

INTERNATIONAL STUDENT SYMPOSIUM  
FOR  
ANIMAL BEHAVIOR AND COGNITION



PRESENTED BY WESTERN UNIVERSITY  
MAY 17<sup>TH</sup> – 20<sup>TH</sup>, 2021  
WESTERN UNIVERSITY

## ISSABC 2021: SCHEDULE IN BRIEF

Date	Time Block	Description	Type	EDT	GMT
May 17th	Pre-Morning Block	Welcome to ISSABC	LIVE	9:30AM	1:30PM
	Morning Block	Plenary 1 Dr. Natalia de Souza Albuquerque	LIVE	10:00AM	2:00PM
	Lunch Break!				
	Afternoon Block 1	Movement & Spatial Cognition			
	Afternoon Block 2	Social Cognition & Communication			
	Evening Social	Join the Zoom Room	LIVE	5:00PM	9:00PM
May 18th	Morning Block	Plenary 2 Dr. Judit Abdai	LIVE	10:00AM	2:00PM
	Lunch Social	Join the Zoom Room	LIVE	12:00PM	4:00PM
	Afternoon Block 1	Evolution, Selection & Development			
	Afternoon Block 2	Fear & Aggression			
May 19th	Breakfast Social	Join the Zoom Room	LIVE	9:00AM	1:30PM
	Morning Block	Plenary 3 Dr. Rowan McGinley	LIVE	11:00AM	3:00PM
	Lunch Break!				
	Afternoon Block	Plenary 4 Dr. Caroline Strang	LIVE	2:00PM	6:00PM
May 20th	Morning Block 1	Learning & Memory			
	Morning Block 2	Perception & Decision Making			
	Lunch Break!				
	Afternoon Block 1	Animal Welfare			
	Farewell Party	Join the Zoom Room	LIVE	2:00PM	6:00PM

# Movement & Spatial Cognition

## Asynchronous

### Lightning Talks

#### **Rhesus macaques learn to identify the numerical middle in series of objects and generalize this concept to new arrays varying in color, shape, and number.**

Zhaoying Chen – University of Pennsylvania, United States

Numerical and spatial skills have been extensively documented in many non-human animal species. Nevertheless, few studies have investigated animals' ability to identify the abstract middle concept. Here we addressed whether rhesus monkeys (*Macaca mulatta*) can use the abstract concept of "middle" in a series of objects. To address this question, we designed three high-controlled computerized experiments. In Experiment 1, we tested whether monkeys could proficiently detect the middle element and how a visual color cue might aid middle identification. We trained two monkeys (Arrow and Tolman) to select the middle dot in a horizontal series of three dots presented on a touchscreen. Our results showed that monkeys continued to choose the middle dot above the chance level despite changes in the appearance, location, and spacing of the series (Arrow:  $p < 0.001$ , Tolman:  $p < 0.001$ ). In Experiment 2, we explored whether monkeys could transfer this abstract concept of "middle" to novel stimuli. We created two three orange dot and three purple triangle probe conditions and mixed them in with the familiar three-red-dot trials. Monkeys maintained high performance when the color, shape and the length of the stimuli were new, indicating that their responses did not depend upon the appearance of the array items (orange dots: Arrow:  $p = 0.016$ , Tolman:  $p < 0.001$ ; purple triangles: Arrow:  $p = 0.003$ ; Tolman:  $p < 0.001$ ). Experiment 3 tested whether monkeys could generalize the middle concept learned with a 3-dot series to a 7-dot series. Though accuracy in 7-dot trials was lower, monkeys continued to select the middle dot with above chance performance (Arrow:  $p < 0.001$ , Tolman:  $p < 0.001$ ). Overall, these findings demonstrate that monkeys can spontaneously extrapolate a middle rule and that they can flexibly apply the rule to novel and larger series.

### Standard Talks

#### **Learning walks in Australian desert ant, *Melophorus bagoti***

Sudhakar Deeti – Macquarie University, Australia

The Central Australian ant *Melophorus bagoti* is the most thermophilic ant in Australia and forages solitarily during the summer months for the hottest period of the day. For successful navigation, desert ants of many species are known to use innate navigational strategies and learned landmark cues around the nest. Ants perform a series of exploratory walks around the nest to acquire landmark information before their first foraging trip, during which they are presumed to learn about their landmark panorama. Here, we studied 15 naïve *M. bagoti* ants transitioning from indoor work to foraging outside the nest. In three to four consecutive days, they performed 3 to 7 exploratory walks before heading off to forage. Naïve ants increased the area of exploration around the nest and the duration of trips over successive learning walks. In their first foraging walk, the majority of the ants followed a direction explored on their last learning walk. During learning walks, the ants stopped and performed stereotypical orientation behaviours which are called pirouettes. They performed complete body rotations with stopping phases as well as small circular walks without stops known as voltes. After just one learning walk, these desert ants could head in the home direction from locations 2 m from the nest, although not from locations 4 m from the nest. These results suggest gradual learning of the visual landmark panorama around the foragers' nest. Our observations show that *M. bagoti* exhibit similar characteristics in their learning walks as other desert ants of the genera *Ocymyrmex* and *Cataglyphis*.

## **Canada jays (*Perisoreus canadensis*) identify and exploit coniferous cache locations using visual cues**

Matthew Furst – University of Guelph, Canada

Food caching is a foraging strategy that has evolved across many different taxa to allow organisms to survive periods of low food abundance. Once cached, stored food may be lost to degradation, particularly for highly perishable items. Canada jays are a resident songbird species of the boreal forest of North America and rely on cached perishable food for overwinter survival and late-winter reproduction. Evidence from field experiments suggest that, some conifers such as spruce trees may aid in cache preservation through protective properties in resin. However, due to the challenges involved with following individuals to their caching locations, cache-site preferences of jays are not easily studied. We investigated eight captive Canada jays' (*Perisoreus canadensis*) ability to both identify and exploit conifer tree species for food caching. Further, we examined potential cues that jays may use in order to identify and select these potentially beneficial sites. We found strong evidence to suggest that birds can quickly identify conifer tree species, and subsequently exploit those cache locations preferentially. Furthermore, we found evidence that birds use structural but not olfactory cues when making caching decisions. We suggest that visual information is essential to both the identification of conifer trees and to cache-site selection decisions. These findings indicate that jays make rapid, fine scale assessments of their environments, discriminating among trees of different species, and use this information to select cache sites.

## **The influence of environmental symmetry on adult reorientation strategies**

Iroshini Gunasekera – University of Manitoba, Canada

This study examined whether environmental symmetry influences the use of featural and geometric cues when adults reorient in one of two octagonal arenas. The arenas contained a distinct feature, but different geometric information due to their distinctive shapes. One arena was bilaterally symmetrical along the main dividing axis, the other was bilaterally asymmetrical. Participants ( $n = 64$ ) searched for a hidden target, located in one of the eight corners, in one of the arenas (between-subjects factor) and were counterbalanced across three testing types (within-subjects factor) in a mixed factor study design. Following training, transformation tests were given that either moved the featural cue or removed it from the arena. Reorientation using only geometry was examined by removing the featural cue (Geometry Only test). The relative weighing of the featural information and geometric information was examined by moving the distinctive feature one or two wall lengths clockwise (One-Move Cue Conflict and Two-Move Cue Conflict tests, respectively). Previous research has reported that women rely more heavily on featural cues compared to men. Therefore, this study also investigated sex differences in the use of featural and geometric cues for reorientation. The results showed that environmental symmetry influenced cue reliance. The order in which the transformation tests were given also influenced the use of featural and geometric cues during cue conflict. A significant sex difference was not found. This study will contribute to our understanding of how featural and geometric information are used by adults to reorient and whether environmental symmetry affects reorientation strategies.

## **Relationship Between Flight and Cluster N Activation**

Chloe Henry – Western University, Canada

Avian migration has served as one of the most fascinating phenomena in the realm of animal behaviour. This behaviour largely relies on navigation via cues that are extracted from the environment. While many exist, magnetoreception is a particular cue that has gained recent traction. Currently, Cluster N is the neural region thought to process magnetic field information that is utilized during magnetoreception. This neural region has been predominantly examined neurobiologically, leaving the behavioural component unexplored. The present study examined Cluster N activation in Yellow-rumped warblers (*Setophaga coronata*) to determine whether activation in this region is present within this species, and subsequently whether activation is flight dependent. Birds were experimentally flown in a wind tunnel under conditions that simulated migratory flight. Brains were collected either immediately following flight or after a 24-hour delay. Using immunohistochemistry, expression of ZENK immunoreactive cells were measured to determine whether Cluster N displays flight-related changes. While ZENK expression was present, there were no significant differences present between the immediate and delayed flight group. These findings suggest that while Yellow-rumped warblers do display activation in the Cluster N region, this region does not appear to be flight dependent.

