24th Annual International Conference on Comparative Cognition

Sponsored by the Comparative Cognition Society

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Radisson Hotel

Melbourne Beach, Florida

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PROGRAM NOTE Five-minute talks are designated by a Talk Number with a grey background. They are five minutes in duration followed by two minutes for discussion. Ten-minute talks are followed by four minutes for discussion.

Wednesday Afternoon

3:30 PM Welcome Reception and Check-In

7:15 PM Opening Remarks (Olga Lazareva, CCS President)

7:19 PM Canine Cognition (Chair: Jonathon Crystal)

2

7:19 PM

Characterization of Structural Connectivity of the Default Mode Network in Dogs using Diffusion Tensor Imaging

Jeffrey Katz, Jennifer Robinson, Paul Waggoner, & Gopikrishna Deshpande (Auburn University)

Diffusion tensor imaging (DTI) provides insight into the micro-architecture of white-matter tracts in the brain. This method has proved promising in understanding and investigating the neuronal tracts and structural connectivity between the brain regions in primates as well as rodents. The close evolutionary relationship between canines and humans may have spawned a unique bond in regard to social cognition rendering them useful as an animal model in translational research. In this study, we acquired diffusion data from anaesthetized dogs and created a DTI-based atlas for a canine model which could be used to investigate various white matter diseases. We illustrate the application of this atlas by calculating DTI tractography based structural connectivity between the anterior cingulate cortex (ACC) and posterior cingulate cortex (PCC) regions of the default mode network (DMN) in dogs. The white matter connectivity was investigated to provide structural basis for the functional dissociation observed between the anterior and posterior parts of the DMN. A comparison of the integrity of long range structural connections (such as in the DMN) between dogs and humans is likely to provide us with new perspectives on the neural basis of the evolution of cognitive functions.

3

7:26 PM

Can dogs remember two different locations at the same time?

Sylvain Fiset, & Virginie Daigle (Université de Moncton in Edmundston)

The objective of this experiment was to investigate whether dogs can spontaneously remember two spatial locations during the same sequence of events. Thirteen dogs were tested in an object permanence paradigm in which two pieces of food were hidden at two different locations within the same trial. To be successful, the dog had to visit the two target screens without looking behind any of the non-target screens. As a group, the dogs performed over chance. However, the performance varied considerably from one dog to another and the analysis of search behaviours suggested that the dogs did not understand the rules of the task.

7:33 PM **What factors really guide domestic dogs' search for an item dropped down a diagonal tube?**

Emma C. Tecwyn and Daphna Buchsbaum (University of Toronto)

4 It has previously been claimed that domestic dogs—like human infants and monkeys—have a 'gravity bias': they expect a dropped object to travel vertically downwards to the lowest possible point, regardless of any obstacles that constrain or impede its trajectory. In the diagonal tube task this bias is revealed by a persistent tendency to incorrectly search the location directly beneath the top of the tube, as opposed to the correct location at the end of the tube. Contrary to past claims, our previous research provided no evidence for dogs exhibiting a gravity bias. In the current study we presented dogs (n = 64) with four new versions of the diagonal tube task to examine what factors do guide their search behaviour. We explored alternative explanations for dogs' previously observed tendency to search the middle location, and also demonstrated that their behaviour is influenced by the proximity between the top of the tube and the search locations. Finally, dogs were presented with a version of the task where there was no gravity location, no middle location, and the top of the tube was equidistant from the search locations, to examine performance with all previous potential sources of bias eliminated.

7:47 PM **Quantity Judgements in Dogs (Canis lupus familiaris)**

Heidi Lyn (University of Southern Mississippi), Stephanie Jett (University of South Alabama), & Mayra Veliz-Aguilar (University of Southern Mississippi)

5 The ability to judge different quantities is an adaptive cognitive trait that can allow animals to judge relative foraging sites, probabilities of winning or surviving aggressive encounters, as well as the potential of lost offspring. Several researchers have looked at the ability of dogs to discriminate quantities, but with relatively small sample sizes. We report on a larger-scale quantity judgement task, completed with a total of 40 dogs (20 male and 20 female). Dogs were tested by simply offering two plates - one contained more treats than the other. Dogs were therefore rewarded on all trials, but would receive a larger reward depending on their choice. Quantities varied from 1 to 6 with different ratios between the plates. Dogs showed limited success in choosing larger quantities of treats, and their results are compared to apes tested with the same procedure. For all species, smaller numbers and larger ratios determined likelihood of success.

7:54 PM *Break*

8:04 PM

Temporal Processing (Chair: Victoria Templar)

8:04 PM **Attribution of a context-based common cause for shifts in reinforcement intervals**

Matthew S. Matell, Rebecca R. Della Valle, & Benjamin J. De Corte (Villanova University)

6 Evidence suggesting an amodal temporal memory system came from rats trained that a tone and light each predicted reinforcement availability after 40s (Roberts, 1982). After halving the tone-food interval, testing revealed a leftward shift in timed responding to the light. Roberts interpreted this as indicating a common (i.e., amodal) memory store. We tested the alternative interpretation that rats attribute changes in one cue's duration as resulting from a common moderating cause. In three experiments using the peak procedure, rats were trained that cue A predicted reinforcement availability at 8s, whereas cue B predicted reinforcement at 16s (counter-balanced). Then, we changed one cue's onset-to-food interval during phase 2 (e.g., 16->32), and found equivalent directional shifts in the other cue's production in phase 3. In Experiment 4, phase 2 re-training was conducted in a novel context. We found that the magnitude of the phase 3 shift was substantially larger when we tested rats in the novel context compared to the original training context. Together, these data suggest that rats attribute a common, context-based cause to changes in temporal expectations.

8:18 PM

7 Withdrawn

8:32 PM

Communication (Chair: Victoria Templar)

8:32 PM

Chickadee song discrimination: Relationship between acoustic preference and discrimination accuracy

Christopher B. Sturdy (University of Alberta), Allison H. Hahn (University of Wisconsin-Madison), Lauren M. Guillette (University of St. Andrews), Marisa Hoeschele (University of Vienna), Kenneth A. Otter (University of Northern British Columbia), & Laurene M. Ratcliffe (Queen's University)

8

Numerous animal species form social groups with dominance hierarchies and individuals often possess status signals to indicate dominance rank. Black-capped chickadees are a North American songbird that lives in winter flocks with linear social hierarchies. Previously, we reported that information regarding a male's dominance rank is contained within the acoustic features of its two-note song, and that females respond differentially to playback of dominant compared to subordinate songs. In the current study, we used two operant conditioning tasks to examine acoustic preference and discrimination of conspecific male songs based on dominance rank. Our results reveal sex difference in learning speed, with females learning to discriminate songs faster compared to males; a result consistent with other discrimination studies that have used chickadee songs as stimuli. In addition, our results indicate that an individual's initial acoustic preference correlates with its performance accuracy during the discrimination task. Taken together, these results provide evidence that when the stimuli used during a perceptual task are biologically salient signals (such as male songs), responses during the task may be influenced by individual differences among the subjects, such as a subject's sex and underlying stimulus preference.

8:46 PM

An investigation of the effect of signal degradation on perceived predator threat

Jenna V. Congdon (University of Alberta), Allison H. Hahn (University of Wisconsin-Madison), Daniel A. Yip, Kimberley A. Campbell, Erin N. Scully, Erin M. Bayne, & Christopher B. Sturdy (University of Alberta)

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In the presence of a predator, black-capped chickadees (Poecile atricapillus) produce mobbing calls. Mobbing calls are used to recruit and coordinate conspecifics and heterospecifics to attack a nearby threat. Avian predators vary in their degree-of-threat to chickadees; for example, smaller owls and hawks are of higher threat to chickadees as they can easily maneuver through the trees, while larger owls and hawks cannot. We conducted an operant discrimination go/no-go task to investigate the effect of signal degradation on perceived threat. We hypothesized that birds should be able to perceive higher threat predators at longer distances compared to lower threat predators. The stimuli included vocalizations produced by high-threat northern saw-whet owls (NSWO) and low-threat great horned owls (GHOW) recorded across six distances. During the discrimination task, chickadees were trained to respond to NSWO or GHOW stimuli that were recorded at close distances, and tested with calls recorded at longer distances. Preliminary analyses support our prediction that birds continue to discriminate high-threat signals at further distances compared to low-threat signals. The ability to perceive predators that pose a higher threat from further distances would allow higher rates of survival and thus, is likely to be selected for through evolution.

8:53 PM

Animal pointing: Changing trends and findings from 20 years of literature

Mark Krause, & Demetri Skopos (Southern Oregon University)

10

The pointing gesture has long been regarded as a window to complex socio-cognitive processes. Once thought to be a uniquely human capacity, over 20 years of research has shown that some nonhuman species produce pointing gestures, and many more comprehend the referential nature of pointing. These include nonhuman primates, domestic dogs and cats, wolves, elephants, dolphins, goats, crows, and horses. So what conclusions can we draw from over 20 years of researching pointing in animals? We systematically examined publications on pointing in animals from 1994 to 2016, and recorded species, aspect of pointing studied (production, comprehension, or both), rearing history, methodology, whether there was evidence of producing or comprehending pointing, and how the attentional status of the experimenters affected the nature of the animal's production or comprehension. We will present and discuss trends, issues, and controversies in the nonhuman pointing literature, including 1) a shifting focus from pointing production to comprehension, 2) how convergent evolution may account for the diverse species that comprehend pointing, 3) the role of rearing history in the production and comprehension of pointing, and 4) how changes in the pointing literature relate to questions comparative psychologists have been asking about the socio-cognitive capacities of nonhumans.

9:07 PM

Break

9:17 PM

Numerosity (Chair: Jessica Stagner)

9:17 PM

Magnitude interference in chimpanzees: When quantity meets quality

Audrey E. Parrish (The Citadel), Anamaria Otalora-Garcia (University of Georgia), & Michael J. Beran (Georgia State University)

11

Magnitude is multifaceted, revealing both quantitative information and qualitative information. We investigated whether competing magnitude information about a stimulus would create interference in magnitude judgments by chimpanzees. Three chimpanzees were presented with an ordinal task, learning to select containers in descending order based on their hidden contents. Next, chimpanzees were presented with a relative quantity judgment task, learning to select different quantities of food in descending order. Then, the ordinal and quantity tasks were combined such that the containers now occluded the food sets. Chimpanzees needed to select the cups based on their memory of the hidden quantities, not based on the container's associated value with food quality. We documented interference effects; the quantitative and qualitative stimulus features influenced choice behavior, sometimes leading to suboptimal responses. In a second experiment, we removed the quantity task and focused on the ordinal task, creating conflict between container value and the occluded foods. This experiment also highlighted degrees of magnitude interference effects, such that chimpanzees shifted to using cup value to guide choice behavior following the first choice. Chimpanzees also showed some evidence of the cognitive control needed to inhibit responding based solely on the learned values of the cups.

9:31 PM

Zebrafish prefer the larger to a smaller shoal

Diane Seguin, & Robert Gerlai (University of Toronto Mississauga)

12

Numerical abilities have been demonstrated in a variety of vertebrates, but underlying biological mechanisms have been difficult to study due to paucity of experimental tools. Numerous genetics and neurobiology tools have been developed for zebrafish. However, numerical abilities have not been examined in this species. Here we investigate the choice made by single experimental zebrafish between numerically different shoals of conspecifics presented concurrently on opposite sides of the tank using both genetically well defined quasi-inbred AB strain zebrafish and a genetically undefined heterogenous stock of wild type zebrafish. The amount of time the experimental zebrafish spent near each stimulus shoal as well as the total number of visits to each shoal were recorded and used as a measure of shoal preference. We found zebrafish of both strains to prefer the numerically larger shoal to the smaller one as long as the contrasted ratio was above 3:1. These results confirm that zebrafish possess the ability to distinguish larger number of items from smaller number of items. Our findings now open the possibility to explore both the behavioural as well as the biological mechanisms of numerical abilities in fish.

13 9:45 PM

Spatial representation of magnitude in gorillas and orangutans

Regina Paxton Gazes (Bucknell University), Rachel F.L. Diamond, Jasmine M. Hope (Emory University), Damien Caillaud (Dian Fossey Gorilla Fund International University of California Davis), Tara S. Stoinski (Dian Fossey Gorilla Fund International Zoo Atlanta), & Robert R. Hampton (Emory University)

Humans mentally represent magnitudes spatially, responding faster to one side of space when processing small quantities and to the other side of space when processing large quantities. While the orientation of these spatial representations of magnitude are consistent with cultural preferences, the spatial nature of magnitude representation may be a phylogenetically ancient fundamental organizing feature of cognition. We tested for such space-magnitude correspondence in gorillas and orangutans by presenting animals with a two item numerocity discrimination containing dot arrays in quantities 2 through 10. Subjects picked the larger quantity in one condition (pick large), and the smaller in another (pick small). Response latencies to the left and right sides of the screen were compared across adjacent quantity pairs. Apes showed evidence of spatial representation of magnitude, however unlike humans, individual apes did not all adopt the same orientation. A negative correlation between slopes in the pick large and pick small conditions across individuals indicated strong tendencies for spatial representations within individuals and flexible alteration of these orientations based on task instructions. Results suggest that spatial representation of magnitude is phylogenetically ancient and that consistency in the orientation of spatial representations in humans is likely culturally mediated.

9:59 PM

Abstract learning in day-old ducklings: Towards a broader view of imprinting

Antone Martinho & Alex Kacelnik (University of Oxford)

14

The ability to identify and retain logical relations between stimuli and apply them to novel stimuli is known as relational concept learning. This has been demonstrated in a few animal species after extensive reinforcement training, and it reveals the brain's ability to deal with abstract properties. Here we show relational concept learning in newborn ducklings without reinforced training. Newly hatched domesticated mallards briefly exposed to a pair of objects that were either the same or different in shape or colour later preferred to follow pairs of new objects exhibiting the imprinted relation. Thus, even in a seemingly rigid and very rapid form of learning like filial imprinting, the brain operates with abstract, conceptual reasoning, a faculty often assumed to be reserved to highly intelligent organisms. This finding has implications on our understanding of filial imprinting, and of the importance of abstraction in visual learning in general, and poses several questions as to other types of abstraction and concept formation available to imprinting juvenile birds.

Thursday Morning – 10:30-11:30 A.M. – Manatee Room

10:30 AM CO3 Mentoring Program III: Engaging undergraduates in research (Chair: Lauren Guillette)

Do you have questions about what it is like to conduct research at a teaching-intensive institution? Are you interested in incorporating undergraduates into your research program? To encourage conversation between students and established experts in comparative cognition, an informal meet-and-greet will be held in the Manatee room. One mentor will be seated at each of six tables. Graduate and undergraduate students are encouraged to come and go from table to table to get to know the different mentors. Feel free to ask the mentors questions about leading large and/or small research teams, how to balance research with teaching, attracting undergrads to your research team, or how to obtain funding for undergrads? A poster identifying each mentor and a summary of their research and academic career will be on display at the entrance to the Manatee room. This session will end promptly at 11:30.

Thursday Afternoon

12:00 PM Ron Weisman Outstanding Student Presentation Competition (Chair: Dave Brodbeck)

16 12:00 PM

Replay of episodic memories in the rat

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

Episodic memory in people has been characterized as the replay of events in sequential order. We recently showed that rats remember multiple unique events and the contexts in which they occurred using episodic memory. However, it is not known if rats remember a stream of events in sequential order using episodic memory. Here we show that rats remember multiple events in sequential order. Rats were presented with a variable length list of trial-unique odors, followed by memory assessments that required judgments about the order of events. Three lines of evidence suggest that rats remember the sequential order of events. First, rats correctly selected items when both sequence and familiarity cues of the odors were put in conflict. Second, memory for items in sequence was resistant to a retention-interval challenge. Third, item sequence memory was resistant to interference from memory of other odors. We conclude that rats remember a stream of events using episodic replay.

17 12:07 PM

A cross-species comparison of personality in harbour seals (Phoca vitulina) and California sea lions (Zalophus californianus): group- and individual-level patterns of contextual consistency.

Amber de Vere, Malin Lilley (University of Southern Mississippi), & Lauren Highfill (Eckerd College)

Although personality has now been studied in a range of animals, a comprehensive assessment is available for only one marine mammal, the bottlenose dolphin, a species that also shows evidence of individual patterns of contextual plasticity. Consistent individual differences have been identified for a number of behaviors in grey seals, but to date there have been no assessments of personality across a broad range of traits in any pinniped species. A population containing both harbor seals (Phoca vitulina) and California sea lions (Zalophus californianus) was assessed for personality using behavioral coding. Exploratory factor analyses revealed three personality factors for seals and two for sea lions; two factors were largely consistent across species, and shared similarities with the human factors of Extraversion and Openness to Experience. Species differences were also found in the frequency of behaviors directed towards the environment versus other animals. However, there were some animals who did not conform to species-level trends, demonstrating individual patterns of contextual consistency. This study therefore demonstrates personality dimensions and cross-context patterns in two novel species, thus facilitating further cross-species comparisons and shedding light on the personality of pinnipeds.

18 12:14 PM

Effects of early-life experience and social environment on material choice in nest-building birds

Alexis J. Breen, Chloe Guerard, Susan D. Healy, & Lauren M. Guillette (University of St Andrews)

Evidence is accumulating against the notion that birds build nests by instinct alone: a bird can learn from their own and others' building experiences. What role the developmental period before adulthood plays, however, is unclear. To examine the role of early-life experience in birds' first-time building decisions, we manipulated two components of male (the builder) zebra finches' juvenile experience: (i) access (yes or no) to an experienced adult builder and/or (ii) material of a different colour from their natal nest. At sexual maturity, we tested males' preferences among three options: material that matched (in colour) to their (i) natal experience, (ii) juvenile experience, or, was (iii) novel (for males without material access, two of these options were novel). When choosing material for their first nest, males that experienced both an adult builder and material as juveniles preferred the colour of material from that time. Males without juvenile experience of an adult builder and/or material did not typically prefer one particular material colour. Thus, first-time nest builders use their juvenile experience to select material but only if they learned about it in the presence of an adult builder. Bird nest building is, then, shaped by the social environment in early life.

12:21 PM **A Contextual Congruency Effect in the Absence of Semantic Knowledge: A Pigeon Model**

Victor Navarro, & Edward Wasserman (The University of Iowa)

19

The background on which a visual target stimulus is presented can either enhance or impair target categorization, the so-called contextual congruency effect. Humans and monkeys are quicker and more accurate in categorizing pictures of animals when they are superimposed on congruent backgrounds (e.g., a forest) than when the same pictures are superimposed on incongruent backgrounds (e.g., a classroom); precisely the opposite trend holds in categorizing pictures of human-made objects. In our experiment, we trained pigeons on a 2AFC task to categorize 20 pictures each of animals or objects, presented on 20 natural or 20 artificial backgrounds. Targets were more accurately categorized when presented on congruent trials (animal-natural or object-artificial) than when presented on incongruent trials (animal-artificial or object-natural). Subsequently, 20 novel targets and backgrounds of each type were added to the training set. Pigeons reliably transferred categorization performance to novel targets; most importantly, pigeons also showed the contextual congruency effect with completely novel targets and backgrounds. The robust contextual congruency effect seen in this animal model conflicts with traditional accounts based on humans' and monkeys' semantic knowledge derived from prior covariation experience between animals and natural backgrounds, and between human-made objects and artificial backgrounds. Alternative explanations are discussed.

12:28 PM **Cache protection strategies of the pinyon jay (Gymnorhinus cyanocephalus), a highly- social food-caching corvid**

Alizée Vernouillet, & Debbie Kelly (University of Manitoba)

20

Food-storing birds rely on food they cache in order to survive when resources are scarce. These valuable stores are at risk of being stolen by other individuals. Hence, storers can lower the risk of losing their caches by identifying potential thieves and by limiting the information available to these observers. These store protection strategies have been explored in relatively social and non-social species, but not in highly social species where individuals cannot store food privately as they are typically surrounded by other individuals. Instead, they have to adopt alternative strategies to reduce theft risk. During this study, we investigated whether pinyon jays (Gymnorhinus cyanocephala), a highly social corvid species, were able to identify risks associated with being observed and if so, which strategies they employ to protect their food stores. Individuals were given 50 pine seeds to store in two visually-distinctive trays under three conditions: alone, in the presence of an observer or in the presence of an inanimate object. Our results suggest pinyon jays do not change the number of caches they made, but rather seek out safer caching locations.

12:35 PM

Choice (Chair: Heidi Lyn)

12:35 PM **Social network structure can buffer costs of forgetting in the evolution of cooperation**

Jeffrey R. Stevens (University of Nebraska-Lincoln), Jan K. Woike (Max Planck Institute for Human Development), Lael J. Schooler (Syracuse University), Stefan Lindner (Technical University of Berlin), & Thorsten Pachur (Max Planck Institute for Human Development)

21

Analyses of the evolution of cooperation often rely on two simplifying but unrealistic assumptions: (i) individuals interact equally frequently with all members of their social network and (ii) they have near perfect memory for a partner's past cooperation or defection. We examine how more realistic, skewed patterns of contact---in which individuals interact primarily with only a subset of network members---influence the cooperation rate. In addition, we test whether skewed contact patterns can counteract the decrease in cooperation caused by forgetting. We investigate these issues using evolutionary simulations of a repeated prisoner's dilemma game that vary the agents' contact pattern (high, low, or no skew), forgetting rate, and type of memory error. We find that skewed contact patterns foster the evolution of cooperation by buffering the detrimental effects of forgetting. This buffering occurs when memory failure results in either replacing the partner's forgotten action with a randomly chosen one or reverting to a memory of a previous action. Although cognitive limitations may constrain the evolution of cooperation, social network structure can counteract some of these constraints. A more comprehensive understanding of the evolution of cooperation requires simultaneously modeling realistic aspects of the environment and cognition.

12:49 PM **Gambling in rhesus monkeys: The influence of informative cues on risky decision-making**

Travis Smith, & Michael Beran (Georgia State University)

22

Seven rhesus macaque monkeys (Macaca mulatta) participated in a risky decision-making experiment where monkeys could choose between a safe option delivering 2 pellets with certainty ($p = 1.0$, expected value = 2) and a risky option delivering 8 pellets with a 0.2 probability (expected value = 1.6). Between the choice selection and the outcome there was a 6-s delay for the monkeys to anticipate the outcome. In signaled sessions the monkeys were provided information about the outcome of the risky choice during the delay period, and the screen flashed red/white for wins or yellow/white for losses. In the unsignaled sessions the monkeys were not informed about the outcome of a risky choice, and the screen flashed black/white regardless of the outcome. Overall, six monkeys showed a greater preference for the risky option in signaled sessions, even though this preference did not result in greater reward access. This procedure simulates a typical gambling environment, such as a slot machine, where the feedback of a gamble is seldom instantaneous with choosing that gamble. Thus, this procedure may help us investigate the mechanisms involved in risky decision-making in a gambling context.

