led to extensive research on the species, it also caused exploitation by private owners and entertainment industries such as circuses and advertisement agencies. These animals are often abused and mistreated, which can result in potentially life-long post-traumatic stress behaviours (PTSB) even after individuals are rescued. PTSBs pose a significant challenge for zoos and animal sanctuaries to maintain these apes in social and stimulating environments, which could further amplify the long-term effects of early trauma. Here, we conducted a two-month behavioural survey of two groups, each with five individuals, of former pet and entertainment chimpanzees, currently housed at the sanctuary Fundación MONA in Spain, using the digital data collection software *ZooMonitor*. A total of 116 hours of multifocal observations were gathered regarding individual PTSB (e.g. self-poke, overgrooming, self-scratch) as well as group dynamics, i.e. allogrooming patterns. We matched these behaviours to individuals' information such as origin, early history, age at rescue, and social conditions prior to rescue; then, we fitted a linear mixed model to test for the relationship between variables. Remarkably, the time spent on PTSB was positively correlated with the age at rescue for individuals who were kept in isolation, but the correlation disappeared for individuals kept in groups, suggesting that social isolation imposes a strong and potentially irreversible trauma on individuals. Our result supports the expectation that the traumatic experiences endured by the chimpanzees during early development shape their future life and behaviour, and highlights the necessity of ethical review and discussion when considering the use of primates for public or private entertainment reasons. It also underlines the need to take individual past experiences into account when making care management decisions regarding group formations and husbandry.

Poster 18

Social tolerance in wild vervet monkeys assessed using an experimental co-feeding paradigm.

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Individuals interacting in proximity to each other with minimal aggression is commonly referred to as social tolerance. Differences in levels of social tolerance between primate species have been evidenced to covary with kinship differences. In general, social tolerance studies have been focused on species level differences. However, evidence

suggests that there are also differences in social tolerance within species, and that this can change over time, between groups, and according to group composition. To our knowledge, no studies have been conducted on these social tolerance differences with wild Vervet monkeys (*Chlorocebus pygerythrus*). In this study we further aimed to examine whether these potential differences are associated with kin preferences differences. To assess this, we used an experimental cofeeding paradigm using a method adapted for field work. We presented a fake grass carpet with a fixed density of corn and with a plot area proportional to the group size, so to calculate dyadic and group level social tolerance. This study was conducted at “Inkawu Vervet Project” with four habituated monkeys’ groups. We hypothesized that the proportion of kin-biased social tolerance between groups and over time would be negatively correlated with group level social tolerance. We also hypothesized that group composition, typically the presence of mothers with infants, would positively affect kin-biased social tolerance and negatively affect group level social tolerance. Preliminary results suggest that wild vervet groups have differing levels of social tolerance, and analysis of the influence of kinship upon this is ongoing.

Poster 19

Behavioural Assessment And Effect Of Enrichment In A Group Of Aged *Macaca Mulatta* Previously Housed Under Lab Conditions

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Rhesus macaques (*Macaca mulatta*) are widely used as non-humane primate models for biomedical research. Macaques kept in captivity needs an environment that allows them to exhibit their natural behaviours; otherwise, they are prone to developing mood disorders, stereotypic behaviours, and other behavioural disorders. The objective of this preliminary study was to monitor the behaviour of three aged rhesus macaques (≥ 20 yo), relocated from a laboratory to a Rescue Center for Exotic Animals (Italy), and to assess the impact of novel food enrichments on these aged subjects. We collected behavioural data over 18 weeks, starting at their arrival at the new site, via continuous focal sampling method based on video recordings of the three subjects. Simultaneously, faecal samples were collected for cortisol analysis (currently ongoing). The observation period was divided into three phases: a control phase without enrichments, a feeding enrichment phase (divided into two periods), and a final control phase without enrichments. Each phase comprised 900 minutes of observations for each subject. We analysed data using generalized linear mixed models. Results showed an increase in locomotion during the enrichment and final phase compared to the initial phase. On average, subjects moved for only 7% of the time in the initial phase, whereas they were observed moving for 11% of the time in the final phase. Similarly, we found a decrease in resting behaviour in both the enrichment (12% of observation time) and final control phase (13%) compared to the

initial phase (24%). Moreover, results showed a decrease in scratching and body shake behaviour in final phase compared to the initial phase.

In conclusion, we assumed that the rehabilitation of non-human primates previously housed in laboratories is feasible, and the implementation of an enrichment program proves to be a valuable tool in enhancing the welfare of aged non-human primates.

Poster 20

On social knowledge in tolerant macaque

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Macaques live in groups where dominance and kinship influence social bonds. In more intolerant species (e.g. *Macaca mulatta*), social relationships are strongly regulated by kinship and dominance, making social interactions predictable. In more tolerant species (e.g. *M. tonkeana*), kinship and dominance have less impact and social predictability is lower. Our aim is to understand the processes involved in social decisions in a tolerant macaque species, through cognitive tasks using touchscreens and analysis of interactions dynamics, considering individual (e.g. sex, rank) and dyadic socio-demographic (e.g. kinship and dominance relationships) factors. Behavioural data are collected on a group of 28 semi-free-ranging Tonkean macaques at the Centre of Primatology (Strasbourg, France), focusing on >4yo individuals (N=21). We collect 15min focal observations to record continuously the focal activity (feeding, socializing, resting, traveling) and the identity of individuals in close proximity every five minutes. Agonistic interactions are recorded *ad libitum*. To understand how individuals decide to interact with a particular individual, and to test whether individual and dyadic characteristics impact these dynamics, for each grooming and aggressive interaction, we record which individual is approaching, initiating, terminating and leaving, and the audience composition (<3m). Data collection and analysis are ongoing. We expect little influence of kinship and dominance in this tolerant species, although there might be inter-individual variation, e.g. individuals with more kin might approach and interact with more diverse individuals than more isolated individuals, more constrained in their social choices. Cognitive tasks will provide information about which criteria monkeys use to make those decisions. These choices structure the social network and are foundational to understand social knowledge, i.e. what individuals know of their social world.

Poster 21

Perspectives in primatology: unleashing knowledge with *Revue de Primatologie (RdP)*, a pioneering, free, and open-access journal by researchers for researchers

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Established in 2009 by French-speaking primatologists, the *Revue de Primatologie* (RdP; Primatology Journal; Licence CC-BY-NC-ND 4.0) has evolved into a privileged diamond open-access scientific publication, developed through the voluntary commitment of researchers. Initially, the journal aimed to bring together French-speaking primatologists from various fields, including conservation, ecology, paleontology, anthropology, cognitive sciences, biomedical sciences, ethology, and physiology. In recent years, the RdP has adopted a more global perspective, expanding the number of articles and publishing in English and French. Currently, there is one issue published annually, featuring a special issue edited by an external researcher on a specific topic, alongside other independent papers published continuously throughout the year. The journal aims to bring together a broader primatological community by providing articles in the two languages and a free translation service, while maintaining a robust scientific standard. Promoting linguistic diversity in primatology appears essential when considering that scientists from primate range countries are not predominantly anglophone. Each scientific article submitted is reviewed by two researchers, with final decisions made by the Editorial Board. This poster explores the current landscape of primatological journals, open-access criteria, and questions the quest of impact factors. Using website visits and article download statistics, it provides a clear and up-to-date snapshot of the RdP, including the scope of its scientific contributions, its national and international impact, and its strategies for wider dissemination. The poster concludes with thoughts on the journal's future and suggestions for preserving its vitality.

