

31st Annual International Conference on Comparative Cognition



Sponsored by the
Comparative Cognition Society

April 10th to 13th, 2024

Hotel Albuquerque at Old Town
Albuquerque, New Mexico

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CO3 2024 Program Summary			
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Cultural Event (by Visit Albuquerque)	(TBA)	10:30- 11:30 AM	8
Ron Weisman Outstanding Student Presentation Competition: Paper Competition	FGH	12:00	9
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In Honour of the Contributions of Nicola Clayton	FGH	4:14	30
Closing Remarks	FGH	5:30	31
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PROGRAM NOTE: Five minute talks are designated by a **Talk Number with a grey background**. They are 5 minutes in duration followed by 2 minutes for discussion. Ten minute talks are followed by 4 minutes for discussion. All times are PM unless otherwise noted.

Wednesday Afternoon

3:00 Registration & Poster Session I Setup
PM (Atrium & Alvarado ABC)

7:00 Opening Remarks by Lauren Guillette (Alvarado FGH)
PM

7:10 Concept Learning (Chair: Anna Wilkinson)
PM

Comparison of the efficacy and welfare of positive punishment versus positive reinforcement training in stopping chase behavior

Anamarie C. Johnson & Clive D. L. Wynne (Arizona State University)

Several studies have investigated the use of electronic shock collars (“e-collars”) and concluded that positive punishment has negative welfare impacts and is no more effective than positive reinforcement. However, these studies did not specify the schedule and intensity of punishment — critical for assessment of the efficacy and welfare implications of an intervention. Dogs were randomly assigned to three conditions: positive punishment with e-collars, positive reinforcement with shaping of lure speed and another positive reinforcement group where the lure was presented at high speed as in the e-collar group. Dogs in the positive punishment condition stopped chasing after one or two sessions and after six sessions none chased the lure in three tests in the training arena and 67% were successful in a novel arena. None of the dogs in the either positive reinforcement condition was successful in training or test. Video behavior coding showed no stress-related behaviors in either training group. Despite the apparent positive findings for punishment training, we do not support use of e-collars by the typical dog owner where the risks of misuse are unacceptable.

7:17 **First-sight recognition of touched objects**
PM *Elisabetta Versace (Queen Mary University of London)*

In 1688, William Molyneux posed a question that has puzzled philosophers and scientists ever since: If a congenitally blind person learns to distinguish between a cube and a sphere by touch, would they immediately recognise these objects by sight, if their vision is restored? In other words, is it possible to recognize objects by matching representations between different sensory modalities, without the need of previous experience? To address this question, we hatched domestic chicks in darkness, exposed them to tactile smooth vs. bumpy stimuli in darkness, then tested them in light, in a visual recognition task. At their first visual experience, chicks previously exposed to tactile smooth stimuli approached the visually smooth stimulus significantly more than chicks previously exposed to the tactile bumpy stimuli. This visual recognition at first sight, based on tactile experience, shows that cross-modal recognition does not require previous experience with simultaneous multi-modal stimuli.

7:31 **Animal Emotions (Chair: Anna Wilkinson)**
PM

Always the Optimist: Assessment of a Red Tegu's Judgment Bias in Response to Visitor Interactions

Jordyn Truax, Jennifer Vonk, & Sophia Vecchi (Oakland University)

The judgment bias task assesses optimism and pessimism through responses to ambiguous stimuli. An optimistic individual would anticipate receiving a reward when interacting with ambiguous stimuli whereas a pessimistic

individual would anticipate a lack of reward or something aversive from interacting with ambiguous stimuli. An animal's judgment bias can reflect their affective state across different situations. We assessed the judgment bias of a zoo-housed red tegu (*Salvator rufescens*), a lizard native to South America, in response to visitor interactions (touching allowed or not). In training sessions, the lizard learned that a container on the left side of an arena contained food, whereas a container on the right side of an arena contained no food. Once this association was established, we introduced an ambiguous container covered with newspaper equidistant from both the left and right locations. The tegu searched for food on every ambiguous trial. In addition, the tegu's average approach time to the ambiguous location was more similar to that of the food location versus the non-food location across both conditions, indicating that visitor touch did not negatively impact its optimism.

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7:38
PM

Cognitive bias in bonobos after hearing conspecific laughter

Sasha Winkler (University of California Los Angeles), Isabelle Laumer (Max Planck Institute of Animal Behavior), & Erica Cartmill (University of California Los Angeles)

Emotions drive cognition. For example, humans and other animals in positive emotional states are biased to expect more positive future events. This so-called optimism bias is assessed by presenting animals with ambiguous stimuli that are perceptually equidistant from two cues previously trained as rewarding and unrewarding. When animals treat the ambiguous stimulus like the rewarding one, they are said to behave more optimistically. In our study, we trained four bonobos on a task with black boxes that held food rewards and white boxes that did not. We then assessed optimism bias by playing a recording of laughter (the experimental condition) or a control sound and measuring how the bonobos responded to ambiguous, gray-colored boxes. Bonobos typically laugh during play, and this experimental condition was therefore intended to produce a positive emotional state. The bonobos in our study were more likely to treat the ambiguous boxes like the positive ones after hearing laughter than after hearing the control sound (an effect that was borderline significant despite our small sample size). This suggests that hearing laughter induced optimism bias in bonobos, demonstrating that the interplay between emotion and cognition is important for social interactions across species.

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7:45
PM

Using the Attention Bias Test to Assess the Emotional State of Dogs

Holly G. Molinaro, Ella Smith, Esmé Crawford-Paz Soldán, & Clive D. L. Wynne (Arizona State University)

Because cognitive processes reciprocally influence emotions, cognitive tests can be used to measure an animal's emotional state. In this study, dogs were first naturally induced into a positive, negative, or neutral (control) state by their owner for two minutes before being entered into the attention bias test. In this test they were exposed to threatening stimuli for 10 seconds (a standing fan with cardboard pieces to add noise and colorful streamers for visual disturbance) and then observed for three minutes after stimulus removal to determine their valenced state. Preliminary results indicate dogs in the negative condition attenuated more towards the area of the fan after it was covered and exhibited more vocalizations. Dogs in the positive condition ate more than dogs in both neutral and negative conditions and explored more of the arena than dogs in the negative condition. Finally, dogs in the neutral condition lay down more than the other two conditions. This novel test demonstrates promise as a tool for evaluating dogs' emotional states.

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7:52
PM

Will Dogs Rescue Their People - and Why?

Clive D. L. Wynne & Joshua Van Bourg (Arizona State University)

We explored dogs' readiness to help a distressed human in two experiments. In the first, dog owners (N = 60) entered a box and cried out in Distress or Read calmly while their dog was nearby. In a Control condition, a treat was dropped into the box. 20 dogs rescued their owner in the Distress test, 16 in the Reading test and 19 retrieved treats in the Control task. After accounting for ability to open the box to obtain food, dogs released their owner more often in the Distress condition than the Reading condition ($p < .0001$). In a second experiment we pre-trained dogs (N = 60) to open the box. 44 dogs opened in the Distress test, 43 in the Reading test and 42 in an additional Silent condition. These differences were not significant, however there were significant differences in latency to open the box ($p < .0001$) with dogs opening slower in the Silent test than the Distress or Reading tests. These results will be discussed in the context of inter-species prosocial behavior and the adaptation of dogs to human cohabitation.

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8:06 **Comparing the Differential Effects of Neighborhood Walks and Nature Walks on Behavior and Urinary Cortisol Levels in Dogs**

PM *Glenna Cupp, Erica Feuerbacher, Lisa Gunter, Robin Foster, & Jessica P. Hekman (Virginia Tech)*

Members of the dog training community suggest that walks in nature provide more welfare enhancing benefits than the neighborhood walks that most dogs experience. While this is a well-studied phenomenon in humans, to date there has been little investigation of this topic in companion dogs using objective measures. This study compared the effects of walks in nature to walks in dogs' home neighborhoods. Fifteen dogs took part in a within-subjects design that measured urinary cortisol and behavior during walks to examine the effects of the two walk conditions. Dogs had free catch urine samples taken multiple times per day and were video recorded during walks. We found significant variation in cortisol levels in accordance with time of day, but no difference was seen between neighborhood walk and nature walk conditions. Several stress, movement, and exploratory/foraging behaviors were found to differ between conditions. While walk conditions did impact the behavior of the dogs in this study, they did not impact cortisol levels.

8

Prenatal and Recent Cannabis on Social Motivation Using a Tickling Task

8:13 PM *Francisca Bertin, Vanetza Quezada-Scholz, Mario A. Laborda (Universidad de Chile), Felipe Alfaro (Universidad de Aysen), Felipe I. Varas, Jonathan Badilla, Viviana Sáez, Angélica Buendía, Kasely Esteban, Gonzalo Miguez (Universidad de Chile)*

Cannabis is among the most consumed drugs and its gestational use has increased, however, its consequences on motivation using social rewards (i.e., social motivation) are unclear. The endocannabinoid system contributes to modulate reward processing and motivation, but few studies have evaluated social motivation, essential for a species' development and survival. We aim to determine the effects of Prenatal (P) and Recent (R) exposure to cannabis on social motivation using a tickle task, a social reward for rats. We used Sprague Dawley descendants from mothers exposed to cannabis (P+) or vehicle (P-). After weaning and tickle training, both groups were subdivided and administered cannabis (R+) or vehicle (R-) before testing. Social motivation was defined as the latency to approach the hand before tickling at test. We observed that R+ had a low latency, indicating a high social motivation, while P+ had an opposite marginal effect. Post hoc analysis found differences between the P+/R- and P-/R+ groups. Finally, a Bayesian analysis determined that the presence of both exposure conditions had a medium motivational response, similar to control. Our findings suggest that cannabis produces bidirectional effects over social motivation depending on the time of drug exposure.

8:20 PM *Break*

8:30 PM **Associative Processes I (Chair: Laurent Prétôt)**

Evidence of Inference by Exclusion in Pigeons using an Expanding Set

Kayley Ozimac, Cyrus Kirkman, & Aaron P. Blaisdell (University of California Los Angeles)

In language acquisition, fast mapping is a relational learning strategy observed in human children that involves inference-by-exclusion of known word-object associations to associate a novel word with a novel object. While extensively studied in children, its emergence in nonhuman animals remains underexplored. Previous research (Aust et al., 2008) using a choice-by-exclusion procedure to comparatively study fast mapping found little-to-no evidence of either of these processes in their pigeons when subjects were trained using eight stimuli. Nevertheless, that same year, Bodily et al. (2008) demonstrated that larger training sets fostered relational learning in pigeons in a Matching-to-Sample (MTS) task. Thus, we investigated the role of increasing training set sizes on pigeons' acquisition of novel stimulus-stimulus associations via choice-by-exclusion. Seven pigeons learned associations between binary pairs of stimuli in a conditional MTS task. Training size was doubled after each set was mastered (3, 6, 12, 24, etc.). Initially pigeons showed scant evidence of choice-by-exclusion, but after 4 expansions (24 items in the new set) began showing significant evidence of choice-by-exclusion. They

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showed better performance on novel-sample training trials when the foil comparison was familiar (and thus could be excluded) than when it was novel.

8:37 **Is “Bouba” rounder than “Kiki” for a baby chick? A comparative study on sound-symbolism**

PM *Maria Loconsole, Silvia Benavides-Varela, & Lucia Regolin (University of Padova)*

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If you hear the non-words “Kiki” and “Bouba”, you may be more likely to associate them with a spiky and a round object, respectively, rather than the opposite. Although sound-symbolism has been widely attested in humans, including preverbal infants, less is known about whether sound-shape associations can also be found in non-human species. Here we tested the Bouba-Kiki effect in three-day old chicks (*Gallus gallus*) using a free-choice task. Baby chicks first learned to circumnavigate a panel to obtain a food reward. Then, they were presented with two identical panels, one depicting a spiky shape, and one depicting a round shape, while hearing the sound “Bouba” or “Kiki”. We recorded which panel the chick chose with either sound, in a total of 24 trials. Preliminary data on 26 subjects show that chicks prefer the panel with the spiky shape when hearing the “Kiki” sound, and that with the round shape when hearing the “Bouba” sound. Our results hints at an early available predisposition for matching the two dimensions of shape and sound, possibly shared across different species.

8:51 **The pigeon as an associative machine**

PM *Edward Wasserman (University of Iowa), & Brandon Turner (Ohio State University)*

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Never known for its smarts, the pigeon has proven to be a prodigious classifier of complex visual stimuli. What explains its surprising success? Does it possess elaborate executive functions akin to those deployed by humans? Or does it effectively deploy an unheralded, but powerful associative learning mechanism? In a series of four experiments, we first confirm that pigeons can learn a variety of complex category structures – some devised to foil the use of advanced cognitive processes. We then contrive a simple associative learning model to see how effectively the model learns the same tasks given to pigeons. The close fit of the associative model to pigeons’ actual categorization behavior provides unprecedented support for associative learning as a viable mechanism for mastering complex category structures and for the pigeon’s using this mechanism to adapt to a rich visual world. This model will help guide future neuroscientific research into the biological substrates of visual cognition.

9:23 **Associative Processes II (Chair: Kenneth Leising)**

PM

An Associative Analysis of Category Learning

Andrew Delamater (Brooklyn College - CUNY), & Santiago Castiello (Yale University)

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Category learning poses interesting challenges to associative theories, partly because organisms seem to encode exemplars in terms of their category membership rather than individual binary exemplar-category associations alone. For example, studies have shown that after category learning increased generalization occurs among within-category exemplars (than between), and this suggests that category learning goes beyond learning individual binary associations. The “total-partial” reversal task provides evidence for this. After learning that several exemplars map onto category A and several other exemplars map onto category B, reversal learning is superior when all exemplars reverse together than when only a subset reverse. We illustrate how a multi-layered connectionist network model can learn the basic category learning task and readily account for greater within- than between-category generalization. However, such models suffer from catastrophic interference during a total reversal, unless some mechanism is implemented to produce stability of the category representations developing at the hidden layer. Following Mackintosh (1975) and Pearce and Hall (1980) we show how such stability can be achieved when learning rates between different layers of the network change with prediction error. In this way, a purely associative theory can explain some of the important characteristics of category learning.

9:37 **Role of Post-Choice Information on Associative Learning**

PM *Aaron. P. Blaisdell, Fang Li, & Cyrus Kirkman (University of California Los Angeles)*

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People benefit from informative feedback during learning to a greater extent than just being told whether their response was “correct” or “incorrect”. We used a Many-to-One matching task to assess whether pigeons also benefit from informative feedback in addition to reward. Reward can be viewed as being told if the prior choice

was “correct” or “incorrect”. Pigeons learned mappings between sample stimuli and left or right choice keys, with each sample assigned to a specific key. Each experiment involved a within-subject design in which half the sample stimuli (the “informative” condition) were followed by a variable 2-5 s re-presentation of the sample immediately after choice and before reward was or was not delivered based on choice accuracy. The other half of the sample stimuli were followed by either non-informative feedback or no feedback (other than immediate non/reward). Informative feedback resulted in improved learning performance compared to non-informative feedback with identical non-informative stimulus types, but did not differ from performance resulting from non-informative stimuli that were unique to each sample, or from immediate food reward (or nonreward). We discuss these results in terms of the role of primary reward, information regarding similarity, and information regarding conditional relations.

Trial frequency and trial spacing benefits without increasing training time: There is a free lunch ... sometimes

9:51

PM

Ralph R. Miller, James E. Witnauer, Dave Jiang (State University of New York), Santiago Castiello (Yale University), & Robin A. Murphy (University of Oxford)

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Two rules of learning with broad generality are the benefits of increased trial spacing and more training trials. Conventionally, benefitting from either manipulation requires lengthening the training session. Using hairless apes as subjects in a contingency learning task designed to level the playing field when comparing effects of Number of trials with that of Duration of trials, Number of trials had a much larger effect than Duration of trials. Hence, increasing Number of trials while inversely decreasing the Duration of those trials enhanced training without increasing the length of the training session and sometimes even shortening it. We demonstrate this relationship with respect to cue-outcome pairings, extinction learning, degraded contingency (i.e., outcome-alone presentations), and co-absence of the cue and outcome, as well as across diverse types of stimuli, different cue-outcome temporal relations, and different indices of learning. But like all behavioral phenomena, there are some boundary conditions.

(More than) 50 years of nonverbal transitive inference research: Is it time for a new methodological approach?

10:05

PM

Olga Lazareva (Drake University)

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Since a seminal paper by Bryant and Trabasso (1971), nonverbal transitive inference has been studied by presenting a series of five or more overlapping simultaneous discriminations (e.g., A+ B-, B+ C-, C+ D-, etc.) and evaluating a choice in a probe pair comprised of two non-end-anchor items (e.g., BD). Multiple converging lines of evidence indicate that probe choices in this task are frequently affected by associative processes leading some researchers to question the use of this methodology for assessing nonverbal reasoning (e.g., Wright, 2012). We propose a different methodological approach based on a simultaneous chaining task instead of a two-alternative stimulus discrimination task. The use of a simultaneous chaining task diminishes potential contribution of associative processes and highlights an influence of an ordered representation. Our data collected with human participants show an increase in transitive behavior with an increase in awareness suggesting strong similarities with a traditional transitive inference task. We encourage the use of this novel transitive inference list (TIL) task with different species and hope that it will shed light on mechanisms of nonverbal transitive inference.

Thursday

10:30-11:30 AM - *Cultural Event by Visit Albuquerque*

(Location TBA)

Showcasing the history of Flamenco dance in Albuquerque, with a performance.

12:00
PM **Ron Weisman Outstanding Student Presentation Competition**
(Chair: Jenna Congdon)

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Processing negation demonstrates compositionality in rhesus macaques

Angelle Antoun, Rohini Murugan, Kathleen J. Bostick, & Benjamin Wilson (Emory University)

Compositionality, the ability to flexibly combine meaningful words into higher-level representations, is a critical feature of language. While there is some evidence for call combinations in non-human primates (e.g., Arnold and Zuberbuhler, 2006), these combinations are minimal, resulting in limited expressivity compared to language. This suggests that true compositionality may be uniquely human. In language, negative clauses (e.g., ‘not red’) are necessarily compositional; the meaning of the phrase cannot be derived from either word in isolation. To assess compositionality in non-human primates, we developed a series of novel, non-linguistic ‘negation’ experiments. We presented six rhesus macaques with cue stimuli paired with either a ‘positive’ or ‘negation’ label, alongside two choice stimuli. On positive trials, monkeys were required to select the stimulus that matched the cue, and on negation trials to select the non-matching stimulus. Critically, on all trials the cue and choice stimuli were novel, to avoid learning about individual stimuli. The monkeys solved this task, combining the cue and label on a trial-by-trial basis, to select the appropriate choice stimulus. Our results provide strong experimental evidence for compositionality in non-human primates, suggesting that the core of this ability may not be unique to humans.

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12:07
PM **Zebra finches learn, but do not generalize, a physical shape-frame matching problem**

Connor T. Lambert, Cailyn Poole, Benjamin A. Whittaker, Andrés Camacho-Alpízar, Julia L. Self, Sara C. Blunk, & Lauren M. Guillette (University of Alberta)

Animals can benefit from learning about the physical properties of their environments. For example, learning how objects interact is important for behaviors like tool use or nest building. Shape-frame matching problems test physical cognitive abilities by requiring individuals to select and fit an object into a matching-shaped opening. Human children perform well on shape-frame matching problems from a young age. Primates, cockatoos, and other parrot species can also solve similar shape-frame matching problems. Male zebra finches encounter a natural version of a shape-frame matching problem when building a nest in a box with a small entrance, and choose shorter, rather than longer, pieces of string. We investigated zebra finch physical cognition using a simplified string-pulling version of the shape-frame matching problem and predicted that males- the primary nest builder- would perform better than females. We found that both male and female birds learned to solve the problem but did not generalize what they learned to a novel, similar problem. Moreover, and contrary to our predictions, there were no sex-differences in learning or generalization. This work suggests zebra finches can solve shape-frame matching problems but do not readily generalize this learning to similar tasks.

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12:14
PM **Replay of Incidentally Encoded Episodic Memories in Rats**

Cassandra Sheridan, Danielle Panoz-Brown, & Jonathon D. Crystal (Indiana University)

Although events are not always known to be important when they occur, people remember details about such incidentally encoded information using episodic memory. In one task, rats reported the third-to-last item in a list of trial-unique odors. In a second task, rats foraged in a radial maze in the absence of odors. On a critical test, rats foraged in the radial maze, but scented lids covered the food. Next, memory of the third-last odor was assessed. All participating rats correctly answered the unexpected question after 0- and 15-minute delays. In a control condition, a list of odors in the trained encoding context was followed by a list of odors in a novel encoding context. Next, rats were given a choice between the third-last odors from lists 1 and 2 in the trained memory-assessment context. All participating rats chose the list 1 odor, suggesting that rats did not automatically encode odors for the purpose of a future test of memory. In another control condition, we used entirely novel odors during the critical test. All participating rats selected the third-last odor in the memory assessment. We propose that rats replay episodic memories of incidentally encoded information in an unexpected assessment of memory.

