

#ABL2022

17-18 Nov

abstract booklet 2022

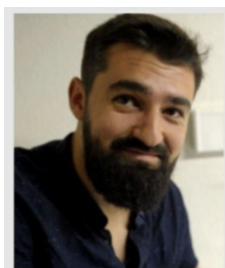
Animal Behaviour Live

www.animalbehaviour.live

Animal Behaviour Live 2022

The organising committee would like to thank the European Society for Evolutionary Biology (ESEB) for funding this event through the Equal Opportunities Initiative grant

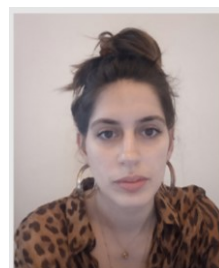
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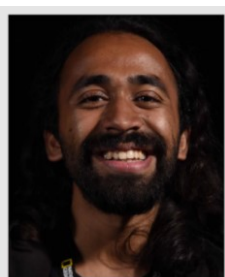
Alexis Buatois
University of Gotenburg,
Sweden



Valentin Lecheval
University of Leeds,
UK



Natacha Rossi
University of Sussex,
UK



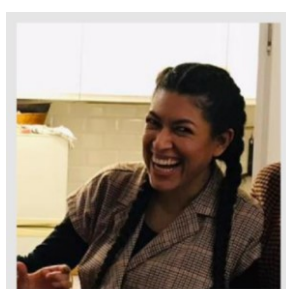
Ebi Antony George
University of Lausanne,
Switzerland



Amanda Facciol
University of Toronto,
Canada



Saeed Shafiei Sabet
University of Guilan,
Iran



Kenzy I. Peña-Carrillo
National Institute of
Forestry, Agriculture and
Livestock Research, Mexico

Day 1 (17th November 2022)		
Day	Time (GMT)	Talk
Day 1 / Session 1 (17th Nov 2022)	6:45	Conference Introduction
	7:00	Plenary 1 - Pr. Madeleine Beekman : Why I love studying honey bees
	8:00	Break
	8:10	Mathilde Chevallay : Should I stay or should I go? Behavioural adjustments of fur seals related to foraging success
	8:30	Sheethal Vepur Ramamurthy : Collective construction: adjustment of underground foraging tunnels by leaf-cutting ants
	8:50	Poster Session 1
	9:20	Tsighie Venturini : Individual processing of face-like stimuli enhances proto-arithmetical calculation in days old domestic chicks
	9:40	Ofri Eitan : Functional daylight echolocation in highly visual bats
Social Break 1 : STRANGE WORKSHOP (11:00 GMT)		
Day 1 / Session 2 (17th Nov 2022)	14:00	Plenary 2 - Pr. Leticia Avilés: On habitat filtering and limiting similarity - the ecology of spider sociality
	15:00	Break
	15:10	Charlotte Wiltshire : DeepWild: application of the pose estimation tool DeepLabCut for behaviour tracking in wild chimpanzees and bonobos
	15:30	Maud Bonato : Assessing the welfare of two semi-captive herds of African elephants using tail-hair cortisol and self-directed behaviours
	15:50	Poster Session 2
	16:20	Subhasmita Patro : Integration of signaling traits during social interaction in a colour-changing lizard
	16:40	João Gabriel de Almeida : When looks are deceiving: vibrational displays during aggressive interactions between males do not represent an assessment of fighting capacity in the spider <i>Trichonephila clavipes</i>
Social Break 2 : Meet the PI / Science Outreach Initiative		
Day 1 / Session 3 (17th Nov 2022)	21:00	Plenary 3 - Pr. Elizabeth Tibbetts : How communication, cognition and flexible hormone titers mediate social competence in paper wasps
	22:00	Break
	22:10	Stotra Chakrabarti : Social distancing in lions
	22:30	Emmanuel I. Archibong : Allegory of the tortoise in African folklores: implications for the phenomenology of experience of children
	22:50	Poster Session 3
	23:20	Luan Dias Lima : On the functional role of chemically insignificant cues in multitrophic caterpillar-ant-plant symbioses
	23:40	Wesley Webb : A global comparison of female birdsong complexity

Day 2 (18th November 2022)		
Day 2 / Session 1 (18th Nov 2022)	7:00	Plenary 4 - Pr. Hema Somanathan : Bees beyond twilight
	8:00	Break
	8:10	Matilda Gibbons : Motivational trade-offs and modulation of nociception in bumble bees
	8:30	Nimish Subramaniam : An arachnid's guide to being an ant: morphological and behavioral mimicry in ant-mimicking spiders
	8:50	Poster Session 4
	9:20	Sydney Hy : Workerless queens and queenless workers: the behaviour of the social parasite <i>Tetramorium atratum</i> with <i>Tetramorium immigrans</i> in its introduced range
	9:40	Deyatima Ghosh : Can biological pest regulation benefit from integrating predator cognition?
Social Break 3 : Meet the PI		
Day 2 / Session 2 (18th Nov 2022)	14:00	Plenary — Pr. Erica van de Waal : Lab cognition going wild: field experiments on vervet monkeys [CANCELLED]
	15:00	Break
	15:10	Ishani Mukherjee : Shoals in troubled waters? Impact of rising temperatures on shoal properties, foraging behaviour and metabolism in mixed species fish shoals
	15:30	Fabrizio Dell'Anna : Grooming reciprocity in Geoffroy's spider monkeys (<i>Ateles geoffroyi</i>): partner-control vs. partner-choice
	15:50	Poster Session 5
	16:20	Emilia Moreno : Differences in habituation and dishabituation between pollen and nectar foragers contribute to foraging division of labour
	16:40	Adelaide Sibeaux : Distance estimation in the goldfish (<i>Carassius auratus</i>)
Break		
Day 2 / Session 3 (18th Nov 2022)	21:00	Social Break 4 : STRANGE WORKSHOP
	22:00	Break
	22:10	Nour-eddine Kaikai : Chronic exposure to the pesticide metam sodium in mice elevated anxiety and depression-like behaviours: involvement of serotonergic depletion and gut microbiota dysbiosis
	22:30	Leticia Paiva : Scale-free movement patterns in termites
	22:50	Poster Session 6
	23:20	Chinmay Hemant Joshi : Robustness of communication to individual-level errors: comparing social insect food recruitment systems
	23:40	Katja Kochvar : Exploring the signal value of the Atlantic puffin colourful bill

Day 1 (17th November 2022)	
Day	Poster
Day 1 / Session 1 (17th Nov 2022) 08:50 - 09:20 GMT	1 Congnan Sun : Geographical variation of territorial calls and perceptual discrimination in male Himalayan leaf-nosed bats
	2 Ehud Fonio : Ants, liquid brains and the emergence of cognition
	3 Jade Sourisse : Effects of developmental temperature on the locomotory innate and learned behaviour to olfactory cues in zebrafish
	4 Sikha Hariharan : Dietary diversity of the endemic primate, lion-tailed macaques, of the Western Ghats, India: a review
	5 Lucie Michel : Spatial and social structure of rewilded laboratory mice
	6 Andrea Sommese : Multisensory mental representation of objects in dogs
	7 Matthieu Paquet & Kaija Gahm : SORTEE: promoting open, reliable, and transparent ecology and evolutionary biology
	8 Emma Lokuciejewski : The development of ecological competence in immature Sumatran orangutans
Day 1 / Session 2 (17th Nov 2022) 15:50 - 16:20 GMT	9 Coulibaly Mohamed : Aquatic macroinvertebrate structure and diversity in Anguededou stream (Anguededou basin : Cote d'Ivoire)
	10 Abhishek Singh : Zebrafish violates rationality in a social decision-making task
	11 S. Gangothi : Changing diet for male house mice over generations influences the female mating preferences
	12 Mary Varoux : Should I stay or go? Short-term effects of monitoring greater horseshoe bats in maternity roosts
	13 Justine Fouassier : Behavioural and physiological responses of the European abalone <i>Haliotis tuberculata</i> to thermal stress
	14 Nadiia Drapushko : The motivation behind innovation: the impact of reward type on the problem-solving performance of wild house mice
	15 Maria Santacà : Disentangling olfactory and visual cues and the role of compatibility during mate choice in the zebrafish, <i>Danio rerio</i>
	16 Louis Devers : Are ants mechanically optimal when they clear their way? A story of millinewtons and joules
	17 Sree Subha Ramaswamy : Chemical cues mediate mound building behaviour in termites
18 Rocío Lajad : Honey bee colonies increase the diversity of collected pollens after experiencing deterrent-adulterated pollen inside the nest	
Day 1 / Session 3 (17th Nov 2022) 22:50 - 23:20 GMT	19 Kirstin Gaffney : Pay to stay in anemonefish societies
	20 Maria Loconsole : Spontaneous pitch-size association in tortoises (<i>Testudo hermanni</i>)
	21 Alice Mignot : Are interactions in Animal-Assisted Interventions a risk factor for the well-being of the dogs involved?
	22 Carmen Hernández : The role of neophobia in an olfactory enrichment for amazons, macaws, and toucans
	23 Matteo Panaccio : Social Network Analysis of small social groups: analysis of aggression in the Alpine marmot (<i>Marmota marmota</i>)
	24 Janire Castellano Bueno : Animal welfare in the centre of animal behaviour science
	25 Laure Cauchard : Exploring the links between cognition and reproductive success in free living great tits (<i>Parus major</i>)
26 Jesse Balaban-Feld : Experience with predation influences social group risk-taking and foraging behaviours	

Day 2 (18th November 2022)	
Day 2 / Session 1 (18th Nov 2022) 08:50 - 09:20 GMT	27 Suyash Sawant: Do neighbours influence an individual's singing? A case study of song sharing in white-bellied sholakili
	28 Baheerathan Murugavel: Following a flying fox: home ranges and the influence of moon phases on the movement ecology of Indian flying fox males in southern India
	29 Bhavya Pratap Singh: Who would a fish choose to hangout with? Individual behavioural traits and water clarity determines the mate-association preferences
	30 Alon Silberbush: Chemical signals released by fish-associated bacteria repel ovipositing mosquitoes
	31 Marion Charrier: When ancestors transmit their stress: prenatal maternal stress transmission across generations in a precocial bird
	32 Sabine Roussel: Studying behaviour to improve survival in a stock enhancement program
	33 Cassandra Mahe: Effects of family structure on isolation calls in a monogamous rodent
Day 2 / Session 2 (18th Nov 2022) 15:50 - 16:20 GMT	35 Asmi Jezeera M: Spatial resolution and contrast sensitivity of flight control in Indian stingless bee, <i>Tetragonula iridipennis</i>
	36 Jingliang Kang: Gene family contraction towards dedicated cleaning behaviour
	37 Tarunkishwor Yumnam: Higher relative humidity makes eyespots bigger in the tropical butterfly <i>Mycalesis mineus</i>
	38 Pedro Oliveira: Arginine vasotocin regulation of social behaviour and dominance in the common waxbill
	39 Francesco Locatelli: Purinergic receptor P2y12 is a key regulator of behaviour in the zebrafish
	40 Patrick Krapf: Foraging valour linked with aggression: selection against completely abandoning aggression in a high-elevation ant?
	41 Lara Sophie Burchardt: Mapping beat precision in acoustic signals in the vocal learning harbour seal <i>Phoca vitulina</i> throughout ontogeny
42 Wim Pouw: Tracking the inflation of siamang airsacs during singing using Hough transformations	
43 Dina Almudafar: Knockout of quaking b causes increased anxiety and sociability in zebrafish	
Day 2 / Session 3 (18th Nov 2022) 22:50 - 23:20 GMT	44 Katharina Hirschenhauser: Animal behaviour in science education: learning and socio-emotional development of primary school children as citizen scientists
	45 Samin Gokecekus: Social familiarity and spatially variable environments independently determine reproductive fitness in a wild bird
	46 T. Thang Vo-Doan: Insect-machine hybrid system: navigation control for a cyborg beetle
	47 Samara Danel: Wild skuas can follow human-given behavioural cues when objects resemble natural food
	48 Chiara Canori: Audience effect on domestic dogs' behavioural displays and facial expressions
	49 Stefan Popp: Ants combine systematic meandering and correlated random walks when searching for unknown resources
50 Claire Bailey: Honey bees continuously retract the edges of their comb following nest expansion	
51 Benjamin Larue: Determinants of spring molt in bighorn sheep: life-history, plasticity and phenology	

Scientific talks

Should I stay or should I go? Behavioural adjustments of fur seals related to foraging success

Mathilde Chevallay

Centre d'Etudes Biologiques de Chizé - CNRS, France
mathilde.chevallay@cebc.cnrs.fr

Understanding foraging strategies and decision-making processes of predators provide crucial insights into how they might respond to changes in prey availability and in their environment to maximize their net energy input. In this work, foraging strategies of two closely related species of fur seals, the Antarctic and the Northern fur seals, were investigated in order to determine foraging behaviour adjustments according to local foraging success at different time scales. As those two species display either neritic/epi-benthic or oceanic/pelagic foraging strategies, we hypothesised that they would respond differently to a change in prey capture success depending on their foraging strategy. To do so, 40 females were equipped with tags that measured tri-axial acceleration, dive depth and GPS coordinates, from which we derived behavioural metrics and prey capture attempts as an index of foraging success. We studied the influence of this prey capture success on both vertical and horizontal movements of seals at the multi-dive, night and foraging trip scales. Our results show that both species adjusted their foraging behaviour according to prey encounter rates at different time scales but we highlighted contrasted decision-making processes between neritic and oceanic divers irrespective of their species. Indeed, at the multi-dive scale, oceanic divers responded to a decrease in foraging success by increasing dive depth and duration, while neritic divers only adjusted their foraging behaviour at larger scales, i.e. at the night and trip scales. We suggest that prey characteristics may play an important role in foraging decisions of top predators as different prey types likely require contrasted hunting tactics. Therefore, we show that foraging decisions of top predators are more complex than predicted by theoretical frameworks mentioned above, and that multiple factors including prey type and behaviour must be included to refine foraging models.

Collective Construction: Adjustment of underground foraging tunnels by Leaf-cutting ants

Sheethal Vepur Ramamurthy, Friedrich Schiller
University of Jena and University of Würzburg, Germany
sheethal.vr.c@gmail.com

Leaf-cutting ants build underground nest chambers connected to each other through various tunnels, and also connecting outside the nest - to foraging areas. Mechanisms like self-organization through local interactions and stigmergic communication explain the emergence of global structures. However, most studies have focused on nest chamber construction as a whole, whereas very few studies have looked into emergence of tunnels and the related feedback mechanisms.

