

Gesellschaft für Primatologie (GfP) Conference 2024

13-16 March 2024; Konstanz; Germany



Centre for the Advanced Study
of Collective Behaviour



Universität
Konstanz



MAX PLANCK INSTITUTE
OF ANIMAL BEHAVIOR



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1 Program

1.1 Wednesday, March 13

Time	Location	Event	Speaker	Title
14:00-20:30	Uni Konstanz	Arrival, Registration, Poster Set up		
16:00-16:40	M629	Welcome notes		
16:50-18:30		Keynote Session	Dina Dechmann & Gabriel Ramos-Fernandez	Collective Foraging
18:30-20:30		Poster Session with Finger Food & Drinks		

1.2 Thursday, March 14

Time	Location	Event	Speaker	Title
9:00-9:15	M629	Housekeeping Notes		
9:15-9:30	M629	Session I	Brigitte Weiß	Chemical signatures of social information in Barbary macaques (<i>Macaca sylvanus</i>)
9:30-9:45		Smells & Sounds	Marlen Kuecklich	Primate metabolomics: understanding chemical diversity of different scent sources in primates
9:45-10:00		Chair: Tracy Montgomery	Gabriella Gall	Exploring the pūkeko vocal repertoire: a roadmap for robust classification of acoustic signals
10:00-10:15			Angele Lombrey	Individual differences and plasticity in the communicative behaviour of captive and semi-wild chimpanzees
10:15-10:30			Vlad Demartsev	Vocal grooming in meerkats: weakly bonded subordinates call more in response to dominants
10:30-10:45			Monika Mircheva	Common marmoset (<i>Callithrix jacchus</i>) volubility across different contexts
10:45-11:15	M630	Coffee break		
11:15-11:30	M629	Session II	Julia Kunz	Reproductive consequences of sexual coercion in chacma baboons
11:30-11:45		Reproduction, Parental Investment & Independence	Barbara Fruth	Infanticide in bonobos (<i>Pan paniscus</i>): the gentle ape reconsidered
11:45-12:00		Chair: Caroline Schuppli	Iva Pavlovic	Sibling rivalry in seasonally breeding monotonous Assamese macaques
12:00-12:15			Revathe Thillaikumar	Not all mothers are the same: Individual variation and plasticity in Sumatran orangutan maternal investment
12:15-12:30			Emma Lokuciejewski	The development of ranging competence in wild immature Sumatran Orangutans (<i>Pongo abelii</i>)
12:30—13:30		Lunch Break		
13:30-13:45	M629	Session III	Sonja Ebel	Developmental trajectories of chimpanzee tool use across the lifespan
13:45-14:00		Tool use, social learning, & animal culture	Tatiane Valença	Stick tool use by capuchin monkeys from Ubajara National Park, Brazil
14:00-14:15		Chair: Brendan Barrett	Thibaud Gruber	Habitual ground nesting in the Bugoma Forest chimpanzees (<i>Pan troglodytes schweinfurthii</i>), Uganda
14:15-14:30			Claudio Tennie	A new, intuitive framework for social learning based on types of transmitted information
14:30-15:00	M630	Coffee break		
15:00-15:15	M629	Session IV	Rahel Brügger	Social tolerance of common marmosets living in experimentally manipulated interdependence lineages
15:15-15:30		Social tolerance, social partners, and sleep	Stefanie Keupp	Chimpanzees evaluate conspecifics' competence
15:30-15:45		Chair: Vlad Demartsev	Emily Campos Sindermann	Turn-taking in captive female geladas
15:45-16:00			Josefine Iffelsberger	Higher nighttime temperatures reduce sleep duration and efficiency in wild capuchin monkeys
16:05-17:20	M629	GfP General Assembly	GfP Members	
18:15-22:00	Konzil	Keynote session, reception and exhibition (together with MPI-AB)	Maria van Noordwijk & Carel van Schaik	Orang-Utans and the Evolution of Intelligence

1.3 Friday, March 15

Time	Location	Event	Speaker	Title
9:00 - 9:15	M629	Housekeeping Notes	The Committee	
9:15 - 9:30	M629	Session V	Malika Gottstein	Ecological contributions of brown-headed spider monkeys (<i>Ateles fusciceps fusciceps</i>) to seed dispersal in the Ecuadorian Chocó
9:30 - 9:45		Foraging, Seed Dispersal, and Conservation	Livia Schäffler	Local extinction of Mme. Berthe's mouse lemur (<i>Microcebus berthae</i>) and changes in the composition of a cheirogaleid species assemblage in dry forests of Western Madagascar
9:45 - 10:00		Chair: Gisela Kopp	Patrick Lauer	Long-term food choices and nutritional goals of a leaf-eating primate
10:00 - 10:15			William O'Hearn	Can increased foraging capability make a baboon more popular? A manipulative field experiment in the tolerant multi-level society of Guinea baboons
10:15 - 10:30			Grace Davis	When to go? Conflicts of interest and consensus costs over the timing of group movements in cohesive groups of white-faced capuchins
10:30 - 10:45			Mina Ogino	Collective intelligence facilitates emergent resource partitioning through frequency dependent learning
10:45-11:15	M630	Coffee Break		
11:15 - 11:30	M629	Session VI	Paola Cerrito	Cortical ontogeny and behavioral maturation in a cooperatively breeding, prosocial primate
11:30 - 11:45		Cognition, Development, and Personality	Heike Lahusen	Just keep moving? Long-term temporal stability and dynamics of locomotor activity and exploratory tendencies in captive grey mouse lemurs (<i>Microcebus murinus</i>)
11:45 - 12:00		Chair: Revathe Thillaikumar	Yvonne Pohlner	The Differences Matter: ex and in situ Western lowland gorillas' personality structure. A comparison across the genus <i>Gorilla</i>
12:00 - 12:15			Judit Stolla	The effect of reward value on the performance of long-tailed macaques (<i>Macaca fascicularis</i>) in a delay of gratification exchange task
12:15 - 12:30			Michèle Schubiger	A novel information-seeking tubes task to test the passport effect
12:30-13:30		Lunch Break		
13:30 - 14:30	Affenberg Salem	Commute to Affenberg Salem from Uni		
14:30 - 17:00		Visit Affenberg Salem (with coffee and cake)		
17:00-18:00		Depart Affenberg, Ferry to Insel Mainau		
18:00 - 22:00	Mainau, Comturey	Banquet Dinner		

1.4 Saturday, March 15

Time	Location	Event	Speaker	Title
9:00 - 9:05	Uni Konstanz	Housekeeping Notes	The Committee	
9:05 - 9:20	R611	Session VII	Damien Farine	The fitness benefits of living in a multilevel society
9:20 - 9:35		Social organisation and group dynamics	Emily Grout	Uncovering the drivers of fission-fusion dynamics in white-nosed coatis
9:35 - 9:50		Chair: Ariana Strandburg-Peshkin	Odd Jacobson	Shared Spaces: Exploring the Influence of Numerical Superiority between Neighboring Groups on Capuchin Home Ranges
9:50 - 10:05			Kathrine Stewart	Balancing risk and reward: factors influencing bonobo (<i>Pan paniscus</i>) intergroup encounter dynamics
10:05 - 10:20			Julián León	Dear-enemy and nasty-neighbour effects are habitat-dependent in Diana monkeys, <i>Cercopithecus diana</i>
10:20 - 10:50	M630	Coffee Break		
10:50 - 12:30	R611	Keynote Session	Sarah Brosnan & Alex Jordan	Pathways to Increasing Complexity in Behaviour
12:30-13:00	R611	Farewell	The Committee	

2 Important Information

2.1 Location, Venues, and Map

2.1.1 University of Konstanz

The presentation component of the conference is hosted at the University of Konstanz, Konstanz, Germany.

The destination address is: [Universitätsstraße 10, 78464 Konstanz, GERMANY](#).

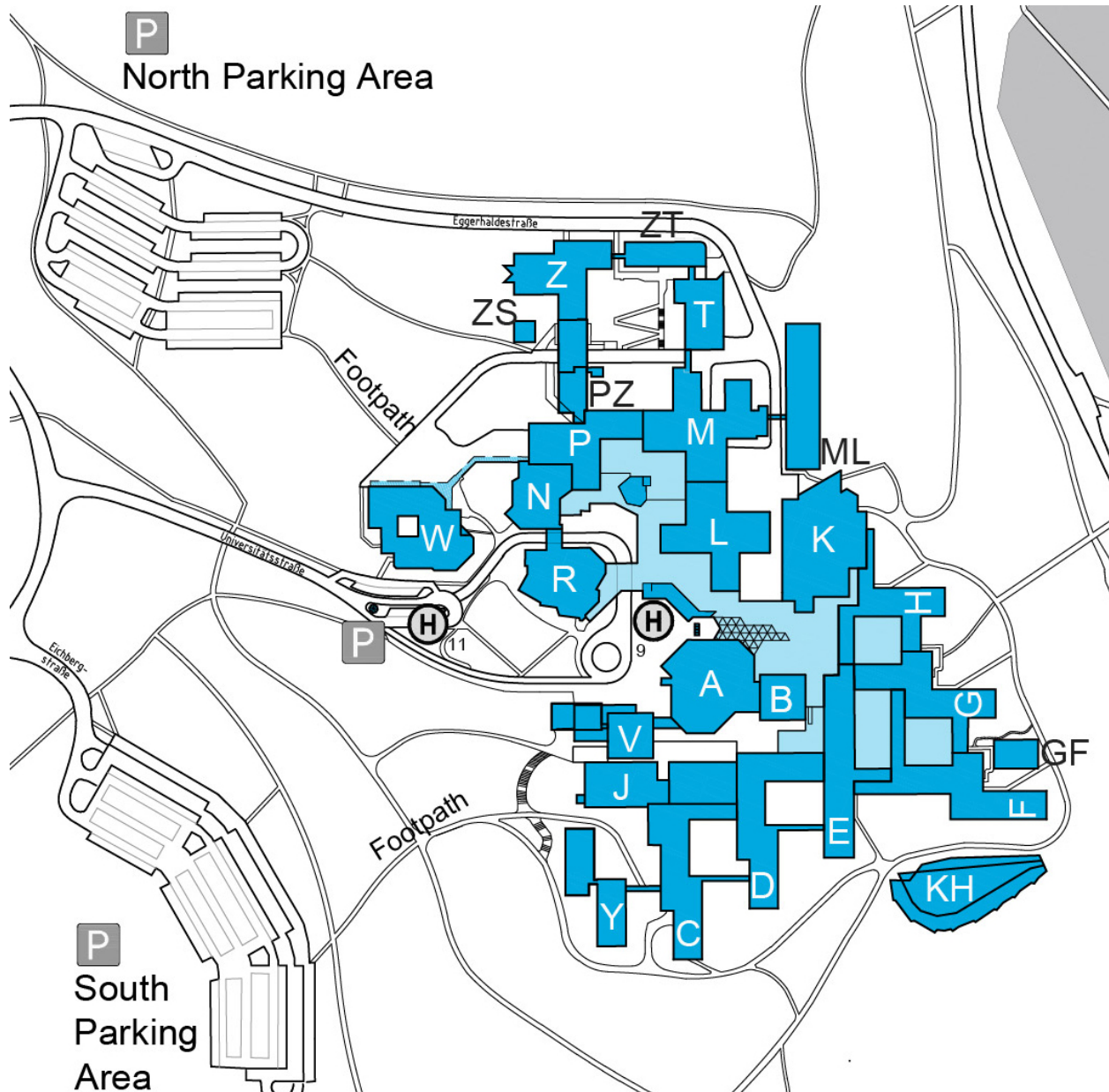


Figure 1: A map of the University of Konstanz. The temporary bus stop is near the North Parking area. The conference sessions are held in Building M (Wednesday-Friday) and building R (Saturday). Lunch is available for purchase at the [Mensa in building K](#)

2.1.2 Konzil

The Konzil building in (built in 1388) served as a warehouse for traveling and local traders. It was also a key shipment point for trade goods at the Konstanz port for almost 500 years. During the Council of Konstanz, from 1414 to 1418, the conclave to elect Pope Martin V took place here in 1417– the only place a Catholic pope was elected outside of Italy due to multiple leaders claiming ownership to the papacy. It is considered the largest surviving medieval secular building in southern Germany and has been used as a restaurant, ballroom and conference center since 1912.

2.1.3 Affenberg Salem

Affenberg Salem consists of a 20-hectare forest area that hosts nearly 200 Barbary macaques (*Macaca sylvana*), which move freely in the area in a climate similar to their homelands on mountainous slopes in Morocco and Algeria. Originally developed as a tourist attraction in 1976, current director Roland Hilgartner directs proceeds of the park to raise awareness funds to support conservation efforts in protecting wild populations of Barbary macaques– an IUCN-listed endangered species. It is also hosts and supports behavioral research on the social behavior of macaques, and is involved in the protection and conservation of native white storks.

If you are attending the excursion to Affenberg Salem, but will not be joining the Banquet at Mainau please reach out to the organizing committee.

2.1.4 Insel Mainau

The final banquet will be held at the Comturey on [Insel Mainau](#), a 45 hectare island that hosts a popular, private, 150 year old Arboretum in one of Germany’s most temperate climates.

After the reception, attendees may return to downtown Konstanz via public bus departing from the entrance of Mainau (21:11 and 22:11). If you wish to bike home from Mainau, it is possible to park bikes before our trip to Affenberg Salem. A bus will stop at the Mainau entrance shortly after 13:30 to pick up cyclists. **Please reach out to the organizing committee if you want to take this option.** For attendees who wish to travel directly to Mainau for the banquet dinner, you can **park your bike or car at the parking lot “Schwedenschenke.”** Please say that you will be attending the event with the Universität Konstanz at the entrance. Do not park bikes at the Comturey.

2.2 Getting Around Konstanz

Normally, Konstanz has a good public bus system, bus lines 9A and 9B run from the city center to the University every 15min. As there is much construction at the University and Konstanz, there are many temporary bus stops and connections– particularly to get to the Hauptbahnhof. Google Maps and the “Mein Konstanz” app are up to date with current transit. Tickets can be purchased online, at machines at the bus stations or directly in the bus. If you have a Deutschland Ticket, it will cover all public transit in Konstanz. There are also [public bike](#) and multiple eScooter options available, which can be booked via the respective apps.

Due to construction work, the current bus stops for lines 9 A/B, 9C and 11 in front of the main entrance of the university are currently unavailable. Please use the **temporary bus stop at car park “Nord”** (at the top, by Eggerhaldestr.) instead.

2.2.1 Bus Tickets

Guests staying at official venues will receive transit passes for the city. Deutschland Tickets will cover all regional transport in Konstanz. Single and Daily Tickets can be purchased at machines or [through this app](#). A daily group ticket, that covers up to 5 adults can be purchased for 10 Euros.