## **Habitat use and home range extension by a smooth-coated otter family (*Lutrogale perspicillata*) in the Singapore Botanic Gardens.**

Anusha Shivram – National University of Singapore, Singapore; University of British Columbia Okanagan, Canada

The smooth-coated otter (*Lutrogale perspicillata*) is a Vulnerable species facing threats driven by urbanisation throughout their range. Hence, studies on their adaptations are valuable. In the Central Watershed of Singapore, smooth-coated otters use lotic canalised waterways for territory. Inland use of lentic systems is rare. In 2019, one family group resided in the lentic system of the Singapore Botanic Gardens, a World Heritage Site, for the first time. Isolated from waterways by roads and urban development, the gardens were used by the family group as a nursery site. This study analysed the habitat use and post-natal home range expansion attempts of the family. Field sightings supplemented by verified records from otter-watchers in the Otter Working Group were used to plot otter residency and movement. Habitat variables of holts and foraging sites revealed that while the family was adaptable to human disturbance, they showed preference for sites with vegetated or artificial cover. When pups were young, the family used ponds and lakes across the gardens to forage. The smaller, shallower water bodies were used to teach pups how to swim and the larger, deeper lakes were used by adults to forage. When the pups grew stronger, the typical pattern of post-natal territorial expansion was rebuffed by territorial resident families in the nearby waterways of Singapore and Kallang Rivers. This smooth-coated otter family remains nomadic, moving between lotic and lentic waterways within the urban matrix, and have proved to be highly adaptable to Singapore's urban environment.

## **Social Cognition & Communication**

### **Asynchronous**

#### **Lightning Talks**

##### **Bugs in the code: Using a computer model to understand fly larvae collective behaviour**

Tanya Shoot – Wilfred Laurier University, Canada

Being part of a group entails both costs and benefits. When and with whom animals choose to group can help us identify which benefits are being reaped in a specific situation. Collective digging behaviour in *Drosophila melanogaster* larvae has been shown to provide individuals within the group more access to food than when alone. Collective digging has been observed in third instar larvae, at a time when hunger is elevated due to the imminence of pupation. To isolate how population density affects digging frequency and cluster size, we created an agent based model of collective digging, based on existing empirical findings. We find that higher densities aid individuals in increasing food intake, up to a threshold, beyond which increased density is detrimental. Cluster size and duration are consistent across the range of population densities tested. As expected, time spent clustering increases as population density increases. By modeling both collective and individual behaviours, group behavior dynamics can be understood at a mechanistic level.

#### **Standard Talks**

##### **“More Leaders or Safer Relocation”- Understanding leader recruitment in a tandem running ant during colony relocation**

Purbayan Ghosh – Indian institute of Science Education & Research Kolkata, India

Recruitment is a widespread behaviour throughout the animal kingdom. In insect colonies, recruitment can occur during foraging, colony defense, nest construction and entire colony relocation; thus different insect species use distinct recruitment mechanisms. One of such recruitment strategies is tandem running that some ant species employ during colony relocation. During tandem running, only the leaders possess information about the new nest's location and quality and transport the nestmates by forming a tandem pair, making the leader recruitment process complicated. Previous studies have shown that tandem running ants recruit additional leaders to keep the relocation time unchanged if they need to relocate further. Here we investigated the leader recruitment process of a tandem running ant, *Diacamma indicum*, by keeping their relocation distance fixed and increasing single transport time. Since there is a direct link between increases in relocation time and increased mortality risk, we expected that as we increase the single tandem run time, relocation time will remain unchanged, and more leaders will be recruited to the process of relocation and stay active for a longer time. Upon comparing relocation dynamics of control (CT: unmanipulated colonies), manipulated control (MC: every transport was held for 2s) and manipulated colonies (MN: every transport was held for 60s) we found that *D. indicum* has sturdy leader recruitment process, which does not get affected due to increasing single transport time. Even though the individual behaviour of leaders gets affected as they become experienced, the overall work distribution remains unaffected. Contrary to our expectation, the colony chooses to spend additional time relocating and does not recruit additional leaders to relocate faster. To have a holistic picture of the evolution of recruitment strategies additional studies are needed to understand how different biotic and abiotic factors affect leader recruitment process across different genres of ants in diverse ecosystems.

## **Social learning in a harsh environment**

Emil Isaksson – University of Ottawa, Canada

How external factors influence selection on cognitive traits is still largely unknown, as little research has been dedicated to the relation between the environment and cognitive abilities. Living in an environment with uncertain food access should favour cognitive abilities that can mitigate this uncertainty, like learning about potential food sources to exploit. This “harsh environment” hypothesis has been tested for asocial learning and memory, but not tested for social learning yet. Social learning is an important cognitive process, the benefit of which, as a foraging strategy, received strong theoretical support in a computer-based modelling competition. However, little is known about variation in social learning tendencies in natural populations. I tested the harsh environment hypothesis by comparing social learning performance across two tasks for great tits (*Parus major*) from several sites at high and low elevation habitats. Compared to low elevation, high elevation habitats exhibit lower temperature and deeper, more persistent, snow cover, making high elevation sites harsher. We predicted individuals from high elevation to show higher reliance on social learning than individuals from low elevation. Initial analysis demonstrates the presence of social learning in great tits from both habitats, as we found that individuals from either elevation were more likely to engage in two novel extractive foraging tasks following demonstration by a trained individual than individuals without demonstration (control). However, there was no difference in propensity to perch, i.e. approach the task, between high and low elevation birds (N=40; 20 per elevation). This result suggests, tentatively, that SL is equally beneficial in either habitat. Further analyses are underway, including survival analysis of the latency to perch and/or pull an item, which will give a more complete picture of the SL tendencies of birds of both habitats.

## **The effect of the presence of the handler on the exploration of novel objects in case of intensively socialised, adult wolves (*Canis lupus*)**

Rita Lenkei – Eötvös Loránd University, Hungary

Though it is widely accepted that the complex social behaviour of the common ancestor of the dog (*Canis familiaris*) and the wolf (*Canis lupus*) had a key role in the domestication of dogs, our knowledge is surprisingly scarce about the relationship that might develop between hand-reared, intensively socialised wolves and their human handlers. These experiments – although indirectly – would help us to understand how the socio-ecological features of the ancient wolf might affected the process of early domestication. If indications of a complex interspecific social behaviour is found towards humans in case of hand-reared wolves, it might similarly have been also present at the time of the early domestication of the dog. The presence of a familiar individual has a calming effect in case of a stressful situation in several social species. This might have an important role in situations that require cooperation. In case of captive wolves it was found that the presence of a pack mate facilitated the approach and exploration of a novel object, suggesting a stress reducing effect of the familiar individual. Based on this we investigate whether this social buffering effect would also develop towards their human handlers in intensively socialised wolves (N=10). The subjects were exposed to a novel object in their enclosure alone and in the presence of their handler for 5-5 minutes. Based on our preliminary results (N=5) though there is no difference in the latency of approaching the objects but the wolves sniffed and gazed it more frequently when they were with their handler. Our results seem to support the hypothesis that hand-reared wolves rely on their handler as a secure-base and the presence of a familiar person enhances exploratory behaviour similarly as a pack mate would do.

## **Dogs can mentally represent jealousy inducing social interactions**

Billy Lim – University of Nebraska Lincoln, United States

Jealousy is a complex, secondary emotion thought to have evolved to protect highly valuable social bonds. As dogs live in close proximity to humans, elements of jealousy may have developed to protect such relationships. Although majority of dog owners report jealous behaviour in their dogs (Morris, Doe, & Godsell, 2008), studies on how these behaviours are expressed and how similar they are to human jealousy are limited by alternate explanations such as experimenter cues and general arousal effects, and have yielded mixed results (Harris & Prouvost, 2014; Prato-Previde et al., 2018). Utilising a novel pulling-force paradigm, the current study aimed to find three signatures of human-like jealousy in dogs, namely that jealous behaviour should emerge: (1) only when the relationship is threatened by a social rival, (2) as a consequence of the interaction between the owner and interloper, rather than merely due to the presence of a conspecific, and (3) when the focal interaction is not directly visible to the subject, but rather has to be inferred through mental representation. We found dogs pull with greater force when their owners interacted with a hidden realistic stuffed dog rather than a fleece cylinder, even though the stuffed dog was present in both conditions. Furthermore, in a control trial where the interaction with the perceived social rival was directly visible, there was no difference in pulling force than when the interaction was not visible, controlling for the visual access and distraction hypotheses. The results support claims that dogs display jealous behaviour and provides the first evidence that dogs can mentally represent jealousy-inducing social interactions.