1:03 PM **Laboratory models of relapse in humans and nonhumans**

Christopher A. Podlesnik (Florida Institute of Technology)

23 Relapse following successful treatment is a defining feature of problem behavior. Laboratory models of relapse offer methods to evaluate factors contributing to relapse in thorough and systematic ways. I review a range of approaches to assessing relapse of operant behavior using laboratory models with nonhuman animals, university students, and children diagnosed with Autism Spectrum Disorder. These findings demonstrate reliable relapse across species and reveal additive effects when combining different methods of evoking relapse (e.g., resurgence, renewal). These procedures offer a platform from which to develop and refine treatments for problem behavior, including addictions, fear, and severe problem behavior.

1:17 PM **Audience Effects on Chimpanzee Decision-Making in the Primate Gambling Task**

Darby Proctor (Florida Institute of Technology and Living Links Center Yerkes National Primate Research Center), Kimberly Burke, & Frans BM de Waal (Living Links Center Yerkes National Primate Research Center)

24 Social contexts, such as being in a casino, often cause an increase in the persistence of gambling behavior in humans, which results in greater long-term economic losses. However, the mechanisms behind this behavioral pattern are unclear. Here, we use chimpanzees to explore the influence of audience rank in the Primate Gambling task (PGT). Chimpanzees (n = 7, one male) were presented with a computerized PGT where a close-up video of another chimpanzee's face (either the alpha female or the lowest-ranking female) played on the screen with the task. The chimpanzees then made a choice between two symbols, one which represented a small but consistent reward delivery pattern and another reward pattern that included larger gains, but also zero outcomes. The results indicate that chimpanzees took more risks when seeing the lowest-ranking female as compared to the alpha female (Wilcoxon signed rank test: $Z = -2.2$, $p = 0.028$). Thus, chimpanzees take into account the identity of audience members when making decisions. As human gambling studies often take place in a laboratory with strangers, this is an area that needs to be further explored in order to more fully understand what components of an audience influence gambling behavior.

1:24 PM **Precrastination in Pigeons**

Jacob Case, Danielle Andrews, & Thomas Zentall (University of Kentucky)

25 Procrastination, the tendency to delay action longer than would be optimal, is often seen in humans. Recent research has shown, however, that with certain tasks humans "precrastinate" or begin tasks sooner than they need to, even if it involves exerting additional effort. For example, humans given a choice between picking up a pail one third of the way to a goal or two thirds of the way to a goal will often choose to pick up the pail earlier than would be optimal in terms of expended energy. We asked if pigeons would do the same with an analogous task. Pigeons were given a choice between two signaled behavioral chains. The first involved a fixed interval 5-s schedule followed by a fixed interval 15-s schedule (5-15). The second involved a fixed interval 15-s schedule followed by a fixed interval 5-s schedule (15-5). Each chain was followed by reinforcement. Much like the humans but inconsistent with delay reduction theory, the pigeons tended to precrastinate. That is they preferred the 5-15 schedule. In both species the preference was attributed to the conditioned reinforcement associated with reaching sub-goals sooner.

1:31 PM *Break*

1:41 PM # Cognitive Processes I (Chair: Martha Escobar)

1:41 PM **Is Behavioural Flexibility Evidence of Cognitive Complexity? How Evolution Can Inform Comparative Cognition**

Irina Mikhalevich (Humboldt-Universitat zu Berlin), Russell Powell (Boston University), & Corina Logan (University of Cambridge)

26 Behavioural flexibility is treated as the gold standard of evidence for complex forms of animal cognition, such as planning, metacognition, and mindreading. However, the evidential link between behavioral flexibility and complex cognition has not been explicitly or systematically defended. Such a defense is particularly pressing because observed flexible behaviors can often be explained by putatively simpler cognitive mechanisms. This leaves complex cognition hypotheses open to 'deflationary' challenges that are frequently accorded greater evidential weight because they offer putatively simpler explanations of equal explanatory power. This paper argues that once the blanket preference for simpler explanations is dispensed with, and the full spectrum of evidence—including evolutionary, ecological and phylogenetic data—is accorded its proper weight, an argument in support of the prevailing assumption that behavioural flexibility can serve as evidence for complex cognitive mechanisms begins to take shape. In particular, we propose an adaptive model of cognitive-behavioural evolution, which argues that the existence of convergent trait-environment clusters in phylogenetically disparate lineages can serve as evidence for the same trait-environment clusters in other lineages, thus permitting reliable inferences of cognitive complexity in cases of experimental underdetermination and thereby bolstering the received view.

1:55 PM **The relationship between personality traits and cognitive bias in domestic swine**

Kristina Horback (University of California Davis), & Thomas Parsons (University of Pennsylvania School of Veterinary Medicine)

27 Knowledge of personality traits among domestic swine could help to improve animal welfare by identifying individuals which are more susceptible to stress. In this study, 35 genetically similar sows were continuously observed from birth through their second parity. The teat rank, weight and response to human handling and open field tests were recorded at 3 and 5 weeks old. At the first farrowing, each sow was evaluated for her reaction toward an experimenter removing her piglets from her farrowing pen. One week after weaning, aggressive and exploratory behaviors were recorded for 1 h during each sow's introduction to an unfamiliar group pen. During the second gestation, the affective state of each sow was evaluated via cognitive bias testing. Two traits which explained ~70% of the variance in the data were determined using PCA; PC1: aggressive/reactive and PC2: active/exploratory. Individuals receiving high PC1 trait scores were determined to have more positive cognitive biases, suggesting that more aggressive/reactive individuals experience a more positive affective state in a group pen. These results indicate that personality traits may influence how ambiguous stimuli are appraised, and thus, have an effect on the psychological welfare of domestic swine.

2:09 PM **28** Withdrawn

2:23 PM

Serial Processes (Chair: Chris Sturdy)

2:23 PM **Humans Also Employ Both Association and Chunking Strategies to Produce an Interleaved Pattern**

Karen E. Doyle, Desiree Austin, Minyon McCray (Marygrove College), & Stephen B. Fountain (Kent State University)

29 This comparative study examined the extent which humans will utilize cognitive chunking to produce an interleaved pattern in a serial multiple choice paradigm. Participants were presented with a "game" consisting of a circular set of stimuli on a computer screen and prompted to click on the correct stimulus with the cursor. Correct choices were reinforced with an auditory stimulus along with "game points". The correct choices were organized into a target "run" response subpattern (123456) and an interleaved alternation response subpattern (787878) forming the interleaved pattern 172837485768. Manipulations to the interleaved alternation response subpattern occurred between groups. Manipulations included both presence of "cued" forced choice or "uncued" free choice trials, and either a rule-based alternation pattern structure or random elements. Following the acquisition, groups were transferred to a modified interleaved pattern consisting of the identical target "run" response subpattern (123456) and a "shifted" interleaved alternation response subpattern (878787) presented as the pattern 182738475868. Following transfer, performance on the target response subpattern was dependent on both cuing and pattern structure conditions akin to previous findings with rats. These results may be further evidence that rats cognitively chunk information in an interleaved pattern as performance is comparable between species.

2:37 PM **The Role of Associative Cues in Chunk Boundary Element Acquisition**

Melissa D. Muller (University of Mount Union), & Stephen B. Fountain (Kent State University)

30 The current experiment examined the factors that determine acquisition for elements of highly structured serial patterns. Three groups of rats were trained on three patterns with parallel rule-based hierarchical structure, but with 3-, 4-, or 5-element chunks, each with a final violation element. Acquisition data revealed that chunk boundary elements were learned faster than within-chunk elements or violation elements. To assess the extent to which the learned response pattern depended on intra-chamber location cues for anticipating different element types, rats in the 4-Element and 5-Element Chunk Groups were presented with probes that constituted a spatial shift in the location of the chunk boundary and violation elements. When rats made errors at chunk boundaries, they were of three basic types: "violation expectation" errors, "continuation of runs" errors, and "perseveration errors." Results for both groups suggest that rats may have abstracted the pattern structure, but that associative cues (such as element location and phrasing cues) were more important in mediating responding on chunk boundary elements.

2:51 PM **Procedural Memory in Pigeons' Serial Response Learning**

Walter Herbranson (Whitman College)

31

The Serial Response Time (SRT) task was developed to investigate procedural memory in humans. While it has recently been adapted to study learning in animals, interpretation in terms of procedural memory remains tentative. An experiment was conducted to determine how pigeons learn to respond quickly to predictable cues in an SRT task. Three groups of pigeons saw sequences of illuminated cues and were intermittently reinforced for pecking them. In group L, cue locations were predictable based on locations (but not colors) of preceding cues. In group C, locations could be predicted based on colors (but not locations) of preceding cues. In group LC, locations could be predicted based on either colors or locations. Results showed response time facilitation in all groups. However, learning was better for the groups that could use information about location to create an efficient motor program. Furthermore, transfer conditions manipulated validity of color and location information, and support procedural learning in groups L and LC, and associative learning in group C. These findings indicate that pigeons learn the task procedurally, even when associative learning could be used, supporting a multiple memory systems approach to avian cognition.

3:05 PM *Snack Break*

3:35 PM Cognitive Processes II (Chair: Heather Hill)

3:35 PM **Tuskedness in African elephants? An anatomical investigation of laterality**

Craig Bielert, Nick Costo, & Andrew Gallup (State University of New York at Oneonta)

32

Evidence for handedness and behavioral lateralization has been documented across diverse species, ranging from primates to insects. Given the distinct anatomical and behavioral characteristics of elephants, they represent an interesting model for the study of laterality. Recent research has documented side preferences for trunk movements among Asian elephants, and in an 1878 article there is even discussion of differential tusk use by elephants (species not provided). In particular, reference is made to the right tusk being employed more often in rooting and is therefore more likely to be broken as a consequence. Here, we provide the first systematic investigation of anatomical lateralization in elephant tusks. Data were collected on over 600 African elephants to assess potential lateralization in tusk weight, length and circumference. Consistent with earlier descriptions, preliminary analyses provide support for a slight right tusk bias. This work sets the stage for follow-up studies examining behavioral lateralization in tusk use among elephants. Further comparative research could go on to assess anatomical and behavioral tusk laterality in other animals, such as warthogs and wild boars.

3:42 PM **Visual laterality in bottlenose (Tursiops truncatus) and rough toothed dolphins (Steno bredanensis) when viewing video footage**

Kelley A. Winship (Dolphins Plus), Stan A. Kuczaj (University of Southern Mississippi), & Holli C. Eskelinen (University of Miami)

33

Visual laterality has been reported in a variety of terrestrial and aquatic vertebrates. Such information is useful when attempting to understand animal processing abilities in a non-invasive manner. Cetaceans have demonstrated eye preferences when viewing familiar and unfamiliar stimuli (i.e. humans and objects) when presented in live-action scenarios, with recent research suggesting laterality may also be present in these animals when viewing video images on television screens. Two species of captive dolphins were presented with video clips to record eye laterality present when watching novel images. Video sessions were broadly categorized based on content (presence or absence of cetaceans) as well as visual design (live action versus cartoon). Across all video watching, significant eye preferences were seen in both the bottlenose and the rough toothed dolphins. The bottlenose dolphins displayed a left eye preference, while rough toothed dolphins primarily watched binocularly. There was no significant difference in the use of binocular or left-eye dominant vision in either species. While differences were seen in eye preferences between video content categories, no statistical significance was found in either species. This data suggests that species differences may play a role in the processing of stimuli by cetaceans.

3:56 PM

All roads lead to Rome, but some are shorter: hummingbirds change their foraging routes in response to changes in sucrose quality

Maria Tello Ramos (University of Nevada Reno USA), Mabel Barclay, & Susan D. Healy (University of St Andrews UK)

34

Animals that use routes when foraging will benefit from changing those routes to avoid less profitable locations. Like other central place foragers, rufous hummingbirds follow routes called traplines. In order to find out whether these birds can reroute their traplines in response to changes in sucrose quality, we trained twelve wild hummingbirds to feed from five equally rewarded artificial flowers (25% sucrose). Once a bird had established a trapline, the quality of the flower the bird visited first in their trapline most often was reduced to 5% sucrose. In a second experiment, we used the same protocol but reduced the quality of the flower that was the one visited second most often. In order to avoid visiting the poor quality flower while keeping the shortest route, we expected birds to change the origin and direction of the trapline when the first flower of the trapline was changed but only to change direction when the second flower's quality was decreased. During both experiments, birds changed both the origin and the direction of their traplines, using the shortest routes that connected the high quality flowers. By remembering the location and quality of flowers, hummingbirds optimized their foraging routes.

4:10 PM

Carrion: It's What's for Dinner! Talking "Trash" about the Impact of Urbanization on Scavenger Ecology, Behavior, and Cognition

Stephanie E. Jett, Adam M. Stern, Takia N. Smith, Lauren Wheat, & Ashley Tatham (University of South Alabama)

35

This research is a part of a larger investigation of how urbanization is impacting the behaviors and cognitive abilities of species acting as scavengers along an urban to rural gradient in Mobile County, Alabama. The first step utilizes trail cameras and bait stations placed in locations varying in level of urbanization in order to observe what species are acting as scavengers in what parts of the gradient and if there are any differences in the inter- and intra-species interactions in those areas. Ecology is a dynamic system that can have a rapid impact on a species' behavioral and cognitive toolkits. Focusing on scavenging systems provides a unique opportunity to investigate the impact of ecology on behavior and cognition. It has been proposed that species who engage in scavenging demonstrate a high degree of behavioral flexibility, suggestive of heightened cognitive flexibility. This research informs characterization of these landscapes in terms of scavenging activity to elucidate the impact of urbanization on these important parts of the ecosystem and guide efforts towards large-scale cognitive testing of a wide variety of species. Preliminary findings will be discussed in terms of diversity of species observed and inter- and intra-species behavioral interactions at the bait sites.

4:24 PM

How do we justify analogical inferences about the mental capacities of other animals?

Shereen Chang (University of Pennsylvania)

36

Cognitive ethology often focuses on a few exemplary subjects of research, especially in long-term studies of complex cognitive capacities. Consider two nonhumans who demonstrate communicative behaviours similar to humans. Kanzi the bonobo and Alex the parrot can both understand spoken English words. Given such behaviour, on what basis might we infer that the mental mechanisms involved in their behaviour are similar to mechanisms in analogous human behaviour? When direct evidence is not available, we might try to impute similar mental mechanisms for similar behaviours on the basis of analogical inference. In this presentation, I investigate when and on what basis such inferences are justified. I analyse two plausible proposed justifications for arguments from analogy: Elliott Sober's justification from a common cause and Sandra Mitchell's justification from causal isomorphism. Sober's and Mitchell's approaches give similar results in intraspecific human-to-human inferences, but they work differently in interspecific inferences, especially between species that are phylogenetically distant (human-to-parrot). I assert that Mitchell's approach provides useful guidance about the kinds of causal factors that may be relevant and worthy of further scientific investigation.

4:31 PM *Break*

4:36 PM Symposium in Honor of Stan Kuczaj (Chair: Radhika Makecha)

4:36 PM **Playing for Life…The Game of Science**

Marie Trone (Valencia College), Rachel Walker (University of the Incarnate Word), & Heather Hill (St. Mary's University)

37 Stan Kuczaj was play incarnate. Stan began his research career by exploring human babbling as a form of play behavior. In the infancy of his career, Stan embarked on a lifelong journey into the game of science, applying the same moderately discrepant events that are observed in play behavior across taxa to his own life. Stan expanded his research from infant babbling to other forms of play behavior, including animal social, bubble, and object play. His insatiable curiosity led Stan to explore tangential fields of study across taxa, such as communication, emotion, imitation, cooperative behavior, problem solving, attentional behavior, observational learning, activity budgets, and lifespan development. The diversity of species studied included bottlenose dolphins, Indo-Pacific bottlenose dolphins, Pacific white-sided dolphins, rough tooth dolphins, beluga whales, humpback whales, sperm whales, killer whales, sea otters, walruses, California sea lions, Asian and African elephants, horses, macaws, and bush babies. These scientific forays took Stan across the globe to conduct animal research in Honduras, Spain, Japan and Columbia just to name a few. We have showcased the medley of scientific discoveries brought to light by innovative scientific designs devised by Stan to explore the behavioral and cognitive world of many fascinating species.

4:50 PM **Dolphin Cognition through the Decades: Reflections in Memory of Stan Kuczaj**

Heidi E. Harley (New College of Florida Disney's Epcot's The Seas)

38 The scientific study of dolphin cognition began in living memory. In the 1940s and '50s dolphin echolocation surfaced as a key sensory system of odontocetes. The 1960s brought more discoveries in the realm of their phonic productions: their signature whistles and pulsed sounds. Work in psychophysics was prominent in the '70s, and the 1980s featured Lou Herman and colleagues' work on sequential processing related to aspects of language. Stan Kuczaj's curiosity and expertise in child language led him to begin his work with dolphins at the Kewalo Basin Marine Mammal Lab where he worked with Lou on the interpretation of anomalous commands by dolphin Akeakamai, and Stan's openness and energy for collaboration made him a good mentor for Mark Xitco and John Gory on communication and planning projects at Disney's The Seas in the 1990s. Here I reflect on some of the past work in dolphin cognition as a foundation for the presentations of Stan's students featuring their 21st-century work as it emerged from Stan's program at the University of Southern Mississippi's Marine Mammal Behavior and Cognition Laboratory.

5:04 PM **Sparking a Dolphin's Curiosity: Individual Differences in Dolphins' Reactions to Surprising and Expectation-Violating Events**

Malin Lilley (The University of Southern Mississippi), Deirdre Yeater (Sacred Heart University), Amber de Vere, & Stan Kuczaj II (The University of Southern Mississippi)

39 Non-scientific literature consistently describes dolphins as "curious animals," but there has been little systematic research on curiosity in dolphins. Curiosity in humans and some non-human animal species has been studied by examining individual differences in exploration and reactions to novel stimuli. Additionally, research has explored how human infants and non-human animals react when an event violates their expectations. Dr. Stan Kuczaj's interest in dolphins' curiosity and individual differences in dolphins played an integral role in the development of this study. The present study found that bottlenose (Tursiops truncatus) (N=15) and rough-toothed (Steno bredanensis) (N=6) dolphins spent a higher percentage of time looking at a surprising compared to a non-surprising stimulus. Subjects also displayed more open-mouth behaviors, produced more bubble bursts and bubble trails, and were visibly startled more frequently in the surprising condition. Additionally, there was a wide range of individual differences in observed behaviors. In contrast, subjects did not have a longer gaze duration when shown a violation-of-expectations paradigm where one object appeared to transform to another object when passing behind a barrier, but did display individual differences in several behaviors. The results of this study highlight individual differences in dolphins' curiosity and the behaviors that accompany surprising events.

5:18 PM **Creativity in Dolphins and Sea Lions**

Deirdre Yeater (Sacred Heart University), Holli Eslelinen (Dolphins Plus), Dawn Melzer (Sacred Heart University), Allison Kaufman (University of Connecticut), & Kathleen Dudzinski (Dolphin Communication Project)

40 A recent study in collaboration with Dr. Stan Kuczaj demonstrated that three male bottlenose dolphins (Tursiops truncatus) varied their behavior when asked to respond to a "create" or "vary" cue. The dolphins were able to represent their past actions and used these representations to modify behaviors they had performed to successfully create new behaviors, sometimes novel ones. A newly published article based on this investigated the reinforcement techniques, learning strategies used, and intensity of the behavioral response by the same three dolphins. Our current study applies a human creativity test (Modified Torrance Test), to investigate innovative capabilities in bottlenose dolphins (N = 22) and sea lions (Zalophus californianus) (N = 7) using a similar "create" cue. The data were analyzed for fluency, flexibility, and originality of behavioral responses. Our goal is to ultimately compare abilities in marine mammals and young children to provide insight on the evolution of cognitive abilities. The modified task may enable us to assess creativity in very young children and those with developmental delays in future research.

5:32 PM **Advantages of Conducting Research on Animals in Managed Care and the Wild**

Kathleen M. Dudzinski (Dolphin Communication Project)

41

Comparative studies of wild animals with those in managed care are conducted on both terrestrial and aquatic species. In the latter half of his career, Stan Kuczaj focused much of his research on dolphins, specifically their behavior and cognition. Because of limitations placed on observers in both arenas, comparative studies of captive and wild dolphins are difficult to conduct. Each platform offers a unique opportunity to better understand the social lives of dolphins from both internal and external perspectives. For example, the external expression of certain behaviors might be affected by internal body states (e.g., hormone levels) that cannot readily be measured in the wild. Routine husbandry care often allows a trainer or researcher insight into motivation for behavior that allows an informed perspective on a single animals actions or interaction between peers. This presentation offers a review of some of Stan's studies of both captive and wild dolphins to elucidate the overlap between both arenas and information available from each.

8:30 PM Poster Session I (8:30 – 11:00)

See Poster Abstracts Starting on Page 27

Poster Presenters: Please set up your posters between 8:00 and 8:30

Friday Morning – 9:00-11:00 A.M.
Oak Ballroom

9:00 AM Workshop: Multilevel Modeling for Repeated Measures Analysis (Mike Young)

This workshop is designed to introduce comparative psychologists to the use of multilevel modeling for the analysis of behavioral change. Repeated measures ANOVA has forced scientists into a model in which continuous predictors like trial, day, and session are treated as categorical to make them fit into the ANOVA framework. Multilevel modeling provides a powerful tool to perform repeated measures regression and repeated measures logistic regression (for choice data). The workshop will progress from brief treatments of general linear modeling and generalized linear modeling to multilevel modeling. Mastery cannot be achieved during a single workshop, but I hope to highlight topics important to comparative psychologists and to inspire further learning.