2.3 Official Accommodations

Aqua Hotel: [map location](#)

B & B Hotel: [map location](#)

IBIS Hotel: [map location](#)

2.4 Wi-Fi

University of Konstanz has **eduroam** and you should be able to access it from the venue. There is also the offere WLAN-SSID **UniKN-Open**. To use this network, you must accept the conditions.

3 Invited Speakers

3.1 Public Plenary: Orang-Utans and the Evolution of Intelligence

3.1.1 Maria van Noordwijk



Maria van Noordwijk studied biology in Utrecht (PhD 1985). Throughout the 80's she studied mainly long-tailed macaques in a Sumatran rain forest with a focus on individual career trajectories of both females and males: patterns in reproduction, dispersal and dominance throughout their lives. After a period with more focus on early childhood education in Durham NC (USA), she was the research coordinator of the Tuanan Orangutan Research Project in Kalimantan for 15 years, based at the University of Zürich. Her studies on orangutans include developmental trajectories as well as the cost of motherhood, and reproductive strategies of both sexes. Currently she is a fellow of the Max Planck Society based at the Institute of Animal Behavior, Konstanz.

3.1.2 Carel van Schaik



Carel van Schaik studied biology in Utrecht (PhD 1985). He was a professor at Duke University (USA) from 1989 until 2004, when he moved to the University of Zurich to lead the Anthropological Institute and Museum. Initially, he was interested in how the environment and the life histories of primate species shape their societies. He subsequently studied orangutans, setting up two new field sites, and studied their socioecology and culture. This gradually turned him into an evolutionary anthropologist, whose main aim is to understand what made us (one bipedal great ape among many) human. In addition to writing scientific papers and books, Kai Michel and he also try to convey the new insights of evolutionary anthropology to a broader audience through trade books. Currently he is a fellow of the Max Planck Society based at the Institute of Animal Behavior, Konstanz.

3.2 Conversations: Collective Foraging

This session will be moderated by Teague O'Mara. Teague is the Director of Conservation Evidence at Bat Conservation International, USA. He is faculty at the Department of Biological Sciences, Southeastern Louisiana University, USA and an affiliate of the Department of Migration, Max Planck Institute of Animal Behavior, Germany and the Smithsonian Tropical Research Institute, Panamá.

3.2.1 Dina Dechmann



Dina Dechmann studied biology in Zurich (PhD 2005). She joined the University of Konstanz and Max Planck Institute of Animal Behavior (MPI-AB, at the time Ornithology) in 2009, where she leads the ephemeral resource adaptations group. She is interested in the behavioral, morphological and physiological adaptations of animals to food landscapes that are variable or unpredictable in time and or space. A strong focus from the very beginning has been how social information use can help animals find food more efficiently and predictably, and how this benefit may be linked to the formation and persistence of groups. She predominantly studies these questions in bats and shrews with several long-term studies in Panama, Germany and Africa. Currently she is a research group leader at the MPI-AB.

3.2.2 Gabriel Ramos-Fernandez



Gabriel Ramos-Fernandez studied biology and psychology at the University of Pennsylvania (PhD 2001). His main interests lie in the behavioral and cognitive mechanisms underlying social complexity, as well as its ecological consequences. Has focused most of his research on fission-fusion dynamics in spider monkeys, using agent-based models, social network analysis and information theory to understand the way in which properties of the social structure emerge from social interactions. Lately he's become very interested in collective intelligence, exploring the way in which fission-fusion dynamics allows a group to forage in a distributed fashion. Co-managed a field study on spider monkeys in the Yucatan peninsula, Mexico, for 24 years. Currently he is a researcher at the Institute on Applied Mathematics and Systems at the National Autonomous University of Mexico.

3.3 Conversations: Pathways to Increasing Complexity in Behavior

This session will be moderated by Julia Fischer. Julia is the director of the Cognitive Ethology Laboratory at the German Primate Center and the University of Göttingen, Germany.

3.3.1 Sarah Brosnan



Sarah Brosnan studied biology at Emory University (PhD 2004). She studies decision-making in humans and other primates, particularly decisions relating to cooperation and inequality, and how those decision processes evolved. She is particularly interested in the mechanisms that individuals use to make these decisions, and how social and environmental contexts influence them. Although her research initially focused primarily on capuchin monkeys and chimpanzees, two highly cooperative primates, she has become interested in broader taxonomic comparisons, including a variety of primates as well as canids and reptiles. Currently she is a Distinguished University Professor of Psychology, Philosophy and Neuroscience and Co-Director of the Language Research Center at Georgia State University.

3.3.2 Alex Jordan



Alex Jordan is interested in how behaviour has evolved, what the adaptive value of behaviour is, and what the mechanisms that underlie behaviour are. He seeks to understand how the physical structure of behavior changes over evolutionary time, how conserved patterns of behaviour can take on new function, how social interactions are modified by current context, how animals perceive and cognitively process social cues, and how environments – both social and physical – change and are changed by behaviour. Prior to joining the MPIAB, Alex was the Integrative Biology Fellow, working in collaboration with Mike Ryan, Dan Bolnick, and Hans Hofmann at UT Austin, and before that a JSPS fellow in Osaka working with Masanori Kohda. He completed his PhD with Rob Brooks at the University of NSW, and did his undergraduate honours thesis with Madeleine Beekman and Ben Oldroyd at the University of Sydney.

4 Talk Abstracts

4.1 Wednesday, March 13th

4.1.1 Keynote I: Collective Foraging

Social information use in foraging bats

Dina Dechmann¹

1. Ephemeral Resource Adaptations Group, Department of Migration, Max Planck Institute of Animal Behavior, Germany

Using bats as a model, I will show that the evolution of social systems is likely strongly influenced by the link between the value of social information use and resource ephemerality.

Collective use of foraging information in spider monkeys' fission-fusion dynamics

Gabriel Ramos Fernandez¹

1. National Autonomous University of Mexico, Mexico

Fission-fusion dynamics can be thought of as a collective strategy to forage in heterogeneous environments in a distributed fashion. In this talk I will explore whether and how spider monkeys increase collective foraging success by sharing information about known fruiting trees, using a combination of field observations and agent-based models.

4.2 Thursday, March 14th

4.2.1 Session I: Smells & Sounds

Chemical signatures of social information in Barbary macaques (*Macaca sylvanus*)

Brigitte M. Weiß^{1,2,3}, Marlen Kücklich^{1,2,3}, Claudia Birkemeyer^{3,4}, Anja Widdig^{1,2,3}

1. Behavioural Ecology Research Group, Institute of Biology, Leipzig University, Talstraße 33, 04103 Leipzig, Germany

2. Department of Primate Behavior and Evolution, Max-Planck-Institute for Evolutionary Anthropology, Deutscher Platz 6, 04103 Leipzig, Germany

3. German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Puschstraße 4, 04103 Leipzig, Germany

4. Research Group of Mass Spectrometry, Institute of Analytical Chemistry, Leipzig University, Linnéstraße 3, 04103, Leipzig, Germany

Managing social relationships poses considerable cognitive challenges, requiring animals to obtain and update social knowledge about conspecifics. The sense of smell is among the evolutionarily oldest of the animal senses and may provide access to social information that is (temporarily) absent in other sensory domains, or enhance the precision and reliability of other sensory cues. As such, olfactory cues could contribute significantly to managing social relationships, but the cognition of social attributes and relationships in catarrhine primates has been studied primarily in the visual and auditory domain. To assess the role of olfaction for social cognition in a catarrhine primate, we related the chemical composition of body odour to social attributes at the individual or dyadic level. We non-invasively collected over 500 body odour samples from 74 Barbary macaques living in three groups in a naturalistic social setting at Affenberg Salem, Germany. Samples were collected using thermal desorption tubes, which capture mainly volatile compounds, and were analysed with gas chromatography–mass spectrometry to obtain chemical profiles that were statistically related to social information. Pairwise similarities between chemical profiles were significantly affected by individual identity and genetic relatedness, whereby kin odour similarities were modulated by sex. Similarities of chemical profiles were also weakly related to age, but did not differ systematically between high and low-ranking individuals of either sex. Overall, results suggest chemical signatures of important social attributes in Barbary macaque body odour. We

discuss the possible roles of these signatures for the social lives of this strongly visually-oriented primate.

Primate metabolomics: understanding chemical diversity of different scent sources in primates

M. Kücklich^{1,2,3}, C. Birkemeyer^{3,4}, A. Widdig^{1,2,3}, B. M. Weiß^{1,2,3}

1. Behavioural Ecology Research Group, Institute of Biology, Leipzig University, Talstraße 33, 04103 Leipzig, Germany
2. Department of Primate Behavior and Evolution, Max-Planck-Institute for Evolutionary Anthropology, Deutscher Platz 6, 04103 Leipzig, Germany
3. German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Puschstraße 4, 04103 Leipzig, Germany
4. Research Group of Mass Spectrometry, Institute of Analytical Chemistry, Leipzig University, Linnéstraße 3, 04103, Leipzig, Germany

While chemical communication in plants has been studied widely, challenges remain to understand chemical cues in animal metabolomics. A wide variety of chemical cues arises from various scent sources. In mammals, for example, secretions from specialized scent glands, excretions such as urine and faeces, or body odours may convey redundant or complementary chemical information about individuals. However, systematic studies investigating differences between scent sources, and establishing the best suitable method per scent source to detect relevant chemical cues are missing. Accordingly, this study examined chemical cues in three scent sources (urine, faeces, body odours) and compared three sampling methods (thermal desorption tubes, polydimethylsiloxane sticks, headspace analysis) that were applied for all available scent sources. Samples were collected from 8 female and 6 male Barbary macaques (*Macaca sylvanus*), a catarrhine species lacking specialized scent glands, at Affenberg Salem (Germany) and analysed with gas chromatography-mass spectrometry. We found that chemical composition differed across scent sources as well as across sampling methods. As a proof of concept, we investigated whether chemical composition differed between sexes. Indeed, different sex-specific substances were found depending on scent sources and method used. Together, our results revealed different chemical cues produced in different scent sources which could be used for olfactory communication in Barbary macaques. Importantly, our study underlines that the choice of both, methods and scent sources, influences which part of the chemical spectrum can be studied. It thus provides an important contribution for selecting appropriate methods for future studies in primate metabolomics and communication.

Exploring the pūkeko vocal repertoire: a roadmap for robust classification of acoustic signals

Gabriella Gall¹, 2, Vlad Demartsev¹, 2, Kristal Cain, Jim Quinn

1. Centre for the Advanced Study of Collective Behaviour, University of Konstanz
2. Max Planck Institute of Animal Behavior, Department for the Ecology of Animal Societies

Many animals emit a multitude of vocalizations to communicate with others and coordinate activities. Taken together these vocalizations constitute a species vocal repertoire. Owing to its ubiquity and ecological importance, quantifying and comparing animal vocalizations is a major part of animal behaviour and communication research. However, to date there is no consensus on how to define and quantify the vocal repertoire of species. More specifically, it remains difficult to distinguish between discrete and graded call types, especially given differences in individual vocal production as well as an overall lack of knowledge on how slight differences in vocalisations are perceived. Here we classify vocal signals produced by pūkeko (*Porphyrio melanotus*) a species of Swamphen common in New Zealand. In the study population, these birds live groups of on average 7 birds, within small breeding territories (0.7-3ha). Data was recorded for 24h continuously using passive acoustic recorders placed within pūkeko nests for 24h, thus recording all vocalizations emitted by group members. In each recording we manually annotated sound segments based on separation by short silent periods or sudden spectral shifts. To verify the distinctness of classified segments and call types we used Uniform Manifold Approximation and Projection (UMAP). By putting calls into context of ‘neighbourhoods’ this method allows to assess how different sounds relate to each other, e.g. whether they are graded or distinct. We next assessed the combinatorial abilities of pūkeko by analysing how different sound segments (notes) were combined to produce stable note sequences.

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

Angèle Lombrey¹, Adriana Luna², Nick Dannenmann¹, Marlen Fröhlich¹

- 1 Palaeoanthropology, Institute for Archaeological Sciences, Department of Geosciences, Eberhard Karls University of Tübingen, Germany
- 2 Development and Evolution of Cognition Research Group, Max Planck Institute of Animal Behavior, Konstanz, Germany

Human communication exhibits immense behavioural plasticity, given the flexibility with which language use is adjusted to the social context and interaction partner. To date, the lack of comparative studies focusing on the individual level prevents an

accurate assessment of communicative plasticity in non-human primates, our closest living relatives. Behavioural variability can be partitioned into environmental, between-individual (individual differences in the average expression of behaviours), and within-individual sources (e.g. responsiveness of individuals to environmental changes), which all may have important consequences for the evolution of communicative behaviour. Such a “behavioural reaction norm” framework has already been applied in a variety of non-primate studies, but little is known about individual differences in primates’ communicative behaviour. This study aimed at investigating the extent of individual variation and plasticity in communicative behaviour in chimpanzees (*Pan troglodytes*) using a multimodal approach (i.e. focusing on gestures, vocalizations and facial expressions). We examined both repertoire and use of communicative signals (e.g. multimodality and persistence) in 49 zoo-housed and 37 semi-wild adult subjects, focusing on the effects of social context and individual identity simultaneously. Results showed no group differences in repertoire size but limited signal overlap, namely little repertoire similarity, among individual chimpanzees, both within and between social groups. Moreover, signal use consistently differed between individuals irrespective of age-sex class and varied within individuals depending on context (e.g. feeding versus resting). Together, our findings revealed extensive between- and within-individual variation in chimpanzee communicative behaviour, warranting further exploration of how behavioural plasticity may have impacted language evolution.

Vocal grooming in meerkats: weakly bonded subordinates call more in response to dominants

Vlad Demartsev^{1, 2}, Gabriella Gall^{1, 2}, Ariana Strandburg-Peshkin^{1, 2}, Marta B Manser

1. Max Planck Institute of Animal Behavior, Department for the Ecology of Animal Societies

2. Centre for the Advanced Study of Collective Behaviour, University of Konstanz

Grooming is often used for maintaining social bonds in animal groups. However, with increasing group size, the time required for grooming can quickly become a limiting factor. As a solution, physical grooming can be complimented by vocal grooming: a vocal exchange with specific partners. Vocal grooming does not require physical proximity and can be a “cheaper” option for maintaining bonds with many individuals. While first shown in primates, recent evidence suggests that vocal grooming extends beyond the primate order. We explored the usage of vocal grooming in meerkats (*Suricata suricatta*), cooperatively breeding mongooses that live in highly cohesive groups and demonstrate an unequal distribution of physical grooming, with subordinates disproportionately grooming the dominant female. As a candidate for vocal grooming signals, we focused on “sunning calls”, short, tonal vocalizations emitted by meerkats after emergence from the burrow. Sunning calls are socially facilitated and produced in a call-and-response turn taking pattern. To test whether the response intensity in sunning call exchanges depends on the bond strength between individuals, we played back sunning calls to individuals and recorded their responses. To estimate bond strength, we constructed proximity-based social networks. Subordinate meerkats exposed to calls of dominant individuals increased their call rate, specifically when having a weak bond with the dominant caller. The despotic structure of meerkat groups makes the relationship with dominant individuals especially important. We suggest that subordinate meerkats use vocal grooming to improve weak bonds with dominant individuals, thus reducing dominance assertions and avoiding costly eviction from the group.