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12:21 No Evidence for Self-Directed Learning, But Rhesus Monkeys (*Macaca mulatta*) and Capuchins (*Cebus s. apella*) Differ in Preferred Learning Strategies

PM *Joseph W. McKeon, & Michael J. Beran (Georgia State University)*

Self-directed learning (SDL), a form of learning wherein individuals have primary control over much or all of the learning process, emerged as a topic in the field of adult education in the 1960s. However, little research has been done to investigate this topic in nonhuman animals. The current study involved testing two primate species, rhesus monkeys and tufted capuchin monkeys, on a chained sequential learning task to assess whether they could engage in SDL. Monkeys were either forced to sequence a randomly assigned number of items, allowed to choose the number of items they wanted to sequence, or allowed to choose the number of items they wanted to sequence in a set of items they had experienced in the previous testing session. Species differences in choice behavior emerged, with rhesus monkeys preferentially choosing long sequences and capuchins preferentially choosing medium-length sequences. However, neither of these strategies proved advantageous for maximizing task performance or rewards. The results did not support the idea that nonhuman primates engaged in SDL in this task, and potential causes for the species' different strategies will be discussed.

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Socially-mediated activation in the snake social-decision-making network

12:28 PM *Morgan Skinner (Wilfrid Laurier University), Dania Daanish (McMaster University), Chelsey Damphousse (University of Minnesota), Randolph W. Krohmer (Saint Xavier University), Paul Mallet, Bruce McKay, & Noam Miller (Wilfrid Laurier University)*

Brain areas important for social perception, social reward, and social behavior – collectively referred to as the social-decision-making network (SDN) – appear to be highly conserved across taxa. These brain areas facilitate a variety of social behaviors such as conspecific approach/avoidance, aggression, mating, parental care, and recognition. Although the SDN has been investigated across taxa, little is known about its functioning in reptiles. Here, we present the results of an experiment in which ball pythons interacted with a same-sex conspecific for one hour and neural activation was investigated through Fos immunoreactivity. Compared to controls, snakes that interacted socially had higher Fos counts in brain areas implicated in social behavior across taxa, such as the medial amygdala, preoptic area, nucleus accumbens, and basolateral amygdala. Additionally, we found differential Fos immunoreactivity in the ventral amygdala, which facilitates communication between social brain areas. In many of these areas, Fos counts differed by sex, which may be due to increased competition between males. Fos counts did not differ in early sensory (i.e., vomeronasal) processing structures. As ball python social systems lack parental care, cooperation, or long-term group living, these results provide valuable insight into the basal functions of the vertebrate social decision-making network.

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12:35 PM Canine Cognition I (Chair: Christopher Krupenye)

Development of a Spotted Lanternfly egg mass training aid

Kane, S.A., Aviles-Rosa, E.O., & Hall, N.J. (Texas Tech University)

The Spotted Lanternfly (*Lycorma delicatula*), SLF, is an invasive agricultural pest in the Northeastern U.S (Urban, 2020). One proposed method to slow the spread of SLF, and thus mitigate loss, is to employ trained SLF-egg detection dogs. The aim of the current study was to develop an egg-impermeable, odor-permeable training aid that enabled SLF-egg detection dogs, to spontaneously generalize and detect eggs in a mock deployment scenario. Dogs (n=7) previously trained to detect cold-killed SLF egg masses using an olfactometer, were presented with six training aids during unrewarded “probe” trials. Sniff time was recorded across every “probe” trial. The training aid that was both durable and had the longest cumulative sniff time (>3s) was selected for use in the mock-deployment scenario. Two dogs were trained to search pallets to find the SLF training aid. After the dogs reached >90% accuracy during training they completed three double-blind testing scenarios. The two dogs achieved greater than 85% accuracy across the three tests. In this study, a training aid was developed which resulted in near spontaneous generalization by trained SLF detection dogs, and high accuracy in a mock-deployment test, indicating that this aid could be useful for training operational dogs.

Detection of non-bacterial *Clostridium difficile* odorant by dogs

12:42 PM Sarah T. Boysen (*Comparative Cognition Project*), Kathy Hatch, Barbara K. Bell Sally Nicholson (*Summit Detection Dogs*), Paola A. Prada-Tiedemann, Shawna Gallegos, Nayelly Rangel (*Texas Tech University*), Rebecca Gabriliska, & Kendra Rumbaugh (*Texas Tech University Health Sciences Center*)

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Among hospital-acquired diseases, *Clostridium difficile* is one of the most difficult to eradicate since the bacteria throw spores that lie dormant. Because it is prevalent in hospitals and nursing homes, victims are often the elderly or immuno-compromised individuals. Additional cleaning procedures are often necessary to adequately sanitize rooms and equipment that have become contaminated. A dog was trained to detect samples derived from pure cultures, but such samples for training and in situ detection are not optimal. In our study, eight dogs with training in scent detection were exposed to the chemical signature of *C. diff.* that had been derived from direct cultures, but which lacked the biosafety hazards of actual samples. Despite previous extensive training with anise odor during which the dogs were trained not to respond to novel odors, the dogs successfully alerted to *C. diff.* odorant upon introduction, among blank distractors, and during sessions with a novel distractor odor. These findings represent the first proof-of-concept for detection of a safe odor sample derived from a bacterial culture by dogs which may have future applications in a real-world setting for the identification of *C. diff.* reservoirs in acute care settings.

12:56 PM **Enhancing Detection Canine Performance in Target Lean Environments**

Nathaniel Hall, Mallory DeChant, & Edgar Aviles-Rosa (*Texas Tech University*)

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Detection dogs are trained to detect a variety of critical targets. Often, training is comprised of a rich schedule of targets available, although operational deployments have substantially leaner schedules of targets. In a series of studies, we developed a laboratory model of this phenomenon and demonstrated that dogs showed reduced search behavior in the target lean conditions. Non-contingent reinforcement and the presentation of Pavlovian conditioned stimuli failed to increase search behavior in the target lean conditions. Reducing the mismatch in target frequency between the simulated training and operational deployment contexts increased search behavior and detection accuracy in the target lean conditions. This increase in performance was extended in a final experiment using operational detection canine teams.

1:10 PM **Human Perceptions of Canine Intelligence**

Miriam Ross, Daphna Buchsbaum, Bertram Malle, & David Sobel (*Brown University*)

24

Over two experiments, we explore lay people's conceptualization of dog intelligence. In Experiment 1 we elicited people's intuitions about what makes a dog smart or dumb. Qualitative coding of our free-response survey showed that people picture smart dogs as socially understanding and dumb dogs as struggling with physical reasoning. In Experiment 2, we took emerging themes from Experiment 1 and validated their predictive power. We asked participants to picture either a smart or a dumb dog, and rate that dog's likely performance in a series of hypothetical scenarios. The questions in Experiment 2 were developed from the most consistent conceptual themes from our free-response answers in Experiment 1. A Principal Components Analysis of Experiment 2 revealed three factors predictive of people's concepts: Social Ability (understanding humans), Physical Reasoning (navigation skills), and Temperament (excitement meeting new people). Together, our experiments suggest that people believe smart dogs are socially skilled with a good temperament, dumb dogs are especially bad at physical reasoning and avoiding threats. In future work, we will investigate dog guardians' perceptions of their own pet's intelligence, and compare a survey of dog owners' expectations of their own dogs' performance, to their pet's actual performance on several cognitive tasks.

1:17 PM **Pain and the brain: impaired spatial working memory in female dogs with osteoarthritis**

Michael Mendl, Melissa Smith, & Joanna C. Murrell (*University of Bristol UK*)

25

Chronic pain in humans is associated with impaired working memory. However, it is not known whether this is also the case in long-lived companion animals, such as dogs, who are vulnerable to age-related chronic pain conditions such as osteoarthritis. Pain-related impairment of cognitive function may impede a dog's ability to learn effectively in training situations, and to engage with its owners and environment, in turn affecting its quality of life. Here we compare the performance of 20 dogs with osteoarthritis and 21 healthy control dogs in a disappearing object task of spatial working memory. Female, but not male, osteoarthritic dogs had lower

predicted probabilities of successful task performance than control dogs of the same sex. Moreover, with increasing memory retention interval, performance declined more steeply in osteoarthritic than control dogs, suggesting that cognitive effects of osteoarthritis, and potentially other pain-related conditions, are more clearly revealed in tasks presenting a greater cognitive load. One possibility is that ongoing pain occupies cognitive resources resulting in insufficient cognitive capacity for solving tasks, especially more difficult ones. Our findings parallel results from studies of human pain and working memory. That female dogs may be particularly prone to these effects warrants further investigation.

1:31
PM *Break*

1:41 **Canine Cognition II (Chair: Elizabeth Warren)**
PM

Mothers matter: How early life experiences influence canine cognition and behavior

Emily Bray (University of Arizona), Laura Douglas (Canine Companions), Gita Gnanadesikan (Emory University), Daniel Horschler (Hill's Pet Nutrition), Brenda Kennedy, Kerinne Levy (Canine Companions), & Evan MacLean (University of Arizona)

Early maternal interactions have long-lasting effects in many species of mammals. In the current study, we observed 59 litters of Canine Companions service dog puppies (n = 235) from birth until three weeks of age. In addition to collecting behavioral measures on the dams pre-pregnancy, we also conducted behavioral tests on the offspring at 8 weeks of age and collected observations via questionnaires over the first year and a half of life to measure later behavior. We found that certain dam characteristics were associated with later mothering behavior. We also found several associations between maternal care and diverse measures of subsequent cognitive and temperament traits of their puppies. Finally, we found that puppies who experienced greater maternal investment were more likely to graduate from the service dog program, relative to dogs who experienced less maternal investment. While environmental influences on common dog behaviors are widely recognized, few studies have considered the consequences of experiences during the first weeks of life. Our results suggest that this period may make important contributions to the etiology of diverse behavioral outcomes.

Characterizing Dog Cognitive Aging Using Spontaneous Problem-Solving Measures: A Battery of Tests from The Dog Aging Project

Stephanie Hargrave, Emily Bray (University of Arizona), Stephanie McGrath (Colorado State University), Gene Alexander (University of Arizona), Theadora Block (Canine Companions), Naomi Chao (University of Arizona), Martin Darvas (University of Washington), Laura Douglas (Canine Companions), Janet Galante (Sit Stay Play), Brenda Kennedy (Canine Companions), Breonna Kusick, Julie Moreno (Colorado State University), Daniel Promislow (University of Washington), David Raichlen (University of Southern California), Lorelei Switzer (University of Arizona), Lily Tees (Colorado State University), Mikayla Underwood Aguilar (University of California-Davis), Silvan Urfer (University of Washington), Dog Aging Project consortium, & Evan MacLean (University of Arizona)

Companion dogs are a valuable model for aging research including studies of cognitive decline and dementia. With advanced age, some dogs spontaneously develop cognitive impairments and neuropathology resembling features of Alzheimer's disease. These processes have been studied extensively in laboratory beagles, but the cognitive assays used in that context – which rely on operant procedures – are not easily scalable for large samples of community-dwelling companion dogs. We developed a battery of five short-form tasks targeting three aspects of cognition that are impaired in Alzheimer's disease: spatial memory, executive function, and social cognition. We tested a cross-sectional sample of dogs (N = 117) and estimated associations between age and task performance. Older dogs scored lower on measures of spatial learning, memory, and response flexibility, and spent less time near, but more time gazing at the experimenter. We found no differences in associations between age and performance across dogs of different body masses, a proxy for expected lifespan.

26

1:48
PM

27

- 1:55 **Do dogs flexibly deploy coping strategies for self-control?**
 PM *Amalia P.M. Bastos, Patrick M. Wood, & Christopher Krupenye (Johns Hopkins University)*
- 28 Studies on delayed gratification in dogs suggest that dogs that wait longer for better rewards display behavioural patterns analogous to some of the “coping strategies” found in children succeeding at self-control tasks: looking away from the food reward, maintaining a larger distance from the food, and waiting in a laying position. However, given that neither past study involved a within-subject control condition where self-control was not required, it is impossible to determine the causality of these behaviours: do certain dogs wait longer because they happen to exhibit these behaviours, or do dogs deliberately employ these strategies to prolong their waiting times? Using a within-subject “forbidden food” paradigm where dogs were asked to leave a food reward on a plate, we compared the most consistent self-control behaviour in dogs – gaze-avoidance – when dogs were on leash versus off leash. When off leash, dogs must exert more self-control to avoid the food than when on leash, given that the leash physically impedes stealing. If dogs can differentiate between these contexts and strategically employ self-control strategies to resist the temptation of the “forbidden food”, we expect to see higher total looking times at the food when on leash compared to off leash.
- Characterizing the Heritability of Cognitive and Behavioral Traits Across Development in Domestic Dogs (*Canis lupus familiaris*)**
- 2:09 *Gitanjali E. Gnanadesikan (Emory University), Emily E. Bray (University of Arizona), Kerinne M. Levy (Canine Companions for Independence), Daniel J. Horschler (Hill’s Pet Nutrition), Stephanie Hargrave (University of Arizona), Laura E.L.C. Douglas, Brenda S. Kennedy (Canine Companions for Independence), Marina M. Watowich (Vanderbilt University), Noah Snyder-Mackler (Arizona State University), & Evan L. MacLean (University of Arizona)*
 PM
- 29 In humans, many behavioral and cognitive traits are moderately-to-highly heritable, with cognitive measures tending to increase in heritability over the lifespan, and personality measures tending to decrease in heritability. However, fewer studies have explored the heritability of analogous traits in non-human animals or the changes of these heritability estimates across development. We phenotyped 415 dog puppies and 520 adults on the Dog Cognitive Development Battery (DCDB). Scores across tasks were weakly intercorrelated, and we observed a wide range of estimated heritabilities. Using an animal model and the population pedigree, the most heritable traits in puppies involved looking to a human when spoken to (“human interest looking”, $h^2 = 0.32$) and reactions to both a novel object ($h^2 = 0.56$) and surprising events ($h^2 = 0.61$). Most heritability estimates decreased over development, although human interest looking time ($h^2 = 0.36$) and novel object reactions ($h^2 = 0.31$) remained moderately heritable in adults. Similar heritability estimates were found using a genomic-relatedness matrix in a subset of individuals. Our results address the psychological structure of individual differences early in dog development, characterize the extent to which these traits are heritable and available to selection, and demonstrate changes in heritability across canine development.
- 2:23 **Effects of physical activity on odor detection performance**
 PM *Liza Rothkoff, Edgar O. Aviles-Rosa, & Nathaniel J. Hall (Texas Tech University)*
- 30 Detection dogs serve many roles for the military, law enforcement, and conservation work. However, dogs are prone to psychological and physiological variables that can affect their performance.. Herein, we evaluated the effects of physical exercise on detection dogs’ olfactory sensitivities. In Experiment 1, we evaluated the effect of accelerometer model and attachment position on its capability of identifying different walk/running paces on a treadmill to validate a method to assess levels of physical exercise. In Experiment 2, dogs were exercised at 4 or 8 km/h on a treadmill while simultaneously doing a go/no-go olfactory detection threshold task. We found that both accelerometers tested showed a significant correlation with pace, indicating that a dog’s exercise pace can be determined using an accelerometer. Furthermore, dogs showed a decrease in olfactory sensitivity for lower odor concentrations while working under greater exercise intensity. At the lowest odor concentrations, performance declined from nearly 100% accuracy to 0% accuracy after running for 25 min at 8 km/h. These results demonstrate the importance of physical activity monitoring for operational working canines to maintain high levels of olfactory sensitivity.

2:30
PM

Human-Animal Interactions (Chair: Zebulon Bell)

Painting Pigeons: Exploring Digital Art Generation in Non-Human Animals

Cyrus Kirkman, Kayley Ozimac, Tianxing (Cameron) Guo, Robert Tsai, & Aaron P. Blaisdell (University of California Los Angeles)

Besides the occasional story of a painting elephant, pig, or chimp, the creation of art has been deemed unique to humans. Considering the expression in the web of an orb weaver or song of a zebra finch, however, this notion may be more a function of anthropocentric bias than meaningful difference. Previous research of non-human animal art has been constrained to organisms capable of wielding a paintbrush; we developed touchscreen-based digital paint programs tailored to response patterns of pigeons, which facilitated the generation of unique, colorful, and detailed artworks. Though the quantification of artwork may seem abstractly reductionist, we have attempted to analyze generated artwork via a variety of clustering and bout analyses of spatial, temporal, and situational peck data and have found patterns within and across subjects. We've also explored motivational processes, including some evidence of intrinsic generation of artwork. We aim to translate our paint programs for other organisms able to interact with a touchscreen in the hopes of comparing the artistic process and output of diverse species. Insights into artwork created by animals could not only enhance understanding of artistic expression in humans, but also provide an analog to the evolving realm of AI-generated art.

31

Tailoring the C-BARQ to Shelter Dogs: Identification of Five Reliable Factors

2:37
PM

Rachel Gilchrist, Molly Gardner, Patrick Manapat, Lisa Gunter (Arizona State University), Erica Feuerbacher (Virginia Polytechnic Institute and State University), Michael Edwards, & Clive Wynne (Arizona State University)

Despite the multitude of studies on dog behavior using the Canine Behavioral Assessment and Research Questionnaire (C-BARQ), little is known about its utility in a shelter population. This study aimed to identify and validate a subset of items adapted from the C-BARQ to assess behavior in sheltered dog populations. 445 questionnaires were analyzed for dogs at 11 shelters, and exploratory (n = 222) and confirmatory (n = 223) factor analysis revealed a five-factor structure (Fear, Arousal, Human Excitability, Dog Aggression, and Human Aggression) consisting of 24 items. These factors exhibited above-threshold internal consistency reliability (M = .78) and meaningful inter-factor correlations, affirming their suitability for assessing the behavior of sheltered dogs. Furthermore, item response theory analysis underscored the reliability and validity of these items in measuring the underlying constructs. These findings can be particularly valuable for shelters facing resource constraints, offering both efficiency and validated data collection methods to collect behavioral information.

32

Testing the concept of seeing in dogs

2:44
PM

Ludwig Huber, Martina Putnik, Veronika Szewczak, Pauline van der Wolf, Lucrezia Lonardo, & Christoph Völter (University of Veterinary Medicine Vienna)

Central to the question of "mind-reading" in non-human animals is whether they can form the concept of "seeing". More specifically, can non-human animals attribute the concept "seeing" without relying on behavioural cues? And would subjects infer from such concepts, once established, what others know and intend to do next? One way to solve this problem is to use previous experience of one's own perspective and infer what others can possibly see in the present situation. By utilizing the experience-projection paradigm in a food-stealing scenario, we tested whether dogs can use their own experience of seeing with novel barriers to infer whether others could or could not perceive the same visual information through these barriers. In another study we investigated if dogs appreciate not only what others can see at the time of decision-making, but what others might see. In essence, we tested the dog's ability to factor in the potential visual access of humans even when those humans were not within their line of sight. The cumulative findings from our studies do not lend support to the hypothesis that dogs reason about the mental state of "seeing" when the sole available cue is derived from their own past visual experiences.

33

- 34** **2:58 PM** **Dolphin Recognition of Individual Humans?**
Heidi E. Harley (New College of Florida and Disney's EPCOT's The Seas), & Wendi Fellner (Disney's EPCOT's The Seas)
- Wild bottlenose dolphins live in fission-fusion societies in which conspecifics separate, convene, and often join the same individuals repeatedly using individually unique cohesion calls, i.e., “signature whistles”. Dolphins in human care also move apart and come together, use signature whistles, and spend more time with some individuals than others. Does their fission-fusion society extend to humans? Here we made a first step at investigating this possibility by trying to confirm that dolphins can discriminate and recognize individual humans visually via a 3-alternative matching-to-sample task, presenting samples and alternatives in large underwater windows. We tried many kinds of stimulus sets including: live humans, varying in familiarity; sets of humans and objects; humans in photos and videos (photo-photo, photo-video) with still humans, with humans portraying different movements, and with trainers presenting trained behavior-eliciting hand-signs; and also isolated moving hands presented through a black curtain. The two male dolphins’ performance accuracy was generally low when discriminating humans (averaging 25% to 43%; chance=33%) but much higher with isolated hands (72% to 81%; chance=33%), perhaps because humans’ hands are a focal point for dolphins in managed care since humans mostly convey information to dolphins through their hands.
- 3:12 PM** *Snack Break*
- 3:42 PM** **Social Learning, Cognition, and Neuroscience (Chair: Reggie Gazes)**
- 35** **The impact of environment on social cognition in lizards**
Agnese Crisante, Oliver H. P. Burman, Thomas W. Pike, & Anna Wilkinson (University of Lincoln)
- It is well established that environmental conditions can impact the cognition of mammals and birds, however, little is known about whether the same effect is found in reptiles. As reptiles are now commonly kept as pets, it is critical to understand the effect that their captive environment has on their cognitive capabilities. In the present study, we investigated how different housing conditions (standard vs enriched) affected gaze following abilities in a group of captive bearded dragons. The lizards (n = 12) individually experienced each housing condition (order counterbalanced across subjects) for a period of 4 weeks before their ability to follow the gaze of a conspecific into distant space was tested. Our results revealed that while animals housed in both standard and enriched conditions were able to gaze follow, animals in enriched conditions did this in more scenarios. This finding suggests that the presence of environmental complexity may be a key factor in allowing lizards to display their social cognitive abilities and inappropriate housing may account for the misperception that reptiles are ‘sluggish, inert and unintelligent’.
- 36** **3:49 PM** **No honor among fiends: Chickadees show no difference in behavior when presented with a trapped vs. non-trapped conspecific**
Katharine H. Stenstrom, Moriah J. Deimeke, Prateek K. Sahu, & Sarah M.L. Smeltz, Christopher B. Sturdy (University of Alberta)
- Rescue behavior is a type of altruism in which an individual aids another individual that is in distress or danger, with no explicit benefit to the rescuer. Black-capped chickadees are well-known for their cooperative behavior (e.g., predator mobbing). We conducted an experiment to test for rescue behavior in wild-caught chickadees. We exposed chickadees to one of two conditions. In each condition, one bird was contained while a partner was allowed to fly freely in the experimental arena. In the trapped-other condition, the contained bird was placed inside a Potter trap. In the free/home condition, the bird was placed within its home cage, while the trap remained empty. The chickadees did not exhibit any rescue-oriented behavior towards the trapped conspecific, and on several occasions performed dominance displays towards their trapped partner instead. Birds landed on the trap faster when it was empty than when it contained a bird, and produced more vocalizations overall when in the trap than when in their home cage. We argue that, while the chickadees failed to attempt rescuing their partner, the

rescue paradigm itself could provide a way to observe dyadic dominance interactions in captive chickadees while minimizing risk to the birds.

