Proceedings of the 18th Annual International Conference On Comparative Cognition

Talks
Posters

Sponsored by the
Comparative Cognition Society

March 2 to March 5, 2011

Radisson Hotel

Melbourne Beach, Florida

President	Jonathon Crystal
Conference Organizer	Debbie Kelly
Secretary	Jeffrey Katz
Treasurer	Michael Brown
Program Committee	Deb Kelly (Chair), Jon Crystal, Steve Fountain, Jeff Katz, Ken Leising, Suzanne MacDonald
Team CO3	Adam Goodman, Lauren Guillette, Marisa Hoeschele, John Magnotti, Christiane Wilzeck
Member-at-Large	Chris Sturdy

Past Presidents	Mike Brown, Bob Cook, Suzanne MacDonald, Marcia Spetch, Ed Wasserman, Ron Weisman, Tom Zentall

C03 - 2011 Program Summary

Discrimination Learning	12:47	13
Tool-use, Causality & Behavior	2:09	14
Perception	2:44	15
In Honor of the Contributions of Alex Kacelnik	4:15	15
Master Lecture Alex Kacelnik	6:00	16
Banquet	7:30	16
Saturday		
Business Meeting of the Comparative Cognition Society	1:00	17
Group Photo Shoot	2:10	17
Cognitive Processes	2:45	17
Attention & Associative Processes	4:21	18
Closing Remarks	5:24	19
Poster Session II	8:30 - 11:00	26

3:30 PM *Welcome Reception & Check-In*

Wednesday Evening

7:00 PM Opening Remarks - Jon Crystal

7:05 PM Metacognition & Numerosity (Chair: Jon Crystal)

1 7:05 PM **Action monitoring and self-identification**

Justin J. Couchman (University at Buffalo, the State University of New York)

It has been suggested that some form of metacognition is the basis for sophisticated human mental abilities such as self-awareness and theory of mind. Our metacognitive self-monitoring allows us to understand our own mental states and know that we cause actions. It is thus important to understand the nature of metacognition, how and when it emerged evolutionarily, and whether or not any nonhuman animals share this ability. Converging evidence in comparative cognition has shown that some animals have the ability to monitor their mental states, some understand the relationship between kinaesthetic movements and perceived events, and some can identify their bodily movements. However, in all of these paradigms the critical behaviors – secondary responses, glances, body-touches, etc – are optional and are not rewarded. This inevitably leads to a variety of alternative explanations for why animals might exhibit or not exhibit the behaviors. The reported experiments on humans and rhesus monkeys use an abstract, computer-based task that requires the identification of self-caused actions. This moves the critical response from an optional, non-rewarded behavior to the rewarded primary response. Success in the task therefore requires the ability to monitor self-caused actions, possibly via a metacognitive system.

2 7:12 PM **Information-seeking by orangutans: A generalized search strategy?**

Heidi L. Marsh & Suzanne E. MacDonald (York University)

Recent work in comparative metacognition has suggested that some species of non-human primates may be aware of their knowledge states. One finding to support this claim is that great apes seek information about the location of a hidden food item when they need it, but not when they already know the location. However, an alternative explanation claims that this behaviour may instead reflect a generalized search strategy, in which subjects reach for food when they see it, and search for it when they do not. The present experiment addressed this possibility by testing orangutans in three conditions in which the location of a food item was sometimes shown or could be inferred, and other times required subjects to visually seek the missing information. All subjects exhibited behaviour consistent with a metacognitive interpretation in at least two of the three conditions. Critically, in two of the conditions, subjects refrained from seeking visual information, and correctly found the hidden food item without ever seeing it. The results therefore suggest that animals that succeed in this information-seeking task are not merely acting according to a generalized search strategy, and instead may be metacognitive.

3 7:19 PM **Rats respond for information in a T-maze**

William A. Roberts, Neil McMillan, & Krista Macpherson (University of Western Ontario)

The purpose of this experiment was to find out if rats would make an instrumental response in order to obtain information about the location of reward. Two groups of rats were trained to press a bar in order to receive a pellet reward at the choice point in a T-maze. A press on the bar also turned on a light at the end of one of the two alleys, with the location of the light varied randomly between trials. For rats in the experimental group (information group), a food cup at the end of the lit alley contained an additional pellet, and the food cup at the end of the dark alley was empty. Each rat in a control group (no information group) was yoked to an experimental rat, such that it received a reward pellet for choosing either alley on each trial that the experimental rat was rewarded. Rats in both groups learned to press the bar on all trials, and rats in the experimental group learned to choose the lit alley for reward. During subsequent testing, pressing the bar was no longer reinforced with a pellet at the choice point but still turned on a light with the same reward contingencies in the alleys as in training for each group. Rats in the control group showed a steady decline in bar pressing (extinction), but rats in the experimental group showed an initial decline followed by a recovery of bar pressing. These results suggest that experimental rats learned to press the bar in order to gain information about the location of reward.

4 7:33 PM **Humans and Monkeys Show Similar Skill in Estimating Uncertain Outcomes**

Theodore A. Evans, Katharine Owens, Michael J. Beran (Georgia State University)

Typically, animals perform well in comparing quantities of preferred items (e.g., food) in a variety of circumstances. We know less about how repeated experience with discrete judgments that are each unique along a quantitative dimension might lead to the formation of an expected value. Previous work with chimpanzees has suggested that animals can estimate an average rate of obtained rewards across multiple quantity comparisons. The present study addressed how nonhumans would compare to adult human performance, given the same task. First, capuchin monkeys and human participants were shown two sets of items one set at a time, and then they were to point to whichever set they wanted. Subsequently, the protocol was changed and only one of the sets of items was uncovered, whereas the other set remained unknown to the participant. Capuchins and humans varied their rate of selection of specific known (uncovered) quantities in test trials as a function of the average number of items received in the training trials. Thus, humans and nonhuman primates share a capacity for spontaneous representation of ongoing reward rate in tests of trial-unique quantity comparisons.

5 7:47 PM **Quantity discrimination by fish: are numbers more cognitively demanding than continuous quantities?**

Christian Agrillo, Laura Piffer, Angelo Bisazza (University of Padova)

In quantity discrimination tasks, adults, infants and animals have been sometimes observed to process number only after all continuous variables that co-vary with number, such as area or density, have been controlled for. This has been taken as evidence that processing number may be more cognitively demanding than processing continuous variables. We tested this hypothesis by training mosquitofish (Gambusia holbrooki) to discriminate 2 items from 3 in three different conditions. In one condition, continuous variables were controlled while numerical information was available; in another, the number was kept constant and information relating to continuous variables was available; in the third condition, stimuli differed for both number and continuous quantities. Fish learned to discriminate more quickly when both number and continuous information were available compared to when they could use continuous information only or number only; there was no difference in the learning rate between the two latter conditions. On the whole results do not support the hypothesis that processing numbers imposes a higher cognitive load than processing continuous variables. Rather, our results suggest that availability of multiple information sources may facilitate discrimination learning.

8:01 PM **What counts for "counting"? Chimpanzees (Pan troglodytes) know what does or does not matter during quantity judgments**

Michael Beran, Joseph McIntyre, Jessica Bramlett, & Theodore Evans (Georgia State University)

6 Many animals can successfully choose the larger of two food quantities. These judgments are made when two visible food sets are presented, when sets are presented in sequential order, or when animals must sum sets across two or more spatial locations. We assessed how chimpanzees (N = 4) chose between two sets of food items when the items were distributed across separate spatial arrays. Each item was covered by a container, and then was revealed in sequence so that neither whole set was visible at one time. In one test, all containers were revealed, but then some with food under them were revealed again. Here, the chimpanzees should ignore what they saw when food items were re-revealed, and they did (performance was 83% to 95% correct). In another test, some of the items were transposed in location and then uncovered again. Here, chimpanzees saw food items in locations that previously had none, but they also saw the transposition. The question was whether they would recognize that the newly shown food items were ones they already had seen. They did, performing at 68% to 94% correct. Thus, chimpanzees made accurate quantity judgments even when distracting re-presentations of items were included.

8:15 PM *Break*

8:20 PM Auditory Discrimination, Song and Concept Learning (Chair: Jeff Katz)

8:20 PM **Discrimination of fish prey by human listeners using dolphin and porpoise echolocation signals**

Caroline M. DeLong & Irene Kannyo (Rochester Institute of Technology), Kelly J. Benoit-Bird (Oregon State University), & Whitlow W.L. Au (University of Hawaii)

7 Dolphins and porpoises use echolocation to identify prey yet their outgoing signals differ in frequency bandwidth and length. The goal of these three experiments was to determine whether signal differences could affect animals' ability to discriminate among fish. Echoes were collected by projecting dolphin and porpoise signals at live fish (sea bass, pollack, grey mullet, and Atlantic cod), and recording from all lateral aspect angles of the fish. Human listeners were presented with these prerecorded echoes and asked to discriminate between the fishes. In the first experiment, when participants listened to echo trains from all aspects of the fishes (360 degrees), they performed significantly better using dolphin echoes. In the second experiment, when participants were presented with echo trains spanning 0-90 degrees (head-broadside) and 0-180 degrees (head-tail), there was no difference in discrimination performance when they listened to dolphin vs. porpoise echoes. Participants reported using patterns of loudness across the echo trains to discriminate among fish. In the third experiment, this cue was removed by normalizing all echoes within the trains. This modification negatively impacted participants' ability to discriminate among fish using porpoise echoes, but participants were able to successfully use other cues to discriminate among fish using dolphin echoes.