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

Monika Mircheva¹, Judith Burkart

1. University of Zurich

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.

4.2.2 Session II: Reproduction, Parental Investment & Independence

Reproductive consequences of sexual coercion in chacma baboons

Julia A. Kunz¹, Dada Gotelli², Axelle Delaunay¹, Alecia Carter³, Guy Cowlshaw², Elise Huchard¹

1. Institute of Evolutionary Sciences Montpellier (ISEM), CNRS, IRD, UMR5554, University of Montpellier, France

2. Institute of Zoology, Zoological Society of London, London, UK

3. Department of Anthropology, University College London, London, UK

Sexual coercion is a widespread phenomenon in animals. While its occurrence and various expressions are increasingly well documented, its reproductive consequences for both males and females remain little investigated in primates, as long-term data are paramount. Chacma baboons (*Papio ursinus*) are one of few examples where male aggression decoupled from the female receptive period has been reported to increase their mate guarding success in the future. Here, we set out to test if males that use intimidation have higher siring success, using long-term behavioural and genetic data from two troops over 15 years at the Tsaobis Baboon Project, Namibia. Behavioural data of individually recognized baboons on aggression, grooming, mate guarding, and mating were collected during annual field seasons lasting on average 5.5 months (2 - 9 months) between 2005 and 2023. Paternities for 91 infants born between 2005 and 2019 were assigned using 16 polymorphic, autosomal microsatellite loci obtained from tissue samples. For 45 of these conception events behavioural data on cycling females (N = 31) could be matched. Using generalized linear mixed models, we find that higher levels of aggression towards specific cycling females during their non-fertile periods increase the male's chances to sire the female's next offspring, while controlling for male rank, female parity, the number of candidate fathers and mate guarding during the conceptive cycle. Further studies will evaluate the impact of sexual coercion on female reproductive success. Evaluating reproductive consequences of sexual coercion is crucial to understanding its evolution and its implications for intersexual conflict dynamics.

Infanticide in bonobos (*Pan paniscus*): the gentle ape reconsidered

Barbara Fruth^{1,2}, Gottfried Hohmann^{1,2} and the LuiKotale Bonobo Project Team

1. Max Planck Institute of Animal Behavior, Konstanz & Radolfzell, Germany

2. Centre for Research and Conservation/KMDA, Antwerp, Belgium

Infanticide, the intentional killing of an infant by a member of its own species, is a phenomenon observed in various animal taxa, including non-human and human primate societies. It is often considered as an adaptive behaviour triggered by a complex interplay of ecological, social and behavioural factors, with males more often than females perpetrating and benefiting from the act. Infanticide is well-documented in chimpanzees (*Pan troglodytes*) but we lack published evidence from closely-related bonobos (*Pan paniscus*). In contrast to highly territorial chimpanzee societies, characterized by high rates of severe to even lethal aggression, bonobo societies are typically characterized by tolerance facilitated by food-sharing and conflict-mediation via affiliative behaviours (e.g., sex and grooming). Given these intriguing differences in social structures despite the two species' common ancestry, information on infanticide in bonobos is highly valuable to the discussion about its drivers. Here, we present four cases of direct and indirect infanticide observed between 2015 and 2020 in the context of inter-community encounters at LuiKotale, Democratic Republic of the Congo. We relate these incidents to general infant mortality and compare them to what is known from both Pan species. In addition, we examine the socio-ecological conditions that facilitated these specific incidents, and review the role of so-called alternative male strategies (e.g., social bond formation, agonistic support, parental care) in minimizing infanticide in this Pan species. Finally, we discuss the adaptive benefits that male and female bonobos may derive from infanticide.

Sibling rivalry in seasonally breeding monotocous Assamese macaques

Iva Pavlovic^{1,2}, Suchinda Malaivijitnond^{3,4}, Oliver Schülke², Julia Ostner^{1,2}

1. Department of Behavioral Ecology, Georg-August University Göttingen, Germany

2. Social Evolution in Primates Group, Deutsches Primatenzentrum, Leibniz Institute for Primate Research

3. Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand

4. National Primate Research Center of Thailand, Chulalongkorn University, Saraburi, Thailand

The birth of a younger sibling is a pivotal stage in the ontogeny of many monotocous species with immediate and often life-long effects. To investigate the transition to siblinghood (TTS) we used behavioural data collected during 4 birth seasons between

2013 - 2016 from four groups of wild Assamese macaques in Phu Khieo Wildlife Sanctuary, Thailand). We aggregated data by day and matched observations from the three months after birth of a younger sibling with those from three months before and created a control data set for mother-offspring dyads where no birth occurred (total 64 mother-offspring dyads). We predicted that after TTS maternal investment would decrease, sibling rivalry would ensue and that older offspring born 2years prior would not change their behaviour after TTS as much as those born 1year prior. Our study revealed that maternal affiliative behaviour decreased after the birth of a younger sibling, suggesting that mothers indeed reduced their investment in the older offspring in favour of her newly born. Since neither offspring affiliation towards the mother nor responsibility in maintaining spatial proximity to her changed after TTS (and aggression was too rare to be analysed), reduced maternal investment was, however, not met with behavioural adaptations in older siblings. Ongoing analyses investigate the fitness effects of short inter-birth intervals for current and previous offspring.

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

T Revathe¹, Sri Suci Utami-Atmoko, Maria A. van Noordwijk¹, Marlen Fröhlich, Caroline Schuppli¹

1. Max Planck Institute of Animal Behavior

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 on between-individual but not within-individual behavioral variation. We quantified between- and within-individual variation in maternal behaviors in Sumatran orangutans (*Pongo abelii*), while controlling for offspring age. We used repeated observations of mothers and partitioned the observed behavioral variance into its within-individual, between-individual, and fixed effect (here, offspring age) components using generalized linear mixed models. We used 1360 focals of 15 mother-offspring pairs collected from 2007-2002 in the Suaq Balimbing research area in South Aceh, Indonesia. Our results showed that Sumatran orangutan mothers differed in their maternal investment (i.e., between-individual variation in investment) in five behaviors, namely contact initiation, proximity initiation and termination, feeding in proximity, and carrying, after controlling for offspring age. Additionally, mothers showed plasticity (i.e., within-individual variation in investment) and differed in their plasticity (i.e., between-individual variation in plasticity) in these behaviors over offspring age. 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 studies¹ on maternal behavioral variation, to ultimately address its causes and consequences for mothers and their offspring.

The development of ranging competence in wild immature Sumatran Orangutans (*Pongo abelii*)

Emma Lokuciejewski¹, Dr Caroline Schuppli¹, Tatang Mitra Setia²

1. Max Planck Institute of Animal Behaviour

2 Universitas Nasional Jakarta

Orangutans are the only apes with a semi-solitary lifestyle. They also have a remarkably long dependency phase. Immature orangutans therefore undergo a pivotal transition from 8 years of maternal reliance, to independent survival. Little is known about what drives immature individuals to spatially transition from shadowing their mother, to roaming independently, as well as when and how knowledge-led independent movement develops. To investigate the decision making and learning opportunities driving independent movement, spatio-temporal and corresponding behavioural data was taken during (n=249) full-day follows of 24 immature individuals in the Suaq Balimbing Research Site, in the Gunung Leuser National Park, Sumatra, home to the highest population density of Sumatran orangutans. Immatures' daily travel paths were longer than adults', and the presence of conspecifics had a significant positive effect on path length [GLMM: pClass = 0.002, pAssociation = 0.015]. The number of key foraging hotspots visited, and time spent in them was lower than adults [GLMM: p < .001]. Temporally across the juvenile phase, movement significantly decreased in tortuosity [Ramble Ratio GLMM: pAge=0.032], and more so when alone than when with conspecifics [Sinuosity GLMM: pAssociation =0.019], signifying movement transitioning from exploratory to straighter, knowledge-led paths. Our results suggest that immatures gradually gain ranging competence throughout the juvenile phase, and social effects may play a major role during this learning process. Ultimately, this study provides a deeper insight into orangutan cognition, and the factors driving unusual life history traits.

4.2.3 Session III: Tool use, social learning, & animal culture

Developmental trajectories of chimpanzee tool use across the lifespan

Ebel, S. J.^{1,2}, Kopp, K. S., Kirilina, E., Lipp, I., Cohen, H., Crockford, C., Haun, D. B. M., Wittig, R. M.
1. University of Leipzig
2. Max Planck Institute for Evolutionary Anthropology

While humans demonstrate a slow life history characterized by prolonged developmental trajectories that involve a long learning phase for crafting and utilizing tools, chimpanzees display comparable behaviors, participating in a diverse range of tool use. However, the development of tool-use skills in chimpanzees throughout their lifespan, particularly the acquisition of knowledge concerning the functional attributes of tools and the potential decline in old age, has not been thoroughly explored. To investigate these developmental trajectories, we conducted a study involving 77 chimpanzees housed in zoos and sanctuaries, ranging in age from 1 to 53 years. The experimental design recreated typical scenarios where chimpanzees employ sticks as tools to access food sources. We provided tubes for extracting juice through dipping, along with standardized sets of sticks featuring variations in properties related to their tool functionality, such as length, thickness, solidity, and fraying. Our study focused on developmental trajectories concerning tool selection, functionality, efficiency, precision and speed in tool use. The results are discussed with respect to their significance in advancing comparative research and shedding light on the fundamental understanding of the origins of human tool use.

Stick tool use by capuchin monkeys from Ubajara National Park, Brazil

Tatiane Valença^{1,2,3}, Gabriela Affonso², Tiago Falótico^{1,2,4}, P author^{1,2}, Others¹
1. University of São Paulo, São Paulo, Brazil
2. Neotropical Primates Research Group, São Paulo, Brazil

3. Max Planck Institute of Animal Behavior, Department for the Ecology of Animal Societies, Constance, Germany
4. Max Planck Institute for Evolutionary Anthropology, Technological Primate Research Group, Leipzig, Germany

Stick tool manufacture and use is rare among platyrrhini monkeys. The only monkey population known to customarily use sticks are the bearded capuchin monkeys (*Sapajus libidinosus*) living at Serra da Capivara National Park (SCaNP), Brazil. Here we describe the stick tool use repertoire of a second population of *S. libidinosus* at Ubajara National Park (UNP), Brazil. We followed a group of 31 individuals from October 2021 to July 2023, totaling 1,778.6 h of contact time. We recorded 62 episodes of stick tool use. The sticks were used on the ground (65%) to extract spiders and oothecae; in rock crevices (8%) to obtain lizards; and in trunks (27%) to obtain carpenter bees, insects, and water. They used sticks with a lower frequency (0.07 ep/100h/individual) than in SCaNP (0.68 ep/100h/individual). Most events (92%) occurred during the dry season, which contrasts with SCaNP where sticks are used throughout the year. Stick tools were thinner than the tools used in SCaNP. Similarly to SCaNP, the events were restricted to males and the overall success was low (37%), especially when used in trunks (24%). The similarities found in these populations and in other anecdotal reports suggest that the general pattern of stick tool use in capuchin monkeys is to obtain invertebrates in trunks. Our results suggest possible cultural differences: sticks to obtain honey and wax and to aid the capture of small mammals in SCaNP; and sticks to obtain spiders from the ground in UNP.

Habitual ground nesting in the Bugoma Forest chimpanzees (*Pan troglodytes schweinfurthii*), Uganda

Thibaud Gruber^{1,2}, Harmonie Klein^{2,3}, Catherine Hobaiter^{2,3}

1. Faculty of Psychology and Educational Sciences, and Swiss Center for Affective Sciences, University of Geneva, Switzerland
2. Bugoma Primate Conservation Project, Uganda
3. School of Psychology and Neurosciences, University of St Andrews, UK

We report the presence of habitual ground nesting in a newly studied East African chimpanzee (*Pan troglodytes schweinfurthii*) population in the Bugoma Central Forest Reserve, Uganda. Across a 2-year period, we encountered 891 night nests, 189 of which were classified as ground nests, a rate of about 21%. We find no preliminary evidence of socio-ecological factors that would promote its use and highlight local factors such as high incidence of forest disturbance due to poaching and logging, which appear to make its use disadvantageous. While further study is required to establish whether this behavior meets the strict criteria for nonhuman animal culture, we support the argument that the wider use of population and group-specific behavioral repertoires in flagship species, such as chimpanzees, offers a tool to promote the urgent conservation action needed to protect threatened ecosystems, including the Bugoma forest.

A new, intuitive framework for social learning based on types of transmitted information

Claudio Tennie

University of Tübingen, Germany.

There is an often lamented (over-)growth of unintuitive and often not mutually exclusive terminology in social learning research, due to the historical absence of an overarching sorting principle. Several ways to subsequently “bring order” to this field were arguably either too dichotomic (e.g. low-fidelity vs. high-fidelity) or else they failed to intuitively “carve culture at its joints”. Even for experts of animal social learning, overlaps in terms as well as low learnability do not infrequently lead to misunderstandings in print and at meetings. To ameliorate the situation, we have recently developed a new framework. The main objective was to design an intuitive framework that fosters learnability, that eases communication, and which nevertheless retains high “findability” (e.g. in online searches). To do this, we harvested already existing every-day concepts to sort social learning mechanisms anew simply by the type of information that they transmit. These types of information are already delineated via the so-called W-questions (where; what; why; who; when – and how). For example, stimulus enhancement is a type of social learning that transmits a “know-what”; imitation is a type that transmits “know-how” etc. I will present this new framework, with examples. Early feedback (from colleagues, students, and the media), shows that this new framework does achieve all its intended goals.