3:56 E-quail-lateral Triangle? How Individuality, Lateralization, And Sociality Influence Inhibition?

PM

Femke Timmerman, Katy Willcox, Luc Lens, Frederick Verbruggen, & Alizee Vernouillet (Universiteit Gent)

37

In many species, the brain is lateralized such that each hemisphere specializes in specific cognitive functions. This cerebral specialization often translates into behavioral lateralization (i.e., preferential use of one side of the body during behavioral/cognitive tasks). That the social environment influences lateralization has been suggested but remains poorly investigated. Similarly, how lateralization and cognitive performance relate to one another remains relatively unexplored. In this study, we investigated whether 1) quails were lateralized at an individual- and at a population-level; 2) whether social conditions during rearing influenced lateralization, and 3) whether less lateralized (i.e., more ambidextrous) individuals were more flexible in their cognitive abilities or, on the contrary, whether lateralization enhanced cognition. We assessed the strength of behavioral lateralization and the cognitive performance of 120 Japanese quails during two inhibition tasks (i.e., Cylinder and Detour). Sixty quails were raised in small groups of five and 60 quails in large groups of 15 quails. Preliminary results indicate that there was considerable individual variation in the strength of lateralization that was not related to social conditions during rearing. Together, these results broaden our understanding of laterality in animals.

4:10 Cold-blooded Roommates– The effects of social housing and temperature on snake personality.

PM

Gokulan Nagabaskaran, Morgan Skinner, & Noam Miller (Wilfrid Laurier University)

38

Snakes, like other animals, show individual differences in behaviour that are consistent across time and context, often called personality. The extent to which personality limits behavioural plasticity in response to environmental changes is an important open question. We assessed plasticity in boldness and sociability as an effect of social housing and changes in temperature in western hognose snakes (*Heterodon nasicus*; n=23). Snakes were housed alone or in pairs for 8 months prior to the study. Snakes were either “charged” to a specific temperature before each trial (25, 28, or 31 °C), or allowed to choose their own temperature from a gradient. We predicted that pair-housed snakes would be less bold and more social than isolated snakes, and that heating snakes would increase boldness and decrease sociability (by increasing locomotion). Each snake participated in two trials assessing each trait (boldness and sociability) at each temperature, in a counter-balanced order. Pair-housed snakes were significantly bolder than isolated snakes, and all snakes showed a trend for increasing boldness with increasing temperature. We found no significant effects of housing or temperature on sociability. These results suggest that the expression of some personality traits, like boldness, may be more sensitive/plastic to environmental factors than others.

4:17 Metacognition & Information-Seeking
(Chair: Alizée Vernouillet)

PM

Information-seeking by pigeons (*Columba livia*) in a luminance-discrimination task

Keigo Washizuka, Riho Kondo, Tomokazu Ushitani (Chiba University), Kazuhiro Goto (Sagami Women’s University), & Arie Watanabe (Chiba University)

39

Metacognition enables humans to monitor their own cognitive states and to control their own behavior. We tested metacognitive ability of pigeons using information-seeking paradigm in a luminance-discrimination task. We presented the subjects with a star-shaped stimulus (information-seeking stimulus) along with two square stimuli (discriminative stimuli) of various luminance. The pigeons were rewarded for pecking the target, which was discriminative stimulus with higher luminance. Response to the information-seeking stimulus eliminated the discriminative stimulus with lower luminance (distractor), leaving only the target available. The difficulty of the task was controlled by adjusting the luminance of the discriminative stimuli. If pigeons have metacognition, their use of the information-seeking stimulus should increase with the difficulty of the luminance-discrimination task (i.e., as the difference in luminance of discriminative stimuli becomes smaller). However, in contrast to such a prediction, information-seeking rate increased regardless of the task difficulty when the target and distractor were of relatively low luminance. This result implies that the subjects used information-seeking not as a result of metacognitive process but due to the physical properties of the discriminative stimuli. This possibility was further

supported by our additional experiment in which the target was replaced with the discriminative stimulus with lower luminance.

4:24
PM

Assessing capacities for basic reflective thinking in human infants, dogs, and pigs

Kirsten Blakey, Eva Rafetseder (University of Stirling), Zsófia Virányi, Ariane Veit, Kea Amelung, Kinga Kovacs, Franziska Freudensprung (Messerli Research Institute), & Giacomo Melis (University of Stirling)

40

Some philosophers argue that reflection, the ability to assess one's reasons for beliefs and actions, is the defining feature of rational thinking. However, they also tie reflective thinking to linguistic abilities, excluding human infants and non-human animals. To assess capacities for basic reflective thinking, without linguistic requirements, we investigated whether 2-year-old children, dogs, or pigs could identify information coming from an unreliable informant as misleading. In an object-search task, informants repeatedly hid rewards using three different actions. One informant's actions reliably indicated the reward location, while the other's actions were unreliable, indicating the reward location in 50% of trials. Using different actions to hide rewards put subjects in the position to make generalisations about the reliability of the evidence provided by each informant. Neither 2-year-olds nor animals responded differently to the reliable and unreliable informants. While children became less likely to follow the indications of either informant in later trials, animals continued to follow both at the same rate. These results provide no evidence that infants, dogs, or pigs made a generalisation about the reliability of each informant across the hiding actions. It remains an open question whether infants, dogs, and pigs are capable of basic forms of reflective thinking.

4:38
PM

Memory (Chair: Alizée Vernouillet)

Investigating the presence of working memory and familiarity in chickens

Jad Nasrini, Tristan Correa, & Robert R. Hampton (Emory University)

41

Humans and monkeys rely on working memory for holding information in mind, and on familiarity for identifying something they have seen before. These two memory processes are dissociable. For example, monkeys learn a match-to-sample memory task that can be solved using familiarity faster than one that must be solved using working memory. The extent to which these two memory systems are conserved across taxa is unclear. To investigate whether birds share these same memory processes, we tested ten domesticated chickens using touchscreens on match-to-sample tasks with either a large or small set of images, which monkeys solve using familiarity and working memory respectively. If chickens rely on the same memory processes as monkeys to solve these tasks, they should learn the familiarity task faster than the working memory task. Contrary to monkeys, our preliminary data suggest that chickens learned the working memory task faster than the familiarity task. This suggests either that chickens did not use the same memory systems as monkeys to solve this task, or that they use these memory systems differently.

4:45
PM

Cognition in parids

Anders Brodin, Ernő Vincze, & Utku Urhan (Lund University)

42

The first evidence that birds possess cognitive abilities was published 1720 when J.F.A. von Pernau demonstrated that marsh tits remember the locations of their cached seeds. Most parid species are large scale food hoarders that can be seen as spatial memory specialists. They have been model species in many types of memory experiments in North America and Europe. A very different wintering strategy occur in the Eurasian great and blue tits that do not store food at all but are very innovative when it comes to obtaining food from humans. The great tit is the world's most studied wild bird species. I have studied foraging, memory and cognition in parids since 1989 in many species and published around 50 papers on this. I will summarize my most important results, on for example caching memory longevity in willow tits, species differences in observational memory ability, and impulse control and problem solving ability in great tits. I will also briefly describe the highlights in this field during the last 60 years. This will include the true story behind the famous milk bottle opening by tits in Western Europe and a discussion of "culture" in great tits.

8:30 PM Poster Session I (8:30 - 10:30) in Alvarado ABC.
- with cash bar

See Poster I Abstracts Starting on Page 32.

*Note for Poster Presenters: Please set up your posters between 3:00PM and 6:00PM on Wednesday afternoon.

Friday

9:00-10:30 AM Poster Session I Setup (Alvarado ABC)

10:30-11:30 AM CO3 Mentoring Session (Alvarado DE)

“Grant Writing 101: Advice from Reviewers & Successful Applicants”

Funding application fears? Come and ask your questions to our friendly panel of expert application reviewers and writers. From student fellowships to general research grants, the panellists can provide guidance on strengthening your skills, suggest resources that will aid in preparing your application, and generally demystify the process.

This event is open to **all** conference goers, with special encouragement to students, postdocs, and early career faculty to attend and ask questions! The session will open with a panel Q&A and transition into small group discussions with individual panellists and senior conference attendees. We strongly encourage and welcome senior faculty to support the next generation of comparative cognitive scientists by attending the event and sharing valuable experiences in funding acquisition. We also particularly encourage individuals from underrepresented groups to attend to promote greater equality in science. To get the panel kickstarted, submit your funding-related questions and discussion themes of interest by April 9th, 2024. Input from all is welcome, please share your suggestions in this form: bit.ly/co32024mentorevent.

Tea and coffee will be provided.

Panellists include:

- Dr. Michael Beran, Professor, Georgia State University, USA
- Dr. Gitanjali Gnanadesikan, FIRST Postdoctoral Fellow, Emory University, USA
- Dr. Michael Mendl, Professor, University of Bristol, UK
- Dr. Valerie Kuhlmeier, Professor, Queen’s University, Canada
- Dr. Susan Healy, Professor, University of St. Andrews, UK

12:00 PM Early Career Award Winner - Christopher Krupenye
(Chair: Lauren Guillette)

43

The Social Minds of Humans and Other Apes

Christopher Krupenye (Johns Hopkins University)

Several studies will be presented, examining the rich social cognitive capacities that are shared across apes and allow them to flexibly navigate their complex social worlds.

12:20
PM **Problem Solving & Causality (Chair: Gitanjali Gnanadesikan)**

Innovative problem solving by wild falcons

12:20
PM *Megan L. Lambert, Katie J. Harrington, Remco Folkerstma, Alice M.I. Auersperg (University of Veterinary Medicine Vienna), & Laura Biondi (Instituto de Investigaciones Marinas y Costeras)*

44

Innovation (solving a novel problem or applying a new solution to a familiar problem) plays an important role in species' ecology and evolution, and serves as a useful measure for cross-group comparisons of behavioural flexibility and problem solving. We introduce a new and highly relevant model species for innovation and problem solving: the striated caracara (*Phalacrocorax auratus*), a falcon species native to the Falkland Islands that shows levels of curiosity and neophilia rarely found in birds. We presented wild individuals with a novel, 8-task puzzle box to assess individuals' manner, rate and flexibility of innovative problem solving over repeated exposure. Striated caracara performed at rates similar to tool-using parrots, reaching near ceiling levels of innovation in very few trials, repeatedly and flexibly solving the tasks and displaying rapid learning of responses as they did so. We discuss our findings in relation to the birds' ecology (e.g., geographic restriction, resource unpredictability and generalist lifestyle) and encourage future work investigating their cognitive abilities in a natural context.

12:34 **Insights from Vertical String-Pulling Challenges and Biomechanical Strategies in Asian Hornbills**

PM *Elias Garcia-Pelegrin (National University of Singapore)*

45

The vertical string-pulling test stands as a hallmark in avian cognition, requiring subjects to employ a degree of motor control and planning for retrieving out-of-reach rewards attached to a suspended string. Proficient birds display a sophisticated motor technique, involving coordinated actions such as reaching, gripping, pulling, crafting a loop, stepping on the string, and repeating these manoeuvres. In terms of motor skills, the most demanding element in birds' string pulling seems to be the action of stepping on the string, yet limited research delves into how bird species with less dexterous feet approach this problem. Motor systems and pedal anatomy vary widely among the avian taxa, this diversity encompasses various biomechanical ranges that could influence responses to the vertical string-pulling test. Syndactyly is a foot configuration where two or more toes are fused. Among species like hornbills, extreme syndactyly eliminates independent toe operation, an adaptation likely motivated by the necessity for augmented grip strength during perching. This presentation aims to showcase the strategies employed by a group of Asian hornbills when faced with vertical string-pulling problems. It will examine the diverse biomechanical approaches embraced by this sample, highlighting the distinct opportunities presented by the suspended string and the accompanying reward.

12:41
PM **Perception (Chair: Gitanjali Gnanadesikan)**

Cleaner fish and other wrasse match primates in their ability to delay gratification

Mélisande Aellen (University of Neuchâtel Switzerland), Valérie Dufour (University of Tours Strasbourg France), & Redouan Bshary (University of Neuchâtel Switzerland)

46

Humans excel at achieving mutual cooperation for direct benefits. One often-quoted factor that drives our cooperation skills is our ability to delay gratification for future benefits, which is thought to be linked to our advanced cognitive abilities compared to other species. The paradigm to test delayed gratification in primates and birds involves offering them small food rewards that can be exchanged for bigger (quantitative task) or better quality (qualitative task) food rewards following a delay. We applied this paradigm to the cleaner fish, *Labroides dimidiatus*. Cleaners remove ectoparasites from reef fish 'clients', despite their preference for eating client mucus. This eating against preference reflects delayed gratification, as clients whose ectoparasites are removed revisit cleaner later. Cleaners performed efficiently in the quantitative task, performing similarly to monkeys.

Conversely, cleaners underperformed in the qualitative task. Other wrasse species were evaluated in the quantitative task, revealing that a different species of cleaner and non-cleaner wrasse both performed well, the latter despite no evidence that they need such ability to cooperate in nature. However, only the two cleaner species demonstrated anticipation ability. We conclude that the capacity to delay gratification does not warrant advanced cognitive abilities, although the underlying mechanisms vary between fish species.

12:55 **Mental rotation in pigeons (*Columba livia*)**

PM *Tomokazu Ushitani, Kazuki Fujii, Asuka Shirasaki, Wenhui Yuan, & Ariei Watanabe (Chiba University)*

47

In a study examining mental rotation in pigeons (Delius & Hollard, 1982), the time required to discriminate geometric figures and their mirror images did not increase but was flat as a function of the angle of presentation of the figure. To investigate the cause of this puzzling result, we selected one of the figures used by Delius and Hollard and conducted a replication. At the beginning of the trial, either the figure or its mirror image appeared as a sample stimulus. Responding to the sample stimulus produced the same figure and its mirror image as the comparison stimuli. Pigeons were rewarded when they responded to a comparison that was different from the sample (odddity-from-sample task). Unlike in the previous study, the pigeons in the present study showed difficulty in the discrimination between the original image and its mirror image, but two of the four pigeons completed the training. When these pigeons were presented with the comparison stimuli that appeared at an angle different from that of the training, the reaction time increased as a function of the presentation angle. Methodological causes that produced results inconsistent with those of the previous study are discussed.

Development of an Automated Human Scent Olfactometer and its use to evaluate detection dog perception of Human Scent

1:09

PM *Edgar O. Aviles-Rosa, Andrea C. Medrano, Ariela Cantu, Paola Prada-Tiedemann, Michele N. Maughan, Jenna D. Gadberry (Texas Tech University), Robin R. Greubel (Excet), & Nathaniel J. Hall (Texas Tech University)*

48

Working Dogs have shown an extraordinary ability to utilize olfaction for victim recovery efforts in mass disaster events and missing persons cases. Although instrumental analysis has chemically characterized odor volatiles from various human biospecimens, to date, it is still not clear what constitutes HS from a detection dog perspective. Thus, the aims of this research were 1) to develop an automated human scent olfactometer (AHSO) to present HS to dogs in a controlled laboratory setting and 2) use the AHSO to evaluate dogs' response to different scented articles and individual components of HS to determine the main constituents of HS dogs utilize. The apparatus was validated with naïve dogs and certified search and rescue dogs. We then utilize the apparatus to test dogs' response to different scented articles exposed to the volunteer or to different constituent of human scent in two different experiments. Data shows that of all scented articles and individual constituents of human scent, breath seems to be the main constituent of human scent utilized by dogs. These results have significant implications for SAR and human scent detection teams as it suggests breath is a critical constituent of HS.

1:23

PM *Break*

1:33 **Communication (Chair: Chris Sturdy)**

PM

Bonobos Point More For Ignorant Than Knowledgeable Social Partners

Luke Townrow & Christopher Krupenye (Johns Hopkins University)

49

A growing body of work suggests that nonhuman primates share with humans rich precursors of theory of mind, the ability to infer the mental states that guide others' actions. For example, across numerous experiments, primates respond appropriately to cues associated with another's perspective, knowledge and even beliefs. However, the representations underlying these abilities remain hotly debated. Whilst some researchers posit that NHPs are able to attribute knowledge and ignorance states to others, alternative proposals suggest primates are instead relying on awareness tracking. The present highly-controlled, pre-registered study tested these conflicting hypotheses. Two captive bonobos could point and remedy a human partner's ignorance in a cooperative game.

Bonobos could receive a reward they had watched being hidden under one of several cups, if their partner could locate it. If bonobos can represent a partner's ignorance and are motivated to communicate based on this mental state, they should point more frequently, and more quickly, to the hidden food's location when their partner was ignorant. These predictions were largely confirmed, providing evidence that apes can represent (and act on) others' ignorance in some form, and respond appropriately by flexibly adapting their communication to change their partner's behavior.

1:40 Neurobiological Underpinnings of Graded Vocal Production Learning Across Phocid and Otariid Species

PM *Peter Cook (New College of Florida)*

50

Parallel neurobiological adaptations supporting vocal production learning have been elucidated in humans and psittacine birds. In addition, graded brain adaptations have been mapped corresponding to varied vocal learning capability across primate and bird species. To date, there are limited data on relevant brain circuits in any non-primate mammal. We present the first tractography study of auditory-motor and brainstem circuits covarying with vocal learning capability across pinniped species. Following rapid speciation on moving to an amphibious lifestyle, extant pinnipeds demonstrate a spectrum of vocal production learning capabilities. Otariidae are vocally stereotypic. Phocids show more vocal flexibility, with elephant seals demonstrating critical period vocal learning sensitivity, and harbor seals showing some signs of graded vocal production learning throughout the lifespan. Using post-mortem diffusion imaging and tractography, we found evidence of graded vocal motor and auditory connectivity and altered brainstem circuits matching putative vocal learning behavior across California sea lions, Northern elephant seals, and Pacific harbor seals. These findings solidify the pinnipeds as a valid large mammal model for studying the evolution of vocal learning.

1:54 A Tale of Tails: The potential function of tail-flagging behaviours in Eurasian red squirrels (*Sciurus vulgaris*)

PM *Shannon M. Digweed, & Juliana Kaneda (MacEwan University)*

51

Not only do animals communicate with one another, but they also demonstrate the use of mixed communication strategies. One such strategy, multimodal communication, involves multiple sensory signals used together to communicate messages. For example, an animal may use visual signals, auditory signals, or a combination of both, to communicate. Eurasian red squirrels have been reported to use visual (tail flags) and acoustic (chip call) signals in multiple contexts, like mating, social interactions, and predator encounters, and thus they provide an excellent opportunity to study the specific circumstances in which multimodal communication occurs. Our preliminary research indicates that tail flagging was produced more often in the presence of a conspecific and when entering another squirrel's area/territory. Both may be situations of increased arousal and thus the flagging may indicate an aggressive interaction. The chip call, however, was produced more often when squirrels were alone and in their own territory and in the presence of a predator/threat. Unlike tail flags, chips may be used in non-social, predator interactions to warn or identify threats. We found only four instances of joint use of acoustic and visual signals, thus multimodal communication may not be a key feature of their communication system.

2:08 Categorization of Burst-Pulse Vocalizations in Common Bottlenose Dolphins (*Tursiops truncatus*)

PM *Wendi Fellner (University of St Andrews and Disney's Animals Science and Environment), Heidi E. Harley (New College of Florida and Disney's Animals Science and Environment), & Vincent M. Janik (University of St Andrews)*

52

Bottlenose dolphins use a complex system of vocalizations to communicate. Although some aspects of their vocal repertoire are well-studied (e.g., signature whistles and echolocation), less is known about a third, affect-linked type of vocalization, the burst pulse, in part due to the lack of a consistent, reproducible categorization scheme. Creating a categorization scheme requires developing a reliable technique of differentiating between varieties of burst pulses as they may have different functions, particularly since many characteristics overlap with echolocation. Here we randomly selected 203 pulse trains from two dolphins engaged in three types of activities: returning to the water following a medical procedure, navigating with echolocation while blindfolded, and echoically inspecting an object. We first converted each pulse train into a frequency contour using pulse repetition rate and then used the neural network-based program ARTwarp to categorize trains based on similarity. This process yielded 25 categories averaging 8.1 contours each, 14 of which (56%) contained contours from a single context. 39.4% of all contours were placed within single-context categories, comparing favorably to human

sorters. This technique provides a promising, reproducible method of categorizing burst pulses and lays a foundation for future investigations into their functions.