Poster 22

Food puzzles increase food engagement time and can potentially improve group dynamics in captive golden-headed lion tamarins *Leontopithecus chrysomelas*

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Golden-headed lion tamarins are endangered primates endemic to the Atlantic forests of Brazil. Ex situ conservation can ensure the long-term survival of this species, however, under-developed foraging and locomotion skills, as a result of insufficient enrichment in captivity, hinder reintroduction success. Zoos provide a safe haven for the protection of

endangered species, but the welfare of individuals is crucial, as elevated stress levels can impair reproduction. Habitat enrichment has been proposed to ensure welfare in zoos and increase successful reintroduction, but we still lack evidence of the benefits and costs of enrichment in captive golden-headed lion tamarins, which are often housed in small enclosures. Here, we enriched the environment of six golden-headed lion tamarins with food puzzles and measured their food engagement time and stress-related behaviour measured through self- and allo-grooming. As expected, food puzzles increased food engagement time. Despite this, we found no clear evidence that grooming and activity levels were affected by food puzzle treatment. Our results suggest that, although effective in other species and contexts, habitat enrichment alone may not be sufficient to decrease stress behaviours in golden-headed lion tamarins housed in small enclosures.

Poster 23

Do cues of agency enable great apes to understand goal-directed actions?

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Goal-based action prediction is a fundamental, early developing ability in humans, and it helps us to function in the social world. After being familiarized to the video of a hand reaching for an object, great apes and human infants looked predictively towards that object, even when its location was changed. However, they made no predictions when the action was performed by a mechanical claw. Studies with human infants suggest that such an understanding of goal-directed actions initially developed based on their familiarity with human actions and morphology. Other studies have proposed an innate sensitivity to behavioural cues for identifying agency and goal-directed actions, even for morphologically unfamiliar agents. Here, we used eye tracking to study if great apes can predict the goal of a mechanical claw when cues of agency were included. We measured their predictive looks towards the goal object of a reaching claw, with cues such as self-propelled motion and equifinal variation added to it, compared to a mechanically moving claw lacking such agency cues. While these cues proved effective in evoking agency attribution in morphologically unfamiliar agents in human infants, their impact has not been tested in great apes. If great apes looked predictively towards the same goal, this would be evidence that cues of agency are sufficient for great apes to attribute mental states such as intentions to an object. Finally, we also re-created the condition with a reaching human hand, to replicate the goal-based action prediction found in a previous study. Data collection is currently ongoing; results will be presented at the conference upon completion.

Poster 24

Facial expressivity benefits top ranking male macaque

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Social living affords primates (including humans) many benefits. Communication has been proposed to be the key mechanism used to bond social connections, which could explain why primates have evolved such expressive faces. In this study, we compared social network data (based on social proximity and grooming measures) and expressivity indices (based on an anatomically based facial coding system, MaqFACS) between captive rhesus macaque (*Macaca mulatta*) groups in uniform physical and social environments (n groups = 9, n individuals = 66). More facially expressive dominant male macaques had more cohesive social groups and were more socially connected within their groups. These findings show that inter-individual differences in facial expressivity are related to differential social outcomes at both an individual and group level. These patterns suggest that more expressive individuals are able to occupy more advantageous social niches, which could help explain selection for complex facial communication in primates. Ultimately, these findings also help explain why humans have evolved such uniquely expressive faces.

Poster 25

Studying the variability of urban vervet monkeys' diet by DNA metabarcoding of faecal samples

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Foraging decisions in vervet monkeys (*Chlorocebus pygerythrus*) may be affected by social transmission of information between individuals in a group, and more specifically between mother and offspring. Due to increasing habitat fragmentation and conversion, the range of vervet monkeys in urban areas has widened considerably, potentially leading to the presence of anthropogenic food in their diet. Due to their generalist and opportunistic feeding behaviour, studying urban vervet monkeys' diet is important to help understanding the impact of urban ecosystems on their foraging behaviours. However, accurately determining the variety of food types consumed by omnivorous species may in cases be complicated by mere observations. Consequently, environmental DNA (eDNA) based techniques provide complementary study options that can result in more complete assessments. In this study, we determined urban vervet monkeys' dietary components using DNA metabarcoding of faecal samples. 448 samples were analysed from 2 different monkey groups of respectively 23 and 21 individuals, collected during a 4-month period in an eco-estate in South Africa. We aim to define the amount of natural food versus human food ingested, and to compare diet variability between the two groups of monkeys, as well as between different sex-age classes, especially between mother and offspring. We assess

if dietary patterns have been socially transmitted, and whether this is distinguishable at matrilineal and intergroup levels.

Poster 26

Do neighbors matter? Exploring the impact of intergroup interactions on the social networks of two adjacent groups of chimpanzees

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Chimpanzees (*Pan troglodytes*) may live in large communities of up to 150 individuals in their natural habitat, with complex social structures and dynamics. Yet, the size of chimpanzee groups in captivity is usually much smaller and, therefore, less complex. Housing institutions may decide to maintain smaller groups for reason such as limited resources, limited enclosure sizes and/or to attempt to reduce aggressions and risk of injuries. However, such smaller groups can be housed in adjacent habitats, which could increase the number of potential social partners (for non-contact interactions), providing additional opportunities for relationships and greater social complexity. This study aimed to evaluate the impact of social interactions between two neighbouring groups of chimpanzees based on two social network indices (vertex strength centrality and deviation from edge weight disparity). Additionally, linear mixed models (LMM) were run to assess whether chimpanzee's sex, age and intra/intergroup directionality influenced these indices. We recorded occurrences of social interactions, social proximity, and whether chimpanzees observed individuals from the other group as a measure of interest. As expected, most social interactions were directed toward members of their own group; however, 13% of all recorded social interactions were directed toward members of the neighbouring group. Specifically, we found that agonistic behaviours, such as displaying of strength, were the most frequent interactions between both groups of chimpanzees, followed by social proximity through the barrier that separated them and affiliative behaviours. These findings suggest that, although lacking physical contact, interactions between neighbouring groups have the potential to provide social stimulation and thus increase social complexity, without increasing the risk of injury.

Poster 27

Ecological functions drive variation in eye coloration across macaques

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A growing number of studies have investigated the evolutionary drivers of external eye appearance in primates, but conclusive evidence is lacking. The literature has distinguished between two types of functions. Communicative functions, such as announcing a tame temperament via conjunctival depigmentation, and photo-regulatory functions towards the amount and quality of light in a given species' environment. Here, we assess the relative contribution of photo-regulatory and communicative functions to macaques' external eye appearance. Macaques' relatively well described social structure

and wide distribution make them interesting to explore. We find that their sclera is more pigmented closer to the equator, suggesting photoprotective functions. However, this is not the case for the conjunctiva. We also explore individual variation in pigmentation adjacent to the iris, suggesting eyeball pigmentation in macaques is distributed to reduce damage to the corneal limbus. We find no evidence that communicative functions drive variation in external eye appearance in macaques.