## **Daily pattern of vocalization of *Sciurus carolinensis* and *Tamias striatus* (Family: Scuridae) in an urban forest patch in northern Ontario.**

Bruna Schuab – Algoma University, Canada

Quantifying vocal communication is a useful tool for understanding diel activity patterns of species, and it have been studied in a diverse group of animals. For example, many birds, mammals, anurans, and insects have a peak in vocalization during the twilight hours at dawn and/or dusk. In sciurids, seasonal and diel patterns of acoustic communication are not well studied. For instance, most studies focus on alarm calling and social species (i.e., ground squirrels). I used automated recorders and spectrographic analysis to examine the vocalization rate of northern Ontario sciurids (eastern gray squirrel: *Sciurus carolinensis*, eastern chipmunk: *Tamias striatus* and the American red squirrel: *Tamiasciurus hudsonicus*) at five sites during eight weeks of fall (14 September – 6 November) in a 13 hectares urban forest patch, in Sault Ste. Marie, Ontario. Supplemental food was provided bi-weekly (and repeated three times) at the recording stations to test how changing resource abundance influenced vocalization rates. I analyzed recordings on 8-12 days before and after food addition, and then calculated vocalization rate (call/h) for dawn, morning, evening, and dusk for *S. carolinensis* and *T. striatus*. *T. hudsonicus* was not present at the woodlot. This study is the first to analyze daily vocalization patterns of populations of *S. carolinensis* and *T. striatus* in northern Ontario, and thus, our results will contribute with more knowledge in the Scuridae family, by better understanding their vocal behavioral patterns with respect to food cues and may result in new research questions about this family in the future.

## Evolution, Selection & Development Asynchronous

### Lightning Talks

#### Preference for Paternal, Maternal, and Hybrid Birds by Bengalese-x-Long-tailed Finch Hybrids

Moises Rivera – City University of New York, United States

Filial imprinting in Estrildid finches plays an important role in the attention to and learning of conspecific behaviors crucial for adult social behaviors. In the majority of Estrildid mating systems, males display courtship behaviors (e.g., song, dance, plumage advertisement) toward conspecific females, and females select conspecific males based on their preference for these displays. Hybridization raises complications in genetic, physiological, and behavioral traits, leading to the maladaptive development and exhibition of these in hybrid offspring. The present study explores whether Bengalese-x-Long-tailed finch hybrids exhibit social preference for opposite-sex birds of their maternal, paternal, or sibling (hybridized) species. We tested male and female Long-tailed finches, Bengalese finches, and Bengalese-x-Long-tailed hybrids using an iterative Miller two-choice paradigm. We predicted that hybrids would prefer birds of their paternal species given the important role of males as song tutors in Estrildids, and would prefer hybrids over their maternal species given that hybrids were tutored by male Long-tailed finches. We found that while male hybrids exhibit preference for females of their paternal species, females prefer males of their maternal species over males of their paternal species as well as over hybrid males. Our results suggest differential effects of sex on imprinting and subsequent social preference in these Estrildid hybrids.

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La impronta filial en pinzones (Estrildidae) juveniles desempeña un rol importante en la atención y el aprendizaje de comportamientos que posteriormente serán cruciales para apropiadamente interactuar con conspecíficos en la etapa adulta. En la mayoría de los sistemas reproductivos de pinzones, los machos ejecutan exhibiciones de cortejo (por ejemplo, presentaciones de movimiento, plumaje, canción) hacia hembras conspecíficas, y a su vez las hembras eligen machos cuyos desfiles de cortejo alinean con sus preferencias. La hibridación genera complicaciones en los rasgos genéticos, fisiológicos, y comportamentales, conduciendo al desarrollo y la exhibición desadaptativa en la progenie híbrida. En este estudio investigamos si los pinzones híbridos (*Lonchura striata domestica* X *Poephila acuticauda*) exhiben preferencia social por aves del sexo opuesto de su especie materna, paterna, o sus congéneres (híbridos). Utilizamos pruebas de dos opciones (“paradigma Miller”) iterativamente para evaluar la preferencia de machos y hembras de las especies materna, paterna, e híbrida. Predijimos que ambos machos y hembras híbridos preferirán aves de su especie paterna (*P. acuticauda*) dado el rol importante que juegan los machos como preceptores cantoral en estas especies. Como tal, también predijimos que híbridos prefirieran a otros híbridos sobre la especie materna, ya que los híbridos aprendieron canción solo de sus padres ya que las hembras de estas especies no cantan. Encontramos que mientras que los machos híbridos prefieren hembras de su especie paterna, las hembras híbridas prefieren machos de su especie materna. Nuestros resultados sugieren la existencia de efectos diferenciales del sexo sobre la impronta y subsiguiente preferencia social en pinzones híbridos.

## **The Ontogeny of Social Behavior in Garter Snakes**

Morgan Skinner – Wilfred Laurier University, Canada

Developmental studies of sociality in non-human animals offer important insights into the evolution, function, and plasticity of social behavior, especially in understudied species. I will present data on garter snakes – a species that does not form permanent social groups, whose social behavior is little studied. We examined the social tendencies of a group of 6 Eastern garter snakes over the first year and a half of their lives. We then compared their behavior to two groups of adult garter snakes. To assess their social patterns and construct social networks, we recorded their social interactions over an 8-day period. We repeated this process 7 times across the snakes' development. Additionally, two females were removed from the social group across the 7 trials. We examined changes in association patterns over time and found that preferences to associate with particular individuals tended to increase across development. Two factors drove this change: First, when male snakes reached maturity, they began regularly choosing the same social groups. Second, the removal of females from the network caused the network to tighten more than computer simulations predicted. This was represented by a significant increase in the global efficiency of the network. Global efficiency measures the spread of information (or pathogens) through a group. As such, the behavioral changes we observed could have important consequences for the spread of pathogens through a population. This research shows that even in a species without permanent social groups, social context can have important effects on sociability.

## **Standard Talks**

### **Effect of auditory experience on myelination of vocal control regions of songbirds**

Adriana Diez – Western University, Canada

Song learning in songbirds typically happens early in life. When young birds are transitioning to sexual maturity, they are vulnerable to extrinsic factors, such as acoustic experience, that can influence the protracted song learning process. Songbirds raised in isolation develop an abnormal song. However, isolation also extends the period of song learning, such that a period of song plasticity extends into later life. The development of fine motor control often depends on myelination of neural tracts, but little is known about the development of myelination in the songbird brain. We examined the process of myelination during the development of the vocal control system and the effects that manipulating the acoustic environment can cause. We collected brains from 49 male zebra finches (*Taeniopygia guttata*) that were exposed to different tutoring environments, ranging from isolation or late exposure to adult tutors at different stages of song learning. Using endogenous markers of myelination, we found significant differences in the myelination patterns of the HVC - RA tract (a tract involved in song production) between zebra finches raised with different auditory experience. These different patterns were found at both early phases of song development and later in life when song crystallization supposedly took place. We found that myelin develops slowly in untutored compared to tutored zebra finches and it seems to reach similar patterns to control birds when untutored birds are exposed to a tutor later in life, which corresponds to behavioral changes in song found in previous experiments.