The aim of our study was to investigate how do leaf-cutting ants assess space within a tunnel. We investigated by presenting a two-dimensional digging arena with a tunnel whose width varied between 1 cm (narrow) and 4 cm (wide), along the entire length of the tunnel. The rationale is that there would be high congestion among individuals in the narrow part of the tunnel than when compared to wider parts of the tunnel, which would lead to an initial low traffic flow. High congestion would lead to widening only narrow parts of the tunnel through digging such that the tunnel widens over time, causing traffic flow and speed of individuals traversing the tunnel to fall back to normalcy. We empirically found that traffic flow was low initially, increased gradually as the tunnel widened and remained constant. We also found a significant positive correlation between traffic flow and width of the tunnel. Finally, the overall tunnel width reached a threshold such that it did not widen more than needed. These results suggest that leaf-cutting ants surely use certain cues while assessing space within the tunnel; whether it is narrow or wide. We also speculate that feedback loops play an important role in regulating digging behavior through amplification and dampening of digging, in order to widen the tunnel.

Individual processing of face-like stimuli enhances proto-arithmetical calculation in days old domestic chicks

Tsighie Venturini

Department of Developmental Psychology and Socialization, University of Padua, Padova, Italy

tsighie.venturini@unipd.it

Chicks can master a variety of number processing skills such as discrimination of different numerosities. Previous studies have shown that chicks can discriminate between small numerosities as well as between large ones, but have difficulty with 3 vs 4. However, cognitive strategies revealed helpful, such as object individuation. Given that individual recognition among chicks relies primarily on conspecifics' face and head features, the aim of this study was to assess whether individual processing of face-like artificial stimuli affected numerical discrimination, in day-old domestic chicks (*Gallus gallus*) engaged in a proto-arithmetic task $1+1+1$ vs $1+1+1+1$. In Experiment 1, chicks ($n=14$) were reared and tested with seven individually different face-like displays; in Experiment 2, a new group of chicks ($n=15$) was reared and tested with seven identical copies of a face; in Experiment 3, birds ($n=15$) were reared with seven copies of a same face and then tested with seven all different and novel faces; in Experiment 4, chicks ($n=15$) were reared with featureless outlines and tested with seven different faces. Chicks successfully discriminated 3 vs 4 in Experiment 1 and 3, but failed in Experiments 2 and 4. These results highlight the importance of individual processing in numerical performance, but suggest that previous experience of individuals is crucial. Furthermore, previous experience with identical copies of one same face- is sufficient to boost proto-arithmetic calculations of many novel and distinct faces, but it is insufficient in favouring discrimination of sets of the same face. Overall, our evidence confirms the hypothesis that early exposure to facial features enhances both individual processing and proto-arithmetic calculations, and the type of prior experience differently affects the ability to discriminate 3 vs 4.

Functional daylight echolocation in highly visual bats

Ofri Eitan

Tel Aviv University, Israel

ofrieitan@gmail.com

Animals often integrate information from multiple sensory modalities to acquire information about their surroundings. Most fruit bats are typically nocturnal and use sensitive vision in darkness. In recent years, we have observed a shift in Egyptian fruit bat activity from previously nocturnal behavior to daytime foraging in urban areas in Israel. Like other fruit bats, Egyptian fruit bats have excellent vision and should have no difficulty in solely relying on vision most of the time. In addition, these bats use a unique type of echolocation by tongue clicking, which probably evolved to assist them when orienting in the lightless caves in which they roost. We recorded Egyptian fruit bats during diurnal foraging and drinking events and found that they consistently use echolocation even in broad daylight. We further show that they adjust the echolocation emission rate according to the complexity of the task, demonstrating the functionality of echolocation during daytime. We hypothesize that fruitbats complement their excellent vision with accurate ranging information provided by echolocation. Our results thus shed light on visual–acoustic sensory integration and provide new insights into the evolution of echolocation in bats.

DeepWild: application of the pose estimation tool DeepLabCut for behaviour tracking in wild chimpanzees and bonobos

Charlotte Wiltshire
University of St Andrews, Scotland
cw266@st-andrews.ac.uk

Studying animal movement allows us to understand how different species and individuals navigate their physical and social worlds. Machine learning approaches are used to automate the recognition of patterns within data, considerably reducing the time taken to extract data and improving reliability. However, tracking visual information to recognise nuanced behaviour is a challenging problem and, to date, the tracking and pose-estimation tools used to detect behaviour are typically applied where the visual environment is highly controlled. Animal behaviour researchers are interested in applying these tools to the study of wild animals, but it is not clear to what extent doing so is currently possible, or which tools are most suited to particular problems. To address this gap in knowledge, we describe the new tools available in this rapidly evolving landscape, suggest guidance for tool selection, and provide a worked demonstration of the use of machine learning to track movement in video data of wild apes. We use a pose-estimation tool, DeepLabCut, to demonstrate successful training of two pilot models of an extremely challenging pose estimate and tracking problem: multi-animal wild forest-living chimpanzees and bonobos across behavioural contexts from hand-held video footage. With DeepWild we show that, without requiring specific expertise in machine learning, pose estimation and movement tracking of free-living wild primates in visually complex environments is an attainable goal for behavioural researchers.

Assessing the welfare of two semi-captive herd of African elephants using tail-hair cortisol and self-directed behaviours

Maud Bonato

Knysna Elephant Park, South Africa
research@knysnaelephantpark.co.za

This study aimed to determine the effect of two management systems on hair cortisol (hC) concentration, a novel and non-invasive physiological measure of chronic stress for African elephants. We also attempted to link several trunk and tail related self-directed behaviours (SDBs), a subset of displacement activities validated as anxiety indicators with hC concentration. Tail-hair samples were collected from 17 individuals maintained at the Knysna Elephant Park (KEP) and Plettenberg Game Research (PGR), South Africa, in March 2021. They were sectioned, powdered, and incubated overnight to extract cortisol. A commercially available cortisol ELISA kit was used to interpolate cortisol concentrations for each elephant. In addition, each individual of the KEP herd was followed as focal animals for a period of 30 mins, twice daily from February 2020 to March 2021. SDBs were recorded as they occurred, together with the numbers of tourists present in the field. The general linear mixed model procedure of R version 4.0.5 was used to determine the effect of management system on hC as well as of hC on the expression of SDBs. Individuals from KEP and PGR were observed to have similar average hC concentration ($9.68 \pm 0.58\text{pg/mg}$ and $8.13 \pm 0.56\text{pg/mg}$, respectively; $P < 0.05$). The average number of SDBs displayed per month by an individual of the KEP herd was 59.69 ± 5.54 . Interestingly, hC had a significant inverse relationship with the expression of SDBs ($P < 0.05$), with lowest concentrations of cortisol occurring with highest frequencies of SDBs. Also, whilst the number of tourists present in the field did not affect the expression of SDBs ($P > 0.05$), higher hC concentrations were found with higher numbers of tourists ($P < 0.05$). These findings may thus suggest that the expression of SDBs acts as an adaptive coping mechanism for individuals under anxiety.

Integration of signaling traits during social interaction in a color-changing lizard

Subhasmita Patro
Indian Institute of Science, India
subhasmita.patro1@gmail.com

During social interactions, animals display various static and dynamic signaling traits that are mediated by the neuroendocrine system. For an animal to respond appropriately to a social context, all the traits involved in generating an optimal response should be suitably coordinated. The extent to which these trait components are correlated determines the direction and outcome of a social interaction. Males of the agamid lizard, *Psammophilus dorsalis*, have elaborate social behaviors that involve dynamic changes in body color and behavior, along with associated change in steroid hormone levels. Using wild-caught lizards, we staged male-male interactions and recorded their responses using digital cameras to quantify behavior and color. Males displayed a suite of behaviors, along with dynamic color change in both visible and UV spectrum. Blood samples were taken to measure baseline and social interaction-induced hormone levels. In this study we show that, some aspects of body color i.e. maximum chromatic contrast of dorsal yellow and the size of UV patch, predict behavior displayed during an interaction. Individuals that had larger UV patches and displayed higher chromatic contrast on their dorsal body region, were also behaviorally more active during social interactions. Testosterone and corticosterone levels also change due to social interaction and are potential mediators for components of the complex signaling suite. Identifying relationships among these traits is essential to understand the spectrum of social strategies in animals.

When looks are deceiving: vibrational displays during aggressive interactions between males do not represent an assessment of fighting capacity in the spider *Trichonephila clavipes*

João Gabriel de Almeida
Federal University of Minas Gerais, Brazil
jgabriel.bio2@gmail.com

An important point in the understanding of animal contests is how individuals decide to withdraw a contest. Theoretical studies suggest that this decision is based on the individual cost-threshold related to their own fighting capacity (self-assessment strategy) or on the asymmetry between the individual fighting capacity and his rival (mutual-assessment strategy). However, many empirical studies fail to find conclusive support for both mutual or self-assessment. There is empirical evidence that highlights that this lack of support can occur due to the possibility that individuals can adopt different assessment strategies, or change their strategy, through contest phases. In the orb-web spider *Trichonephila clavipes*, males fight for a preferential mating position in female webs. The contest is structured in an initial phase represented by vibrational interactions between males, followed by a physical contact phase. Even though most contests end in vibrational phase, the function of this phase was never tested. To solve this, we evaluated the hypotheses that the vibrational interaction represents a self or a mutual assessment phase. To identify the assessment strategy adopted by males, we measured the duration of the vibrational interaction as a proxy of fighting cost in this phase, and the length of the first legs of males as a proxy of fighting capacity. We separate the vibration interaction in contests that escalate to physical contact phase, and contests that did not escalate to physical contact. We suggest that vibrational interaction in *T. clavipes* males may be explained by two distinct mechanisms. For contests that escalate, we found support for an opponent-only assessment strategy, in which males decide to escalate to a costly behavior based on rivals fighting capacity. For contests that did not escalate, we found support for a size-based aggressiveness, in which bigger residents vibrate the web as a advertise of his dominance to intruders.

Social Distancing in Lions

Stotra Chakrabarti
Macalester, United States
schakrab@macalester.edu

Understanding sexual segregation is often imperative to comprehend the fundamental origins and outcomes sociality. Through a comparative analysis of long-term demography and behavior data on lions from Serengeti and Ngorongoro in Tanzania, and Gir in India; we show that association between the sexes depend on male and female group-size, prey size and availability, and the number of female groups (prides) that each male coalition currently resides. Males maintain proximity with females, while females are reluctant to associate with males. However, such a reluctance from the females vanishes at large kills. Lions feed on the largest prey in Ngorongoro and the smallest in Gir; females spend the most time with males in Ngorongoro and the least in Gir. Females roar less often in prey-scarce environments such as in the dry season in Serengeti and year-round in Gir possibly to prevent being tracked by males that parasitize on kills made by the females. Contrasting resource availability between Gir and Serengeti/Ngorongoro explain varying degrees of sexual segregation in a species where sociality has typically been considered to be ubiquitous. Such resource mediated differences in social behavior seems to drive disparities in mating systems between these lion populations. Gir lionesses resort to promiscuity, while females in Serengeti/Ngorongoro remain fidel to their resident males.

Allegory of the tortoise in African folklores: implications for the phenomenology of experience of children

Emmanuel I. Archibong
University of Uyo, Nigeria
emmaiarchibong@uniuyo.edu.ng

African literature is replete with stories about the behaviour of the tortoise and as its major character. The tortoise as an allegory symbolises several moral and epistemic universals such as "truth", "wisdom", "knowledge", "ego" and so on. Stories about the tortoise is always captivating and enchanting to children in their infant years. The continual representation of the tortoise in a particular cast leaves an indelible impression in the formative minds of children especially with regards to such virtues as "knowledge", "wisdom", and "truth" and vices as "selfcentredness" and "being cunning". One implication in all these is that, children begins to come to terms with certain virtues or vices that the tortoise depicts in its behaviour. This goes a long way to affecting either positively or negatively, their experiences of the self and others in the environment. This study attempts a phenomenological exposition of how stories found in folklores about animal characters like the tortoise can implicitly or explicitly help to create a sense or virtue or vices in the formative minds of children. The major finding of the study is that, the phenomenology of human experience of the self and others is being shaped by cultural affinity to a society hence, can be better harnessed in the right direction for the educational pedagogy of young children in their understanding and application of core universal concepts.

On the functional role of chemically insignificant cues in multitrophic caterpillar-ant-plant symbioses

Luan Dias Lima
University of São Paulo, Brazil
luandiaslima@hotmail.com

Ants use mainly cuticular hydrocarbons (CHCs) as chemical cues for recognition, which are exploited by myrmecophiles to usufruct the benefits of the social habit. We aimed to identify the functional role of CHCs of two riodinid caterpillar species that obligately associate with different multitrophic ant-plant symbioses. We analysed CHCs using gas chromatography/mass spectrometry and performed experiments in the field to assess the role of ant-organs in ant-caterpillar interactions and the obligatoriness of this symbiosis as well as to test the adaptive value of the chemical insignificance in the myrmecophily. Experiments of ant acceptance of caterpillars showed the concerted action of larval-ant-organs that produce liquid rewards (tentacle nectary organs, TNOs) and luring signals (anterior tentacle organs, ATOs) was key to ant appeasement and larval survival. Experiments changing the symbiosis were often lethal for the caterpillars, mainly after emptying the secretions of their TNOs and their ATOs were never activated. Chemical profiles of caterpillars were insignificant. Field bioassays with chemically insignificant palatable insect prey attracted fewer ants, indicating that insignificant cues may reduce the probability of ant attacks. Thus, caterpillars control the emission of signals of ant-organs during symbiosis, whereas the cues of CHCs are silenced. It is possible that a trade-off exists between signals under control and non-controlled cues. Chemical insignificance may allow for a crucial period for caterpillars to make tactical decisions to appease aggressive ants and could be extended to other communication channels according to the sensorial universe of the receiver.

A global comparison of female birdsong complexity

Wesley Webb
Massey University, New Zealand
wesleythewebb@gmail.com

Elaborated traits or 'ornaments'—such as complex songs and colourful plumages in songbirds—play a key role in animal communication. Theory and research have focused almost exclusively on male ornamentation, yet in many species females too are highly ornamented. How ornaments in female animals have evolved is poorly understood. In particular, little is known about the evolution of complex female birdsong. Illuminating the global pattern of where complexity is concentrated is an important step towards understanding why female vocal elaboration has evolved. To this end we have compiled a database of all female birdsong recordings available from the online repositories Macaulay Library and XenoCanto. Having screened all 5000 putative female birdsong recordings from adult oscine passerines, we were able to verify 475 female recordings of useable quality for analysis, from 150 species. We segmented recordings into songs, then classified and measured all syllables to extract a robust suite of song complexity metrics for comparison across taxa. In this talk we will reveal the geographic and phylogenetic distribution of female song presence and complexity. For example, does Australasia have more prevalent—and more complex—female song than the northern hemisphere (as has sometimes been asserted)? Our results contribute to advancing a holistic understanding of animal elaboration that explains ornaments in both sexes.