2:15
PM

Using mobile eye tracking to study dogs' understanding of human referential communication

Christoph J. Völter, Karoline Gerwisch, Paula Berg, Zsófia Virányi, & Ludwig Huber (Messerli Research Institute - University of Veterinary Medicine Vienna)

53

A large body of research in canine cognition has been devoted to the question to what extent dogs understand and follow human referential communication. While it is widely accepted that dogs follow (some) human referential signals, the way they understand them remains controversial. Here, we applied mobile eye tracking with dogs (N=20) to investigate the impact of ostensive pointing and gaze cues on dogs' visual attention during an object-choice task. We addressed the question whether dogs would exhibit a greater response to referential communication compared to other directional actions. Five conditions were tested (pointing, pointing+gazing, gazing, fake throwing, and no-cue control), each cue-condition indicating the location of a hidden food reward. Results demonstrated that the combination of pointing and gazing significantly increased dogs' attention towards the signaled referent (baited bowl). In the pointing+gazing condition, dogs chose the signaled bowl significantly above chance levels and maintained longer attention on the correct bowl compared to other conditions. While alternative cues (fake throwing) directed the dogs' gaze in the indicated direction, they did not significantly affect subsequent choice performance. Our findings highlight that the joint use of pointing and gazing is a particularly effective method for directing dogs' attention to a signaled referent.

2:29
PM

Pointing on the other hand – Can dogs understand contralateral points?

Heidi Lyn, Katie West, Christopher Bass, Joclyn Villegas, & Steven Baker (University of South Alabama)

54

Over the past several decades, interest in canine communicative abilities have grown. Initial reports suggested that dogs were particularly good at following human communicative gestures, such as points. We will report on our study specifically comparing how dogs perform on ipsilateral (same-side) and contralateral (opposite side) points. We will also compare data from an ongoing meta-analysis of over 2200 data points of dogs and wild canids. Our experimental findings suggest that dogs follow ipsilateral points (Average 61.8% correct), but fail to follow contralateral points (Average 47.0% correct). We found a similar pattern in the meta-analysis, with dogs being more successful at ipsilateral points. In addition, dogs were equally successful at ipsilateral points when the humans indicated their communicative intentions or not (for example, by calling the dogs' name, or by providing gaze cues in addition to the point) but the few dogs that were successful at following contralateral points were only successful when communicative cues were present. Overall, these findings suggest that dogs generally succeed in point following tasks through well-understood associative learning mechanisms, but that those few that follow contralateral points may to process point gestures as communication.

2:43
PM

Snack Break

3:13
PM

Attention (Chair: Kate Chapman)

Pigeons' perception of steam/bounce motion

Kiho Morita (Chiba University), Aya Kokubu (Kyoto University), Satoru Isoda, Kakeru Endo, Honoka Hoshijima, Arie Watanabe, & Tomokazu Ushitani (Chiba University)

55

Stream/bounce motion involves the approach, overlap, and separation of two disks. Humans typically perceive this motion as a stream (Sekuler et al., 1997), whereas chimpanzees tend to report it as a bounce (Matsuno & Tomonaga, 2011). This difference in perception may be attributed to varying dominance of global information processing, with chimpanzees paying attention more to local information (Fagot & Tomonaga, 1999) compared to humans. In the present study, we investigated whether pigeons, known for their local precedence (Cavoto & Cook, 2001), would report stream/bounce motion as bounce, like chimpanzees. Pigeons were trained to choose the target disk, initially indicated by red outline which gradually faded to match the other disk but matching the other disk during motion after both disks moved to the center and exhibited either an obvious bouncing or

streaming motion. When the birds were exposed to a test involving steam/bounce motion, they reported the motion as a stream, aligning with the perception of humans. We will discuss species differences, considering the results of the further experiments that introduced a sound at the timing at which the disks overlap, which induces a perception of bounce in humans.

3:20 Pigeons Show No Attentional Boost Effect in a Working Memory Task

PM *Walter T Herbranson (Whitman College)*

56

Divided attention usually impairs performance on memory tasks. However, under some circumstances, humans show an opposite effect in which divided attention improves memory. To test whether this attentional boost effect also occurs in pigeons, a parallel procedure was created. Birds were tested using a sequential delayed matching to sample task. During the study phase, birds saw sample colors projected one after the other onto the center key of an operant chamber. After a short delay, the test phase presented matching and nonmatching colors onto the side keys, and pecks to the matching color were reinforced. To match attentional boost research in humans, some trials were divided attention trials, on which a distractor stimulus was projected over samples during the study phase. The form of the distractor stimulus indicated whether a bonus reward would be available later, but no additional response was required to obtain that bonus. Pigeons were better than chance on both divided attention and control trials. However, whereas humans show attentional boost by performing better on divided attention trials, pigeons were worse. This result is inconsistent with attentional boost, but consistent with standard resource-based models of attention.

3:34 Cognitive control suppresses incidental visual memory in rhesus macaques

PM *Mackenzie F. Webster, & Robert Hampton (Emory University)*

57

Previous research has demonstrated a dissociation of working memory and familiarity processes in rhesus macaques. The use of familiarity to solve recognition tasks is widely considered to be automatic. The current study compared rates of incidental memory, memory for non-cued items, between conditions that require the use of cognitively controlled working memory (using a small-set of repeating images) and conditions that have previously been shown to favor automatic familiarity (using a large set of trial-unique images). We found significantly more incidental memory in tests of familiarity than in tests of working memory in rhesus monkeys ($n=6$; $t(5) = 8.72$, $p < .001$). Furthermore, while incidental memory during working memory was not significantly different from chance (25%; $t(5) = 0.88$, $p = .42$), incidental memory in the familiarity condition was ($t(5) = 7.61$, $p < .001$). These results indicate that, for monkeys, familiarity processes often occur automatically, even when subjects' expectations do not require memory of an image. In contrast this does not occur for working memory, where cognitive control presumably focuses processing on target stimuli.

3:41 Some Evidence of Dimensional Organization of Attention by Pigeons

PM *Muhammad A. Qadri, & Suzanne L. Gray (College of the Holy Cross)*

58

Vertebrate behavior is fundamentally organized. While a large body of literature has examined how this organization is controlled by factors external to an animal, less is known about the cognitive control of biological systems when examining production-like open-ended tasks. To explore this aspect, recent studies have examined how animals select items in a multi-target multi-dimensional visual search task. In this design, humans organize their behavior into "runs" – repeated discrimination within a single dimensions, while pigeons have been shown to prioritize discriminability. After three new pigeons were trained to complete a bright/dark and vertical/horizontal discrimination, they were tested with displays different sizes, distributions, positions, and compositions of targets. By exploring these properties, we discovered some conditions under which some pigeons would show the same "runs" of selections. Implications regarding the evolution of behavior and the interpretation of similar experimental outcomes will be discussed.

Categorising and counting by spider-eating spiders

3:55

59

PM *Fiona R. Cross (University of Canterbury, New Zealand), & Robert R. Jackson (International Centre of Insect Physiology and Ecology, Kenya)*

Jumping spiders (family Salticidae) have unique, complex eyes and a capacity for spatial vision exceeding that known for any other animals of similar size. *Portia africana* is a spider-eating salticid spider known to execute pre-planned detours for reaching its prey and for representing the number of spiders in a scene, with evidence

from previous research showing that *P. africana* experiences expectancy violation when the number seen at the end of a detour differs from the number seen at the beginning. There was a limit of no more than 3, but here we show evidence of this spider exceeding this limit in more complex tasks in which categorising and counting are required at the same time. In earlier experiments, prey and competitors (i.e., conspecific rivals) were presented in a scene, but with the overall number varying between trials. In new experiments, the overall number remained the same between trials, but with the number of prey and competitors varying within the total. Despite the overall number remaining the same, there was evidence of *P. africana* experiencing expectancy violation when there was any change in number, suggesting that *P. africana* simultaneously categorises spiders and attends to number within categories.

4:09
PM **Nest Building (Chair: Shannon Digweed)**

Lessons in love: does staying with the same partner facilitate learning in a nest-building context?

Benjamin A. Whittaker, Cailyn Poole, Jessica Hewitt, Andrés Camacho-Alpizar, & Lauren M. Guillette (University of Alberta)

60

Zebra finches are socially-monomamous songbirds that build nests to reproduce. Males build nests with individual style (size and shape), learning more consistent individual style after gaining nest-building experience. Do female partners play a role in learning nest style? Twenty males each built five nests using string in a laboratory. Ten males built nests with the same female partners (Same-Partner Group, SPG), whereas, the other ten males built each nest with a different female partner (Different-Partner Group, DPG). Nest style was measured using linear morphometrics (size) and geometric landmark analyses (shape). SPG males built nests with consistent style, whereas, DPG males did not have consistent nest style. The SPG reduced the amount of material used to complete successive nests and became faster at completing successive nests, whereas, the DPG did not reduce the material used nor time taken to complete nests. Whether directly or indirectly, females influenced nest building. Birds that remained with the same partner learned to solve an ecologically important task (nest building) with a more consistent response (nest style), faster, and using fewer resources than birds that changed partner. This implies that learning to solve tasks alongside the same partner may be an advantage of social-monomamy.

4:23 **Wild birds associate reproductive success with their nest materials**

PM *Susan D. Healy (University of St. Andrews)*

61

There are increasing data to show that birds use a variety of information to make nest-building decisions, including their own experience. These data are almost exclusively from birds tested in the laboratory, and mostly from zebra finches, as species in which males are the primary builder. Here I present data to show that wild female blue tits building around St Andrews associate the materials with which they build their first nest with their success at producing offspring: females that produce young from their first nest build the same nest in the subsequent season, while the females that are not successful make changes. The unsuccessful birds increase the amount of insulation they include into their nest, or they change nest boxes, or they change their mate. Those previously-unsuccessful birds that increase the amount of insulation into their nest are, as a result, more likely to be successful in producing young from their second nest. These data, by supporting the laboratory data from a different sex and species, show the generality of learning and memory in nest-building decision-making.

8:30 **Poster Session II (8:30 - 10:30 PM) in Alvarado ABC**

PM *- with cash bar*

See Poster II Abstracts Starting on Page 40.

***Note for Poster II Presenters: Please set up your posters between 9:00AM and 10:30AM on Friday morning.**

Saturday

11:00AM-12:00PM *Business Meeting (All are welcome!)*
in Alvarado EFG

12:40 PM *Group Photo ☺ (Location TBA)*

1:00
PM **Decision-Making (Chair: Ralph Miller)**

Measuring tolerance and dominance across food and non-food contexts in chimpanzees

Elizabeth Warren (Johns Hopkins University), Dora Biro (University of Rochester), Richard P Mann (University of Leeds), & Christopher Krupenye (Johns Hopkins University)

Variation in inter-individual tolerance and dominance is central to cooperative and competitive behavior in non-human primates. Definitions of tolerance range widely between investigations, particularly in whether they include factors other than rates of co-feeding. Given the context-sensitivity of both tolerance and dominance, social behaviors outside of co-feeding or resource monopolization may shed light on primates' willingness and strategies when acting collectively. The aim of the current study is to explore whether a broad range of dyadic social behaviors, including co-feeding, grooming, co-sleeping, comfort-seeking, and non-food resource sharing, reflect a single, unified concept of tolerance, or multiple dissociable forms of tolerance. This investigation focused on a zoo-housed chimpanzee group, and deployed caretaker survey assessments of dyadic tolerance and dominance. The surveys posed a range of hypothetical social interactions and asked caretakers to select their impression of the most likely behavioral outcomes, which were assigned numerical scores of tolerance and dominance. These survey responses were then compiled for factor analysis, to identify covariation between different groups of social behaviors. This work will characterize the range of dissociable forms of tolerance and dominance from caretaker reports, and contribute to a broader examination of their relationship to experimental measures of these constructs.

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1:07
PM **Experimental Emergence of Conventions: Emergence, stability and cognitive implications**
Oviya Mohan & Dora Biro (University of Rochester)

Conventions can be defined as arbitrary and self-sustaining practices that emerge in a population and facilitate solving coordination problems. A recent study (Formaux et al., 2021) successfully traced the formation of simple conventions in a small population of captive baboons (*Papio papio*) in the context of a colour-matching 'game'. Nonetheless, several questions remain, including whether and how conventions form depending on how much information subjects have about the task. We replicated this task with human dyads under a variety of conditions and found no effect of the amount of information available to the subjects on the emergence of conventions (an arbitrary ranking of colours that determined choices in any given colour-pairing). In fact, more information delayed convention formation. Interestingly, dyads maintained a convention despite the availability of an alternative, potentially simpler, cognitive strategy. We hypothesise that these differences are rooted in the extent to which human subjects are prompted to employ cognitively less or more sophisticated processes, which were assessed via self-reported strategies. Transmission of conventions from experienced to naive individuals were also explored. We discuss our results in light of how animal, including human, groups solve coordination problems, with significant implications for our increasingly interconnected societies.

63

- 64** 1:14
PM **Sex predicts response to novelty and problem solving in a wild sub-Antarctic bird with reversed sexual dimorphism**
Samara Danel (University of Rochester), Nancy Rebout (University of Clermont Auvergne), Francesco Bonadonna (University of Montpellier), & Dora Biro (University of Rochester)
- A wide range of animals, including a number of bird, fish, mammal, and reptile species, show sex differences in cognitive tests. Hardly anything is known, however, about whether and how sex-specific noncognitive factors (e.g. response to novelty) affect the expression of cognition in the wild. We used a series of learning and problem-solving tasks in wild breeding skuas, a species in which females are the larger sex (reversed sexual dimorphism). We also evaluated the birds' response to novelty (novel objects) before and after the tasks were administered. We found that both sexes performed equally well in learning (Discrimination-learning task) and re-learning (Reversal-learning task) food associations with colour and spatial cues, but female skuas outperformed males in problem-solving tasks (String-pulling task, Box-opening task). Furthermore, females were bolder - faster than males at accepting a food reward in novel situations. Our results suggest that better female performance does not imply better cognition per se. Sex-specific differences in food motivation may translate into bolder or shier behavioural types, which, in turn, predict females' problem-solving success and response to novelty. Species with reversed sexual dimorphism may present a useful model to assess the interactions between sex, non-cognitive factors and cognition in the wild.
- 65** 1:28
PM **Prosocial or Photo Preferences in a Bachelor Group of Gorillas (*Gorilla gorilla gorilla*)**
Jennifer Vonk (Oakland University)
- Three male Western lowland gorillas (*Gorilla gorilla gorilla*) were given the opportunity to select their own or conspecific photos on a touchscreen to indicate whether they wished the experimenter to deliver a food reward only to them or to them and the selected conspecific(s). This is the first test of prosocial preferences using photographs of potential recipients as symbolic choices on a touchscreen. The use of photographs allowed for tests of transfer to validate whether choices represented prosocial intentions. Gorillas rapidly learned to avoid selecting a photograph of an empty enclosure that resulted in no rewards for any of the gorillas and transferred this learning to a novel photograph. They did not behave in a consistently self-interested or prosocial manner but they clearly rejected the opportunity to choose spitefully. However, their preferences for certain photographs did not transfer to novel photographs of the same individuals so they did not necessarily reflect a preference to be prosocial toward that particular individual. The results call into question whether gorillas recognize themselves and conspecifics in photographs but cannot conclusively speak to whether gorillas have prosocial preferences. They do stress the importance of carefully probing alternative explanations when inferring intentions from observable behaviors.
- 66** 1:42
PM **Evolution & Development (Chair: Amalia Bastos)**
The Horowitz Validation Protocol
David A. Leavens (University of Sussex)
- Many contemporary theories of the genesis of language point to Plio-Pleistocene origins for language-relevant cognitive innovations in the human lineage, after our split from the last common ancestor of chimpanzees, bonobos, and humans. A key empirical foundation for these Discontinuity Theories is based on direct comparisons between humans and apes. The typical finding is that human children raised in postindustrialised societies respond differently in these tests, compared to older, institutionalised apes. Here, I describe a validation protocol for tests administered to representations of different species at different life history stages. I call this the Horowitz Validation Protocol, after Alexandra Horowitz, who first developed and applied this validation procedure. Previous applications of this validation procedure reveal that adult humans tend to respond more like adult great apes than like human children. This supports a family of Continuity Theories, which posit important elements of psychological continuity between apes and humans. Specifically, our hominin ancestors were pre-adapted for key elements of joint attention, which facilitates language acquisition.

- 67** 1:56 PM **The evolution and development of social curiosity in children and chimpanzees**
Laura S. Lewis, Oded Ritov (University of California Berkeley), Esther Herrmann (University of Portsmouth), Rachna Reddy (University of Utah), Alison Gopnik, & Jan Engelmann (University of California Berkeley)
- Curiosity, or the drive to gain new information, is adaptive, enhances learning, and drives innovation. Research on curiosity has focused on ecological domains, yet humans and our closest living phylogenetic relatives, chimpanzees, are deeply social beings who rely on social relationships for survival. Thus social curiosity, or the drive to gain social information, may adaptively guide social learning and the formation and maintenance of social bonds. Relatively little is known about how social curiosity has evolved or develops in great apes. We developed a novel cross-species paradigm to directly compare social curiosity in children and chimpanzees. In Study 1, we compared whether participants preferred to watch videos of a single conspecific or videos of a social interaction between two conspecifics. In Study 2, we compared whether participants would pay a cost (forgo a reward) to gain social information. In Study 3, we compared whether participants preferred to watch positive or negative social interactions. Preliminary evidence suggests that children prefer to gain information about social interactions over information about a single individual. The results from these studies will highlight the value of social information and illuminate the selective pressures that shaped the evolution of social curiosity in great apes.
- 68** 2:10 PM **Can children, chimpanzees and capuchin monkeys form abstract representations to guide their behavior in a sampling task?**
Elisa Felsche, Christoph Völter (Max Planck Institute for Evolutionary Anthropology), Esther Herrmann (University of Portsmouth), Amanda Seed (University of St Andrews), & Daphna Buchsbaum (Brown University)
- Abstract concepts are acquired early in human development, but whether any non-human animals have similar capabilities remains unsettled. We tested 3 to 5-year-old children, chimpanzees, and capuchin monkeys in a unified, ecologically relevant foraging task. Participants foraged for food items (or stickers) from a series of containers that either each contained items of uniform (all high or all low) value, or each contained a mixture of both high- and low-valued items. This provided the opportunity to learn the generalization “containers are uniform in item type” or “containers are mixed”. Next, participants were presented with two new containers, which unbeknownst to participants contained only low valued items. We predicted that participants would switch away from the first container after sampling fewer items if they’d previously learned the generalization that containers are uniform, than if they had learned that containers bear a mix of item types. We compared the number of samples before switching containers for each species to the predictions of a Bayesian ideal learner model, capable of forming abstract representations in this same task. Children and, to a more limited extent, chimpanzees demonstrated evidence of abstract knowledge, while capuchins did not exhibit conclusive evidence for abstract knowledge formation.
- 2:24 PM *Break*
- 2:34 PM **Discrimination (Chair: Katherine Bruce)**
- 69** **Amphipods (*Gammarus pseudolimnaeus*) show evidence of escape learning within sessions despite a failure to demonstrate improved escape performance across sessions of training**
Joshua Wolf, Carmella Nowak, Sophia Ruppel, Emma Mikelson, Taylor Nowak, & Genevieve DeVeau (Carroll University)
- Amphipods can successfully escape from a 3-D printed aquatic t-maze with discriminable (i.e., black & yellow) arms. Early research supported the idea that across sessions, amphipods may learn to escape faster and with fewer errors. However, after maze acclimation was added to the procedure, most of the evidence of learning (i.e., faster escape & fewer errors) disappeared. This may be because the black and yellow arms, while discriminable, may

provide a “safe” area to rest and hide that conflicts with the required escape. It is also possible that amphipods may be learning to escape across trials within a single session, but be unable to consolidate the memories from training and thus fail to show improvement across sessions. The current study had two main goals. The first goal was to see if using a textured maze arm (i.e., smooth vs. textured) versus using a black (i.e., dark) arm would facilitate escape behavior, aide learning, without providing a “safe” place to hide. The second goal was to determine if amphipods demonstrate escape learning within sessions using a textured maze. Amphipods did not demonstrate evidence of learning across sessions but did escape faster and with fewer errors across trials within a session.

70

2:48 PM The effects of manipulating temporal and physical salience in a spatial feature-positive discrimination with rats

Sara Bond, Jordan Nerz, John Solorzano-Restrepo, Macy Lasater, & Kenneth Leising (Texas Christian University)

In operant feature-positive discriminations, responses are reinforced (+) when a target stimulus (A) is presented with a feature stimulus (X), but not when the target is presented alone (A-). Typically, when X and A are simultaneously paired, X directly controls responding, whereas, serial pairings lead to X setting the occasion for responding to A. However, Holland and colleagues found that decreasing the salience of X relative to A resulted in occasion setting with simultaneous XA pairings. The current experiment manipulated the physical and temporal salience of X in a spatial feature-positive discrimination. Responses at one location (e.g., left lever) were reinforced during XA trials (XA:R1+), but responses at a different location (e.g., right lever) were reinforced during A-alone trials (A:R2+). Rats in some groups received simultaneous XA trials with a high or low salience X, or serial X→A trials with a high salience X and a 30-s or 60-s interstimulus interval. Results from the simultaneous group with a higher salience X revealed direct control, but occasion setting was observed in the other group with an X lower in salience. The serial groups were unable to acquire the discrimination. The role of stimulus salience and temporal proximity will be discussed.