## **Why big brains? A comparison of models for primate brain size evolution**

Helen Chambers – University of Salford, United Kingdom

Researchers have long been intrigued by those variables thought responsible for the evolution of large brains. Primates have received substantial attention in the literature, principally due to variation in brain and body size, their complex societies and use of extractive foraging techniques. Such attributes make them excellent models for testing brain evolution theories. The social brain hypothesis has garnered substantial support, mostly from studies of primate sociality, where brain size has been found to correlate with many social proxies. Despite this, more recent research has failed to find support for sociality. Instead, it appears there is now emerging evidence suggesting ecology better predicts brain size across several mammalian orders. Furthermore, the field has been dogged by the use of different analytical techniques, potentially accounting for the disparity between results. Thus, in efforts to regain clarity within the field, here, different models of brain evolution were tested and the relative importance of social, ecological and life-history variables were re-assessed in primate lineages. Concurring with recent research, evidence is found for consistent associations between brain size and ecological factors; however, evidence was also found advocating sociality as a selection pressure driving brain size. Life-history associations reveal large-brained primates are counterbalancing the costs associated with expensive brain tissue through extended developmental periods and extended maximum lifespan. Critically, the use of different brain measures, such as relative brain size, yielded disparate results. This hinders modern research, as without clarity regarding the most suitable correction measure, there is little certainty concerning the ‘true’ correlates of brain size. We recommend future studies give careful consideration of body size correction factors as proposed here, and look to integrate multiple variables, thus fully capturing all of the potential factors influencing brain size.

## **Effects of Methylmercury on Song Sparrows' (*Melospiza melodia*) Reproductive Onset During Photostimulation**

Calista Henry – Western University, Canada

Methylmercury is a neurotoxicant that has become an established environmental concern due its widespread toxic effects. Previous research has demonstrated that this contaminant has the ability to affect both reproductive hormones and behaviour, through altering the functioning of the hypothalamic-pituitary-gonad (HPG) axis. However, to date, no empirical work on avian species has explored how gonadotropin-releasing-hormone (GnRH) cells specifically are being affected in the presence of methylmercury exposure. Given that GnRH regions are directly related to reproductive activity and onset, understanding how this system can be affected is of importance. Thus, the present study aimed to bridge this gap, and assessed the impact methylmercury has on GnRH cells in the hypothalamus of Song Sparrows. Methylmercury exposure was provided through an experimental diet, and both winter and spring photoperiods were simulated in order to assess the role of seasonal transition. Following euthanasia and brain collection, immunohistochemistry was performed to stain and visualize the tissues before analysis using Zeiss microscopy. No significant differences were observed between the control and methylmercury group in terms of total immunoreactive-GnRH cell counts, average size of cell bodies, and mean grey value of cell bodies. These findings suggest that methylmercury does not hinder reproductive onset in Song Sparrows.

## **Assortative mating by personalities and its adaptive value in the brown booby *Sula leucogaster***

Guadalupe López-Nava – National Autonomous University of Mexico, Mexico

Animal personalities are heritable and consistent across times and contexts. Recently, it has been suggested that an individual personality may function as a mate choice trait, affecting fitness via direct and indirect benefits. Particularly in species with extended periods of biparental care, such as the brown booby *Sula leucogaster*, choosing a mate of similar personality (assortative mating by personality) may lead to improved cooperation during breeding and potentially influence reproductive success. In this study, we will investigate (1) whether brown boobies show behavioral types or personalities, (2) whether individuals mate assortative based on personality, and the fitness consequences of this mating pattern. Also, we will investigate (3) the potential genetic and non-genetic contributions of parents to the personality of offspring. The study will be carried out in the brown booby breeding colony at Islas Marietas, Mexico. Through a series of behavioral tests within and between breeding seasons we will evaluate the short and long-term intra-individual repeatability and will monitor breeding success from focal pairs. We expect reproductive pairs of similar personality types to have higher parenting coordination and reproductive success. During the second year of this study, we will perform a cross-fostering experiment during incubation and will evaluate the personality type of genetic and foster parents and the offspring. If the offspring's personality type has a strong genetic signature, we expect a positive correlation between the genetic parents and the offspring's personality, even if the offspring are raised by foster parents. If the offspring personality type is primarily the result of non-genetic effects, we expect a correlation between the offspring and the foster parents' personality type.

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Las personalidades animales son heredables y consistentes a lo largo del tiempo y diferentes contextos. Recientemente se ha sugerido que la personalidad puede funcionar como un rasgo de elección de pareja, afectando a la adecuación mediante beneficios directos e indirectos. En especies con largos periodos de cuidado biparental, como en el bobo café *Sula leucogaster*, la elección de una pareja por personalidad similar (apareamiento concordante por personalidad) puede conducir a una mayor cooperación entre parejas durante la crianza y potencialmente influir en el éxito reproductivo. En este estudio, investigaremos (1) si existen personalidades en el bobo café, (2) si los individuos se aparean de forma concordante por personalidades, y las consecuencias en adecuación de este patrón de apareamiento. Además, investigaremos (3) las posibles contribuciones genéticas y no genéticas de los padres a la personalidad de la descendencia. El estudio se llevará a cabo en la colonia de reproductiva de bobo café en las Islas Marietas, en México. A través de una serie de pruebas de comportamiento dentro y entre las temporadas de anidación, evaluaremos la repetitividad de comportamiento intraindividual a corto y largo plazo, y monitorearemos el éxito reproductivo de las parejas focales. Esperamos que las parejas reproductoras con personalidades similares tengan una mayor coordinación parental y por lo tanto mayor éxito reproductivo. Durante el segundo año de estudio, realizaremos un experimento de nidadas cruzadas durante la incubación y evaluaremos el tipo de personalidad de los padres genéticos y sus crías. Si la personalidad de la descendencia tiene una fuerte firma genética, esperamos una correlación positiva entre la personalidad los padres genéticos y de las crías, incluso si estas han sido criadas por padres adoptivos. Si la personalidad de las crías es el resultado de efectos no genéticos, esperamos una correlación entre la personalidad de las crías y de los padres adoptivos.

## **The evolution of skilled hindlimb movements in birds**

Clara Peçanha – Federal University of Minas Gerais, Brazil

The ability to grasp and manipulate objects with limbs has evolved repeatedly among tetrapods. In birds, while objects manipulation is, to a large extent, carried out by the beak, some species, like parrots and raptors, have evolved the ability to hold and manipulate objects with their feet. Surprisingly, there have been no systematic studies of the evolution of foot manipulation among birds, and it is unclear to what extent different avian clades differ in their ability to manipulate objects with their feet. Here we used bird photographs and videos from web-based repositories and previous literature to quantify birds' foot manipulative skills. We found and quantified foot use in 1004 species of birds, comprising 16 orders and 73 families. Our results show that the use of feet has evolved repeatedly among birds, mainly in Teluraves, particularly the ability to grasp and lift objects with their feet. Among passerines, the use of feet to hold food is common and is present in at least 43 different families. However, the ability to grasp and lift objects is only present in some families, all of which, except one, belong to the superfamily Corvoidea. Not surprisingly, we found that parrots show higher foot dexterity than other birds. Among raptors, falconiformes show higher manipulative skills than owls and accipitriformes, while new world vultures and some old-world vultures show the lowest skill. Our results suggest that: 1) the ability to grasp and manipulate items with hindlimbs has evolved independently several times and is largely (but not exclusively) related to an arboreal niche. 2) abilities to manipulate food with the feet vary between and within clades. Our work provides the first systematic comparison of foot use in birds and a solid basis for future research on the morphological and neural adaptations of foot use in this vertebrate group.

## **Fear & Aggression Asynchronous**

### **Lightning Talks**

#### **Being Bold does not mean being aggressive, the case of a poison frog**

Ricardo Cossio – University of Veterinary Medicine Hannover, Germany

Fighting interactions are common among animals when competing for resources. Most disputes are influenced by each individual's fighting abilities, or resource holding potential (RHP). Recently, it has been reported that boldness personality may contribute as RHP during fights, and that the performance during a combat can subsequently alter individual's personality. Here, we investigated the association between boldness personality and fighting performance in a red colour morph population of *Oophaga pumilio*. We measured boldness three times before and after a dyadic contest; and fighting performance in terms of aggressive intensity. We registered the latency to move and forage after a predator simulation attack as boldness measurement. We found that neither boldness measurements nor individual's body condition predict the fighting performance during a combat. We also found that fighting performance of an individual does not alter boldness mean level or repeatability. Additionally, we observed that individuals show generally bold behaviour after a predator attack simulation. Overall, our findings suggest that boldness and the level of aggression displayed during a fight are independent; therefore, other factors may be linked with fighting performance in this population. Furthermore, a lack of postfight changes in boldness may suggest this personality trait is intrinsic in this population.

## **Cattle or no cattle? Presence of cattle on pasture does not affect fearfulness in broiler chickens**

Lisa Schanz – University of Natural Resources and Life Sciences Vienna, Austria

Keeping broiler chickens on pasture with cattle may increase range use of the chickens and reduce predation by predatory birds. Previous studies suggest that increased range use is associated with shorter durations spent in Tonic Immobility (TI), a measure of fearfulness. Does duration spent in TI differ between broilers housed with or without young cattle on pasture?