8:34 PM **Schedules of reinforcement alter spontaneous and evoked black-capped chickadee calls**

Christopher B. Sturdy & Darren S. Proppe (University of Alberta)

8 Songbirds often alter their vocal output in response to context changes (e.g., song-type matching during aggressive interactions), but whether songbirds also alter vocal output in response to environmental factors such as food availability is not well understood. Here we test whether different schedules of reinforcement (continuous vs. partial) cause black-capped chickadees to modify their chick-a-dee call output during seven, weekly recording sessions. We examined calling in two contexts: solo, unstimulated calling and calling in response to an alarming stimulus. Baseline recordings revealed that calls produced during solo recording differ from those produced during alarmed recording session both in terms of note-type composition and frequency (i.e., pitch). Call production also changed across the duration of the experiment depending upon the schedule of reinforcement that birds were working. In addition, birds on different reinforcement schedules responded differently during the two recording conditions. Our findings suggest that calls can be altered on a short time scale and as a function of environmental conditions.

8:41 PM **Dominance and geographic cues in black-capped chickadee songs**

Allison H. Hahn, Marisa Hoeschele, Lauren M. Guillette (University of Alberta), Daniel Mennill (University of Windsor), Ken Otter, Thibault Grava (University of Northern British Columbia), & Christopher B. Sturdy (University of Alberta)

9 Using bioacoustic analyses, members of our group previously reported that the relative amplitude of the two notes in the black-capped chickadee fee-bee song was more consistent in songs sung by dominant males. In the present study, we conducted a more extensive bioacoustic analysis of 1,142 fee-bee songs originating from two locations: Eastern Ontario and Northern British Columbia. Preliminary results from linear discriminant analyses suggest that songs of dominant birds can easily be classified as "dominant", while subordinate songs are more likely to be classified as either status. Additional linear discriminant analyses suggest that these fee-bee songs can be accurately classified based on the location of origin. In the majority of black-capped chickadee populations, males sing a single fee-bee song type, and across most of North America, little geographic variation has been found for this song. However, variation in song features and multiple fee-bee song types have been documented in relatively isolated populations. Results from the current study, suggest that there may also be geographic variation within the common fee-bee song type of birds living in other regions. This suggests that additional differences may exist in the features of this song (based on dominance status or location) than was previously thought.

8:48 PM **Going to the Extremes: Cross-Dimensional Mapping and Memorization by Pigeons**

Carl Erick Hagmann & Robert G. Cook (Tufts University)

10 Analogies are based on the relationship between first-order relations across dimensions. Pigeons seem to have difficulty with analogical reasoning tasks, but can easily discriminate between stimuli that vary within a dimension, such as size or location. In this experiment, we sought to better understand how pigeons use order in one dimension to guide behavior in another ordered dimension. We examined acquisition rates for six pigeons on a size/location mapping task. They were presented with circles of differing sizes that analogously mapped onto ordered locations (e.g., small->left, big->right) on a touchscreen for three birds and unordered locations for the other three birds. Ordered mapping provided an initial advantage relative to unordered mapping that reduced over time. This suggests memorization may be as effective as cross-dimensional mapping for pigeons in analogical tasks.

8:55 PM **The Problem of Relational Learning in Autism Spectrum Disorder**
Kenneth J. Leising (Texas Christian University), Anthony A. Wright (U Texas Med School at Houston), & Richard E. Frye (U Texas Med School at Houston)

11

Many of the cognitive deficits characteristic of Autism Spectrum Disorder (ASD) may result from a failure to make a developmental transition from item-specific to relational learning. Deficits in relational learning lead to failures in understanding relationships between objects, features, words, and people (i.e., social relationships) and a reliance on item-specific learning. Item-specific learning results in specific associations between a stimulus (object, feature, word, or person) and behavior, often without regard to context or function. Previous research in animal learning developed a matching-to-sample (MTS) task that animals can learn either relationally or item specifically —depending upon the training conditions. We investigated the type of learning that occurs in children with high-functioning ASD with variations in the MTS task. Results indicate some reliance on item-specific processing, but this reliance is likely minimized by previous experience with similar types of tasks during school-based interventions.

9:09 PM **Attempts at error reduction in a within-session simultaneous discrimination reversal by pigeons**
Jessica P. Stagner, Rebecca Rayburn-Reeves, Daniel M. Michler, & Thomas R. Zentall (University of Kentucky)

12

Behavioral flexibility can be advantageous for an organism that lives in a variable environment. To test pigeons behavioral flexibility, we trained them on a simple, simultaneous color discrimination with one color correct for half of each 80-trial session and the other color correct for the remainder of the session. After many sessions of training, the pigeons continued to anticipate the reversal well before it occurred and to perseverate well after the reversal occurred suggesting that they were using the time (or number of trials) into the session as a cue to reverse. To make the reversal point more salient, in one experiment we inserted irrelevant simultaneous discrimination trials involving different colors (blue and yellow) before the reversal occurred. In another experiment, we attempted to discourage errors by adding a penalty following an incorrect choice (a 5-s timeout in the presence of the incorrect choice stimulus).

9:16 PM *Break*

9:21 PM Canine Cognition (Chair: Suzanne MacDonald)

9:21 PM **Does exaggeration or inhibition of predatory response predict the performance of working dogs on a human-guided task?**
Monique A. R. Udell, Margaret Ewald, Nicole R. Dorey, Clive D. L. Wynne (University of Florida)

13

Domestic dogs' responsiveness to human action has been a topic of scientific interest for over a decade. Recently it was demonstrated that domestication is not a prerequisite for responding to human gestures, and that the classification Canis familiaris is not enough to predict success on human–guided tasks. For example, some populations, such as shelter dogs, are initially less responsive to human gestures than pets; although above chance performance is achievable with additional experience. Another resounding question has been: Are all breeds of domestic dog equally prepared to succeed on human-guided object choice tasks? To address this question we chose two breeds of working dog that have traditionally been bred for partially intact predatory responses, including attentiveness and a tendency towards stalking or chasing moving stimuli: Border collies (herding dogs) and Airedale Terriers (hunting dogs). As a comparison group we chose a breed of dog commonly used to guard livestock and therefore traditionally bred for the reduction or inhibition of such tendencies: Anatolian shepherds. In the current study we asked if and how these opposing selection pressures corresponded with each breed's tendency to track and follow a human point to a target in an object-choice task.

9:28 PM **Assessing differences in aggression between wolves and wolfdogs over seasonal variation**
Lindsay R. Mehrkam (University of Florida), Roger K.R. Thompson, Ph.D. (Franklin & Marshall College)

14

The ownership of wolfdogs as pets is a controversial issue due to claims of unpredictable behavior, particularly, aggression. Interestingly, however, there is virtually no empirical research has been carried out to date that would provide more information about wolfdog agonistic behaviors. The objective of this study was therefore to assess differences in inter- and intra-pack aggression between wolves and wolfdogs reared in captivity over seasonal variability. Non-invasive empirical observations of both packs were conducted during pre-breeding seasons of two packs at the Wolf Sanctuary of Pennsylvania and the California Wolf Center. Frequencies of various agnostic behaviors were observed and recorded within the pack over seasonal variation. The results presented here indicate obvious differences in observed aggression between wolves and wolfdogs as a function of both pack composition and seasonal variability. Despite the conflicts in differentiating between aggression in wolf and wolfdogs in an observational context, this research has provided an opportunity for a unique comparative study between these two types of closely related, yet behaviorally distinct animals. Future research that specifically investigates wolfdogs' response to humans in various contexts would thus have implications for how to prevent problem or dangerous behavior. Furthermore, such research may provide information to promote responsible ownership and improve the welfare of these controversial animals.

9:35 PM **Learning Where to Look: Manipulating Gazing Responses in Domestic Dogs (Canis lupus familiaris)**
Jessica Spencer, Clive Wynne (University of Florida)

15

Recent research has focused on domestic dogs' (Canis lupus familiaris) exceptional ability to both comprehend and produce signals in interactions with humans. Some have argued that dogs have evolved special cognitive mechanisms during domestication that enable them to use behaviors, such as gazing at a human's face, to communicate a message. In contrast, other research has demonstrated that the gazing behavior in dogs can be increased or decreased by providing or withholding reinforcement, presenting evidence that dogs' tendency to gaze at owners is simply the product of operant processes and not necessarily a higher-level ability. The purpose of the current experiment is to strengthen the argument that the gazing response is a learned behavior by demonstrating the ease with which this behavior can be manipulated using differential reinforcement. Gazing at various targets is reinforced with preferred food and subsequently extinguished over a series of several phases, including a condition where the target is an inanimate object. By removing the human face from the equation, we show that a dog will look wherever is required in order to gain access to reinforcement, decreasing the likelihood that gazing is part of a complex communication system that has evolved between dogs and humans.

16 9:42 PM

Assessing Attachment of Wolves to Human Caretakers

Nathaniel J. Hall, Monique A.R. Udell, Clive D.L. Wynne (University of Florida)

The Strange Situation Test was originally developed to assess children's attachment to their parents (Ainsworth & Bell, 1970). A similar test has been applied to assess domestic dogs' (Canis lupus familiaris) and wolves' (C. l. lupus) attachment towards a human caregiver (Topál et al., 2005). This research indicated that dogs form an attachment to human caregivers, whereas wolves do not. Topál et al. (2005) argued that dogs' attachment formation to humans is a phylogenetic product of domestication. The purpose of the current study was to further explore the potential for wolves to form attachments to human caregivers. The Strange Situation Test was given at earlier ages than in the previous study to assess whether wolves demonstrate attachment behaviors at younger ages. We report here that two of four wolf pups show a pattern of behavior consistent with attachment at six and a half weeks of age. These results demonstrate that wolf pups can form an attachment to human caregivers. The ontogenic contribution of attachment to humans needs further consideration.