12:00 PM Social Learning I (Chair: Lauren Guillette)

12:00 PM **Not just response facilitation: Dolphins can choose to copy THAT one**

Kelly Jaakkola, & Emily Guarino (Dolphin Research Center)

42 Some have argued that animal imitation can often be explained by response facilitation, an automatic process in which perceiving an action performed by another primes that action in the brain of the perceiving animal, making it more likely to be performed (e.g., Bates & Byrne, 2010; Byrne, 1994). Such response facilitation is believed to be widespread in the animal kingdom, and is generally regarded as quite distinct from a more cognitively demanding, deliberate imitation (e.g., Bates & Byrne, 2010; Byrne & Russon, 1998). The current study was designed to demonstrate experimentally whether imitation for dolphins can be the result of a deliberate choice, as opposed to just an automatic response. In a modified

12:14 PM **Pigeon see, pigeon read?**

Damian Scarf (University of Otago New Zealand), Karoline Boy, Anelisie Uber Reinert (Ruhr-University Germany), Jack Devine (University of Otago New Zealand), Onur Güntürkün (Ruhr-University Germany), & Michael Colombo (University of Otago New Zealand)

43 Learning to read involves the acquisition of letter–sound relationships (i.e., decoding skills) and the ability to visually recognize words (i.e., orthographic knowledge). Although decoding skills are clearly human-unique, given they are seated in language, recent research and theory suggest that orthographic processing may derive from the exaptation or recycling of visual circuits that evolved to recognize everyday objects in our natural environment. An open question is whether orthographic processing is limited to visual circuits that are similar to our own or a product of plasticity common to many vertebrate visual systems. Here we show that pigeons, organisms that separated from humans more than 300 million y ago, process words orthographically. Specifically, we demonstrate that pigeons trained to discriminate words from nonwords picked up on the orthographic properties that define words and used this knowledge to identify words they had never seen before. In addition, the pigeons were sensitive to the bigram frequencies of words (i.e., the common co-occurrence of certain letter pairs), the edit distance between nonwords and words, and the internal structure of words. Our findings demonstrate that visual systems organizationally distinct from the primate visual system can also be exapted or recycled to process the visual word form.

12:28 PM **The evolution of perspective-taking in the primate lineage**

Ben Phillips (University of the Pacific)

44 How did our capacity to grasp the visual perspectives of others evolve? Nonhuman primates are certainly sophisticated gaze-followers (Rosati et al. 2016). There is also evidence that some primate species (including apes and some Old World monkeys) couple this ability with an understanding of what others can and cannot see (Hare et al. 2001; Flombaum & Santos 2004, 2005). On the other hand, evidence that nonhuman primates understand the way in which others see objects, where this incorporates an ability to attribute inaccurate visual states to others, is sparse. In addressing the question of how the various levels of visual perspective-taking evolved, I argue that not enough attention has been paid to the distinction between direct-line-of-gaze, and covert attention. Once this distinction is kept at the fore, a new level of visual perspective-taking emerges: one that has not been adequately tested for in comparative studies of primates. I conclude by outlining the kinds of experimental strategies that are required, and how they promise to shed light on hypotheses concerning the evolution of perspective-taking.

12:42 PM **Imitation as a non-learning phenomenon**

Tomas Persson (Lund University)

45 A case will be presented of imitative learning in chimpanzees (using plastic containers in specific ways to make noise), that can not be easily attributed to a learning function of imitation, i.e. the acquisition of novel, instrumental behaviors. Rather, the behavior can be a result of a social function of imitation, i.e. associated with affiliation, cohesion, and communication. Seeing imitation as an incidental learning phenomenon, rather than an evolved mechanism for learning, has the pontential to explain several forms of observational learning where the learned action seems e.g. redundant, partial, or play-like. The construal of imitation as having primarily a social function, and only secondarily a learning function, will be backed up by studies of the prosocial effects of synchronous behaviour between individuals, also in species that do not evidence learning by imitation. A social primacy of behavior copying can be observed both in ontogeny and pyhologeny, making it conceivable that learning functions can evolve out of less instrumental forms of copying. By not assuming that the purpose of imitation is always learning, one can explain imitation in the absence of abilities that are purportedly crucial for it, e.g. theory of mind, and better explain varieties in copy fidelity.

12:56 PM **Immediate early gene expression and social learning in zebra finches**

Lauren M Guillette, Tas Vamos, Eira Ihalainen, Sophie C. Edwards, Susan D. Healy (University of St Andrews), & Simone Meddle (University of Edinburgh)

46 Zebra finches, a gregarious songbird, use social information when faced with uncertainty: females copy males foraging on novel foods and males copy the nest-material choices of familiar, but not unfamiliar, males. Immediate early gene (IEG) expression (a marker of neural activity) is linked to variation in gregariousness across five finch species: the more social the species the higher IEG expression in areas of the brain belonging to the social-behaviour-network, in response to social stimuli. Here we asked whether intraspecific variation in social information use is also related to IEG expression in the social-behaviour-network. In our experiment, female observers watched live-streamed video of male demonstrators forage from one, but not a second, available novel coloured feeder for 30 minutes. Then females were presented with both feeders and allowed to feed for 60 minutes before IEG expression was quantified. Both the demonstrator and observer were video recorded and several behaviours, including whether or not the observer copied the foraging decisions of the demonstrator, were quantified. In this way we can connect social information use by an individual directly to their neuronal activity.

1:03 PM **A paradoxical pupil size effect in rhesus monkeys performing a social vicarious reinforcement task**

Benjamin M. Basile, Chloe L. Karaskiewicz (Laboratory of Neuropsychology NIMH/NIH), Steve W.C. Chang (Department of Psychology Yale University), & Elisabeth A. Murray (Laboratory of Neuropsychology NIMH/NIH)

47 Previous research shows that rhesus monkeys (Macaca mulatta) choose to deliver rewards to other monkeys under some conditions. This apparent prosocial preference suggests that the sight of another monkey receiving reward is vicariously reinforcing. Here, we evaluated how pupil size, often an autonomic correlate of arousal, changed when monkeys anticipated that juice would be delivered to themselves, another monkey, or not at all. Two monkeys sat opposite each other while one, the actor, was visually cued to the upcoming juice delivery outcome and could choose to complete or abort the trial. Consistent with previous research, actor monkeys chose to complete most self-reward trials, a moderate number of other-reward trials, and the fewest neither-reward trials, suggesting that they did prefer juice delivery to the other monkey over juice delivery to nobody. Pupil size was widest in anticipation of the monkey's own reward, consistent with arousal. Paradoxically, pupil size was more constricted in anticipation of reward to the other monkey than in anticipation of reward to nobody. Thus, trial completion rates suggest monkeys find reward delivery to another monkey reinforcing, but pupil size suggests they find it aversive. We discuss possible reasons for this apparent discrepancy.

1:10 PM **Are chimpanzees socially enactive?**

Sarah Vincent (University of North Florida), & Shaun Gallagher (University of Memphis)

48 In their 1978 paper, psychologists David Premack and Guy Woodruff posed the question, "Does the chimpanzee have a theory of mind?" They treated this question as interchangeable with the inquiry, "Does a chimpanzee make inferences about another individual, in any degree or kind?" Daniel Dennett (1978) challenged Premack and Woodruff's interpretation of the data, citing the possibility that what was demonstrated was merely associative reasoning. And so a debate was born about the mindreading abilities of chimpanzees, one that continues to center on the notion of a "theory of mind." We will sketch an alternative explanation, positing that while chimpanzees may not possess a theory of mind in the strict sense, we ought to think of them as enactive perceivers of practical and social affordances. Taking seriously the enactivist approach might demand of us revisions in experimental design or the greater inclusion of naturalistic observations in these debates/discussions. Additionally, the enactivist view fits nicely into the evolutionary story. IT is able to acknowledge and can begin to make sense of the different, but still rich, meaning-laden social worlds that vary across species, while recognizing that humans alone may be capable of higher order mindreading.

1:24 PM *Break*

1:29 PM Spatial Cognition (Chair: Ken Cheng)

1:29 PM **Cognitive Mechanisms used by Pigeons to Determine Motion**

Gabriella Wozniak, Muhammad Qadri, & Robert Cook (Tufts University)

49 The recognition of others' behavior is vital for all animal species. Previous research shows that pigeons (Columba livia) are able to discriminate behaviors using a combination of static poses and smooth motion action sequences. We investigated how pigeons use perceptual or memory mechanisms during this discrimination. Three pigeons were tested using a go no-go task in which they were presented with either single stationary poses or multiple stationary poses of two distinct behaviors presented over time. After training and different tests, momentary perceptual features were found to be more important to the pigeons' discrimination than sequential comparisons to previous views. This suggests that visual features might be accessible than the memory of recently viewed poses. Comparisons to theories of human action recognition will be discussed.

1:36 PM

The navigating brain of the nocturnal bull ant, Myrmecia midas

Cody Freas, Ajay Narendra, J. Frances Kamhi, Yuri Ogawa, & Ken Cheng (Macquarie University)

50

The heretofore unstudied bull ant, the night-active Myrmecia midas, face the challenge of navigating under dim conditions. They start foraging in the twilight of the evening. They head to a specific tree for some hours of the night, sometimes (~30%) to the tree right where their nest is at. We displaced ants on the ground and found evidence that they use predominantly the surrounding landmark panorama for homing. We displaced ants onto their nest-trees, and found that they also use the surrounding landmark panorama for getting to the side of the tree where their nest is at. Blocking the surrounding scene led to disorientation in both cases. Ants that forage at their nest tree, however, are not oriented if displaced onto the ground 5m from their tree. We hope to show some neuroanatomical and neurophysiologal data as well.

1:50 PM

Cryoloops in An Avian Species: A Method to reversibly deactivate the hippocampus

Madeleine I. R. Brodbeck, Stephen G. Lomber, David F. Sherry, & Scott A. MacDougall-Shackleton (Western University)

51

The hippocampus is known to participate in a variety of cognitive functions in humans, non-human primates, rodents, and birds. A great deal of previous research on the avian hippocampus has examined its role in spatial memory and orientation. The avian hippocampus is homologous to the mammalian hippocampus, but has a very different anatomical location and cytoarchitecture and lies on the dorsal surface of the brain. To examine the function of the hippocampus, reversible inactivation of the hippocampus provides many advantages over lesion methods. These advantages include that animals can serve as their own controls and the possibility of recovery of function is less likely to restrict the interpretation of results compared to lesion methods. I use implanted cryoloops placed over the hippocampus to reversibly inactivate the hippocampus of brown-headed cowbirds during the performance of spatial tasks on a touch screen. I will describe the cryoloop technique for cooling and reversibly inactivating the hippocampus, essential control procedures for reversible inactivation of neural structures, and preliminary results obtained with cowbirds using this technique.

1:57 PM

Song (Chair: Jim Rowan)

1:57 PM

Differential effects of songs and calls on ZENK immediate early gene expression in the auditory brain regions of black-capped chickadees (Poecile atricapillus)

Shannon K. Mischler, & Scott A. MacDougall-Shackleton (Western University ; Advanced Facility for Avian Research)

52

Songbirds are one of the few taxa that have developed the capacity of vocal learning. They produce songs that are learned early in development, and calls that are typically thought to be innate. Calls are used in a variety of contexts, such as in aggressive encounters or to indicate mild alarm. The neural underpinnings of call perception are much less studied than those of birdsong. We studied the response of black-capped chickadee auditory cortex to song and a variety of call types. Chickadees produce a variety of complex calls, which include the gargle and the chick-a-dee calls. Previous research has shown that chickadees respond differentially in the auditory cortex to songs versus one call type (e.g. chick-a-dee). The gargle call is an extremely complex call that is produced prior to an aggressive encounter between two chickadees, exhibits geographic variation, and likely learned. In this study chickadees were presented with one of 5 possible stimuli; fee-bee songs, gargle, chick-a-dee calls, pink-noise or silence. ZENK immediate early gene expression was measured in the auditory regions following these exposures. Preliminary results indicate that all vocalizations produced more activation of the auditory cortex than noise or silence, and gargles produce the most activation.

2:04 PM

ZENK expression in black-capped chickadees (Poecile atricapillus) as a function of D note number and duty cycle

Erin N. Scully, Jenna V. Congdon (University of Alberta), Allison H. Hahn (University of Wisconsin Madison), Brenna C. Schuldhaus, Kimberley A. Campbell (University of Alberta), David R. Wilson (Memorial University of Newfoundland), Daniel J. Mennill (University of Windsor), & Christopher B. Sturdy (University of Alberta)

53

Black-capped chickadees (Poecile atricapillus) use their namesake chick-a-dee call for multiple functions by altering note type and order to convey information. Duty cycle, or the proportion of time that a call can be heard, can also encode important information.Wilson and Mennill (2011) found that chickadees respond more (e.g., approach vocalizer) to higher duty cycles, but not to a greater number of D notes. Here we presented chickadees with chick-a-dee calls that contained either 2 D notes with a low duty cycle, 2 D notes with a high duty cycle, 10 D notes with a high duty cycle, or 2 D notes with a high duty cycle but played in reverse. We then measured ZENK expression in the auditory nuclei. We predicted that there would be highest expression to the 10 D notes/high duty cycle playback. Based on the behavioral results of Wilson and Mennill (2011), we predicted similar expression following both high duty cycle groups. We did not find any effects of altering the duty cycle or note number presented; alternative explanations will be considered and discussed.

2:11 PM

Memory (Chair: Jim Rowan)

2:11 PM

Garden slugs show the testing effect

Martha Escobar, & Francisco Arcediano (Oakland University)

54

Testing appears to improve long-term memory retention (e.g., Roediger & Karpicke, 2006). This "testing effect" (or "test-enhanced retention") has been repeatedly observed with humans, and it is believed to reflect the effect of retrieval practice in consolidation of learned information, possibly by creating new connections among studied material. The present study assessed the possibility that repeated testing could enhance memory in a relatively simple model, the common garden slug (lehmania valentiana). Slugs were exposed to a novel odor that predicted exposure to a mildly noxious substance. Slugs showed little aversion to the odor during a test conducted 24 h after exposure. However, aversion to the odor increased when the same slugs were once again tested with the odor after 10-day retention interval in the absence of further training. This suggests that the testing effect may not be limited to complex concept learning, but a more general phenomenon.

2:18 AM

The Ephemeral Reward Task: What Makes it so Difficult to Acquire

Thomas R. Zentall, Jacob P. Case, Jonathon R. Berry, & Jasmine Luong (University of Kentucky)

55

In the ephemeral reward task an animal is given a choice between two alternatives, A and B. If it chooses A, reinforcement is provided and the trial is over. If it chooses B, reinforcement is provided but then a response to A is reinforced as well. Thus, choice of B is optimal because it results in two reinforcements. Wrasse (fish) and parrots quickly learn to choose B but monkeys and apes do not. We found that pigeons and rats also fail to choose optimally and pigeons actually show a significant preference for the suboptimal alternative. We tested the hypothesis that if we delayed the outcome of the initial choice by requiring pigeons and rats to complete a fixed-interval 20-s schedule before receiving the initial reinforcement it would encourage them to be less impulsive and integrate the two reinforcements associated with the optimal alternative. We found that both pigeons and rats for which the initial outcome was delayed chose optimally, whereas those without the delayed initial outcome chose suboptimally, at or below chance.

2:32 PM

Strategies for revitalizing the field of comparative cognition: A reprise

Ed Wasserman (University of Iowa)

56

In 1994, I proposed a few simple strategies for researchers to follow which might provide added energy and recognition to the realm of comparative cognition. I reprise those strategies and show how they have helped to keep my research program active and productive in challenging times. Those strategies include: uncircle the wagons, make a friend, play both ends against the middle, apply yourself, and don't say "no." Other tactics will be suggested and discussed.

2:46 PM

Snack Break

3:30 PM

In Honor of the Contributions of Ralph Miller (Chair: Aaron Blaisdell)

3:30 PM

The Expression and Regulation of "Intelligence" in Genetically Heterogeneous Mice

Louis D. Matzel, & Bruno Sauce (Rutgers University)

57

The processing efficacy of human working memory co-varies with individuals' "intelligence". This relationship, as well as the reliance of most cognitive tasks on working memory, has led to the hypothesis that variations in the efficacy of working memory may regulate (at least in part) individual differences in intelligence. Data from our laboratory indicates that genetically heterogeneous mice express a trait that is qualitatively and psychometrically analogous to "intelligence" (encompassing learning, attentional, and reasoning abilities), and that the expression of this cognitive trait varies across individuals. As in humans, the expression of intelligence in mice is strongly correlated with individual's performance on tests of working memory capacity, and intensive working memory training causally promotes improvements in the general cognitive performance of both young and aged animals. Consistent with this role for working memory, variations in intelligence are predicted by the expression of a cluster of dopaminergic genes in the PFC (an area integral to working memory) as well as dopamine D1 signalling in the PFC. In total, our results suggest that the efficacy of working memory and its regulation by dopaminergic activity in the PFC accounts for much of the variance in individual differences in "intelligence".

3:45 PM **Two Shots of Habit: Genetic Propensity Towards High Alcohol Preference and Acute Intoxication Promote Habitual Responding in Mice**

Nicholas Grahame (Dept. of Psychology)

58 Habitual, or S-R based instrumental behavior, tends to dominate over response-outcome based behavior after long training, and other studies have shown that exposure to drugs of abuse tends to promote habitual responding. The current studies address two aspects of habitual responding that have not been studied: individual differences in habit, and effects of acute drug intoxication. In a series of studies, mice were trained on a VI schedule using access to a flavored fluid reinforcer. After completion of training, they were tested in extinction prior to and after devaluation of the reinforcer using LiCl taste aversion. Mice selectively bred to drink alcohol acquire habitual responding more rapidly than those selected not to drink. In addition, acute intoxication with alcohol (1.0 and 1.5 g/kg), but not nicotine (0.5 mg/kg), amphetamine (2.0 mg/kg), or yohimbine (1.0 mg/kg) shifted instrumental retrieval towards S-R, and away from R-O based behavior. These studies show that both a genetic proclivity to drink and acute intoxication promote habit based responding, suggesting that habit may be a mechanism underlying compulsive drinking behavior.

4:00 PM **Competition and facilitation in compound conditioning**

Gonzalo P Urcelay (Department of Neuroscience)

59 Despite the generality and theoretical relevance of cue competition phenomena such as blocking and overshadowing, recent findings suggest that this may be due to some degree of publication bias, and that we lack insight into the boundary conditions of these phenomena. The present commentary does not question the existence of cue competition phenomena. Rather, I will review findings showing that three variables, namely 1) relative stimulus duration, 2) contingency, and 3) contiguity parametrically determine not only whether cue competition is observed, but also whether no cue interaction, or cue facilitation occur. I discuss the theoretical relevance of these findings, which may provide illuminating insights into the generality and functional significance of learning.

4:15 PM **Spatial integration during performance in the pigeon, Columba livia**

Aaron P. Blaisdell, Julia E. Schroeder (UCLA), & Cynthia D. Fast (APOPO)

60 We've shown that pigeons can integrate separately acquired spatial maps into a cognitive map. Integration requires an element shared between maps. In three experiments using a spatial-search task in pigeons, we test spatial combination rules when no shared element was present during training. In all three experiments, pigeons first learned individual landmark-target maps. In subsequent tests involving combinations of landmarks, we found evidence that landmarks collaborate in guiding spatial choice at test (Experiment 1). In Experiment 2, pigeons received tests of landmark compounds whose spatial information was either concordant or put in conflict. In Experiment 3, pigeons were trained on two new landmarks with different proximities to the target. On tests on a compound of both landmarks, two of three pigeons showed stronger spatial control by the more proximal landmark, a performance overshadowing effect, while the third bird was indifferent between the two. Extinction of the proximal landmark shifted spatial control to the non-extinguished distal landmark. This reveals that the performance overshadowing effect was associative in nature, and not due to perceptual or spatial biases. This emphasis on spatial control during performance reflects the emphasis on performance processes that were a major focus in Ralph Miller's lab.

4:30 PM *Break*

4:35 PM **Cue interaction in human causal learning is affected by information about total number of causes.**

Kouji Urushihara (Health Sciences University of Hokkaido)

61 Three experiments were conducted in human causal learning situation to investigate how information about total number of causes in a given situation has an effect on cue interaction such as blocking and unovershadowing. In Experiment 1, pairings of three compound cues with an outcome (i.e., AX+, BY+, and CZ+) followed pairings of a component of one of compounds with the outcome (i.e., A+) and presentations of a component alone (i.e., C-). In this situation, blocking effect (i.e., lower ratings of X than Y) was more robust when participants were told there is only three causes than when they were told there are five causes or when no information was given. In contrast, unovershadowing effect (i.e., higher rating of Z than Y) was observed consistently regardless of the information given. Experiments 2 and 3 demonstrated that blocking (Experiment 2) and unovershadowing (Experiment 3) effects were affected not only by the information about total number of causes in that situation but also by the status of an irrelevant cue. These results were discussed in the frameworks of associative learning theories and the propositional approach.

4:50 PM **"Comparative" examination of retrospective revaluation effects.**

Todd Schachtman, & Yaoran Li (University of Missouri)

62 Retrospective revaluation was examined in two cultural groups. Chinese undergraduates in Beijing and American undergraduates were given a questionnaire asking participants to imagine themselves as allergists, determining which food(s) produce allergies. Initially, two predictive/causal foods were presented with an allergy outcome. In phase 2, one (nontarget) food was either increased in its predictive/causal validity ("backwards blocking" or "inflation"); or the nontarget food had its validity reduced ("deflation"). Participants rated whether each food would cause an allergic reaction on a 9-point Likert scale after each phase. Such treatments can cause test performance to the target food to decrease or increase, respectively (retrospective revaluation). Moreover, culture can impact causal attributions (Nisbett et al. (2001, Psychological Review); Asian individuals (e.g., those high on dialectical thinking, DT, a personality trait) are less likely to show competition between causes. We predicted retrospective revaluation effects in European-American students (low "DT") but not for Chinese individuals. Chinese participants didn't exhibit inflation, $p > .05$; while those from the United States did, $F(1,110) = 4.35$, $p < .05$. Deflation effects were found for both cultures, $p<.005$. Statistical tests revealed DT mediated this culturally-based inflation difference.

5:05 PM **Assessing the blocking of occasion setting**

Gonzalo Miguez, Felipe Alfaro, Jorge Mallea, Aracelli Cañete, & Mario Laborda (Universidad de Chile)

63 Two experiments evaluated whether blocking and its retrospective reevaluation, typically observed in Pavlovian stimuli (CSs), can be observed in occasion setters (OS). Experiment 1 first trained a positive OS (i.e., OS1 -> A+ / A-), then in a second phase trained a second OS in compound with the first to the same CS (OS1 & OS2 -> A+ / A-), following in blocking test, OS2 was tested alone with the target CS (OS2->A). Results showed blocking of the OS2 potential. Finally, in a third phase, a group that received extinction of the modulatory potential of OS1 (OS1 -> A- / A+) responded greater to OS2->A, suggesting the retrospective reevaluation of the blocked OS. Experiment 2 tested whether blocking could be observed when a different CS was trained from the elemental training phase to the compound training phase (i.e., Phase 1: OS1 -> A+ / A-; Phase 2: OS1 & OS2 -> B+ / B-) to assess whether blocking affects also the transfer properties of OS. Responding indicative of blocking and retrospective revaluation reported here add to other analogies between OS and Pavlovian CSs reported in the literature (e.g., Oberling & Miller, 2002). These analogies may suggest a common underlying mechanism.