During two years, three batches of broilers (approx. 110-120 broilers each) were TI tested at four weeks of age and then allocated to control (only pasture) and treatment (pasture with ten cattle) balanced for seconds in TI. All broilers were kept for six weeks on pasture with or without cattle and were then TI tested again. TI tests were performed by one handler. Broilers were carried individually to the testing area, turned on their back and held with one hand over the head and one on the sternum for 10 s. The time until the broiler righted itself was measured as time in TI (max. 600 s). If a broiler righted itself earlier than 10 s after release, TI was not induced and the described process was repeated (max. 5 attempts).

Number of attempts necessary to induce TI and duration in TI were compared between treatment and control group after six weeks on pasture. Due to the small number of replicates (at group level) we used descriptive statistics and visual inspection for interpretation. Duration in TI was lower in broilers ranging with cattle (mean  $\pm$  sd 139 s  $\pm$  150 s) compared to broilers ranging with conspecifics only (150 s  $\pm$  146 s), but number of attempts did not differ ( $2 \pm 1$ ). Due to the small difference (10 s) found, we conclude that the presence of cattle did not influence the fearfulness measured by number of attempts and duration in TI.

## **Standard Talks**

### **A South African Mammal Community Fears the Human “Super Predator”**

Nikita Frizzelle – Western University, Canada

Humans have been considered “super predators” due to our ability to kill every animal on the planet. This is especially true in Africa, where the trophy hunting industry attracts thousands of tourists and generates hundreds of millions of US dollars in revenue each year. However, there is very little experimental literature to document how hunting affects the behaviour of these hunted African mammals. Fear behaviour, in particular, is an incredibly important behaviour to study as it quantifies the level of threat perceived by wildlife in response to humans and has the potential to cause cascading effects in the population, affecting both foraging behaviour and fecundity. Thus, my research objective was to experimentally test whether fear behaviour of a South African mammal community is affected by human presence and hunting. I used a newly developed technology, the Automatic Behavioural Response system (ABR), to video record the responses of wildlife to five playback treatments: birdsong, lion snarls, gunshots, dog barks, and human voices. These ABRs were set up in two reserves adjacent to Kruger National Park, allowing me to gauge whether fear behaviour is influenced by high versus low hunting pressure. My results show that the majority of the species in the community flee most to the human voice, surpassing their response to both lions and hunting stimuli. However, there was no difference in behaviour seen between areas of varying hunting pressure or human presence. These findings demonstrate that not only can humans be more frightening than non-human predators, but also that this fear of us can pervade whole communities of mammals, regardless of the amount of hunting occurring in an given area.

## **Indoor-only cats show more intense reaction than indoor-outdoor cats to stimuli that show resemblance to prey**

Muhzina Shajid Pyari – Eötvös Loránd University, Hungary

The domestic cat is a species that historically was and is still favored by humans because of its natural predatory behaviour. At the same time, cats' predation on wildlife raises ecological concerns worldwide. Currently in the industrialized countries the majority of companion cats are raised under human supervision. Some of them are raised in the presence of their mother but some are adopted shortly after birth and are fostered by the owner. Additionally, more and more companion cats are being kept completely indoors. If we assume that cats were not selected intentionally against hunting behaviour, we can still hypothesize that because of the differences in their epigeny and prey-related experiences, there could be differences between the willingness to show hunting-like behaviour in adult cats. Considering that the environmental effects (such as the early support from the mother, and the experience with real prey animals outdoors) could be at least partly responsible for the development of hunting skills in cats, in the present study we investigated the influence of raising conditions and keeping conditions on predatory play behaviour in companion cats. Predatory play is widely considered as a useful proxy for testing predatory behaviour in cats among non-invasive conditions. Tested subjects were presented the subjects with artificial stimuli like balls of different sizes, catching wand and playback sound of birds, paper crumpling, plastic bags, and mice. The tests were video-recorded, and we analyzed various behavioural parameters that indicated the cats' interest in the stimuli. Indoor-only cats approached, touched or played with balls sooner than indoor-outdoor cats irrespective of the size of the balls. Indoor-only cats started searching sooner than indoor-outdoor cats for each type of playback sound. Cats raised with the mother for 0-2 months reacted faster in searching for the sound of the bird. Indoor-outdoor cats, if they belong to '0-2 months raising group', and the indoor-only cats if they belong to the 'more than 2 months raising group' hold the chaser for the longest duration. Cats raised with mother for more than 2 months had less failed attempts in catching the chaser than cats raised with mother for 0-2 months irrespective of the keeping condition. There is a negative correlation between bird sound and duration of holding chaser. Our results point out that indoor-only cats were more interested in the artificial stimuli that show more or less resemblance with the prey, even though these cats are completely deprived of experience with live prey. There are various theories that can explain these findings, including higher play drive because of the lack of stimulation; less refined prey recognition; or reduced fear due to lack of experience in the indoor-only cats.

## **Fear of predators has enduring effects on the brain and behaviour in wild animals**

Lauren Witterick – Western University, Canada

Predators affect prey populations not only through direct killing, but also through perceived predation risk – the fear of predators. Responding to predation risk is critical for prey survival, however trade-offs from prolonged anti-predator behaviour can have enduring effects ranging from individual changes in neurobiology up to population and community level effects. To experimentally test the enduring effects of predator fear on the brain and behaviour we manipulated perceived predation risk using auditory playbacks of predators or non-predators in wild caught birds. We conducted a series of manipulations through increasingly natural conditions, starting with acoustic isolation and progressing to semi-natural conditions in both the breeding and non-breeding seasons, with the goal of assessing these effects in free-living wildlife. We found immediate effects on both foraging and escape behaviour and enduring behavioural effects in response to conspecific alarm cues and explored the connection to neural activation, neurogenesis, and neuron structure in the 'fear centres' of the brain. Our research aims integrate biomedical research studying the enduring effects of fear on the brain with fear-induced behavioural changes documented by ecologists in the field, to understand the mechanisms leading to the demonstrated population and community level response to fear.

## **Learning & Memory Asynchronous**

### **Lightning Talks**

#### **If it ain't broke don't fix it: breeding success affects nest-building decisions**

Andres Camacho-Alpizar – University of Alberta, Canada

Nest-building birds have a variety of material with which they can build their nest. Previous experiments with zebra finches (*Taeniopygia guttata*) show that birds learn to associate nest material with nesting success, which affects subsequent nest-building decisions when selecting between two familiar materials. In the current experiment, we ask if nesting success affects the subsequent selection of familiar versus novel materials that differ in their structural properties. Male-female pairs experienced one breeding attempt, all using the same nesting material (coconut fiber), and their breeding success was manipulated by allowing them to raise chicks (successful pairs) or removing their eggs (unsuccessful pairs). During a second breeding attempt, birds were provided with the material from their first nesting event and a novel material (white cotton string). Successful pairs used significantly more familiar material compared to novel material, while unsuccessful birds used the familiar and novel material types equally. These results show that birds use their experience in selecting between nesting materials that differ on their structural properties to build a subsequent nest.

### **Standard Talks**

#### **Cognitive robustness and the evolution of longevity in *Heliconius* butterflies**

Jessica Foley – University of Bristol, United Kingdom

With an ageing global population, biogerontological research is increasingly becoming a biomedical priority. Work on particularly long-lived lineages across the tree of life has helped to elucidate the mechanisms some species have evolved to delay the ageing process. The remarkable lifespans displayed by the *Heliconius* butterfly genus rank among the longest recorded in butterflies, and are up to 5 times longer than those of their nearest close relatives. A comparison, then, between the longer-lived *Heliconius* and their closely-related but shorter-lived outgroups offers a neat experimental framework to investigate the impact of ageing on behavioural performance between the two clades, and may help to illuminate the mechanisms that permit an extended longevity. Previous work has demonstrated that this lifespan extension in *Heliconius* is accompanied by a delay in reproductive senescence; however, there have not yet been any studies examining behavioural senescence in this genus. We conducted learning and memory trials at varying ages in both *Heliconius hecale*, which lives up to 6 months, and the shorter-lived *Dryas iulia*, which typically lives for 1 month, to probe the existence of an age-related memory impairment in these species. Considering the evidence for age-related memory impairment in many other insects, we expected to see a similar decline in memory performance in these species as they aged, albeit at different rates. However, our results showed no evidence for such an impairment in either species – an especially intriguing result within *Heliconius*, individuals of which continued to perform well on long-term memory tests even at ages far beyond the maximal lifespans of their close relatives. The cognitive robustness demonstrated by these species contributes to an understanding of the evolutionary trajectory *Heliconius* followed in order to facilitate its lifespan extension, and paves the way for future work aiming to uncover the mechanistic basis of this delayed senescence.