17 9:49 PM

Numerical Discrimination in Dogs (Canis familiaris)

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

While studies of the cognitive ability of dogs have increased dramatically over the past ten years, there is still little known about numerical competency in this species. One exception is the West & Young (2002) study, which showed that when presented with a simple additive calculation (e.g., 1 + 1 = 2), dogs stared longer at an unexpected result (e.g., 1 + 1 = 3) than at an expected result (e.g., 1 + 1 = 2). This procedure, however, hinges on the assumption that longer staring time indicates understanding on the part of the dog. The present discussion will present data from other counting experiments with dogs, as well as a small sample of wolves. Similar to previous counting studies conducted with chimpanzees (Beran, 2001; Beran & Beran, 2004) the subjects in these experiments watched as different quantities of food were dropped into each of 2 containers. The subjects were then allowed to select and consume the contents of 1 of the containers. Preliminary data suggest that although dogs demonstrate some numerical competency, such skills seem to be very limited in this species.

Thursday Afternoon

12:00 PM Communication (Chair: Marcia Spetch)

18 12:00 PM

Do you think I ate it? Owner perception and behavioral assessment of the "guilty look" in dogs

Julie Hecht (University of Edinburgh) & Márta Gácsi (Eötvös Loránd University)

Dog owners ascribe guilt to dogs (Morris et al., 2008). Using a questionnaire and conducting an experiment, our study investigated associated behaviors of guilt — "ABs" as coined by a recent study (Horowitz, 2009). We explored the owner-reported anecdote that upon an owner returning home, a dog greets an owner and sometimes displays ABs, thereby alerting the owner to a dog's misdeed. Our experiment explored (1) whether dogs that were disobedient in an owners' absence show ABs upon the owners' return to a room and (2) whether owners can determine if dogs were disobedient based on the dog's greeting behavior. No significant difference was found in greeting behavior between dogs that ate in the owner's absence and dogs that did not eat in the owner's absence. Owners seemed able to determine whether or not their dog ate in their absence. At the same time, we cannot confirm that owners relied solely on dog greeting behavior. Our questionnaire confirmed that owners ascribe guilt to dogs. It also revealed a possible adaptive function to the presentation of such behaviors as 59% of owners reported that dog presentation of ABs leads them to scold their dog less.

19 12:07 PM

Persistence and Bargaining after Denied Requests in a Speech-Using African Grey Parrot (Psittacus erithacus)

Erin Colbert-White (University of Georgia)

Previous research has shown that the speech production of pet African Grey parrots is related both to social context and to social relationship maintenance. The purpose of the current study is to explore the vocal behavior of one African Grey parrot, Cosmo, during social interactions where Cosmo's caregiver denies Cosmo's requests for objects, thus creating a conflict between owner and bird. Linguistic analysis of videotaped conversations is on-going; however preliminary review indicates Cosmo uses speech patterns in response to denied requests that are distinct from speech patterns during situations where requests are accepted. Strategies include persistent repetition of denied requests as interrogatories (e.g., "Cosmo go up, okay?") and declarations (e.g., "Cosmo go up."), as well as an increase in bargain-like behavior (e.g., "Cosmo don't bite, okay?" "Cosmo be a good girl"). These results indicate Cosmo has developed the use of basic, language-like conversational devices to guide social interactions in her favor.

20 12:14 PM

Disambiguation and Fast-Mapping in Psittaciformes: Do Birds Utilize Exclusionary Rules to Comprehend Novel Words?

Stephanie E. Jett (University of Southern Mississippi) and Joan M. Sinnott (University of South Alabama)

Four members of the Psittaciforme order were tested for their ability to utilize the word learning strategies of disambiguation (reasoning by exclusion) and fast-mapping (learning by exclusion) in an operant 2AFCLR procedure using 3D visual stimuli and auditory stimuli articulated by a human experimenter. To test for disambiguation, familiar objects were paired with novel objects with the novel objects labeled in half the trials and the familiar objects labeled as foils in half the trials. The birds chose the novel objects as the referent for the novel labels at levels that did not differ from their performance on the foil trials when the novel objects were paired with familiar objects. They also chose the correct novel objects as the referents for the novel labels when the novel objects were paired with each other. Therefore, all four birds used disambiguation when presented with an ambiguous lexical decision and recalled the novel labels after a single exposure and a week long retention interval demonstrating fast-mapping. This study is the first to directly demonstrate the use of exclusion in word learning by Psittaciformes, which lends support to the assertion that similar cognitive strategies may be used during word learning in Psittaciformes and human infants.

21 12:21 PM

Echoic pointing by the bottlenose dolphin

Heidi E. Harley (New College of Florida & Mirage Dolphin Habitat), Adrienne Cardwell (Mirage Dolphin Habitat), Jenna Clark & Amanda Vennare (New College of Florida)

Dolphins clearly use echolocation, a form of biosonar, to recognize objects, but they may also be able to use it to point to objects referentially. Two dolphins performed a cooperative echoic 3-alternative matching-to-sample task in which one dolphin experienced the sample and the second dolphin, who did not experience the sample, was reinforced for choosing the object identical to the sample. When both dolphins were in the water facing the array of objects available during the choice period, they performed at above-chance levels: 72% when Pablo chose, and 81% when Squirt chose. However, performance accuracy plummeted when the dolphin who investigated the sample was out of the water, in the water facing away from the choice array, or when the objects were in air during the choice segment of a trial. These findings, in concert with the number and pattern of echolocation clicks produced by each dolphin in each role, suggest that the dolphins may be using referential echoic points to identify their choices.

22 12:35 PM

Apes Communicate about Absent and Displaced Objects: Methodology Matters

Heidi Lyn (University of Southern Mississippi, Gulf Coast), Jamie L. Russell (Yerkes National Primate Research Center), David A. Leavens (University of Sussex), Kim A. Bard (University of Portsmouth), Sarah T. Boysen (Ohio State University), Jennifer Schaeffer (Yerkes National Primate Research Center), & William D. Hopkins (Yerkes National Primate Research Center, and Agnes Scott College)

Although methodological differences are well known to alter the results of cognitive studies, recent publications, even in reputable journals, have displayed a lack of attention to these issues. In this study, chimpanzees and bonobos of diverse rearing histories are shown to gesturally reference both displaced and absent objects. These findings support previous observational research suggesting that apes are capable of referring to absent objects, but contradict a recent study by Liszkowski et al. in Psychological Science (2009), reporting that human children, but not chimpanzees, could reference displaced items in their task. We suggest that these contradictory findings are a result of methodological distinctions and interpretive errors. In particular, Liszkowski et al. applied different selection criteria and utilized different procedures to representatives of the two species of interest (humans and chimpanzees), rendering their comparison problematic. Comparative studies are of great importance in elucidating the evolution of human cognition, however, greater care must be taken with methodology and interpretation for these studies to accurately reflect species differences.

12:49 PM **Generalization based on Octave Equivalence**

Ronald Weisman (Queen's University), Marisa Hoeschele, & Christopher Sturdy (University of Alberta)

23

Perceiving similarity between pitches separated by octaves (and subsequent harmonics) is critical to understanding music and speech and is probably important to understanding communication in other species. But pitch chroma perception, especially in humans without extensive music training, is difficult to define let alone measure. Briefly, pitch chroma perception is generalization to the most similar pitches in an adjacent octave (either a doubling or halving in frequency) rather than to other pitches more similar in frequency (of similar pitch height). In this presentation and the next, we describe simple, direct methods of studying the perception of similarity between pitches spaced an octave apart, using go/no-go discriminations, octave generalization, and octave transfer tests in humans. For the purposes of this research, we have divided the octave into three, broad pitch ranges consisting of four musical notes each. In this first talk, we present results for S- (no-go), S+ (go), S- (no-go) pitch-range discriminations among notes in the 4th octave. We observed overwhelming evidence for generalization to notes in the 5th octave. That is, humans with limited musical training effortlessly generalized pitch-range discriminations to the higher octave.

1:03 PM **Transfer based on Octave Equivalence**

Marisa Hoeschele, Christopher Sturdy (University of Alberta), & Ronald Weisman (Queen's University)

24

The next step in demonstrating octave equivalence in humans was a test for positive and negative transfer. Here we trained human subjects with an S-, S+, S- discrimination among thirds of the 4th octave, then tested for transfer in two ways. In the positive transfer group, the discrimination in the 5th octave was again S-, S+, S- between thirds of the octave, but in the negative transfer group the discrimination in the 5th octave was S+, S-, S+ (opposite to in the 4th octave). We counterbalanced the experiment by teaching other groups an S+, S-, S+ discrimination in the 4th octave, then reversing the discrimination in the 5th octave in the negative transfer group. Both transfer groups that learned the opposite discriminations in the 5th octave failed to fully reverse generalization from the 4th octave. That is, generalization of discrimination from the 4th to the 5th octave engendered positive transfer when the discrimination was the same in both octaves and engendered negative transfer when the discriminations were opposite in the two octaves. It has not escaped our notice that similar protocols could be used to study octave equivalence in other species.