5:20 PM **Associative versus predictive processes in Pavlovian conditioning**

Jérémie Jozefowiez (Université de Lille)

64 While for the layman, learning and memory are basically the same thing, different research communities are devoted to them in psychology. The concept of association, central both to the field of conditioning and to the one of retrieval and forgetting, could be used to bridge the gap between these two communities. Unfortunately, important differences exist in the use of that central concept between the two fields: "Association" as used among students of learning does not have exactly the same meaning as "association" in the field of memory. This presentation will argue that the Rescorla-Wagner model is mainly to blame for that situation. By viewing Pavlovian conditioning as the outcome of a predictive process but using the old associative language developed in memory studies to describe this process, it has introduced an unnecessary confusion between memory and prediction within the field of learning. We need to acknowledge that confusion and discriminate once more between associations and predictions. This could allow for a better integration of the fields of learning and memory, something Ralph Miller has been advocating his whole career and that constitutes one of his enduring legacies.

6:00 PM Introduction - Aaron Blaisdell

6:00 PM Master Lecture - A Taxonomy of Forgetting and the Fates of Forgotten Memories - Ralph Miller

7:00 PM Group Photo Shoot

7:30 PM Banquet

7:45 AM Associative Learning (Chair: Jessica Stagner)

7:45 AM **Attentional Strategies during Concurrent Visual Search in Pigeons**

Suzanne L Gray, Muhammad A Qadri, Daniel I Brooks, & Robert G Cook (Tufts University)

66 The strategic allocation of attention is necessary for everyday survival, such as when a bird is navigating while escaping a predator. In order to study this process, we gave pigeons two different, simultaneously available dimensional discrimination tasks. We investigated what strategy the pigeons used when presented with a visual search display varying in two orthogonal dimensions, varying along brightness (light to dark) and orientation (vertical to horizontal). On each trial, up to 32 stimuli were simultaneously displayed on the screen with an equal number in the two dimensional tasks having reinforced and non-reinforced values. The order in which pigeons selected items was correlated with the difficulty of the discrimination, with the birds choosing the most discriminable reinforced stimuli first regardless of dimension. This suggests pigeons may be choosing stimuli based on overall discriminability (easiest to hardest) rather than dimension (e.g., brightness to orientation) in visual search displays. These data imply that pigeons do not allocate attention to any one given dimension and will switch attention between dimensions if it is more likely to yield reward.

7:52 AM **Is vocal learning important in identifying acoustic stress patterns?**

Marisa Hoeschele (University of Vienna), & Juan Manuel Toro (ICREA - Universitat Pompeu Fabra)

67 Prosody, a salient aspect of human speech that includes rhythm and intonation, has been shown to help infants acquire some aspects of syntax. Very little is known, however, whether these abilities are human specific, or whether we can find them in other species. We used a go/nogo operant paradigm to compare humans to budgerigars (Melopsittacus undulatus) and rats (Rattus norvegicus) in their ability to distinguish two-syllable nonsense words that differed only in their prosody. We chose budgerigars as a comparison because they are vocal learners, like humans, and we chose rats because they are more closely-related to humans, but are not vocal learners. Once the three species learned the task, we presented novel words and also words that had certain cues removed (pitch, duration, loudness, or vowel quality) to determine which cues were most important in the perception of prosody. All three species learned the task and generalized the discrimination to two-syllable nonsense words they had never heard before. However, when some prosodic cues were removed, humans were the least impaired, followed by budgerigars, and rats were no longer able to solve the task. This suggests that vocal learning may be relevant for processing prosodic information.

8:06 AM **Ability to categorize sex of vocalizing birds may depend on vocalization type in black-capped chickadees (Poecile atricapillus)**

Kimberley A. Campbell (University of Alberta), Allison H. Hahn (University of Wisconsin-Madison), Jenna V. Congdon (University of Alberta), Erin N. Scully (University of Alberta), & Christopher B. Sturdy (University of Alberta)

68 Black-capped chickadees (Poecile atricapillus) are non-migratory songbirds found commonly throughout most of North America. Their chick-a-dee call consists of five note types (A, B, C, D-hybrid, and D) and contains information regarding individual identity, geographic origin, and flock membership. We identified the starting frequency of A notes as a potential cue for determining the sex of the caller in a previous bioacoustic analysis. In the current experiment, we used a true/pseudo category go/no-go operant discrimination paradigm to evaluate if chickadees categorize calls based on the sex of the caller. Birds in the true category group did not learn the task faster than birds in the pseudo category group. In addition, preliminary results show that birds in the true category group did not generalize to novel stimuli. These results suggest that chickadees were relying on rote memorization rather than categorization to learn the task. Since calls are used in a number of contexts that do not require a sex-specific response (such as indicating a food source or warning of a predator), it is possible that it is not critical to use categorization to determine the sex of a caller.

8:13 AM **'Aesop's fable' experiments demonstrate trial-and-error learning in birds, but no causal understanding**

Stefano Ghirlanda (Brooklyn College and CUNY Graduate Center), & Johan Lind (Stockholm University)

69 Experiments inspired by Aesop's fable The crow and the pitcher have been suggested to show that some birds understand cause–effect relationships pertaining to water displacement. For example, birds may prefer to drop stones in water rather than in sand in order to retrieve a floating food morsel, suggesting that they understand that only the level of water can be so raised. Here we re-evaluate the evidence for causal understanding in all published experiments. We first show that commonly employed statistical methods cannot disentangle the birds' initial performance on a task (an indicator of causal understanding) from trial-and-error learning that may occur during the course of the experiment. We overcome this shortcoming with a new statistical analysis that quantifies initial performance and learning effects separately. We present robust evidence of trial-and-error learning in many tasks, and of an initial preference in a few. We also show that both seeming demonstrations of causal understanding and of lack of it can be understood based on established properties of instrumental learning. We conclude that Aesop's fable experiments have not yet produced evidence of causal understanding, and we suggest how the experimental designs can be modified to yield better tests of causal cognition.

8:27 AM **Serial visual reversal learning in harbor seals (Phoca vitulina)**

Nicola Erdsack, Guido Dehnhardt, & Frederike D. Hanke (University of Rostock)

70 Serial reversal learning (SRL) has been a common method to test the cognitive abilities and behavioral flexibility in a species for decades. Although numerous vertebrate and invertebrate species had been tested, SRL studies in aquatic mammals are sparse. Particularly in pinnipeds a high degree of behavioral flexibility seems probable as they are facing a highly variable environment in air and underwater. We tested four harbor seals, differing in type and degree of experimental experience, in a visual two-alternative forced choice discrimination task and successive reversals. We found significant individual differences in their performances and their approaches to solve the task. One individual was able to solve numerous reversals showing progressive improvement of performance. However, its performance was still significantly inferior to other mammals and birds, tested in comparable tasks. One seal had difficulties even in learning the discrimination task and did not learn a reversal. There are various reasons for these large individual differences and comparatively limited SRL abilities, such as minor significance of behavioral flexibility in this species and differences in flexibility and learning abilities, depending on the type of reversal or the used sensory system.

8:41 AM

Social Learning II

8:41 AM **Effects of Mother-Infant Interaction on Anxiety and Social Behavior of Infant Chimpanzees (Pan troglodytes schweinfurthii) at Gombe National Park, Tanzania**

Maria Botero (Sam Houston State University), Suzanne MacDonald, Stuart Shanker (York University), Anne Pusey (Duke University), & Bill Wallauer (Independent Scholar)

71 This study examines the effect of the mother's touch on anxiety levels and social interactions in six infant chimpanzees (Pan troglodytes schweinfurthii) in the Kasekela community at Gombe National Park, Tanzania. In this study, touch was chosen as the behavior of interest, as there is strong evidence from human and non-human studies that touch is one of the essential elements of the mother-infant interaction affecting primate development (Botero, 2016). The duration of touch given by the mother to the infant was observed through the first year of life in six mother-infant pairs, using frame-by-frame analysis of videotaped interactions. The social interactions and anxiety behaviors, measured as rough scratching (RSS), of these same individuals during adolescence were recorded using focal sampling in the field. Results showed that the higher the rate of maternal touch towards the infant, the lower the RSS rate in the adolescent. The higher the rate of maternal touch given to the infant, the higher the rate of play found in the adolescents. These results strongly suggest that the duration of the mother's touch has long lasting impact on the infant's anxiety levels and its ability to engage in a complex social interaction such as play.

8:55 AM **Radiotracking the general movement and flock structure of black-capped chickadees in winter**

Christopher J. Course, & David F. Sherry (Western University)

72 In North American birds, the fall and winter seasons are of critical importance for flock formation, which occurs simultaneously with seasonal behaviours such as migration and overwintering. In addition to seasonal photoperiodic cues, flock mates communicate seasonal timing cues through group interactions. Group formation and stability are difficult to observe in the field by conventional methods. I constructed a network of automated radio-towers in a 60 hectare forest to track flock formation and the stability of winter flocks in fall and winter in Black-capped chickadees, a non-migrant that overwinters in flocks of 3-12 individuals. I radio-tagged 54 chickadees and obtained radio-pulses of individual activity every 40 seconds for 12 hrs a day simultaneously for all birds for the entire fall and winter. Seasonal radio-profiles indicate that flocks can be easily identified from telemetry data alone, and that flock cohesiveness may be stronger than indicated in previous field studies. This research shows that automated telemetry can be used to study social groups of birds in real time and has the potential to answer a variety of questions about social behaviour directly in the field.

9:02 AM *Break*

9:10 AM

Perception (Chair: Olga Lazareva)

9:10 AM **Singing Whales and Ringing Oceans**

Eduardo Mercado III (University at Buffalo)

74 When humpback whales sing, the sounds they produce are so loud that they often reverberate. Historically, the reverberation generated by singers has been viewed as an incidental side-effect of high-amplitude, long-distance, sound transmission. An alternative possibility, however, is that reverberation actually contributes to the structure and function of songs. Unlike most other singing animals, humpback whales do not maintain territories, do not spend much time with mating partners, and are most likely to sing when alone. Consequently, most hypotheses of song function assume that songs reveal not only the fitness of singers, but also their locations. Some sounds within songs reverberate for durations longer than the interval between sounds. These highly reverberant sounds are often repeated regularly throughout song production, and are focused at frequencies that are interleaved with those of surrounding sounds. These properties strongly suggest that singing humpback whales not only produce sounds that are conducive to long-duration reverberation, but also sequentially structure songs to avoid interference between sound production and ongoing reverberation. Singer-generated reverberant energy that is received simultaneously with directly transmitted sounds can potentially provide listening whales with unique spatial cues that may enhance the ability of listeners to locate singers.

9:24 AM **Visual Discrimination of Rotated 2D Objects in Goldfish (Carassius auratus)**

Caroline M. DeLong, Irene Fobe, K. Tyler Wilcox, & Taylor O'Leary (Rochester Institute of Technology)

75 Many studies have addressed the ability of humans and non-human animals to visually recognize objects from different orientations, but few have used fish subjects. This capability would be advantageous for fish because they frequently view objects from different orientations. We tested the ability of goldfish to recognize 2D stimuli from multiple orientations using a two-alternative forced choice task. First the fish were trained to discriminate between two objects at 0 degrees, then they were tested with the same objects at novel aspect angles (45, 90, 135, 180, 225, 270, and 315 degrees). The stimuli for Experiment 1 were a half circle and an upward-pointing arrow, and the stimuli for Experiment 2 were drawings of a turtle and a frog. The current results for Experiment 1 indicate that overall performance was above chance for all aspect angles except 135 (M = 56%) and 225 (M= 64%), but there was no main effect of aspect angle. Current results for Experiment 2 reveal that performance was above chance for all aspect angles except 180 (M = 61%), 225 (M = 61%), and 270 (M = 44%), and performance at 270 (M = 44%) was significantly worse than at 0 (M = 73%).

9:38 AM **Dogs demonstrate perspective taking based on geometrical gaze following**

Ludwig Huber, & Amélie Catala (Messerli Research Institute)

76 Are non-human animals capable of ascribing mental states to others? This question lies at the heart of one of the most contentious issues in contemporary comparative cognition research – Theory of Mind. Rather than dealing with this problem in an all-or-nothing manner, researchers nowadays tackle it in a stepwise procedure. A basic requirement for mind-reading is perspective-taking and using this as a basis for whom to rely on as an informant in a food searching task. Domestic dogs (Canis familiaris) show high sensitivity towards human gazing and have proven able to assess the attentional state of humans in food-stealing or food-begging contexts. Here we present a study in which we not only replicated the main results of Maginnity and Grace (2014), who recently found that dogs succeeded in a Guesser-Knower task, but in which we expanded on this finding with a further, critical control for behavior-reading: two informants showed identical looking behavior, but due to their different position in the room only one had the opportunity to see where the food was hidden by a third person. Preference for the Knower even in this critical test provided solid evidence for geometrical gaze following and perspective taking in dogs.

9:52 AM **An Echolocator's Discrimination of Marine Animals Using Vision**

Wendi Fellner (Disney's The Seas), Heidi E. Harley (New College of Florida and Disney's The Seas), Lisa Green, Cathy Goonen, & Kim Odell (Disney's The Seas)

77 Although dolphins are known for their sophisticated abilities as echolocators, less is known about how they deploy their echolocation in natural settings and the contributions of other senses to their standard activities, e.g., foraging. Dolphins do not require echolocation to catch fish, and their echolocation signals can alert some prey to the dolphins' presence. Here we sought to determine whether vision alone was sufficient for a dolphin to recognize a variety of marine species within a naturalistic environment by examining the ability of two dolphins to discriminate among marine animals using only the visual domain. The dolphins participated in a 3-alternative matching-to-sample task in which the sample stimulus was a still photograph of a marine animal projected onto an underwater window and the alternatives were three video clips of animals swimming within a complex marinescape. The dolphins performed this task with an accuracy of 86% across 10 sets (5 18-trial sessions for each set) of stimuli composed of different marine species. The dolphins' success in this purely visual task suggests that visual detection and discrimination likely play a significant role in foraging.

9:59 AM **Rats transfer of metacognitive responding across odor-based delayed match-to-sample tests**

Victoria L. Templer (Providence College)

78 Long-Evans rats were presented with a decline option that allowed a four-choice odor-based delayed match to sample (DMTS) tests to be by-passed. Rats performed significantly better on tests they chose to take than on tests they were forced to take, indicating metacognitive responding. To examine the possibility of stimulus control by external cues, rather than internal introspective cues, subjects received three generalization tests in which external contingencies were inconsistent and therefore could not serve as discriminative cues. Rats transferred adaptive use of the decline response in tests that eliminated memory by presenting no sample, increased memory by presenting multiple samples, and both weakened and strengthened memory by varying the retention interval. Subjects chose to take or decline the test before encountering the memory test, providing evidence that rats based their metacognitive responding on introspective cues. To our knowledge, this is the first robust evidence for metamemory in rats using the DMTS decline-test paradigm in which several possible sources of external stimulus control can be ruled out.

10:13 AM

Cognitive Processes III (Chair: Ludwig Huber)

10:13 AM **The role of within- and between-stimulus congruency on task switching in pigeons and humans**

Leyre Castro, & Edward A. Wasserman (The University of Iowa)

79 Pigeons and people were trained on two concurrent tasks: a numerosity discrimination (few vs. many) and a size discrimination (small vs. large). For Consistent groups, low magnitudes (few and small) were paired with one report response and high magnitudes (many and large) were paired with a second report response. For Inconsistent groups, one low magnitude and one high magnitude were paired with one report response and one low magnitude and one high were paired with a second report response. In addition, each stimulus displayed the relevant dimension and the congruent or incongruent value of the irrelevant dimension (e.g., a few trial could have three small or three large circles), so that congruent and incongruent trials were presented to both Consistent and Inconsistent groups. Accuracy was higher in the Consistent groups than in the Inconsistent groups. Interestingly, in the Consistent groups, when the magnitudes of the relevant and irrelevant dimensions in the stimuli were congruent, subjects' accuracy was higher than when they were incongruent. Just the opposite was true in the Inconsistent groups; when the magnitudes of the relevant and irrelevant dimensions in the stimuli were incongruent, subjects' accuracy was higher. Implications of these within- and between-stimulus interactions will be discussed.

10:27 AM **From association to cognition: Bootstrapping hierarchical abstraction**

Cameron Buckner (University of Houston)

80 According to associationists, minds are brewed by associating sensory impressions with one another along relations of similarity and spatiotemporal proximity. The cognitivists retort: But how could such associations ever be bootstrapped or scaffolded into reasoning of the more deductive and rule-governed variety, which comparative cognition lately insists that even infants and nonlinguistic animals possess? The old empiricist answer to this question appeals to abstraction: we come to learn general theoretical principles about, for example, triangles—that they all have three angles (but not necessarily of any particular degree), that they have three sides (but not necessarily of any particular length or orientation), or even such general laws as the Pythagorean Theorem—by considering aspects of particular triangles "in the abstract". I here review recent advances in avian categorization and "deep learning" to show how associative networks can form implicit "transformational representations" that provide knowledge of higher-order and hierarchical similarities between many particular triangles which—in terms of low-level properties such as size, angle magnitude, or rotation—are quite perceptually distinct. The key is that these representations grant us an implicit ability to transform the particular features of individual triangles into a common representational format that captures deeper invariances.

10:41 AM **Does list linking design pose a special challenge to reinforcement-based models of TI?**

Olga Lazareva, Kaitlyn Kandray, Clara Bergene (Drake University), Regina Gazes (Bucknell University), & Robert R. Hampton (Emory University)

81

In a transitive inference (TI) task, animals are presented with several overlapping pairs of stimuli (e.g., A+ B-, B+ C-, C+ D-, and D+ E-). Later, stimuli B and D are given together, and the choice of B is interpreted as an indication of TI. The ability of reinforcement-based models (RBM) to predict TI behavior after such training has been extensively documented; however, some experimental designs such as list linking are presumed to challenge RBM account. In list linking, two separate lists are trained independently (e.g., A….E and F…J) and then connected via a linking pair (e.g., FJ). The demonstration of TI in between-list pairs (e.g., AF) is believed to be problematic for RBM because it is intuitively plausible that both stimuli should have comparable associative values after training. However, our simulations show that RBM readily accounts for transitive choices in between-list pairs and in list 1 pairs (e.g., BD). On the other hand, RBM do not predict transitive choices in list 2 pairs (e.g., GI). Our results underscore the non-intuitive nature of RBM and the importance of conducting direct simulations with raw data before concluding that RBM does or does not explain a specific pattern of TI performance.

10:55 AM **Mentalizing in the ape false belief task**

Kristin Andrews (York University)

82

Krupenye and colleagues (2016) found that chimpanzees predict false belief behavior, and they claim this shows apes ascribe false beliefs. Cecilia Heyes (forthcoming) argues that apes may submentalize, i.e., predict behavior with low-level, domain-general psychological processes that do not characterize others as agents. I critique both these interpretations, and offer third, viz., that apes are mentalizers who do take others as agents, but do not engage in belief reasoning. By considering the nature of belief, and the role of belief in an intentional system, I argue that we can fully explain the chimpanzee false belief tracking behavior in terms of seeing, rather than believing. Consider that the ape subjects might predict that the human will go to the left haystack because that's where the actor last saw King Kong, and actors seek out things where they last saw them. This explanation fits the findings of the current study, and is consistent with the larger body of evidence. To find evidence for belief attribution in apes requires an understanding of how belief attribution fits into the intentional system. Belief attribution serves a normative role, and empirical evidence that apes understand others' beliefs will come from normative behaviors, not predictive ones.

11:09 AM **A tough nut to crack: Mirror self-recognition and the mark test in corvids**

Dawson Clary, & Debbie M. Kelly (University of Manitoba)

83

Few species have passed the mark test, which is often considered the definitive test of whether an animal can recognize itself in the mirror. To date, great apes and other large-brained mammals, such as dolphins and elephants, have shown evidence for self-recognition during the mark test. Controversially, European magpies have also passed the mark test, the first demonstration of self-recognition in corvids. However, whether the magpies used the mirror or tactile cues provided by the marks has been questioned, and as such, it is unclear whether corvids are capable of this cognitive feat. Here, we conducted the mark test with another corvid, the Clark's nutcracker, during which birds were marked with a red dot and then exposed to a regular mirror, a blurry mirror, or an opaque barrier. The nutcrackers identified the mark more often with the blurry mirror than with the opaque barrier – an advantage that could not be accounted for by the use of tactile cues. Additionally, one bird showed evidence for using both the regular mirror and the blurry mirror to aid in identifying the mark. Together, the results suggest that although some nutcrackers may be capable of self-recognition, using blurred reflections may facilitate this ability.

11:16 PM Closing Remarks (Olga Lazareva, CCS President)

8:00 PM Comparative Cognition Society Business Meeting

8:30 PM Poster Session II (8:30 – 11:00)

See Poster Abstracts Starting on Page 36

Poster Presenters: Please set up your posters between 8:00 and 8:30

Posters

Poster Session I - Thursday Evening

P1

Support for mediated performance over mediated extinction in sequential second-order conditioning.

Benjamin M Seitz (Binghamton University), Paul Craddock (University of Lille), Jessica S Wasserman, Cody W Polack, & Ralph R Miller (Binghamton University)

Second-order conditioning sometimes depends on mediation by first-order cues. The competing assumption, that there is a direct second-order and outcome association, is challenged by experiments that have shown that responding to the second-order cue is attenuated after the first-order cue is extinguished. Alternatively, we propose that extinction of the first-order cue could result in mediated extinction to the second-order cue. We will discuss experiments designed to differentiate between these two accounts. Experiment 1 assessed responding to a first-order cue following extinction of a second-order cue. Experiment 2 assessed how the second order cue would be affected by a discriminative stimulus for the first order cue. Our results suggest that mediated extinction does not fully explain the observation that extinguishing the first-order cue also reduces responding to the second-order cue. Thus, the data support the view that second-order conditioning depends on the associative status of the first-order cue.

P2

Navigational variability as a function of reinforcement palatability in a small-n design in rats

Elizabeth Edelen, Michelle Milligan, Alexander Ramos, Alexis Robinson, & W. David Stahlman (University of Mary Washington)

Recent research has consistently found that variability in instrumental behavior is a function of the nature of the reinforcer. In two experiments, we investigated locomotor behavioral variability as a function of reinforcer quality. In an A-B-A design, rats were allowed to navigate a column maze with many possible routes to food reinforcement. In Phases 1 and 3, arrival at the goal location allowed for the consumption of a sugary cereal; in the intervening Phase 2, arrival at the goal allowed for consumption of maintenance chow. We hypothesized that behavioral variability would increase upon reward change from the highly palatable cereal to the less palatable chow, and decrease when subsequently shifted back to cereal. We found that decreasing reinforcer palatability produced greater variability in navigational performance. We situate these results in a broader context of creative action and make suggestions for future behavioral research.

P3

Two blocking cues counteract in human contingency learning.