4.2.4 Session IV: Social tolerance, social partners, and sleep

Social tolerance of common marmosets living in experimentally manipulated interdependence lineages

Rahel K. Brügger¹, Monika Mircheva¹, Adele Tuozzi¹, Alyssa Müller¹, Elena Georgieva Stoilova¹, Judith M. Burkart^{1,2}

¹. Institute of Evolutionary Anthropology, University of Zurich, Switzerland

². Center for the Interdisciplinary Study of Language Evolution (ISLE), University of Zurich, Switzerland

Social tolerance distinguishes humans from other animals enabling many of our most impressive traits, most prominently high levels of cooperation and resource sharing. Even though research on social tolerance in non-human animals in recent years has focused on species and group level differences, less is known about the drivers of those differences. One possible driver of higher social tolerance levels are higher levels of interdependence. We therefore experimentally manipulated the interdependence levels of cooperatively breeding common marmosets ($N_{individuals} = 57$, $N_{groups} = 14$) by exposing them to daily feeding challenges. Groups in the high interdependence treatment were exposed to feeding platforms where food could only be acquired collaboratively whereas for groups in the low interdependence treatment the feeding boards were only accessible to one single individual who crucially could acquire food without any involvement of others. While exposed to this treatment (ongoing), we assessed social tolerance levels of all groups in eight-week intervals. Groups were exposed to a standardized co-feeding paradigm three times per week. The task consisted of a feeding board being placed inside the home enclosure where animals could feed from highly preferred liquid gum only accessible when situated on the board. We analyse social tolerance as amount of co-feeding per group over time and preliminary results show that groups in the higher interdependence treatment are more socially tolerant. These results suggest that interdependence indeed can lead to increased social tolerance, which has implications to understand intraspecific variation in marmosets but also human evolution.

Chimpanzees evaluate conspecifics' competence

Stefanie Keupp¹ & Esther Herrmann

¹. German Primate Center (DPZ), Göttingen, German

Previous research found that chimpanzees developed a preference for a cooperation partner when they successfully solved a task with this partner, preferentially approached an experimenter who had behaved generous in social interactions over an experimenter who behaved nasty, and learned from successful individuals. In the current study, we tested if chimpanzees' social evaluations of conspecifics relied on outcome-focused evaluations based on previous interactions, or if chimpanzees formed impressions that allow them to make wider inferences about partner quality. Chimpanzees sampled information of how two conspecific partners solved a puzzle box task. One partner always solved the task whereas the other partner rarely solved it. Depending on condition, subjects subsequently had to choose the partner with whom they want to cooperate ($n = 11$) or who should be their opponent ($n = 10$). In the cooperation condition, the chimpanzees chose the competent partner above chance

from trial 1, indicating that they made domain-specific inferences about the partners' competence. In contrast, the chimpanzees only learned to choose the incompetent partners with increasing trial number in the competition condition, indicating they didn't transfer their knowledge from information sampling to test phase. This difference between conditions may be related to the competitive condition affording increased cognitive demands compared to the cooperation condition.

Turn-taking in captive female geladas

Emily Campos Sindermann

1. University of Amsterdam (alumni)

The question of how the human language faculty evolved seems to remain a mystery. A better understanding of how this complex, uniquely human trait came about, requires a close look into the similarities as well as differences between the various sub components of human and animal communication systems. One universal component, which seems to lie at the core of our capacity to engage in interactive language usage, is the ability to take turns. In order to contribute to the yet scarce turn-taking evidence across species, the present study examined the interactions of captive female geladas (*Theropithecus gelada*). Focusing on the context of grooming, I first looked into frequency, length and type of gelada interactions and later focused on the presence of the four turn-taking elements proposed by Pika and colleagues [1]. The results of the present study showed that female geladas used all exchange types, mostly engaging in mixed signal-action exchanges. These behavioral exchanges exhibited, at least to some extent, all four turn-taking elements. They seemed to be flexible in regard to their length and combinatorial structure, showed participation framework establishment via gaze and body orientation and exhibited all timing categories, whereby response latencies were generally slower compared to other species. Moreover the present study is the first to address the gestural repertoire of geladas. Hence, it does not only contribute to comparative turn-taking research, but also expands our knowledge about non-vocal communication in geladas.

Higher nighttime temperatures reduce sleep duration and efficiency in wild capuchin monkeys

Josefine Iffelsberger^{1, 2}, Shauhin E. Alavi¹, Damien Caillaud, Ben T. Hirsch, Roland Kays, Margaret C. Crofoot^{1, 2}

1. Max Planck Institute of Animal Behavior, Department for the Ecology of Animal Societies

2. University of Konstanz

Sleep is essential for every animal's health. How long and how well an animal sleeps can be influenced by many intrinsic and extrinsic factors including temperature, physical exercise, and location. However, sleep is most often studied in controlled laboratory settings, and thus the effects of ecological and social pressures on wild animals' sleep remain underexplored. We aimed to determine factors that influence sleep in wild white-faced capuchin monkeys (*Cebus capucinus*) on Barro Colorado Island, Panama. We measured sleep using accelerometry data from collar sensors and applied an algorithm that has been validated in other primate species. We used multilevel Bayesian regression models to analyze the effects of ecological and social variables on the duration and efficiency of capuchins' sleep (N=7; from 7 groups). Higher night temperatures reduced capuchins' sleep efficiency and shortened sleep duration, with an average decrease of 8.69 minutes in total sleep time for every one-degree rise in temperature. Capuchins spent less time sleeping on nights after they traveled farther the previous day, but sleep site location within the home range did not appear to affect the duration or quality of capuchins' sleep. Furthermore, we found weak evidence of capuchins compensating for poor night sleep through daytime napping. Overall, our study explores factors that shape sleep patterns in capuchins and highlights the influence of temperature on sleep. These results suggest that rising global temperatures caused by climate change may interfere with animals' physiological need to sleep. The resulting sleep deprivation could have consequences for their health and fitness.

4.2.5 Keynote II: Orangutans and the evolution of intelligence

Orangutans and the evolution of intelligence

Maria A. van Noordwijk¹, Carel P. van Schaik^{1,2}

1. Comparative Socioecology Group, Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany

2. Department of Evolutionary Biology and Environmental Studies, University of Zurich, Switzerland

Humans stand out among animals by having extraordinarily large brains and showing great intelligence. How and why did this evolve? We present results of long-term field studies on orangutans, large-brained relatives, with a focus on their developmental trajectory of skill acquisition and the quality and quantity of social inputs. We complemented these findings with large-scale comparative studies. Together, they support the conclusion that large brains, while slowing down development and reproduction, facilitate behavioral flexibility, largely due the developmental construction of intelligence, resulting in improved survival at all ages.

4.3 Friday, March 15

4.3.1 Session V: Foraging, Seed Dispersal, & Conservation

Ecological contributions of brown-headed spider monkeys (*Ateles fusciceps fusciceps*) to seed dispersal in the Ecuadorian Chocó

Malika Gottstein¹, Citlalli Morelos-Juárez², Eckhard W. Heymann³ & Katrin Heer¹

1. Faculty of Environment and Natural Resources, Eva Mayr-Stihl Professorship for Forest Genetics, Albert-Ludwigs-Universität Freiburg, Freiburg im Breisgau, Germany

2. Fundación Reserva Tesoro Escondido, Quito, Ecuador

3. Verhaltensökologie & Soziobiologie, Deutsches Primatenzentrum – Leibniz-Institut für Primatenforschung, Göttingen, Germany

In tropical rainforests, large vertebrates are particularly important as seed dispersers, as tropical tree species often produce large seeds to facilitate seedling survival under very difficult light conditions. Spider monkeys are the main seed dispersers for many plant species throughout their distribution area. The brown-headed spider monkey (*Ateles fusciceps*) is one of three primate species of the Chocó bioregion. The Chocó rainforest in Ecuador is heavily impacted by anthropogenic activities and the population size of spider monkeys was reduced to a few hundred individuals. In this study, we aimed to assess the diversity of dispersed seeds, the impact of gut passage on germination rates, and dispersal distances. We followed groups of brown-headed spider monkeys within the Tesoro Escondido conservation area in Esmeraldas, Ecuador, from March to August 2023. We recorded feeding events on 82 plant species from 33 families. 73% of the feeding events involved ripe fruits from which spider monkeys swallowed the seeds. Seeds collected from feces showed a higher germination rate (64%) than seeds collected from ripe fruits (29%). Spider monkeys deposited seeds at distances of 3 to 665m from the mother tree (mean=221m, median=230m). Our results underline the important ecological contribution of spider monkeys to seed dispersal. In threatened ecosystems such as the Chocó, the extinction of these important seed dispersers would result in a dramatic reduction in regeneration potential.

Local extinction of Mme. Berthe’s mouse lemur (*Microcebus berthae*) and changes in the composition of a cheirogaleid species assemblage in dry forests of Western Madagascar

Livia Schäffler^{1,3}, Matthias Markolf², Léonard Razafimanantsoa³, Peter M. Kappeler^{3,4}

1. Conservation Ecology Section, Centre for Biodiversity Monitoring and Conservation Science, Leibniz Institute for the Analysis of Biodiversity Change, Bonn, Germany

2. Chances for Nature e. V., Göttingen, Germany

3. Behavioral Ecology and Sociobiology Unit, German Primate Center, Göttingen, Germany

4. Dept. Sociobiology/Anthropology, University of Göttingen, Germany

Lemurs – the endemic primates of the global biodiversity hotspot Madagascar – are globally the most threatened group of mammals. Madame Berthe’s mouse lemur (*Microcebus berthae*) of the family Cheirogaleidae is the smallest known species of all primates with a biogeographic range confined to the dry deciduous forests in the central Menabe region of western Madagascar. Within this small distribution area, the species only occurs in least degraded forest parts and depends on interspecific interactions with sympatric cheirogaleid species. In the latest IUCN Red List of Threatened Species update, *M. berthae* was categorized as “critically endangered” due to a continuing decline in its area of occupancy and extent of occurrence. Concerns that *M. berthae* may be close to extinction called for a new survey covering the species’ entire biogeographic range. I will report on our ongoing field work (2022-2024) and present preliminary results to show how the nocturnal lemur community has changed over almost two decades in which available forest habitat was massively reduced by slash-and-burn practices. Most recently, *Microcebus berthae* has been listed among the Top25 most endangered primates for the third time in total and the second time in a row. *Mirza coquereli* is yet another species of the central Menabe cheirogaleid community that has now been included in this list. Only strict protection of remaining forest habitat and prompt relocation of individuals from most degraded habitat patches can save *M. berthae* from extinction and *M. coquereli* from being regionally extirpated.

Long-term food choices and nutritional goals of a leaf-eating primate

Patrick Lauer^{1, 2}

1. Universität Konstanz

2. Max Planck Institute of Animal Behaviour

Efficient foraging plays a critical role for animals to maximize their fitness, yet their food choices and underlying nutritional goals vary. Understanding those choices and goals is crucial for informed statements about the importance of different food resources and ultimately, for implementing more effective conservation measures by directing habitat protection or restoration efforts towards these resources. We investigated the long-term food choices and underlying nutritional goals of red colobus monkeys (*Ptilocolobus tephrosceles*), an endangered, folivorous primate. We used long-term data collected between 2006 and 2016 on the feeding behavior and ecology (abundance, distribution, and phenology of potential plant food resources) of red colobus in Kibale National Park, Uganda, to determine the composition of their diet and their food preferences. Based on these results and nutritional information of young leaves of different frequently consumed species, we tested hypotheses about the nutritional goals of red colobus. Red colobus clearly chose young leaves over other plant parts. Considering both different species and plant parts, red colobus fed on many different food items, but a few items dominated their diet. Additionally, there were mostly stable preferences for specific items. The protein-to-fiber ratio had no association with the preference for different young leaves, but with the frequency the young leaves of different species were consumed. Our results provide a robust picture of the food choices and nutritional goals of a leaf-eating primate that can be used for more effective conservation.

Can increased foraging capability make a baboon more popular? A manipulative field experiment in the tolerant multi-level society of Guinea baboons

William O’Hearn¹, Jörg Beckmann, Lorenzo von Fersen, Carolin Niederbremer, Roger Mundry, Federica Dal Pesco, and Julia Fischer

1. German Primate Center, Göttingen, Germany

Successfully navigating a group’s social environment means making adaptive partner choices, which is facilitated by the ability to evaluate the social ties, traits, or capabilities of other group members. Much is known about non-human primates’ knowledge of third-party kin, dominance, and social relationships. However, less is understood about how individuals evaluate others’ capabilities. Our project investigates whether Guinea baboons in one captive and two wild groups recognise the foraging capability of group members, and whether knowledge of conspecifics’ capabilities affect their choice of social partners. In our study we artificially increase the foraging capability of one group member using an apparatus only the chosen individual – the specialist – can operate. We measure the specialist’s social interactions before, during, and after the period of apparatus presentations to determine if other group members alter their treatment of the specialist in response to their novel foraging capability. We find a dramatic increase in the grooming the specialist receives, but only from his associated females and only while the apparatus is available. Non-associated females and other males eat nearly as much of the reward from the apparatus as associated females, but do not alter their behaviour toward the specialist. In my talk I discuss these findings and their implications.

When to go? Conflicts of interest and consensus costs over the timing of group movements in cohesive groups of white-faced capuchins

Grace H. Davis¹ and Margaret C. Crofoot^{2,3}

1. Universität Zürich

2. Max Planck Institute of Animal Behavior

3. University of Konstanz

This study investigates an important daily decision in social animal groups: when to collectively leave one feeding patch and move on to the next. Using collective foraging data on groups of wild white-faced capuchin monkeys (*Cebus capucinus*) on Barro Colorado Island, Panama, we use the marginal value theorem to examine: (1) if optimal foraging strategies of group members differ, creating conflicts of interest about when the group should leave feeding trees, (2) how such group decisions are made and which group members exert influence, and (3) the costs that individuals pay when they compromise to achieve consensus. Using the focal tree method on group feedings in *Attalea butyracea* palms, we calculate individual feeding rates for all group members in each palm. These feeding rates generate individual foraging gain curves that predict optimal departure times. We compare foraging theory results with conventional methods of assessing who has influence over group decisions (i.e., which individual(s) successfully initiate group movements). Our results indicate that while conflicts of interest are ubiquitous over when to go, groups often make decisions that are optimized at the group-level (predicted by foraging theory). While all group members

successfully initiate group movements away from trees, dominant adult females are the most successful initiators. Dominants pay lower consensus costs to group decisions than subordinates, and individuals who pay higher consensus costs ultimately receive less food. This study illustrates how applying classic models from foraging theory to empirical data provides insight into how groups resolve conflicts of interest and reach consensus.