1:10 PM Serial & Temporal Processing (Chair: Olga Lazereva)

1:10 PM **Factors Affecting Rats' 5-choice Serial Reaction Time Performance**

Varakini Parameswaran, Sara Gallant, Jerome Cohen (University of Windsor)

25

During initial training in this study, rats obtain reinforcement (food pellet) after nose poking five keys in succession as they are lit (signaled) along the back wall of the operant chamber. Each session consists of 60 reinforcements with a fixed spatial pattern of the presented nose-poke key signals for the first and last 20 reinforcements and random spatial patterns for the middle 20 reinforcements. Following initial training, rats are exposed to continued training with nose poke signal durations that vary between 1000 ms and the originally trained 3000 ms and inter-signal-intervals that vary between the originally trained 1000 ms and 3000 ms. During original training, rats' reaction times over the five successive signaled nose pokes systematically declined within the first and third blocks of 20 reinforcements but not within the middle block of 20 reinforcements. Results from the final experiments will help determine the extent to which reaction times over fixed nose-poke signal patterns reflect an overall spatial representation or acquired automatic motor control.

1:17 PM **Pigeons learn a violation better than a run on a sequence learning task**

Dennis Garlick (UCLA), Stephen B. Fountain (Kent State University), & Aaron P. Blaisdell (UCLA)

26

Six pigeons were presented with 8 disks arranged in a circular array on a touchscreen. On each trial, two of the disks were illuminated. Correct responding consisted of serial patterns involving "run" chunks (e.g., 123 234, etc.) Each chunk was also signified by a different color, which served as a phrasing cue. For the Run group (n=3), the final chunk of 812 also conformed to the pattern. For the Violation group (n=3), the final chunk of 818 violated the pattern. In contrast to rats, it was found that pigeons made fewer errors on the final trial in the Violation than the Run condition. This is possibly attributable to pigeons learning a configuration of color and positional cues independent to the sequence. Performance on trials where color and positional cues were ambiguous, however, was also above chance. This indicates that while pigeons learned something about the sequence, performance came under stronger control by specific color/positional knowledge when it was available.

1:31 PM **Linear Representations of Hierarchical Patterns in Human and Rat Serial-Pattern Learning**

James D. Rowan (Wesleyan College), Shannon M.A. Kundey (Hood College), Charisma Enam, Priyata Thapa, Whitney Thomas, Sujala Maharjan, Aditi Dey, Alicia Blease, Tiffany Blackshire, & Tonial Butler (Wesleyan College)

27

Theories explaining how organisms learn serial patterns have often stressed that the representation of the pattern structure that is formed will be the one that has the simplest formal structure. These theories allow for the simplification of the cognitive representation of the pattern by using rule-nesting. This experiment examines the assumption that organism, represent the pattern structure as assumed by previous theories by using rule-nesting. Human subjects were assigned to one of 6 groups (1, 3-Level Perfect Hierarchical Nested Pattern, 1, 3-Level Hierarchical Pattern with a Disrupted Structure, or 4, 2-Level Linear Patterns). Rats were assigned one of 4 groups (1, 3-Level Perfect Hierarchical Nested Pattern, 1, 3-Level Hierarchical Pattern with a Disrupted Structure, and 2, 2-Level Linear Patterns). Findings support earlier studies which demonstrate that, for both humans and rats, a 3 level hierarchical pattern is learned faster than a version with the hierarchical structure disrupted. The performance of additional (linear 2-level) patterns, however, brings into question the idea that they somehow encode a representation of the multilevel hierarchical structure. The results suggest a more linear representation of the pattern structure is encoded instead of the accepted structural tree representation as proposed by Fountain and Rowan (1995) and others.

1:45 PM **Inhibitory Trials Disrupt Interval Timing in Pigeons**

Neil McMillan & William A. Roberts (University of Western Ontario)

28

Usually, pigeons are able to time a 60-s fixed interval (FI); when birds are tested on empty probe trials, they show a Gaussian distribution of responses with a peak near 60 s. We trained pigeons on two types of trials, half with a green sidekey presented for a 60-s FI terminating in a grain reinforced pecking response, and the other half with a red sidekey presented for 60 s and terminating in no food reward. On 120-s empty probe trials with the green sidekey presented, pigeons were expected to show a scalloped increase in responding as 60 s approached, and a similar decrease past 60 s. However, pigeons showed little or no timing of the 60-s rewarded interval. The mere presence of a nonrewarded stimulus appears to disrupt or eliminate normal timing of an excitatory stimulus.

29 1:52 PM **Averaging of temporal memories across drug states**

Allison Kurti & Matthew S. Matell (Villanova University)

Previous work from our lab has demonstrated that rats will generate scalar temporal expectations based on an average of two different temporal memories associated with different modality cues when presented with the compound stimulus (Swanton, Gooch & Matell, 2009; Swanton & Matell, in press). In the present experiment, we sought to examine whether such averaging would also occur when the two temporal memories were associated with distinct drug states. We trained rats (n=10) on a discrete-trials peak-interval procedure in which an auditory cue signaled reinforcement availability after 5s (on sessions preceded by a saline injection), whereas the same cue signaled reinforcement availability after 20s (on sessions preceded by a 0.5 mg/kg amphetamine injection). The first 5 trials of each session were non-reinforced probes to ascertain temporal expectations prior to feedback, and saline versus amphetamine sessions were pseudo-randomly selected. On training sessions, rats peaked at 6.4s (saline) and 21.7s (amphetamine), indicating accurate expectation based on interoceptive state. Administration of an intermediate dose of amphetamine (0.25 mg/kg) on the final test session (in extinction) revealed scalar responding with a peak time midway between the anchor durations (14.0s). These data indicate that the temporal expectations associated with different drug states can be averaged.

30 1:59 PM **Averaging of temporal memories under conditions of incomplete information**

Joseph Leman, Matthew S. Matell & Michael Brown (Villanova University)

Previous work has demonstrated that rats will generate scalar temporal expectations based on an average of two different temporal memories associated with different modality cues when presented with a compound stimulus (Swanton, Gooch & Matell, 2009; Swanton & Matell, in press). In such cases, presentation of the compound stimulus results in retrieval of multiple temporal expectations due to "superabundant" information. In the present work, we are interested in whether subjects will retrieve and average temporal memories when there is ambiguity in temporal expectation due to incomplete information. To this end, we have trained rats (n=10) on an occasion-setting variant of the peak-interval procedure in which a variable duration auditory feature (1 or 4 kHz tone, counter-balanced) specifies whether reinforcement will be available either 10s or 20s following onset of a visual target (houselight). Onset of the feature occurred 3-11s (uniformly distributed) prior to onset of the target and they co-terminated upon reinforcement or probe trial end. During fixed-interval training, subjects generated differently sloped fixed-interval scallops indicating specific temporal expectations as a function of the feature. We will present probe data from trials with information-present (feature and target present), information-absent (feature absent/target present), and information decaying (feature terminating prior to target).

31 2:06 PM **Is timing inherently imprecise?**

Jonathon D. Crystal (Indiana University, Bloomington)

For 35 years, the central assumption underlying theories of timing is that the representation of time is inherently imprecise. Indeed, most insights about timing are derived from variability properties of temporal performance. I present data that raise some questions about this central assumption. A food pellet was delivered contingent on the first lever press after 100 seconds had elapsed. The next fixed interval began immediately after the previous pellet was delivered. The daily session lasted 12 hours, and in almost all cases supplemental food outside the session was not needed. The latency to the first response after food delivery (post-reinforcement pause, PRP) was 100.4 seconds. This PRP is optimal because effort and wasted time are minimal. Moreover, the distribution of PRPs was maximal at 100 seconds, and there was an abrupt 75% decline in frequency within the next 1-second interval. Thus, the rats aimed for 100 seconds with exceptional precision. Comparisons are made with conventional examples of fixed interval performance (i.e., shorter fixed interval and session length) to show that this is an example of non-scalar timing. I suggest that the representation of time is not imprecise and that other factors may mask the inherent precision of temporal representations.

2:20 PM *Break*

2:25 PM Choice (Chair: Christiane Wilzeck)

32 2:25 PM **Irrational decision-making in wild rufous hummingbirds**

Kate Morgan (University of St Andrews), T. Andrew Hurly (University of Lethbridge), Susan D. Healy (University of St Andrews)

A rational choice is independent of irrelevant alternatives. Irrational choices however, can be altered by alternative options even when the alternatives are clearly inferior. Animals, like humans, frequently make irrational choices, choices that appear to violate the assumptions of optimal foraging theory. Behavioural economics theory may provide an alternative explanation. We aimed to determine whether behavioural economics or optimal foraging theory better explains decision making in wild rufous hummingbirds. In foraging experiments, wild free-living hummingbirds were presented with options that were manipulated in either volume or concentration. In each treatment birds experienced a set of trials in which there were only two options and two sets of trials in which there were three options to choose among. In both the volume and concentration treatments, one of the decoys increased the preference for the least preferred option. These irrational outcomes cannot be explained by energy balancing by the animal. Rather, they resemble the irrational decisions made by humans.