James Witnauer, John Benicasco, & Kristen Kopunek (SUNY Brockport)

Many associative models are challenged by the observation that two Pavlovian cue competition treatments (e.g., degraded contingency and overshadowing [Urcelay & Miller, 2006]) counteract in their potentials to compete with a target CS. The present experiment revealed a counteraction effect in human contingency learning. In an allergy task procedure, all participants received Phase 1 A+ and B+ trials. In Phase 2, participants received either CDX+, ADX+, or ABX+ trials. Behavioral control by X was greater after training with two blocking cues (A and B) than after training with only one blocking cue (A and D). These results replicate counteraction effects observed in Pavlovian procedures (e.g., Witnauer et al., 2008) and are explained by models that assume a critical role for within-compound associations at the time of testing.

P4

An Extinction Cue Fails to Prevent the Renewal of Extinguished Fear Conditioning

Javier Bustamante, Consuelo San Martín, Mario A. Laborda, & Gonzalo Miguez (Universidad de Chile)

An extinction cue is typically a discrete stimulus that precedes most of the extinction trials which, when presented during testing, has been shown to attenuate response recovery. Two experiments examined the role of an extinction cue on the renewal of extinguished fear conditioning, and whether it acquired inhibitory properties during extinction. Experiment 1 investigated whether a sound cue attenuated ABC renewal. The results showed robust renewal in both conditions with and without an extinction cue. Additionally, the extinction cue showed no inhibitory properties in both summation and retardation tests. Experiment 2 included an appetitive pretraining aimed to enhance the salience of the extinction cue and modified its temporal properties but was otherwise similar to Experiment 1. The results of Experiment 2 showed again no attenuation of renewal, no summation but showed retardation of acquisition. Overall, the results showed that an extinction cue did not attenuate the recovery of extinguished fear conditioning, and the pattern of results of the inhibitory tests suggests latent inhibition instead of conditioned inhibition.

P5

Imidacloprid Slows the Development of Preference for Rewarding Food Sources in Bumblebees (Bombus impatiens)

Jordan Phelps, Caroline Strang (Western University), Malgorzata Gbylik-Sikorska (Państwowy Instytut Weterynaryjny), & David Sherry (Western University)

Bee pollination is economically and ecologically vital, making recent declines in bee populations a great concern. One possible cause of bee declines is pesticide use. Bumblebees exposed to imidacloprid, a neonicotinoid pesticide, are less efficient foragers than unexposed bees (i.e. collect less pollen on foraging trips). We investigated whether bumblebees (Bombus impatiens) chronically exposed to imidacloprid at field-realistic levels (2.6 and 10 ppb) showed learning deficits. Bees were tested on their ability to associate flower colour with reward value in a simulated foraging environment. Bees completed ten foraging trips in which they collected sucrose solution from artificial flowers that varied in reward quality (i.e. sugar content). The reward quality of each artificial flower was perfectly predicted by a coloured corolla. Unexposed bees acquired a preference for the most rewarding flower colour on the second foraging trip, while bees exposed at 2.6 and 10 ppb did not until the third and fifth trip respectively. The delay in preference acquisition in exposed bees may be due to reduced flower sampling and foraging trip duration. These results show that bumblebees exposed to imidacloprid are slow to learn the reward value of flowers and may explain previously observed foraging inefficiencies associated with pesticides.

Regarding the Acquisition of Inhibitory Potential of the Extinction Context

Jorge Mallea, Felipe Alfaro, Mario A. Laborda, & Gonzalo Miguez (Universidad de Chile)

P6 Three experiments in rats assessed the inhibitory potential of the extinction context. Experiment 1 evaluated whether the extinction context could become inhibitory, and if this potential is impaired by context exposure during extinction. The target and a transfer CS were pair separately with a foot shock in one context and then the target CS was extinguished in a different context. One group received extinction to the target CS with a 6s-ITIs and the other with a 600s-ITIs. Finally, all subjects were tested with both CSs in the extinction and in a neutral context. Results showed that the extinction context reduced responding to the transfer CS in both groups. Experiment 2 trained the transfer CS immediately before test to prevent secondary extinction. Results showed excitatory summation of the extinction context with the transference CS, independent of the amount of context exposure. Experiment 3 evaluated if the inhibitory potential is improved by using variable ITIs during extinction. Rats received similar training than the past Experiments but one group experienced extinction to the target CS with a variable ITI (6s in average) and the other group with a fixed 6s-ITI. The results are discussed within the frame of performance-focused theories of learning.

Massive extinction training reduces the reacquisition of ethanol tolerance

Mario A. Laborda, Francisca Díaz, Aracelli Cañete, Consuelo San Martín, & Gonzalo Miguez (Universidad de Chile)

P7 The amount of extinction training was manipulated to study its effect on the reacquisition of extinguished ethanol tolerance in rats. First, all subjects received acquisition training in which an intraperitoneal injection (i.e., the CS) of an ethanol solution (i.e., the US) was administered daily for 21 days. After this, half of the subjects received 9 extinction trials (i.e., moderate extinction) consisting of a saline injection (i.e., CS alone trials) while the other half received 84 of such trials (i.e., massive extinction). Finally, all subjects were tested in a reacquisition trial. Ethanol tolerance was indexed by measuring the subject's ataxic response. Results showed the acquisition and extinction of tolerance to the ataxic effects of ethanol in all subjects. More importantly, an extensive extinction training showed to be successful in reducing the reacquisition of ethanol tolerance. This results are in line with previous reports of the effect of using a greater number of extinction trials in other Pavlovian preparations (e.g., fear conditioning).

Matchmaker, Matchmaker, make me a match: Unsupervised learning in pigeons

Marisol C. Lauffer, Leyre Castro, & Edward A. Wasserman (The University of Iowa)

P8 Most discrimination learning tasks are supervised: correct and incorrect responses are differentially reinforced. We sought to document discrimination learning in pigeons using an unsupervised symbolic matching task. In training, pigeons had to peck one of eight sample stimuli (A-H) before one of eight test stimuli (1-8) appeared to its left or right. Pigeons then had to peck the test stimulus to receive food. Stimuli were paired so that associations between them could be formed (A-1, B-2, etc.). In subsequent choice testing sessions, two test stimuli now appeared to either side of the sample after completion of the sample observing response: one was the previously paired test stimulus and the other was one of the other seven test stimuli chosen at random. Pigeons could peck either choice stimulus to receive food; choice behavior was measured to assess the birds' acquisition of sample-test associations in training. Pigeons exhibited below chance responding, reliably preferring the unpaired to the previously paired choice stimulus. Additional training groups indicated that: (1) the original training group had truly learned specific sample-test associations and (2) below chance responding was attributable to the original training group being required to peck the sample stimuli more often than the testing stimuli.

Through the eyes of dingoes (Canis dingo): A window into the evolution of dog-human eye contact

Angie M. Johnston, Courtney Turrin (Yale University), Lyn Watson (Australian Dingo Foundation), & Laurie R. Santos (Yale University)

P9 Through domestication, dogs have developed a robust ability to form interspecific bonds with humans (e.g., Topál et al., 2005). Recent work comparing dogs and wolves suggests that eye contact is an important behavior underlying these bonds (Nagasawa et al., 2015); however, it remains unclear how this feature of interspecific bonding evolved. We explored eye contact in a unique comparison species that represents an intermediate point in canid domestication: Australian dingoes (Canis dingo). In contrast to wolves tested previously (Nagasawa et al., 2015), dingoes initiated more eye contact with humans (6 out of 11 wolves vs. 22 out of 23 dingoes; Fisher's exact test: $p=.008$), but did so for a shorter time than dogs (2.7sec vs. 40sec; Mann-Whitney U test: $U=8$, $p<.001$). Next, we examined whether dingo-human eye contact was modulated by familiarity. In contrast to dogs tested previously (Hernádi et al., 2012), dingoes maintained eye contact with humans for equal time, regardless of familiarity (Wilcoxon signed-ranks test: $W=186$, $p=.802$). Given that dingoes share only an early domestication history with dogs, our results suggest the motivation to initiate eye contact with humans evolved early in domestication. However, the tendency to maintain prolonged eye contact with familiar humans may have evolved later.

Timmy's in the well: Empathy and prosocial helping in dogs

Emily Sanford, Emma Burt, & Julia E. Meyers-Manor (Macalester College)

P10 Dogs have been found to empathetically respond to humans' emotional states, as they attend more to crying people than humming people (Custance & Mayer, 2012). However, whether dogs can actively provide help to humans in need, and whether they provide help based on empathetic evaluations of humans' emotional states, is unclear. This study used a trapped-other paradigm, modified from use in research on rats, to study prosocial helping in both registered therapy dogs and non-therapy dogs. A human trapped behind a door either cried or hummed, and the dog's behavior and physiological responses was recorded. In addition, gaze-orientation behaviors were evaluated during an impossible task. This study found that dogs do help humans. Dogs in the distress condition opened slightly less frequently, but significantly more quickly, than dogs in the neutral condition. There was no difference in opening behavior between therapy and non-therapy dogs. During the impossible task, dogs who opened more quickly in the prosocial task gazed longer at their owners, which supports that prosocial helping may be an affiliative response. This indicates that dogs may be capable of empathetically evaluating humans' emotional states and modifying their behavior accordingly.

Vocal Intonation Affects Dogs' Choice Behavior in the Absence of Visual Cues

Erin N. Colbert-White, Alexa Tullis, David R. Andresen, Kiona M. Parker, & Kaylana E. Patterson (University of Puget Sound)

P11 The impact of intonation (i.e., tone of voice) has been tested in conjunction with pointing, facial expression, and words in the object-choice task (OCT). As such, whether intonation conveys unique information, or merely solicits attention, is unknown. We isolated intonation from facial and speech information by presenting cues with the experimenter's back turned and by using non-word vocalizations. Testing included 12 OCT trials using Positive (i.e., happy-sounding, rising "ooOOH"), Negative (i.e., sad-sounding, falling "OOooh"), and Control (timed breath exhale) cues. In Experiment 1 (N = 24), each of the two containers was presented with one of the three cues, and one of the containers received a pointing gesture in addition to the cue. As expected, dogs chose the pointed-to container significantly more often, however, there were no significant effects of intonation. In Experiment 2 (N = 16), we removed the pointing cue, leaving only intonation as a potential social referencing cue. Here, the dogs were significantly more likely to choose the container that had been presented with the Positive intonation. The findings indicate that dogs will use intonation as a social referencing cue, but only when a more salient cue (e.g., pointing) is absent.

Any reward will do: Effects of Reversed Contingencies on Size Preference with Pet Dogs (Canis lupus familiaris)

Haleh Amanieh, Jonathan K. Fernand, David J. Cox, & Nicole R. Dorey (University of Florida)

P12 A common experimental design presented to animals is the reverse-reward contingency task where subjects choose between one plate containing a large amount of food, a second plate containing a small amount of food, and a third plate containing no food (control). Previous investigations have found that multiple species fail to maximize choice under reverse-reward contingencies (i.e. choosing the smaller option when it leads to consumption of the larger option). In the current study, eight dogs were tested in three conditions. In Condition 1, plates of food were presented and dogs were allowed to consume their choice. In Condition 2, plates with a visual representation of the food options were presented and dogs received the same sized food item as their choice. In Condition 3, plates with a visual representation were presented and dogs received the reverse sized food item to their choice (e.g., received small food amount if large plate chosen). We found all dogs developed and maintained preference for the larger stimulus option across conditions. Results suggest a history of choosing the large stimuli to receive the large food with the visual representation might interfere with sensitivity to changes in reinforcer magnitude when the reverse-reward contingency is in effect.

Relationships between human-guided object-choice task performance and human-directed behavior during an unsolvable task in detection dogs

Lucia Lazarowski, Andie Thompkins, Martha R. Forloines, Lily Strassgberg, Paul Waggoner, Gopikrishna Deshpande, & Jeffrey Katz (Auburn University)

P13 Dogs possess a unique bond with humans enabling them to occupy a significant niche in our society in companion and working roles. Considerable research has revealed the sophisticated socio-cognitive abilities of dogs, but findings are limited to pets neglecting other sub-populations such as detection dogs. We measured two aspects of canine social cognition in explosive detection dogs (EDDs) and pet dogs. In the unsolvable task (UT), we measured behavioral tendencies indicative of attachment towards a familiar person. In the object-choice task (OCT), we assessed dogs' ability to utilize social cues given by a familiar or unfamiliar person to locate a hidden reward. Human-directed behaviors in the UT were correlated with OCT accuracy, and the effect of familiarity was greater in pets than EDDs in the OCT. Socio-cognitive measures also correlated with aspects of trainer-reported EDD evaluations (e.g., environmental soundness, hunt, trainability). These findings suggest a global mechanism for social cognition in dogs which may be influenced by experience, and may have implications for developing selection tools for successful working dogs.

Dogs detect sound size manipulations in their own barks

Zachary Silver, Joseph Plazak, & Ellen Furlong (Illinois Wesleyan University)

P14 A variety of mammalian species use vocalizations to perceive the size of conspecifics. Specifically, mammals demonstrate prolonged attention to manipulated calls that suggest a larger conspecific compared to those suggesting a smaller conspecific. In humans this behavioral effect depends on the observer's size—perceptions of 'big' or 'small' may differ between individuals. We explored whether this generalizes to other species by manipulating formant dispersion of dogs' own barks to create synthetic barks that perceptually sounded either larger or smaller than the dog subject. We played these sounds to dogs and recorded how long they looked at the playback speaker. Dogs tended to look at the speaker longer in response to synthetic 'larger' dog sounds compared to synthetic 'smaller' sounds. Like humans, dogs may respond to novel barks by comparing the source's probable size to their own.

Auditory conspecific recognition in the domestic dog and cat

Zsofia Budai, Kazuo Fujita, Hitomi Chijiiwa, Hika Kuroshima, Saho Takagi, & Arahori Minori (Kyoto University)

P15 Individual recognition of conspecifics is an important ability for survival. Young animals of several species are able to recognize their mother`s individual vocalizations from early ages and recent acoustic analyses revealed that vocalizations are individually distinct in both domestic dogs and cats (Scheumann et al, 2012; Yin &McCowan, 2004). Furthermore, both species are able to differentiate their owner`s voice from unfamiliar voices and dogs can match it cross-modally as well (Adachi et al, 2007; Saito & Shinozuka, 2013). In the present study we aim to explore whether domestic cats and dogs can recognize familiar conspecifics based on auditory information alone. Vocalizations from both species are elicited using a standard procedure and pre-recorded for use in an expectancy violation task. Subjects are presented with a train of vocalizations first, followed by a photo appearing on a screen, while looking times are recorded. Each subject participates in four trials: two congruent (vocalizations and photo are a match) and two incongruent (vocalizations and photo are a mismatch). If dogs and cats can recognize familiar conspecifics based on their vocalizations, then they are expected to look longer in the incongruent condition. Data collection is in progress, results will be presented at the conference.

Investigating numerical cognition in the domestic dog.

Julia Espinosa, Emma Tecwyn, & Daphna Buchsbaum (University of Toronto)

P16 Reasoning about quantities (often called numerical cognition) has ecological importance for many species, for instance when assessing the abundance of food items or competitors in the environment. The majority of previous research in this area focuses on humans and other primates, particularly in the area of statistical inference which is an important skill for making decisions when faced with uncertain outcomes. Our current research extends these investigations in a new direction, to focus on the domestic dog. The 1st experiment establishes that dogs are able to understand that samples drawn from populations of a single food type will be representative of those populations. The 2nd builds on the sampling procedure and tests dogs' ability to make inferences when samples are drawn from mixed populations of preferred on non-preferred foods. The 3rd experiment will manipulate the population quantities and ratios of the preferred and non-preferred foods within them to identify if dogs are using statistical inferences to choose between samples. Results are discussed in the context of previous findings in humans and other primates.

Resurgence with ABA and ABB context changes in children with Autism Spectrum Disorder in an automated touchscreen computer task

Karli Silverman, Corina Jimenez-Gomez (Florida Institute of Technology), Toshikazu Kuroda (Aichi Bunkyo University), & Christopher A. Podlesnik. (Florida Institute of Technology.)

P17 Resurgence is the process by which a previously reinforced and extinguished response increases following the extinction of an alternative response, and has been demonstrated across multiple species, from fish to humans. This study compared the resurgence of a target response with ABA and ABB contextual changes in children diagnosed with ASD. We used a touchscreen computer presenting a target and alternative response superimposed on two different contexts. Contexts A and B consisted of different background colors. Target and alternative responses were pressing different colored buttons superimposed on the background. In Phase 1, we reinforced target responses with edibles in Context A. Phase 2 introduced extinction of the target response and reinforcement of the alternative response in Context B. Phase 3 consisted of multiple presentations of both contexts, per ABBABAAB or BAABABBA designs, counterbalanced across participants. In Phase 3, both responses were available but neither produced reinforcers. All participants demonstrated resurgence of the target response when returning to the training context (ABA) but little to no resurgence occurred when remaining in the extinction context (ABB). These findings provide a platform for examining factors influencing the effects of reinforcement contingencies and contextual changes in relapse from behavioral treatments.

P18 Withdrawn

Scents and Signals: Female and male responses to conspecific odor in the Chambered Nautilus

Naomi Lewandowski (Brooklyn College- City University of New York), Mahwish Ashfaq, Chaya Fastow, Yasmely Luna, Divya Roy, Neelima Dosakayala, Lucy DeJesus, Ibtihaj Daylami, Jensine Sajan, & Jennifer Basil (The Graduate Center- City University of New York)

P19 Chemicals released by an animal are used in the detection of, and communication with, conspecifics. Identifying suitable mates and initiating appropriate mating behaviors may be mediated by the chemicals that an animal emits. Sexual-selection processes in Nautilus pompilius, a solitary, deep-water cephalopod, have only partially been described. Mating may be opportunistic, perhaps occurring when groups gather at foraging sites. We have demonstrated that nautiluses can detect conspecific odor, and males at least will choose conspecific odor over a blank stimulus. Females seem to avoid female conspecific odor, but are attracted to male odor. In addition, the rectal gland is a likely location for the putative odor signal. Here, in a Y-maze, we tested male and female recipients against two donors simultaneously (m/m; m/f; f/f) to determine if 1.) males continue to be indiscriminate in choice of odor, 2.) females actively choose male odor over female odor, while avoiding female odor, and 3.) if certain individuals are more attractive than others. Experiments completed to date suggest that males and females have a similar preference for both the opposite and same sex. However, there are differences in individual attraction to specific scent donors with some individuals appearing more 'attractive' than others.

Delayed choice in a pigeon gambling procedure

Danielle Andrews, Jacob Case, Aaron Smith, & Thomas Zentall (University of Kentucky)

P20 Animals are known to choose suboptimally when provided with cues that signal whether reinforcement is coming or not. For example, there is evidence that pigeons do not prefer an alternative that produces cue for reinforcement, over an alternative with a 50% chance of reinforcement, if half of the time it provides a cue for reinforcement and the rest of the time it produces a cue for no reinforcement. There is evidence from delay discounting research, however, that if the results of the initial choice are delayed, it will encourage pigeons to choose optimally. When we tested this hypothesis by forcing pigeons to wait following choice by requiring them to complete a fixed interval 20 s schedule most of them chose optimally.

Testing for a gravity bias in a Harbor seal (Phoca vitulina) and a California sea lion (Zalophus californianus)

Afia Azaah (St. Francis College), Kristy Lindemann-Biolsi (St. Francis College and Center for the Study of Pinniped Ecology Cognition), Candyce Paparo (Center for the Study of Pinniped Ecology Cognition and Long Island Aquarium and Exhibition Center)

P21 Hood defines a gravity bias as an effect that happens when, "preschool children expect a falling object to travel in a straight line even when there are clear physical mechanisms that deviate the object's path" (as cited by Hood, Houser, Anderson, & Santos, 2001, p. 35). The gravity bias has been witnessed in non-human primates such as Pan Troglodytes (Tomonaga, Imura, Mizuno, & Tanaka, 2007), and Macaca Mulatta (Southgate & Gomez, 2006), also Canis Lupus Familiaris (Osthaus, Slater, & Lea, 2003) The study currently being conducted, focuses on the responses of two marine mammals. This study is conducting testing on Zalophus califonianus and Phoca vitulina, or the California sea lion and the harbor seal respectively; either of which has not been studied on their knowledge of gravity, or if they would understand a test such as the opaque tube task. The opaque tubes task will determine whether Calypso and Bunker can fight or succumb to the effects of a gravity bias. Each subject's performance and results, in relation to comparative cognition, will be discussed at the time of this presentation.

Modeling representation and decision making under conflicting cues in computationally autonomous robots

Frank W. Grasso (BioMimetic and Cognitive Robotics Lab)

P22 In comparative psychology we sometimes contrive experimental situations in which two or more cues are placed into conflict to understand the nature of representation and organization of cognition in animal decision making. Computationally autonomous robots offer an opportunity to study the consequences of information processing structures (representations) and decision making for behavioral decisions. We explore cue-conflict paradigms using mobile robots controlled by distributed artificial neural networks. Our networks are designed to be intrinsically parallel and share computational resources. Our controllers use these recurrent neural networks to implement short-term memory at explicit sensory, motor, and central processing levels as well as modeling central learning processes. In robot implementations in an arena using a simple navigation task we explore the consequences of different representations on the decision making process. Since the representation is known the consequences of the representation for behavior can be observed in the behavior of the robot. Our studies provide insights into the causes of variable responses of an animal presented with the same environmental situation on multiple occasions. They also illustrate representational contexts under which cue conflicts are resolved robustly. These studies explain behavioral variability as a result of competing dynamic processes rather than environmental or internal noise.

Goal-directed tail use in Colombian spider monkeys is highly lateralized

Giulianna A. Kendall, & Eliza L. Nelson (Department of Psychology Florida International University Miami FL)

P23 Problem solving is a hallmark of human behavior, and often studied through tool use paradigms. Little research has been conducted on spider monkeys due to their four-digit hand structure, which is unusual among primates. However, the spider monkey has a very powerful prehensile tail, and we previously observed that some monkeys use the tail spontaneously to manipulate objects. In a series of experiments, we probed the capacity of the tail to solve a problem where a desired object was out of reach of the hands and feet. A high-value food item was placed in one of the following five conditions at a distance accessible only by the tail: (1) on a hard surface, (2) inside a bowl suspended on a chain, (3) on top of elevated bookends, (4) inside an angled transparent container, or (5) floating in a small pool of water. Up to 10 data points per monkey per day were collected until 30 successful trials were obtained on each task (N = 7). Results show that monkeys can solve each of these problems through goal-directed tail use, and that skilled tail use is highly lateralized.

Jar Opening by Octopus bimaculoides: Cross-modal Transfer between Visual and Tactile Representations?