Motivational trade-offs and modulation of nociception in bumblebees

Matilda Gibbons

Queen Mary University of London, England

tildagibbons66@gmail.com

Insects are traditionally thought to respond to noxious stimuli in an inflexible manner, without the ability to modulate their behavior according to context. We test whether an insect, the bumblebee (*Bombus terrestris*), is capable of context-dependent, centrally- controlled reduction of nocifensive behavior. We used a motivational trade-off paradigm, where animals must flexibly trade-off two competing motivations. For example, hermit crabs require higher voltages of electric shock to evacuate their preferred shell species. We expanded on the motivational trade-off paradigm by ensuring that the trade-off relied on conditioned cues associated with the motivational stimuli, rather than direct sensory experience of the stimuli themselves. Bees were given the choice between either unheated or noxiously-heated (55°C) feeders with different sucrose concentrations and marked by different colors. Bees avoided noxious feeders when the unheated feeders contained high sucrose concentrations ($z = -13.12$, $p < 0.001$, $N = 41$), but progressively increased feeding from noxious feeders when the sucrose concentration at unheated feeders decreased ($z = -2.068$, $p = 0.039$, $N = 32$). This shows a motivational trade-off of nociceptive responses. Unlike trade-offs described in other invertebrates, the bees used learnt color cues for their decisions, so this trade-off relied on associative memories, rather than direct experience of the stimuli. Thus, it was based on processing in the brain, rather than just peripheral processing. Therefore, bees can use contextual information to modulate nociceptive behavior. This ability is consistent with a capacity for pain experiences in insects.

An arachnid's guide to being an ant: Morphological and behavioral mimicry in ant-mimicking spiders

Nimish Subramaniam
Azim Premji University, Bangalore, India
nimish.subramaniam@gmail.com

Batesian mimicry imposes several challenges to mimics and evokes adaptations in multiple sensory modalities. Myrmecomorphy, morphological and behavioral resemblance to ants, is seen in over 2000 arthropod species. Ant-like resemblance is observed in at least 13 spider families despite spiders having a distinct body plan compared to ants. Quantifying the extent to which spiders' shape, size, and behavior resemble model ants will allow us to comprehend the evolutionary pressures that have facilitated myrmecomorphy. *Myrmaplata plataleoides* are thought to closely resemble weaver ants, *Oecophylla smaragdina*. In this study, we quantify the speed of movement of model, mimic, and non-mimetic jumping spiders. We use traditional and geometric morphometrics to quantify traits such as foreleg size and hindleg size, body shape between the model ant, mimic, and non-mimics. Our results suggest that while the mimics closely resemble the model ants in speed of movement, they occupy an intermediate morphological space compared to the model ants and non-mimics. Ant-mimicking spiders are better at mimicking ants' locomotory movement than morphology and overall body shape. Some traits may compensate others, suggesting differential selection on these mimetic traits. Our study provides a framework to understand the multimodal nature of mimicry and helps discern the relative contributions of such traits that drive mimetic accuracy in ant-mimicking spiders.

**Workerless queens and queenless workers: The behavior of the social parasite
Tetramorium atratum with *Tetramorium immigrans* in its introduced range**

Sydney Hy

University of Massachusetts Lowell, United States

sydneyahy@gmail.com

In ant societies, strict chemo-tactile recognition systems act like a social immune barrier so that colony members are allowed to enter the nest, and non-nestmates are rejected. Nevertheless, a considerable assortment of animal codebreakers have evolved mechanisms to invade ant nests. Among them, workerless ant social parasites employ various strategies to infiltrate heterospecific colonies where they exploit the social food flow system of their hosts and deposit new queen and male brood to be reared by host workers. Here, I report observations of *Tetramorium atratum*, a rare workerless social parasite of the pavement ant, *Tetramorium immigrans*, first introduced to North America during the Colonial Era. *Tetramorium atratum* parasitizes numerous *Tetramorium* species, but little is known about how it interacts with *T. immigrans* and how parasite acceptance, rejection, and tolerance are mediated by host and parasite behavior. To address this, I filmed parasites on the surface of host nests, as well as inside artificial nests from mid-summer to late fall in part of the parasite's North American range. Although some female *T. atratum* were fatally injured by their hosts, others were groomed by host workers, and readily duplicated host tactile signals to initiate trophallaxis (mouth-to-mouth food sharing) with them. Host workers were observed carrying live parasite queens from their natal nests, while other queens were observed dispersing alone. Parasite queens were collected from neighboring host nests, suggesting they may have a limited dispersal range. Lawns, sidewalks, and weathered fragments of impermeable surfaces are highly attractive nesting sites for pavement ants. Dispersing female *T. atratum* are therefore likely to find an abundance of suitable, orphaned host colonies to invade in urban settings. Given the expected increase in urbanization, the increasing ubiquity of pavement ants and their once rare social parasites in North America challenges existing paradigms about invasive species and biodiversity.

Can biological pest regulation benefit from integrating predator cognition?

Deyatima Ghosh

Ashoka Trust for Research in Ecology and the Environment, India

deyatima@atree.org

Mitigating crop pests is a global challenge. Amidst the burgeoning growth in population, increase in agriculture is inevitable. Considering the detrimental impacts of agrochemicals, it is only pertinent to rely on a more sustainable alternative i.e biological pest regulation. However, biological pest regulation overlooks the behavioral aspects of the predators. A major challenge in bioregulation is to choose a relevant bioregulator. We selected *Calotes versicolor* as a model reptile to understand how cognition can be the next step in bioregulation. Oriental Garden lizards are predominantly found in agricultural lands, they are generalist, insectivorous, and ambush predators. They have high adaptability, high capacity to thrive in urbanized landscapes, and are prolific breeders. These traits make them promising bioregulators. But can they decide where to forage? We monitored their decision-making over a certain number of trials in a field-based semi-natural experimental set-up. Reptiles had to choose a better foraging patch based on prey availability, given two choices. Results show evidence of learning. Reptiles could discriminate between a better patch given two options and choose to navigate to the better patch which impacted their food intake. Foraging decision is crucial for a predator and it requires judgment which finally decides whether or not they succeed. The implication this has on bioregulation can be anticipated to cause advancement in the field of integrated pest management.

Shoals in troubled waters? Impact of rising temperatures on shoal properties, foraging behaviour and metabolism in mixed species fish shoals

Ishani Mukherjee

Indian Institute of Science Education and Research Kolkata, India
im18rs098@iiserkol.ac.in

Climate model predictions suggest that water temperatures around the world will increase at least by 3°C in 2100. It is well studied that rising temperatures in freshwater systems increase metabolism and food intake in fishes. Based on these established facts, in our current study, we ask whether rising temperatures impact shoal properties, foraging behaviour and metabolism in mixed species shoals. Zebrafish (*Danio rerio*), flying barb (*Esomus danricus*) and gambusia (*Gambusia holbrooki*) were spotted as mixed species shoals- swimming and foraging together in water-bodies around Haringhata (West Bengal, India). In the same habitat, these species were also spotted as single species shoals. We collected these shoals and brought them to the laboratory where they were maintained for 45 days at either 24°C, 31°C or a fluctuating temperature treatment (where the temperature changed to either 24 or 31 every 24 hours). After conditioning to a given temperature regime, we measured the standard body length and weight of these fishes. To understand shoal properties, shoals comprising 6 fish were introduced into a 40cm×35cm arena and were video recorded for 5 minutes. Next, to gain insight into foraging behaviour, we added 18 bloodworms into the arena and recorded the shoal for another 5 minutes. Thereafter, to understand metabolism, we measured skeletal muscle glycogen content in these species. Our experiments revealed: (i) there was no significant change in shoal properties (polarisation, cohesion) across the three temperature treatments (ii) While *Gambusia* individuals consumed significantly greater proportion of bloodworms, overall food intake was comparable across the temperature regimes (iii) Interestingly, the muscle glycogen decreased at higher temperatures in flying barbs indicating greater anaerobic respiration. Although shoaling and foraging behaviour are comparable in these mixed species shoals across the three temperature regimes, we observe inter-species differences in proportion of food consumed. Further, fish species show increase in metabolism with increase in temperatures.

Grooming reciprocity in Geoffroy's spider monkeys (*Ateles geoffroyi*): partner-control vs. partner-choice

Fabrizio Dell'Anna
Universidad Veracruzana, Mexico
dellanna.fabrizio@gmail.com

The role of reciprocity in the evolution of cooperation in non-human primates remains a debated topic among ethologists and primatologists. There is mounting evidence of reciprocal exchanges of several behaviours in non-human primates: nonetheless, the debate on which processes are guiding reciprocity is ongoing. Two main models are considered: “partner-control” and “partner-choice” models of reciprocity. Distinguishing between those two models is of fundamental importance in order to study reciprocity. Grooming is a frequent, easily observable behaviour in non-human primates, used to clean the fur and to build and strengthen social relationships between individuals. From January 2019 to December 2020, we observed a group of 44-54 Geoffroy's spider monkeys (*Ateles geoffroyi*) in the Otoch Ma'ax Yetel Kooch natural reserve, near Punta Laguna (Yucatán, Mexico). Data were collected using 10 minutes continuous focal samples on adult and subadult individuals of both sexes. We collected 2129 focal samples during 1799 hours of group following. In order to accurately assess the prevalence of each process that could guide reciprocity, two different statistical analyses were conducted. Survival analysis was used to analyse “partner-control” reciprocity, whereas Generalized Linear Mixed Models were used to analyse “partner-choice” reciprocity. The results obtained showed evidence of “partner-control” grooming reciprocity, whereas “partner-choice” grooming reciprocity seemed to be absent in *A. geoffroyi*. The prevalence of “partner-control” reciprocity might be due to the high degree of fission-fusion dynamics that is characteristic of spider monkeys' social organization. This feature, which causes individuals to spend time in separated subgroups, reduces the probability of partners being together, therefore hampering “partner-choice” processes of reciprocity. Our study provides new evidence regarding the processes behind reciprocity in non-human primates, focusing on a wild population of a species currently under-represented in the scientific literature.

Differences in habituation and dishabituation between pollen and nectar foragers contribute to foraging division of labor

Emilia Moreno

Universidad de Buenos Aires, Argentina
emiliamorenoc@gmail.com

Division of labor is central to the ecological success of social insects. Among foragers of the honeybee *Apis mellifera*, specialization for collecting nectar or pollen correlates with bees' sensitivity to sucrose. It has been shown that pollen foragers returning to the hive are more sensitive to sucrose than nectar foragers. Differences between nectar and pollen foragers have been also found in associative learning, with individuals performing better when rewarded with the stimuli to which they are more sensitive. Nevertheless, these differences haven't been proved in non-associative learning. One of the most common non-associative learning processes is habituation, characterized by a graded decrease in a behavioral response as result of the repeated presentation of a stimulus. The habituated response can be dishabituated (recovered) by the same stimulus presented at a higher intensity or by an equivalent but different stimulus. Here, we hypothesized that pollen and nectar foragers differ in their habituation and dishabituation performance. We quantified bee's performance by the proboscis extension reflex (PER), an innate response elicited when sucrose solution contacts the antennae. Habituation trial consisted in the repeated presentation of either: i) sucrose-water solution (10%w/w) on the antenna or ii) sucrose-water solution (10%w/w) on the antenna plus hand-collected kiwi pollen on the first tarsi. Dishabituation was tested in bees habituated with sucrose solution (i) by means of repeated presentation of sucrose solution (10%) on the antenna and pollen on the tarsi. Our results showed that habituation with sucrose solution was similar in pollen and nectar foragers. However, pollen foragers habituated less (they showed higher PER proportion during habituation) than nectar foragers if trials included pollen as habituating stimulus. Moreover, dishabituation was higher in pollen than in nectar foragers. Taken together, our results suggest that both forager types perceive pollen differently, resulting in different performance during habituation and dishabituation.

Distance estimation in the Goldfish (*Carassius auratus*)

Adelaide Sibeaux

The University of Oxford, England

adelaide.sibeaux@biology.ox.ac.uk

Neurophysiological advances have given us exciting insights into the systems responsible for spatial mapping in mammals. However, we are still lacking information on the evolution of these systems and whether the underlying mechanisms identified are universal across phyla, or specific to the species studied. Here we address these questions by exploring whether a species that is evolutionarily distant from mammals can perform a task central to mammalian spatial mapping – distance estimation. We developed a behavioural paradigm allowing us to test whether goldfish (*Carassius auratus*) can estimate distance and explored the behavioural mechanisms that underpin this ability. Fish were trained to swim a set distance within a narrow tank that displayed a striped pattern on the sides and bottom. We then changed the background pattern and measured whether the distance traveled by the fish was impacted. We also measured fin beats and time traveled as possible alternative mechanisms to optic flow. We found that goldfish learned to swim the target distance and that doubling the spatial frequency of the background pattern resulted in a large overestimation of the swimming distance. Our results indicate that visually-based distance estimation is widely spread across taxa but that the visual information extracted (frequency versus angular speed) differs from fish compared to insects or mammals. Our results provide a compelling basis to utilise goldfish as a model system to interrogate the evolution of the mechanisms that underpin spatial cognition, from brain to behaviour.

Chronic exposure to the pesticide metam sodium in mice elevated anxiety and depression-like behaviors: involvement of serotonergic depletion and gut microbiota dysbiosis

Nour-eddine Kaikai
Cadi Ayyad University, Morocco
kaikai.noureddine@gmail.com

Anxiety and depression are highly prevalent mental illnesses worldwide. Epidemiological and experimental studies have reported a higher incidence and an elevated risk to develop these psychiatric disorders following exposure to pesticides. The purpose of this work was to verify whether these two neurobehavioral effects occur during adulthood following Metam Sodium (MS) exposure, a widely used pesticide in agriculture and public health. We also intended to examine whether MS exposure results in changes in the serotonergic system and gut microbiota given their crucial input in anxiety and depression. In this context, mice received chronic treatment with increasing doses of MS and were subjected to a set of behavioral paradigms to evaluate locomotor activity (open field test), anxiety-like (elevated plus maze and light-dark box tests), and depression-like behaviors (tail suspension and splash tests). Following behavioral assessment, we investigated the integrity of the serotonergic system by immunohistochemistry as well as gut microbiota abundance and diversity by MALDI-TOF-mass spectrometry. Our findings showed that chronic exposure to MS did not affect locomotor activity, but resulted in increased anxiety- and depression-like behaviors. MS-induced behavioral changes were accompanied by a depletion of serotonin-like neurons within the dorsal raphe nucleus and a reduction in serotonergic terminals in the infralimbic cortex and the basolateral amygdala. In addition, MS exposure also reduced the total bacterial number and the diversity of gut microbiota in all MS-exposed animals. Taken together, our data demonstrated that MS exposure during adulthood induced anxiety- and depression-like behaviors that could be related to serotonergic system impairment and gut microbiota dysbiosis.