Poster 28

The value of studying and conserving nocturnal primates as a model for early primates

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Ancestral reconstruction is a popular tool for studying the evolutionary pathways for various traits across primates. This method requires researchers to populate their models with known information to simulate how primates diversified or conserved the ancestral condition. It is generally understood that nocturnal primates may share more traits with ancestral primates than diurnal primates, but whether they are the best model for early primates is an ongoing discussion. Given our growing knowledge of extant nocturnal primates and extinct primates, now is the time to assess the viability of nocturnal primates to act as the best model for early primates. We hypothesize that extant nocturnal primates are a good model for ancestral primates and that they have poor representation in published ancestral reconstructions. We predict that nocturnal primates will reflect the most internal node more often than diurnal primates in studies that conducted an ancestral reconstruction. We also predict that relative to the number of nocturnal primates within the Order Primates, nocturnal primates are disproportionately absent from these studies. To test these predictions, we plan to complete a comprehensive literature review using Google Scholar and the Web of Science of studies that performed an ancestral reconstruction, including primates. Thus far, for each paper included in our analysis, we recorded whether or not the ancestral state matched the state of the nocturnal primates. We also recorded the number of nocturnal primates included in the study compared to diurnal primates, as well as what outgroup they included. If nocturnal primates are in fact the best representation of early primates, it is important that we conserve and expand our understanding of this important group of primates to help create more comprehensive reconstructions in the future.

Poster 29

The effect of tool use on patterns of aggression within the framework of self-domestication

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Recent strides in hominin evolution research have extended beyond the archaeological record, instead delving into that which does not fossilise: behaviour. One theory that has emerged in this process is self-domestication. It hypothesises that hominins underwent a process of selection for reduced reactive aggression and increased social tolerance and was accompanied by a host of behavioural and physiological changes. I will be using this theory as a lens to study the evolution of hunting behaviours in early hominins, using non-human primates, with whom we share a common ancestor, as analogues to infer behaviours. Considering self-domestication predicts for the development and use of tools, and a reduction in reactive aggression and increase in proactive aggression, this will be done by comparing tool use, proactive aggression – using hunting as a proxy - and reactive aggression –using in-group aggression as a proxy. This will be conducted through the use of phylogenetic comparative methods (PCMs) in order to disentangle the potential evolutionary mechanisms underlying hunting evolution. There are three main questions I want to address with this research. 1) Are there observable patterns of tool use correlating with aggression across the primate order? 2) How can we extrapolate this into the theory of self-domestication? 3) Could this self-domestication have facilitated the decoupling of aggression and tool use in hunting in early hominins? Results are expected to indicate a relationship between tool use, increased hunting and decreased intra-group aggression. This relationship may be stronger in primates more closely related to humans i.e. catarrhines and weaker / not present in less related primates such as strepsirrhines. This research is ongoing and will be submitted as an MSc thesis in August 2024 and will act as proof of concept for a PhD in the same area beginning in October 2024.

Poster 30

Vocally coordinated departure in wild western gorilla groups

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The ability to coordinate actions is of vital importance for group-living animals, particularly in relation to travel. Groups can only remain cohesive if members possess a shared mechanism to synchronize departures. However, difficulties arise naturally because individuals usually have different priorities and some individuals may be more influential than others. To better understand how hominids achieve coordinated behaviour, we investigated departures after group resting in three habituated groups of western gorillas (*Gorilla gorilla*) in Central African Republic. Compared to other great apes, gorillas are highly sexually dimorphic with dominant male silverbacks being twice the size of adult females, which has been taken to suggest that they act as the main decision-makers. To address this hypothesis, we analysed how the timing and direction of

group departures were coordinated and whether some individuals were more influential than others. We found no evidence for unshared leadership by silverbacks. While higher-ranking individuals were more successful in indicating the direction of future travel, the timing of departure seemed to be shared among group members, through a vocal voting system. We concluded that western gorillas make travel decisions collectively, hereby relying on a complex vocal negotiation process.

Poster 31

Ecology and Bioecology of *Ptilocolobus badius temmincki* in the Saloum Delta National Park, Senegal

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The *Ptilocolobus badius temmincki* is one of Senegal's flagship species, at its northernmost limit. This specifically folivorous and arboreal monkey, faced with the current effects of climate change and human activities, is classified as endangered on the IUCN red list and is one of the species targeted by the colobus conservation action plan for 2026. However, data on this primate in Senegal are scientifically non-existent. The aim of this ongoing study is therefore to update the distribution and numbers of the Senegalese colobus populations through surveys and fieldwork, and to study their ecology and bio-ecology. This enabled us to list 14 sub-groups in the Saloum Delta National Park, representing a total of 236 individuals, the largest of which (30) is found in the Fathala reserve (the fenced-off part of the park). Floristic surveys of the area frequented by a band of 27 individuals enabled us to identify 368 trees belonging to 20 species, dominated by *Terminalia macroptera* (50% of the total), an indicator of degradation, followed by *Bombax costatum* (15.76%), i.e. a density of 331.2ind/ha. Surveys carried out among people living in the surrounding villages show that 79% of those questioned are familiar with the West African colobus bays, especially the older ones (who have fond memories of it and never see it).

Poster 32

Assessing the theory of mind development in nonhuman primates to improve their well-being

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The presence and extent of Theory of Mind (ToM) in non-human primates remains a topic of active debate in the field of primatology. While some studies suggest basic ToM abilities in tarsiers, monkeys, and apes, such as understanding gaze direction and intentions, conclusive evidence across the spectrum of primate species, including lemurs and lorises, is yet to be established. In response to this uncertainty, we propose a novel approach: the development of multimodal shift tasks to assess ToM in these primates.

This method involves varying the sensory inputs and presentation modes to probe the cognitive adaptability of primates, aiming to provide clearer insights into their mental states. Alongside this, we recommend employing Wellman's developmental scale, originally used for human children, to evaluate the complexity and progression of ToM in non-human primates. The recognition of ToM in primates has far-reaching implications for their welfare. Improved care strategies, acknowledging primates' mental states, can lead to enriched environments that stimulate cognitive abilities and foster healthy social interactions. In conservation efforts, understanding primates' cognitive abilities allows for the development of strategies. By enhancing our understanding of primate cognition and applying these insights, our primary objective is to review and potentially update general guidelines for primate welfare. These guidelines, while serving as a foundational framework, will be critically assessed to ensure they align with the latest discoveries and can be tailored to meet the specific needs and contexts of individual primate species and settings.

Poster 33

Deciphering gelada yawn complexity by disentangling sensory components

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Yawning is undeniably contagious and hard to resist. Interestingly, in our species, even the mere sound of a yawn can trigger this contagious response, especially when the yawner is someone emotionally close. Together with humans, only another mammal species is known to produce loud and distinct vocalisations while yawning, *Theropithecus gelada*. Geladas are known for their complex social organization and rich vocal communication, making them intriguing subjects for studying yawn contagion (YC). Yet, much remains unknown about the role of different sensory modalities in motor resonance phenomena. To explore the effects of hearing yawn sounds in geladas, we conducted playback experiments in a large zoo-housed colony composed of two adjacent groups. We exposed geladas to yawn sounds (Test) or affiliative grunts (Control) produced by ingroup or outgroup males. The results were remarkable, as simply hearing yawn sounds led to YC, with a higher number of yawns produced in response to ingroup yawn stimuli. In addition, acoustic analyses (i.e., DFA) performed on the yawn vocalisations produced by the males of the colony uncovered that cues of individuality are present in yawn sounds. This suggests that geladas may recognize group members by their yawn sound, possibly explaining the social modulation of auditory YC. Furthermore, we also collected observational data (more than 1400 yawns from 67 animals) that will tell us more about the modulation of the phenomenon in terms of emotional closeness and sensory modalities used (e.g., only heard vs only seen vs seen and heard yawns). Collectively, we suggest that sensory modalities beyond visual perception might be especially adaptive in complex multilevel societies where visual contact is often inhibited. Overall, our work prompts intriguing questions about the evolution of multimodality in mimicry and behavioural contagion.