71

2:55 PM Discrimination of numerical and nonnumerical magnitudes in a multiple necessary cues task

Francisca Diaz & Edward A. Wasserman (The University of Iowa)

Approximate numerical estimations can be influenced by the nonnumerical magnitudes of the stimuli, but the nature of this interaction is still unclear. The present project evaluated the extent to which the numerical and nonnumerical magnitudes of stimuli control discriminative behavior of human participants and pigeons. Using a Multiple Necessary Cues paradigm, we created a stimulus space defined by all possible combinations of the number of items and the cumulative area of visual displays. Subjects were trained on a two-alternative forced-choice task in which choice of the stimulus that corresponds to the center of the stimulus space was reinforced, whereas choice of the remaining stimuli was not reinforced. Results indicate that human participants' discriminative responses were controlled by both the numerical and nonnumerical magnitudes of the displays, whereas pigeons' discriminative responses were primarily controlled by nonnumerical magnitudes of the displays rather than number.

72

A Universal Mind? Mapping the Capacity for Probabilistic Inference Across Species

3:02 PM *Donna Kean, Melissa Johnston, Eva Shair-Ali (Universitat Autònoma de Barcelona), Mathilde Eriksen, Anisia Prokshina (University of Canterbury), Harshkumar Vasoya (Universitat Autònoma de Barcelona), Ximena Nelson (University of Canterbury), Raoul Schwing, Ludwig Huber (University of Veterinary Medicine Vienna), & Alex Taylor (Universitat Autònoma de Barcelona)*

Is there a universal mind that evolves repeatedly due to similar environmental challenges? It is possible to test for this deeper structure by searching for mechanistic convergence between distantly related species. Kea parrots have displayed the most sophisticated capacity to make probabilistic inferences of any non-human animal to date. To assess the universal mind hypothesis, we will examine if humans and kea show the same information processing patterns when engaging in novel probabilistic inference tasks. Subjects will be required to make inferences about urns containing different proportions of coloured tokens, and the resultant information processing patterns, in terms of solutions, biases, errors and limits, will be compared. Rats will also be tested as a phylogenetic control to account for explanations based on common ancestry. Preliminary data will be presented from humans and kea. Similar information processing patterns between humans and kea, but not rats, would provide support for the convergent mind hypothesis, and suggest that humans' cognitive biases in probabilistic inference are not evolutionary mistakes but adaptive features of the mind.

73

3:09
PM**Automatic imitation of intransitive actions in Blue throated macaws***Esha Haldar (Max Planck Institute for Biological Intelligence), Padmini Subramanya (University of Bremen), & Auguste von Bayern (Max Planck Institute for Biological Intelligence)*

We report the first evidence of ‘automatic imitation’ of intransitive actions (no object related) in non-human animals in this study, using the stimulus-response-compatibility (SRC) paradigm. According to this paradigm, observation and execution of unmatched actions (opening vs. closing of fist) are more difficult to perform than matched actions (opening vs. opening of fist) due to ideomotor compatibility resulting in more errors during execution of incompatible actions. The subjects for this study were 8 macaws (*Ara glaucogularis*) who acted as test subjects and models interchangeably during the sessions. Two intransitive actions: lift leg and wing flap were used to investigate the performance of the subjects divided into two groups: i) compatible and ii) incompatible. After preliminary training, the subjects were asked to perform the same action as the model (leg for leg, wing for wing) in the compatible group and the unmatched action in the incompatible group (leg for wing and vice-versa). Results showed that incompatible group committed more errors than compatible group and took significantly higher number of sessions to reach the correct response criteria. This study provides the first evidence of mirror-like system in a bird species that is responsive to intransitive actions unlike previous studies investigating ‘automatic imitation’.

74

3:16
PM**Cross-modal mental representation of the locations and identities of multiple agents by a bonobo***Luz Carvajal & Christopher Krupenye (Johns Hopkins University)*

Humans are particularly adept at navigating the social world in part because we flexibly map the locations of agents around us. The ability to mentally represent groupmates’ identities and whereabouts would be beneficial to any social animal, especially species with fission-fusion societies or dense ecologies in which conspecifics are often out-of-view. While field studies suggest several species can track individual conspecifics, controlled experiments are needed to determine the complexity of this capacity and isolate the underlying representations. We therefore tested a bonobo, one of humans’ closest relatives. Across five novel object-choice tasks, we show that this bonobo can, at one time, track the locations and identities of multiple hidden agents (Experiment 1), that this capacity deploys mental representations of absent agents rather than tracking the last location where they were observed (Experiment 2), and that these representations are cross-modal, integrating visual and auditory signatures of identity (Experiment 3). Finally, we show that this bonobo can also mentally represent the locations and identities of multiple objects (Experiments 4 and 5), suggesting that multiple agent- and multiple object-tracking recruit common representational machinery. Taken together, this work uncovers the rich representations of the social world that are shared by humans and other apes.

75

3:23
PM**Marmosets don’t appear to have octave equivalence – an essential perceptual ability allowing humans with different vocal ranges to match their vocalizations***Marisa Hoeschele, Bernhard Wagner (Acoustics Research Institute - Austrian Academy of the Sciences), Vedrana Šlipogor (University of South Bohemia, University of Vienna), Jinook Oh (Cremer Group - Institute of Science and Technology Austria), & Marion Varga (University of Vienna)*

Pitches separated by a doubling in frequency, known as octaves, are perceived by humans as highly similar; a phenomenon known as octave equivalence. Human children and adults spontaneously use octave equivalence when imitating sounds during language acquisition or when singing together. Previously we have argued that four traits underlie this phenomenon: (1) vocal learning, (2) clear harmonics, (3) differing vocal ranges, and (4) chorusing. Comparative studies can help us test how relevant these respective traits are, while controlling for enculturation effects and addressing questions of phylogeny. A head-turning study showed that humans already have octave equivalence in infancy. We conducted a highly similar study with 11 common marmosets (*Callithrix jacchus*), because this is a species that partially shares three of the four traits with humans (lacking different vocal ranges). Marmosets were familiarized with note sequences and then tested with modified sequences where one note had either been transposed by an octave or another interval. Unlike human infants, marmosets did not treat octave-transposed familiarized sounds as familiar. This suggests that marmosets do not perceive octave equivalence, and that potentially octave equivalence is especially important in species that have different vocal ranges: whether between the sexes or between juveniles and adults.

3:37 **Prey chemical cue discrimination in adult gopher snakes (*Pituophis catenifer*)**PM *Mark Krause (Southern Oregon University)*

The vomeronasal system of snakes is highly attuned to differences in chemical cues given off by potential prey. Responses to prey chemical cues can reflect important information about prey preference, dietary experience, and developmental factors. Tongue-flicking frequency is a typical dependent measure used to examine how snakes (and other reptiles) respond to chemical cues. Very little information exists on responses to prey chemical cues by gopher snakes. In this study, thirteen adult, wild-caught gopher snakes were tested in laboratory conditions on responses to prey cues (rodent and bird) and two control conditions (water and hexane). I found a significant effect for stimulus type, $F(3,30) = 8.5$, $p < 0.001$, and tongue-flick responses to both prey cues were significantly higher ($p < 0.05$) than to controls, with the exception of bird vs hexane ($p = .14$). To my knowledge, this is the first study to show chemical discrimination of prey cues by gopher snakes.

3:44 **Snack Break**

PM

4:15 **In Honour of the Contributions of Nicola Clayton
(Chair: Jonathon Crystal)**

PM

Mental time travel in the rat*Jonathon Crystal (Indiana University Bloomington)*

Mental time travel involves reexperiencing the past and imagining the future. Theoretical perspectives focus on autoeotic consciousness and chronesthesia. Because phenomenology is not assessed in nonhumans, comparative studies take a functional perspective, asking what an animal capable of mental time travel can do via its behavior. The central hypothesis of animal models of episodic memory is that, at the moment of a memory assessment, the animal remembers back in time to a specific earlier event. Tests of this hypothesis suggest that rats are a suitable model of episodic memory. Here, I outline the perspective that rats are capable of mental time travel. A functional prediction of mental time travel is that the animal searches its representations in episodic memory in sequential order to find information. I review research that demonstrates that rats are capable of searching representations in episodic memory to find specific event memories, rule out the use of memory-trace strength and working memory, show that this ability is hippocampal dependent, and that rats replay incidentally encoded episodic memories. I argue that searching the contents of memory is a form of mental time travel in nonhumans that is relatively tractable because it focuses on the contents of memory.

4:30 **Testing raven social cognition**PM *Thomas Bugnyar (University of Vienna)*

Social life has been proposed as a driving factor for the evolution of cognition in humans and non-human animals. Yet, key aspects of this intuitive hypothesis are still poorly understood. From a human perspective, studies on closely related non-human primates can inform us about the evolutionary origin of human-specific traits, while studies on distantly related animals may inform us about the selection pressures leading to such traits. In this talk, I focus on the latter and, on the basis of selected examples, highlight what we know about the social life and socio-cognitive skills in a large-brained bird, the common raven, *Corvus corax*. I argue that competition for resources and social status in raven foraging groups provide the basis for their sophisticated social decision-making involving mental simulation of conspecifics and their ability to 'see' as well as mental representation of third-party relationships. Furthermore, I speculate how this Machiavellian-type of cognition may inform solutions to other social challenges like cooperation and social learning.

4:45 **Episodic cognition: From birds to cephalopods**

PM *Christelle Jozet-Alves (Université de Caen Normandie), & Nicola S. Clayton (University of Cambridge)*

79

The ground-breaking studies set up by Prof. Clayton and colleagues in jays have opened up new avenues of research to explore the evolution of episodic cognition. Inspired by this fascinating work, a new set of experiments has been designed to determine whether some features of these abilities are shared with a cephalopod mollusc: the cuttlefish. We showed that cuttlefish keep track of what they have eaten, where and how long ago (unique what-when-where events), in order to match their foraging behaviour with the rate of replenishing of different food items. Cuttlefish are also able to determine the origin of these memories: they can retrieve the perceptual features belonging to the memory of a previous event (namely whether they have seen/smelled an item) when unexpectedly asked. Cuttlefish not only adapt their foraging behaviour to different replenishing rates, but also to the availability of their preferred food in the proximate future. Indeed, they reduce their crab consumption during daytime when their preferred prey is predictably available the following night (availability on alternate nights). While cuttlefish are commonly described in literature as opportunistic predators, this range of experiments shows that they can adopt day-top-day flexible foraging behaviours including selective, opportunistic and future-dependent strategies.

Birds Retained for Future Gain, Cephalopods from Temptation Refrained, and the “Magic” in Comparative Cognition Explained

Michael J. Beran (Georgia State University)

80

5:00
PM

The continued impact of Professor Nicola Clayton’s career cannot be summarized by reference to one research topic, one species, one methodological approach, or one 15-minute presentation. Perhaps one can get a glimpse of the impact of that career through selective sampling of just a tiny portion of all that she has learned and shared about the nature of animal minds, and that is the goal of this presentation. What her research has illustrated will be put into comparative perspective, and particularly in relation to research with nonhuman primates. This will include studies on prospective memory, metacognition, self-control, and the role that illusion plays in the cognition and choice behavior of different species. In these areas and others, her innovative experiments, often presented to understudied species, shifted comparative cognition away from an erroneous view that studies with nonhuman primates typically afforded the best opportunity to see cognitive capacities as they might also manifest in humans or as they could best manifest in a nonhuman species.

5:30 PM - Closing Remarks – Lauren Guillette

5:35 PM - Master Lecture – Nicola Clayton

7:00 PM - Banquet (Alvarado DE) - *with cash bar*

Posters

Poster Session I - Thursday Evening

Ostensive behavior by humans is associated with increased attention from dogs, but not increased point-following

Maeve K. Glover, Emily A. Sundby, Hannah M.R. Burrows, Adam Phillips (Queen's University), Julia H. Espinosa (Harvard University), & Valerie A. Kuhlmeier (Queen's University)

P1

The ManyDogs Project recently found no evidence to support the claim that dogs follow human points (contralateral, momentary) more often when pointing is preceded by ostensive behaviors (e.g., calling the dog's name, making eye contact) than when pointing is preceded by non-ostensive behaviors (e.g., a light cough, no eye contact; ManyDogs Project et al., 2023). However, it remained unclear whether the human's ostensive behavior altered the dogs' behavior in any other way. In this subsample of 39 dogs from the larger ManyDogs study, we examined (1) whether dogs' head orientation was directed to the human pointer more often when ostensive signaling occurred, and (2) whether the proportion of this orientation toward the pointer was associated with dogs' point-following performance. Using a series of generalized linear mixed models, we found greater orientation toward the pointer when ostensive signaling was present, but this increased attention toward the pointer did not yield higher accuracy in dogs' point-following responses. These findings suggest that using a dog's name and making eye contact may increase dogs' attention to humans, yet these ostensive cues are separable from the interpretation of points as informative.

Organized Behavior: The Effect of Joystick Usage on Human's Cognitive Control During Multi-Target Multi-Dimensional Visual Search

Sandra Rodriguez, Suzanne L. Gray (College of the Holy Cross), Michael J Beran (Georgia State University), & Muhammad A Qadri (College of the Holy Cross)

P2

Given the amount of competing visual information in the physical world, what retains an animal's attention and motivates choice is a topic of continued interest. One-way agents can organize behavior by task or situation, reflecting cognitive control or executive function processes. We tested 30 college students in a computerized joystick task where they were presented with 16 stimuli, counterbalanced across positive/negative assignments and brightness/orientation dimensions, for 48 trials. Examining the participants' data after learning, humans were more accurate with brightness stimuli compared to orientation stimuli, similar to non-human primates. Individually, two thirds of the participants repeatedly selected items from one dimension more than expected if their behavior was not organized by dimension. Therefore, research with non-human primates demonstrating a mixture of individuals, some organizing behavior by dimension while others not, may not reflect a meaningful difference in cognitive abilities.

Local/Global Bias in Emu (*Dromaius novaehollandiae*) in an International Zoo Collaboration

Jenna V. Congdon (Concordia University of Edmonton), Muhammad A. J. Qadri, & Suzanne L. Gray (College of the Holy Cross)

P3

Visual stimuli are both complex and hierarchical, containing multiple layers of information; species have likely evolved distinct biases in extracting relevant information effectively. For example, the human bias to attend to global ("big picture") over local ("fine detail") information is well-established using hierarchical letter stimuli (e.g., a large "P" constructed of small separated "O"s, and vice versa; e.g., Navon, 1977). This global bias, however, is not universal. Honeybees and redbelly splitfin fish have also shown a global bias, whereas dogs have shown a non-significant bias to the global information. Additionally, several species of nonhuman primates and two avian species (pigeons, domestic chicks) have demonstrated a local bias. More species are required to map the ecological and evolutionary impacts of information processing. Thus, an international collaboration has been initiated, starting with Franklin Park Zoo and Edmonton Valley Zoo to examine the attentional bias of several species under-represented in research. Although often dismissed regarding their cognitive abilities, emu are the only remaining species of the Dromaiidae family and the primary focus in a series of touchscreen perceptual tasks. The methodology and preliminary results of this novel emu project will be discussed, expanding our scientific knowledge about attention and perception in understudied species.

Do Asian elephants (*Elephas maximus*) recognise visual attention from face and body orientation?

Hoi-Lam Jim (Kyoto University), Shinya Yamamoto, & Joshua M. Plotnik (Hunter College - City University of New York)

P4

The understanding of visual attention has been studied in primarily visual species, such as dogs and nonhuman primates. Although elephants are more reliant on acoustic and olfactory information, they still use visual displays and gestures to communicate with each other. Smet and Byrne (2014) demonstrated that African elephants (*Loxodonta africana*) recognise visual attention from the face and body orientation of a human. This has not been investigated in Asian

elephants (*Elephas maximus*), but previous research has found that African elephants used human pointing cues to find hidden food and Asian elephants did not, which suggests potential differences in their perception of visual cues. This study investigates whether Asian elephants are sensitive to the visual perspective of a human. We are examining whether the frequency of human-directed gestures to request food differs when the human's face and/or body orientation is facing towards or away from the elephant to directly compare the results of Asian and African elephants. We are collecting data with 18 Asian elephants at the Golden Triangle Asian Elephant Foundation in Thailand, and results will be reported. This study will further our knowledge of elephant cognition and, more broadly, visual attention in animals.

Let's talk about tseet, baby: perception of sex differences in the black-capped chickadee contact call

Moriah J. Deimeke, Sarah M. L. Smeltz, Katharine H. Stenstrom, Prateek K. Sahu, John A. Jones, Nikhil Kumar, Alexandra D. Garcia, & Christopher B. Sturdy (University of Alberta)

P5

Black-capped chickadees (*Poecile atricapillus*) produce a brief, one-note contact call: the tseet. The tseet is the most frequent vocalization of the species and is produced by both sexes. Like their fee-bee songs and chick-a-dee calls, tseets differ acoustically based on the sex of the caller. Here we used an operant go/no-go discrimination task to investigate if black-capped chickadees perceived the acoustic differences between male- and female-produced tseet calls. We assigned birds to two true groups, one that was trained to respond to male tseets and one that was trained to respond to female tseets, and a pseudo group, which had to solve the task solely using rote memorization. Preliminary analysis indicates that black-capped chickadees were able to learn the discrimination between male and female tseets, with the true groups learning faster than the pseudo group. We also found that previous training with the tseet discrimination aided a subsequent sex-based fee-bee discrimination. Future work will explore the acoustic mechanisms underlying these abilities.

A comparison of auditory and visual memory in monkeys

Ty Henley & Robert R. Hampton (Emory University)

P6

Studies of memory in primates most often use visual stimuli. Non-human primates have trouble learning auditory memory tasks, requiring extensive training with some subjects failing to learn the task to criterion (Colombo & D'Amato, 1986; Colombo & Graziano, 1994; Kojima, 1985; Hashiya & Kojima, 2001). Auditory working memory is likely critical for the development of language. Comparing working memory across primate species may provide an exciting path to study the evolution of language. Monkeys (*Macaca mulatta*) learned auditory and visual versions of a 2-choice match-to-sample task. Subjects took longer to learn the auditory than the visual version, regardless of which they learned first (mean auditory session = 413; mean visual = 45). These results, comparing learning under matched conditions, indicate a comparatively limited capacity for auditory processing compared to visual processing.

Diffusion Tractography of Ascending and Descending Auditory Pathways in Echolocating and Non-Echolocating Cetaceans

Sophie Flem & Peter Cook (New College of Florida)

P7

We report the first application of DTI tractography to a mysticete in an opportunistically acquired Sei whale brain, analyzed alongside three odontocete brains from common, pantropical, and Atlantic white-sided dolphins. To establish foundational knowledge on mysticete auditory connectivity, and to investigate neurobiological differences from odontocetes that may subservise the closely-related parvorder's echolocative capabilities, we conducted probabilistic tractography on ascending and descending auditory pathways in all four brains. Tracts were seeded in the inferior colliculi (IC), a nexus for ascending auditory information, and cerebellum, a sensorimotor integration site. Direct IC to temporal lobe pathways were found in all animals, replicating previous cetacean tractography. We also discovered that the mysticete's contralateral right IC-left cerebellum pathways were 17x stronger, while odontocete left IC-right cerebellum pathways were 2-4x stronger. Additionally, odontocete IC-cerebellum tracts exhibited higher overall strength, implying their possible role in supporting the rapid acousticomotor integration demands of echolocation. The stronger right cerebellum-left IC connectivity observed in odontocetes may corroborate the theory that odontocetes preferentially produce echolocative sounds with their right phonic lips, as the right lips are likely innervated by left-cortical efferents that pass through the right cerebellum. The reversed lateralization of IC-cerebellar tracts in the non-echolocating mysticete further supports this interpretation.

Do domestic cats (*Felis catus*) show gravity bias?

Arii Watanabe, Tomohiro Suzuki, Heirishun Hayashi, & Tomokazu Ushitani (Chiba University)

P8

Previous studies have shown that human children (Hood, 1995) and some primate species (Hood et al., 1999) show gravity bias, which is the assumption that objects fall straight down even when there are obstacles in their paths. This bias is thought to be due to the possession of a naïve theory about how gravity works. Gravity bias is typically tested with a diagonal tube apparatus, in which subjects with gravity bias erroneously search for objects at a location just beneath the drop-off point even though the correct location is diagonally across from it. We first presented domestic cats with the original version of the diagonal tube apparatus and recorded their gaze movement and found that they followed the object movement correctly. When the auditory cues were eliminated, the cats' gaze towards the gravity-bias location increased.

These findings suggest that although cats are adept at using auditory cues to follow object movement, they make errors in line with gravity bias when no such cues are available. The results will be discussed in terms of cats understanding of the physical world and how they compare with domestic dogs.