Scale-free movement patterns in termites

Leticia Paiva

Universidade Federal de São João Del-Rei, Brazil

leticia.paiva@ufsj.edu.br

The study of animal movements in a social context is important because these regulate the rate of interactions that are the basis for building self-organization global patterns of behaviour. Here we present previous and more recent results, where we inspected an extensive set of data (c.a. 1.8 million datapoints) on termite movements in experimental arenas. As the density of workers is increased, a clear group effect emerges, because the number of interactions increases as well. Termites engage in social contacts that truncate their otherwise almost rectilinear trajectories. As the density is increased, the workers tend to form dynamically changing clusters that act as social traps. Power-law distributions, the hallmark of Lévy walks, consistently produced the best fits to our step-length data. We expand this observation by exploring the fine details of termite movement patterns to demonstrate that the value of the scaling exponent μ of a power law describing the Levy walk of an individual is modified collectively as the density of animals in the group changes. We have observed focal individuals having scaling exponents μ in the range $3/2$ to 2 . As the density increases, we observed that the goodness of fit to a power law gets better. Moreover, we show for the first time that such movement pattern arises from preferential attachments among individuals, who engage interactions with a limited number of “favourite” nestmates.

Robustness of communication to individual-level errors: comparing social insect food recruitment systems

Chinmay Hemant Joshi
University of Arizona, United States
chjoshi@arizona.edu

Social insect foraging is characterized by self-organization, where individual-level information is often shared, and amplified to the group level. Social insects achieve this feat through a variety of communication modes. Any type of communication is susceptible to errors at the individual level. If not mitigated, these individual-level errors can get amplified, and can severely affect the whole colony. How do social insects mitigate such error cascades, and does the architecture of different communication modes confer robustness to the foraging process against these individual-level errors? To investigate this question, we created an agent-based simulation model of collective foraging, implementing different types of communication modes: central place communication, direct individual communication, stigmergy, and no communication. We also implemented different error types: false positive sensing, transmission errors, wrong target memory, and no errors. We then test how different error types, error magnitudes, and probabilities of individual-level errors affect the collective foraging of colonies when they are using each of these communication modes. Our results show that different communication modes differ a lot in terms of foraging performance and thus in terms of robustness against different error types and error probabilities. This suggests that robustness against error along with a combination of other factors was important in the evolution of different communication modes. Our study also generates new hypotheses about various aspects of communication modes and their role in mitigating against individual errors in collective systems in general.

Exploring the signal value of the Atlantic puffin colourful bill

Katja Kochvar

Memorial University of Newfoundland, Canada

khkochvar@mun.ca

While most attention has been directed at species with sexually dimorphic ornamentation, many animals display mutual ornamentation, where both males and females exhibit elaborated characters. Atlantic puffins (*Fratercula arctica*) are an example of a mutually ornamented species, with both sexes displaying a conspicuous red-orange bill during the breeding season. As a long-lived species with obligate bi-parental care, the colourful bill may serve as an honest signal of parental quality mediating interactions between mated pairs. However, because puffins are also social animals with high site and mate fidelity, complex features such as the bill may instead act as a signal of identity. In this study, we first investigated whether the bill's properties align more closely with a quality or identity signal in a cohort of Atlantic puffins on Gull Island in Newfoundland, Canada. For each individual, colouration of the bill, cere, and rosette was assessed from models of puffin vision generated from multispectral photos (visual and ultraviolet), yielding four colourimetric variables (hue vis, hue UV, achieved saturation, luminance). We assessed these colourimetric variables' lability over the breeding season, frequency distribution across individuals, and condition-dependence, with conflicting results. Bill colouration as a quality signal was further explored in a subset of puffins, where parental quality was evaluated in terms of chick hatch date, growth rate, and asymptotic mass. Achieved saturation on two regions was higher in parents of late hatching chicks compared to early hatching chicks, directly coinciding with timing of local prey availability (i.e., capelin spawning). However, no relationship was observed between colouration and patterns of chick development. These results provide a more nuanced understanding of the potential role of the colourful bill in Atlantic puffins, and pave the way for further research on mutual ornamentation.

Scientific Posters

Geographical variation of territorial calls and perceptual discrimination in male Himalayan leaf-nosed bats

Congnan Sun
Hebei Normal University, China
suncn622@nenu.edu.cn

Vocal characteristics can vary among and within populations. Bats are widely distributed throughout the world and emit rich social calls for social communication. Geographical variation in social calls and vocal discrimination abilities are well studied in birds but largely unexplored in bats. In this study, we recorded male territorial calls of the great Himalayan leaf-nosed bat, *Hipposideros armiger*, from eight colonies at a large geographical scale (1978 km) and investigated the patterns and causes of geographical variation in territorial calls. We also performed playbacks in three colonies to investigate whether males can discriminate local from non-local territorial calls. Overall, our results showed significant geographical variation in territorial calls across colonies. Neither climatic differences, morphological differences, geographical distances nor genetic distances between colonies explained the observed acoustic variation between colonies. Males were able to discriminate between calls of males from their own colony and those of males from a colony. This study provides behavioural evidence that bats can discriminate geographical variation in social calls.

Ants, liquid brains and the emergence of cognition

Ehud Fonio

Weizmann Institute of Science, Israel

ehud.fonio@weizmann.ac.il

Ant colonies demonstrate the emergence of complex collective behaviors in many aspects of their lives, making the notion of super organism well deserved. In addition, recent studies of various information processing networks show that cognition could emerge also in complex system where the basic architecture is not of the “classical” neuron-based network, like in brains, where the basic components (i.e. neurons) are relatively static in space, and the connectivity is relatively rigid for long durations. These different architectures, sometimes referred as liquid brains, convey intriguing opportunities to discover novel mechanisms of emergent cognition. Here we use cooperative ant behavior to demonstrate how such collectives can solve non-trivial puzzles.

Effects of developmental temperature on the locomotory innate and learned behaviour to olfactory cues in zebrafish

Jade Sourisse
The University of Hong Kong
jadesrs@connect.hku.hk

Temperature is a determinant factor affecting the physiology of aquatic ectothermic animals. Global warming of water bodies may therefore impact survival, reproduction but also behaviour in aquatic animals and in turn modify interactions such as mating, predator escape, and others that directly influence population dynamics. Understanding the impacts of near-future temperature changes on the behaviour of aquatic animals is therefore of primary importance. In this study, we investigate the effects of developmental temperature on the behaviour, the learning abilities and the underlying molecular mechanisms through gene expression in the zebrafish *Danio rerio*. We exposed zebrafish post fertilization to current day control (28°C) or future elevated temperature (30°C) for 7 days. Both temperature groups were then confronted with olfactory cues, namely water control, neutral catfish cue and injured conspecific cue. We video recorded their innate response to evaluate a potential change in their swimming activity, first due to cue exposure and then to temperature. However, no significant alteration in their swimming activity after any olfactory cue exposure was observed, and elevated temperature did not influence their response. We further tested the learning ability of 7dpf larvae to associate the neutral cue to a threat after conditioning and the effect of elevated temperatures on learning. Zebrafish larvae did not show any signs of associative learning. Transcriptomic analysis of larvae will allow to evaluate differential gene expression caused by elevated temperature. Our research provides insights into the molecular and behavioural response of a model species to future thermal conditions, illustrating strategies deployed by aquatic animals facing a rapidly changing world.

Dietary diversity of the endemic primate, lion-tailed macaques, of the Western Ghats, India: A review

Sikha Hariharan
Centre for Wildlife Studies, Bangalore, India
sikha.hariharan@gmail.com

Lion-tailed macaques are endangered and endemic primates to the rainforests of the Western Ghats, India. The literature review of lion-tailed macaques spans 55 years (1967–2022) and covers 197 publications across the species' geographical range. Studies on captive and semi-free-ranging populations were excluded from the review. The specific objectives of this review were: (1) to document the identified food species from existing literature; (2) to review the spatial and temporal coverage of existing knowledge on food trees of wild macaques; (3) to examine the population-level variations in diets as well as to discuss their conservation-related implications. Geographic coordinates from publications for study locations or, if not provided from Google Earth (Google Inc. 2012). Certain plant species contribute to more than 65% of the macaques' diet. A previous compilation by Krishnamani and Kumar (2000) made a checklist of 218 species across 6 studies. However, the current study, compiled 400 food-plant species, excluding fungi, mushrooms, lichens, and animal matter. The macaques feed on a variety of animal matter to meet protein requirements including insects, frogs, bird eggs, and young ones of small mammals. This review also reveals important limitations regarding the lack of standardization in reporting the percentage of diet and regional gaps in studies. The review is an assessment of current knowledge about the diet of these species and draws attention to the potential importance of small-scale habitat heterogeneity for primate ecology and calls for studies between populations to understand the nuances of dietary diversity.

Spatial and social structure of rewilded laboratory mice

Lucie Michel
ENS Paris-Saclay, France
lucie.michel@ens-paris-saclay.fr

As an essential biomedical model organism, house mice have been studied intensely under laboratory conditions, yet they evolved to survive and reproduce in complex and dynamic environments. There has been recent interest in the study of 'rewilded' mice reared in complex outdoor environments, particularly for understanding the brain and behavior. Yet little work has examined lab mouse behavior under free-living conditions. Here, we characterize the emergent spatial and social structure of replicated populations of C57BL/6J (C57) mice over 10 days in large outdoor field enclosures and compare them to populations of recently wild-derived outbred house mice under the same conditions. We observed shared aspects of space use and social structure focusing on aggressive male-male interactions across all trials. Results showed that C57 mice, as well as the outbred ones, chose territoriality instead of a dominance hierarchy social structure. Male C57 mice seemed to wait longer before establishing territories and kept displaying aggressive behavior towards males for a longer time than outbred mice. Importantly, this work demonstrates that C57 mice recapitulate many, but not all, aspects of social structures generated by wild mice in outdoor conditions. Rewilding allows for tractable, replicable, and ecologically realistic approaches to studying mouse behavior and can facilitate the study of the biological basis of higher order social organization.

Multisensory mental representation of objects in dogs

Andrea Sommesse
Eötvös Loránd University, Hungary
sommese.andrea@gmail.com

Little research has been conducted on dogs' (*Canis familiaris*) ability to integrate information obtained through different sensory modalities during object discrimination and recognition tasks. Such a process would indicate the formation of multisensory mental representations. In Experiment 1, we tested the ability of 3 Gifted Word Learner (GWL) dogs that can rapidly learn the verbal labels of toys, and 10 Typical (T) dogs to discriminate an object recently associated with a reward, from distractor objects, under light and dark conditions. While the success rate did not differ between the two groups and conditions, a detailed behavioral analysis showed that all dogs searched for longer and sniffed more in the dark. This suggests that, when possible, dogs relied mostly on vision, and switched to using only other sensory modalities, including olfaction, when searching in the dark. In Experiment 2, we investigated whether, for the GWL dogs (N = 4), hearing the object verbal labels activates a memory of a multisensory mental representation. We did so by testing their ability to recognize objects based on their names under dark and light conditions. Their success rate did not differ between the two conditions, whereas the dogs' search behavior did, indicating a flexible use of different sensory modalities. Little is known about the cognitive mechanisms involved in the ability of GWL dogs to recognize labeled objects. These findings supply the first evidence that for GWL dogs, verbal labels evoke a multisensory mental representation of the objects.

SORTEE: promoting open, reliable, and transparent ecology and evolutionary biology

Matthieu Paquet
University of Bordeaux, France
matthieu.paquet@outlook.com

Science and society benefit when scientists conduct research in a transparent, reproducible, and collaborative fashion. The Society for Open, Reliable, and Transparent Ecology and Evolutionary biology (SORTEE) was founded in December 2020 with the aim of bringing together researchers working to improve reliability and transparency through cultural and institutional changes in ecology, evolutionary biology, and related fields. SORTEE's goals and philosophy are described in O'Dea et al (2021) Towards open, reliable, and transparent ecology and evolutionary biology *BMC Biology* 19: 68. In 2021 and 2022, hundreds of researchers became members of SORTEE and participated in the first two editions of the Society's annual virtual conference. This poster will showcase SORTEE's efforts to promote open, reliable, and transparent research practices and its activities and success thus far.

The development of ecological competence in immature Sumatran Orangutans

Emma Lokuciejewski

Max Planck Institute for Animal Behaviour, Germany

elokuciejewski@ab.mpg.de

Orangutans are unusual among apes due to their semi-solitary lifestyle. Juvenile Sumatran orangutans (*Pongo abelii*) are highly reliant on their mother until around 9 years old, when they begin to range more independently. One of the major challenges that the juveniles face is learning where and when they can find food. They must acquire a vast repertoire of skills prior to independence, to allow them to survive independently, and this skillset continues to expand and develop into maturity. This project investigates how individuals learn to navigate through the landscape, optimize food intake, and increase their skillset, to provide further insights into orangutan cognition. We focus on various aspects of the development of ranging competence, including cognitive maps, planning and decision making in daily movement trajectories. We also examine learning strategies and the development of ecological skills such as food recognition. We have a unique opportunity to combine long-term, detailed behavioural data with spatial data, collected at the Suaq Balimbing monitoring station, in Sumatra, Indonesia. Data reveals the drivers of daily movement trajectories and optimisation of food search paths, leading to the establishment of ecological competence.