Poster 34

Rapid facial mimicry in a despotic monkey

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During risky interactions like play fighting, the use of communicative strategies such as rapidly mimicking the playmate's facial expressions (Rapid Facial Mimicry, RFM) can help in deterring aggressive escalation and result in behavioural and/or emotional synchronization. Here, we studied facial communication in a large group of rhesus macaques (*Macaca mulatta*), specifically testing hypotheses on the presence, function, and possible emotional meaning of RFM. For the first time in a despotic macaque group and in contrast to previous data, we found RFM of play faces (PFs) to be present and common during play fighting, particularly between same-aged young subjects. The presence and frequency of RFM prolonged playful sessions, possibly facilitating motor synchronization. When investigating if also bystanders could mimic PFs, we found that macaques not actively involved in the interaction did not show RFM, this implies that direct participation in the play session is necessary for emotional involvement. Moreover, playmates making breaks during their playful interactions re-started playing with shorter latencies if, before stopping, they had been at least an event of RFM. Importantly, this possibly indicates that after events of RFM playmates have a more aroused internal state, linking the presence of facial mimicry to more gratifying interactions. While further comparative studies on RFM in the *Macaca* genus are needed, we emphasize here the possible emotional significance of contagious behaviors such as facial mimicry and their role in promoting behavioral coordination during play.

Poster 35

How do baboons adjust to an environmental shock?

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Understanding wildlife behavioural responses to the anthropogenic variables is paramount to address human-wildlife interactions issues and promoting conservation in human-dominated landscapes. This study, conducted in 2019, focused on a troop of chacma baboons (*Papio ursinus*) named Madiba's troop which inhabits George Nelson Mandela University campus situated in the Garden route in South Africa. This region faced a fire in October 2018 that burnt 86000ha impacting the campus by burning mostly pine plantation. Our objective was to understand the fire's impact on Madiba's troop behaviour. We recorded baboon movements to estimate home range size, troop dispersion and any urban foraging events (UFE) where troop members tried to entered houses or open any object that may contain anthropogenic food. Data were compared with those collected in

2018 (before fire). The shock experienced by Madiba's troop led to the departure of half of the troop whereas new individuals incorporated it leading to a troop being half the size as before fire. The fire burnt 32% of the home range and led to the arrival of another troop reducing Madiba's home range by 53%. Consequently, troop members stayed mainly on campus to rely on anthropogenic food and performed as much UFE as before fire. Surprisingly, burnt pine plantation represented 28% of their new home range and troop members visited more pine plantation than natural forest. This result can be explained by the cut of the standing pines leading to an easy access to pine nuts. Even if the troop reduced its home range, it was more scattered than before fire, decreasing the number of participants in an UFE and thus the risk to be detected but still caused important damages. Such environmental change in fragmented landscapes increased pressure on urban areas by the troop worsening perception of baboons by people.

Poster 36

Understanding affective states in free-ranging Japanese macaques (*Macaca fuscata*): A multi-methods investigation using behavioural and infra-red thermal techniques

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To navigate our complex social world, humans have evolved rich socio-emotional capacities which have deep evolutionary roots. Studying the evolution of emotional processes in our primate relatives offers an opportunity to understand their unique behaviours, and to comprehend how physiological and psychological processes evolved in our own species. An emerging technique, infra-red thermal imagery (IRT), offers an opportunity to study socio-emotional processes by non-invasively monitoring physiological changes in the autonomic nervous system via facial temperature changes. Thus far, studies using IRT in free-ranging animals are limited to chimpanzees, with findings suggesting that competitive/high-intensity social events lead to lower nasal temperatures as compared to cooperative/low-intensity, showing higher nasal temperatures. This study addresses this imbalance by using IRT to investigate emotionality and its link to social behaviour in a captive population of free-ranging Japanese macaques at Affenberg Landskron (Austria). Being a social and despotic species, Japanese macaques behavioural patterns are strongly impacted by linear dominance hierarchies and rank, especially during periods of high competition including the mating season. My project explores the relationship between macaques emotional responding, as measured using IRT and behavioural markers, and key social events within their daily lives. Through focal behavioural observations of 17 adult macaques (>4.5 years old; 8 males, 9 females), I am investigating the impact of agonistic behaviours, allogrooming and social feeding on the occurrence of self-directed behaviours, a behavioural marker of anxiety, nasal temperature and respiration by using IRT. I test the hypothesis that anxiety-inducing events lead to conspicuous changes in nasal skin temperature, respiration, and the occurrence of SDB, with an influence of social affiliation and rank. The on-going data collection will be presented, with a focus on the using of a multi-methods approach to understand primate affective states.

Poster 37

Factors determining non-vocal communication in captive yellow baboons (*Papio cynocephalus*) and hamadryas baboons (*Papio hamadryas*)

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Living in a group is an adaptive challenge that requires solutions, such as communication mechanisms that bind the group together and make cooperation possible. In baboons (genus: *Papio*) the repertoire of non-vocal behaviors is extremely rich and unique. In addition to behaviors such as grooming, hugging, mock bites or holding, non-vocal communication also includes multimodal examples, which can be categorized as greetings. These greetings are non-aggressive behavioral exchanges between individuals, often involving multiple modalities –tactile, visual and vocal. Greetings can include even potentially harmful behaviors such as genital fondling or ischial callosities holding, that may facilitate disease transmission. For this reason, greetings allow to test the strength of the bonds between individuals or signal their status. The aim of our research was to distinguish factors determining non-vocal communication in yellow (*Papio cynocephalus*) and hamadryas baboons (*Papio hamadryas*). We collected behavioral observations from May to September 2023 in two Polish zoos – Wrocław and Warsaw, using the focal animal sampling method. We examined the following factors: species, castration of males, position in the hierarchy, sex, number of people in the proximity, and weather, on the intensity and dominant forms of communication between individuals and in the group. Our results showed that castration of males and species had a significant effect on the non-vocal communication of baboons in captivity. Furthermore, we observed sex differences in non-vocal communication. Lastly, this study presents an overview of greetings in female baboons, what has not been described so far.

Poster 38

Genetic assays as tool for conservation management of non-human primate species

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The breadth of genetic diversity in immune response genes within a population is of great importance to minimize the possibility that a population is wiped out by one pathogen. In addition, knowledge on the parentage and geographical origins of a species may enhance colony management and opens ways to control exchanges between different populations, for instance to prevent inbreeding. In the past two decades we have developed several assays to characterize the genetic diversity in great ape, Old and New World monkey, and lemur species. One of the assays enables a quick and robust characterization of the major histocompatibility complex (MHC) DRB gene profile. The MHC region is highly polymorphic and polygenic, and encodes molecules that play a crucial role in immune

responses. Our platform has proven to be widely applicable to multiple species, and can be used to monitor and manage colony or population composition. Next to invasive techniques, such as drawing blood, this protocol can also be applied using DNA isolated from non-invasive sources, such as hair and feces. Furthermore, validated assays are available for origin determination by mitochondrial DNA analysis as well as for parentage definition by selecting for up to 23 different polymorphic microsatellites. In conclusion, these assays offer valuable tools for enhancing the conservation management of non-human primates, supporting their long-term survival and well-being, and enabling to assess and preserve genetic diversity within populations.