Collective intelligence facilitates emergent resource partitioning through frequency dependent learning

Mina Ogino¹
1. Universität Zürich

Deciding where to forage must not only account for variation in habitat quality, but also where others might forage. Recent studies have suggested that when individuals can remember recent foraging outcomes, negative frequency-dependent learning can allow them to avoid resources exploited by others (i.e. indirect competition). This process can drive the emergence of consistent differences in resource use (resource partitioning) at the population level. However, indirect cues of competition are noisy and difficult for individuals to sense. Here, we propose that information pooling and collective decision-making—i.e. collective intelligence—can allow populations of group-living animals to more effectively partition resources relative to populations of solitary animals. We test this hypothesis by simulating (i) individuals preferring to forage where they were recently successful, and (ii) cohesive groups that choose one resource using a majority rule. While short-term memory (three previous foraging outcomes) can allow solitary animals to avoid indirect competition through negative frequency-dependent learning, emergent specialisation and resource partitioning is more prominent in populations of group-living animals. Larger groups also become more specialised than smaller groups or individuals, especially in environments with more choices. These results have implications for the evolution of specialisation, optimal group sizes, and territoriality.

4.3.2 Session VI: Cognition, Development, and Personality

Cortical ontogeny and behavioral maturation in a cooperatively breeding, prosocial primate

Paola Cerrito^{1,2}, Judith M. Burkart^{1,3}

1. Department of Evolutionary Anthropology, University of Zurich, Zürich, Switzerland
2. Collegium Helveticum, ETH Zürich, Schmelzbergstrasse 25, Zürich, 8092, Switzerland
3. Center for the Interdisciplinary Study of Language Evolution (ISLE), University of Zurich, Zürich, Switzerland

Brain development in primates 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 must adapt to a richer social environment. Here, we examine the region-specific gray matter ontogenetic trajectories of the cooperatively breeding common marmoset (*Callithrix jacchus*) and relate them to behavioral milestones. We target brain regions that are significantly more involved than others when observing social interactions and find that: (i) these regions share similar developmental trajectories and (ii) attain their maximum volume right after peak provisioning by group members; (iii) in these regions 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 ontogenetic trajectory of brain areas implicated in the evaluation of social interactions coincides with fundamental social milestones that, similarly to humans, brain development continues into early adulthood. 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 of marmosets. Since humans are also cooperative breeders with prolonged brain development, our findings have significant implications for the evolution of human social cognition.

Just keep moving? Long-term temporal stability and dynamics of locomotor activity and exploratory tendencies in captive grey mouse lemurs (*Microcebus murinus*)

Heike Lahusen¹, Ute Radespiel¹

1. Institute of Zoology, University of Veterinary Medicine, Hannover

Among-individual variation and contextual intra-individual stability of behaviour over time is considered the main criterion for establishing personality in animals. We investigated behavioural stability and drivers of locomotor activity and explorative

behaviour in captive grey mouse lemurs (*Microcebus murinus*) in an experimental Large Open Field (2x2 m) over a period of five years. Behavioural analyses covered 360 experiments conducted across seven experimental series with a total of 72 (37 males, 35 females) individuals. Fourteen different behavioural variables were quantified to characterize locomotor activity and exploratory tendencies. Temporal behavioural stability was investigated over 18 time intervals ranging from 2 weeks to 50 months. As expected, repeatability decreased over time, but consistent repeatability was detected over intermediate timescales (up to 10 months) in ten behavioural variables. The influence of sex, age, season, body mass and previous experimental experience on the behavioural dynamics was tested using generalized linear mixed models while controlling for individual effects. Age was a major driver of behavioural dynamics. Older animals explored more and were more active than younger animals, while animals moved and marked less during the non-reproductive season compared to the reproductive season. Body mass only impacted scanning behaviour with lighter individuals scanning more, while sex only influenced movement speed with males moving faster. Finally, increasing experimental experience decreased activity and exploration, suggesting important long-term memory effects in mouse lemurs. The age- and condition-dependent changes in activity and exploration are discussed with regard to possible life history trade-offs in mouse lemurs and implications for mouse lemur personality.

The Differences Matter: ex and in situ Western lowland gorillas' personality structure. A comparison across the genus *Gorilla*

Y Pohlner¹, C Andrews¹, A Weiss² and HM Buchanan-Smith¹

1. Behaviour and Evolution Research Group and Scottish Primate Research Group, Psychology, Faculty of Natural Sciences, University of Stirling, Stirling, Scotland, UK

2. Lester E. Fisher Center for the Study and Conservation of Apes, Lincoln Park Zoo, Chicago, IL, USA

Socio-ecological comparisons aid our understanding of the emergence and persistence of personality dimensions in species. These personality dimensions appear to be products of selection. With the phylogenetic relatedness of gorilla subspecies, congruence in their personality structures is expected, holding significance for welfare and conservation. We used the Hominoid Personality Questionnaire to measure the personality of Western lowland gorillas in ex situ (eWLG) and in situ (iWLG) populations (203 and 198 gorillas, respectively) and tested for demographic variables (sex and age). Differences were found between eWLGs and iWLGs personality structures. The structure of eWLG personality included six factors labelled as Dominance, Openness, Conscientiousness, Agreeableness, Neuroticism, and Extraversion, while iWLGs' personality structure includes four factors labelled Neuroticism, Sociability, Dominance, and Tolerance/Self-Control. A comparative analysis with Virunga mountain gorillas highlighted structural differences, emphasising socio-ecological factors shaping personality. Exploring social and ecological disparities, e.g., in resource availability, diet, habitat use, predator risk, and social structure, implicated factors influencing personality variation within and between gorilla subspecies. These findings underscore the substantial impact of socio-ecological factors on personality traits, contributing relevance to conservation, management, and reintroduction programmes by informing strategies tailored to captive and wild populations' specific needs. For example, gorillas' well being may be enhanced by selecting matching partners to maximise adaptation and minimise conflicts within social groups. This study offers possible insights for effective stewardship of gorilla populations in both ex situ and in situ conditions, providing a robust foundation for sustainable conservation practices within a broader ecological context.

The effect of reward value on the performance of long-tailed macaques (*Macaca fascicularis*) in a delay of gratification exchange task

Judit J. Stolla^{1,2}, Julia Fischer^{1,2,3} & Stefanie Keupp^{1,2,3}

1. German Primate Center - Leibniz Institute for Primate Research, Cognitive Ethology Laboratory, Kellnerweg 4, 37077 Göttingen, Germany

2. Georg-August-Universität Göttingen, Johann-Friedrich-Blumenbach Institute, Department for Primate Cognition, Kellnerweg 4, 37077 Göttingen, Germany

3. Leibniz ScienceCampus, German Primate Center - Leibniz Institute for Primate Research, Kellnerweg 4, 37077 Göttingen, Germany

In the context of a global research initiative called ManyPrimates, scientists from around the world collaborated to collect data aimed at comparing the ability of various primate species to delay gratification. We contributed data from long-tailed macaques (*Macaca fascicularis*) and found that they rarely exchanged the provided food item for more food later. However, we had the impression that the protocol might not adequately reflect the abilities of the study subjects. More specifically, we suspected that possession of a high value food item interfered with engagement in any participation in a food exchange task or delay of gratification paradigm. To disentangle this potential mental block from poor delay of gratification skills, we tested six long-tailed macaques in two conditions, in which we assessed the effect of the value of an exchange item and the relative value difference on the frequency of exchanges. Subjects received either a high or low value food item, which could be exchanged for

three high value food items. The monkeys exchanged low value food items more often than high value food items across three delay periods. Furthermore, the probability for an exchange decreased with increasing delay period. Reducing the value of the exchange item resulted in long-tailed macaques showing considerably better abilities to delay gratification in an exchange task. These findings indicate that being in possession of a high value item played a substantial role in the low performance of these monkeys in the original delay of gratification exchange protocol.

A novel information-seeking tubes task to test the passport effect

M. N. Schubiger^{1,2,3,4}

1. Behavioural Ecology & Sociobiology Unit, German Primate Center, Göttingen, Germany
2. Leibniz ScienceCampus 'Primate Cognition', Göttingen, Germany
3. Department of Anthropology, University of Zurich, Zürich, Switzerland
4. World Ape Fund, London, United Kingdom

The information-seeking tubes task has provided the main evidence that non-human primates have metacognition. Yet, its current design cannot rule out non-metacognitive explanations. In the traditional tubes task, subjects are either watching, or prevented from watching, in which one of usually two opaque tubes a food reward is hidden. They can then gain the reward by choosing the tube that contains it. When subjects do not know the food's location, they are more inclined to look inside the tubes before making a choice compared to when they do, suggesting they metacognitively monitor their own states of knowledge. Interestingly, however, subjects tend to also look inside the tubes when they already know the reward's location and doing so is redundant and somewhat costly. A metacognitive explanation for this behaviour is that subjects know they should know the reward's location, but re-checking is less costly than mistakenly choosing the empty tube. This behaviour has been termed the 'passport effect' because of its similarity to a human traveller repeatedly checking the location of a packed passport because doing so is less costly than missing a flight. An alternative non-metacognitive explanation, however, is that subjects simply repeatedly look at the food inside the tubes because doing so is intrinsically rewarding. I will present a novel information-seeking task I conducted with orangutans and chimpanzees to test between the two hypotheses.

4.4 Saturday, March 16

4.4.1 Session VII: Social organization and group dynamics

The fitness benefits of living in a multilevel society

Damien Farine^{1,2}

1. University of Zurich
2. Australian National University

Multilevel societies—where social units interact with specific other social units—are among the most intriguing social systems. Initially focused on human societies, recent empirical evidence has substantially expanded the scope of species that are known to express between-group social preferences. However, the drivers of multilevel social structures remain comparatively unknown, with the most prominent hypotheses relating multilevel societies to surviving harsh conditions. Here, I report on a combination of field experiments and long-term population-level tracking in birds that is providing evidence in support of the harsh conditions hypothesis. In superb fairywrens, a common Australian bird, playback experiments demonstrate that birds are more likely to provide higher-cost cooperative help to individuals from the same high-level social unit than to other birds in the same population—mirroring helping behaviour in human multilevel societies. However, these behaviours are only expressed during periods when conditions are harsh. In vulturine guineafowl, a highly social bird that lives in the semi-arid landscapes of East Africa, long-term GPS tracking and daily population censuses of group membership reveal a significant survival benefit of forming higher-level social units during droughts, but not outside of droughts. Together, these studies demonstrate the potential for studies on birds to generate new insights into the evolution and ecology of multilevel societies, with recent findings providing clear support for the hypothesis that multilevel societies provide important survival benefits to individuals faced with harsh environmental conditions.

Uncovering the drivers of fission-fusion dynamics in white-nosed coatis

Emily M. Grout^{1, 2, 3, 6}, **Josué Ortega**^{1,5}, **Pranav Minasandra**^{1, 2, 3}, **Matthew J. Quin**⁴, **Margaret C.**

Crofoot^{1,2,5,6}, **Ariana Strandburg-Peshkin**^{1, 2, 6}, and **Ben T. Hirsch**⁴

1. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany

2. Department of Biology, University of Konstanz, Germany
3. International Max Planck Research School for Organismal Biology, Konstanz, Germany
4. James Cook University, Queensland, Australia
5. Smithsonian Tropical Research Institute, Panama
6. Centre for the Advanced Study of Collective Behaviour, University of Konstanz

There are costs and benefits to group living; benefits include increased ability to find resources and detect predators, whereas costs include increased competition between group members for those resources. Some mammalian social groups exhibit fission-fusion dynamics, where groups regularly break up (fission) into subgroups, and later regroup (fusion). These dynamics are thought to be an important strategy to balance the costs and benefits of sociality. However, for many species, it remains unclear how social and physiological factors affect these processes. To investigate this, we recorded the vocalisations and GPS-positions of nearly all members of three groups of wild white-nosed coatis (*Nasua narica*), that differed in their demographic profiles. Quantifying group movements and subgrouping patterns, we found that two of the three groups we tracked exhibited fission-fusion behaviours, with groups splitting into subgroups that persisted over varying timespans from minutes to days. In contrast, the third group remained together across the entire observation period. In the groups which exhibited fission-fusion behaviours, we found that subgroup membership was associated with genetic relatedness, which suggests that subgrouping serves to mitigate the risks of receiving aggression. Despite this, we found that the subgroup which left the main group was not consistent over time, suggesting that the dynamics of splits are flexible and context dependent. Combining multi-sensor technology has allowed us to uncover the factors which drive fissions-fusion dynamics, ultimately shedding light on the decision-making processes in these highly social, frugivorous carnivores.

Shared Spaces: Exploring the Influence of Numerical Superiority between Neighboring Groups on Capuchin Home Ranges

Odd T. Jacobson^{1,2,3}, **Brendan J. Barrett**^{1,2,4,*}, **Susan Perry**^{5,*}, **Margaret C. Crofoot**^{1,2,4}

1. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany

2. Department of Biology, University of Konstanz, Konstanz, Germany

3. International Max Planck Research School for Quantitative Behavior, Ecology and Evolution, Radolfzell, Germany

4. Center for the Advanced Study of Collective Behavior, University of Konstanz, Konstanz, Germany

5. Department of Anthropology, University of California Los Angeles, Los Angeles, USA

An animal’s home range size is determined by a variety of factors, including energetic needs, social interactions, and the distribution of resources. In group-living species, both individual and group-level characteristics affect space-use patterns, but how they interact remains poorly understood. Demography likely plays an underappreciated role as group size and composition not only affect within-group competition for resources but also the power balance between neighboring groups. According to the ecological constraints model, home range size should increase with group size as more food is required to sustain every individual. Yet, whether home ranges “expand” or “contract” may also depend on the relative competitive strengths of groups compared to neighbors. Using 30 years of movement data from 12 white-faced capuchin (*Cebus capucinus imitator*) groups at the Lomas Barbudal Monkey Project, we explore the influence of numerical superiority within group-level dyads on home range expansion and overlap. We found that capuchin home ranges increase with group size across and within groups, but the extent of expansion into neighboring ranges depends on the interaction between focal group size and that of its neighbors. Our findings illustrate the intricate relationship between group size and space-use patterns, highlighting the importance of group-level metabolic demands as well as a group’s capacity to extend spatial boundaries and displace its neighbors.

Balancing risk and reward: factors influencing bonobo (*Pan paniscus*) intergroup encounter dynamics

Kathrine Stewart^{1,2,3}, **Shahin Alavi**¹, **Meg Crofoot**^{1,2} and **Barbara Fruth**^{1,4,5}

1. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany

2. Department of Biology, University of Konstanz, Konstanz, Germany

3. International Max Planck Research School for Quantitative Behavior, Ecology and Evolution, Radolfzell, Germany

4. Department of Migration, Max Planck Institute of Animal Behavior, Radolfzell, Germany

5. Centre for Research and Conservation/KMDA, Antwerp, Belgium

Encounters between groups of conspecifics can significantly shape and be shaped by intra- and inter-group social relationships, with consequences for how social groups and systems form, persist and change over time. Thus, studies of intergroup encounter dynamics, including what motivates groups to interact in the first place, can shed light on how social systems emerge and evolve. With their high fission-fusion social system and flexible intergroup encounter behaviour, bonobos (*Pan paniscus*) are an excellent study species for investigating how varying socioecological conditions influence decision-making during intergroup encounters and contribute to variation in encounter dynamics. Using data collected between 2017 and 2020 ($n \approx 44$ distinct

encounters with known visual contact), we investigated how potential social benefits and risks influenced the decision to interact between two groups of wild bonobos at the LuiKotale field site, Democratic Republic of the Congo, Africa. Specifically, we used a Bayesian generalized linear model to investigate whether the potential for extra-group mating opportunities, female transfer opportunities and infanticide avoidance influenced the probability that the two groups initiated an interaction once they were within audio detection distance (1 km). Here, we present the results of this analysis and discuss their implications in the broader contexts of extra-group association incentives and the evolution of intergroup tolerance – a trait thought to be foundational to the formation of complex, multi-level societies such as our own.