## **Serial Reversal Learning in Two Macaw Species**

Alexandra Koch – Max-Planck-Institute for Ornithology, Germany

Enhanced behavioural flexibility has been linked to relatively large brain size and social complexity. It is commonly tested using the (serial) reversal learning task with binary-choice paradigm. However, a frequent problem associated with such a paradigm is individual developing side bias, which may risk measuring their true cognitive performance. Here, we used a poke box with twelve choices of two visual stimuli in a serial reversal learning paradigm, and assessed two neotropical parrot species of Ara (*A. ambiguus* and *A. glaucogularis*) that exhibit the properties of relatively large brain size and social complexity. In the acquisition learning phase, the individuals had to discriminate between two contrasts (bright and dark that were presented as ‘white’ and ‘black’, respectively, on the box). Once they reached a stringent learning criterion, the reward contingency was reversed for a total of 10 reversal learning phases. Behavioural flexibility (and thus learning performance) was measured as the number of errors within a trial, and for each reversal learning phase. We also conducted social observations to create each individual’s social score using the total frequency of social interactions within each group (species). We found that 1) both groups made significantly fewer errors per trial within each reversal phase and over the course of ten reversal phases; 2) more social individuals reduced errors faster within reversal phases than less social individuals, and this effect becomes stronger as the learning phases progress; and 3) all individuals gradually developed the ‘learning to learn efficiently’ strategy i.e., ‘win-stay-loose-shift’. Together, our results show that the two Ara species demonstrate behavioural flexibility. The results also support the Social Intelligence Hypothesis in that individuals’ social interaction was positively related to their learning performance within a reversal learning phase and across reversal learning phases.

## **Bending and unbending of tools by New Caledonian crows (*Corvus moneduloides*) in a problem solving context**

Magdalena Pelayo-van Buuren – University of Vienna, Austria

In the field of tool related cognition, New Caledonian crows (NCCs) are an important study species as they are not only proficient in tool use, but also tool manufacture. Since 2002, the hook bending of a single individual has been cited as a remarkable example of causal reasoning. Recent field studies have shown that bending is a part of their natural behavioural repertoire and beg reexamining previous findings in this new context. Additionally, tool bending and unbending in a controlled problem solving context have yet to be repeated on additional NCCs. Here, we tested a total of 17 subjects in one bending and three unbending tasks. In the first study, we trained two groups of five subjects, one in the use of solid hooks and the other in the use of solid straight tools. Subsequently, the subjects were provided with only the wrong tool, but made from flexible material. Three subjects consistently produced hooks, and one subject consistently made straight tools. In the second study, 10 subjects were tested in a new unbending task with a Z-shaped tool requiring the straightening of two joints. Four subjects solved at least one trial, and two solved the task consistently. In the third study, we tested 8 subjects (including successful subjects of the second study), in another unbending task requiring novel unbending behaviour. Here two subjects solved at least once, and one, a previous solver, solved consistently. From our results we conclude that NCCs can bend or unbend flexible materials in order to solve a problem. The underpinning mechanisms seemed to vary across subjects, but were mostly trial-and-error learning.

## **Cortisol is negatively related to performance under pressure in tufted capuchin monkeys**

Meg Sosnowski – Georgia State University, United States

Stress responses among mammals have been well-conserved throughout evolution, likely because those responses typically lead to appropriate responses to physical threat. However, in humans, at least, acute stress responses can also result in compromised cognitive ability (colloquially, “choking under pressure”). While choking and its relationship to the stress response has been studied extensively in humans, no research has focused on the effect of acute pressure on cognitive performance in non-human subjects. To assess if non-humans are prone to choking under pressure, and the degree of individual variation, we tested 20 tufted capuchin monkeys (*Sapajus [Cebus] apella*) on a computerized delayed-match-to-sample task in which some trials included cues that in previous training resulted in harder but better rewarded trials (i.e., a high-pressure context); further, throughout the duration of testing we non-invasively collected fecal samples (N = 124) to assess how cortisol, a biomarker of stress, might be related to each individual’s likelihood of choking. Monkeys’ performance on high- versus low-pressure trials varied significantly by individual, and the likelihood of choking was predicted both by each individual’s average cortisol level and, potentially, lack of experience with the task. These data suggest that the stress response plays a critical role in how individuals perform under pressure in non-humans, as it does in humans, and that experience with performing under pressure may ameliorate some of the negative performance associated with high cortisol.

## **Perception & Decision Making Asynchronous**

### **Lightning Talks**

#### **Differences in spontaneous preference for novel locations in two avian species**

Chelsey Damphousse – Wilfred Laurier University, Canada

Our understanding of the avian hippocampal formation (HF) may be furthered by studying spatial behaviours that are less species-specific, as this permits direct comparisons between avian families, and potentially across classes. Towards this goal, we adapted a y-maze test from mammalian studies. In the easiest variation of the task, birds explore a y-maze for 5 minutes with one arm blocked. After a 1 minute delay, the subject is placed back into the maze with all arms open at test. In the hardest variation, birds explore two identical y-mazes with different arms blocked in two different rooms with unique extra-maze cues. Birds then explore both mazes with all arms open. Both Japanese quail (*Coturnix japonica*) and Silver King pigeons (*Columba livia*) show preference for the novel arm in a single y-maze, but only pigeons differentiate between the two contexts. These data show that reaction to novelty can be utilized across a number of avian species as the basis for testing spatial cognition. Studies of this nature may provide evidence that a number of tasks previously used exclusively in mammals may be adapted for birds.

## **Crossmodal correspondences between luminance and spatial position in young domestic chicks (*Gallus gallus*)**

Maria Loconsole – University of Padua, Italy

We often associate non-redundant information across different sensory modalities, i.e. crossmodal correspondences. E.g., we match high luminosity with high pitches and low luminosity with lower sounds. Three-month-old infants and some non-human species (i.e. chimps, monkeys, and dogs) showed crossmodal correspondences akin to adult humans, suggesting a shared origin (at least among mammals). Limited, or no experience was seemingly required, although its role was not specifically investigated. Here we aimed at investigating visual-spatial crossmodal correspondences in a precocial avian species, i.e. the domestic chicken, providing evidence from a non-mammalian species and, at the same time, deepening the role of experience. Three-day-old chicks were presented with two identical panels, either black (low luminance) or white (high luminance), placed on the left and right side in an arena. Subjects could approach and circumnavigate either panel to obtain a food reward. Consistently to what reported for humans, chicks circumvented more often the left panel in the low luminance trials (black panels) and toward the right one in the high luminance trials (white panels). The control group, tested with two grey cardboards, showed no spatial preference. Based on our data, we hypothesized that crossmodal correspondences might rely on an inborn spontaneous associative mechanism for multisensory Perception & Decision Making. This is consistent with evidence of multimodal integration of information reported in many animal species, included the domestic chicken. Moreover, as such mechanism is shared between different species, it might date back to an old ancestor, common to mammals and birds.

## **Standard Talks**

### **Canada jays (*Perisoreus canadensis*) employ multiple context-dependent cache protection strategies**

Jeff Martin – Western University, Canada

Food caching is a behaviour employed by a variety of birds and mammals and can be an essential strategy for surviving food-scarce periods. As such, ensuring that cached food remains available for later recovery is critical to the fitness of caching individuals. Cache-robbers, conspecific or heterospecific individuals that remove and consume food stored by the original cacher, present a unique threat to food-caching individuals. Accordingly, caching species are predicted to have evolved a variety of cache protection strategies in order to limit the potential risk of cache-robbery. We assessed these cache protection strategies in Canada jays (*Perisoreus canadensis*), year-round residents of Canada and the Western United States that rely on cached food to survive food-scarce winters. We evaluated caching behaviour and movement patterns of captive Canada jays in a variety of caching contexts that varied in potential risk of cache-robbery (e.g. presence vs absence of model cache-robber/visual cover). We found that depending on perceived risk, Canada jays flexibly employed a variety of non-mutually exclusive cache protection strategies including cache depression, out-of-sight, and spacing. These cache protection strategies likely reduce the risk of cache-robbery and increase the probability of caches remaining available for recovery and consumption.