Poster 39

Bodily rotation in the play and communication of primates

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In primates (and many other mammals), bodily rotation features as a common part of play (Fagen, 1981) and communication (Byrne et al, 2017). We report the findings of a study of primate rotational behavior based on a large video database collected from YouTube. We searched YouTube using phrases that referred to primate clades crossed with various rotational behaviors (e.g., gorilla twirling, monkey flipping), collecting videos in which the animal performed at least one full rotation. Using text provided with the video and clues from the video itself, we inferred as much information as we could about the individual animals (e.g., name, age, sex) and the site where the behavior occurred. Our search returned 394 videos, comprising roughly 1170 distinct behaviors and 3975 individual rotations. This data included 18 videos of bonobos (with confirmation of at least 13 distinct individuals and 8 unique sites), 53 of chimpanzees (30 individuals, 33 sites), 114 of gorillas (51 individuals, 48 sites), 93 of orangutans (40 individuals, 34 sites), 31 of gibbons (13 individuals, 14 sites), 76 of monkeys (24 individuals, 33 sites), and 9 of lemurs (2 individuals, 3 sites). The animals performed different types of behavior that varied in the bodily axis and direction of rotation, including somersaults, rolls, pirouettes, rope spins, back flips, and various other idiosyncratic behaviors. We are currently coding the behaviors for evidence of intentional communication according to criteria of audience checking, response waiting, persistence, and deliberate physical contact. Preliminary results of chimpanzees show that nearly half (47%) of the behaviors exhibit at least one of these criteria. Our talk will present the characteristics of these behaviors and how they varied across clades, age, and sex. We will discuss our findings in context of the pros and cons of using YouTube for animal behavior research.

Poster 40

Reductions in Orangutan Flange Size after Initial Development: Relationship to FAI, Antagonistic Interactions, and Age

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Male orangutans are bimature with two sexually active male morphs: the unflanged male and the flanged male. Unflanged males are similar to females in overall appearance, whereas flanged males have a larger body mass, more hair, developed throat sacs capable of making long calls, and large fatty cheek pads known as flanges. Numerous field sites have anecdotally reported the presence of flanged males with degraded flanges, which in some research has been associated with the term "past-prime". I investigated 3 potentially causative factors of this condition by measuring flange size after initial development at two sites across multiple photographs of the same individuals and correlated these observed changes with local FAI, antagonistic interactions, and behavioural data to examine the cause of this condition. GLMM results indicated that age was the only significant factor in flange size deterioration, and individuals with diminished flanges produce more long calls per day. This research suggests that maintenance of the flange size is not metabolically costly and that variance in flange size after development is likely not due to ketosis, but may be driven by age-related deterioration of muscle fibres and connective tissue that supports the structure of the flange. I also suggest change in long call behaviour may be due to an decrease in the loudness of the long call, requiring increased ranging and production of long calls in order to vocally establish presence in an area.

Poster 41

Updated census of living chimpanzees seized by Spanish authorities

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Due to its geographical proximity to the African continent, Spain has always been a primary entry point for exotic species into Europe. During the late seventies, many chimpanzees were imported to Spain to be used as props at Spanish beaches. It was common to see photographers using them to attract clients who wanted to be photographed with them. These photographers profited at the expense of these creatures until they grew up and became difficult to handle. Eventually, they were sold to circuses or individual households and new baby chimpanzees were acquired to continue with the business. When Spain signed the Convention on International Trade in 1986, some chimpanzees were seized by police and ended up in roadside zoos or other institutions. In 2022 the Administrative CITES department changed to a new ministry and one of its main goals is to update and list all the living specimens placed in different institutions and

assess their welfare. Hence during 2023, we conducted a census to determine the current number of living chimpanzees originally seized in Spain and obtain preliminary data on their welfare status. 84 individuals have been reported in 15 institutions across Europe. Ten in Spain, one in the United Kingdom, one in the Netherlands, two in France, and one in Germany. 53 of these chimpanzees were born in the wild and 31 are descendants of the former. The fact that many of these animals were wild-caught and most have been used at least during their infancy as pets or entertainers, sets them apart from other chimpanzees found in regulated zoos. Keeping track of these animals, ensuring their welfare and finding sustainable solutions for those who are not yet housed in species-adequate conditions is of utmost importance.

Poster 42

Individual differences in facial expression processing ability in rhesus macaques

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Facial expressions are important communicative signals used in social interaction. How an individual processes and reacts to facial expressions could, therefore, affect their social relationships, which can have profound effects on their health and survival. Despite this, the social impact of individual differences in expression production and perception have been largely overlooked. This study investigates the form, function and development of individual differences in rhesus macaque (*Macaca mulatta*) facial expression perception. Using a captive population of rhesus macaques at the MRC Centre for Macaques, UK (N=71), we conducted a series of looking time experiments to quantify the facial expression processing abilities of each macaque and we are in the process of analysing this in relation to data on mother-infant interactions (early rearing environment) and adult social network position. This examination of individual differences could provide important insights into which aspects of facial communication result in better social outcomes, and why facial expression has evolved to be so complex in human and non-human primates.

Poster 43

Social learning shapes the spread of a scarce novel feeding opportunity in a troop of wild vervet monkeys

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For a long time, the occurrence of social learning beyond humans was not acknowledged. However, it is now widely accepted that social learning, defined as learning from others, plays a significant role in the appearance and development of cultures and traditions in the animal kingdom, particularly amongst non-human primates. Previous studies have assessed different social learning strategies in vervet monkeys, generally using

experimental set ups with abundant food sources. However, how individuals learn from each other in a natural context, where food sources are often scarce, is yet to be fully understood. This study has innovated by exposing a troop of wild vervet monkeys to a novel food source that is both scarce and provided discretely to dissociate it from humans. Such a method also enabled the collection of data on lower-ranked or shy individuals who would often avoid experimental set ups where higher-ranked monkeys tend to monopolize the food source. Our study shows that vervet monkeys adhere to the novel food item significantly more after observing another individual having interacted with this food item rather than by purely exploring this opportunity on their own. Moreover, social bonds play an important role in the learning process since vervet monkeys observe particularly individuals with whom they usually share more affiliative interactions. Finally, we also investigate the importance of specific behaviors, such as muzzle contact or simply observing, and how important these different behaviors are in the learning process and in the spread of a novel feeding opportunity across the troop. This study aims to contribute to the knowledge on social learning, especially in a novel food context, which is of a growing importance in nowadays fast-changing environments.

Poster 44

Primate cognition in an anthropogenic landscape: how do semi-urban vervet monkeys use their problem-solving skills?

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Urbanization presents evolutionary novel challenges for many species and its impact on animal cognition is beginning to be studied. To thrive in habitats transformed by anthropogenic influences, urban animals use cognitive abilities to utilize available resources. Yet to what extent the urban environment boosts cognitive skills, like novel problem-solving is yet to be uncovered. Here we explored the cognitive abilities of semi-urban vervet monkeys, *Chlorocebus pygerythrus*, to shed light on this species' cognitive flexibility and the impacts of an anthropogenic environment. Using a two-option puzzle box design with increasing levels of difficulty, we conducted over 675 field experiments with two troops of vervet monkeys (Acacia N=331 involving 18 individuals & Savanna N=406 with 22 individuals) at the study site of Simbithi Eco-Estate, KwaZulu-Natal in South Africa. First, we investigated whether monkeys with experience from the anthropogenic environment differ in their physical problem-solving abilities compared to wild conspecifics (existing data from Inkawu Vervet project and to what extent they need social learning to solve the puzzle box (Canteloup et al, 2020)). Our second objective was to examine inter-individual variability in exploration tendency and different strategies to successfully solve the different levels of difficulty of the presented problem. Data processing is still ongoing, though our findings will have crucial implications to what extent previous experiences with anthropogenic artefacts influence monkeys' capabilities to successfully solve novel challenges. As such, our study contributes to the understanding in which way urban animals' cognitive skills are shaped by their environment.