Dear-enemy and nasty-neighbour effects are habitat-dependent in Diana monkeys, *Cercopithecus diana*

Maxence Decellieres¹, Klaus Zuberbühler^{1,2,3}, Julián León^{1,4}

1. Taï Monkey Project, Centre Suisse de Recherches Scientifiques, Abidjan, Cote d'Ivoire

2. Institute of Biology, Department of Comparative Cognition, University of Neuchâtel, Neuchâtel, Switzerland

3. School of Psychology and Neuroscience, University of St Andrews, St Andrews, U.K.

4. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behaviour, Konstanz, Germany

Since territorial threat is costly and variable across contexts, evolution has favoured behavioural flexibility to maximize any cost/benefit ratio. This is well illustrated in how animals react to familiar or unfamiliar outgroup members. In some situations, neighbours are better tolerated than strangers, resulting in a ‘dear-enemy effect’; in other situations, the pattern is reversed, resulting in a ‘nasty-neighbour effect’. Typically, the effects are species-specific traits, although both can also occur within the same species. Here, we investigated a wild population of Diana monkeys in the Taï Forest, Ivory Coast, in their reactions to outgroup individuals using playbacks of both familiar and unfamiliar male alarm calls to eagles. We found that Diana monkeys adjusted their vocal response to conspecific alarm calls depending on the familiarity with the caller in habitat-dependent ways: we have shown that groups living in primary forest –high group density, high food availability and low predation pressure– showed behaviours consistent with a ‘nasty neighbour’ strategy whereas groups living in secondary forest –low group density, low resources and high predation risk– showed behaviours in line with a ‘dear enemy’ strategy. These results suggest that group density, predation pressure and food availability can impact how hostile behaviour is displayed in nonhuman primates. Our results confirm a high behavioural flexibility in primate relationships between conspecifics of different identities depending on ecological traits of the habitat, which allows them to optimize their cost/benefit ratios and thus increases their fitness.

4.4.2 Keynote III: Pathways to Increasing Complexity in Behaviour

The many different pathways to cooperation

Sarah F Brosnan¹

1. Departments of Psychology & Philosophy, Neuroscience Institute, Language Research Center, Center for Behavioral Neuroscience, Georgia State University, USA

Although cooperative outcomes are widespread across species, it is not always apparent what mechanisms underpin this. Comparative approaches allow us to address this by using similarities and differences in individuals’ outcomes to unpack how they achieve them. I have done this using economic games to make direct comparisons across species and found that within the primates, there are differences in how pairs coordinate both across species and, potentially, within species. These differences highlight the myriad ways in which cooperation can be achieved and suggest that even in highly encephalized species, cooperation may be achievable using very simple mechanisms.

Diving into Darwin’s Dreamponds to understand the evolution of complex behaviour

Alex Jordan¹

1. Behavioural Evolution Lab, Max Planck Institute of Animal Behavior, Konstanz, Germany

Understanding how behaviour evolves presents a major challenge in biology – in particular how complex behavioural phenotypes may evolve from more simple ancestral states. Novel behaviours may arise in various ways; i) existing behavioural repertoires may be augmented by de novo development of behavioural elements; ii) changes in the sequence or frequency of existing elements that retain their original function but may produce a different outcome; or iii) behavioural exaptation may occur, in which existing behavioural elements are modified to suit a novel purpose. In this talk I will explore these different evolutionary pathways by discussing our work in the explosive adaptive radiation of Lake Tanganyikan cichlids. In this study

system we employ emerging techniques including machine learning-based animal tracking, behavioural decomposition, and 3D scene reconstruction to quantify and compare the behaviour of animals in their natural settings.

5 Poster Abstracts

Twenty years of the LuiKotale Bonobo Project: how do long-term research and traditional hunting influence mammal communities in the buffer zone of Salonga National Park, DRC

Nadia Balduccio^{1,2,3}, Mattia Bessone^{1,2}, Fabiola Iannarilli⁶, Francesco Rovero^{4,5}, Barbara Fruth^{1,2,6,7}

1. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany
2. Centre for the Advanced Study of Collective Behaviour, Department of Biology, University of Konstanz, Konstanz, Germany
3. International Max Planck Research School for Quantitative Behavior, Ecology and Evolution, Radolfzell, Germany
4. Department of Biology, University of Florence, Florence, Italy
5. Tropical Biodiversity Section, MUSE - Museo delle Scienze, Trento, Italy
6. Department of Migration, Max Planck Institute of Animal Behavior, Radolfzell, Germany
7. Centre for Research and Conservation/KMDA, Antwerp, Belgium

Overhunting in African tropical forests poses a substantial threat to wild mammal populations and jeopardises the livelihoods of local people, who rely on wild meat for subsistence. There is evidence of the protective effect of research sites for wildlife populations, particularly by reducing hunting activities, but the potential downsides have rarely been explored. Assessing how hunting and long-term protection impact animal populations should therefore be a key goal of community conservation projects and the first step towards a sustainable use of forest resources. This is particularly important in the buffer zone of protected areas, where forests may act as wildlife corridors, mediate wildlife population dynamics, and provide local communities with vital resources. Since 2002, the LuiKotale Bonobo Project operates in the buffer zone of Salonga National Park, the largest protected forest-block of the continent. The study site spans approximately 500 km², encompassing community forests that have been free from hunting for two decades, as well as those utilized for hunting until recently. Here, we combine line-transect and camera trap surveys conducted between June 2022 and August 2023, to investigate mammal diversity, occupancy and species-specific occurrences comparing the hunted vs. non-hunted areas. With detailed information on animal population size, rates of reproduction, and ethnographic data, we can develop novel management strategies that address both conservation of wildlife and the livelihoods of the people living in the buffer zone of protected areas.

Impact of hunting strategies on five primate species, in the community forest neighbouring the LuiKotale field site, DRC

Mattia Bessone^{1,2}, Josuè Ausse^{1,2,3}, Tartis Longwango^{1,2}, Pascal Naky^{1,2,4}, Bénédicte Nsilu^{1,2,3}, Jean Semeki³, Barbara Fruth^{1,2,5,6}

1. Centre for the Advanced Study of Collective Behaviour, Department of Biology, University of Konstanz, Konstanz, Germany
2. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany
3. Department of Natural Resources Management, Faculty of Agronomy, University of Kinshasa
4. Institut Congolais pour la Conservation de la Nature (ICCN), Kinshasa, Democratic Republic of the Congo
5. Department of Migration, Max Planck Institute of Animal Behavior, Radolfzell, Germany
6. Centre for Research and Conservation, Royal Zoological Society of Antwerp, Antwerp, Belgium

In Central Africa, 34% of mammals, birds, reptiles, and amphibians are currently threatened by extinction due to over-hunting. Primates are among the species most represented in the bushmeat trade, and increasingly so today that traditional and seemingly sustainable hunting equipment, like bow and arrow, are being replaced by new strategies, including guns. Here, we investigate how different hunting strategies affect the primate population of the community forest of three villages collaborating with the LuiKotale Bonobo Project (LKBP), in the buffer zone of Salonga National Park, Democratic Republic of the Congo. First, we use line transect distance sampling data collected between July and September 2023 over an area of more than 500 km² (103 km of transects) to assess the abundance and distribution of the five primate species most targeted by local hunters: *Ptilinopus tholloni*, *Colobus angolensis*, *Lophocebus aterrimus*, *Cercopithecus ascanius* and *Cercopithecus wolfi*. Second, we investigate the potential impact of hunting-strategies and compare 1) the success rate of 681 hunting trips targeting primates, collected via a hunter self-reporting system, and 419 semi-structured interviews with local hunters; and 2) the spatial distribution of 233 hunting trips recorded with GPS by collaborating hunters over a period of 6 months. By assessing the impact of hunting on the primate population, we discuss how changes in local hunting strategies and an increasing demand for wild meat from other areas of the country may affect the long-term viability of primate species in the community forest of the collaborating villages.

Emotional contagion in Barbary macaques: A study plan

Carina Bruchmann^{1,2}, Oliver Schülke^{1,2}, Julia Ostner^{1,2}

1. Dept. Behavioral Ecology, University of Göttingen, Kellnerweg 6, 37077 Göttingen, Germany
2. Social Evolution in Primates Group, German Primate Center, Leibniz Institute for Primate Research, Kellnerweg 4, 37077 Göttingen, Germany

Animal emotions have been understudied due to the difficulty of measuring subjective expressions in nonhuman individuals. Empathy is usually seen as a uniquely human trait, yet when divided into different layers of varying cognitive complexity, communalities between humans and non-human animals emerge. At the most basic level is emotional contagion, i.e., the emotional state-matching between individuals. Previous research on emotional contagion mainly focused on negative valence and laboratory settings. In my PhD project, I propose to increase ecological and social validity by studying emotional contagion by assessing the emotional response of bystanders towards naturally occurring social interactions of positive and negative valence in Barbary macaques (*Macaca sylvanus*) at Affenberg Salem, Germany. I will use infrared thermography, allowing contact-free, non-invasive measurement of emotional responses in freely moving animals. I will assess emotional responses of individuals after they themselves engaged in a social interaction of varying valence, i.e., friendly or aggressive, and, crucially, after witnessing those social interactions without directly participating. This will be the first study to assess emotional contagion during affiliative social interactions in free-ranging nonhuman primates.

***Callithrix jacchus*' migration patterns under two contrasting environments in north-eastern Brazil.**

Debora da Cruz Silva^{1,2}, Arrilton Araújo¹, Igor Eloi Moreira¹, Judith Burkart²

1. Universidade Federal do Rio Grande do Norte, Natal, Brazil
2. University of Zürich, Zürich, Switzerland

The study of cooperative breeding species has been predominantly focused on birds and some mammals, revealing key features such as delayed dispersal and reproductive contest. Decisions regarding these aspects are crucial to understanding groups social dynamic. However, there is a notable gap in understanding how these phenomena manifest in cooperatively breeding non-human primates. Callitrichids, for instance, exhibit flexible behaviors depending on both environmental pressures and interdependence levels, less is known, however, about how they balance these driving forces to maintain group stability. Therefore, we aim to broaden the knowledge on social dynamics in callitrichids, using a comprehensive demographic dataset from wild common marmosets (*Callithrix jacchus*) spanning over 30 years. The study encompasses 10 groups inhabiting two distinct environments, Caatinga and Atlantic Forest in north-eastern Brazil. We seek to investigate migration patterns in common marmosets by analyzing environmental and social factors known to affect dispersal in other species. We predict that adverse social and environmental conditions will prompt migrations to happen. Moreover, migrations under different environmental pressures will be more clustered over the years in a semi-arid site (Caatinga) than in Atlantic Forest. Concurrently, cooperative care-taking is one key feature among many aspects of common marmosets' ecology. Thus, we expect that the presence of immatures (i.e. infants under 3-month-old) will also be a factor inhibiting migrations, following the predictions for interdependence in cooperative breeding species. By providing insights into this socioecological aspect, we hope to fill the gap on marmosets' life-history and build foundation for further investigations on their sociality

Do male bonobo (*Pan paniscus*) mating strategies align with predictions of the self-domestication hypothesis? A preliminary investigation

Francesca Decina^{1,2,3}, Gottfried Hohmann¹, Barbara Fruth^{1,4}

1. Max Planck Institute of Animal Behavior, Konstanz, Germany
2. University of Konstanz, Germany
3. International Max Planck Research School for Quantitative Behavior, Ecology and Evolution, Radolfzell, Germany
4. Centre for Research and Conservation/KMDA, Antwerp, Belgium

In animal societies, reproductive and resource control is normally biased toward one sex. Male power is often associated with aggressive behavior and male-biased dimorphism in size. In contrast, female power comes from morphological, physiological and behavioral traits that hinder male competition and female monopolization, and allow females to leverage mating opportunities for benefits such as food access and social support. Female empowerment also selects for male traits that enhance female dominance, such as docile and cooperative phenotypes. Bonobos present a unique combination of male-biased sexual dimorphism in size and female social dominance, sparking debates about the nature of their social system. The self-domestication hypothesis (SDH) proposes an evolution against aggression, with female choice for docile males playing a pivotal role. Supporting this framework, previous studies indicate that male aggression is mostly directed at other males, with infrequent male-female aggression. However, these findings conflict with others: e.g., despite being more aggressive, dominant males have higher mating rates

and paternity success. Using one year of behavioral data from two wild bonobo (*Pan paniscus*) communities at the LuiKotale field site, DRC, I characterize mature male bonobo (n=16) mating strategies and investigate their influence on mating success. Male mating strategies include male prosocial behavior with proceptive females, male prosocial behavior with immature individuals as a form of mating effort, and male-male aggressive behavior. This study represents an initial investigation into predictions of the SDH, with results serving as a starting point for future research on male mating strategies and reproductive success in wild bonobos.

Basic Rights for Great Apes: The Great Ape Project

Colin Goldner¹

1. Great Ape Project, Landau a.d. Isar, Germany

The Great Ape Project, initiated 30 years ago by the philosophers Paola Cavalieri from Italy and Peter Singer from Australia, calls for the Great Apes to be granted certain basic rights on the grounds of their close genetic similarity to humans as well as their similarly complex cognitive, affective and social abilities. Basic rights, which are so far reserved for humans: The fundamental right to live, to individual liberty and to physical as well as mental/emotional intactness, which actually covers all cases of great apes being affected by humans, such as hunting, circus, zoo, animal testing and destruction of their natural habitats. Great apes are to be granted the same moral and legal – i.e. enforceable – status, which every human being enjoys. Singer et al. convincingly established that the traditional discrimination of humans and great apes is no longer sustainable in the light of scientific knowledge and therefore is to be morally discarded.

The poster gives an overview on the current situation of the International Great Ape Project – successes, obstacles and failures – as well as an outlook on its further endeavours.