**Aquatic macroinvertebrate structure and diversity in Anguededou stream
(Anguededou basin: Côte d'Ivoire)**

Mohamed Coulibaly
Université Nangui Abrogoua, Côte d'Ivoire
coulibalymohamed9153@gmail.com

Aquatic macroinvertebrates play an important rôle in ecosystems and are usually used as bioindicators to assess their health. This study aims to assess the structure and diversity of these organisms on one hand and the effect of the environmental variables on the characteristics of their communities in Anguededou Stream basin (Côte d'Ivoire) on the other hand. Six stations were monthly sampled during one year period (March 2018 - February 2019). A total of 171 taxa belonging to 77 families and 14 orders were recorded. The Insecta class was the most diversified with 150 taxa (87.20% of total species richness); followed by the Gasteropoda, Malacostraca, Acheta and one species in Oligocheta. The highest values of diversity indices were collected in the upstream station A1; while highest values of Sorensen similarity index were found between the midstream stations (i.e. A3, A4, A5). A strong positive correlation between conductivity, turbidity, salinity, and a negative correlation with dissolved oxygen was found with the Chironominae subfamily, and the species *Diplonychus sp.*, *Hydrobius sp.*, *Hydracharina sp.*, *Hydrochara sp.* and *Physa marmorata*, while the Tanypodiinae subfamily was highly associated with increased of dissolved oxygen. Macroinvertebrates diversity and species composition was found significantly affected by anthropogenic disturbances

Zebrafish violates rationality in a social decision making task

Abhishek Singh
Ashoka University, India
abhishek.singh_phd19@ashoka.edu.in

Animals, from unicellular organisms to humans, are known to violate normative economic principles of rationality. The cognitive and neural basis of behaviors that do and do not conform to normative rationality is relatively poorly understood. We tested whether the principle of the Independence of Irrelevant Alternatives (IIA) of rationality is upheld in shoal size choice preference in zebrafish (*Danio rerio*). Zebrafish decision-making was studied while making choices in shoaling social behavior with groups of various numbers of conspecific individuals. IIA was tested in terms of the invariance of choices in sequences of binary and ternary choice sets. We provide the first report of evidence for violation of IIA in zebrafish using fish trajectory data, both in terms of assumptions of constant ratio and regularity of IIA. This also is an example of a rarely reported single-dimensional violation of rationality, and it opens a wide range of possibilities to study the mechanism behind the 'rational' decision-making.

Changing diet for male house mice over generations influences the female mating preferences

S. Gangothri

Indian Institute of Science Education and Research, India
sgangothri18@iiserb.ac.in

Animal's attractiveness plays an important role in determining its reproductive fitness during mate choice. Since attractiveness is plastic in nature, the traits associated with it could be influenced by genetic and/or environmental conditions. Diet is known to influence various traits associated with life history, physiology and behaviour, however, its role in affecting the behavioural traits intergenerationally has not been fully explored. In this study, we investigated the role of diet given to male house mice in influencing the female mating preferences under semi-natural conditions. We tested two hypotheses in this study: Silver spoon hypothesis and Match-mismatch hypothesis. Four populations of male house mice were equally provided with either standard quality diet (SQ) or high quality diet (HQ) for three generations. Two out of the original four populations experienced a shift in their diets during the third generation, resulting in the four following treatments: HQ, HQ/SQ, SQ, SQ/HQ. We conducted a female mate choice experiment for males from all treatments (N = 24 total setups, 4 males from each treatment per setup) in the fourth generation. Our results showed that the males originating from HQ treatment attracted most of the females. We also saw that sons of the males experiencing a diet switch in the F3 generation showed lower mate preferences in the fourth generation. The results demonstrate that diet can affect the mating preferences by influencing traits in a sex specific manner. The experiment also provides a basis for further studying the role of phenotypic plasticity and inter-generational plasticity on sexual selection of organisms.

Should I stay or go? Short-term effects of monitoring Greater Horseshoe bats in maternity roots

Mary Varoux

Université Claude Bernard Lyon 1, France

mary.varoux@univ-lyon1.fr

Monitoring populations by capture-marking-recapture makes it possible to study important and unacknowledged aspects of the biology of species but can have undesirable effects.

In order not to lead to a conflict between animal welfare and the quality of monitoring, the study of potential impacts must be a major concern in order to assess and minimize the adverse effects. Indeed, too few studies to date report the consequences of long-term monitoring.

Thanks to the capture-recapture monitoring of individuals equipped with a PIT-tag within a population of Greater Horseshoe bats in Southern-Est France, we are studying the effects of capture, tagging, and recapture on phenology and the outgoing and returning movements of individuals to maternity sites during four summers. These effects are studied according to the age groups, sex, and lactation stages of females.

The results seem to indicate that these disruptive events may have short-term effects on the activity of individuals. Indeed, departures from the colony are later for juveniles, newly marked individuals and some of gestating females, but after two days, the phenology returns to normal. Indeed, departures from the colony are later for juveniles, newly marked individuals and some of gestating females. Moreover, there is no significant variation in the number of individuals at the different sites, which means that individuals do not desert the colonies.

This study, in addition to providing us with knowledge about the species and our impact, shows us that our CMR approach can provide comparison between marked and "control" animals, allowing us to study the behavior of individuals in a comprehensive and holistic approach.

Behavioural and physiological responses of the European abalone *Haliotis tuberculata* to thermal stress

Justine Fouassier

Laboratoire des Sciences de l'Environnement Marin, France

justine.fouassier@hotmail.fr

The effects of environmental drivers, such as global warming, are still unknown in the European abalone *Haliotis tuberculata*. This marine gastropod mollusk species is the subject of commercial fisheries and growing aquaculture in France and could be threatened by the rise in temperature in its natural environment and in aquaculture facilities. This study focused on the effects of temperatures on the physiology and behaviour of adult abalone to assess optimal temperature and thermal limit of this species. Since a multiparametric approach is needed to fully understand the effects of environmental changes, behavioural measurements were performed in addition to biological and physiological assays.

Adult *H. tuberculata* were reared under controlled conditions of temperatures ranging from 12°C to 27°C (n = 3 independent aquariums per temperature, each containing 30 abalone). Histopathological, physiological (including metabolism, growth, oxidative stress, histopathology, reproduction), and behavioural (diurnal rhythm, feeding, righting and sheltering) responses were assessed following a 1-month exposure under controlled conditions with temperatures ranging from 12°C to 27°C. Our results showed that temperature have an influence on the overall energy budget of *H. tuberculata* via effects on inputs (feeding behaviour), costs (activity during diurnal rhythm, maintenance of metabolism, growth, and reproduction), and energy reserves (evaluated with righting and sheltering tests). A characteristic U-curve (or inverted U-curve) response was observed for a large range of the biological and behavioral variables. This study highlighted an optimal temperature range between 18°C and 21°C allowing maximal growth for *H. tuberculata*, although investment in reproduction could result in higher sensitivity to pathogens at these temperature levels. A multiparametric approach is necessary to fully understand the consequences of an environmental change. Behavioural measures complement this approach very well, and are necessary to assess the effects of environmental drivers such as ocean warming.

The motivation behind innovation: The impact of reward type on the problem-solving performance of wild house mice

Nadiia Drapushko

Max Planck Institute for Evolutionary Biology, Germany
n.drapushko24@gmail.com

In the wild, animals often face ecological challenges that they must overcome to survive and thrive. This often requires them to come up with solutions to novel problems or to find new solutions to existing ones; i.e., they need to innovate. As innovation is directly affected by the animal's motivation to engage with the problem and to obtain the reward, most cognitive studies rely on the assumption that high-quality food is a good motivator that can induce innovation. However, it is not yet clear how other motivators might differentially affect different species or populations, and thus impact their perceived problem-solving abilities. In this pilot study, we attempted to understand whether two different motivators, food and escape, can impact the problem-solving success of three populations of wild house mice, *Mus musculus*. We used three problem-solving set-ups where the reward was either a preferred food reward or an escape path to the focal animal's home cage. We found that different motivators affected both the persistence and the solving latency of the animals in most cases. The overall solving success, however, depended on the type of set-up and the population of the animals, irrespective of the motivator used. We also saw a large discrepancy in the solving success for each population, potentially indicating the importance of life history in the perceived cognitive abilities of our animals. Problem-solving performance remains difficult to interpret, but disentangling the interplay between life-history, motivation and cognitive abilities is paramount in understanding the ecological relevance of innovative behaviour.

Disentangling olfactory and visual cues and the role of compatibility during mate choice in the zebrafish, *Danio rerio*

Maria Santacà

Department of Biology, University of Padova, Italy
santacamaria@gmail.com

Research on mate choice has mainly focused on the role of morphological traits, but other sensory modes may play an important role. Since olfactory cues are likely related to compatibility among the partner at major histocompatibility complex (MHC), they could strongly affect female mate choice in a macrosmatic species such as the zebrafish (*Danio rerio*). To investigate this aspect, we used a recently developed experimental set-up that allows the separate manipulation of olfactory and visual information. In a preliminary experiment, we tested the receptivity window of the zebrafish to maximize protocol for mate choice in this species. After also assessing the repeatability of the procedure, we assessed the role of visual and olfactory cues on precopulatory mating preference. We also investigated the genetic similarity of the tested fish to further understand the contribution of the compatibility during mate choice. To do so, we presented the same two males to the female in two consecutive days, but in one day the female could rely only on vision to choose between males whereas in the other day also olfactory cues were provided. Once completed the trials, both females and males were measured to assess morphological traits (e.g., size and body coloration) and genotyped to determine their MHC similarity and relatedness. Preliminary results revealed that the procedure is highly repeatable and females are more sexually receptive 7 days after natural mating whereas the results of the role of visual and olfactory cues will be discussed.

Are ants mechanically optimal when they clear their way ? a story of millinewtons and joules

Louis Devers

Centre de Recherche sur la Cognition Animale (CRCA CBI), France
devers.louis@gmail.com

Messor barbarus is a granivorous ant species that collects and brings seeds to its nest along several meter-long physical trails. The underground nests of these species are formed by a network of narrow galleries, leading to chambers where the seeds are stored. Throughout the foraging process these galleries can be obstructed by all sorts of objects and thus must rapidly be cleared to restore forager traffic and maintain a functioning network.

In this study we focused on the decision-making process underlying the clearing behaviour of underground galleries by ants. In the laboratory, we partially obstructed with a small wooden stick a transparent tube linking an artificial ant nest to a foraging area where ants could collect seeds. The tube was arranged horizontally or with different inclinations. To clear the way ants had thus to carry the stick in either direction of the tube, towards the nest or the foraging area. We noted the direction in which ants pulled and extracted the stick as a function of both the inclination angle of the tube and the position of the stick in the tube. By computing the mechanical work needed to extract the stick and thus complete the task, we were able to measure the optimality of the ants clearing behaviour. The results show that, whereas ants' individual behaviour is mechanically optimal, a bias emerges at the collective scale leading to suboptimal clearing decisions. Moreover, we show that the only model able to reproduce this bias is a model in which ant's consistency in pulling behaviour is based on mechanical cues. Besides, the duration of ants pulling behaviour are more important when pulling in the correct direction. We conclude that ants do take into account the mechanical cost they have to achieve when engaging in a clearing task.

Chemical cues mediate mound building behavior in termites

Sree Subha Ramaswamy
National Centre for Biological Sciences, India
sreesubharamaswamy@gmail.com

The mound-building termites *Odontotermes obesus* build massive, intricate structures out of soil. These mounds, which can attain heights of up to 3 meters overground and similar depths underground, house the entire termite colony. The mound consists of numerous interconnected corridors and galleries leading to the subterranean nesting chambers. The building of these mounds relies on the close coordination of the individual actions of several termites of different castes who excavate and deposit soil in the process of construction. How termites communicate with each other to collectively build such large mounds has been a long-standing question. One hypothesis - the so-called stigmergic hypothesis - states that termites communicate with each other by embedding cues in the structures that they build. To test this hypothesis, we devised an experimental assay to determine how termites respond to soil that has been previously processed by other nestmate or non-nestmate termites. In this assay, the termites must choose between two soil patches which are thermally or chemically treated to remove or alter the embedded cues. Our data show that the preference for the soil at the site of repair is mediated by volatile and non-volatile chemical cues deposited by the termites in the soil. The volatile chemicals are short-lived but have a larger spatial range. The non-volatile chemicals, on the other hand, are long-lived and encode a signal helps termites distinguish between soils handled by nestmates vs non-nestmates. These cues elicit distinct building responses in major and minor workers. Our results suggest that termites communicate with each other by depositing a hierarchical combination of chemicals such that different combinations specify whether a soil patch is being processed by termites that are of the same species, or even from the same nest.

Honeybee colonies increase the diversity of collected pollens after experiencing deterrent-adulterated pollen inside the nest

Rocío Lajad

Laboratorio de Insectos Sociales, IFIBYNE-UBA-CONICET, Universidad de Buenos Aires,
Argentina
roolajad@gmail.com

Pollen is essential for the optimal development of honeybee *Apis mellifera* colonies. Forager bees do not consume fresh pollen at the floral sources but transport it to the nest. Once there, young bees process pollen into the easily digestible bee bread. Because pollen differs in quality for the bees, we hypothesized that adjustment of pollen selection requires the resource to be processed within the nest. In dual choice experiments with colonies confined inside flying cages, foragers change their preferences after in-hive experiences with pollens whose suitability was reduced by the addition of amygdalin (0.1 M), a deterrent present in almond pollen that causes malaise after ingestion in bees. Here, we study whether such a change in foraging preferences can also be observed in a multiple choice natural context. To this aim, we compared colony foraging preferences by means of the composition of pollen samples trapped at the entrance of the hives. Samples were taken before and after the offering of amygdalin adulterated pollen from one of the dominant flowering plants in the field (*D. tenuifolia*) to a first group of colonies. We included a second group of colonies that were fed unadulterated *D. tenuifolia* pollen to control the effect of the amygdalin and a third group where no pollen was offered to control the effect of the feeding. Our results showed that pollen samples from treated colonies were more diverse than in the controls (estimated by Shannon's H-index), suggesting that experiences with an unsuitable highly available pollen biased foraging towards pollens from new sources.

Pay to stay' in anemonefish societies

Kirstin Gaffney
University of St Andrews, Scotland
kirstinkg@gmail.com

In cooperatively breeding societies of unrelated individuals, helping effort by non-breeders is an evolutionary mystery, because it is unclear why they invest in unrelated offspring. One explanation is that subordinates are appeasing the dominants to avoid being evicted from the group (the 'pay-to-stay' hypothesis). This has been observed in mammals, birds and freshwater cichlids, however, in marine fishes within-group behaviours are still largely unknown. We tested the pay-to-stay hypothesis in anemonefish societies which form strict size hierarchies consisting of one dominant breeding pair and non-breeding subordinates. We hypothesized that subordinates 'help' dominants through defending and maintaining the anemone host. We investigated whether subordinates were punished for not helping (as predicted by 'pay to stay') by experimentally manipulating this behaviour through handicapping subordinates. Findings will clarify the importance of helping behaviours in maintaining social groups and expand our understanding of the evolution of sociality in the marine realm.