Poster 45

A comparative study on context-specific emotional responses in two macaque species

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Exploring animal emotions and understanding how these emotions influence their behavior and physiology presents a difficult challenge. Nevertheless, it is crucial for gaining insights not only into animals' lives, but also to improve our understanding of human behavior. (Animal) emotions can be defined as a multidimensional reaction constructed by a range of physiological, behavioral, and cognitive responses to stimuli or specific situations. This study, therefore, aims to investigate animal emotions through a non-invasive, non-interactive and multidimensional approach to unravel the physiological and behavioral responses during potentially threatening situations. The data for this study were collected from three groups of long-tailed macaques (*Macaca fascicularis*) and two group of rhesus macaques (*Macaca mulatta*), all housed within their established naturalistic social groups in captivity at the Biomedical Primate Research Center. The experimental setup involved exposing the groups for 30 minutes to two distinct predator models—a rubber python snake and a bird of prey (Eagle) model— on separate days. During and after each predator exposure, we collected data on facial temperature, vocalizations, and behavior. Here, we will discuss species and group level responses with regard to emotional arousal during predator exposure from the perspective of three different social 'conditions' (i.e., mothers, adult females and, adult males) of. We expect changes in the temperature of the tip of the nose during the predator exposure independently of their condition. We also expect that mothers will react more emotionally aroused than non-mother adult females. Lastly, we expect that females in both conditions will react more negatively aroused than adult males. All data were collected, and we hope to show some preliminary results in June.

Poster 46

Rethinking Behavioural Observations – a direct comparison of sampling method performance

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Reliably and efficiently generating social networks is an essential part of the research of the evolution of social relationships. The challenge of capturing a full record of all social interactions among animals emphasizes the need to systematically sample behaviour through standardized observation methods. But what methods are most fit to create robust social networks? Traditionally, researchers have relied on continuous focal sampling assuming it provides the most accurate results. However, recent simulation studies suggest that instantaneous scan sampling might be more effective. In this project we are comparing the performance of focal continuous sampling with an adapted version

of scan sampling by recording social interactions (proximity, body contact, grooming and agonism) and constructing social networks of a group of semi-free ranging Japanese macaques (*Macaca fuscata*) at the Affenberg Landskron, Austria. For three months, two observers simultaneously collected social interaction data on 30 target females. One observer used focal sampling, while the other used scan sampling, with a daily alternation of observer-method. From these data we will generate networks using BISO [Bayesian Framework for Inference of Social Network], which estimates edges with explicit uncertainty based on observation effort. We will compare the scan and focal networks in their similarity, confidence in the edge weights and robustness of estimated network metrics at individual, dyadic and global network levels. These analyses will allow us to examine the impact of lower observation effort on the estimated network metrics, providing an indication of which method provides a more reliable and representative estimation of the true behavioural rates and underlying network structure. Drawing preliminary conclusions, it seems that scan sampling is more time efficient compared to focal sampling, resulting in higher quantity of data for the same observation effort.

Poster 47

Exploitation of the sisal field as a new habitat by Ring-tailed lemur (Linné, 1758) in the Berenty private reserve

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The exploitation of sisal fields by Ring-tailed lemur represents a new challenge for the survival of its population in the Berenty private reserve. This study focuses on the survival conditions of a Ring-tailed lemur population in the sisal fields around the Berenty private reserve. In addition to botanical studies on plant diversity and phenology along the transect lines, the "scan animal sampling" method was used to follow two groups resulting from a fission, Ialygate 1 living in the gallery forest and Ialygate 2 living in the sisal fields from January 10 to 20, 2022 and from August 24 to September 13, 2022. The Berenty private reserve is located in the southern Madagascar. The results showed that the ecological traits of the sisal fields offer >50% range and availability of food resources for Ialygate 2. This group has a good-quality frugivorous diet compared with a low-quality folivorous diet for the other group during lactation and gestation. The nutritional values of *Agave sisalana* flowers, the group's main food source, are significantly higher (1322) than those of the Ialygate 1 group's main and complementary resources (870). The fragmentation of the Berenty forests therefore obliges Ring-tailed lemur to explore possible matrix habitats surrounding its natural habitat. In conclusion, the survival of the Ring-tailed lemur population in sisal fields is conditioned by the nature of the food resources present there. On those perspectives on the sustainability accompaniment of the survival of this species outside the forest should be taken into consideration. Since 2014, outmigration from the reserve has already been confirmed. Recent monitoring with annual censuses shows increasing populations of Ring-tailed lemur exiting outside the 20 forests throughout the entire reserve, and their numbers are steadily decreasing.

Poster 48

Foraging strategy and tree structure as drivers of arboreality and suspensory locomotion in savannah chimpanzees

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Chimpanzees are unique amongst apes to live across the forest-savannah habitat spectrum, providing a valuable opportunity to investigate the influence of habitat structure on ape evolution. Notably, open vegetation with fewer arboreal pathways is characteristic of savannah-mosaic habitat and traditionally associated with increased terrestriality and less terminal branch locomotor behaviours (e.g., suspension). However, we previously found that the savannah chimpanzee community (*Pan troglodytes schweinfurthii*) from Issa Valley, Tanzania, was just as arboreal, and notably more suspensory, as their forest-dwelling counterparts. Here, we discuss substrate use in the context of foraging behaviour and feeding tree structure, to test the hypothesis that Issa chimpanzee foraging strategy selects for high arboreality and terminal branch locomotion. Specifically, we predicted that Issa chimpanzees forage more frequently, and for longer periods, in trees with relatively wide crowns and abundant terminal branch foods (characteristic of woodland feeding trees e.g., *Brachystegia* spp.) in response to spatially restricted food sources. We collected data over 5 months on Issa adult foraging behaviour during arboreal feeding bouts [recording duration, number of patch changes, food type consumed (e.g., ripe/unripe fruit, leaf) and location] during half day focal follows, marking feeding trees for later measurement (DBH, crown height and diameter, branch number). We tested for any association between feeding tree structural characteristics and foraging behaviour using multivariate models, controlling for food availability and individual variation. Results improve our understanding of chimpanzee habitat use and the selective pressures acting on ape positional behaviour in a savannah-mosaic, and have important implications for the interpretation of hominoid behaviour from morphology.

Poster 49

Morphological variants of open-mouth faces are situation-specific in mature and immature chimpanzees

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The human smile is highly versatile, modulated in form from a young age according to the social context in which it is displayed. This complex production of smiles seems essential for fluid social interactions, with variants thought to convey specific information about individuals' intentions and emotions. The present work examined if one of our closest living relatives, chimpanzees (*Pan troglodytes*), modulate a morphologically comparable facial expression, open-mouth faces (OMFs), according to varying social situations. The OMFs of thirty-one semi-free-ranging chimpanzees (1-30 years old) produced during

spontaneous, dyadic play were examined using ChimpFACS. GLMM analyses revealed that infant, juvenile, and mature chimpanzees were more likely to produce facial movements associated with exposure of the upper teeth (i.e., AU10 and AU12) in rough than gentle play. Two additional facial movements, the lower lip depressor (AU16) and mouth stretch (AU27), were predominantly observed during rough play in infants, juveniles, and adult chimpanzees. These findings provide empirical evidence that immature and mature chimpanzees may have a diverse repertoire of OMFs, which they produce distinctively depending on the play type, possibly to convey different information. Together with findings on human smiles, this evidence puts forth the possibility that the complexity of such expressions may have evolved to serve adaptive functions during social interactions in our last common ancestor.