Ecological and social drivers of range use in the endangered red colobus monkeys (*Piliocolobus tephrosceles*) in Kibale National Park, Uganda

Martin Golooba^{1,2}, Patrick Omeja, Colin Chapman, Urs Kalbitzer

1. Makerere University, Uganda 2. Max Planck Institute of Animal Behavior, Germany

Many free ranging primates show strategic ranging patterns adapting them within their home ranges in response to changes in food availability, competitors, reproductive partners, predators and/or polyspecific associations. Several studies have investigated the role of food availability and polyspecific interactions in ranging patterns in primates feeding on fruits, an unevenly distributed food resource. To increase our understanding of primate ranging patterns, investigations about species feeding on leaves, an evenly distributed resource, are fundamental. Therefore, we investigated the ranging behaviors of red colobus (*Piliocolobus tephrosceles*), a leaf-eating monkey in Kibale National Park, Uganda, in response to distribution of feeding trees and polyspecific associations. From Dec-2022 until May 2023, we conducted full-day follows to collect positional data on feeding trees and polyspecific interactions from a well-habituated group. We classified data into dry and wet season and for each full-day follow calculated the distances between (1) feeding trees and centroids of movement paths (2) points when the group traveled alone/in association. Results indicate that the group ate from more feeding trees and species in wet season than in dry season and *Prunus africana* was the topmost consumed. Red colobus associated often with red-tailed monkeys and traveled longer distances alone or in association in the wet season. Therefore, ranging in red colobus appears to be particularly influenced by feeding tree species. Evaluating the relationships between tree species and range use is relevant for identifying habitat patches with keystone tree species to guide restoration and strengthening habitat quality for the monkeys.

CCC-Pipe: Connecting sequencing with parentage analysis

Nicolas Goppold^{1,2}, Christian Roos^{3,4}, Julia Ostner^{1,2}, Oliver Schülke^{1,2}

1. Behavioral Ecology Department, University of Göttingen, Göttingen, Germany

2. Primate Social Evolution Group, German Primate Center, Leibniz Institute for Primate Research, Göttingen, Germany

3. Gene Bank of Primates, German Primate Center, Leibniz Institute for Primate Research, 37077 Göttingen, Germany

4. Primate Genetics Laboratory, German Primate Center, Leibniz Institute for Primate Research, 37077 Göttingen, Germany

Parentage analysis is widely used in behavioral ecology to test evolutionary hypotheses. DNA microsatellite markers are often used when dealing with degraded material typical for non-invasive sampling. Recently, microsatellite marker systems have been adopted for use in massively parallel sequencing, resulting in large datasets. CHIIMP (Barbian et al 2018 Ecol Evol) is a bioinformatic pipeline for analysing microsatellites in high-throughput sequencing datasets that was developed for a chimpanzee (*Pan troglodytes*) study. When applied to a new primer set for cercopithecine primates developed for multiplex PCRs, however, the pipeline required substantial reprogramming to accommodate PCR artefacts, such as wobble positions in primers and

incorrectly bound primers. Here we present a Python-based pipeline that automates genotype sorting and streamlines quality control during the creation of genotypes. The pipeline includes a graphical user interface (GUI) and simplifies post-PCR quality control and manual correction of artifacts that are not addressed by CHIIMP or the pipeline itself. Since the primer set was developed and tested for use across cercopithecines our new pipeline should be widely applicable.

Automated tracking of behavioural synchrony in cooperating marmosets

Vasudha Kulkarni^{1,2}, Nikhil Phaniraj¹, Judith Burkart¹

1. Institute of Evolutionary Anthropology, University of Zurich, Switzerland
2. Indian Institute of Science Education and Research (IISER) Pune, India

Interacting humans tend to align with each other at physiological, neural and behavioural levels. Behavioural synchrony is the degree to which behaviours in an interaction are patterned or synchronised in both timing and form. In humans, behavioural synchrony between individuals positively correlates with cooperation, prosociality and social cognition. Intense cooperation and proactive prosociality have convergently evolved in humans and cooperatively breeding common marmosets, which makes them a great model to study the mechanisms underlying social cognition. Marmosets regularly engage in cooperative tasks, but it's not known if they too exhibit behavioural synchrony to facilitate coordination. It is also challenging to define and objectively evaluate behavioural synchrony and posture imitation in non-human animals. Here, we conducted an experiment to study behavioural synchrony in marmoset dyads before and after they engage in a prosocial task to investigate the effect of prosociality on behavioural synchrony. We tracked the body parts of marmosets using DeepLabCut, a markerless, automated, machine-learning-based pose estimation tool. We used MATLAB's stereo-camera calibration to reconstruct 3D trajectories of the marmosets. These trajectories were then used to quantify spatial and posture synchrony of the dyads using recurrence analysis and investigate the correlation between behavioural synchrony and prosociality. Moreover, an automated tracker allowed us to explore, at a fine temporal resolution, how marmosets use mutual gaze to coordinate during the task. Studying the processes of synchronisation in marmosets will help us understand the overlap of proximate mechanisms regulating cooperation and social cognition in humans and marmosets

Biological validation of an HPLC - MS/MS assay for hair steroid quantification in marmoset monkeys

Benjamin Laubi^{1,2}, Gaëtan Glauser³, Redouan Bshary⁴, Carel van Schaik², Judith Burkart¹

1. Department of Evolutionary Anthropology, University of Zurich, Switzerland
2. Department of Evolutionary Biology and Environmental Studies, University of Zurich, Switzerland
3. Neuchâtel Platform of Analytical Chemistry, Faculty of Science, University of Neuchâtel, Switzerland
4. Department of behavioural ecology, Faculty of Science, University of Neuchâtel, Switzerland

Steroids play an essential role in behavioral biology, serving as biochemical markers that unveil insights into the physiological and behavioral states of individuals. Steroid measurement in fur has emerged as a valuable tool in evaluating long-term endocrine levels in primates and other animals. However, to date, there is no research documenting the utilization of a High-Performance Liquid Chromatography (HPLC-MS/MS) - based methodology for comprehensive hair steroid profiling in common marmosets (*Callithrix jacchus*). Consequently, the aim of the present study was to enhance both sample preparation and steroid extraction processes to develop a customized HPLC-MS/MS assay for profiling nine pivotal glucocorticoids and sex steroids in marmoset fur, i.e. androstenedione, corticosterone, cortisol, cortisone, dehydroepiandrosterone, estradiol, 11-ketotestosterone, testosterone and progesterone. Over a period of 24 months we repeatedly collected fur samples from 39 female and 33 male common marmosets. In addition to chemical validation, we explored the effects of breeding roles and sex on endocrine profiles, along with age-dependent changes in hormone levels. Our analysis unveiled biologically meaningful variations in the considered steroids, demonstrating expected sex differences in male and female sex hormones. Notably, female breeders exhibited significantly elevated levels of glucocorticoids compared to their male counterparts. This finding provides valuable insights into the physiological demands associated with reproductive responsibilities in this primate species. The developed methodology can provide a practical and valuable alternative for longitudinal assessments, extending the temporal window for understanding chronic stress, reproduction and life stage transitions.

Sequences of behavior show a common statistical structure across specie

Pranav Minasandra^{1,2,3}

1. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany
2. Centre for the Advanced Study of Collective Behaviour, Department of Biology, University of Konstanz, Konstanz, Germany
3. International Max Planck Research School for Quantitative Behavior, Ecology and Evolution, Radolfzell, Germany

Animal behavior can be decomposed into a continuous sequence of discrete activity bouts over time. Analyzing the statistical structure of such behavioral sequences provides insights into the drivers of behavioral decisions in animals. Laboratory studies, predominantly in invertebrates, have suggested that behavioral sequences are characterized by multiple timescales and exhibit long-range memory, but the extent to which these results can be generalized to other taxa and to animals living in natural settings remains unclear. By analyzing accelerometer-inferred predictions of behavioral states in three species of social mammals (meerkats, coatis, and hyenas) in the wild, we discovered surprisingly consistent structuring of behavioral sequences across all behavioral states, all individuals, and all study species. These common patterns suggest similar structural principles in behavioral sequences across all study species. We explore multiple plausible explanations for the emergence of these patterns, including environmental non-stationarity, behavioral self-reinforcement via positive feedback, or a combination of multiple relevant timescales driven by the hierarchical nature of behavior. The existence of highly consistent patterns in behavioral sequences across all three study species suggests that these phenomena could be widespread in nature, and points to the possible existence of fundamental properties of behavioral dynamics across species that could drive such convergent patterns.

Physiological synchrony during cooperation in marmoset monkeys: Methodological challenges

Konatsu Ono¹, Rahel K. Brügger¹, Judith M. Burkart²

1. Institute of Evolutionary Anthropology, University of Zurich, Switzerland

2. Center for the Interdisciplinary Study of Language Evolution (ISLE), University of Zurich, Switzerland

Synchronization studies have gained popularity in the last decade as it closely correlates with successful cooperation in human dyads and groups. Exploring physiological synchrony within species other than humans, however, is still very scarce. We therefore tested if physiological synchrony would facilitate cooperation in a cooperatively breeding primate species, the common marmoset (*Callithrix jacchus*). We used a widely applied cooperation task, the string-pulling task, to elicit cooperation within common marmoset dyads, and infrared thermal imaging to simultaneously measure changes in arousal in both dyad partners. We compared arousal synchrony within dyads in four experimental conditions: 1) cooperative task with visual access to partner, 2) cooperative task without visual access, 3) individual task with visual access, and 4) individual task without visual access. The results show that marmosets do synchronize within dyads. However, randomly composed pseudo-dyads within the same condition showed equally high synchronization, suggesting that the structured presentation of the task, rather than cooperation per se was responsible for the correlation. This was corroborated by the finding that synchronization did not differ between conditions and was also not correlated with behavioral markers of cooperation such as success in a task, or gaze and mutual gaze with a partner. Thus, the synchronization of the dyads was most likely externally induced by the pace of the experiment, which was held constant. The results highlight that correlated changes in physiology need careful scrutiny to avoid false conclusions, in particular with regard to the methods to quantify synchronization and behavioral contexts.

Great apes show an altercentric bias when confronted with conflicting beliefs

Marie Padberg

A recent study by Lurz et al., (2022) showed that great apes use the simulation model to predict what another individual believes. In this model, individuals simulate believing what another agent believes, resulting in behaving as if one shares the same belief (altercentric bias). These simulations are so strong that they overwrite the individuals' own beliefs. In a novel search task, apes were allowed to dig for grapes in a trough of hay, after they have seen an experimenter hiding it there. The task was designed in a back-and-forth game between a human agent and the chimpanzee. The subject always had visual access to the grape, and could see the grape being relocated from one location to the other. The agent, however, only saw the relocation of the grape in the true belief condition. In the false belief condition, she only saw the grape being buried in the first hiding location, while missing the relocation to the second one. The results by Lurz et al., (2022) support the hypothesis for the simulation model: the chimpanzees searched for the grape closer to the first hiding location when the agent believed it to be there (false belief condition) compared to the true belief condition. In this project, we replicated the findings by using the same paradigm with all four species of great apes. Further, we investigated the developmental trajectory with infants from the Chimpanzee Sanctuary Tacugama.

Water scooping: tool use by a wild bonobo (*Pan paniscus*) at LuiKotale, a case report

Sonya Pashchevskaya^{1,2,3,4}, Barbara Fruth^{1,2}, Gottfried Hohmann¹

1. Max Planck Institute of Animal Behavior, Konstanz, Germany
2. Centre for Research and Conservation, Royal Zoological Society of Antwerp, Antwerp, Belgium
3. International Max Planck Research School for Quantitative Behavior, Ecology and Evolution, Radolfzell, Germany
4. University of Konstanz, Konstanz, Germany

Tool use diversity is often considered to differentiate our two closest living relatives: the chimpanzee (*Pan troglodytes*) and the bonobo (*P. paniscus*). Chimpanzees appear to have the largest repertoire of tools in nonhuman primates, and in this species, many forms of tool use enhance food and water acquisition. In captivity, bonobos seem as adept as chimpanzees in tool use complexity, including in the foraging context. However, in the wild, bonobos have only been observed engaging in habitual tool use in the contexts of comfort, play, self-directed behaviour and communication, and no tool-assisted food acquisition has been reported. Whereas captive bonobos use tools for drinking, so far, the only report from the wild populations comes down to four observations of moss sponges used at Lomako. Here, we present the first report of tool use in the form of water scooping from a wild bonobo at LuiKotale. An adult female was observed and videotaped while using an emptied Cola chlamydantha pod to scoop and drink water from a stream. We discuss the conditions for such observations, the importance of looking out for rare behaviours, and attempt to put the observation into the context of the opportunity versus necessity hypotheses. By adding novel information on tool use, our report contributes to the ongoing efforts to differentiate population-specific traits in the behavioural ecology of the bonobo.

Mathematical modeling of marmoset vocal accommodation

Nikhil Phaniraj^{1,2,3}, Kaja Wierucka^{1,4}, Judith M Burkart^{1,2,5}

1. Institute of Evolutionary Anthropology, University of Zurich, Zürich, Switzerland
2. Neuroscience Center Zurich (ZNZ), University of Zurich and ETH Zurich, Zürich, Switzerland
3. Department of Biology, Indian Institute of Science Education and Research (IISER) Pune, Pune, India
4. Behavioural Ecology and Sociobiology Unit, German Primate Center – Leibniz Institute for Primate Research, Göttingen, Germany
5. Center for the Interdisciplinary Study of Language Evolution (ISLE), University of Zurich, Zürich, Switzerland

Vocal production learning (VPL) is a critical substrate of language and plays an important role during speech development in human infants. While VPL involving drastic changes in vocalizations or novel vocal outputs are only seen in a few clades, such as songbirds, many non-human primates show more modest changes in vocalizations in the form of vocal accommodation (VA). VA in these species remains understudied, and the mechanisms are poorly understood. Here, we tracked acoustic changes in the vocalizations of adult common marmosets, for up to 85 days after pairing with a partner. We identified four properties of VA in marmosets: (1) bidirectional vocal learning, i.e., males and females underwent equal amounts of vocal change (2) exponential decrease in the vocal distance between the paired individuals with time, (3) sensitivity to initial vocal distance, i.e., more VA when vocalizations were more dissimilar before pairing and (4) dyadic acoustic feature synchrony during VA, i.e., males and females moved through the acoustic space in a synchronized manner during vocal convergence. We developed a mathematical model that showed all four properties of marmoset VA to explain the observed temporal dynamics. The model suggests mechanisms involving real-time comparison of the marmoset’s own call to its partner’s call, leading to the generation of a dynamic error signal. Such a signal may drive learning, resulting in the convergence of call properties of marmosets. All in all, the model provides crucial insights into the mechanisms underlying VA in primates.