Frank W. Grasso (BioMimetic and Cognitive Robotics Laboratory Department of Psychology Brooklyn College CUNY), & Jesse Farruggella (Ecology Evolutionary Biology and Behavior Department of Biology The Graduate Center CUNY)

P24 Octopuses are invertebrates with complex behavioral repertoires. Their capacity for object manipulation is supported by sophisticated sensory-motor and memory systems. The ability of Octopus vulgaris to uncork jars to access food has been documented. We studied the ability of Octopus bimaculoides (n=2) to open lidded jars. Octopuses were presented with a live crab contained in a transparent, glass jar in a four-stage shaping procedure (one trial per day) to train them to open the jar. First, the jar was presented without a lid. Second, the jar was covered with Parafilm. Third, an opaque, screw-top lid covered the jar. Finally, the lid was screwed in place. The octopuses immediately removed the crabs from open and Parafilm-covered jars. In phase three, the octopuses took 10-12 trials to learn to immediately remove the crab. The octopuses retained this ability for 10 subsequent trials, until the final phase, in which they learned to remove the screwed-on lid in 3-4 trials. There is an interesting cognitive explanation for these results: since the octopus cannot see the crab while it lifts the jar lid, we infer that the octopus is capable of a form of sensory information transfer between its visual and tactile systems.

Do belugas and Pacific white-sided dolphins form expectations that can be violated when looking at novel or familiar objects?

Heather Hill, Kendall Pasko (St. Mary's University), & Deirdre Yeater (Sacred Heart University)

P25 Representational skills of pre-verbal human children and non-human animals can be assessed by examining their reactions to unexpected changes to the characteristics of stimuli. Using a violation-of-expectation paradigm within a free swim context, we investigated the representational capacity of 11 belugas (Delphinapterus leucas) from two facilities and 6 Pacific white-sided dolphins (Lagenorhynchus obliquidens, lags). It was predicted that the belugas and lags would look longer at unexpected outcomes than at expected outcomes. The results indicated that there was no difference in gaze durations from the first presentation to the second presentation. The belugas tended to view both of the presentations with both eyes (binocular vision) while the lags took a lateralized view. Belugas attended to more trials overall than the lags and showed longer gaze durations. It is possible that the animals did not notice any change from one presentation to another. Moreover, familiarity of the stimulus did not influence the results. This pattern of behavior is similar to humans who experience change blindness.

How can we test for the animacy effect in non-human primates?

Jennifer M. Johnson, & David A. Washburn (Georgia State University)

P26 Literature has shown that humans have preferential processing of animate over inanimate stimuli. Specifically, humans remember animate stimuli better than inanimate, and animate stimuli capture attention more quickly. The literature claims that this is due to evolutionary adapted mechanisms: our ancestors needed to monitor living things more closely because they are most important to survival. They could be predator, prey, mate, or any social or informative encounter. However, there has been no research done to see if this adaptation theory holds true for non-human animals. Understanding what stimuli are naturally salient is important not only for future research designs, but also for understanding underlying cognitive mechanisms that influence memory and attention. Ways in which we can examine the animacy effect in non-human primates by replicating the effect in humans using computerized symbolic-matching tasks with pictures will be discussed.

Simians in the Shape School: A comparative study of executive function in rhesus monkeys

Kristin French, Michael Beran, & David Washburn (Georgia State University)

P27 Executive functions consist of higher-order, goal-directed cognitive control processes that include set-switching, inhibition, planning, and monitoring. They are critical for resisting stimulus control of attention and behavior. The Shape School task (Espy, 1997, 2006) is a game developed for children in which multidimensional characters must be sorted according to various rules, including stimuli that are exceptions to those rules and should not be sorted. These characters vary in color, shape, mood, and whether or not they wear hats, allowing for different rules to be established. We presented the Shape School game to rhesus monkeys. We assessed whether they could learn the sorting rules, manage switching between sorting rules, and respond appropriately to inhibitory stimuli. Seven of nine monkeys learned that characters with sad faces needed to be sorted based on their shape, and those with happy faces needed instead to be sorted based on their color. These monkeys gradually also learned to inhibit sorting characters that wore hats (the inhibitory stimuli). The monkeys maintained high performance for all character sorting (and non-sorting) as the proportion of inhibitory stimuli decreased from 50% to 20% to 5%. These performance patterns resembled those previously reported with older preschool children.

Spatial representation in nonverbal transitive inference: An individual differences approach

Nora Balboa, Courtney Kalender, & Olga Lazareva (Drake University)

P28 Transitive inference (TI) is a form of deductive reasoning which allows one to derive a relation between items (if B < C and C < D, then B < D). Although on average human participants demonstrate nonverbal TI, their performance shows considerable individual variability, with some participants selecting transitively correct stimulus at chance or even strongly preferring an incorrect stimulus (Lazareva & Wasserman, 2010). Spatial models suggest that TI is based on mental representation of spatial order among the training stimuli. We therefore hypothesized that the individual differences in TI performance may positively correlate with measures of spatial ability. The participants received a standard 6-item TI task, a postexperimental awareness questionnaire, three tests of spatial ability (Vanderberg-Kuse mental rotation test, Paper Folding test, and Perspective Taking test), and a deductive reasoning test (Bacon-Ford Syllogistic Reasoning test). We found a modest positive correlation between accuracy to the training pairs and the mental rotation score (r = .28); however, none of the measures predicted accuracy to the testing pairs. Our results suggest that the ability to learn the overlapping pairs of training stimuli may be associated with spatial ability; however, other factors are necessary to explain individual variability in TI test performance.

Cognitive and pharmacological correlates of sensitivity of rats to performance feedback in a probabilistic reversal-learning paradigm.

Rafal Rygula (Institute of Pharmacology Polish Academy of Sciences), & Michal Rychlik (Department of Behavioral Neuroscience and Drug Development)

P29 In the present study, we aimed at evaluating the pharmacological and cognitive correlates of feedback sensitivity in rats. For this we trained the rats in an operant version of the probabilistic reversal learning (PRL) paradigm where for successful completion of the task, subjects had to learn to ignore infrequent and misleading feedback, arising from the probabilistic (80:20) nature of the discrimination. Subsequently, in the first experiment we evaluated the effect of fast acting antidepressant drug - ketamine (5, 10, and 20 mg/kg) on feedback sensitivity 1, 24, and 48 h after administration and in the second experiment we correlated the sensitivity of rats to positive and negative performance feedback with their cognitive judgment bias (optimism/pessimism) measured using the ambiguous-cue interpretation paradigm. We report that acute administration of the ketamine rapidly and persistently decreased the sensitivity of rats to negative feedback. We also report significant correlation between the negative feedback sensitivity and pessimistic judgment bias in rats. The results of our study suggest that preclinical version of the PRL task could be used for modelling cognitive deficits associated with depressive disorder in rodents.

Farmer's Almacaque: How Do Monkeys Solve the Weather Prediction Task

Will Whitham, & David A. Washburn (Georgia State University)

P30 In probabilistic category learning tasks, categorization decisions must be made on an probabilistic basis in which category membership is not absolute (Kruschke & Johansen, 1999). Instead, category membership can only be inferred from the relative weight of information in the decision-making environment. The weather prediction task is perhaps the most prominent probabilistic category learning task. In the conventional weather prediction task (e.g., Knowlton, Squire, & Gluck, 1994), an array of one to four cues, normally stylized as tarot cards, are presented to the participant. They are then given a choice between two options, usually stylized as “rainy” or “sunny”. Participants are partially informed whether the weather will be rainy or sunny by the tarot cards on a probabilistic basis and, with time, they acquire some understanding of the relative weight of evidence conferred by the cues. The work of Meeter and colleagues (2006) provides a framework for modeling how different participants solve the weather prediction task that has been fruitfully applied for data in several populations. The present research applied this framework to data from rhesus macaques to investigate how they solve the weather prediction task.

The longevity of a fox squirrel’s caches is related to food assessment and cache effort

Mikel Delgado, & Lucia Jacobs (University of California at Berkeley)

P31 Models of scatter-hoarding assume the cache owner has a retrieval advantage, despite the lack of field studies of caching and retrieval, particularly in mammals such as squirrels. In this study, 20 free-ranging fox squirrels cached hazelnuts implanted with RFID tags (range: 1-45 nuts), allowing us to track the movement of caches. For each cache, we quantified food assessment behaviors (head flick, paw manipulation), cache effort (digging, tamping, covering, cache concealment and time spent caching), and the length of time the cache remained in the location it was buried. Caches remained undisturbed on average for 32 days (range: 0-300, Median: 4 days). The longevity of a cache was related to behaviors exhibited at cache creation, including the level of concealment of the cache and the time spent paw manipulating a nut. When caches were buried in open areas without cover, squirrels spent more time creating a cache (digging, tamping and covering). They also increased the time spent caching as the weight of the nut increased. I will present our results in the context of ongoing spatial analysis of the caches in this study and microsatellite PCR analysis to determine if relatedness between individuals influences cache and retrieval behaviors.

Seasonal changes in cognitive bias assessed by response latency task in western lowland gorillas

Molly C. McGuire, Jennifer Vonk (Oakland University), Stephanie Allard, & Grace Fuller (Detroit Zoological Society)

P32 Cognitive bias reflects a tendency to view ambiguous or neutral stimuli as being positive or negative, and is indicative of an individual's affective state. Cognitive bias in nonhumans has been assessed with discrimination tasks that typically require extensive training. We assessed cognitive bias in Western lowland gorillas (Gorilla gorilla gorilla) using a response latency paradigm. During training, a grey square was presented on a touchscreen computer to obtain a baseline response time for touching the square. During testing, we compared latencies to touch squares containing threatening stimuli (images of unfamiliar gorillas assuming threatening postures) to latencies to touch squares containing neutral stimuli (images of gorillas in non-threatening postures). We predicted that latencies will be faster in general when the gorillas had access to the outdoor component of their habitat, compared to when they were restricted to indoors. The gorillas should show slower response latencies to threatening compared to neutral stimuli, and this difference should be pronounced when they are more pessimistic, such as when they are restricted to smaller areas within their habitat. Preliminary data indicates a tendency for the gorillas to react more pessimistically after sleeping in a confined space overnight compared to a larger, more enriched space.

Signature whistle production during a bottlenose dolphin group integration: Preliminary results

Megan Broadway, & Heidi Lyn (University of Southern Mississippi)

P33 Bottlenose dolphins are an important species of comparison when studying complex animal communication because they possess a rare combination of traits that is present in few species. Signature whistles are distinctive calls that are unique for each individual. Looking at the context in which signature whistles are used is likely the most pragmatic way of learning the various functions of these whistles and discovering when and how they are typically used. We observed the behavior and whistle production of captive bottlenose dolphins during the introduction of a new individual to an existing group and recorded audio and behavior. A preliminary analysis of the data showed that the new individual produced more signature whistles than non-signature whistles during the pre-introduction phase and his signature whistle made up one-third of all whistles observed during the post-introduction phase. The signature whistles of the group members were observed more during the post-introduction phase than the pre-introduction phase. Comparing signature whistle production from multiple introductions will be needed to determine if bottlenose dolphins produce signature whistles in a predictable way during introductions.

Behavioral Development of Pacific White-Sided Dolphin Calves Over the First 30 Days of Life

Kendal Smith (University of Southern Mississippi), & Lance Miller (Chicago Zoological Society)

P34 Cetacean development is an important topic of study for both general comparative understanding, as well as the implementation of informed husbandry policies concerning calf intervention. Odontocetes are strikingly different from mysticetes, in that odontocete calves have extended nursing periods, yet earlier onset of independence from their mothers. However, due to the inaccessibility of many of these species, previous research in cetaceans has been limited to belugas, orcas, bottlenose dolphins, and Yangtze finless porpoises. Developmental behaviors for three Pacific white-sided dolphins (Lagenorhyncus obliquidens) were recorded in twenty-four hour observation sessions to determine the developmental trajectory of this species for the first thirty days of life. Observers recorded nursing bout frequency and duration, as well as respiration rates and association rates for each individual dolphin. The first occurrence as well as the developmental trend for each of the observed behaviors was analyzed using an Auto-Regressive Integrated Moving Average (ARIMA) model. The results identify species differences in the onset and development of these behaviors in Pacific white-sided dolphins, as well as similarities to previously studied cetacean species.

The development of sex differences in play behavior of young belugas (Delphinapterus leucas) in managed care

Sara Guarino (Texas Christian University), Anna Villarreal, Paloma Silva, Magdalena Banda, & Heather Hill (St. Mary's University)

P35 Play is a significant developmental milestone for many animals, providing insights into the social, physical, and cognitive abilities. Beluga calves develop different forms of play over time. However, it is currently unclear if sex differences exist early in development or if they emerge over time. Using archived video footage of a longitudinal study of belugas in managed care, this research study investigated the relationship between beluga sex and types of play displayed. Play behaviors of seven beluga calves were assessed using video recordings selected from birth to 24 months. The results indicated that sex was related to the category of play. Females preferred to play with objects, while males preferred to play socially. There was no difference in the classes of objects with which males and females played. Females preferred to play alone, while males preferred to play with other animals, but age influenced the types of play displayed by male and female belugas. These findings suggest that male and female beluga calves develop different play preferences and those play preferences may continue into adulthood. These results are discussed within the context of human development.

Context controls mid-session reversal in pigeons

Hayden MacDonald, William Roberts, & Krista Macpherson (University of Western Ontario)

P36 Six White King pigeons (Columba livia) were trained in a 60-trial mid-session reversal task in operant boxes with key lights that were either red or green. Initially, pigeons learned to peck a key light for rewards in the first 30 trials before switching to the opposite key light in the last 30 trials. The colour key that was rewarded in the first half of trials was counterbalanced across pigeons and the spatial presentation of the colours (either left or right) was counterbalanced across trials. Responding on the keys required a fixed ratio that was incrementally increased from 1 to 10 over 10 sessions. After pigeons showed typical response patterns (anticipatory and perseverative errors around the reversal point), a context manipulation was introduced where a red or green houselight signaled which reward contingency was currently in effect. This context manipulation rapidly came to control pigeon responses, resulting in near-perfect reversals after only one session. Anticipatory and perseverative errors as well as within-trial key switching were substantially reduced near the reversal point. Further manipulations investigated the effects of intertrial interval and point of reversal on mid-session reversal with and without the context cues.

The Effect of Delay and Differential Outcomes on Same/Different Performance in a Touchscreen Task with Rats

Lauren Cleland, Cheyenne Elliot, Elle Repeta, & Ken Leising (Texas Christian University)

P37 The differential outcomes effect occurs when acquisition of a discrimination is facilitated by delivering a unique outcome (e.g., reinforcer) following the target response for each discriminative stimulus. Learning can also be facilitated by presenting a stimulus (e.g., a tone) after only the correct response (i.e., a secondary reinforcer) or after both correct and incorrect responses (i.e., a marking stimulus). In same/different learning, the correct response is not contingent on a particular discriminative stimulus but on the relationship between two stimuli. In the current study, rats were trained in an iPad-equipped operant box. On any given trial, rats were presented with one of four visual stimuli as the sample. A touch to the sample was followed by a 50-ms, 1000-ms, or 2000-ms delay before displaying the test stimulus in the same location. After a touch, it disappeared and response boxes appeared to the left and right. Touches to the box associated with "same" were reinforced if the two stimuli matched or for touching the other box ("different"). No differential outcomes effect was found. Contrary to the literature, we found that rats were more accurate on trials with longer delays between sample and test displays.

Tiger Salamanders' (Ambystoma tigrinum) Response Retention and Usage of Visual Cues Following Brumation

Shannon M. A. Kundey, Anne Lessard, Aleyna Fitz, & Manika Panwar (Hood College)

P38 We explored the impact of brumation on tiger salamanders' (Ambystoma tigrinum) retention of a learned response to a visual cue. Initially, all salamanders were trained to turn toward a particular compound proximal visual cue as start position and cue location were varied on each trial in a T-maze. All salamanders learned to turn in the direction indicated by the cue. Then, using a forced-choice procedure, each salamander was evaluated for turning preference towards the foreground or background of the visual cue. Next, salamanders were divided into three groups for a delay of 90 days: maintenance in their home cage under normal laboratory conditions, immediate brumation following training, or delayed brumation after a 24-hour delay spent in the home cage under normal laboratory conditions. After the delay, we evaluated whether turning toward the compound proximal visual cue was maintained and we repeated foreground versus background testing. Results indicated that all salamanders continued to execute a turning response within the T-maze after the 90-day delay; however, preference for foreground versus background differed across groups after the delay. These results indicate that salamanders can learn to execute responses utilizing visual cues, if required, and that such learning is retained over brumation.

Development of a Raven's Progressive Matrices to Examine General Intelligence in the Pigeon, Columba livia

Mary E. Flaim, Julia E. Schroeder, & Aaron P. Blaisdell (University of California - Los Angeles)

P39 Raven's progressive matrices (RPM) is a nonverbal test that examines abstract intelligence by asking subjects to correctly complete a stimulus matrix where transformations between stimuli in the matrix follow one or more rules. While this test has been used since 1936, and has been modified to accommodate a variety of humans (genius, children, etc.), it has never been adapted for testing non-human animals. Our study is an attempt to adapt the RPM-task for pigeons. Pigeons were trained on a task that could progressively increase in complexity through the addition of rules by which the matrix is completed. Pigeons were initially trained on one rule at a time, using a go/no-go discrimination procedure with pecking reinforced when the rule was present (Go) but not when the rule was absent (NoGo). As discrimination performance reached criterion, pigeons were tested for transfer of the rule to novel stimuli. Following this, pigeons were then trained on a second rule. So far, two pigeons have been able to learn one rule and show complete transfer to novel stimuli. They currently are acquiring discrimination involving the second rule. Not all pigeons learned the first rule, however. We will discuss the basis for failures to learn.

Pattern Symmetry in Nested Hierarchical Serial Patterns in the Serial Multiple Choice (SMC) Procedure in Humans.

James D. Rowan, Rosamond Goodson, Ashley Monic, Rachel Millan, Amanda Schroeder, Ariel Richardson (Wesleyan College), & Barbara Rowan (Pearson North America)

P40 This experiment compares acquisition, in human subjects, of a perfectly nested serial-pattern (symmetrical),where there were equal numbers of chunks on both sides of a 3rd order Mirror/Reverse rule, to acquisition of 5 other patterns that were not (asymmetrical). The non-symmetrical patterns did not have numbers of chunks on either side of the Mirror/Reverse rule. All patterns contained equal numbers of elements and equal numbers of chunks overall. If subjects can use higher 3rd order rules (such as Mirror or Reverse rules), then completely nested patterns should have a much simpler cognitive representation, and thus, should be easier to learn than patterns with a non-nested, linear, structure. Using the Serial Multiple Choice Procedure (SMP) first described by Fountain and Rowan (1993), it was found that all 6 patterns were learned equally well in this experiment, bringing into question the assumption that subjects actually encode these points in the pattern as 3rd order rules and can use them to hierarchally nest the pattern representation. It may be that subjects simply encode the patterns with a linear representation, as sequential chunks of information expressed by 1st and 2nd order rules.

Rule Abstraction in a Honeybee T-maze: A Pilot Study

Victoria Torres (University of Detroit Mercy), Desiree Austin (Marygrove College), Arthur McCray (University of Detroit Mercy), & Karen E. Doyle (Marygrove College)

P41 Can foraging honeybees utilize an abstract rule to navigate a T-maze? Bees have previously demonstrated a flexible and proficient navigational system along with the creation and adaption of categorical abstract rules. Thus, they would be good candidates for sequential rule abstraction. A colony of bees was maintained in an observation hive with access to the outside for foraging. Exiting bees were presented with a PVC T-maze equipped with both correct and incorrect pathway arms. Both pathways included LED emitter-detector pairings to track movement. Only a correct pathway choice allowed bees outside access. To test for rule abstraction, maze components were alternated nightly (e.g. Day 1 – Left Arm Correct, Day 2 – Right Arm Correct, Day 3 – Left Arm Correct). Interrupted emitter-detector pairing signals were recorded and counted as a behavioral choice. The amount of correct and incorrect choices were compiled each day and compared across the experiment. Probe violation trials were introduced throughout acquisition to test for rule abstraction. Bees initially demonstrated a left arm bias, but further training allowed bees to flexibly choose either side. Although alternating rule abstraction has not been initially established, this project demonstrates bees' adaptable ability to navigate an alternating maze.

Serial Pattern Retention in Male and Female Rats: Forgetting Curves for an Element that Violates Pattern Structure

Jessica L. Sharp, Megan E. Miller-Cahill, David C. Riccio, & Stephen B. Fountain (Kent State University)

P42 We examined serial pattern retention in rats focusing on retention for a single pattern element that violated pattern structure. Violation elements were targeted because they are typically unusually difficult to learn, contrasting with rule-learning in the structured pattern. They are also sensitive to selective manipulation of central neurotransmitter and plasticity systems. Adult male and female rats were trained in a serial multiple choice task to perform nosepoke responses for water in receptacles mounted on the 8 walls of an octagonal chamber. Rats learned to nosepoke in the pattern, 123-234-345-456-567-678-781-818, where digits represent the clockwise position of successive correct receptacles, dashes indicate brief pauses, and the final "violation element" is inconsistent with pattern structure. Rats were trained twice to an 85% correct criterion on the violation element prior to testing after 4-week and 2-week retention intervals, respectively. After each retention interval, rats received a 1-day 10-pattern retention test. Results indicated that rats had approximately 57% retention of the violation element after 2 weeks and 28% retention after 4 weeks. Sex differences were not significant. The results indicate that serial pattern memory, particularly violation element memory, can be assessed by characterizing forgetting curves using traditional methods.

Serial Pattern Extrapolation is Spared during a Cholinergic Challenge in Rats

Megan E. Miller-Cahill, Jessica L. Sharp, & Stephen B. Fountain (Kent State University)

P43 We assessed the effect of a cholinergic challenge on serial pattern extrapolation in rats. Male and female rats learned a rule-based serial pattern of nosepoke responses in receptacles on the walls of an octagonal operant chamber. The training pattern consisted of seven chunks of a rule-based serial pattern (123-234-345-456-567-678-781). After learning to a criterion of 90% correct responses on all elements of the pattern, rats were given i.p. injections of 0.6 mg/kg scopolamine hydrobromide 30 minutes before testing on a transfer pattern consisting of the training pattern with an added eighth chunk that was either consistent with pattern structure (chunk "812") or contained a terminal element that violated pattern structure (chunk "818"). Under scopolamine, and even with impaired performance throughout the pattern, rats in both groups extrapolated known pattern structure, producing approximately 60% rule-consistent responses on the terminal element of both added chunks. Despite scopolamine exposure, both male and female rats extrapolated well-learned pattern structure to a new chunk. In the case of the chunk containing the violation element, when confronted with a new trial requiring a response inconsistent with already learned pattern structure, rats attempted to apply the well-learned rule.