33 2:32 PM **The rational starling**

Tiago Monteiro, Marco Vasconcelos, Justine Aw & Alex Kacelnik (University of Oxford)

Two principles of rationality are frequently violated in results of behavioural experiments: transitivity and independence of irrelevant alternatives. The former implies circular preferences between options, while the latter implies variations in the relative preference between two options when further, 'irrelevant' alternatives are added to the choice set. Since most studies of animal choice use just two alternatives, we examined the effect of enlarging the set. We trained starlings (Sturnus vulgaris) in no-choice trials with five different delays to food (Experiment 1) or with six probabilities of reinforcement (Experiment 2) before testing their preferences in all possible binary and trinary combinations. Both transitivity and the independence of irrelevant alternatives were upheld, in that choices in trinary combinations were predictable from binary preferences.

34 2:39 PM **The effect of social enrichment on gambling-like behavior in pigeons**

Kristina F. Pattison, Jennifer Laude, & Thomas Zentall (University of Kentucky)

Pigeons have been found to show suboptimal choice behavior when choosing an alternative that provides 50% overall reinforcement over another that provides 75% reinforcement when reinforcement and nonreinforcement is signaled following choice of the 50% alternative. We have suggested that this finding is related to suboptimal human monetary gambling behavior because in both cases the organism overemphasizes the occurrence of the winning event and underemphasizes the losing event. We tested the hypothesis that pigeons exposed to an "enriched environment" would be less likely to show this suboptimal choice behavior. Pigeons which were given access to a large enclosure with three other pigeons for four hours a day did not show the typical preference for the suboptimal choice whereas normally housed pigeons in a control group displayed the typical suboptimal choice bias.

35 2:46 PM **Sub-optimal choice behavior in pigeons: Effect of level of food motivation**

Jennifer R. Laude, Kristina F. Pattison, and Thomas R. Zentall (University of Kentucky)

Contrary to the law of effect and optimal foraging theory, pigeons show suboptimal choice behavior when they choose an alternative that provides them with 50% reinforcement (on half of the trials choice is followed by a stimulus that signals 100% reinforcement, on the remaining trials with a stimulus that signals 0% reinforcement) over an alternative that provides them with 75% reinforcement (the choice is followed by a stimulus that signals 75% reinforcement). We tested the hypothesis that the greater the level of motivation for food the greater would be the tendency to choose sub-optimally. In fact, pigeons trained on a highly restricted diet chose sub-optimally significantly more than pigeons trained on a mildly restricted diet. Thus, paradoxically, the pigeons that needed the food the least obtain more food than those that needed it the most.

36 2:53 PM **Spatial discounting of food and social rewards in guppies**

Jeffrey R. Stevens, Nelly Schmücking (Max Planck Institute for Human Development), & Simon Reader (Utrecht University)

In temporal discounting, animals trade off the time to obtain a reward versus its quality. Similar discounting can apply over space, when animals choose between smaller, closer versus larger, more distant rewards. Most studies of temporal and spatial discounting use food as the reward, and we do not know if animals trade off other rewards in similar ways. Here, we offered guppies (Poecilia reticulata) a spatial discounting task in which we measured preferences for a larger reward as the distance to this reward increased relative to a closer but smaller reward. We varied whether the reward type was food items or conspecific shoaling partners to test whether the fish discounted reward types differently. In this task, subjects switched their preferences from the larger to the smaller reward as the distance to the larger reward increased, but this did not differ across the two reward types. An analysis of travel times, however, suggests that the fish swam faster to the food rewards than to shoaling partners. Therefore, our results suggest that the fish showed similar spatial discounting across food rewards and shoaling partners, but this pattern did not hold when accounting for travel times.

37 3:07 PM **Risky Choice in People**

Elliot A. Ludvig (Princeton University), Marcia L. Spetch (University of Alberta), Christopher R. Madan (University of Alberta)

When faced with risky decisions, people tend to be risk averse for gains and risk seeking for losses (the reflection effect, a cornerstone of Prospect Theory). Studies examining risk-sensitive decisions in people typically give them described hypothetical choice scenarios. Following several unsuccessful attempts to obtain a reflection effect in pigeons, we began to assess people's risky choices when outcomes are implicitly learned through experience, rather than verbally described. People chose between two options—one that provided a 50/50 chance of a small or large outcome (e.g., 0 or 40 points), and one that always provided an intermediate outcome (e.g., 20 points). On some trials these outcomes were gains and on other trials they were losses. On description trials, the outcomes and probabilities were explicitly indicated, whereas on experience trials they were learned through feedback. For the description-based decisions, we found the usual reflection effect with greater risk seeking when faced with losses. For experience-based decisions, however, we found the opposite of a reflection effect in the same individuals: Here people were more risk seeking for gains than for losses. This reversed reflection effect for experience-based choices appears to be driven by an overweighting of extreme values.

38 3:21 PM **When to acquire new information? How persistence and reward affect sampling and tracking in foraging bumblebees**

Aimee S. Dunlap, Daniel R. Papaj, Anna Dornhaus (University of Arizona)

Tracking changes in resources requires foraging animals to make decisions on when to sample resources and how to apply the information gained through sampling in future decisions. Theory suggests that the value of sampling depends on the rate of environmental persistence, and on the relative costs of making errant decisions; and that there are many instances in which sampling and using new information is not optimal. We tested these predictions with bumblebees. Using a serial Y-maze offering sucrose solution rewards, we gave bumblebees repeated choices between a resource providing a steady, mediocre reward and a resource fluctuating between a bad reward and a good reward. We varied the persistence of the fluctuating resource and the relative value of the good reward in a 4 x 3 factorial experiment. Bumblebees did sample and adjusted their behavior to changes in persistence. Bees sampled the fluctuating resource as predicted at moderate values of persistence, but showed surprisingly suboptimal tracking except when the fluctuating resource was very persistent and the potential rewards high. We see differences in patterns of choice, lose-stay choices increase under low persistence and resource constancy changes with the potential good reward. Bees sample, but do not always use new information.

3:35 PM *Break*

4:06 PM Social Learning (Chair: Tom Zentall)

39

4:06 PM **Social effects on neophobia and object exploration in captive and wild spotted hyenas confronted with a novel problem-solving task**

Sarah Benson-Amram (Michigan State University), Alan B. Bond (University of Nebraska) & Kay E. Holekamp (Michigan State University)

We designed a Thorndike-like puzzle box to study problem-solving in captive and wild spotted hyenas; a rebar box contained meat that hyenas accessed by sliding a latch. We conducted 417 trials on 62 individuals in the wild and 156 trials on 18 individuals in captivity. In captivity, ten hyenas watched one of two demonstrators open the puzzle box prior to each of their trials. Six hyenas served as controls and never saw another hyena interact with the puzzle box. Wild hyenas observed conspecifics working on the puzzle box opportunistically. Both wild and captive hyenas observed and acquired information from watching conspecifics solve the puzzle, but this additional experience did not produce higher success among observers. However, in both captivity and the wild, seeing a conspecific at the puzzle box significantly decreased approach time of naïve hyenas, implying social reduction of neophobia toward a novel object. Seeing the box opened also led wild hyenas to focus more attention on the latch side of the puzzle box, and it affected the strategy used by captive observers to open the puzzle box. These results provide evidence for social influences on object exploration in spotted hyenas, likely via the mechanism of localized stimulus enhancement.

40

4:13 PM **Social cue driven cache protection strategies in Clark's nutcrackers (Nucifraga columbiana): A case for cognition over association**

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

The food-caching corvid, Clark's nutcracker (Nucifraga columbiana), is highly dependent on cached food for surviving periods of limited food resources. These caches are at risk of being pilfered by other birds, yet this risk can be managed through the use of cache protection strategies. In this study, Clark's nutcrackers are shown to use cache protection strategies similar to that of other previously studied food-caching corvids, and that these cache protection behaviors are more likely to occur after the caching bird has been witnessed making a cache by a conspecific. Also, through the use of a novel control condition, these behaviors are shown to be a result of social cues, rather than associative mechanisms.

41

4:20 PM **Ravens (Corvus corax) learn from video demonstrations**

Elizabeth Price (Smithsonian National Zoological Park), Andrew Whiten (University of St. Andrews), & Thomas Bugnyar (University of Vienna)

Recent work with corvids suggests that they share many of the cognitive abilities previously thought restricted to apes, yet social learning in corvids remains underexplored. Video demonstrations allow for the use of conspecific models, while still granting precise experimental control, and thus are gaining favor in social learning studies. Here we provide the first analysis of video playback with common ravens (Corvus corax). First, we measured behavioral reactions to a series of different video stimuli. Overall, ravens spent more time watching and displaying during video clips of ravens versus other bird species. A second study assessed whether ravens could socially learn a novel, two-step task from a video demonstration. Those subjects that had previously seen video footage of a conspecific solving the task were significantly more likely to attempt a solution than those that received no prior information. Although subjects tended to match the demonstrated method, this effect may be ephemeral when a simpler method is discovered. This provides the first evidence of social learning from video demonstrations in ravens. Future work should include experimental conditions that vary the both the amount of information available in the demonstration, and the complexity of the task.

42

4:27 PM **Social influences on spatial location and spatial choice**

Michael F. Brown & Matthew R. Keller (Villanova University)

Previous work from our laboratory indicates that pairs of rats making choices together in a radial-arm maze or an open field choice paradigm influence each others' choices in two ways. There is a social affiliation effect, resulting in an increased tendency to make choices to spatial choice alternatives where a familiar rat is present. A countervailing tendency to avoid locations that were previously depleted of food by the other rat occurs if the other rat's visit is remembered but the other rat is no longer present in that location. Data will be presented from an open field paradigm in which rats are tested either alone or together. We have previously reported social memory effects on the spatial choices made, consistent with the summary description above. Here, we track the locations of the rat (or two rats) during these trials. This allows social effects on movement/location to be dissociated from social effects on choice. The results provide some theoretical resolution of the discrepant effects of a foraging partner on spatial choice.