Spontaneous pitch-size association in tortoises (*Testudo hermanni*)

Maria Loconsole
Queen Mary University of London, England
m.loconsole@qmul.ac.uk

Crossmodal correspondences are shared, arbitrary associations between different sensory modalities. For instance, we consider lemon scent as spiky, and vanilla scent as rounded, or we match elevated and low spatial positions with smaller and bigger stimuli, respectively. It is not only adult humans possessing crossmodal correspondences. These were also reported in preverbal infants and in some non-human mammalian species (i.e., chimpanzees, monkeys, and dogs). To present, there is only one evidence from a non-mammalian species (i.e., the domestic chicken). We investigated a case of crossmodal correspondences (i.e., pitch-size association) in tortoises (*Testudo hermanni*). Tortoises could enter one of two possible flapping doors, each signalled by either a large or a small circle, to obtain a food reward. Subjects preferentially entered the door signalled by the smaller circle when hearing a high-pitched background sound, and that signalled by the larger circle when hearing a low-pitched background sound. This is consistent with literature from adult humans and domestic dogs. Our results shed light on a spontaneous associative mechanism shared between species from different clades. We discuss whether this mechanism has evolved to answer specific environmental needs common to different clades, and whether it may be at the basis of more complex multimodal perception.

Are interactions in Animal-Assisted Interventions a risk factor for the well-being of the dogs involved?

Alice Mignot
Paris Nanterre, France
comportementcanin@outlook.com

Research on Animal-Assisted Interventions has a strong anthropocentric tendency, whereas human-animal interactions, which are central in these practices, have a stressful potential for the dogs involved. We conducted a behavioral analysis in focal animal sampling on 35 sessions as well as a questionnaire addressed to the handlers on the behaviors of the dogs and the beneficiaries observed during the session. The results show that the interactions during the AAI are mainly represented by affiliative interactions within the triad of handler-beneficiary-dog. However, we also observed subtle stress-related behaviors and avoidance behaviors in the dogs, which contradicts the results of previous studies. Beneficiaries and handlers also exhibited potentially stressful behaviors with physical restraint and behaviors symptomatic of certain illnesses (screaming, sudden gestures). Finally, we noted a positive bias in handlers' observations that tended to omit the observation of subtle stress signals in their dogs (lip flexing, passive behavior, panting, self-grooming, looking away, and yawning). Our results suggest risk factors for the well-being of dogs in AAI within the interactions that take place in the session as well as in the observations of the handlers. Our findings emphasize that research should be interdisciplinary and study interactions in animal mediation without focusing solely on one of the interactants, on certain behaviors or moments of the session.

During this communication, we also wish to present results on the chains of interactions during the sessions that we were able to film (currently being analyzed).

The role of neophobia in an olfactory enrichment for amazons, macaws, and toucans

Carmen Hernández

Universidad Autónoma de Madrid, Spain

mcarmen.hdez.glez@gmail.com

Despite the crucial importance of environmental enrichment for the well-being of captive animals, certain types of sensory enrichment have been neglected, especially olfactory devices. For birds, including new enrichment protocols can be challenging because of their aversion to novelty. However, differences between bird taxa are poorly understood. The goal of this study was to investigate if the participation in an olfactory enrichment and latency times varied between bird taxonomic groups (*Amazona spp.* / *Ara spp.* / *Ramphastos spp.*). To test this, we exposed 257 birds (red-lored amazons *Amazona autumnalis*, yellow-naped amazons *Amazona auropalliata*, scarlet macaw *Ara macao*, great green macaw *Ara ambiguus*, keel-billed toucan *Ramphastos sulfuratus* and yellow-throated toucan *Ramphastos ambiguus*) to scented containers which had inside cotton soaked in different liquids (water / vinegar / fruit juice). We register if the individuals interacted with the enrichment and how much time they took to interact with the containers. Our results showed that toucans are significantly more prone to participate in the enrichment compared to amazons and macaws. Moreover, the latency time to engage with the scented containers was significantly higher in amazons. Our study indicates that toucans are neophilic species which could benefit from higher exploration rates while amazons tend to be particularly neophobic, possibly because of their less opportunistic feeding habits compared to toucans and their higher vulnerability to be preyed on compared to macaws. Our findings highlight that olfactory enrichments can be highly successful for toucans while a more natural design should be applied for psittacids.

Social Network Analysis of small social groups: analysis of aggression in the Alpine marmot (*Marmota marmota*)

Matteo Panaccio
University of Chester, England
panaccio.matteo@gmail.com

Social Network Analysis (SNA) has recently emerged as a fundamental tool to study animal behavior. While many studies have analyzed the relationship between environmental factors and behavior across large, complex animal populations, few have focused on species living in small groups due to limitations of the statistical methods currently employed. Some of the difficulties are often in comparing social structure across different sized groups and accounting for zero-inflation generated by analyzing small social units. Here we use a case study to highlight how Generalized Linear Mixed Models (GLMMs) and hurdle models can overcome the issues inherent to study of social network metrics of groups that are small and variable in size. We applied this approach to study aggressive behavior in the Alpine marmot (*Marmota marmota*) using an eight-year long dataset of behavioral interactions across 17 small family groups (7.4 ± 3.3 individuals). We analyzed the effect of individual and group-level factors on aggression, including predictors frequently inferred in species with larger groups, as the closely related yellow-bellied marmot (*Marmota flaviventris*). Our approach included the use of hurdle GLMMs to analyze the zero-inflated metrics that are typical of aggressive networks of small social groups. Additionally, our results confirmed previously reported effects of dominance and social status on aggression levels, thus supporting the efficacy of our approach. We found differences between males and females in terms of levels of aggression and on the roles occupied by each in agonistic networks that were not predicted in a socially monogamous species. Finally, we provide some perspectives on social network analysis as applied to small social groups to inform subsequent studies.

Animal welfare in the centre of animal behaviour science

Janire Castellano Bueno

Wild Animal Initiative, U.S.A ; Newcastle University, Newcastle upon Tyne, England

janire.castellanobueno@wildanimalinitiative.org

At its dawn, animal welfare science relied heavily on animal behaviour research. This continued until fields considered “hard science” and “more reliable” such as immunology or endocrinology developed further and replaced the use of behavioural methods. Now, influenced by further understanding of mental health in humans, and an increasing body of research revealing the association between the displayed behaviour and the affective state of animals, the study of behaviour has returned to a central space in animal welfare assessment. Yet, the inverse, the incorporation of welfare science into animal behaviour research, is not equally true. Thus, contrary to evidence from the literature and recommendations from frameworks such as STRANGE, the welfare perspective is not routinely integrated into animal behaviour studies.

Consideration of the welfare state of study animals can aid the understanding of individual differences and reduce the unreliable interpretation of results that has been adding to the replicability crisis the animal behaviour field is currently facing. In this talk, we aim to highlight the importance of integrating welfare assessment into the study of animal behaviour alongside some examples of its successful application.

Exploring the links between cognition and reproductive success in free living great tits (*Parus major*)

Laure Cauchard
Swiss Ornithological Institute, Switzerland
laure.cauchard@gmail.com

The ability to innovate (i.e. use novel or modified behaviours to solve a problem) has been found in many taxa and is thought to play a key role in rapid adaptation, accounting for the evolutionary success of some species. Recent studies showed that interindividual variations in problem-solving can be related to mating, reproductive success and survival in natural populations. Yet, whether and how variations in problem-solving are causally linked to fitness or whether a third variable is involved is currently unknown, which is a major knowledge gap in understanding how cognition can help animals to adapt to their changing environments. We tested problem-solving ability (solver vs. non solvers) using a string-pulling task attached to the entrance of nest boxes in wild breeding great tits (*Parus major*) monitored for breeding data (hatching date, brood size, number of fledglings) as well as adult morphological measurements (age, sex, body condition, blood sampling). During chick rearing, we installed infrared cameras inside nest boxes to record food provisioning (feeding rate, size number and type of preys). We expected that parents best able to solve the string-pulling task would supply their brood at a faster rate and with bigger and/or better preys. We showed that although females were more likely to solve the task, solver males delivered preys at a higher rate and brought more larvae, a particularly nutritious prey, to their chicks, than non-solver males. Path analyses showed that both males and females solving status influenced their provisioning performances. However, we identified a causal link between problem solving status and reproductive success in males mediated by their foraging performance, whereas the underlying mechanism(s) remains to be discovered in females. We explored other hypotheses that could explain a link between cognition and reproductive success.

Experience with predation influences social group risk-taking and foraging behaviors

Jesse Balaban-Feld
University of Saint Joseph, United States
jbalabanfeld@usj.edu

Prior experience with predation risk can provide valuable information and influence how individuals decide to forage and trade-off food and safety. We examine foraging and refuge use behaviour among groups of social goldfish (*Carrasius auratus*) at risk of predation from egrets (*Egretta garzetta*) for groups containing only fish that previously experienced predators, only naive fish, or mixed groups containing both experienced and naive fish. Groups of experienced fish consumed significantly less food than the naive and mixed groups, and spent the least amount of time foraging. Within the mixed treatment groups, naive individuals spent more time foraging compared to experienced group members. Interestingly, the mixed groups experienced overall mortality rates similar to the less active experienced groups, even though the mixed groups foraged more like the naive groups. We found that the mixed groups were able to detect the approaching predator significantly earlier than the all-naive groups. Thus, we show that naive individuals within mixed groups did not reduce foraging via social learning from experienced conspecifics, but did benefit from enhanced collective predator detection.

**Do neighbors influence an individual's singing?
A case study of song sharing in White-bellied Sholakili**

Suyash Sawant
IISER Tirupati, India
suyashsawant@students.iisertirupati

Many studies on animal communication have suggested the importance of vocalizations in mate selection and territorial defense. Studying the structural complexity of these vocalizations can shed light on their significance in mate selection and also in the development of local dialects. In this case study, we study individual-level variation in vocal repertoires of multiple individuals of White-bellied Sholakili *Sholicola albiventris*, an endemic and cryptic species distributed across Shola forests in sky-islands of southern Western Ghats, India. The bird is highly territorial and has complex vocalizations and an extensive vocal repertoire. This study examined multiple color-banded individuals of *S. albiventris* in one of the Shola-forest patches in Kodaikanal, Tamil Nadu. We followed these individuals throughout the breeding seasons over four years to understand the territories and recorded the songs using hand-held shotgun microphones. We used various approaches to study the complexity of these songs as sequences of notes and syllables. We then used N-gram analysis to understand the variation and consistency in individuals' vocal repertoires throughout the years and conducted inter-individual song comparisons to examine the song-sharing patterns in neighbors and strangers. Our results indicate shared note types for neighbor vs. stranger individuals and significant differences in song parameters across individuals. The study also shows the change in the individual vocal repertoires and the variation in using various notes in songs by different individuals. This study proposes novel approaches to studying song sharing in highly complex bird songs and gives insights into the dynamic nature of individuals' songs throughout the years. This case study can help understand cultural patterns in birdsongs, especially for range-restricted and highly territorial species. The study also uses simple and easily applicable approaches with available software to study the song complexity and repertoires, which can be used for a wide range of studies on animal communication.

Following a flying fox: home ranges and the influence of moon phases on the movement ecology of Indian flying fox males in southern India

Baheerathan Murugavel

Indian Institute of Science Education and Research Thiruvananthapuram, India
baheerathanm15@iisertvm.ac.in

Flying foxes belonging to the genus *Pteropus* are amongst the largest fruit bats and potential long-range pollinators and seed dispersers in the paleotropics. *Pteropus giganteus* (currently *medius*) is the only flying fox that is distributed throughout the Indian mainland, and its home range and movement ecology remain little studied. Using GPS telemetry, we have mapped home ranges of *P. giganteus* males and studied their roosting and foraging patterns in a semi-urban landscape in southern India. We show that *P. giganteus* males are long-distance flyers, commuting distances of up to 40 km in a single night, and >100 km between roosts. We also found inter-individual differences in the foraging and roosting patterns of males that may be linked to experience or age. A sub-adult male commuted longer distances per night and had a larger home range (Minimum Convex Polygon area ~ 65 km²) than the three adults (20±8 km²). Individual movement was little influenced by moon phases except for a reduced variance in the nightly distance commuted on moonlit nights. Directional bias in emergence was observed at the colony-level. There was a foraging site in the direction of emergence in over 60% of individual flights. Bats visited 21 plant species such as *Ceiba pentandra*, *Ficus religiosa* and *Agave sp.*, and commercially important trees such as *Magnifera indica*, *Manilkara zapota*, *Azadirachta indica*, *Tamarindus indica*. Our results provide important information on the space use of *Pteropus giganteus* in a semi-urban landscape with implications for understanding their ecosystem services.

Who would a fish choose to hangout with? (Individual behavioral traits and water clarity determines the mate-association preferences)

Bhavya Pratap Singh

Indian Institute of Science Education and Research (IISER), Kolkata, India

bps19ip024@iiserkol.ac.in

Freshwater systems are prone to high levels of turbidity due to both natural causes like rainfall, floods, eutrophication, etc. and increasing anthropogenic activities. The fish behavioral traits which are dependent on vision can get affected by changing levels of turbidity, which could impact evolutionary and ecological processes shaping fish communities. In this study, we investigated behavioral traits (boldness, aggression and activity) which are important for the survival in the wild and potential relationship of these behavioral traits to mate-association preferences in wild zebrafish (*Danio rerio*) in clear and turbid water conditions. Based on repeated measurements, variations in behavioral traits among individuals were initially tested. Further, tests were conducted to explore whether these behavioral traits determine mate-association preferences among tested individuals. Potential differences in their preferences under clear and turbid water conditions were then analyzed. To address these, we maintained 50 test adult zebrafish each under two conditions: Clear water and Turbid water regimes, for 30 days. After 30 days of conditioning, the behavioral tests were done (boldness, aggression and activity) to categorize individuals as proactive (bolder, aggressive and more active) and reactive (shyer, less aggressive and less active). Following this, mate-association preferences of subject fish for stimuli fish, comprising different combinations of behavioral traits and sex of the stimuli fish, were determined using standard two-choice test under clear and turbid water conditions. We found that of the tested traits, boldness was affected in turbid waters while activity and aggression were not. In clear waters, fish showed a preference for reactive males, however, these preferences were not exhibited in murky waters. The type of preference depended on the behavioral traits of the chooser as well. Thus, our results suggest that the preference for tested behavioral traits can change under turbid conditions affecting the mating patterns in the species.

Chemical signals released by fish-associated bacteria repel ovipositing mosquitoes

Alon Silberbush
University of Haifa, Israel
alon-s@sci.haifa.ac.il

Larvivorous fish are the most effective predators of mosquito larvae. In addition to direct predation, the mere presence of fish effects several larval life history traits and adult oviposition behavior. These non-consumptive effects are believed to be caused by fish-released kairomones that trigger anti-predator mechanisms. Although the repellent effect of fish-released kairomones on ovipositing mosquito female is well known, and hypothesized to be of bacterial origin, little information exists on its source and active compounds.