Differences in acquisition and spatial memory in social vs. non-socially housed rats

Brittany M. Hemmer, Keith A. Lee, Celia Butler, Taylor Wise, & Victoria L. Templer (Providence College)

P46 The aim of this study was to determine the cognitive impact of social housing (SH) vs. non-social housing (NSH) in rats from battery 1 conducted in adulthood (~ 7 months of age) to battery 2 conducted in middle age (~ 16 months of age). Memory for fixed location, non-fixed locations, and reversal learning, was assessed in spatial contexts using multiple renditions of the Barnes Maze (BM). SH rats displayed improved acquisition during both testing batteries, but only during battery 2 did SH rats display enhanced spatial navigation when the goal box was non-fixed as compared to NSH rats. Search strategies, velocity, and nose-pokes were analyzed to explore potential differences in locomotor behavior or general exploration. To further assess locomotor behavior and overall levels of anxiety, subjects were also tested on the Elevated Zero Maze and Open Field Test, which revealed no group differences. We conclude that SH rats show subtle learning enhancements in spatial memory tasks. The extent to which these group differences reflect benefits against age-related cognitive decline will be discussed.

P56 Social facilitation of targeted spitting in Archer Fish

Adam Davila, Joanna Keane, Zachary Oxford-Romeike (Villanova University), Alexander A. Brown (Lafayette College), & Michael F. Brown (Villanova University)

Archer fish (Toxotes spp.) are known for their ability to shoot jets of water at prey above the water (e.g., hovering or perched insects). In addition to this unique hunting technique, archer fish are also known to be relatively social. Previous studies have indicated that they are able to learn how to shoot a moving target by watching a conspecific that has been experimentally trained to shoot such targets (Schuster et al., 2006). To begin a systematic examination of social learning in archer fish (Toxotes jaculatrix), the current experiment investigated the effects that the presence of conspecifics has on the tendency and latency to shoot at a target placed above the aquarium. Fish were either isolated, or they were allowed to school while overhead targets were presented. Results will be discussed from the perspective of social facilitation of the shooting behavior.

P59 Measuring sociability in socially housed and non-socially housed Long-Evans rats

Katrina Isabel T. Dayaw, Judith Nicole T. Dayaw, & Victoria L. Templer (Providence College)

Sociability is the quality of interactions with conspecifics and can be quantified by determining the frequency and duration of social interactions. The purpose of this study was to examine the extent to which sustained social contact, as achieved by constant social living conditions, influenced social behavior as compared to individually housed controls. Beginning in juvenility 19 male Long-Evans rats were housed in enriched environments, with half living socially in a large social group and half living individually. After several months in these housing conditions, rats were tested on a sociability test (Phase 1) and social novelty preference test (Phase 2). In Phase 1, non-socially housed rats showed greater tendencies towards engaging with an unfamiliar rat as opposed to an inanimate object as compared to socially-housed rats. In Phase 2, non-socially housed rats visited a novel stranger more than the now-familiar rat (from Phase 1) as compared to the socially-housed rats. These results suggest that non-social housing of rats may increase their motivation for social interaction, particularly with non-familiar rats.

Poster Session II - Saturday Evening

Navigation in the column foraging Sonoran desert harvesting ant, Veromessor pergandei

Marcia Spetch (University of Alberta), Nicola Plowes (Arizona State University and Mesa Community College), & Vadim Bulitko (Department of Computing Science; University of Alberta)

P44 Individual V. pergandei workers follow a pheromone marked column from the nest to a foraging area (fan), where ants forage individually in different directions. Upon finding food, workers navigate back to the column using distant landmarks to orient towards the column, where pheromones then guide the remainder of their return to the nest. The direction and length of columns changes between foraging bouts, and hence the end of the column (unlike the nest location) is a dynamic target. Our study explores whether ants account for distance travelled from the column, and the search patterns of displaced foragers. Foragers were captured from the fan or column, displaced, and their pathways recorded. The distance travelled by fan ants suggests that the orientation target is the end of the column. Column ants (particularly from near the nest), showed "backtracking" (searching in opposite compass direction to that recently travelled) similar to that reported for Australian Melophorus bagoti ants.

Exploring the Relationship between Training and Testing Enclosure Size on the Use of Global and Local Geometric Cues During Spatial Reorientation

Z. Kade Bell, D. Greg Sullens, Kent D. Bodily, & Bradley R. Sturz (Georgia Southern University)

P45 Evidence suggests that enclosure size influences the relative use of local but not global geometric cues during spatial reorientation (Sturz, Forloines, and Bodily, 2012). Yet, it remains unclear whether training size, testing size, or the relationship between training size and testing size is responsible for the relative use of local geometric cues. We examined the extent to which manipulations of enclosure size during training (while keeping testing size constant) or at testing (while keeping training size constant) influenced the relative reliance on corner angles (a local geometric cue) during reorientation. Such a design also allowed us to investigate the potential influence of the relationship between training and testing size (i.e., increase in size from training to testing or decrease in size from training to testing). We trained participants to respond to a unique goal location in differently sized trapezoidal enclosures; we then tested participants in a rectangular enclosure to isolate the use of a global geometric cue and a parallelogram to place local and global geometric cues in conflict. Results suggest that the relationship between training and testing size influenced the relative use of local but not global geometric cues for spatial reorientation.

P46 Moved to the End of Session I

Automated memory testing of winter flocks of birds in semi-natural conditions

Emily Kathryn Brown (Emory University), David F. Sherry (Western University), & Robert R. Hampton (Emory University)

P47 Because cognitive processes are shaped by both long- and short-term environmental pressures, cognition is best understood in its natural context. Laboratory experiments allow meticulous control of experimental variables, but remove cognition from the context that may be necessary for its expression. A long-standing problem in the field of comparative cognition is how best to integrate well-documented natural behaviors with an experimentally testable theoretical framework. Although much research has been motivated by interest in "cognition in the wild," there are relatively few examples of cognitive testing in wild populations. Here we describe the development of an automated cognitive testing system for wild birds. We housed groups of wild-caught birds in outdoor aviaries that approximated natural conditions, including natural light cycles, weather patterns, and social interactions. Individuals were fitted with rfID leg bands that allowed automated identification. We trained birds to interact with the cognitive testing equipment, which rewarded responses with a rich, preferred food reward. Birds completed hundreds of food-reinforced interactions a day despite ad libitum availability of other food. Here we describe initial training and successful acquisition of a delayed match-to-sample memory task. Finally, we discuss implications of automated testing of wild animals for comparative cognition research.

Rhesus monkeys (Macca mulatta) show evidence of working memory rehearsal for unfamiliar stimuli in the match to sample paradigm

Ryan J. Brady, & Robert R. Hampton (Emory University)

P48 In order to maintain representations in working memory, a rehearsal mechanism is required to protect information from effects of time and interference. In humans, this rehearsal process relies heavily on sub-vocal articulation and access to linguistic representations.Thus, the absence of language draws into question the extent to which nonhumans possess similar mechanisms of working memory rehearsal. Previous research in monkeys has only found evidence of working memory rehearsal when testing monkeys with highly familiar stimuli, and not with unfamiliar stimuli. One explanation may be that in tests of recognition memory such as the match-to-sample(MTS) paradigm, evidence of working memory rehearsal is not found with unfamiliar stimuli because monkeys choose the sample based on relative familiarity, rather than working memory. In the current study, we attenuated the use of familiarity in a novel MTS paradigm and observed the effects of concurrent cognitive load on memory performance. If monkeys are rehearsing the unfamiliar stimuli in working memory, then a concurrent cognitive load will decrease memory performance. Our results indicated that a concurrent cognitive load did decrease memory performance for unfamiliar stimuli, but only when familiarity was attenuated. These results provide evidence of active working memory rehearsal for unfamiliar visual stimuli.

The Effect of a Mid-Session Simple Discrimination Task on Performance in a Working Memory Task in Rodents

Shandy A. Nelson, Haily Kelliher, Katherine Dyer, Madeline Mason, Angela Goolsby, Aliana Raulerson, Nicole Webster, Katherine Bruce, and Mark Galizio(University of North Carolina Wilmington)

P49 The Odor Span Task (OST) is an incrementing non-match to sample procedure used to study working memory in rodents. In this task, responding to a novel odor stimulus (S+) is reinforced, but responding to a stimulus previously encountered within the session (S-) is not reinforced. The present study used an automated version of the OST in operant chambers equipped with olfactometers to minimize experimenter error and effort. Rats were trained on the OST using a successive conditional discrimination procedure (Go-No-Go). Twenty-six OST trials (13 S+ and 13 S-) were presented in each session, followed by 12 simple discrimination (SD) trials in which responding to one specified odor stimulus was always reinforced and responding to another specified odor stimulus was never reinforced. Once performance was both discriminative and stable, SD trials were moved to the middle of the session in order to assess whether the SD task functioned to disrupt performance on subsequent OST trials. OST performance following the SD task was impaired relative to performance before the SD task, although performance did recover with training. These results support the further development of the automated OST to study additional parameters of the effect of distractor tasks on working memory.

The Relationship between Number of Items and Performance in a Location Change-Detection Task with Humans and Pigeons

Justin Jacqmain, Nick Malone, Lauren Cleland, & Ken Leising (Texas Christian University)

P50 Investigations of iconic and working memory performance in non-human animals can be studied with a change-detection task. Our location change-detection task required humans and pigeons to view a visual sample display consisting of a specific number of colored circles (2, 4, 8, 12, and 16) on a touchscreen computer for one second, then, following a brief delay (0 ms, 100 ms, and 1000 ms), a test display appeared with one of colored circles in a new position. The subject must then touch, or peck, the colored circle that changed position. The data indicated that the pigeons performed significantly above chance levels on all delays at sample display sizes 2, 4, and 8 but not with 12 and 16 items and a delay of 1000 ms. The data for humans indicated that humans performed significantly above chance during all combinations of delays and set sizes. Performance across species during different delays and sample display sizes will be compared.

Adaptive Memory: Is there a reproductive processing effect?

Cody W. Polack, Ben M. Seitz, & Ralph R. Miller (Binghamton University (SUNY))

P51 Like all biological systems, human memory likely has been influenced by selective mechanisms. Consequently, human memory should be tailored to better remember information relevant to one's evolutionary fitness. Supporting this view, participants asked to rate words based on their relevance to a survival situation better recall those words than words rated with respect to non-survival situations (i.e., survival processing advantage). This suggests a parallel advantage for recall of information that has been rated for relevancy to reproduction, although little evidence exists to assess this proposition. We used paradigm similar to that of the original 'survival processing effect' study (Nairne, Thompson, & Pandeirada, 2007), and across three experiments tested several novel scenarios to determine whether a reproduction processing effect can be found in an ancestral environment, a modern mating environment, and an ancestral environment in which the emphasis was on raising offspring as opposed to finding a mate. Our results replicated the survival processing effect, but provided no evidence of a reproduction processing effect when the scenario emphasized finding a mate. However, when rating items on the relevancy to raising one's offspring in an ancestral environment, a mnemonic advantage comparable to that of the survival processing effect was found.

3D Match-to-Sample in Spider Monkeys

Cassie Vergason, & Darby Proctor (Florida Institute of Technology)

P52 Match-to-sample paradigms have been used for many years to explore learned association and memory in animal species. Frequently, this is done either in an operant conditioning chamber or on a computer. Both methods rely on using two-dimensional visual stimuli. However, relatively little work has been done with match-to-sample paradigms with physical objects. We are interested in whether spider monkeys (Ateles geoffroyi; n=4) can learn a three-dimensional match-to-sample paradigm. The monkeys are presented with a physical object that they must touch and then, after a brief time delay, are asked to choose between the sample and an alternative object. The results of this study may help elucidate the connection between 2D and 3D perceptive abilities. As a secondary goal, we are interested in determining whether these specific individuals can perceive color. Color vision in spider monkeys varies among individuals due to the differing genetics of males, who have dichromatic vision and certain females who have trichromatic vision like humans. This will provide us with more information on the evolution of color vision in these primates, as well as guide future enrichment for these individuals. Keywords: spider monkey, match-to-sample, color vision

Examining Illusory Motion Perception in Pigeons

Dina Bedri, Muhammad Qadri, & Robert Cook (Tufts University)

P53 Illusions are a revealing means of analyzing the visual system. Testing illusions in non-humans animals allows for comparisons between their visual/cognitive systems and our own. Few animal studies have focused on illusions eliciting illusory motion perception from static displays. Here we analyzed whether pigeons (Columba livia) perceived motion the Rotating Snakes Illusion (RSI). We trained three pigeons to discriminate between static and explicitly moving circular objects in a symbolic matching task. Pigeons were then tested with a number of novel objects at increasingly slower speeds. Once this movement vs. static discrimination was well-established, the pigeons were tested on probe trials with the RSI and additional controls. We discuss the implications of these results on pigeons' visual processing of motion.

Visual Object Recognition in North American River Otters (Lontra canadensis)

Irene Fobe, Caroline M. DeLong (Rochester Institute of Technology), Catina Wright (Seneca Park Zoo), David Frye, & Jennifer Dami (Rochester Institute of Technology)

P54 There is little research on visual object recognition in otters. We explored the ability of two North American river otters (Lontra canadensis) to visually discriminate between objects in a two-alternative forced choice task. Each otter was trained with a different pair of objects that varied in shape and color (Heather: red circle and blue triangle, Sara: yellow square and red circle). Once the otters met the training criterion (75%), they were given twelve ten-trial test sessions. Each session consisted of six trials with the training objects and four probe trials with novel objects. The novel objects were either color probes (the same shape as the training objects but different colors) or shape probes (the same color as the training objects but different shapes). The otters chose the novel color probe stimulus with the same shape as their training S+ object 96% (Heather) and 71% (Sara) of the time. They chose the shape probe stimulus with the same color as their training S+ object 75% (Heather) and 50% (Sara) of the time. These results suggest that the otters could use both shape and color to discriminate between objects, and that there may be individual differences in cue use.

Numerical Ability in Horses

Tammy McKenzie, & Lisa Kitz (Brandon University)

P55 Relatively few studies have examined numerical competence in horses, either trained (Gabor & Gerken, 2014; Petrazzini, 2014) or spontaneous (Henselek, Fischer, & Schloegl, 2012; Uller & Lewis, 2009). The studies examining spontaneous numerical abilities have reported conflicting results. The current research examined both spontaneous and trained numerical ability in horses. To examine spontaneous numerical ability, horses were tested using a two-choice task. Each horse was tested using the following quantity discriminations: 1 vs. 2, 2 vs. 3, 3 vs. 4, and 4 vs. 6. They were presented each quantity discrimination twice, once when the volume was controlled and once when volume was not controlled. To examine trained numerical ability, horses were presented with quantity discriminations (1 vs. 2, 2 vs. 4, and 4 vs. 6) on two computer monitors and were rewarded for selecting the correct quantity (either larger or smaller, depending on the horse). Very little evidence was found for spontaneous numerical abilities in horses. However, horses were able to learn to discriminate based on number for the smaller numerical contrasts (1 vs. 2 and 2 vs. 4) supporting previous findings related to trained numerical competence in horses. The 4 vs. 6 quantity discrimination was not learned.

P56 Moved to the End of Session I

(Dis)similarities in Multiple Systems Approaches to Mindreading

Brandon Tinklenberg (York University)

P57 Primates may be responsive to others' perceptual perspectives, though this capacity is generally distinguished from children's ability to verbally reason about others' beliefs. That said, testing belief representation by measuring preferential looking times has some now thinking preverbal infants have mindreading skills as well. Some conjecture that mindreading is not a unitary process, but rather can be decomposed into unique social cognition skills with divergent evolutionary and developmental trajectories. Just as one might distinguish between explicit and implicit knowledge of the causal structure of some physical system, we might discover multiple processing systems for mindreading. Recently Krupenye et al. (2016) show chimpanzees' preferential looking times are comparable to those of preverbal infants on false belief tasks. This raises the question whether or in what sense chimpanzee belief representation is comparable to that of preverbal infants. Progress here relies on disentangling automatic belief representation and perceptual mindreading. Ways of tracking what information is available to conspecifics through perception that may or may not be linked to having a belief that the world is such and such a way. Here I assess revisionary taxonomies that posit intermediary folk psychological states which intend to further clarify the multiple systems approach to mindreading.

Factors Affecting The Social Transmission of Food Preference

Chelsey Damphousse, & Noam Miller (Wilfrid Laurier University)

P58 Living in a group has several benefits. The more individuals in one location, the greater the opportunity for sharing information concerning the location and quality of food. It is well known that interacting rats adopt the food preferences of conspecifics, known as the social transmission of food preference (STFP; Galef, 1984). Additionally, as an increasing body of research shows, information transfer in groups may depend on consistent individual differences (sometimes called 'animal personalities'). We explored the effect of these differences on STFP in pairs of rats. Prior to placing rats into pairs, their individual 'personality' was tested, resulting in scores for each rat's boldness and sociability. Pairs were constructed to consist of a specific mix of traits and given similar or differing food preferences (for cocoa- or cinnamon-flavored food). To determine how food preferences are affected by conspecifics in a more naturalistic setting, pairs were placed into a foraging arena in which powdered food of both kinds could be found. Using a combination of STFP and social exploration of a novel environment, we provide an explanation of how transmission and sharing of social information in a naturalistic setting may be altered by individual differences as well as by pair dynamics.

P59 Moved to the End of Session I

Does Personality Similarity in Bottlenose Dolphin Pairs Influence Dyadic Bond Characteristics?

Kelsey R. Moreno (University of Southern Mississippi), & Lauren Highfill (Eckerd College)

P60 Social structures are crucial to the success of many species and have repercussions on individual and population health, well-being, and adaptation. Yet, little is known about the factors which shape these structures aside from ecology and life history strategies. Dyadic bonds are the basis of all social structures; however, mechanisms for formations of specific bonds or patterns in which individuals form which types of bonds have yet to be demonstrated. There is a variety of evidence indicating personality may be a factor in shaping bonds, but this relationship has not been explored with respect to bond components and is yet to be demonstrated in dolphins. This study related personality similarity with relationship components using a captive population in a naturalistic environment Dyadic bond strength and characteristic qualities were assessed using an exploratory factor analysis to group interactions recorded via underwater videos. Personality was assessed using a Five Factor Model questionnaire. Then, the relationship between the two was determined with a structural equation model. This study expands our understanding of the formation of bonds between individuals and the evolution of social structure. Furthermore, it better equips us for making informed environmental policy decisions and improving captive animal care.

Robot dragons: Using robots to investigate reptile social cognition

Anna Frohnwieser, Thomas Pike, John Murray, & Anna Wilkinson (University of Lincoln)

P61 Robotic animals are widely used in the study of animal behaviour, as they can realistically recreate social stimuli while providing full experimental control. However, their use within animal cognition has been surprisingly limited. Here, we describe our work using robotic bearded dragons (Pogona vitticeps), constructed in accordance with the animals' perception, in social behaviour and cognition experiments. The robots were used to investigate live animals' responses to variation in a key social stimulus (head-bobbing) using a social enhancement paradigm, the results of which will be presented in this talk. We offer several novel insights into the construction and use of robotic animals for animal cognition research.

Cognitive Mechanisms of Reorientation: A Dual Task Study of Humans in a Virtual Environment

D. Gregory Sullens, Z. Kade Bell, Alex Bern, Bradley R. Sturz, & Kent D. Bodily (Georgia Southern University)

P62 The stimuli which control spatial reorientation are often studied via incidental-learning procedures in diverse species (e.g. rats, pigeons, and humans). One common procedure is to train subjects to orientate towards a discrete landmark prior to testing in the absence of the landmark and/or prior to an affine transformation of the landmark within the environment. Cognitive mechanisms involved in linguistic and mathematical abilities have been suggested to be crucial in the process of learning and attending to environmental stimuli which control spatial reorientation. Dual task procedures are commonly utilized for human subjects to gain understanding of the cognitive mechanisms underlying behavior. In the present study, we trained human participants to reorientate towards a goal location within a rectangular enclosure in a desktop virtual environment while under three dual task conditions. Identical goal locations were located in each corner of the enclosure, and a single shaded wall acted as a featural cue for orientation. Participants experienced all three dual task conditions. Following training, and still experiencing the distractor task, participants completed Geometry and Affine tests. Results provide evidence for the roles linguistic and mathematical cognitive mechanism play for reorientation purposes – supporting the adaptive combination view of spatial cognition.

Neurofunctional Correlates of Geometry and Feature Use in a Virtual Environment

Martha R. Forloines, Andie M. Thompkins, Meredith A. Reid, Jennifer L. Robinson, & Jeffrey S. Katz (Auburn University)

P63 Previous research in humans and nonhumans has been studied in depth. However, results from human studies show mixed results regarding differentiation of the hippocampus and medial temporal lobe structures when relying on landmarks versus environmental geometry in spatial tasks. To help elucidate mixed findings, participants engaged in a 3-D virtual environment analogue of the reorientation task while undergoing fMRI scans in which they learned the landmark-to-corner relationship. Participants searched for a goal which was a distinct landmark, or featural cue, consistently situated in one corner, or geometric cue, of a rectangular room. Test trials varied the relationship between featural and geometric cues allowing insight into the neurofunctional role in spatial navigation when utilizing these cues. Results show functional differences when features are presented alone: recruitment of the parahippocampus when utilizing geometry, and the caudate is active with landmarks alone. When cues are in conflict, various navigationally relevant structures are employed (e.g., PCC, cuneus, and precuneus). Behavioral and neurofunctional results will be presented in relation to previous mixed findings. Comparative implications will be discussed.

Features Facilitate Encoding of Geometry by Mice

Kevin Leonard, Benedict Albensi, & Debbie M. Kelly (University of Manitoba)

P64 Geometric (e.g., distance and direction) and featural cues (e.g., colour and texture) are two visual components of the environment mobile animals can use to guide reorientation. Many species studied to date have shown an incidental encoding of geometry in a feature-rich environment. The prevalence of mouse models for understanding human disorders of spatial memory (e.g. Alzheimer's disease) necessitates a better understanding of the abilities of the normal healthy control wild-type mouse. We trained adult C57Bl/6 mice to search for hidden escape platforms in geometrically equivalent corners of a rectangular water maze. Half of the mice were trained with uniform white walls, and half of the mice were trained with feature patterns disambiguating the two geometrically correct corners. Our results show mice trained with the feature patterns required fewer trials to learn the geometric properties of the environment compared to the mice trained in white wall environment. Probe tests revealed that mice trained with the feature patterns were also able to transfer their geometric knowledge to the white walled environment. Behavioural and neuromolecular data show that features facilitate the encoding of geometry.