Processes of gestural development in young chimpanzees

K.A. Bard (University of Portsmouth), S. Dunbar (University College London), V. Maguire-Herring (University of Portsmouth), Y. Veira (University at Buffalo (SUNY)), K.G. Hayes (Emory University), & K. McDonald (Oakland Zoo)
Great apes are useful as a model species for investigating gestural development. The prevailing theory is that gestures develop from actions with motoric effects, but through repeated interactions (with caregivers) actions are abbreviated and ritualized to become communicative signals. We conducted a responsive care intervention for 16 chimpanzees, and recorded the development of species-typical gestures for the first year. Young chimpanzees used gestures for displaying submission, and for initiating and requesting tickle play, comfort/contact, chase play, grooming, and food sharing. Gestures emerged at significantly different ages across contexts. We found a consistent and significant developmental pattern in tickle play, grooming, and chase play: engagement when others initiated, followed developmentally by infant-initiations, then initiations occurred with the use of gestures. Most gestures were not previously effective motor acts but emerged from pre-existing communicative actions. Not all gestures were requests. Chimpanzee gestures were co-constructed or strengthened in response to scaffolded interactions with competent partners. Our new view is that chimpanzee gestures develop from communicative behaviors, through interaction, and communicate socio-emotional desires, but different processes were evident in some contexts. The assumption that a single process underlies all chimpanzee gestural development is unwarranted.

P9

Snake Speed-Dating: How Dyadic Interactions Predict Social Networks

Maggie-Rose Johnston, Morgan Skinner, & Noam Miller (Wilfrid Laurier University)

Social networks in snakes are known to be mediated by personality, context and the conspecifics involved. Moreover, in a large aggregation, no interaction is independent; spending time with one individual entails an opportunity cost of not socializing with another. With so many variables at play, identifying the key characteristics of social networks can be difficult. To break down social networks into their component relationships, and discover how they are constructed, groups of six juvenile corn snakes (*Pantherophis guttatus*) each underwent dyadic 'speed dates' with each other, followed by six days of aggregation and preceded by four individual personality assays (two each for boldness and sociability). We found a strong correlation between the difference in boldness between snakes, but not sociability, and the time they spent interacting. Despite low consistency across our repeated personality assays, a Random Forest classifier was able to reliably predict the identity of snakes based on their dyadic interaction behaviors, suggesting that the social behavior of individuals is consistent over many trials. Networks derived from these dyadic interactions can be used to identify relationships conserved in larger aggregations.

P10

The conjunction fallacy in humans in a contingency learning task

Ikponmwoosa J. Pat-Osagie, Rob Tsai, & Aaron P. Blaisdell (University of California Los Angeles)

Humans and other animals have shown to be capable of reasoning and reasoning errors. Previous research in our lab found that like people, rats are prone to the conjunction fallacy - they rate the conjunction of two independent events as more likely than one of the events alone. We developed an analogous task for humans to learn the contingencies between events analogous to the rat task. The Task was to move a virtual Pacman to the left or the right. Correct direction was rewarded with points depending on the situational cues. Training consisted of four types of trials. The background color (blue or red) served as cues A and B, while the status of a light bulb served as cues X+ (on) or X- (off). Reward was delivered as follows: AX- -> left, AX+ -> right, BX- -> right, BX+ -> left. After learning these discriminations, participants received occasional test trials of which X's bulb was occluded by a virtual curtain. Participants had to make a left/right choice with no light cue (X) information. If participants treat the occluded conditions as though the light is on rather than off, this would demonstrate a conjunction fallacy in a contingency task.

P11

Turning a corner on maze analysis using two species of fish

Tanya Shoot, & Noam Miller (Wilfrid Laurier University)

Complex mazes are often used to explore how single animals make sequences of (spatial) decisions. However, in the wild, many animals are in groups when navigating and making decisions, and the methods for characterizing and analyzing the behaviors of groups in mazes are not well developed. We aimed to address this methodological gap and create an extensive battery of metrics to describe collective decisions in mazes. We validated our measures using groups of fish from two species, zebrafish (*Danio rerio*) and guppies (*Poecilia reticulata*) searching an aquatic maze for a food reward for 10 minutes. We constructed groups of fish with known personality compositions. Paths of individual fish were tracked using a custom video tracker and extracted metrics of maze behavior such as the total proportion of the maze explored, the cohesion of the group, and leader/follower effects. Personality traits significantly affected the proportion of the maze explored, with lower levels of aggression associated with more of the maze being explored. This study highlights

P12

the necessity for standardized metrics of group behaviour in mazes and demonstrates how mazes can be used to explore group composition effects on collective decision-making.

Towards a comparative psychology of information-seeking in cuttlefish

Victor Ajuwon (University of Cambridge), Tiago Monteiro (University of Aveiro), Alexandra K. Schnell, & Nicola S. Clayton (University of Cambridge)

P13

Like humans, a range of mammalian and avian species seek advanced information about uncertain future events, even though the information cannot be used to improve reward outcomes in the lab, a phenomenon frequently referred to as 'paradoxical choice'. These intriguing preferences highlight that non-human animals ascribe subjective value to informative stimuli, and may possess at least rudimentary forms of curiosity. Paradoxical choice studies have established the existence of non-instrumental information-seeking in small number of vertebrate species, but they have also raised fundamental questions concerning the cognitive mechanisms, function, and evolutionary origins of information-seeking behaviour remain actively debated. To address this, we propose to use the paradoxical choice paradigm to investigate curiosity-motivated decision-making in an emerging invertebrate model, the common cuttlefish, *Sepia officinalis*. Experiments will be implemented utilising GoFish, a novel tool we developed for automated cognitive experiments on aquatic species. These remarkably intelligent cephalopods display episodic-like memory, and can take prospective actions for the future. We argue that because cuttlefish evolved advanced intelligence independently from vertebrates, with divergent socio-ecological pressures shaping their cognitive evolution, they offer a unique opportunity to further extend our understanding of the cognitive substrates and socioecological factors that promote curiosity-like behaviour.

Performance of non-cleaner fish on three versions of the biological market task

Laurent Prétôt (Pittsburg State University)

P14

Despite their small brains, adult cleaner fish, *Labroides dimidiatus*, outperform juvenile fish and several non-human primates on the biological market task (aka ephemeral reward task), a dichotomous choice task derived from the cleaner-client fish mutualistic interaction in the wild. When the task is modified to be more salient to primates, however, monkeys improve their performance while fish continue to perform well in the task. An important remaining question concerns the extent to which the cleaner fish results generalize to fish species that do not face the same ecological dilemma. We addressed this question by testing dottyback fish (*Pseudochromis*, N = 14)—a group of non-cleaners that also inhabit coral reefs—in three versions of the biological market task that differed in the cues needed to solve it. Subjects performed poorly in all three versions, further supporting that cleaners' ability to solve the task is linked to specific environmental conditions that are not met anywhere else in the fish taxon. This finding contributes to the growing literature on the biological market task and, more broadly, emphasizes the importance of studying species' ecologies to enhance our understanding of their behavior and cognition.

Interference of Same/Different Learning by Spatial Discrimination

Laiba Rasul, Alaina Pedersen, Daniel Peng, & Thomas Zentall (University of Kentucky)

P15

Same/different learning by pigeons has been studied using several different procedures. One of these procedures is matching-to-sample in which responses to a sample stimulus result in the presentation of two comparison stimuli, one of which matches the sample, the other of which does not. Choice of the matching stimulus is reinforced. In the case of mismatching, choice of the mismatching stimulus is reinforced. Research with transfer of training suggests that same/different can transfer to new stimuli. In the present experiment, we asked if matching acquisition involving three colors (e.g., red, green, & yellow) would be retarded if the correct response to the fourth color was spatial (e.g., left). When acquisition of this task was compared with acquisition of a four color matching task (i.e., the same associations but when the sample is blue choose the blue comparison) we found slower acquisition when one of the associations was spatial. The results suggest that there is an interaction among matching associations, such that either common rules facilitate learning or that an inconsistent (spatial) rule slows down learning. This result provide further evidence of the development of a matching concept.

Serial Pattern Learning: Pigeons Prefer an Improving Schedule Over an Initially Easier Fixed Ratio Schedule

Miri Ifraimov, Zackary D. Large, Daniel Peng, & Thomas R. Zentall (University of Kentucky)

P16

Serial pattern learning describes behavior in which a subject anticipates not only the time and effort needed for the next reinforcer but also the pattern of time and effort to reinforcers after the first. Chandel et al. (2021) found that pigeons left a progressive schedule (in which each reinforcer was successively harder to obtain) earlier than would have been optimal. The pigeons anticipated the harder to obtain reinforcers beyond the next one. In the present experiments, pigeons were trained on a progressive schedule for which each reinforcer was successively easier to obtain. The initial choice was between a fixed ratio schedule (FR23) for which a reinforcer was easier to obtain than the first reinforcer on the improving progressive schedule (32 pecks). Serial pattern learning suggests that the progressive schedule might be preferred because easier to obtain reinforcers would follow the initially harder 32 pecks. A significant preference for the improving progressive schedule was found. The results were consistent with the serial pattern learning hypothesis. In both

experiments the pigeons showed evidence for serial pattern learning, a preference for the improving progressive schedule for which later reinforcers would be easier to obtain.

Initial-link Schedule Affects Suboptimal Choice

Margaret McDevitt (McDaniel College), Jeffrey Pisklak (University of Alberta), Roger Dunn (San Diego State University), & Marcia Spetch (University of Alberta)

P17

Research has demonstrated that pigeons and other animals will sometimes prefer an alternative that leads to less food over one that leads to more food. This phenomenon, referred to as suboptimal or paradoxical, depends on the presence of predictive stimuli on the leaner alternative and the absence of predictive stimuli on the richer alternative. The present study assessed the effect of increasing the duration of the initial-link (choice) schedule on suboptimal choice. Pigeons chose between a suboptimal alternative that led to signaled food 20% of the time and an optimal alternative that led to unsignaled food 50% of the time. In one experiment, the choice schedule was either a fixed-ratio (FR) 1 or variable interval (VI) 30 s. In a second experiment, the choice schedule was either a VI 1.7 s, VI 4.75 s, or VI 35 s. The birds showed extreme preference for the suboptimal alternative when the choice schedule was an FR 1 or a VI 1.7 s. When the choice schedule was a VI 30-s or 35-s schedule, they strongly preferred the optimal alternative. Thus, the present results confirm that suboptimal choice is affected by the initial-link schedule, which has important implications for models of choice.

Suboptimal Choice on Steroids: Pigeons Prefer 20% over 100% Food

Margaret McDevitt (McDaniel College), Jeffrey Pisklak (University of Alberta), Roger Dunn (San Diego State University), & Marcia Spetch (University of Alberta)

P18

Pigeons and other animals sometimes prefer an alternative that provides a lower probability of food over one that provides a higher probability of food. This choice, referred to as suboptimal or paradoxical, occurs when the delivery of food or no food is signaled by distinct stimuli during a delay only on the leaner (suboptimal) alternative. Here we tested a prediction of the Signal for Good News (SiGN) model that pigeons would show suboptimal choice in a procedure in which both alternatives provide signals and the optimal alternative always leads to food. Choice of the suboptimal alternative led 20% of the time to a short (10 s) delay followed by food and 80% of the time to a long (40 s) delay followed by no food. The optimal alternative was identical except that the 40-s delays ended in food. On both alternatives, the short and long delays were signalled by distinct delay stimuli. Consistent with predictions of the SiGN model, pigeons preferred the option that gave 20% food over the option that gave 100% food.

Use of an errorless learning procedure to train a size discrimination in brown capuchin monkeys (*Cebus [Sapajus] apella*)

Jordana Groveman, Aiko Amano, & Reggie Paxton Gazes (Bucknell University)

P19

Errorless learning can provide a beneficial alternative to trial-and-error learning, sometimes resulting in more effective training. We applied this procedure to brown capuchin monkeys learning a go-go size discrimination task. Subjects were presented with a sample stimulus of either a large or small circle and reinforced for selection of the choice symbol associated with that sample circle size. Twelve subjects failed to learn this task using a standard two choice trial-and-error procedure (average 1,024 training trials). Their average performance on their final session was 46.21% and more than half of the subjects had developed significant side or choice symbol biases. We changed the choice stimuli and the color of the sample stimuli, then presented the same subjects with a size discrimination using an errorless learning procedure. The correct choice stimulus (S+) appeared at full brightness, while the incorrect choice stimulus (S-) initially appeared dim (alpha level 0), but was gradually illuminated to full brightness (alpha level 255) as the subject reached criteria (80% correct) at each alpha level. Using this new procedure, subjects did not develop side or symbol biases, and progressed through training successfully. In this case, errorless learning led to more effective task learning.

Social Cognition: Pigeons Determining Friends from Neighbors in Photos

Acklara J. Chhim & Muhammad A. Qadri (College of the Holy Cross)

P20

Humans are social animals capable of recognizing others (like friends and neighbors) through photographs, as evident in social media. Recognizing the correspondence of 2D representation of people to their real selves is a complex visual-cognitive ability. Pigeons are highly visual, social animals who can recognize whether a digitally presented pigeon is familiar. We examined pigeons' ability to discriminate further photographs of "friends", pigeons with whom they regularly interact in an enrichment space, from "neighbors", others who live in the same room. The pigeons were trained in a go/no-go task to peck at images of "friends" for food reward and not reinforced for pecking during "neighbor" presentations. Then, the pigeons were presented with new images to evaluate memorization, which were added afterward to their training repertoire. Multiple iterations of this transfer-then-training procedure were completed. Results show that camera perspective impacted pigeons' performance as the discrimination ratio with novel items seemed related to their similarity to trained instances. Pigeons can likely categorize images between "friend" and "neighbor", however, multiple simple features may be critical when recognizing others in images, as suggested by image analyses.

Visual Discrimination of Rotated Objects in Baboons (*Papio anubis*) and Goldfish (*Carassius auratus*)

Anna Sofia Hege, Logan Brownell, Katie Becker, Jessica Wegman (Rochester Institute of Technology), Jessica Cantlon (Carnegie Mellon University), & Caroline DeLong (Rochester Institute of Technology)

P21

The ability to visually recognize objects despite differences in orientation, known as object constancy, is advantageous for many species because they can observe objects from different viewpoints. In a previous study, we tested the ability of six goldfish to recognize 2D color stimuli from multiple orientations in different rotation planes using a two-alternative forced choice task. All six fish performed significantly above chance at all orientations in the three rotation planes tested ($M = 88\%$). In the current study, we presented the same stimuli to seven olive baboons residing at the Seneca Park Zoo using a match-to-sample task on a touch-sensitive monitor. Subjects were trained to discriminate between the stimuli at 0 degrees, then tested with the same novel orientations in the three rotation planes presented to the fish. Four of the baboons met the training criterion and each performed above chance in the test: Kalamata ($M = 82\%$), Olivella ($M = 87\%$), Pico ($M = 95\%$), and Sabina ($M = 82\%$). Overall, there was no significant difference in performance accuracy as a function of orientation for both the fish and baboons. These comparative studies can provide insight into the origins of object constancy in humans and non-human animals.

Who's Yer Daddy Longlegs? Perception and Learning in Harvesters (*Opilionidae*)

Preston Foerder (University of Detroit Mercy)

P22

Although there is a body of research on cognition in spiders, there has been little research in a similar arachnid species, the harvester (*Opilionidae*) a.k.a. daddy longlegs. Despite their similarity, harvesters, which comprise 6500 species, are not spiders, but are more closely related to mites, ticks, and scorpions. Harvesters have two eyes and it is believed that they distinguish light from dark although the extent of their vision is unknown. Harvesters are autotomous, releasing their legs under pressure. After they lose a leg, they go through a short period of learning to walk on the remaining legs. They have also been shown capable of chemosensory associative learning. To expand on our knowledge of harvesters, we have started a project examining learning and perception in the opilionid species, *Phalangium opilio*. We are examining the extent of their visual and tactile perception and learning abilities.

Serial Pattern Learning: The Anticipation of Worsening Conditions by Pigeons

Marisa Miller, Zohaib Iqbal, Daniel Peng, & Thomas Zentall (University of Kentucky)

P23

Animals are known to be sensitive to the frequency and immediacy of reinforcers. They are generally impulsive and heavily discount outcomes that occur in the future. Furthermore, they should prefer alternatives providing reinforcers with less effort rather than greater effort. In the present research, pigeons had the choice between (1) obtaining reinforcers on a progressively difficult schedule of reinforcement: starting with 4 pecks, then 8 pecks, then 16 pecks, then 32 pecks, and finally 64 pecks on each trial, and (2) colors signaling the number of pecks for a single reinforcer; red = 6, green = 11, blue = 23, or yellow = 45. The optimal choice is to choose the progressive schedule; obtain five reinforcers rather than switch to a color and receive only one. However, if they are sensitive only to the number of pecks to the next reinforcer, they should choose the progressive schedule once before switching to red, twice before switching to green, three times before switching to blue, and four times before switching to yellow. Instead, they systematically switched too early. Appearing to anticipate the increasing difficulty of the progressive schedule, they suboptimally based their choice on the serial pattern of the worsening progressive schedule.

Transitive inference list (TIL) task: An alternative paradigm for studying nonverbal transitive inference

Velouria Mars & Olga Lazareva (Drake University)

P24

In a novel transitive inference list (TIL) task, participants were trained to respond in a correct order to three overlapping lists of images, A -> B -> C, C -> D -> E, and E -> F -> G. Later, participants were given probe pairs constructed within a training list (e.g., A -> C) or across training lists (e.g., B -> F). Postexperimental awareness evaluation has shown that participants with limited or no awareness were significantly more accurate responding to within-list probes than to between-list probes, but that difference disappeared in aware participants. All participants have shown a robust symbolic distance effect suggesting the presence of linear representation across all three training lists. In contrast, the participants in a control condition in which the lists of images did not overlap (e.g., A -> B -> C and D -> E -> F) did not construct a single linear representation. Instead, their performance suggested that they encoded the ordinal position of the images in each list (e.g., A1, B2, C3, etc.) and used this position to determine their choices in list probes (e.g., A -> D). The TIL task therefore provides a promising alternative to a traditional 5-item TI task.

Monkeys did not adaptively adjust working memory load in a spatial memory test

Rael Sammeroff & Robert R. Hampton (Emory University)

P25

Working memory is active and metabolically expensive. If monkeys are sensitive to working memory load, then they should minimize load when possible. Five monkeys performed a spatial memory task in which they saw 3x3 (Experiment 1) and 6x6 (Experiment 2) grids of squares where some squares were filled with gold and the others with blue. After a delay with an empty grid, two silver squares appeared in the place of one of the gold and one of the blue squares. After making a response, a second set of silver squares would appear. Monkeys had to select the silver squares that were

previously gold on the sample grid to earn rewards. After training, monkeys were presented with all ratios of gold to blue squares. Working memory load could be minimized by remembering gold and picking gold when gold squares were in the minority and remembering blue and avoiding blue when blue squares were in the minority. Such adaptive behavior would produce a U-shaped accuracy curve (Cook et al., 1985; Klein et al., 2011). Monkeys appeared to remember gold squares regardless of how numerous these squares were. We therefore found no evidence of sensitivity to cognitive load in monkeys.

ManyOtters1: A Pilot Study on Long-Term Memory in Otters Using Puzzle Feeders

ManyOtters, Caroline M. DeLong (Rochester Institute of Technology), Deirdre M. Yeater (Sacred Heart University), & Heather M. Manitzas Hill (St. Mary's University)

P26

ManyX groups take the big team science approach to investigating animal cognition (e.g., ManyPrimates, ManyDogs, ManyFishes). We have initiated a ManyOtters group to promote studies with larger sample sizes and a variety of species of otters, while developing a collaborative network of scientists. We will share our progress in developing this collaboration and hope to recruit new members to our team here! ManyOtters1 focuses on long-term memory. We are conducting a pilot study with three facilities and three species of freshwater otters: North American river otters (*Lontra canadensis*), Asian small-clawed otters (*Aonyx cinereus*), and spotted-necked otters (*Hydrictis maculicollis*). The otters are presented with 15 puzzle feeders varying in difficulty depending on the number and type of actions required to obtain a food reward. Some puzzles are replications of those used in previous studies while others are original. Initial data will be collected in January 2024 with repeated exposure to the puzzles about two months later to assess whether the solution time or strategies change, providing evidence of long-term memory. The pilot study results will be used to refine the project procedure, which will then be shared and expanded to other scientists and facilities who want to join our team.

Memory in the pigeon, a new paradigm

Thomas Zentall & Daniel Peng (University of Kentucky)

P27

Memory is an important function for survival, be it for foraging or avoidance of predators. In this experiment, a new paradigm was designed to test pigeon's memory for either its first action, or last action. The experiment took place in a standard operant chamber with 3 keys arranged horizontally. Randomly at the beginning of a trial, the left or right key would be lit, once pecked on a FR5 schedule, the key turns off and the opposite side key would turn on. Once this key is pecked on an FR5 schedule, the key turns off and the center key colored either red or green would turn on. Red signals to choose the first action, and green signals to choose the last action. Pigeons accurately learned this task, and to test how the pigeons were learning, delays were introduced between the offset of one key and the onset of the next. When delays were introduced following the first key, no reduction in accuracy was found, however, when delays were introduced following the last key, accuracy dropped dramatically. This suggests that if possible, pigeons rely on single code default, in that it only needs to remember the last action performed.