Here we show that bacteria isolated from the skin of mosquitofish *Gambusia affinis*, Baird and Girard, alters oviposition behavior of the mosquito *Culex laticinctus* Edwards. Kairomones released by mosquitofish repels females from ovipositing in fish-containing pools. We conducted a field experiment using oviposition mesocosms in northern Israel and showed that this repellent effect dissipates after altering fish microbiota. In addition, we show that specific bacterial isolates mimic the fish repellency effect. We believe that these results are an important step in understanding the identity and origin of fish-released kairomones.

When ancestors transmit their stress: prenatal maternal stress transmission across generations in a precocial bird

Marion Charrier

Université de Rennes 1 - UMR 6552 - EthoS, France
marion.charrier1992@gmail.com

Prenatal maternal stress (PMS) induces life-long effects in offspring. Accumulating evidence suggests that these effects can be transmitted across several generations. Although multigenerational transmission (from the F0 maternal generation to the F2 grand-offspring generation) of PMS has been demonstrated in different species, transgenerational transmission (from the F0 maternal generation to the F3 great-grand-offspring generation) has been less explored. Yet, it could be a powerful mechanism in the adaptation and evolution of populations. We showed previously in the Japanese quail that PMS increased F1 offspring's emotional reactivity probably related to the cellular level of epigenetic marks in their brain and to modulation of testosterone levels in eggs from which they hatched. Here, we evaluated the multi- and transgenerational effects of PMS by analysing the emotional reactivity of both the F2 and the F3 offspring. We also investigated the mechanisms potentially involved in the transmission of PMS across generations by analysing the hormonal composition of F1 and F2 eggs and by studying histone post-translational modifications (H3K27me3 and H3K4me2) in F3 brains. Similar to what we observed in the F1, we showed that PMS increased the emotional reactivity and specifically the neophobia of F2 offspring and F3 females' offspring. We also showed modulations of androgens levels in F1 and F2 eggs but no modifications of the level of histone post-translational in F3 brains. Although the mechanisms involved in this transmission still needs to be explored, our results demonstrate a multi- and transgenerational behavioural effect of prenatal maternal stress in birds.

Studying behaviour to improve survival in a stock enhancement program

Sabine Roussel

Université Bretagne Occidentale, France

sabine.rousseau@univ-brest.fr

Abalone are marine gastropods that are found on most continents. Most of them are cryptic species, moving mainly at night to feed on algae. In Europe, natural populations have declined sharply due to a pathogen, *Vibrio harveyi*, causing up to 80% mortality. To re-establish these populations, a stock-enhancement program has recently been set up. One of the main difficulties for the successful implantation of juveniles from nurseries is the very high mortality, often reaching more than 90% in the first month after implantation, a large part of which can be attributed to predation. The objective of this project was therefore to gain a better understanding of the prey-predator relationship using a behavioural approach. The first experiment consisted of studying the behaviour of abalone and one of its main predator, *Necora puber*. Behaviours were filmed for a week in 12-L aquariums in laboratory set-up. The results showed that 50% of the mortality was the result of the crab's prey-seeking behaviour, and the other half the result of the poorly adapted juvenile behaviour, with movements outside the shelter during daytime. The second experiment, carried out in 260-L mesocosms showed that the predation of juveniles was dependent on the juvenile size as well as the predator size. The last experiment, carried out in large 5-m³ mesocosms, showed that the presence of a shelter for implantation adapted to the abalone behaviour improved the survival of juveniles in the short term, but that this difference disappeared after one month. The next step will consist in studying if shelters designed to protect abalone are efficient in the more complex natural environment. Behavioural measures, not often used when studying stock-enhancement program, are a sensitive tool that will allow us to better understand the causes of mortality and hopefully to reduce it during stock enhancement programs.

Effects of family structure on isolation calls in a monogamous rodent

Cassandre Mahe

Laboratoire d'Ethologie Expérimentale et Comparée, Université Sorbonne Paris Nord,
France

cassandre.mahe@univ-paris13.fr

Parental care is known to have an influence on the behavioural development of the offspring. Rodent pups produce ultrasonic vocalizations during their first postnatal weeks when they face an isolation distress. In this study, we assessed how variations of the family structure impact this response in the monogamous mouse *Mus spicilegus*. Pups were raised in a uniparental (mother only), biparental, or polygynous (two female siblings and a male) family unit. On postnatal day 8, vocalizations produced by pups were recorded during two successive 5-minute isolations, separated by a 5-minute return to the nest with parents and littermates. Results showed that the return to the nest had a potentiation effect on the production of vocalizations, characterized by a rebound in the calls produced at the start of the second isolation. This effect was observed in all of the conditions. However, differences were found between the three conditions in the mean call rates produced by pups. Pups from polygynous structures called at a significantly higher rate than those raised by their mother only. The isolation situation may have triggered more anxiety in the pups from the polygynous structure who are less often left alone at the nest, due to the presence of more adults. These results show that family structure can contribute to the shaping of the behavioural profile of the offspring.

Appeasement function of displacement behaviours? Dogs' behavioural and facial displays exhibited towards humans

Giulia Pedretti
University of Parma, Italy
giulia.pedretti@unipr.it

Appeasement signals are behavioural patterns displaying an animal's lack of aggressive intentions and with function of reducing aggressive behaviours in the receiver. In domestic dogs', displacement behaviours, behavioural patterns showed without an apparent function related to the ongoing situation, have been suggested to function as appeasement signals. To test this possibility, we assessed whether the emission of these behaviours was dependent on a social conflict context, predicting that, if displacement behaviours also function as appeasement signals, they should be more prevalent in a conflict vs. non-conflict context. Fifty-three dogs were exposed to two unfamiliar humans approaching them in either a mildly threatening or neutral way. We categorized the attitude of the dogs towards the stimuli as "reactive", i.e. showing a threatening reaction consisting of barking, with a stiff posture towards the stimulus, and "non-reactive", remaining passive in front of the stimuli. We coded dogs' behaviours and facial expressions (using the DogFACS) and modelled their duration or frequency as a function of the interaction between the test condition and the attitude of the dog. Displacement behaviours of "blink", "nose lick" and "lip wipe" were associated with a "non-reactive" attitude, independently from the test condition. "Head turn" was associated with a "non-reactive" attitude in the threatening condition, while associated with a "reactive" attitude in the threatening condition. In conclusion, dogs with non-aggressive attitude emitted more putative appeasement signals, however these were not strictly associated to a conflict-ridden situation, calling for further investigation of their function.

**Spatial resolution and contrast sensitivity of flight control in Indian stingless bee,
*Tetragonula iridipennis***

Indian Institute of Science Education and Research Thiruvananthapuram, India
Asmi Jezeera M
asmijezeera16@iisertvm.ac.in

Optimization of spatial resolution may be required for different behavioural tasks and may differ from the spatial resolution estimated using anatomical methods (theoretical upper limit). For example, the spatial resolution of *Apis cerana* estimated using different behavioural methods and using anatomical methods was different. Though the spatial resolution of *Bombus terrestris* was estimated to be very similar in two different behavioural contexts, the contrast sensitivity was observed to be different in these contexts. The behaviours which are dependent on vision are limited by the constraints of the visual system and miniaturization adds further constraints on the visual system. *Tetragonula iridipennis* is a comparatively smaller stingless bee species distributed across India. In stingless bees, there is only limited information about the ability to use visual motion patterns. In this study, the spatial resolution and contrast sensitivity of *T. iridipennis* for flight control was estimated using a tunnel experiment. The effect of lateral and ventral optic flow on the different flight properties of *T. iridipennis* was also investigated. Our results suggest that *T. iridipennis* has a spatial resolution of at least 0.04 cycles per degree and 0.025 cycles per degree for lateral and ventral optic flow, respectively. The contrast sensitivity of *T. iridipennis* is at least 1.56 for 0.2 cycles/cm. The lateral position and speed of flight of *T. iridipennis* were dependent on the lateral optic flow, whereas the height of flight from the ground was influenced by the ventral optic flow. The spatial resolution of *T. iridipennis* for flight control is lesser than the theoretically estimated limit. These results also suggest that *T. iridipennis* has a poor spatial resolution and contrast sensitivity as compared to *A. cerana*, *A. mellifera*, and *B. terrestris*.

Gene family contraction towards dedicated cleaning behaviour

Jingliang Kang
The University of Hong Kong
jlkang@hku.hk

The bluestreak cleaner wrasse, *Labroides dimidiatus*, is known for its dedication to a cleaning lifestyle throughout its post-larval life by removing ectoparasites, bacteria, diseased and injured tissue from cooperative clients. To investigate the genetic mechanism underlying the specialization to cleaning behaviour, we assembled a chromosome-level genome (726.38 Mb) of *L. dimidiatus* and examined brain gene expression changes when it provides cleaning services to the client *Acanthurus leucosternon*. Comparing with genomes of other Labrid fish species, *L. dimidiatus* experienced contractions in gene families related to sensory, immunity and neural signal transduction, such as olfactory receptors, immunoglobulin and cadherin. In addition, *L. dimidiatus* also displayed low evolutionary rates in genes related to olfactory, visual and social behaviour. When not cleaning, the cleaner wrasse exhibited an overall higher expression in genes, especially for the gene member of contracted gene families. Hence, though the cleaner wrasse exhibits contractions in many gene families related to sensory, the increased expression levels of these contracted gene families when not cleaning may allow the cleaner wrasse to sense clients.

Higher relative humidity makes eyespots bigger in the tropical butterfly *Mycalesis mineus*

Tarunkishwor Yumnam

Indian Institute of Science Education and Research Thiruvananthapuram, India
tarunyumnam18@iisertvm.ac.in

Many insects can produce environment-matching phenotypes in heterogeneous environments through phenotypic plasticities, such as temperature-mediated eyespot plasticity in butterflies, where eyespots are used for antipredatory defences. However, in the tropics closer to the equator, like South India, temporal variation in temperature can be relatively less. Hence we hypothesised that seasonality in relative humidity (RH) could be a reliable cue for eyespot size plasticity in *Mycalesis mineus*. We found that adults that developed from 85% RH had significantly more prominent eyespots than 60% RH adults. Females had larger hindwing eyespots than males in both RH. For forewing eyespot, we found sexual difference only in 85% RH, where females had more prominent eyespots than males. Larval and pupal development periods were longer in 60% RH and adults with longer larval periods had significantly smaller eyespots. Our study proposes that relative humidity modulates eyespot size plasticity directly or indirectly by affecting the developmental period. Alternatively, it is also possible in natural settings that relative humidity affects the hostplant quality, affecting the larval developmental period. Our study underscores the need for further research on the interactive effect of temperature, relative humidity and plant quality on eyespot size plasticity in tropical butterflies.

Arginine vasotocin regulation of social behaviour and dominance in the common waxbill

Pedro Oliveira

Faculty of Sciences of the University of Porto, Portugal
pedromiguel58@live.com.pt

In the most recent decades, hormones have been thoroughly investigated as being one of the most important aspects of animal behaviour. In this group, scientists have been able to identify a variety of chemicals that play crucial roles in all kinds of behaviours. Neuropeptides are a group of hormones known for their ability to both play a role as neurotransmitters as well as neurohormones, depending on the location of their production. Such is the case with Arginine vasotocin (AVT), that has long been thought to only have two functions, vasoconstriction and antidiuresis. But, recently, a wider spectrum of behaviours have been shown to be influenced by it, especially sexual and aggressive behaviour. In birds, this neuropeptide acts through three receptors, V1a, V1b, and V2b, with V1a being the most common. In this study, adult common waxbills (*Estrilda astrild*) were subjected to intramuscular injections of two dosages of both AVT and Manning compound (MC), a V1a antagonist, to determine their effects on social behaviour, using a food competition test. The results showed a significant effect of AVT on the levels of general activity, with the lower dosage of the agonist leading to a decrease in locomotor activity and the higher dosage being responsible for an even higher decrease of activity, and all the observed behaviours. These results are likely due to this neuropeptide's role in the stress response through its interaction with the V1b receptor, leading to a "freezing" response. Interestingly, the lower dosage of the AVT antagonist, MC, led to a tendency to increase male aggression, while not affecting other behaviours. This result point to a role of V1a pathways in modulation of male common waxbill's aggressive behaviour.

Purinergic receptor P2y12 is a key regulator of behavior in the zebrafish

Francesco Locatelli

Sahlgrenska Academy at University of Gothenburg, Sweden

francesco.locatelli@studenti.units.it

Microglia are the resident immune cells of the brain. During the past years, research has provided a better understanding of these cells and their importance in brain development and diseases. However, basic mechanisms underlying their function remain unclear. The purinergic receptor P2Y12 is expressed by microglia and has been proposed to be involved in both neuroinflammation and modulation of behaviors. In this study, we used a newly developed p2y12 CRISPR zebrafish line to better understand the role of P2y12 in regulating behaviors. To examine how knockout of p2y12 affects behavior, we performed behavioral testing in larvae and adults investigating locomotion, responsiveness to the convulsant pentylenetetrazole (PTZ), anxiety, social behavior and aggression. Our experiments showed that P2y12 is crucial for regulating behaviors in both young and adult animals. Firstly, larval p2y12 mutants displayed increased locomotion that was enhanced by PTZ. In adults, mutants showed elevated levels of anxiety in the novel tank diving test. Shoaling tests in adult fish also showed an increased level of sociability in p2y12 mutants and a tendency to remain as a group. Furthermore, the mirror biting assay used to investigate aggression suggested decreased levels of aggressive behaviors in the p2y12 mutant line. Our hypothesis is that the elevated sociability and reduced aggression in mutants could be explained by their increased level of anxiety. Our data indicate that the behavioral effects could be caused by a dysregulation of neuronal excitation mediated by microglial P2y12. Taken together, our findings suggest that P2y12 is critical for various brain functions throughout life.

Foraging valour linked with aggression: selection against completely abandoning aggression in a high-elevation ant?

Patrick Krapf
University of Innsbruck, Austria
krapfpatrick@gmail.com

Aggressive behaviour and its benefits are widely studied in animals. It depends on physiological and environmental factors, which can lead to behavioural plasticity. Moreover, aggression and other behaviours (boldness, exploring, foraging) are often coupled across time and context (“behavioural syndromes”). The adaptive benefit-cost ratio of these behaviours has been studied across various species and situations. However, social insects such as ants have received little attention. Here, we use the high-elevation ant *Tetramorium alpestre*, which often displays peaceful behaviour in inter-colony interactions. Intraspecific peacefulness is rather unusual compared with other species. We analysed boldness, exploring, foraging, and risk-taking behaviours of two behaviourally different populations, an aggressive and a peaceful one. We hypothesized that the aggressive population would be bolder, more explorative, and more risk-prone compared with the peaceful population. We assessed their behavioural consistency (i.e. whether the number of workers engaging in experiments or the time workers needed to engage in experiments remained similar over time), variation within and across colonies, and differences among behavioural experiments. Boldness and exploring behaviours were in both populations the most consistent behaviours. In contrast, no consistent behavioural pattern was detected in foraging and risk-taking behaviours for either population. Additionally, behavioural differences were found between the two populations: The aggressive population was bolder, more explorative, and risk-prone and had more workers present in the experimental arena compared with the peaceful population. These findings corroborate our hypothesis. The results suggest that boldness, exploring, and risk-taking are coupled with aggression and indicate the presence of behavioural syndromes in this ant. We speculate that under specific ecological conditions, aggressive behaviours may be important for finding food: Aggression may have an adaptive value, possibly indicating that selection maintains aggressive behaviour in *T. alpestre*. This may counteract the complete loss of intraspecific aggression, at least under certain conditions.