Dissociating reward rate- from timing-mediated transfer of temporal information across different modality cues

Emma Brousseau (Villanova University), Benjamin J De Corte (University of Iowa), & Matthew S Matell (Villanova University)

P65 In rats trained that the same reward may be available at different times, depending on the modality of a cue, we found that shifting the delay associated with one cue results in similar directional shifts in temporal responding towards the other cue (De Corte et al, submitted). Our 'common cause hypothesis' states that animals assume that different signaled durations covary due to variability in internal or external forces.The current study investigated whether these shifts result from a change in time ora change in cued reward density. Experiment 1trained rats with an 8s FI (tone) and a 16s FI (light). We thenchanged the light to a 32s FI, and doubled the reward for half the rats to keep cued reward density constant. We found that both groups right-shiftedtheir temporal expectation to the 8s cue equivalently. In Experiment 2, half the rats had their 16sFI changed to a 32s FI, while keeping reward amount fixed, whereas the others received half the reward, but the delay was unchanged. Testresponses to the 8s tone shifted to the right more in the time-shifted group. These results indicate changes in temporal expectation, rather than cued reward density, drive temporal updating.

Diurnal and Nocturnal patterns in activity and social behavior of Chambered Nautilus

Mahwish Ashfaq (Brooklyn College City University of NY), Naomi Lewandowski, Rebecca Cohen, Jillian Vanzandt, Divya Roy, Ned Ellis, Yasmely Luna, Jaylene Salas, Samantha Vouyiouklis, Omar Batista, Sana Parvas, Vanessa Robinson, & Jennifer Basil (CUNY Graduate Center)

P66 Cephalopod mollusks (Octopuses, etc) are well known for their vertebrate like intelligence and unique behavioral repertoires. However, little is known about the capabilities of the Chambered Nautilus, often called a living fossil. A deep-water, solitary animal, Chambered Nautilus makes repeated daily migrations from deep waters generally to shallower areas to forage along coral reefs. However, these field observations are rare, and show substantial variation. It is unknown what modulates these daily rhythms – it could be the detection of light driving the dives to deeper depths, or these daily rhythms could be an expression of an endogenous circadian clock. We continuously videotaped a captive group of nautiluses (N=5) under three L:D conditions, of 4 days each. We measured their activity levels, movement patterns, and inter-animal associations for one minute every 10 minutes. Nautiluses show clear entrainment to 12:12 Light: Dark, with peak activity in darkness, beginning around subjective dusk. In constant darkness, subjective dusk/night activity rhythms persisted, although the free-running period was less than 23h. We also documented their inter-individual affiliations under all treatment conditions and found social affiliations amongst sets of animals, and we describe how those patterns vary across day and night conditions.

On the Clock: Interval Timing and Overshadowing in the Domestic Dog

Krista M. Macpherson & William A. Roberts (University of Western Ontario)

P67 Interval timing is an important skill that allows animals to approximate how much time has elapsed since a given event. Little, however, is known about interval timing in domestic dogs. In an initial experiment, dogs were trained to make an operant response on a 30-second fixed interval schedule cued by a light-tone compound signal. When dogs were subsequently tested with nonreinforced 60-second probe trials containing the light-tone compound or the tone alone, rate of responding peaked around 30 seconds. The same dogs showed no evidence of timing when given light-only probes. In a second experiment, a bi-section task was used in which dogs learned to make one response when given a light-tone compound signal for 8 seconds and another response when given the signal for 2 seconds. Probe-trial tests then given with signals presented at 1-second intervals between 2 and 8 seconds revealed psychophysical curves showing control of responding by the light-tone compound and the tone alone, but not by the light alone. These findings demonstrate clearly that dogs are able to time fixed intervals and demonstrate an overshadowing effect of tone over light.

Ontogeny of nut-cracking by wild juvenile capuchin monkeys (Sapajus libidinosus) through kinematics analysis

Ariel Ashline-Winters, & Dr. Qing Liu (State University of New York at Oswego)

P68 Capuchin monkeys are among the few nonhuman primates that use tools regularly to crack nuts on wooden anvils using stone hammers. It is a lengthy learning process and juveniles must gain familiarity of this activity through observance and repetitive practice until they can successfully crack the nuts. Longitudinal data involving the movements of fourteen juvenile capuchin monkeys (aged 0.5 to 7.5 years over seven years) was analyzed to investigate the trajectory of tool-use development and to examine the pattern of preparation prior to obtaining success. Results of 810 strikes show that the lifting height of the hammer stone and maximum downward velocity prior to contact tend to increase with age, though with a large variability within and between individuals. Individual data throughout the monkeys' lifetime ranged from 1-28 episodes and 5-190 strikes per individual. Bodily angles such as knee extension, elbow extension and upper trunk inclination follow the same trend. Nonhuman primates hold large implications on human evolution and the origin of percussive tool use in humans, as well as habitual bipedalism. Our study helps shed light on ontogeny of this strenuous tool use behavior and may inform about development of human percussive tool use.

Captive Orangutans (Pongo pygmaeus pygmaeus) Use Water as a Tool in a Problem-Solving Task

Christina C. Burnett, & Caroline M. DeLong (Rochester Institute of Technology)

P69 The purpose of this study was to examine orangutans' ability to use water as a tool to extract a peanut from a transparent tube. This task was adopted from Mendes et al. (2007), and was a novel task for the two adult orangutans tested at the Seneca Park Zoo. Three conditions were presented with the difficult condition first. In the easy condition the tube was filled quarter-full with water. In the intermediate condition, the tube had no water and six stick tools were provided. In the difficult condition, the tube had no water and no rigid tools were provided. The only way for the orangutan to obtain the peanut was to spit water into the tube. The female orangutan was successful in 50% of sessions while the male orangutan was successful in 100% of the sessions. Both were successful in the easy and intermediate conditions; but only the male was successful in the difficult condition. This is the first evidence that an orangutan can solve this problem in the difficult condition when it is presented first. These results show that orangutans are capable of using water as a tool, and that orangutans are capable of insightful problem solving.

The role of temperature in zebra finch nest structure

Tanya T. Shoot, R. Jeff Martin, & David F. Sherry (Western University)

P70 There has been a great deal of recent interest in physical cognition in animals. Tool use, for example, is widely regarded as involving complex physical cognition. Nest building, which involves similar manipulation of the physical environment, is often regarded as instinctive. My research examines the cognitive components of nest building, specifically behavioural flexibility and the effects of temperature on nest building. Thirty-six pairs of zebra finches (Taeniopygia guttata) were assigned to two conditions: hot (30°C) and cold (14°C), and provided with ad libitum access to nest-building material. Pairs were allowed to build in shallow nest cups, incubate, and raise nestlings until they became independent. Body composition of parents was measured to assess the physiological consequences of nest building and incubation at different temperatures. Preliminary results show that birds building in colder conditions were more motivated to build and built at a higher rate than birds in the hot condition. The structure of nests differed between hot and cold groups, showing that zebra finches respond flexibly to the temperature in which nest building occurs and actively modify the physical properties of their nests in response to ambient temperature.

The influence of foraging behaviors, innovation, and inhibition on behavioral flexibility in bears and cats

Zoe Johnson-Ulrich (Oakland University), Tamra Cater (University of Colorado), Bonnie Perdue (Zoo Atlanta), Charles Robbins (Washington State University), Ellen Furlong (Illinois Wesleyan University), Jennifer Johnson, Ella Brown (Zoo Atlanta), Brandon Evans-Hutzenbiler, Monica Bando (Washington State University), Daniel McCarthy (Illinois Wesleyan University), Paige Barnes, Lily Johnson-Ulrich (Michigan State University), & Jennifer Vonk (Oakland University)

P71 Several theories pertaining to the evolution of advanced cognition suggest that foraging complexity may be a selective pressure for advanced cognition. Aspects of foraging complexity include having a generalist diet, engaging in extractive/manipulative foraging (including tool-use), and having food that is patchily distributed in space and time. We examined the role of these factors across bear (Brown bear, sun bear, spectacled bear, polar bear, and giant panda) and cat (Amur tiger, Amur leopard, and Canadian lynx) species on problem-solving success using a puzzle-box that measures behavioral flexibility, a key component of advanced cognition. We compared performance as a function of species and foraging complexity. In addition, we explored the relationship between innovation, inhibition, and behavioral flexibility with regard to solutions tried with our puzzle-box. We presented five grizzly bears four additional tasks measuring innovation (a novel tool task and a novel object task) and inhibition (a detour task and a reversal learning task) and compared performance on these tasks to each other and to the puzzle-box performance.

Behavioural flexibility by bumblebees on a foraging task

Caroline G. Strang, & David F. Sherry (Western University)

P72 Extracting nectar and pollen from flowers efficiently is essential to successful foraging by bumblebees. Flower handling requires learning and there is an efficiency cost when bees are required to switch repeatedly between flower types. We developed two tasks that model flower handling, each requiring a distinct motor pattern. The tasks required either lifting or depressing a door to access nectar, but general task demands and overall features of the apparatus were otherwise similar. Bumblebees (Bombus impatiens) were trained on one task for 10 trials and then the other task for 10 trials, in a counterbalanced order. Rather than showing a cost of switching, bees that learned a task second showed a shorter latency to success than bees that learned that task first. In addition to learning the specific motor pattern required to extract nectar from a flower, foraging bees learned general task demands that facilitated acquisition of subsequent different motor patterns. Our research suggests that bumblebee foraging has a 'learning-to-learn' component, such that acquiring handling strategies for new flowers is faster for bees with previous flower handling experience.

Did Someone Say Free Food? Observations of Scavenger Behavior in Relation to Urbanization.

Adam M. Stern, Takia N. Smith, Lauren Wheat, Ashley Tatham, & Stephanie E. Jett (University of South Alabama)

P73 Our research discusses observations made of the behaviors of scavengers in and around Mobile County, Alabama utilizing camera monitored bait stations. Here, discussion occurs within the framework of ecological pressures along an urban to rural gradient. Urbanization presents an interesting laboratory for the study of ecological pressures. The processes of urbanization entail drastic changes in landscape and trophic structure. In addition, urbanization tends to not occur in an all-or-nothing manner, but rather as a gradient allowing for the study of ecological pressures along degrees of urbanization. It is hypothesized that urbanization will lead to a more diverse array of species acting as scavengers as you move from more rural to more urban areas. In addition, it is hypothesized that pressures resulting from urbanization will lead species rarely seen scavenging in more rural environments to act as scavengers in more urbanized areas. Preliminary results indicate some support for the hypotheses in terms of varying diversity of assemblages. In addition, distinctions will be made regarding scavenging versus the larger animal assemblages present in the areas. Results from this project will be used in informing the design of apparatus to be used in cognitive testing of these species in the future.

Do Capuchin Monkeys (Cebus apella) Show Self-Control Depletion After Food Exchange and Accumulation Tasks?

Brielle James, Mattea Rossettie, Travis Smith (Georgia State University), Anamaria Otalora-Garcia (University of Georgia-Athens), Michael Beran (Georgia State University), & Audrey Parrish (The Citadel)

P74 The ego-depletion hypothesis states that self-control diminishes over time and with exertion. In a study of the potential depletion effects on self-control, capuchin monkeys were presented with a series of consecutive self-control tasks. Monkeys first were trained to complete a food exchange task with exchange combinations that either decreased or increased in quality. Self-control was required in foregoing an immediately available food for a potentially better reward in the future. Monkeys then completed consecutive self-control tasks to assess depletion effects. Monkeys first completed the accumulation task, in which they were presented with food items one-by-one until the subject retrieved and ate the accumulating items. This required continual inhibition of food retrieval in the face of an increasingly desirable reward. Individual differences in accumulation performance were observed, but no depletion effects were seen in the monkeys' exchange performance. In another experiment, monkeys were presented with both of these tasks counterbalanced across individuals. No order effects were observed in the monkeys' performance on either task. Monkeys' exchange performance was not significantly correlated with their accumulation performance in either experiment. These results indicate that these two tasks may not be related in terms of underlying mechanisms that support performance.

P75 Withdrawn

The Behavioral Effects of Environmental Enrichment and Age in a Large Sample of Captive Tigers (Panthera tigris)

Kate M. Chapman, Lilly Sage McCoy, Luke Gould, & Chase Holiman (University of Arkansas)

P76 Animals often experience increased levels of stress in captivity, resulting in stereotyped behaviors (e.g. pacing, over-grooming) and reduction in species-typical behaviors. Environmental enrichment is typically used to reduce negative behaviors and increase positive behaviors in captive animals. While previous studies have examined the effects of environmental enrichment on captive felids, significant effects are rare due to small sample sizes (N = 2-5). This study evaluated the efficacy of several types of enrichment in a sample of 46 captive tigers (Panthera tigris) at Turpentine Creek Wildlife Refuge. Using focal-animal sampling and time sampling, tiger behavior was assessed in both enriched and baseline conditions. The within-subjects paradigm included scent-only, scented organic object, scented inorganic object, unscented inorganic object and feeding enrichment. While overall activity level was similar during enriched and baseline conditions, tigers displayed a greater diversity of behaviors during enriched sessions, and displayed more stereotypy in baseline sessions. During feeding enrichment, tigers were more active overall than in baseline sessions. Unexpectedly, there was no effect of age on any of the behavioral variables. This may be due to the superior pain reduction practices at TWCR. Alternatively, geriatric tigers may be equally active to compensate for chronic pain.

An investigation of a potential submissive signal in a group of captive Asian elephants (Elephas maximus)

Morgan Melhuish, & Radhika N. Makecha (Eastern Kentucky University)

P77 Group living has many advantages, including protection in numbers, ease in finding resources, and group care of young. In spite of these advantages, tensions can arise when there are limited resources. Social hierarchies are one way in which group tension is mitigated. In order to maintain a social hierarchy, signals are often used to display rank, including behaviors that indicate dominance or submission. Elephants are one such species where social hierarchies are evident, and there are many descriptions on what behaviors may signal dominance/submission, although very few of these behaviors have been studied systematically. One such behavior is the rear orient behavior in elephants, where it is thought that lower-ranking animals will orient their rear towards higher-ranking elephants as a signal of submission, including placement of the tail into the trunk or mouth of a dominant elephant. This study examines the occurrence of this behavior in a captive herd of Asian elephants (Elephas maximus) housed at Busch Gardens in Tampa, using the suggested social hierarchy of the herd as well as individual differences to interpret the findings.

The effect of rank on use of automated touchscreen testing systems by socially-housed rhesus macaques (Macaca mulatta)

Meredith Lutz (Bucknell University), Regina Paxton Gazes (Bucknell Unviersity), Mark J. Meyer (Georgetown University), Thomas C. Hassett, & Robert R. Hampton (Emory University)

P78 Studying cognition in socially-housed animals is becoming increasingly common due to technological advances that allow for individual identification. Participation in studies with automated testing systems is voluntary and self-selecting, so social factors such as dominance rank may impact access to and interest in cognitive testing. We studied the effect of rank on working patterns in socially-housed rhesus macaques that had continuous access to four automated computer testing systems. The group was broken into three approximately equal-sized rank categories: high, medium, and low, based on observed dominance interactions. High and low ranking macaques were equally likely to complete the initial touchscreen training, and those that completed training showed no difference in engagement with the touchscreens over the four-year test period. However, high and low ranking individuals distributed their working times differently throughout the day. Additionally, monkeys tended to work on the computers at the same time as other animals from their rank group. These results indicate that although high- and low-ranked individuals show similar levels of engagement with the automated testing systems, social factors that impact group dynamics also influence cognitive testing activity.

The effects of environmental enrichment on bobcats (Lynx rufus) in captivity

Patrick Ueltschi, Robert W. Mitchell, & Radhika N. Makecha (Eastern Kentucky University)

P79 Multiple enrichment techniques were used with the goal of enhancing the lives of a male and female bobcat (Lynx rufus) sharing a large enclosure at the Salato Wildlife Center in Frankfort, Kentucky. These techniques included introducing new scents, providing foods that the bobcats did not have access to daily, and covering various areas of their enclosure with deadfall in an attempt to decrease pacing. We expected that the enrichments would increase exploratory behavior for both animals. Additionally, due to the male bobcat's tendency to remain stationary and the female bobcat's tendency to move about extensively, we expected enrichment to increase the male's tendency to be active and decrease the female's tendency to be hyperactive. Each animal was observed for two weeks prior to, during, and after the implementation of enrichment. Consistent with predictions, the bobcats explored more during the enrichment period than before or after. Additionally, the female spent more, and male less, time being stationary during the enrichment period than during the post-enrichment period. However, there were no differences in pacing across the enrichment periods. The results suggest that the enrichment period benefited the bobcats by providing engaging stimuli and, in the male's case, by interrupting his inactivity.

P80 Withdrawn

The effects of seasonal temperature on neophobia and problem solving in black-capped chickadees (Poecile atricapillus)

R. Jeff Martin & David F. Sherry (Western University)

P81 Birds residing in northern temperate zones endure stressful conditions for extended periods of time. Black-capped chickadees (Poecile atricapillus) inhabit much of North America and in some regions are subjected to harsh winter conditions for many months of the year. Previous studies have shown that birds inhabiting harsh climates have cognitive advantages over birds from less harsh climates (e.g. Roth et al. 2010, Proc Roy Soc B). This difference has been found between populations from different geographic latitudes, and different altitudes. Though temperature is a major component of environmental harshness, previous studies have not isolated the specific effects of temperature. I examined the impact of seasonal winter temperature on cognition in a population of Ontario chickadees. Birds were housed outdoors and exposed to either natural variation in winter temperature or warm conditions produced by heating birds' outdoor enclosures. Birds' performance on tests of cognition and neophobia was scored. Preliminary results suggest that birds subjected to warmer winters may be more neophobic than birds exposed to natural variation. Results also suggest that birds enduring warmer temperatures had cognitive advantages when compared to birds enduring cold temperatures.

A Comparison of Simultaneous and Delayed Conditioning Procedures

Stephanie Wathen, Alison M. Betz, Jeanine R. Tanz (The Florida Institute of Technology and The Scott Center for Autism Treatment), & Christopher A. Podlesnik (The Florida Institute of Technology and The Scott Center for Autism Treatment and The University of Auckland)

P82 Conditioning procedures are commonly used within applied settings to establish conditioned reinforcers. This is important as children with intellectual disabilities, especially autism, have restricted interests and often do not respond to social reinforcers. While there are studies in the applied literature that indicate conditioning procedures may be effective, there is a lack of direct comparisons evaluating procedural variations. The purpose of the current study was to compare one common variation, delayed conditioning and simultaneous conditioning. The conditioning procedures including pairing a neutral stimulus (a picture) with a reinforcer to determine if the neutral stimulus would take on the reinforcing properties of the reinforcer, thereby becoming a conditioned reinforcer.

An investigation of a potential play signal in a group of captive Asian elephants (Elephas maximus)

William O'Daniel, & Radhika N. Makecha (Eastern Kentucky University)

P83 Asian elephants engage in a variety of social behaviors, including tactile behaviors. The goal of this study was to investigate one of these tactile behaviors, trunk on head placement, where an elephant places two-thirds of its trunk on another elephant's head, in more detail. Our interest in looking at this behavior in greater detail stemmed from its association with two other tactile behaviors that are described to be affiliative in the literature: trunk to mouth placement (where one elephant places its trunk in another elephant's mouth) and trunk tip placement (where two elephants touch the tips of their trunks together). Trunk on head placement behaviors were also observed to occur frequently with what is described as trunk wrestling/trunk twining behavior in the literature, which is thought to be a type of play behavior. Due to the occurrence of trunk on head placement behavior with trunk tip placement behavior, trunk to mouth placement behavior, and trunk wrestling/twining behavior, we investigated this behavior in greater detail, aiming to systematically quantify its occurrence with these behaviors. Additionally, we investigated its potential as a play signal.

Inhibition mediated by neophobia in magpies (Pica hudsonia) and scrub-jays (Aphelocoma californica)

Meara Stow, Alizée Vernouillet, & Debbie Kelly (University of Manitoba)

P84 Inhibition (i.e. restraint of a contextually futile response in favor of a more rewarding behavior) can indicate a species' complex cognitive abilities. Ecological and physiological factors underlying this ability have been previously studied, however neophobia (i.e. reluctance to explore a novel environment) has not received much attention. Neophobia affects an individual's interaction with its environment, so this study will seek to determine the effect of neophobia on the ability to exert inhibitory control. During this study, we measured neophobia in two corvid species, six black-billed magpies (Pica hudsonia) and six Western scrub jays (Aphelocoma californica), based on propensity to explore a novel environment. Inhibition by the two species was measured in a detour-reaching tube task. Individuals had to restrain the instinctual response to peck directly at a transparent tube, instead detouring around to retrieve food from the side opening. The relatively less neophobic scrub jays detoured more readily and used more strategies to detour compared to the highly neophobic magpies. We propose neophobia as a potential factor underlying inhibition, and call for its consideration in future experiments to explore complex cognitive abilities.

Is social rank correlated with cognitive ability in black-capped chickadees?

Gloria Cho, David Sherry, & William Roberts (The University of Western Ontario)

P85 In the wild, dominant individuals control access to limited resources such as food. As a result, subordinate individuals may forage more readily in novel locations or on novel food types. The importance of exploiting novel foods could mean subordinates are better at associative learning than dominants. There may be a trade-off between dominance and cognitive capabilities in which physically dominant individuals fall short cognitively. Here, we asked whether dominance rank is correlated with cognitive ability in black-capped chickadees. We determined dominance rank in six flocks of six chickadees each and tested all birds on cognitive tasks. Chickadees were socially housed to maintain social structure, but cognitive testing was conducted individually. Dominance was assessed daily by observing interactions between flock mates. Cognitive tests examined the ability to associate color cues and spatial locations with food reward. Although subordinate birds in some flocks performed better on some associative tasks, the overall results show variation among flocks in both the linearity of dominance ranks and the relation between dominance rank and cognitive performance.

Visual and Olfactory Recognition of Individual Humans by African Elephants

Victoria Perret, & Preston Foerder (The University of Tennessee at Chattanooga)

P86 Previous research has shown that African elephants (Loxodonta africana) can distinguish between familiar and non-familiar conspecifics. In addition, African elephants have been shown to be able to distinguish between human ethnic groups through vision and olfaction. We investigated whether elephants were capable of recognizing individual humans through vision and olfaction. Our subjects were 3 captive African elephant. Visual recognition was tested using a matching to sample procedure. Initially, the elephants were trained to touch a photo of the person holding an array of 3 photos, one matching that person. Two more sessions were then conducted with 2 other people holding the array as the sample. Recognition was determined if the elephant touched the correct photo at better than chance levels over 20 trials and transferred the ability across the three individuals. Using similar methodology, olfactory recognition was assessed using a t-shirt worn by an individual as the sample above the photo array. The t-shirts of 3 different individuals were used in different sessions. Knowledge of the cognitive abilities of elephants, such as individual recognition, can be useful in both captive elephant welfare and conservation in the wild.

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