A pilot study on using novel objects to investigate curiosity in wild, immature Guinea baboons (*Papio papio*)

Malgorzata Slowinska¹, William O’Hearn, Julia Fischer

1. German Primate Center, Göttingen, Germany

Curiosity is the intrinsic desire to seek out new information and is an essential component of cognitive processes such as creativity, memory, innovation, and learning. To better understand how curiosity is expressed under ecologically valid conditions, we examined the exploration of novel objects in a population of wild Guinea baboons (*Papio papio*) living in the Niokolo-Koba National Park in Senegal. We aimed to assess the feasibility of our experimental approach in the wild and determine predictors of variation in individuals’ curiosity. We presented groups of baboons with three types of visually distinct wooden boxes and measured the animals’ latencies to approach and manipulate the boxes, their exploratory behaviors, and time spent in proximity during 46 trials, involving 77 subjects of all ages (30 immatures, 47 adults) and sex classes (F=39, M=38). Out of 77 individuals, 62 approached the boxes at least once. Middle and large juveniles approached the boxes most and accounted for 84% of exploration and manipulation events (107 of 128). Two middle and two large juveniles managed to open the boxes a total amount of ten times, three of them also inspected the box’s interior. Our methodology is designed to shed light on two

factors effecting curiosity in primates: 1) the type of novel stimulus presented, 2) subjects' ages. While a certain lack of control over subjects is a noteworthy weakness of this study design, a significant advantage lies in the range of natural conditions in which it can be implemented.

Why does rank decline across the lifespan in spotted hyenas?

Eli Strauss^{1,2,3}

1. Department of Biology, University of Konstanz, Konstanz, Germany
2. Department for the Ecology of Animal Societies, Max Planck Institute of Animal Behavior, Konstanz, Germany
3. Department of Integrative Biology, Michigan State University, East Lansing MI, USA

How do social phenotypes change as individuals age, and what are the processes underlying these changes? This study examines changes in position in the social hierarchy with age in a long-term study of wild spotted hyenas (*Crocuta crocuta*), a social carnivore with matrilineal societies resembling those of many Cercopithecine primates. First, it is shown that female hyenas tend to decline in dominance rank across their lifespans. Second, demographic processes are the primary driver of these dynamics. Finally, simulations reveal that the combination of behavioral 'inheritance' of dominance rank and rank-related reproductive success cause demographic turnover to lead to a decline in rank over the lifespan. These results reveal how demographic turnover can be a major driver of within individual changes in social phenotype, and how social processes can alter the way that demographic changes shape the fabric of society.

Measuring cooperative coordination in common marmoset

Adele Tuozzi¹, Judith M. Burkart¹

1. Institute of Evolutionary Anthropology, University of Zurich, Switzerland

Cooperation often involves coordinated action, which can entail different individuals performing either the same or different behaviors. Cooperative coordination thus requires the ability to adjust one's own behavior to the cues and/or presence of others and can be further improved through effective signaling. We propose a paradigm to investigate whether acting together or acting apart differentially affects the individuals' behaviors, their ability to obtain a reward, and signaling. We tested 12 groups of captive common marmosets (*Callithrix jacchus*), the only cooperatively breeding primate aside from humans. We presented them with an apparatus which delivers food in: i) a highly interdependent condition, in which all individuals of the group must be present at the same time to obtain food; ii) and an independent condition, in which an individual can only feed when alone and feeding is prevented when group members are close by. In the interdependent condition, the coordination can also be enhanced by behavioral matching, which can increase group cohesion. Our results show that the subjects were able to learn the task in both conditions and thus took the presence and the behavior of their group mates into account. Moreover, preliminary results suggest the interdependent group were faster in learning the task. Finally, they produced more food calls than the independent group, suggesting that they actively recruited group members. Therefore, marmosets appear very skilled in cooperative coordination, which falls well in line with their high levels of interdependence, social tolerance, and prosociality which are characteristic of cooperative breeders, including humans.

Foraging and information sharing in spotted hyenas

Jana Woerner¹

1. Department of Integrative Biology, Michigan State University, East Lansing MI, USA

Public information, derived from conspecific foraging behaviors, can help animals locate resource patches more efficiently, especially in environments with patchily distributed prey. Use of public information to locate kills can be particularly advantageous for social predators that live in fission-fusion groups, such as spotted hyenas (*Crocuta crocuta*). Fresh carcasses present rich, ephemeral food resources that lead to intense scramble competition among conspecifics. Rapid detection and response to public information cues offer a competitive advantage, crucial for securing these resources. Yet how hyenas obtain public information, and how such information allows them to locate kills, remains poorly understood due to the dispersed nature of hyena social groups. We deployed tracking collars on all adult spotted hyenas living in the same group in the Maasai Mara National Reserve, Kenya. These collars recorded fine-scale GPS locations, accelerometer and magnetometer data, and vocalizations, providing a high-resolution picture of all hunting events and the resulting responses of group members distributed across the hyenas' territory. We find that hyenas located within 1 km of a fresh kill will detect and move towards that kill 41.80% (95% CI [33.47% 50.12%]) of the time. Furthermore, immigrant males, the lowest-ranking group members, exhibit higher speeds when

approaching kills, potentially as a strategy enabling them to feed before higher ranking individuals arrive. We further explore the integral cues driving this information flow, including the visual cues of hunting, vocalizations emitted by the prey animal as it is hunted, feeding sounds, and aggression sounds emitted while fighting over a fresh kill.

Nocturnal huddling sleep strategies in a hierarchical primate society in the wild

Pei-pei Yang, Pritish Chakravarty, Juan Chen, Wen-bo Li, Qi-xin Zhang, Xi Wang, Margaret C Crofoot, Jin-Hua

Li

1. Max Planck Institute of Animal Behavior, Konstanz, Germany

Sleep plays a crucial role in the well-being of animals. When homothermal animals are unable to maintain their body temperature during sleep, it results in significant energy loss, reducing their fitness. Therefore, in cold climate conditions, some animals maintain their body temperature by engaging in body contact with conspecifics, known as ‘huddling’. However, most studies have emphasized the importance of daytime huddling behavior for thermoregulation while neglecting the greater ecological pressures faced during the night. Using non-invasive solar-powered 4G cameras, we monitored a group of wild Tibetan macaques at sleep sites to investigate if individuals engage in huddling sleep to cope with nocturnal ecological and social pressures. We found that ecological and social factors both influence nighttime huddle configuration. Low nighttime temperatures encouraged individuals to form larger huddles and pursue more favorable positions within huddles. Higher ranking and younger individuals were more likely to choose central positions, to have contact more group-mates, and have abdominal contact with other individuals. In contrast, older individuals stayed close to cliff wall, avoiding the central position helps reduce the cost of waking up other members of the group and select positions within the group that likely reduce the risk of predation. Our study highlights the critical role of huddling behavior in nighttime thermoregulation in group-living animals and reveals the trade-offs individuals face between ecological demands and social pressures during the sleep stage. This study is the first to research huddle at night in depth, providing insights into the role of social thermoregulation in sleep.

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

Hanling Yeow¹, Fumihiro Kano, Christoph Völter, Daniel Haun

1. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

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.

6 Code of Conduct

The GfP is dedicated to providing a harassment-free environment. Harassment includes speech and/or actions that are considered to be personally offensive or not welcome. We prohibit any form of harassment, sexual or otherwise, toward any of the participants at our conferences regardless of age, ethnicity, race, gender identity or expression, sexual orientation, religion, ability, marital status, appearance, nationality, language, or any other reason¹. This policy applies to all participants and guests, as well as any exhibitors, sponsors, and/or supporters that attend, participate in, or exhibit at the meeting of the GfP.

The GfP is an all-inclusive society focused on encouraging all areas of non-human primatological scientific research, facilitating cooperation among scientists of all nationalities engaged in primate research, and promoting the conservation of all primate species. We support and encourage research on primates from undergraduate and graduate students, research scientists and professionals, and university faculty from European institutions, as well as from other countries around the world. As such, we encourage respectful exchanges of ideas, acknowledging that English may not be the first language of participants and that there may be cultural differences in communication styles. We do not condone elitism in words or actions by faculty toward students, by senior to junior professionals, or peers, or among individuals with different levels of expertise.

6.1 Acceptable Behavior Policy at the GfP Meetings and on Social Media

The GfP is founded on open and respectful exchange of ideas, words and actions during the GfP meetings and on GfP social media sites. The society will not tolerate inappropriate behavior which includes, but is not limited to:

- inappropriate acts or offensive comments that demean another by means of reference to the individual's ethnicity, gender, character, research interests, race, body size and adornments, clothing style, gender identity, religion, age, English-language proficiency, or disability;
- wanton destruction or vandalism of personal, hotel, or convention center property.

Individuals who are currently sanctioned for assault or harassment by an adjudicating institution (e.g., a university where they work or worked) will be excluded from attending the GfP conference and any other GfP - sponsored events.

6.2 What is Harassment?

Harassment is defined as systematic or continued, unwelcome words or actions that include taunts, threats, advances, and demands and may occur in situations where a power differential exists. It applies to our conferences and all online spaces in which GfP conference attendees conduct professional business, and also includes GfP-sponsored social events at conferences. Harassment includes verbal threats, violation of personal space, unwelcome touching, offensive language that is directed at some aspect of another's physical or emotional presence, stalking and sexual harassment. Sexual harassment includes unwelcome sexual advances, demands for sexual favors, or comments made based upon one's gender. Although European laws might not prohibit simple teasing, offhand comments, or isolated incidents that may not be considered very serious, we do not tolerate this at our conferences. Moreover, harassment is illegal when it is so frequent or severe that it creates a hostile or offensive environment.

6.3 Best Practices: Sexual conduct

Participants at a GfP conference are expected to conduct themselves in a manner consistent with applicable civil and criminal laws prohibiting harassment, rape, and sexual assault. Participants at a GfP conference should also be aware of conditions that may lead to vulnerable or threatening situations. Especially, but not exclusively, members holding positions of power should refrain from engaging in sexual relationships with those holding less powerful positions. If you have the ability to exact damage to a colleague's career or they perceive that you could, it is best not to engage sexually. Be aware of power differentials and have special consideration of colleagues at vulnerable career stages including, but not limited to, postdoctoral researchers, research assistants, graduate and undergraduate students, field project participants, and laboratory interns.

6.4 Reporting Harassment

Harassment and other code of conduct violations reduce the value of our professional meeting for everyone. Regardless of the source of harassment or whether it occurs in-person or online, if someone makes you or

anyone else feel unsafe or unwelcome, or if you are a bystander to such actions, please report it quickly. The “bystander intervention approach” encourages individuals to assess the situation and the perceived level of urgency or danger to the victim, and intervene/say something. You should feel that it is your responsibility to do something and feel confident about intervening. Quick mechanisms to report a harassment complaint:

- support the victim
- speak with one of our confidants (see 6.7)
- alert the organizers of the conference (gfp2024@uni-konstanz.de)

Attempts will be made to resolve the situation by speaking with the individuals involved. Counselors and/or GfP representatives will discuss the details first with the individual filing the complaint, then with the alleged offender, and seek counsel if the appropriate course of action is not clear⁴. During their fact-finding effort, GfP representatives will seek to maintain confidentiality as it pertains to both the identity of the individuals and characteristics of the incident. While we recognize that behavior that is acceptable to one person may not be acceptable to another, and that misunderstandings do occur, we will not hesitate to act if asked to address an unsafe, abusive or threatening situation.

6.5 Punishment for harassment

Failing to adhere to this policy will result in immediate exclusion from the conference, online event, social events and workshops. If deemed appropriate we will assist any victim of harassment in pressing charges.

6.6 Acknowledgments

This text is based on the European Federation for Primatology’s (EFP) Code of Conduct Policy as used for the EFP conference 2022 in Arnhem. We have adjusted it according to the needs of the GfP e.V. We thank the organizers of the EFP 2022 for their permission to use this text. The EFP thanked the APS, and their ad hoc Code of Conduct committee, for allowing them to draw inspiration from their code of conduct policy, and the presidents of the national primate societies in Europa who submitted thoughtful comments on a draft of this policy. Therefore, we also would like to thank all of them.

6.7 Confidants

If you report an incident to us where you feel unsafe or threatened, we will take all feasible actions to keep you safe and to prevent further harm. We will try to obtain your consent for any action we take unless the action is immediately necessary to protect the safety of you and other attendees. This could include, for example, a verbal or written warning to the perpetrator or in more serious cases, barring them from the conference. We can also help you liaise with other support services when appropriate. We will treat your report in the strictest confidence unless there is a need to break confidentiality due to a risk of serious harm to you or others.

If you wish report an incident, the following people have volunteered as confidants, and can be identified with a marker on their name tags.

Ariana Strandburg-Peshkin: astrandburg@ab.mpg.de

Brendan Barrett: bbarrett@ab.mpg.de

Camila Calderon: ccalderon@ab.mpg.de

Eli Straus: estrauss@ab.mpg.de

Katrin Dieter: kdieter@ab.mpg.de

Sibylle Hahn: shahn@ab.mpg.de

If you cannot find a confidant at the conference you feel comfortable talking to, please contact Katrin Dieter at the above email or +49 176 4446 5683.

7 Organizing Committee

7.1 Chair

Urs Kalbitzer: *Chair of Organizing Committee, Gfp 2024, Group Leader, University of Konstanz & Max Planck Institute of Animal Behavior & Centre for the Advanced Study of Collective Behaviour*

7.2 Organizing Committee

Carla Avolio: *Media and Communications, Max Planck Institute of Animal Behavior*

Brendan Barrett: *Group Leader, University of Konstanz & Max Planck Institute of Animal Behavior & Centre for the Advanced Study of Collective Behaviour*

Meg Crofoot: *Professor, University of Konstanz; Director, Max Planck Institute of Animal Behavior; Member of the Centre for the Advanced Study of Collective Behaviour*

Katrin Dieter: *Assistant to the director, Max Planck Institute of Animal Behavior*

Roi Harel: *Postdoctoral Researcher, Max Planck Institute of Animal Behavior*

Gisela Kopp: *Fellow, Zukunftskolleg University of Konstanz; Centre for the Advanced Study of Collective Behaviour; Max Planck Institute of Animal Behavior*

Patrick Lauer: *Masters Student, University of Konstanz*

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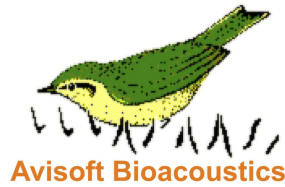
Tracy Montgomery: *Postdoctoral Researcher, Max Planck Institute of Animal Behavior & Centre for the Advanced Study of Collective Behaviour*

Caroline Schuppli: *Group Leader, Max Planck Institute of Animal Behavior*

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