Mapping beat precision in acoustic signals in the vocal learning harbor seal *Phoca vitulina* throughout ontogeny

Lara Sophie Burchardt

Max-Planck Institute for Psycholinguistics, Nijmegen, Netherlands & Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands

lara.burchardt@donders.ru.nl

Many animals produce sounds rhythmically. The temporal structure of animal communication can give insights into many important aspects of a species' behavior, cognition, and ecology. Yet, the mechanism and function of rhythm production are still enigmatic. Zooming in on a key aspect of rhythm, we characterize beat precision in vocal signals of the harbor seal *Phoca vitulina* throughout its ontogeny. Analyzing beat precision in a sequence of sound elements can give insight into different processes. For example its development during ontogeny could inform about the abilities for precise motor control of the vocal apparatus. Beat precision is calculated using a self-developed universal goodness-of-fit value to assess, how well the acoustic signals follow an expected temporal sequence, i.e. the calculated rhythm. Based on a prominent hypothesis in evolutionary neuroscience, we hypothesize that the seals, a vocal learning species with a simple communication structure, will show a high beat precision, that will increase during ontogeny from pup stage to adulthood. We mapped the beat precision and rhythm for a dataset of 180 call sequences from 11 harbor seal pups recorded at the Sealcenter Pieterburen, Netherlands and 17 call sequences of adult sexually mature harbor seal males recorded in the wild in Alaska. Results are presented visually and compared on different levels to get insights into the importance of beat precision for the acoustic communication of the harbor seal.

Tracking the Inflation of Siamang Airsacs During Singing Using Hough Transformations

Wim Pouw

Donders Center for Brain, Cognition, and Behavior, The Netherlands
wim.pouw@donders.ru.nl

We use close-up video recordings of singing siamangs (*Symphalangus syndactylus*) to demonstrate a python-based tracking of circular objects in visual media via Hough Transformations. This particular primate species has a characteristic inflatable, ventricular airsac, that is inflated during some vocalizations and singing bouts. Until now, the specific function of these airsacs remains unknown, apart from being resonators, they have been hypothesized to play as impedance matchers, to suppress resonance or to have no acoustic function at all. The air sac naturally forms a spherical (3D) or circular (2D) shape; such shapes are retrievable from an image using the Hough Transformation to get the optimal representation of the relevant edges of the air sac. The radius of these circular object as well as their position in the frame is tracked and saved for subsequent analyses. With our method we will be able to connect, for instance, inflation radius of the airsac to spectral sound parameters such as fundamental frequency and amplitude; this in turn will help to test for purported function of airsacs in singing displays. More generally, and beyond this particular question, the tracker we used will allow estimating radii of other naturally circular or spherical objects in visual media formats. Such estimation will be applicable to a variety of contexts, for example estimation of other species' (e.g. amphibians') airsacs/buccal cavities, or a variety of roughly circular objects, such as eyes, mouth openings and more.

Knockout of quaking b causes increased anxiety and sociability in zebrafish

Dina Almudafar
University of Gothenburg, Sweden
petronella.kettunen@neuro.gu.se

The quaking (QKI) gene involved in myelination has found to be downregulated in the brains of schizophrenic patients and is considered a possible susceptibility gene for the disease. Out of the three zebrafish qki variants, qkib is the most similar to human QKI. In this project, we investigated the effects of qkib knockout on behaviors in zebrafish. Anxiety was tested with the novel tank diving and open field tests, and sociability was investigated with the social preference test as well as shoaling test. We found that qkib mutants showed significantly longer bottom-dwelling time in the novel tank diving test, in addition to longer freezing in the open field test, compared to controls. Excluding freezing fish in the social preference test showed longer duration in the social zone for knockouts compared to controls. Moreover, in the shoaling test, mutant fish showed increased sociability reflected by shorter inter-fish distances compared to controls. Using pharmacological tools, we managed to revert the anxiety in both mutants and controls. Further research is needed to fully understand the neuronal functions of QKI.

Animal behaviour in science education: learning and socio-emotional development of primary school children as citizen scientists

Katharina Hirschenhauser
University College for Education Upper Austria (PHOÖ)
katharina.hirschenhauser@ph-ooe.at

Involving interested volunteers in the scientific process, such as the use of citizen science (CS) as a methodological approach, can result in large datasets, peer-reviewed publications, as well as increased scientific literacy and biodiversity awareness in society. In particular, CS is considered a powerful supplement for teaching natural sciences (and beyond) at school. Even though involving children of primary school age in scientific activities is still uncommon, previous studies confirmed that they have the capacity to contribute meaningful data as citizen scientists. Typically, some children benefit enormously from participating in a CS-project, however, others don't. To enable decisions for school representatives and funding agencies, empirical tests of the learning benefits of involving CS in routine teaching are needed. We present a project on animal behaviour involving children as citizen scientists. Primary school children were enabled to monitor individuals and to identify social affiliates within a flock of Greylag geese, and our focus was on evaluating CS in the context of science education. We wrap up the results of critical tests of (i) factual learning during a project on the social behaviour of a free-living bird species, i. e. Greylag geese (*Anser anser*), (ii) conceptual learning, i. e. the transfer of knowledge to new contexts and of the children's concepts of 'friendship', and (iii) impulsive behaviour control in primary school children involved in a project as citizen scientists. Our results show in primary school aged children, that the benefits of participating in research activities involving animals become evident at the levels of conceptual learning and at a socio-emotional level rather than merely learning facts.

Social familiarity and spatially variable environments independently determine reproductive fitness in a wild bird

Samin Gokcekus
University of Oxford, England
samingokcekus@gmail.com

Individuals' reproductive success depends not only on their own traits, but also the external social and ecological settings they find themselves in. The 'dear enemy effect' posits that having familiar neighbors at a territory boundary can reduce the need for territory defense and potentially increase cooperation. Although fitness benefits of reproducing among familiar individuals are documented in many species, it remains unclear to what extent these relationships are driven by direct benefits of familiarity versus other socio-ecological covariates of familiarity. We use 56 years of great tit (*Parus major*) breeding data to disentangle the relationship between neighbor familiarity, partner familiarity, and reproductive success, while simultaneously considering individual and spatiotemporal effects. Our results are consistent with direct effects of familiarity on individuals' fitness outcomes. These findings suggest that social familiarity can carry direct fitness benefits, potentially driving the maintenance of long-term bonds and evolution of stable social systems.

Insect-machine hybrid system: Navigation control for a cyborg beetle

T. Thang Vo-Doan
University of Freiburg, Germany
vodoan@bio.uni-freiburg.de

The insect-machine hybrid system, also known as cyborg insect or insect biobot, is a fusion of a living insect platform and a miniature control backpack mounted on its body. Terrestrial insect-machine hybrid systems inherit the excellent locomotion capabilities of living insects, which are controlled by a sophisticated central nervous system and various sensory organs, favoring their maneuvers in complex terrain. However, efficient autonomous navigation of these hybrid systems is challenging. The difficulty in optimizing the stimulation parameters for each insect limits the reliability and accuracy of navigation control. In this study, we overcome this problem by implementing a feedback control system for navigating an insect-machine hybrid system based on a living darkling beetle (*Zophobas morio*). Electrical stimulation of antennae induced left/ right turn while acceleration was achieved by stimulating the elytra of the beetle. Using an on/off thrust controller for acceleration and a proportional controller for turning, the system regulates stimulation parameters based on the current state of the hybrid system. Tuning the control parameters enables reliable and precise trajectory navigation. This tunable performance of the feedback control system provides flexibility for navigation applications of insect-machine hybrid systems.

Wild skuas can follow human-given behavioural cues when objects resemble natural food

Samara Danel
University of Oxford, England
samara.danel@gmail.com

The capacity to follow human cues provides animals with information about the environment and can hence offer obvious adaptive benefits. Most studies carried out so far, however, have been on captive animals with previous experience with humans. Further comparative investigation is needed in order to properly assess the factors driving the emergence of this capacity under natural conditions, especially in species that do not have longstanding interactions with humans. Wild brown skuas (*Catharacta antarctica* ssp. *lonnbergi*) are non-neophobic seabirds that live in human-free habitats. In test 1, we assessed this species' capacity to use human behavioural cues (i.e., pecking at the same object previously picked up and lifted by a human experimenter) when the items presented were food objects: anthropogenic objects (wrapped muffins) and natural-food-resembling objects (plaster eggs). In test 2, we examined the response of another skua population towards non-food objects (sponges). Although all skuas in test 1 pecked at the object, they pecked significantly more at the same previously handled items when they resembled natural food (plaster eggs). Most skuas in test 2, however, did not approach or peck at the non-food objects presented. Our results lead us to suggest that the use of human behavioural cues may be influenced by skuas' foraging ecology, which paves the way to further field studies assessing whether this capacity is directed specifically towards food objects and/or develops after previous interaction with humans.

Audience effect on domestic dogs' behavioural displays and facial expressions

Chiara Canori
University of Parma, Italy
chiara.canori@studenti.unipr.it

In the present study we investigated the influence of positive and negative arousal situations and the presence of an audience on dogs' behavioural displays and facial expressions previously identified as stress-related signals as well as appeasement signals. We exposed dogs to positive anticipation, non-social frustration and social frustration evoking test sessions and measured pre and post-test salivary cortisol concentrations. Cortisol concentration did not increase during the tests and there was no difference in pre or post-test concentrations in the different test conditions, excluding a different level of arousal. Displacement behaviours of "looking away" and "sniffing the environment" occurred more in the frustration-evoking situations compared to the positive anticipation and were correlated with cortisol concentrations. "Ears forward" occurred more in the positive anticipation condition compared to the frustration-evoking conditions, was positively influenced by the presence of an audience, and negatively correlated to the pre-test cortisol concentrations, suggesting it may be a good indicator of dogs' level of attention. "Ears flattener", "blink", "nose lick", "tail wagging" and "whining" were associated with the presence of an audience but were not correlated to cortisol concentrations, suggesting a communicative component of these visual displays. These findings are a first step to systematically test which subtle cues could be considered communicative signals in domestic dogs.

Ants combine systematic meandering and correlated random walks when searching for unknown resources

Stefan Popp
University of Arizona, United States
st.popp@yahoo.de

Animal search movements are typically assumed to be mostly random walks. Only recently have studies begun to look for systematic elements like memory and periodicity in animal search patterns. The detection of systematic behavior is the first step to infer concrete movement rules and analyze search efficiency. We filmed and tracked searching ants (*Temnothorax rugatulus*) in an empty arena of the size of roughly 1000 ant body lengths, resulting in almost 5km of movement trajectories. We observed conspicuous meandering behavior. To test whether the ants' search behavior indeed showed regular meandering, we compared the turn autocorrelations between successive steps for empirical ant tracks and tracks of simulated, realistic Correlated Random Walks based on turning angles matched to each ant. We found that 80% of ants show significant negative autocorrelation around 10mm (3 body lengths). This means that turns in one direction are likely followed by turns in the opposite direction after this distance, i.e. that ants follow a meandering path. This meandering likely makes the search more efficient, as 74% of ant tracks crossed their own paths fewer than the random simulations, while only 23% were more dispersive. Ants can thus avoid searching the same areas multiple times without moving too far away from the nest, which would add return travel time. Additionally, the stochasticity of the movements make the search less susceptible to noise than purely systematic strategies. This study is the first to find evidence for increased search efficiency by regular meandering in a freely searching animal.

Honey bees continuously retract the edges of their comb following nest expansion

Claire Bailey
Auburn University, United States
csb0063@auburn.edu

Honey bees are renowned for being resourceful builders, best exemplified by their hexagonal cells, which maximize storage area while minimizing wax use. Wax is expensive for bees to produce, and it cannot be consumed, so once combs are built, they remain in the colony for life. While workers do not remove combs completely and begin anew, there is the possibility for more subtle adjustments and repositioning of existing wax. To investigate how combs changed over time, we tracked five colonies, photographing their combs every 1-2 weeks, from nest initiation through maturity (211 days). Aligning comb images over time allowed us to determine that wax was moved at the edges of the comb, thereby reducing the total comb area over time. By analyzing 1050 comb images, we found that all five colonies trimmed the wax edges of their nest, with 96% of all combs being trimmed ($n = 50$ combs total; 48 were trimmed). Combs were trimmed once workers were no longer expanding their nests (70 days post nest initiation, 15 June 2021), and continued trimming the comb throughout the experiment (211 days, 1 Nov. 2021). Some combs were trimmed back as much as 60 mm squared, and several frames had approximately 4% of total comb removed. These results demonstrate that honey bees continue to alter their comb, even after comb expansion is complete.

Determinants of spring molt in bighorn sheep: life-history, plasticity and phenology

Benjamin Larue
Université de Sherbrooke, Canada
benjamin.larue@usherbrooke.ca

Anthropogenic climate change and habitat alterations increase the importance of understanding the causes and consequences of variation in phenological traits. Although the timing of phenological events may vary in response to both direct and mediated effects, methods to measure and distinguish direct and mediated effects have seldom been used. We used a Bayesian structural equation model (SEM) to evaluate potential direct and mediated effects of intrinsic individual and environmental factors on the timing and progression of spring molt in bighorn sheep. The SEM showed that molt phenology varied across years, was earlier in prime-aged and in heavier individuals, slower in males, and later in lactating ewes, especially if they were light. These results highlight how individual variation in intrinsic traits and life-history leads to substantial variation in a phenological trait. Indirect effects in the SEM predicted a delay in sheep molt phenology at high population density mediated through negative density effects on body mass and lactation probability. Cooler temperatures in late spring were also predicted to delay molt phenology via a negative effect on body mass. Finally, lactation reduced ewe mass which was predicted to delay molt phenology. This mediated effect thus increased the total delay (sum of direct and mediated effects) in molt phenology experience by lactating ewes. Our results underline the importance of estimating direct and indirect effects when modeling phenological traits. Because indirect effects could substantially affect estimates of total plasticity, they should be critically important to accurately predict phenological mismatches and demographic consequences of environmental change.

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