Item-in-context Memory for Odor Stimuli in Rats

Skylar Murphy, Elijah Richardson, Madeleine Mason, Grace Barnes, Eric Van Leuven, Agastya Aituri, Becca Collins, Harper Morgan, Elizabeth Pursuite, Madeline Spencer, Katherine Bruce, & Mark Galizio (University of North Carolina Wilmington)

P28

Episodic memory (EM) is associated with recalling the context in which events occurred. Previous studies using odor stimuli with rats have used manual procedures and the present study used an automated task to control variability that can occur during manual procedures. Two different contexts were created within operant chambers (Constant light v. Blinking light and clicking sound) using a variation on the Odor Span Task. Responses to the first presentation of each odor in each context (S+) were reinforced on a fixed-interval 5-s schedule; repeated presentations of the same odor (S-) in the same context were not reinforced. Throughout the study, two, three, or four context changes were programmed during each 48-trial session. Probe tests were conducted to dissociate familiarity from episodic-like remembering, and the results were well above chance which replicates previous research and can be taken as evidence of episodic-like remembering. Two features of the results were puzzling: First accuracy declined on probe test performance as more context changes were introduced, and second, probe accuracy declined as the retention interval increased. These two features of the results were inconsistent with previous findings and additional research is needed to determine potential variables involved.

No evidence of perceptual priming when people are tested like pigeons

Rachel Lind, Marcus Fennema (Dickinson College), Muhammad A. J. Qadri (College of the Holy Cross), Matthew S. Murphy (Coastal Carolina University), Emily Kathryn Brown, & Benjamin M. Basile (Dickinson College)

P29

Perceptual priming, a type of unconscious visual memory that is spared in cases of amnesia, is theorized to be phylogenetically widespread. However, only one convincing demonstration exists in nonhumans – in pigeons – and subsequent attempts to demonstrate it in monkeys have found no evidence for priming. Here, as the start of a programmatic cross-species investigation, we evaluated whether a species known to show perceptual priming, humans, would do so when tested under conditions matched to those of the pigeon demonstration. Humans used a touchscreen to

categorize novel, color photographs as containing either cats or cars. The photos were masked and presented briefly to degrade performance. On probe trials, the target masked photo had been seen unmasked on the previous trial. Unlike pigeons, humans were not better at classifying previously-seen images than they were at classifying novel images. After a one-week retention interval, humans showed robust explicit recognition, but only a small and unreliable priming effect. Although preliminary, these results suggest that the pigeon paradigm does not produce a priming effect in a species known to show priming.

Avian Artistry: Training Pigeons to Sketch

Tianxing (Cameron) Guo, Cyrus Kirkman, & Aaron P. Blaisdell (University of California Los Angeles)

P30

Exploring art creation in non-human animals could provide valuable insights into animal cognition and behavior. We gave pigeons opportunities to engage in artistic endeavors via a variety of digital paint programs projected to a touchscreen. Pigeons exhibited intrinsic motivation for art creation and have created more than 500 unique pieces. This prompted the current study in which pigeons were trained to “sketch” a collection of sample lines and shapes of increasing complexity. Our paint program relied on a series of automated shaping programs based around tenants of learning theory. To adapt to pigeons' peck-burst response patterns, the program was structured to assess the appropriate registration of pecks based on fine-tuned spatial and temporal parameters. This approach, combined with a "connect the dot" approach and fading techniques, guided pigeons through the successive stages of acquisition of copying behavior. This study provides valuable insights into the cognitive adaptability and artistic potential of pigeons, laying the groundwork for deeper exploration of avian artistry and its relevance to our understanding of non-human animal cognition, behavior, and expression. Moreover, by revealing pigeons' capacity for sketching and artistic expression, this research holds a mirror up to human sketching as the basis of representational art.

Rhesus Monkeys and Capuchin Monkeys Do Not Show Evidence of the Connectedness Illusion During Relative Quantity Judgments

Elizabeth L. Haseltine (Georgia State University), Audrey E. Parrish (The Citadel), Maisy D. Englund (Georgia State University), Christian Agrillo (University of Padua), & Michael J. Beran (Georgia State University)

P31

Humans and many other species show consistent patterns of responding when making relative quantity judgments (“more or less”) of stimuli. This includes the well-established ratio effect that determines the degree of discriminability among sets of items. However, humans and other species are susceptible to errors in accurately representing quantity, reflecting important aspects of the relation of perception to quantity representation. One newly described illusion is the connectedness illusion, in which arrays with items that are connected to each other tend to be underestimated relative to arrays without such connection. We assessed whether this illusion also occurs in rhesus macaques and capuchin monkeys. We found that comparisons of arrays where one array had connected dots and the other did not was more difficult for monkeys than any other trial type. The monkeys showed a bias to choose connected arrays, suggesting that the connecting lines generated an overestimation of quantity. These results suggest that for these monkeys, quantity was estimated based on density and area where adding connecting lines made the array appear denser and more numerous. This is in contrast to adult human performance, which instead suggests that Gestalt principles may be important in numerosity judgments compared to texture-density features.

Battle of the Beats: Sea Lion Beat Keeping Ability Rivals that of Experienced Human Subjects

Carson Hood (University of California Santa Cruz), Colleen Reichmuth, & Dr. Peter Cook (New College of Florida)

P32

Entraining movement to an auditory rhythm (“beat keeping”) is common in human culture. Whether or not non-human animals have the capacity to beat keep has been debated in comparative psychology for years. California sea lion Ronan has exhibited the most precise and reliable rhythmic performance among non-humans. At three years old, Ronan was trained through operant conditioning to bob her head in tandem with an isochronous pulse, and then transferred behavior repeatedly in tests with novel stimuli. Ronan’s beat keeping, although reliable, was notably less precise than that of humans. In the present study, we (1) revisit this behavior 12 years later to evaluate the effect of practice on rhythmic precision, and (2) provide directly comparable data from human arm movements subtending the same arc as Ronan’s head bobs. In the current experiment, Ronan’s phase angle at 96 BPM was 0.64 degrees, nearly perfect phase, a remarkable change from her original performance at this rate. Ronan’s current rhythmic behavior rivals that of experienced humans raised with music, leaving open the possibility of the same underlying mechanisms supporting synchronization in both species. Our findings emphasize the importance of directly matched behavioral paradigms for inter-species comparisons.

Poster Session II - Friday Evening

Emotion Theory - A Comparative Approach

Elizabeth S. Paul & Michael T. Mendl (University of Bristol)

P33 Are emotions based on a limited set of discrete, adaptive, modular processes (e.g., basic emotion theory) or do they vary continuously and infinitely according to a small number of fundamental dimensions (e.g., core affect theory; constructionist theory)? Much discussion of this question has focused on whether emotions can be considered 'natural kinds' – states that are universal across the human species and beyond – or whether they are states whose origins are primarily social and cultural. But evidence from human psychological research appears to have failed to provide conclusive answers, leading, in recent decades, to many heated (yet unresolved) debates. Here, we examine evidence from animal emotion research to see what the comparative approach can offer towards resolving this issue. We show that evidence from behavioural and learning-based research, using a variety of non-human species, provides support for both modular and dimensional features of emotions in animals. We describe this evidence, classify it, and identify areas in which data are still lacking. Our conclusion is that emotions and affective states can be conceptualized as both discrete and dimensional, and we argue for theories of human and non-human emotion that accommodate and integrate each of these views.

Relationships Between Empathy Measures in Dogs

Calysta Kurz, Kalyn Otzelberger, Jake Hargrave, Jacoby Cefalu (Ripon College), Teresa Romero (University of Portsmouth), & Julia E. Meyers-Manor (Ripon College)

P34 The relationship between humans and dogs has made it crucial to understand how human emotions impact dogs and if dogs show empathetic behaviors in return. This study used different measures of empathy including: an empathy survey, response to emotional stimuli, a cognitive bias task (CBT), and contagious yawning, while also measuring the dog's heart rate variability (HRV). It was hypothesized that if all of these empathy measures were accurate, the results from each section of the study would relate to each other. Dogs in this study showed more person-oriented behaviors during the crying condition, and those that had a lower HRV showed more person-oriented behaviors while the experimenter was crying. Based on the survey, owners predicted the empathetic responses of their dogs. The CBT and the yawning were not related to empathy responses. Our findings suggest that dogs are aware of the emotional states of humans and attend more to distress. However, based on the results of the CBT task, dogs may not be personally experiencing the distress, or the CBT may not be a good measure of short-term emotional states of dogs. Some of the data implies that signs of stress may be misread as empathetic-like behaviors.

Individual and Group-Level Differences in Stereotypy in a Large Sample of Captive Tigers (*Panthera tigris*)

Kate M. Chapman, & Sage L. McCoy (University of Arkansas)

P35 Animals often experience increased levels of stress in captivity, resulting in stereotyped behaviors (e.g. pacing) and reduction in species-typical behaviors. Environmental enrichment is used to reduce negative behaviors and increase positive behaviors in captive animals, but stereotyped behavior often remains. Anecdotal observations from researchers and care staff indicate that dramatic individual differences in stereotypy exists, even among siblings or co-housed individuals. This study used focal-animal and time sampling to assess individual and group level differences in stereotypy in a sample of 55 captive tigers (*Panthera tigris*) at Turpentine Creek Wildlife Refuge. Tigers of varying ages and phenotypes (i.e. orange, white) were observed during environmental enrichment sessions and baseline sessions over the course of several years. Rates of stereotypy were very low in this sample; mean stereotypy across all individuals and sessions was 3.14%, though the minimum/maximum stereotypy rate for a single subject/session ranged from 0%-37%. Fewer than half of the subjects exhibited stereotypy at all. Despite the low rates of these behaviors, more stereotypy occurred in baseline than enrichment sessions. This suggests that even in a comparatively low-stress population, the use of enrichment can further reduce stress-related behaviors and individual differences must be considered when developing animal management plans.

If you're happy and you know it...: Assessing behavioral correlates of positive affect in bonobos (*Pan paniscus*)

Lindsey Johnson, & Heidi Lyn (University of South Alabama)

P36 The emotional experiences of non-human animals are poorly understood, especially positive emotional experiences. Researchers have often avoided the study of positive affect in nonhuman animals due to methodological difficulties and potential charges of anthropomorphism. Our study is part of an ongoing international collaboration that aims to operationalize positive affect across several groups of species. Specifically, our goal was to assess whether bonobos displayed signals/behaviors indicative of positive affect (e.g., vocalizations or play) when they received an unexpected positive outcome (e.g., a large amount of a food reward or interaction with a familiar person via video call). We predicted that bonobos would show the greatest number of signals related to positive affect after unexpectedly receiving a highly valued stimulus (i.e., a positive surprise) as opposed to after receiving an expected highly valued stimulus, or after receiving an unexpected low-value stimulus (i.e., a negative surprise). In line with our hypotheses, the bonobos displayed

the most potential indicators of positive affect after receiving a positive surprise. These findings help clarify which behaviors bonobos may use as indicators of positive affect.

The Role of Reinforcer Value and Pretraining in the Differential Outcomes Effect in Rats

Catrina Gillespie, Katie Cagney, Jordan Nerz, Ana Miranda, Sara R. Bond, & Kenneth J. Leising (Texas Christian University)

P37

A differential outcomes effect (DOE) occurs when learning to make different responses in the presence of different stimuli is facilitated by delivering different outcomes (e.g., food vs. water) for each response. The current experiments examined two different variables within a DOE procedure. In both experiments, rats were trained that a left lever press was reinforced during one visual stimulus (e.g., a flashing light) and a right lever press was reinforced during another visual stimulus (e.g., a steady light). The differential outcomes (DO) groups received a pellet or sucrose for each correct response, whereas the mixed-outcomes (MO) groups received interspersed deliveries of both outcomes for each response. Experiment 1 compared the DOE when using higher-valued versus lower-valued reinforcers. The DO groups acquired the discrimination faster than their respective MO groups, but did not differ from each other. A difference was found between the lower-value and higher-value MO groups. Experiment 2 examined the effects of pretraining with DO or MO prior to DO or MO discrimination training. Contrary to expectations, a DOE was not observed. These results suggest that a deficit in the mixed-outcomes groups, rather than facilitation with differential outcomes, may be the source of the DOE in our procedure.

Blocking trials by visual property eliminates pre and retro-cueing effects in a visual working memory task

John Solórzano-Restrepo, Sophie Jones, Romil Zenny, Catrina Gillespie, & Ken Leising (Texas Christian University)

P38

Directed forgetting and priming research have found that an external cue that signals a task-relevant (target) stimulus improves visual working memory performance in different species. The external cues improve recognition when presented before (pre) or after (retro) the target. Signalling a change in the identity (shape) or spatial properties of an object, in a within-subject's task, has resulted in better performance with pre compared to retro cues, in both identity and spatial trials. We analysed the effect of blocking by property on the pre and retro-cueing effect. Each trial followed the structure: coloured background (CB1), delay, target stimulus (snowflake), delay, coloured background (CB2), delay, probe stimulus. College students were instructed that the colour of CB1 or CB2 would signal whether to evaluate the relationship of the identity or location of the probe stimulus to the target stimulus. An analysis of d' revealed significant differences in property (Identity vs. Spatial), but not in cueing (Pre vs. Retro), and a significant interaction between two testing blocks (64 trials each). Performance in control trials mimicked performance in cued trials based on property. Blocking trials eliminated the effectiveness of the pre and retro cues.

How does a textured t-maze arm impact escape performance of healthy and parasitized amphipods?

Carmella Nowak, Sophia Ruppel, Emma Mikelson, Taylor Nowak, & Joshua Wolf (Carroll University)

P39

Previous research with a 3-D printed aquatic t-maze demonstrated that while parasitized amphipods made more errors and failed to finish the maze more often than healthy amphipods, they did not require more time to escape. However, the low subject number, lack of maze acclimation, and a 60-s cap on trial time complicated the analysis of the data and undermined our confidence with the results. The current study added several improvements, including a larger sample size, a maze acclimation day, and methods to eliminate failed trials and limit ceiling and floor effects. While both healthy and parasitized amphipods successfully escaped from the maze, healthy amphipods outperformed parasitized amphipods, making fewer errors, escaping faster, and having fewer failed trials. However, neither group showed evidence of learning to escape faster or with fewer errors across sessions of training.

Revaluation of a Conditioned Reinforcer Using Reward Upshifts and Downshifts

Jordan Nerz, Sara R. Bond, Macy Lasater, Katie Cagney, Margeaux Manshel, Bebe Silver, Kenneth J. Leising (Texas Christian University), & W. David Stahlman (University of Mary Washington)

P40

In an outcome devaluation procedure, an appetitive outcome (e.g., food) is paired with an aversive outcome (e.g., illness), which results in a reduction of the previously trained response (e.g., lever pressing, LP). According to the hedonic shift hypothesis, reexposure to the affective value of the outcome after devaluation is necessary for behavioral suppression. This prediction has been supported by findings with devaluation of a primary reinforcer, but also with a conditioned reinforcer (CDR). The current experiment examined whether elevation and devaluation of a CDR could occur with a single trial of reward upshift or downshift, plus reexposure to the CDR. Rats were trained to LP for an audiovisual CDR previously paired with a low (sucrose) or high (chocolate-pellet) value reinforcer. The CDR's value was then either upshifted (sucrose → chocolate-pellet), downshifted (chocolate-pellet → sucrose), or unshifted (sucrose → sucrose) via a single pairing. After CDR reexposure, all groups responded more to the active lever than the inactive lever, but with no group differences. The effectiveness of a CDR paired with a low value reinforcer and the challenges of a single-pairing procedure will be discussed.

Pigeons' representation of real-world hierarchical categories

P41

Odysseus Orr, Edward A. Wasserman (University of Iowa), & Robert M. Nosofsky (Indiana University)

Studies in visual cognition rely on both artificial and naturalistic stimuli. Although utilizing artificial stimuli affords greater experimental control, using naturalistic stimuli permits greater generalizability to the real world. Because of this dichotomy, efforts have been made to decompose naturalistic stimuli into their featural components. The present research evaluated how pigeons represent hierarchically organized rock categories. In a two-alternative forced-choice task, pigeons learned to classify 81 unique rocks into 9 different categories. The categories were organized into 3 overarching classes, such that categories within each class were more visually similar to one another than to categories from the other classes. By the end of training, each pigeons' categorization accuracies mirrored the underlying structure of the categories: their accuracy was best on trials in which the incorrect alternative was from a different class, and worst when the incorrect alternative was from the same class as the target. Future work will attempt to derive pigeon-based featural dimensions for each rock in order to elucidate the class-wise differences in the magnitude of the observed effect. Achieving greater control over naturalistic stimuli will allow for a deeper understanding of species differences in categorical perception.

Gender biases and stimulus competition

Noelle Mongene & Martha Escobar (Oakland University)

P42

Career-gender biases (assumptions that men are more proficient than women in science and women are more proficient than men in the humanities) may impact behavior implicitly. Participants viewed complex information about fictional students taking a science or art course, including gender (G1 vs. G2) and credit load (low [L] vs. high [H]). Training took the form of LG1-Pass / HG2-Fail. L was rated as a more robust predictor of passing the class if G1 was consistent with preexisting gender-career biases than if it was inconsistent with those biases, even if ratings of G1 and G2 were equivalent. Thus, even if the biases were not observed explicitly, they impacted ratings of a reliable predictor implicitly. We explain these results in terms of the associative competition phenomena of blocking and overshadowing.

Applying Canine Research To K9 Practices: What do K9 handlers and trainers want to know?

Hannah M.R. Burrows, Emily A. Sundby, Maeve K. Glover, & Valerie A. Kuhlmeier (Queen's University)

P43

Given dogs' unique place in human society, there is the potential for relatively direct, practical applications of comparative cognition research. Despite this--but with notable exceptions--there is often a disconnect between research and practice. In the present study, we used a public scholarship framework to help bridge this gap, developing a 32-item survey for professional dog handlers/trainers in policing and military. 459 participants indicated which research topics would be particularly relevant to their work, how open their field is to new scientific findings, and where they are likely to look for these findings. Among many topics labelled "important" by respondents, odor learning processes and attention to human behavioral cues received high ratings. Further, thematic analysis identified that participants felt there was limited access to current research, emphasizing the need for improved communication channels that could enhance evidence-based training practices and, in turn, dog and handler welfare. This study provides evidence of the value of public engagement for research in comparative cognition, particularly engagement that includes the co-creation of research questions.

Primate-canine comparisons on the Object Choice Task

Hannah Clark (University of Portsmouth), Mahmoud Elsherif (University of Birmingham), Zoe M. Flack (Brighton University), & David A. Leavens (University of Sussex)

P44

Comparative assays of social cognition almost never match sampling, testing protocols, or task preparation across species. We conducted a meta-analysis of 71 studies with nonhuman primates and dogs which employed the Object Choice Task, a frequently used assay of the ability to comprehend deictic gestures, the results of which are widely used as the basis for theories positing human-unique socio-cognitive adaptations. Fully 91% of dogs had pre-experimental histories rich in human interaction, compared with 6% of nonhuman primates ($N = 2534$, $p < .001$) and greater levels of human exposure were linked to increased performance. Of nonhuman primates, 99% were tested with a barrier, in the form of a cage, compared with 1% of dogs ($N = 2534$, $p < .001$). There were also significant differences in the spatial configurations and cue types presented. Such systematic differences in sampling and methodology could account for the "species differences" in performance between apes and dogs. In two empirical studies, we found barriers in the testing environment resulted in differences in the behavioural responses of 18-month- and 36-month-old children and dogs, and at-chance performance in dogs ($N = 37$, $p = .09$). These findings highlight the necessity of matching testing conditions when comparing across groups.

Testing Dogs' Preference to Attend to Attention-Related Behaviors in Others

Dana Ravid-Schurr (College of Staten Island and The Graduate Center - City University of New York), Sarah-Elizabeth Byosiere (Hunter College and The Graduate Center - City University of New York), & Bertram O. Ploog (College of Staten Island and The Graduate Center - City University of New York)

P45

Several studies showed that dogs attend to attention-related behaviors (e.g., Horowitz, 2009; Udell et al., 2011). However, it is not clear whether dogs attribute attention to others (private behavior), or rely on observable (public) behaviors to predict certain outcomes. To address this, this study tests whether dogs rely on others' attention-correlated behaviors or

on other observable behaviors, when both may function as discriminative stimuli. Dogs are trained to approach a Baiter when an Agent retrieves a treat from under a mat, after having watched the baiting; and to approach the mat when the Agent fails to retrieve the treat, after having their back turned to the baiting. Then, in the test, the Agent's behavior is modified, so that in some test trials the Agent's attention-correlated behavior (i.e., looking/not looking) is incongruent with the condition, and in other trials other components of the Agent's behavior (e.g., approaching the baited/un-baited side) are incongruent with the condition. The impact of each incongruent component of the Agent's behavior on the dogs' performance will help determine which stimulus controls the dogs' behavior – the attention related component or one of the other components. Data collection is expected to be completed by early 2024.