4:41 PM Development (Chair: Kent Bodily)

43

4:41 PM **Are you my mother? Lateralized parents' recognition in different breeds of the domestic pigeon (Columba livia f.d.)**

Mareike Fellmin (Heinrich-Heine University) & Inga Tiemann (University of Saskatchewan)

Lorenz was the first to analyze the origin and impact of imprinting and its importance to the individuals' behavior during their lifetime. At first, many studies investigated precocial species like chicks because the effect of imprinting could be detected by a following response. Later, altricial species such as pigeons were observed. The lateralization of the brain has also been studied and found to influence the bird's behavior, but the correlation between early behavioral responses and lateralized behaviors has remained an open question. In our study we were interested in imprinting responses of three different pigeon breeds (Columba livia f. d.): Classic Old Frill, Texan Pioneer and Homing pigeon. The experiments started when pigeons were 25 days old. Pigeons were observed in a multiple choice arena, where they could choose from four live stimulus pigeons, two of which were the parents. We expect the young pigeons to choose their parents more often than the foreigner. Two replications were made under monocular viewing conditions on the following days, to see if lateralization has an impact on the parents' recognition. This is of special interest since previous studies have revealed major influences of lateralization on social recognition in chickens and quails.

4:48 PM **Division of Labor in Cataglyphis cursor Ants Controls Who Administers, and Receives, Rescue Attempts**
Elise Nowbahari, Jean-Luc Durand, Alexandra Scohier (Université Paris 13) & Karen L. Hollis (Mount Holyoke College)

44

Recently, we reported that Cataglyphis cursor ants use sophisticated rescue behavior to extricate nestmates that have become ensnared by collapsing sand or debris. In addition to limb-pulling and sand-digging behavior, ants were able to identify the snare that bound their nestmate, to transport sand away from it, and then to target their bites precisely to it alone, excavating sand as necessary. Here we present evidence that this behavior is strictly regulated by a division of labor, which determines who can administer – and receive – help. We manipulated both the caste of the rescuers and the caste of the victim in a two-way factorial design: Each group of 5 rescuers contained members of only one caste (foragers, nurses, or inactives) and each of these caste-rescuer groups was paired with a single caste victim (a forager, nurse or inactive), for a total of 9 different rescuer-victim combinations. In addition, control tests were conducted in which the victim was anesthetized by chilling. Our results indicate that division of labor, a form of temporal polyethism in which individuals engage in different tasks as they mature, also controls their ability to give and receive the kind of precision rescue behavior of which this species' is capable.

5:02 PM *Break*

5:07 PM Spatial Learning (Chair: Mike Brown)

5:07 PM **What's better to orientate: light polarization or visual landmarks? Tentative answer from the cuttlefish Sepia officinalis**
Lelia Cartron, Anne-Sophie Darmaillacq, Christelle Jozet-Alves (Université de Caen Basse-Normandie, France), Nadav Shashar (Ben Gurion University, Israel) & Ludovic Dickel (Université de Caen Basse-Normandie)

45

For orientation, animals use a variety of reference cues such as visual or olfactory landmarks, geomagnetic field or sky polarization. The choice of a particular cue may depend on the availability or the reliability of this cue. Here, we examined whether cuttlefish were able to orientate using both visual landmarks and the e-vector of polarized light and whether one of these cues was preferentially used when they gave contradictory directions. Experiments were conducted in 3 steps. In step 1, cuttlefish were trained to solve a spatial task inside a Y-maze with two contrasted landmarks and illuminated with a linear polarized light with a single e-vector (45 or 135°). In step 2, cuttlefish that succeeded in step 1 were tested with only one type of cue. In step 3, cuttlefish were tested with both cues but indicating contradictory directions to solve the task. Results of step 1 and 2 indicate that cuttlefish were able to use both polarized light and landmarks to orientate. In step 3, 65% of the cuttlefish followed preferentially the e-vector orientation, 25% the landmarks and 10% did not have a preference. Being able to follow different types of cues may be adaptive depending on the environmental variation.

5:14 PM **Solving for two unknowns: An extension of vector-based models of landmark-based navigation**
Bradley R. Sturz, S. Paul Cooke, Caroline K. Eastman, Scott S. Katz (Armstrong Atlantic State University) & Kent D. Bodily (Georgia Southern University)

46

Vectors are mathematical representations of distance and direction information that take the form of line segments where length represents distance and orientation in space represents direction. Vector-based models have served beneficial in understanding the spatial behavior of a variety of species in tasks that require landmark-based navigation via vector addition and vector averaging to determine a location. Extant research regarding vector-based representational and computational accounts of landmark-based navigation has involved tasks that required solving for one unknown (i.e., a location). Using a novel landmark-based navigation task, we provide evidence consistent with a form of vector algebra that involves solving two simultaneous equations with two unknowns in order to determine a location in space. Results extend vector-based accounts of landmark-based navigation and provide a novel methodological approach to the testing of mobile organisms.

5:28 PM **Influence of epilepsy on orientation in the domestic chicken**
Inga Tiemann (University of Saskatchewan) & Debbie M. Kelly (University of Saskatchewan & University of Manitoba)

47

Birds in general have been intensively studied for their orientation abilities. We examined the orientation behavior of a chicken strain which is genetically affected by light-induced epilepsy. Epileptic seizure has been shown to disrupt spatial abilities in humans, thus we were interested in understanding whether these chickens would show similar spatial impairments. We used a mixed model design to identify the impact of age and epilepsy on orientation behavior. The chickens were full-siblings, of which 50% showed violent seizures beginning with hatching and 50% were categorized as carriers without any epileptic symptoms. The chickens were trained to find a hidden goal within a rectangular arena by using featural and geometrical cues. Once the chickens were accurately locating the goal, we presented test trials in which all features were removed or with the features in the geometrically correct corners removed. Epileptic chickens were not able to encode geometry before maturity and failed to use features distant from the goal whereas their full-siblings passed both tests. The results reveal differences in the encoding of featural and geometric properties of the environment, their value for orientation and the use of these two major cue categories between chickens with and without epilepsy.

5:42 PM **Blocking and the influence of surface-feature arrangement**
Victoria Harms (University of Saskatchewan), & Debbie M. Kelly (University of Saskatchewan, University of Manitoba)

48

We examined the influence of surface-feature arrangement relative to a goal location on encoding of feature and geometric information using a blocking paradigm. Adult humans were trained to localize a target in a three dimensional virtual environment. Participants in the Blocking groups were pre-trained in the environment containing only informative geometric cues. Subsequently, half of the participants were then trained with informative geometric and feature cues where the features formed a boundary at the target corner (Boundary group). The remaining participants were trained with informative geometric and feature cues where a single feature spanned the target corner (Segment group). Two other control groups did not receive the pre-training, but instead were trained only with the informative geometric and feature cues. Results showed that pre-training with geometry impeded subsequent feature learning, but the effect was dependent on feature-arrangement. Specifically, attenuated learning was observed for the Segment arrangement of features, but not for the Boundary arrangement. In addition, cue conflict tests showed greater weighting of geometry by the Segment group compared to the Boundary group. These results demonstrate that the arrangement of surface-features relative to a goal location influences the encoding and relative weighting of feature and geometric information.

5:49 PM **Reliability of Principal Axis Influences Use of Geometric Cues: Evidence for a Unified Orientation Process**

Kent D. Bodily (Georgia Southern University), Caroline K. Eastman, and Bradley R. Sturz (Armstrong Atlantic State University)

49

A substantial amount of empirical and theoretical debate remains concerning the extent to which an ability to orient with respect to the environment is determined by global (i.e., principal axis of space), local (i.e., wall lengths, angles), and/or stored representations (i.e., view-based) accounts. We developed a novel orientation task that allowed the manipulation of the reliability of the principal axis of space (i.e., searching at the egocentric left- and/or right-hand side of the principal axis) between groups while maintaining goal distance from the principal axis, local cues specifying the goal location (i.e., short wall left, short wall right, obtuse angle), and visual aspects of the goal location consistent across groups. Results suggest that the reliability of the principal axis of an enclosure differentially influences the use of geometric cues for reorientation. Such a conclusion has implications for purely global-based, purely local-based, and purely view-based matching theoretical accounts of geometry learning and provides evidence for a unified orientation process.

6:03 PM **Magnetic Compass Orientation by C57BL/6J Mice in a Modified "Plus" Morris Water Maze**

John B. Phillips (Virginia Tech), Paul Youmans (Virginia Tech), Rachel Muheim (University of Lund, Sweden) & Kelly A. Sloan

50

Among rodents, magnetic compass orientation has been demonstrated in two families of molerats, dwarf hamsters and C57BL/6J mice. Given the value of a magnetic compass as a global directional reference, the failure to find evidence for magnetic input in a variety of tasks used to study rodent spatial cognition (e.g., water maze, radial arm maze) is surprising. Here we show that inbred C57BL/6J mice, tested in a radio-frequency free environment, rapidly learn the magnetic compass direction of a submerged platform in a "plus" water maze. Mice in these experiments required only two brief (< 30 sec) training trials (without prior acclimation) to learn the magnetic compass response, suggesting that magnetic cues could play a role in the initial encoding of spatial information in novel environments. Sensitivity to low-level radio frequencies is characteristic of magnetic compass mechanisms involving a light-dependent biochemical reaction that forms radical pair intermediates (Rodgers & Hore 2008. PNAS 106: 353-360). Evidence that a light-dependent magnetic compass found in some animals is mediated by specialized photoreceptors in the retina raises the intriguing possibility that the magnetic field may be perceived as a complex 3-dimensional "visual" pattern superimposed on an animal's surroundings.