## **Assessment of risk behavior in capuchin monkeys using a validated modified balloon analogue risk task.**

Olivia Reilly – Georgia State University, United States

Animals are constantly faced with uncertainty in their environment and must make decisions in response to this uncertainty despite not always knowing what the outcome of their choices will be. Although there is an increasing amount of research on decision-making in the context of risk, there is significant variation in risk behavior across species and contexts, making comparisons difficult. Part of this may be due to the variety of methods used to assess risky decision-making. To address this, we created a modified version of the computerized Balloon Analogue Risk Task (BART), a human risk-taking assessment tool, to use for standardized assessment of risk-taking behavior in both human and nonhuman primates. We first verified that humans responded similarly to our adapted task as they would to the traditional BART. Following this, we tested 21 capuchin monkeys (*Sapajus [Cebus] apella*) on our modified BART program. Although capuchins showed a learning effect as they gained experience with the task, they showed a similar behavioral response pattern to humans when using the modified BART. In particular, capuchins fall short of fully maximizing rewards, as humans who play the traditional BART tend to do. However, capuchins were even farther from reaching the reward maximization point than humans were when playing the modified task, suggesting that capuchin monkeys behave more risk averse than humans. This method allows us to directly compare risk decisions across species in order to better understand how this decision-making under risk has evolved.

## **Delay of gratification in blue-headed macaw**

Eleonora Rovegno – Julius-Maximilians-Universität Würzburg, Germany

Delayed gratification involves foregoing an immediate, appealing option to gain a better one later. This ability is tightly related to self-control: choosing to wait for the better denotes higher self-control. We tested six blue-headed macaws (*Primolius couloni*) in their ability to delay gratification using a token exchange paradigm in an intertemporal choice task. In this paradigm, the parrots were first taught the association between three differently coloured (blue, yellow, white) tokens and the corresponding containers. The birds were also taught that each colour reflected a different delay (0 s, 15 s, 30 s). In the main testing, the birds were only presented with a choice between two rewards differing in quality (or quantity). Rewards were obtainable after different time delays, depending on which container they were presented in; an individual could choose to exchange the token that reflected either an immediate/sooner less preferred reward or a delayed but better (in quality or quantity) one. We predicted that the birds would weigh-off between different outcomes, and respective waiting times, thus making their choices maximizing their pay-off and minimizing their temporal costs. We found that (at the group level) the birds did not wait for a better reward either in quality or in quantity. However, at the individual level, the parrots showed variation in their delay of gratification ability, suggesting that at least some of the subjects possessed the ability to optimise their gain by weighing off the values of the rewards and the waiting times. In sum, our results indicate that the blue-headed macaws have the cognitive abilities necessary to assess and compare the value of the differently delayed rewards, so as to decide whether or not the better rewards (of higher quality and quantity) are worth waiting for, and that their ability to delay gratification varies on the individual level.

## **Sensory divergence in a mimetic butterfly community**

Benito Wainwright – University of Bristol, United Kingdom

Complex tropical forest environments can support more diverse communities by favouring microhabitat partitioning and local adaptation to contrasting sensory conditions. Communities of ithomiine butterflies provide a case study for how closely related species partition tropical forests, where the type and abundance of sensory information varies across small spatial scales. In ithomiines, shifts in mimetic warning colouration are associated with divergence in habitat preference, with co-mimetic species converging on similar ecologies, perhaps exposing species to distinct sensory conditions. Here, we test the hypothesis that this ecological divergence leads to distinct patterns of investment in the sensory processing regions of the brain. We do so by comparing brain architecture across individuals from three clades of ithomiines native to a single community in eastern Ecuador with different levels of mimetic and ecological diversity. Our work demonstrates that interspecific divergence in brain morphology likely accompanies ecological shifts among close relatives. This further suggests that the sensory ecology of species within adaptive radiations are critical for determining how communities are assembled in tropical forest environments.

## **Animal Welfare Asynchronous**

### **Lightning Talks**

#### **Attitudes Toward Bias, Replicability and Scientific Practice in Animal Cognition**

Benjamin Farrar – University of Cambridge, United Kingdom

Understanding animal minds - that are in principle unobservable - is challenging. Throughout the field's history, researchers have cautioned about various biases that might affect animal cognition research, and recently, there have been questions about the reliability of many statistical effects in the field. Here, I will present survey data from 210 animal cognition researchers who answered questions about several classic and contemporary challenges facing animal cognition research.

## **Standard Talks**

### **Perspectives on environmental enrichment for wild songbirds used in research**

Madeleine Brodbeck – Western University, Canada

Chronic stress negatively affects multiple levels of cognition in captive research animals including memory, response inhibition, learning and fear extinction. Thus, chronic stress may impact the execution, interpretability and ethics of animal research. In wild-caught research animals, chronic stress may be induced by housing subjects within artificial settings and depriving them of opportunities to express natural behaviours such as foraging. Environmental enrichment reduces chronic stress in lab animals and can potentially increase the ecological validity of housing and feeding procedures. For instance, a test measuring some aspect of cognition in an animal housed in a well enriched environment will be more predictive of an animal's cognitive processes in the wild, compared to an animal within a poorly enriched or deprived environment. However, in order to convey benefits to research animals, enrichment protocols must be designed appropriately and should take the species' life history into account. We will focus on environmental enrichment for wild-caught songbirds, which are frequent candidates in animal cognition research, but have unique, species-specific behavioural and physiological needs that are different from those of primates or rodents. While there are a variety of standard procedures for providing environmental enrichment to livestock animals such as poultry, best practices for enriching captive environments for wild-caught songbirds have not been established. Insights into the efficacy of environmental enrichment for songbirds in laboratory research could be gathered by surveying practices developed in zoos and wildlife rehabilitation facilities, and by sharing information between research groups that use similar species. We will discuss principles for designing environmental enrichment that simulates natural behaviours in captive songbirds, as well as evidence-based approaches for measuring the effectiveness of enrichment protocols (e.g., for reducing stereotypic behaviours). We propose new avenues for research into the implications of foraging-based enrichment design for outcomes in animal cognition studies using songbirds.

### **Acute effect of fluid control on the welfare of laboratory rhesus macaques**

Janire Bueno – Newcastle University, United Kingdom

Rhesus macaques are widely used in biomedical research due to their phylogenetic proximity to humans and their ability to perform complex cognitive tasks. Some studies require a large number of trials and therefore a high motivation from the subjects. To achieve this, fluid availability can be controlled in the home cage, and subsequently used as a reward during experimental tasks. However, the potential psychological effect of this routine procedure is still debated. Using an unprecedented sample size of 21 adult macaques (5 females and 16 males), this study aimed to investigate the acute effect of fluid control on macaques' welfare using a behavioural approach. Home cage behaviour of the animals was recorded in two conditions: after at least 24 hours of fluid control and after access to fluids ad libitum. Animals' affective state was assessed by quantifying the frequency of (1) pharmacologically-validated behavioural indicators of anxiety (i.e. self-scratching, body shaking and self-grooming); and (2) behaviours suspected to indicate a negative acute affective state but still lacking proper validation (e.g. pacing, yawning, Inactive not alert behaviour). 525 hours of video footage were analysed, covering up to 6 years of intermittent fluid control required by unrelated ongoing experimental protocols. Using generalised linear mixed models and a within-subject mean-centring approach, we disentangled the between- and within- subject effects of fluid control and controlled for the effect of time. We found no linear effect of fluid control on the frequency of any behaviour nor any indication of habituation or sensitisation over time. Additionally, the number of consecutive days under fluid control within the same week had no effect on the indicators of negative welfare. This study suggests that the fluid control protocol, as implemented in this study, does not have a negative impact on the acute affective states of macaques.

## **Public Perception & Decision Making of reptile welfare and cognition**

Agnese Crisante – University of Lincoln, England

Reptiles are becoming increasingly popular as pets (in 2019, PFMA estimated that pet reptiles make up 1.7% of pets in the UK, more than guinea-pigs or hamsters). Unfortunately, this increased popularity has seen a concomitant rise in the prevalence of poor reptile health, and they suffer a high morbidity and mortality rate. Since there is a link between how intelligent the public considers a species and the way they treat it in captivity, this study aimed to understand what the general public currently thinks and knows about reptile cognitive abilities and welfare needs. Public opinion was collected with an online questionnaire; half of the participants were reptile owners, the other half had never had a direct experience with reptiles. The goal was to highlight any differences of opinion and knowledge between reptile owners and non-owners about the essential requirements of reptiles when kept in captivity and the cognitive abilities of reptiles (such as learning, memory retention, communication, social interaction, etc.). In addition, participants were required to provide a score for a range of different pet species for a variety of cognitive abilities; in this way, a comparison could be made between the public Perception & Decision Making of reptile cognitive capabilities and those of other pet species.