The Effect of Background Odors on Detection Thresholds in Canines

Julianne Bullock, Sarah Kane, & Nathaniel Hall (Texas Tech University)

P46

Determining canine olfactory sensitivity for odors is an important metric of odor detection canine capabilities. Often, detection thresholds are measured under clean laboratory conditions, which are rarely encountered by working detection dogs. More research is needed to better understand how background odor noise influences a dog's detection threshold. We here evaluated the effect of background odorant on the detection threshold of 1-bromo-octane, in an olfactometer-controlled 3-alternative forced choice descending threshold procedure. Three dogs' detection threshold was evaluated when the target odor was diluted in a near odorless diluent (mineral oil) and in a complex background consisting of D-carvone, D-limonene, and methyl benzoate. After two replicates of each threshold assessment, performance on the background threshold task improved by 10-fold, whereas there was no improvement for the no-background threshold. The presence of background odor caused on average a 27-fold reduction in detection threshold on the first replicate, but only a 2.5-fold reduction on the second replicate. The effect of background odor appears most important initially, but dogs showed important learning in the detection of the target in a noisy odor background.

Negative Violation of Expectation in Dogs as Seen Through Behavioral Analysis

Kelsey Taylor, Dr. Lindsey Johnson, & Dr. Heidi Lyn (University of South Alabama)

P47

Do dogs have different reactions to a positive versus a negative surprise? In humans, we see that predictions lead to expectations. Violations of those expectations (a surprise) lead to emotion. We question if dogs display different categories (negative/positive) of behavior depending on the category of surprise. Dogs are the subject of this project due to their evolved communication and social skills based on human domestication. To support the hypothesis that a dog's reaction to a violation of expectation correlates to the category of the violation, two experiments were constructed to lead a dog to form an expectation through 5 trials. In the final (6th) trial of each experiment, the same stimulus that was used in trials 1 through 5 was used in an unexpected way to observe the dog's response. In our ongoing analysis, we find support that our canine participants do recognize and react differently to a negative versus a positive violation of expectation. With the disappointing stimulus (less treats or seeing a stranger instead of their owner), we see dogs portraying negative emotions. Monitoring a dog's emotions can help create a better understanding of their capabilities, which can then be applied to humans in their role as domesticators.

Preliminary Test of Long-Term Memory in *Canis Lupus Familiaris* Using Puzzle Feeders

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P48

Long-term memory in dogs has been studied with various tasks such as imitation of actions, odor recognition, "named" objects, individual human recognition, and inanimate object recognition. A study was conducted to evaluate long-term memory in various breeds of dogs, assessing responses when solving different types of puzzle feeders. Each dog was presented with four puzzle feeders varying in difficulty depending on the number and type of actions required to obtain a food reward. Time to solve the puzzle at initial exposure was measured and compared to exposure one month later in nineteen dogs. Data were collected for the time to solve the puzzles, as well as behavioral strategies such as which body part was used. Preliminary results suggest faster solution time and different strategies used, thus possibly providing evidence of long-term memory. Although some subjects never solved the puzzles, the quicker solution time observed for many of the dogs in Session 2 seemed to be linked to individual differences and puzzle task difficulty. Data collection is ongoing to increase sample size and investigate task performance related to individual personality ratings. This study was used to pilot some of the apparatus for a similar study with ManyOtters.

Mechanisms of abnormality detection during CT examination by pigeons

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P49

Computed tomography (CT) scans of the chest are an ideal modality for evaluating pulmonary lung nodules, which radiologists reportedly detect by searching for a sudden appearance and disappearance across images. Pigeons, a highly

visual species with a precise visual system, can also detect these biological irregularities, possibly using different underlying mechanisms. To investigate how pigeons detect nodules, we examined how six previously trained pigeons performed during time-based manipulations. We presented sections in random order or as single-frame presentations disrupting the availability of the usual systematic and smooth transitions between successive images. The pigeons discriminated successfully despite the disruption to time features. This suggests that static features are the basis of these pigeons' generalized discrimination process. Future research should examine what static features support this ability.

Monkeys learn abstract rules, and they know it: Metacognitive awareness of algebraic rules in rhesus macaques

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P50

Humans readily apply abstract rules in areas as diverse as language, music, mathematics and logic. Nonhuman animals have also been shown to learn abstract rules. However, questions remain about how these rules are represented in the minds of animals. Here we ask whether rhesus macaques acquire implicit or explicit knowledge of abstract rules by testing if they are metacognitive when applying these rules. Monkeys were trained on a waiting time paradigm, in which they had to maintain a response (a touch on a touchscreen computer) for a variable waiting time (5-12 seconds) to receive a reward. This was then combined with a three-alternative forced-choice abstract rule task, which they had previously learned. If monkeys are metacognitive in applying these abstract rules (meaning they know when they select the correct stimulus), they should wait longer on trials when they make a correct decision, and pre-emptively abort trials when they are incorrect. Our data suggest that at least some monkeys follow this pattern, demonstrating metacognition, and therefore explicit knowledge, of their decisions based on abstract rules.

If You Give a Rat a LEGO: Generalized and Cross-Modal Relational Concept Learning in Rats

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P51

Most experiments studying conceptual learning in animals assess abstract concept learning using transfer tests with novel stimuli of the same modality. However, it has been argued that a stronger test of relational concept learning would be provided by transfer to a modality different from the one used in training. As same/different concept learning has been previously demonstrated in rats using non-matching-to-sample tasks with olfactory stimuli, the goal of the current study was to investigate if rats could be trained on an incrementing non-matching-to-sample task using 3D plastic objects as stimuli (3D Span Task) and if relational concept learning would then transfer to novel 3D stimuli and olfactory stimuli. In the 3D Span Task, responding to a session-novel shape stimulus was reinforced, but responding to a stimulus already encountered within a session was not reinforced. Four rats were trained in the 3D Span Task. All four rats performed the task with high accuracy and showed above chance generalized non-matching to novel 3D stimuli. One rat has shown immediate transfer to novel olfactory stimuli. Results suggest that relational learning can be demonstrated in a new modality and provide some preliminary evidence of cross-modal transfer of relational responding in rats.

Difficulties in Cross Modal Auditory and Visual Same/Different Concept Learning by Pigeons

Erika Garcia (College of the Holy Cross), Robert G. Cook (Tufts University), & Muhammad A. Qadri (College of the Holy Cross)

P52

Humans use abstract concepts like "same" and "different" regularly, but the ability of animals to learn and use these abstract concepts is uncertain. We examined pigeons' ability to learn and apply this abstract concept to multimodal stimuli. Pigeons were presented with sequences of audio/visual compound stimuli. Successive audio and visual elements were independently varied as repeating (same) or changing (different). Using a go/no-go paradigm, the birds needed to respond based on whether the within-modality relationships were the same or different. Half the birds were reinforced for pecking when the modalities shared their same/different qualities (i.e., both the same or both different). The remaining pigeons were reinforced for pecking when the modalities differed in their same/different qualities. Thus, the birds needed to apply a higher-order, abstract same/different concept. Some birds successfully learned the task, though it was clearly more difficult than traditional sequential same/different tasks. Pigeons' abilities to process stimuli across modalities and learn abstract concepts will be discussed.

Conceptual Set-Shifting in the Squirrel Monkey (*Saimiri* spp.)

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P53

The Conceptual Set-Shifting Task is a simplified, touchscreen-based analogue of the Wisconsin Card Sorting Test. Stimuli consist of 3 shapes in 3 different colors, and a random dimension (either a color or a shape) is selected as the rule for a 100-trial block. Three random stimuli (varying in both color and shape) are presented during each trial, one of which is the correct response needed to obtain a liquid reward. Subjects are tested on the same rule until they reach 80% correct on a block, then a new rule is randomly selected. We tested 11 squirrel monkeys, 5 old (M=20.7 years) and 6 young (M=4.6 years). Older animals require significantly more 100-trial blocks to learn the rule (M=17.2) than younger animals (M=5.0; Mann-Whitney U=29.0, p<.05). There is no difference in perseverative errors (choosing the previously reinforced dimension) made in the first 25 trials following a rule change (old M=18.95; young M=18.96; U=14.0, p>.05);

however, perseverative errors make up a greater percentage of all choices for younger animals (M=67.8%) than older animals (M=59.9%; U=3.0, $p < .05$). These findings suggest that younger animals more quickly adapt to changes in reinforcement contingency.

Supporting Animals and Veterans through Enrichment: An exploratory study on a brief canine socializing intervention

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P54

The welfare of shelter dogs incorporated in animal-assisted interventions (AAI) and the influence of AAI on student veteran populations remains understudied. Thus, we used a mixed methods design to assess if shelter dogs and student veterans could benefit from a 30-minute unstructured interaction. Participating student veterans (N=30, Mage=34, SD=9.2; 24 males, 4 females) interacted with screened shelter dogs (N=30, Mage=2, SD=0.9; 17 males, 13 females), and were encouraged to engage in any activity of their choosing (i.e., petting, playing, talking, providing treats, brushing). Dog behavior was recorded in-shelter and during the beginning, middle, and end of the interaction. Veterans completed a survey before and after the interaction to report their mood and which dog trait and activity completed most influenced their experience. Results revealed that dogs entered the interaction with more fear (e.g., lip licking), general activity (e.g., jumping), and soliciting contact (e.g., soliciting play) behaviors, with all behavioral activity reducing midway. Also, a non-significant trend revealed veterans leaving the interaction in a pleasant-deactivated mood (e.g., calm). The dog's behavior was reported to be the most enjoyable part of the interaction. Veteran-reported pleasant mood states and activity enjoyment, as well as observed decreases in dog fear, suggest program benefits.

Observation learning in pigeons with live and video-recorded demonstrators

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P55

Although there is evidence that some non-human animals can learn from others by observation, the results are inconclusive for pigeons. In this study, we investigated the observational learning ability of pigeons using two demonstrator-observer pairs. We first trained the demonstrator pigeons on a 4-alternative symbolic matching-to-sample task and the scores of the early sessions were recorded for use as the control data. When the demonstrators achieved an accuracy plateau, the observer pigeon was placed in a cage located next to the demonstrator's operant box while the demonstrator engaged in the task. Immediately after the observation, the observer was presented with the same task. There was no significant difference between the performance of controls and observers overall. In the following experiment, we compared the performances of the demonstrators and observers in a reversal learning task. Unlike the demonstrators, which had difficulty in completing the daily sessions, probably due to a sudden drop in reinforcement rate, observers showed stronger persistence. We also repeated the experiment with a video-recorded demonstrator and found that the performances of the observers were inferior to those of live observers. The video observers perhaps confused the stimuli in the video with the real test.

Auditory and Vocal Caching Behaviour in Eurasian Jays

Jamie G. DuBois (University of Cambridge)

P56

The Eurasian jay (*Garrulus glandarius*) and other food-caching animals employ intricate strategies to safeguard their stored food from potential conspecific pilferage using both visual and acoustic information. This study investigates whether Eurasian jays alter the transfer of auditory information during caching when observed by another individual. Using trays filled with noisy gravel or quiet sand, the study recorded the number of peanuts cached under three conditions: when the jays were alone, when an observing bird could see and hear them, and when an observer could only hear them. While the jays tended to cache more peanuts when observed both visually and auditorily, the difference was not statistically significant and no clear preference for noisy gravel or quiet sand was found in contrast to the finding of Shaw and Clayton (2013). This may be attributed to study design limitations, a small sample size, or potential color-matching strategies employed by the jays to conceal visual cues. Subsequent research will employ colored sand and gravel to address color-matching influences, and future studies will explore the prioritization of concealing auditory versus visual cues. The cumulative findings aim to contribute to a comprehensive dissertation on how corvids, particularly Eurasian jays, utilize auditory and visual information in cache concealment, and which strategy, if any, proves more effective in protecting caches.

Role of Response Contingency and Reward Probability on Spatial Behavioral Variability in Pigeons

Megan Cady (University of California), Cyrus Kirkman, & Aaron Blaisdell (Los Angeles)

P57

Behavioral variability is impacted by factors including probability of and proximity to expected reward, but the role of reward schedules on variability has been largely unexplored. We studied spatial variability of pigeon touchscreen pecking responses elicited by various cues as a function of three reward contingencies: Pavlovian, omission, and instrumental, under three Random Ratio (RR) response criteria: RR2, RR5, and RR20. Contingencies were structured such that the relative roles of response contingency and likelihood of reward could be teased apart. Pigeons are an ideal candidate for

this task, known for their autoshaping tendencies and for exhibiting spatially-quantifiable pecking behaviors when a visual signal does or does not predict reward. Initial findings show lower response variability on an RR2 schedule with higher reward probability (instrumental) than a lower probability (omission), with corresponding differing coefficient of quartile variation (CQV) values of 0.26 for instrumental and 0.35 for omission. We found similar probabilities of reward on RR5 and RR20 schedules, resulting in similar CQV values (0.30 and 0.35 for RR5; 0.37 and 0.35 for RR20, respectively). Thus, it appears that spatial variability in pigeon behavior in this task was solely influenced by reward probability and not by schedule type.

Interspecific social play: observations between a Florida manatee and green sea turtle

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P58

Interactions between individuals of different species can present a problem of interpretation. Here, we evaluated the behaviors of a Florida manatee (*Trichechus manatus latirostris*) and a green sea turtle (*Chelonia mydas*). Both animals were housed in a common tank at Mote Marine Laboratory and Aquarium and were observed to interact frequently: torso touching, face touching, tandem swimming, etc. Video analysis of these activities indicated that the manatee and the turtle both engaged in a variety of interactions, with the manatee initiating behavior exchanges more frequently. Although these behaviors might be attributed to a variety of motivations (e.g., affiliation, curiosity, or even aggression), the interactions were consistent with Gordon M. Burghardt's five criteria for play: (1) limited in immediate function; (2) spontaneous, apparently intentional, or autotelic; (3) structurally or temporally different than ethotypic behavior; (4) repeated but not rigidly stereotyped; (5) initiated in an apparently relaxed field. This report describes an unusual interaction between species that suggests social play, which could provide an example of behavioral flexibility not traditionally attributed to either manatees or sea turtles.

An Affordable and Open-Source Operant Box Alternative Controlled by Raspberry Pis

Robert Tsai, Cyrus Kirkman, & Aaron P. Blaisdell (University of California Los Angeles)

P59

Utilizing operant boxes in behavioral experiments is often limited by the general proficiency of their features: namely, affordability, personalization, modularity, and cloud connectivity. Commercial boxes standardize design and software for ease of out-of-the-box use, but come with a plethora of problems. These include limited software applications, defects of timing precision, extraneous hardware, and constrained data structure. They can also cost tens of thousands in set-up costs and maintenance. While substantial efforts have been made toward cost-effective open-source box design (Buscher et al., 2020; Rizzi et al., 2016; Ribeiro et al., 2018), there continues to be a lack of accessible customization of the boxes and integration of experimental software. Towards this end, we have developed a blueprint for a Raspberry Pi-powered operant box with touchscreen capabilities and modular stimulus control. With all components sourced online, this box possesses inexpensive hardware and software that can be fine-tuned with great precision for various tasks, behaviors, and experimental organisms. We lay out a streamlined approach for engineering cloud connectivity, version control of code, and automated data configuration across multiple boxes. Additionally, we explore the potential of utilizing openAI as a backbone for software development and troubleshooting.

Low-Cost Acoustic Tag for Cetaceans

Joclyn Villegas (University of South Alabama), Alasdair Davies, Claire Painton (Arribada), & Heidi Lyn (University of South Alabama)

P60

Acoustic tags are greatly desired in cetacean research; however, many available tags are highly expensive, limiting their use in cetacean acoustic research. Acoustic tags allow researchers to easily identify a signaler and more accurately generate an individual's acoustic repertoire. Our work aims to design a low-cost acoustic tag designed to function in recording dolphin vocalizations. The prototype design is modeled for weight, hydrodynamic shape, adherence, and buoyancy. The initial prototype, generated by Arribada, included a 2-part tag that screwed together to house the recording software which was sealed off by an O-ring. Recording software is encapsulated within the tag, containing a micromoth provided by OpenAcoustics. However, our field tests on live captive dolphins ultimately resulted in leakage within the model. Additionally, the model experienced sliding due to insufficient adhesion from the suction cups. The second prototype was designed to permanently encapsulate the software to prevent leakage. Furthermore, positively buoyant suction cups were engineered and successfully tested on deceased dolphins for safety and better adherence, before being tested on live dolphins. A functioning prototype will bring to market a more economically friendly acoustic tag, costing less than \$1000, opening the field to both a larger community and more targeted research studies.

ManyManys: A large-scale collaboration on comparative cognition and behavior across animal taxa

Laurent Prétôt (Pittsburg State University), & Nicolás Alessandrini (Concordia University)

P61

Over the past decade, behavioral research has seen a surge in the use of Big Team Science (BTS) to address pressing issues such as small sample sizes, stimuli incommensurability, poor replicability, flaws in research integrity, and competing theories. While previous BTS initiatives predominantly concentrated on either single species or multiple species within a singular taxon, cross-taxon comparisons have been infrequent or inconclusive. In this context, the

comparative analysis of species from diverse taxa holds exceptional promise for advancing our comprehension of the evolutionary history of cognitive abilities and unraveling the mechanisms shaping species' behavior and cognition. Here, we introduce ManyManys, a grassroots BTS collaboration investigating comparative cognition and behavior across animal taxa. Firmly rooted in open science principles, ManyManys brings together a team of 50+ researchers and trainees, spanning diverse backgrounds and expertise across all career levels and representing 10+ countries. ManyManys is committed to implementing, providing free training on, and championing open science practices, including pre-prints, open-access publication, preregistration, and open data. We provide an overview of the development and current status of ManyManys, delving into the key advantages and challenges that BTS present to comparative cognition research.

Hand Preferences in a Troop of Olive Baboons (*Papio anubis*) During a Cognitive Task and Natural Behaviors
Logan Brownell, Katie Becker, McKenzie Wolfe, Victoria Curtis, Gabrielle Koehler, Genevieve Wright, Shaya Gibbs (Rochester Institute of Technology), Jessica Cantlon (Carnegie Mellon University), & Caroline DeLong (Rochester Institute of Technology)

P62

Baboons and other primates have been shown to have hand preferences similar to humans. The current study investigated these hand preferences in ten olive baboons residing at the Seneca Park Zoo (Rochester, NY), to understand how brain lateralization and a species level right-hand preference in humans may have evolved from primates. Seven baboons used their hands to complete match-to-sample tasks testing their cognitive skills on a touch-screen computer. We recorded which hand was used to touch the start box, sample stimulus, choice stimulus, and the hand used to collect the food reward. All baboons were also observed on exhibit, where they were carrying out natural behaviors (e.g., grooming, foraging). Handedness index scores were calculated. Five baboons showed a left-hand preference and two showed a right-hand preference when using the touch screen computer. Preliminary observations of the natural behaviors of all ten baboons revealed a left-hand preference for seven baboons, and a right-hand preference for three baboons. Stronger hand preferences were elicited from the cognitive task compared to other behaviors. Five of seven baboons showed a consistent hand preference when performing the cognitive task and on exhibit. These data suggest that baboons have a dominant hand which may remain consistent.

Lateralized social approach in rodents? Relation to both lateralized turning behavior and the display of specific social behaviors in laboratory mice.

Christopher Harshaw, Olivia R. Davis, Anna G. Warner, & Christopher R. Palasch (University of New Orleans)

P63

Lateralized social behavior has been documented in a range of species and taxa, however, it remains largely unexplored in rodents. Here, we re-analyzed two published data sets containing 249 'social interaction tests' (SITs) performed on C57BL/6J mice. Mice were habituated to a testing apparatus for 10 min/day on the two days prior to the SIT, permitting the quantification of general turning bias. In each SIT, a 'target' mouse freely interacted with an unfamiliar stimulus mouse for 10 min. Approaches toward the stimulus mouse were scored as to whether they were preceded by or involved a left or a right turn. We found no evidence of population-wise lateralization of social approach (LSA) in mice. At an individual level, a significant positive relationship between lateralized turning behavior in a non-social context and LSA in a social context was apparent across data sets. Finally, when interaction between the general turning bias displayed by target and stimulus mice was added to models for specific social behaviors (e.g., body sniffing), this interaction became a significant predictor of social behavior. In particular, far more interaction and sniffing occurred when mice displayed opposite turning biases, and far less interaction occurred when mice were similarly lateralized.

White Matter Connectivity of the Insula in Cetacean Species with Different Social Structures: A Diffusion Tensor Tractography Analysis

Isabelle Origlio & Peter Cook (New College of Florida)

P64

Although dolphins and whales share a common terrestrial ancestor and inhabit overlapping ecological niches in the aquatic environment, they exhibit wide variability in social behaviors. Some dolphins and whales are known to have complex social structures, while others are mostly solitary. Prominent theories of brain evolution emphasize the role of social pressures in driving adaptations in brain size and organization. The insula is a brain region that has been shown to be important for social and emotional processing in humans. Despite its apparent hypertrophy in cetaceans, it has barely been studied in this clade. Using postmortem diffusion tensor imaging (DTI), we mapped the white matter connectivity of the insula of several dolphin and whale species with different social behaviors. These ranged from the sei whale, a mostly solitary species, to the pilot whale, which lives in stable, long-term matrilineal pods. We examined differential connectivity of different parts of the anatomical insular cortex, comparing between whale species and with prior published data on terrestrial mammals. Our findings of variable connectivity with subcortical and cortical brain regions emphasize the potential of social ecology to reshape the nervous system over evolutionary timescales.

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Guest editors: Cody A. Freas and Marcia L Spetch

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