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

See Poster Abstracts Starting on Page 20

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

Friday Afternoon

12:00 PM Memory (Chair: Chris Sturdy)

51 12:00 PM

Memory Confusions in Non-humans

Jennifer Vonk (University of Southern Mississippi)

The Deese–Roediger–McDermott (DRM) paradigm refers to the finding that humans often mistakenly remember having studied words that were not on a list of items to be remembered for later. Typically the mistakenly remembered words are those that are conceptually or categorically related to those from the studied list. If non-humans show similar memory "confusions" it might suggest that they also process stimuli at a conceptual or categorical level, rather than simply processing the perceptual features of the stimuli. An adult male chimpanzee and two American black bears have been trained to select three target images on a touch-screen computer across 27 study trials where each image appears in nine locations on the screen. Following these study trials, a test is given in which the three targets are presented alongside six distracters. Following training, the six distracter images at the test phase consist of one categorical and one perceptual match for each of the target images. The chimpanzee has completed 55 sessions of each of the three test sets. He selects only the targets at above chance levels (47%) and his rate of selection of conceptual (24%) and perceptual (28%) distracters does not differ.

52 12:07 PM

Lateral and Frontal Visual Cognition in Pigeons (Columba livia)

Matthew S. Murphy & Robert G. Cook (Tufts University)

Birds as laterally-eyed animals have specialized retinal areas for frontal and lateral vision, which have unique perceptual, anatomical, and cognitive properties. The visual fields largely follow different visual pathways in the brain. There is an additional difficulty in transferring information learned in one field to the other. However, prior research has not thoroughly investigated several critical questions, such as whether intraocular transfer is context- or stimulus-specific, or whether they share a common working memory. Using a behavioral targeting procedure with pigeons, we are able to test transfer of different types of information in various ways between the lateral and frontal fields. The first set of a longer line of experiments will be discussed.

53 12:14 PM

What kinds of time can hummingbirds learn?

Rachael E. S. Marshall (University of St Andrews), T. Andrew Hurly (University of Lethbridge), & Susan D. Healy (University of St Andrews)

Investigations into episodic-like memory have highlighted the various ways in which the time of an event may be encoded by animals. The variability in the way the time of an event can be conceptualised, and an animal's ability to discriminate between these different types of cues, has, however, received little attention. The rufous hummingbird is a useful model for investigating the use of time, as they are able to learn how long ago they last visited an artificial flower. We investigated whether these birds are also able to learn which flower is rewarded based on sequential or circadian rules. Birds were able to learn both these types of information within very few visits, indicating that hummingbirds can learn and use multiple kinds of temporal information.

54 12:21 PM

Rodent olfactory span: The magic number 72 plus or minus 20

L. Brooke Poerstel (University of North Carolina Wilmington), Lucas Watterson (Arizona State University), Kate Bruce, & Mark Galizio (University of North Carolina Wilmington)

The rodent olfactory memory span task (Dudchenko, et al., 2000) measures the number of consecutive odor stimuli that rats can correctly remember. The task was designed as an analogue to human working memory tasks (e.g. digit span task), which define the limits of working memory capacity as the number of items accurately recalled in the order presented. Human digit span data quite famously show a limited capacity of 7 +/- 2 (Miller, 1956); however, research in our laboratory with rats using 24 odor stimuli has indicated something rather different: Spans are typically variable and do not necessarily represent a limit on overall session accuracy. In a further attempt to identify a capacity limitation, six rats were given successively longer span tasks (36, 48, and 72 stimuli to remember). Again, unlike data from human digit span studies, the 36/48/72 span results indicated sustained high accuracies throughout the sessions even at the very highest memory loads. Thus, we argue that the rodent olfactory memory span procedure may provide a better model of human visual and facial recognition memory processes than working memory processes.

55 12:28 PM

Rats exhibit asymmetrical retention functions for hedonic and nonhedonic samples in many-to-one symbolic delayed matching-to-sample

Angelo Santi, Sabrina Simmons, Shannon Mischler, & Claire Hoover (Wilfrid Laurier University)

Rats were trained in a symbolic delayed matching-to-sample task to discriminate hedonic sample stimuli that consisted of food or no food. Retention functions decreased more rapidly on trials initiated by a food sample, than on trials initiated by a no-food sample. Following delay testing, many-to-one delayed matching training was given in which samples of food and one tone were each associated with responding to one comparison lever, and samples of no food and a different tone were each associated with responding to an alternative comparison lever. During retention testing, the asymmetry for food and no-food sample retention was replicated. In addition, forgetting of the tone sample associated with the same comparison lever as the food sample occurred more rapidly than forgetting of the tone sample associated with the same comparison lever as the no-food sample. When rats were trained only with the tone samples parallel retention functions were observed. This is the first study conducted with rats to report asymmetrical retention functions for food and no-food samples and it suggests that rats, like pigeons, may use hedonic samples as the basis for the common coding of nonhedonic samples in many-to-one delayed matching.

12:42 PM *Break*

12:47 PM Discrimination Learning (Chair: Bob Cook)

56 12:47 PM

Mid-Session Simultaneous Discrimination Reversal Differences Between Rats and Pigeons

Rebecca Rayburn-Reeves, Jessica Stagner, Chelsea Kirk, & Thomas Zentall (University of Kentucky)

Research has shown that pigeons given a simultaneous color discrimination task in which a single reversal occurs at the midpoint of each session consistently show anticipatory errors prior to the reversal and perseverative errors after the reversal, suggesting they use a less effective cue (time or trial number) than a more effective cue (local reinforcement). However, rats tested with a spatial discrimination task show no anticipatory errors and very few perseverative errors, suggesting they do use more optimal local reinforcement cues. When pigeons were tested with a spatial task they continued to show sub-optimal reversal behavior as they showed when tested with visual cues. When the rats were tested with a single reversal point that varied in its location during the session they continued to reverse with great efficiency and they also reversed efficiently when they were given multiple reversals in a session showing the development of a win-stay/lose-shift strategy. The fact that rats were able to maximize reinforcement by using the most relevant information afforded by the task, whereas pigeons were not, suggests that levels of flexibility may differ between these species.

57 12:54 PM

The Role of Sample Responding in Change Detection Acquisition by Monkeys and Pigeons

Caitlin Elmore, Anthony A. Wright (The University of Texas at Houston), John Magnotti, & Jeff Katz (Auburn University)

Two groups of pigeons were trained to perform a 2-item change detection task. The group which was trained to view but not respond to the stimuli prior to the change acquired the task faster and achieved a higher asymptotic level of performance than the group which did not receive this training. Interestingly, rhesus monkeys did not benefit from "no response" training. Optimal performance was achieved by monkeys when they were required to respond to the stimuli. Implications for learning, attention, and memory processing in pigeons and monkeys will be discussed.

58 1:01 PM

Transposition task based on speed of motion

Emily Leiker & Olga Lazareva (Drake University)

Pigeons demonstrate robust relational learning after multiple-pair transposition training (Lazareva, Young, & Wasserman, 2005; Lazareva, Miner, Young, & Wasserman, 2008). These studies, however, employed the stimuli varying along the same dimension (i.e., size), raising concerns about generality of the findings. We trained pigeons to select the faster (or the slower) of the two stimuli rotating around X-axis. The first group of pigeons was trained with the pairs 1+ 2- and 2+ 3- (or 1- 2+ and 2- 3+; digits denote speed of rotation and plus and minus signs denote reward and nonreward, respectively). The second group of pigeons was trained with the pairs 1+ 2-, 2+ 3-, and 3+ 4- (or 1- 2+, 2- 3+, and 3- 4+). We expect to replicate an increase in relational learning from two-pair to three-pair training.

59 1:08 PM

Proactive and reactive birds' performance varies according to learning task demands

Lauren M. Guillette (University of Alberta), Adam R. Reddon (McMaster University), Marisa Hoeschele, & Christopher B. Sturdy (University of Alberta)

In a recent review of the proximate mechanisms underlying individual differences in behaviour within a population, Cockrem (2007) proposed two broad classes of bird personalities: proactive and reactive. He theorized that proactive birds are likely to be fast, superficial explorers, and hence would be more successful in predictable or consistent conditions. Conversely, reactive birds are likely to be slow, thorough explorers and hence would be more successful in unpredictable or dynamic conditions. We previously reported that fast-exploring black-capped chickadees learned an operant discrimination task in fewer trials compared to slow-exploring conspecifics. In the current experiment, we tested whether slow-exploring black-capped chickadees would outperform fast-explorers when reward contingencies in an operant discrimination task were reversed. In accordance with the characteristics proposed for proactive and reactive personalities, we found that slow-explorers out performed fast-explorers when the rules of a task were reversed following initial task acquisition.