Poster 50

Press here for a partner – Sex difference in motivational processing of mate-relevant stimuli in long-tailed macaques (*Macaca fascicularis*)

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Mate choice can be influenced by visual cues; facial characteristics can contain information about an individual's health, age, and other characteristics. While previous studies have shown that macaque females show an attentional bias to certain facial characteristics of males (coloration, symmetry), it remains to be established whether there are individual differences in these biases. Therefore, we aimed to investigate to what extent individual macaques presented themselves with stimuli of (a) objects or (b) male faces on a touchscreen. We present data from a naturalistic group of long-tailed macaques (*Macaca fascicularis*) at the Biomedical Primate Research Center (Rijswijk, The Netherlands). Individuals (N=12; 8F, 4M) could watch stimuli (extra-group male faces versus object), presented on a touchscreen, by holding their hand on the screen. Using Bayesian Mixed Models, our preliminary data show that females exerted more effort to watch stimuli of males over objects, while no effect was present for males (1842 clicks in total). We are planning to collect data in two more groups of long-tailed macaques to increase our sample size to N=28 (21F, 7M). In addition, we will add female face stimuli, to study whether females also prefer male face stimuli over female face stimuli. We discuss ideas for further analyses and propose exploring potential connections between the touchscreen responses and real-time social behaviors.

Poster 51

Prosocial behavior in communally breeding house mice and seasonally cooperating steppe mice

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While humans have long since been known to consider the wellbeing of others by making choices that benefit not only themselves but others, the evolution of prosocial behavior in humans and other animals has not yet been fully understood. Among other factors, heightened social tolerance as well as cooperative breeding have been proposed to facilitate prosocial behavior in a species. However, recent studies have found conflicting results on the relationship of cooperative breeding and prosocial behavior, with some cooperative breeders behaving less socially than expected. Further criticism of the cooperative breeding hypothesis points out the strong bias of this theory having initially been derived from primate studies. It has therefore become apparent that in order to gain a better understanding of the evolutionary roots of prosocial behavior, a study spanning a broader range of taxa and social systems is needed, including species exhibiting cooperative breeding and species whose care system requires a certain degree of social tolerance, such as communal breeders. Here, we present the first results of a project, which aims to study prosocial behavior of different species, including both primates and non-primates breeding cooperatively, communally or where single females raise their offspring by themselves by testing them in a prosocial choice test (PCT). This will allow us to investigate whether a species' care system predicts variation in prosocial behavior and further, whether prosocial behavior is more common among group-living species, which would support the idea that mutualistic prosocial behavior is crucial for the evolution of sociality. As data collection is still ongoing, we will present the results of the first experiments focusing on two species of mice: the house mouse (*Mus musculus*), a communal breeder, and the steppe mouse (*Mus spicilegus*), which is known to cohabitate and cooperate in gathering food during the colder season.

Poster 52

Can vervet monkeys learn from a robot?

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Social learning – learning from others – is an important feature of primate social cognition. Vervet monkeys socially learn from their conspecifics, but can they learn from an artificial agent as a robot? To answer this question, we ran a novel food choice experiment in the field in South Africa implying a remotely controlled sheep sized quadruped ANYmal robot. The robot was equipped with a food vacuum system and a speaker that could produce

robotic food calls. After a short period of habituation to the robot, we brought it to one group of monkeys, and we used two other groups as control groups. One control group was presented with the novel food with robotic food calls emitted via a speaker while the other control group was not. We tested whether monkeys observing the robot swallowing one of two novel foods (orange-colored raisins versus purple-colored raisins) started eating the same food as the robot faster than monkeys from the control groups. The experiments have been video recorded, video analysis is currently ongoing and will be done by May. We hypothesized that, if monkeys socially learn from the ANYmal robot, they should eat the same food as the robot first and faster than the control groups that had no demonstrator or only the robotic food call. If only a robotic food call is sufficient to induce eating the novel food, we should not expect any difference between the robot group and the control group with only robotic food call. This study offers exciting perspectives on the phenomena of social acceptance of machines in mammal societies and on the use of such new technologies to collect data in the field.

Poster 53

Idiosyncrasy in gestural communication: a case study of hand clapping in a Barbary macaque (*Macaca sylvanus*)

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While it is well established that apes are able to invent or individually learn new gestures, cases of development and use of novel gestures in monkeys are more rarely described. We report a case of a novel idiosyncratic gesture in a Barbary macaque (*Macaca sylvanus*) at La 'Forêt des Singes', Rocamadour, France, observed during a study at the site which took place between March and June 2022 and 2023. One adult male, Jomanix, was observed hand clapping. To the best of our knowledge, hand clapping has never been described before. To hand-clap, the male briefly shifted his weight onto his legs, lifted his upper body, and clapped both hands together. The gesture is well-audible >10m. We recorded 25 instances of hand clapping. Twenty-one of these hand-claps occurred in combination with other agonistic signals, such as threat stares and open mouth threats. Receivers either responded with counter-aggression (N=6), or a submissive response (N=15). In four of the 25 events, the context was unclear. These observations suggest that the gesture constitutes an agonistic signal. According to the staff at 'La Forêt des Singes', the hand-clapping may have been copied from staff members who used to hand-clap to shoo the animals away from areas where they were not supposed to be, but that notion remains speculative. In the meantime, another subject from the same group reportedly started to hand-clap. The observations show that Jomanix is able to flexibly combine a novel gesture with other, established communicative signals. The use of the hand-clap is clearly goal-directed and fulfils the criteria for first-order intentional communication. In summary, the case reveals greater flexibility in the gestural communication of this species than previously assumed, but also underscores that social learning of the production of communicative gestures occurs rarely in this taxon.

Poster 54

Quantifying research on cognitive tasks in chimpanzees living in captive environment

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Human cognition is known to be heavily dependent on previous experience. Indeed, a large body of psychological research on humans tracks how exposure to certain tasks or experiences influence performance in other areas. Whilst this phenomenon is well studied in field of human psychology, the impact of specific types of previous experience on the cognition of our closest living relatives, chimpanzees, is understudied. This is surprising, considering how chimpanzees are the primary models in comparative cognition studies. Yet, just as in the human case, it is likely that previous experience affects chimpanzee cognition and behaviour. In particular, experience in research tasks (especially long-term) probably impacts how captive chimpanzees respond to novel problems presented in cognitive research paradigms. If true, this finding would have important repercussions for the reliability of studies that generalize findings from captive chimpanzees to a species-wide level, as they may be underestimating the effect of research experience on the chimpanzees' performance in such task assessments. The ARI project aims to evaluate this potential bias via a systematic literature review on all experimental studies from different facilities (including zoos, sanctuaries, and research labs) where chimpanzees are housed in captive facilities worldwide. The data collected for the literature review will be analyzed to determine patterns in cognitive performance with regards to previous experience in research, and other potentially confounding factors, like neophobia, habituation levels etc. Once the analysis is complete, the database will be made open access, allowing other researchers to identify the most appropriate sample for their research questions, thus increasing the robustness and transparency of captive chimpanzee research.