Our results showed that reptile owners, compared to non-owners, assigned higher scores to reptile cognitive abilities and were more informed about reptile welfare requirements in captivity. The analysis comparing the cognitive abilities of different pet species showed a clear pattern: mammals were scored higher than any other animal group, with the overall score following the phylogenetic scale. The implications of our findings for the welfare of reptiles in captivity will be discussed.

## Plenaries Live

**May 17<sup>th</sup> 10:00AM EDT**

### **Emotional and social regulation in capuchin monkeys**

Dr. Natalia Albuquerque – University of Sao Paulo, Brazil

The experience, expression and Perception & Decision Making of emotions are integrated with mostly every process in our brain and body. Emotions have two main roles: individual and social. That is, emotions enable self-regulation, allowing the evaluation and appropriate reaction to distinct situations, and social regulation, allowing the transmission of ecologically relevant information. Thus, emotions drive the behaviour of organisms according to the way they perceive and relate to their environment. Emotions are a key factor to understanding behaviour and cognition. In fact, the way animals perceive and react to their physical and social world is critical for understanding the differences and similarities among individuals, populations and species. When considering social animals, emotional and social regulation sustain the appearance and maintenance of social behaviour, including maternal behaviour, affiliative and agonistic episodes and the social relationships between infants and the members of their group. These emotional processes will provide individuals with a toolkit to interact with the world. For animals such as capuchin monkeys (*Sapajus* spp.), who show a slow development and an extended infancy, compared to other non-human primates, the social environment is frequently changing and an individual must learn to regulate their feelings and their actions in order to succeed within a group. The means of responding to the surroundings will develop throughout life, and that is why studying not only adults, but also infants is extremely informative. Moreover, more studies in the wild with free populations must be considered and pursued, as much of these more subtle yet more complex interactions and mechanisms will only occur in the animals' natural habitat.

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Experiência, expressão e percepção de emoções estão integradas a praticamente todos os processos do nosso cérebro e do nosso corpo. Emoções possuem dois papéis principais: individual e social. Elas concedem ao indivíduo a capacidade de auto-regulação, permitindo a avaliação e a reação apropriada a diversas situações, e a capacidade de regulação social, que permite a transmissão de informação ecologicamente relevante. Assim, emoções direcionam o comportamento dos organismos de acordo com a forma como eles percebem e se relacionam com o ambiente. Emoções são um fator chave para entender comportamento e cognição. De fato, a forma como os animais percebem e reagem ao seu mundo físico e social é fator crítico para entender as diferenças e similaridades entre indivíduos, populações e espécies. Quando falamos de animais sociais, regulação emocional e social sustentam o aparecimento e a manutenção do comportamento social, incluindo o comportamento materno, episódios afiliativos e agonísticos e as relações sociais entre infantes e suas mães e outros membros do seu grupo. Esses processos emocionais vão prover aos indivíduos um toolkit para interagir com o mundo. Para animais como os macacos pregos (*Sapajus* spp.), que apresentam um desenvolvimento lento e uma infância estendida, em comparação a outros primatas não humanos, o ambiente social muda frequentemente e um indivíduo precisa aprender a regular suas emoções e ações para ter sucesso dentro de um grupo. A maneira de responder aos arredores vai desenvolver ao longo da vida, e é por isso que estudar não apenas adultos mas também infantes é extremamente informativo. Além disso, mais estudos na natureza com populações de vida livre precisam ser considerados e incentivados, uma vez que muitas dessas interações e mecanismos mais sutis porém mais complexos apenas ocorrem no habitat natural dos animais.

**May 18<sup>th</sup> 10:00AM EDT**

**Dog-robot interactions - A novel approach to study social behaviour**

Dr. Judit Abdai - MTA-ELTE Comparative Ethology Research Group, Hungary

Recent technological developments have opened up novel possibilities in the investigation of animal behaviour and cognition by allowing the use of remote controlled and self-propelled objects as social partners. Artificial agents enable to carry out highly repeatable, reproducible and controlled experiments. The dog is an important model species to understand the evolution of social behaviour, including human Social Cognition & Communication; however, the presence and behaviour of the dog/human partner can elicit bias in dogs (e.g. expectation based on prior experience). Studies on dog-robot interaction can also provide novel insight into the design of social robots for animal/human-robot interactions. Our main goals are to identify behaviours that are important to accept a robot as a meaningful, long-term social partner, and we apply the dog-robot interaction framework to study social behaviour and cognition of dogs. In a series of studies, we investigated (1) whether simple behaviours can elicit the Perception & Decision Making of robots as animate objects; (2) whether dogs tend to engage in communicative and problem solving interactions with a robot; and (3) whether robots can elicit social bias in dogs. Across studies, we found that dogs perceived inanimate objects as animate based on simple motion cues, they engaged in various interactions with artificial agents, and the robot was able to elicit counterproductive choice in dogs. Overall, dogs displayed similar social behaviour toward interactive artificial agents, as in social interactions with humans. These findings provide promising basis for future studies by offering novel perspective to investigate behaviour and cognition of non-human animals, and they contribute to design the behaviour of social robots capable of engaging in complex communicative and cooperative interactions with social agents (e.g. dogs or humans).

**May 19<sup>th</sup> 11:00AM EDT**

**Contests in Context: Causes, Costs and Correlations**

Dr. Rowan McGinley – Saint Louis University, United States

Contests over limited resources are commonplace and widespread across animal taxa. Rather than unconstrained fighting, animals are expected to adopt strategies that reduce contest costs. One such strategy is mutual assessment, where each rival performs ritualised signals of fighting ability or resource holding potential (RHP), allowing animals to cost-effectively determine which is weaker. However, as assessment itself may also be costly or difficult, an alternative strategy to limit the costs associated with contests may be for rivals to persist until they reach an internal cost-threshold. Each strategy allows for determination of the winner while limiting the costs of fighting. Jumping spiders, with their excellent vision, elaborate displays and dangerous weapons present excellent models for the study of decision making in animal contests. In this talk I will introduce you to an Australian jumping spider, *Servaea incana*, and examine the decision rules used in male-male contests. Size is a strong predictor of contest outcome and correlations between size and levels of contest escalation suggest that smaller spiders are less willing to escalate, regardless of opponent size. This suggests the use of internal thresholds rather than mutual assessment. Video playback experiments reveal that visual assessment of opponent size may influence the decision to display towards or approach an opponent. The potential for injury, or even death, may explain the unwillingness of small spiders to engage in escalated contests.

**May 19<sup>th</sup> 2:00PM EDT**

**Flexibility and foraging: The cognitive mechanisms of flower handling in bumblebees**

Dr. Caroline Strang – University of Texas at Austin, United States

Foraging bumblebees (*Bombus impatiens*) extract nectar and pollen from a wide variety of morphologically distinct flower species, referred to as flower handling. This behaviour is learned and acquisition of multiple flower handling techniques is a demonstration of behavioural flexibility. My research on flower handling has three goals, (1) identify the cognitive mechanisms that support flower handling learning, (2) understand how bumblebees avoid interference costs between multiple handling techniques, and (3) explore how exposure to agrochemicals impacts flower handling. To address these goals, I used a laboratory model of flower handling and adapted the apparatus to measure bees' ability to switch between two handling tasks, representing different flower morphologies. All bees demonstrate the same repertoire of motor behaviours in initial trials on the flower handling task and improve across trials by increasing or decreasing the frequency of these behaviours depending on their success and reinforcement. These findings support a combination of innate motor patterns and learned associations as the mechanism through which bumblebees are able to forage successfully on a variety of flower species. Exposure to a commonly used agrochemical results in a dose dependant reduction in bumblebees' ability to improve on the flower handling task, and specifically impacts their ability to switch from using an unsuccessful motor behaviour to a successful one. Bumblebees are able to achieve remarkable behavioural flexibility when foraging through a simple cognitive mechanism, and the successful use of that mechanism is susceptible to disruption from anthropogenic factors.

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