Poster 55

Investigating Climate Impact on Indri's Song Occurrence

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The examination of how animals adjust their behaviors in response to weather variables has gained particular importance within the context of climate change. This investigation provides valuable insights into potential threats faced by endangered species and offers guidance for conservation efforts. In this scenario, the utilization of non-invasive, cost-effective, and potentially long-term monitoring systems, like Passive Acoustic Monitoring (PAM), becomes especially relevant. Our research delves into the correlation between weather variables and the vocal behavior of Indri indri, the solitary singing lemur species native to Madagascar. Through PAM in Maromizaha New Protected Area, we analyze the factors influencing the vocalization patterns of this primate species in its natural habitat.

The examination of an extensive audio dataset collected over different years revealed the distinct impact of temperature and precipitation on *Indri indri* vocal activity. Notably, we observed a negative influence of rainfall on vocalizations, while warmer temperatures correlated with an increased emission of songs. Additionally, the timing of vocal emissions was affected by various environmental factors, showing the same pattern. Furthermore, our research underscores the effectiveness of PAM as a valuable tool for swiftly studying animal vocal communication, providing insights into long-term behavioral patterns that would be challenging to obtain through alternative methods. This investigation contributes significant information about how indris utilize vocalizations in their environment and adapt to changes in their surroundings.

Poster 56

Laterality in naked mole-rats (*Heterocephalus glaber*)

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Lateralization, or the preferential use of one side of the body over the other, is widespread in various animal species. This phenomenon can impact learning and decision-making processes critical for survival. Naked mole-rats (*Heterocephalus glaber*) are cooperatively breeding subterranean rodents with remarkable spatial orientation, living in underground tunnel-and-chamber systems spanning several kilometres. Here, our aims were to investigate i) whether naked mole-rats display laterality and ii) if laterality is affected by their age, sex, or group membership. We tested 69 captive individuals from 5 families in 24 trials, using a T-maze apparatus that was systematically rotated (0°, 90°, 180°, 270°) to mitigate potential environmental effects. Trials started with the initial turn at the starting chamber and ended when individuals chose and entered one of the two side chambers of the T-maze. We calculated Z-scores, Laterality and Absolute Laterality Index, and constructed linear regression models. We expected a left laterality bias and a stronger laterality bias in older individuals, but no sex or group effects. While most individuals displayed a right-turn preference in their initial turn, we found that most individuals were ambilateral when choosing between the two side chambers. Furthermore, there were no age, sex or group effects on direction or strength of laterality in the initial turn, nor on the direction of laterality in choosing a chamber. However, there were significant effects of age and family group on the strength of laterality in the latter. Further investigation is warranted to understand the underlying mechanisms and ecological implications of laterality and turning bias in naked mole-rats.

Poster 57

Does social familiarity influence an individual's dispersal destination?

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Dispersal between social groups is a fundamental aspect of many animal societies, impacting gene transmission, knowledge, culture but also individual fitness. Despite this, our understanding of dispersal remains highly limited, and little is known about what information individuals use when dispersing between groups. Joining a new group can be costly (e.g. aggression from unfamiliar individuals) and pre-existing social relationships might reduce integration risks (e.g., reduced aggression, coalitions with kin members) as well as the stress associated with joining an unfamiliar social structure. Mountain gorillas (*Gorilla beringei beringei*) have large-scale societies, in which individuals' social relationships extend beyond their immediate social group. They exhibit a highly flexible dispersal pattern, with approximately 50% of females and males dispersing from their natal groups, and females can disperse multiple times across their lives. In this study, we will examine how social familiarity at the individual and group levels influences mountain gorilla dispersal. We predict that inter-group relationships significantly shape dispersal decisions, leading individuals to preferentially disperse into groups they are more familiar with. To test this, we will use two decades of long-term data from the Dian Fossey Gorilla Fund (2003-2023), including demographic, behavioral, intergroup encounter and ranging data. Intergroup familiarity will be quantified using home-range overlap, intergroup encounters, and the presence of known individuals that previously lived in the same group as the dispersing individual. This data analysis is ongoing. By investigating the influence of mountain gorillas' large-scale society on dispersal, this study will broaden our understanding of the information used to make these key social decisions. This will not only contribute to a better understanding of population dynamics in this endangered ape but also provide insights into the foundations of our own highly flexible society, characterized by individuals moving between various social groups throughout their lifetimes.

Poster 58

Development and plasticity of multimodal communication during joint activities of German children

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The study of human communication has traditionally been centred around language use, with developmental research considering gesture focusing on the way it impacts language acquisition. These methodologies limit comparability with non-human great ape intentional gesture use, as ape research largely relies on ethological methods describing the form and function of gestures. However, Kersken and colleagues (2019) found that the

far majority of preverbal human infants' gesture forms also appear in non-human great apes, hypothesizing that these gestures disappear as children enter the verbal stage and switch to co-speech gestures. We aim to use ethological methods typical to great ape gestural studies to investigate gesture repertoire and flexibility in German children of two age groups, one in the paraverbal stage (1.5-2 years old) and one in the verbal stage (2-3 years old), focusing on communication during joint action. We specifically distinguish between gestures shared with non-human great apes and human-unique gestures, to investigate the usage of both categories of gesture and their interaction with speech. We will focus particularly on individual differences in repertoire size and usage, comparing this with individual differences in language development. We expect a decrease in shared ape gestures over time, and a lower usage among children who use more speech, with an associated increase in human-specific gestures. These human-specific gestures are also expected to be accompanied by speech more often, and seen more in children with more developed speech. Additionally, we expect that among the younger age group there will be more overlap in gestural repertoire, while the older age group uses more individualised iconic gestures. This study will provide a new perspective on the development of multimodal communication in human infants, and will allow for future comparisons with similar studies carried out in non-human great ape species.

Poster 59

Revealing the invisible: Assessing activity budgets through acceleration data in a wild social primate

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Optimizing time allocation across various activities is crucial for the survival and reproduction of animals. Activity budget studies play a pivotal role in comprehending the behavioural ecology of a species and the adaptive processes underlying these behaviours. Traditionally, primate studies have predominantly utilized direct observation. Nonetheless, this approach encounters difficulties when attempting to simultaneously observe multiple individuals over prolonged periods and across vast expanses. The recent and rapid progress of bio-logging technologies has opened new avenues for scientists to further investigate the field of behavioural ecology. Building on these advances, our study aimed to develop a machine learning-based framework to identify main behaviour classes using collar-mounted tri-axial acceleration data in 36 wild vervet monkeys in South Africa. The application of this method allowed for the comprehensive assessment of both daytime and night-time activity budgets throughout the course of a year. This approach successfully identified four distinct behaviour categories (resting, sleeping, eating, and walking) achieving an average precision of 87.6% and an average recall of 61.7%. When applied to the acceleration data, the model's behavioural predictions aligned well with a prior study for daytime activity budgets in the same vervet population. While night-time activity budgets revealed discrepancies, particularly with the misclassification of sleeping bouts as grooming behaviour, this approach provided unique insights into vervet behavioural activity throughout the night. Our findings contribute to a deeper

understanding of temporal allocation in animal behaviour by allowing continuous remote monitoring of behaviours. This study highlights the potential of acceleration-based classification models in behavioural ecology and conservation . In contrast to traditional direct observation, these models enable the simultaneous collection of high-resolution behavioural data from multiple individuals, allowing for computation of activity budgets at finer temporal scales, ranging from daily to hourly intervals.