60 1:15 PM

Investigating Exploratory Behaviour and Cerebral Lateralization in Pigeons Using a Novel Operant Box Design

Michele K. Moscicki, Jean-Francois Nankoo, Peter L. Hurd, Marcia Spetch (University of Alberta)

Cerebral lateralization, the preferential partitioning of cognitive functions into a certain hemisphere, has recently been found to be related to certain personality traits in animals. It is postulated that animals differ in personality-like behaviours depending on the degree that one hemisphere of the brain is able to assert control over the other (i.e., hemispheric metacontrol). Strongly lateralized animals tend to behave in a bolder manner, form more rigid routines, and make quicker decisions. Strength of cerebral lateralization was investigated in the domestic pigeon using a novel operant box design that allows presentation of different stimuli to each eye simultaneously. Pigeons were trained on a Go/NoGo colour discrimination task using a different pair of stimuli for each eye. Degree and direction of hemispheric metacontrol, speed of discrimination learning for each eye, and speed of reversed contingency learning for each eye were investigated and related to the personality trait of exploration in a novel environment. We used a novel method to replicate findings that there are individual differences in the degree of hemispheric metacontrol in pigeons and extend these findings to relate hemispheric metacontrol to individual differences in exploratory behaviour.

61 1:22 PM

Modeling relational learning in transposition: Joint effects of generalization gradients, relational disparity, and novelty

Olga Lazareva (Drake University), Michael Young (Southern Illinois University at Carbondale), & Edward Wasserman (University of Iowa)

We propose a new model of relational responding in transposition task that uses the difference in generalized associative strength between the stimuli in the testing pair, the dissimilarity between the testing stimuli, and the Euclidean distance from the training pair to the testing pair as predictors of relational choice in a novel testing pair. Our simulations using prior data (Lazareva, Young, & Wasserman, 2005; Lazareva, Miner, Young, & Wasserman, 2008) show that after one-pair training, both relational disparity and gradient generalization contribute to testing performance. As the number of training pairs increases, the contribution of relational disparity increases and the contribution of the gradient generalization decreases. The contribution of novelty remains stable and does not depend on training conditions. The implications of the model for past and future research will be discussed.

1:36 PM **Risk-sensitive foraging: the effect of joint variability in different reward dimensions.**
Martin Shapiro (California State University, Fresno)

62

Animals typically show risk-aversion with gain in reward and risk-seeking with delay. European starlings were tested in three experiments investigating whether variability itself influences decision making when other factors were equated. The first experiment used a titration design in two phases: the first phase determined the indifference point between a small reward with a small delay and a larger reward with an adjustable delay. These amount/delay combinations were then used separately in two titrations experiments where one had high variability in amount and the other had high variability in delay of reward. In other experiments, choice proportion and latency of response were used as measures of preference. In these experiments, three amount/delay combinations were used and paired against each other in three treatments followed by a fourth treatment with all three combination used with one option associated with two amount/delay combinations with equal probability. In one experiment, the variable option was less valued, and in the other, the variable option was more valued. Our results gave no strong evidence that variability, per se, plays any additional role in preference, beyond that predicted by the influence of the value of each amount/delay combination alone.

1:50 PM **Categorization of Moving and Static Geons by Pigeons.**
Angie Koban (Thiel College) & Robert Cook (Tufts University)

63

Four experiments explored the ability of four experienced pigeons (Columba livia) to learn and to recognize a set of geons whose features varied (2 colors and 2 sizes presented both in motion and statically). In Experiment 1, pigeons acquired each of the geons in a choice key task. In Experiment 2, a baseline was developed that demonstrated that the pigeons found color and size to be irrelevant to shape recognition, but found motion to be advantageous across sessions. In Experiments 3 and 4, color (Exp. 3) and motion (Exp. 4) variations of the original stimuli were tested. All pigeons were able to discern the geons despite these changes, and continued to show consistently higher accuracies with the moving geons over the static geons. The results from these Experiments suggest that pigeons are able to acquire a set of geons based on shape, and that the varying features (color and size) of the geons are irrelevant, except for motion, which is advantageous in geon recognition.

2:04 PM *Break*

2:09 PM Tool-use, Causality & Behavior (Chair: Angelo Santi)

2:09 PM **Are tool-using woodpecker finches better physicists?**
Sabine Tebbich (University of Vienna), Irmgard Teschke (Max Planck Institute for Ornithology, Seewiesen Germany)

64

The use and manufacture of tools has been considered to be cognitively demanding and thus a possible evolutionary driving factor of intelligence. Animal tool-use provides the opportunity to investigate whether the use of tools evolved in conjunction with enhanced physical cognitive abilities. However, success in physical tasks may simply reflect enhanced general learning abilities and not cognitive adaptations to tool-use. To distinguish between these possibilities, we compared the performance of the tool-using woodpecker finch (Cactospiza pallida) and its close relative, the small tree finch (Camarhynchus parvulus) in two general learning tasks and two physicals tasks. Woodpecker finches, habitually use twigs or cactus spines to probe arthropods out of tree holes. Both species belong to the group of Darwin's finches and are similar diet, morphology and size.Contrary to our predictions, woodpecker finches did not outperform small tree finches in either of the physical tasks and excelled in only one of the general learning tasks. Our data provide no evidence that tool-use in the woodpecker finch has evolved in conjunction with enhanced physical cognition instead they indicate that the cognitive abilities necessary for tool-use have preceded the evolution of this ability.

2:23 PM **A Comparative Analysis of Rescue Behavior in Sand-dwelling Mediterranean Ants**

Karen L. Hollis (Mount Holyoke College) & Elise Nowbahari (Université Paris 13)

65

Recently, Nowbahari, Durand, Scohier & Hollis (2009) reported a novel form of rescue behavior in Cataglyphis cursor ants. In addition to limb-pulling and sand-digging, rescue behavior that was extended only to nestmates, C. cursor rescuers also were able to recognize what, exactly, held the victim in place (a nylon snare), to transport sand away from that object, and to target bites precisely to it alone, excavating more sand as necessary. To expand our understanding of both the prevalence and form of this novel rescue behavior, we conducted field experiments with four species of sand-dwelling Mediterranean ants, including a closely related Cataglyphis species, C. floricola. We presented foragers with a single ensnared victim near their nest entrance. The victim was either a nestmate, a member of a different colony of that same species (Heterocolonial victim), or a member of a different ant species (Heterospecific victim). Control tests were performed, as in our previous work, with an empty snare. Our results reveal interesting similarities and differences, not only in rescue behavior, per se, but also in the extent to which foragers display aggressive behavior toward heterocolonial and heterospecific victims. These results will be discussed in terms of each species' unique ecology.

2:37 PM **Great Grey Owls do not comprehend the functional role of the string in string pulling tasks**
Tanya Obozova & Zoya Zorina (Lomonosov Moscow State University)

66

An experimental approach to investigate some cognitive abilities of owls, the night predators, has been developed, with the Great Grey Owl (Strix nebulosa) as a model subject. By using this approach it has been shown that the owls do not comprehend the functional role of the string in string pulling tasks. The subjects were 6 owls – all the birds that showed no fear for being tested – from a group of 12 owls living together in a bird nursery (Moscow Province). They were offered two string-pulling tasks: 1. with the bait attached to single string; and 2. with two baits attached to two strings, one of which being broken. The results and individual differences between the birds in task performance will be discussed.

2:44 PM Perception (Chair: Kenneth Leising)

2:44 PM **67**

A chimpanzee (Pan troglodytes) recognizes spoken words synthesized as sine-wave speech

Lisa A. Heimbauer, Michael J. Beran, & Michael J. Owren (Georgia State University, The Language Research Center)

The human ability to understand distorted speech is argued to constitute evidence of specialized perceptual processing. To examine this claim, we previously showed that an adult, language-trained chimpanzee named Panzee was able to recognize "noise-vocoded" speech (synthesized from noise bands). Panzee is of particular interest because she was reared in a language-rich environment, and reliably identifies 125 spoken words using graphical, "lexigram" symbols. Here, we report Panzee's ability to recognize words synthesized as "sine-wave" speech, which is based on just three pure tones, is highly unnatural-sounding, and lacks traditional acoustic cues to phonetic content. On each trial, one of 48 familiar words was presented in natural or sine-wave form, and Panzee chose a corresponding lexigram from among four options. Performance on sine-wave words was significantly above chance, including first trials of hearing these stimuli. Panzee had no opportunity to learn the correct responses, as she received no reward or other feedback on synthetic trials. While less accurate with sine-wave than noise-vocoded words, the chimpanzee's performance was similar to that of humans tested with the same stimuli. Results indicate that early life experience with spoken language and general auditory-processing mechanisms alone are sufficient for perceiving highly impoverished synthetic speech.

2:51 PM **68**

Detection of Low Frequency Vibratory Stimuli by Florida Manatees

Joseph Gaspard (University of Florida), Gordon B. Bauer (New College of Florida), Roger Reep (University of Florida), David Mann (University of South Florida), Kimberly Dziuk, Adrienne Cardwell, LaToshia Read (Mote Marine Laboratory)

Two Florida manatees were tested in a go/no-go procedure using a staircase method to assess their ability to detect water movement. Hydrodynamic vibrations were created by a sinusoidally oscillating sphere that generated a dipole field at frequencies 5 – 150 Hz, which are below the apparent functional hearing limit of the manatee. The first tests were done on the facial region. The manatees detected particle displacement of less than a micron from 15 – 150 Hz, and for some frequencies less than 0.003 microns. Restricting the facial vibrissae with various size mesh openings indicated that specialized sensory hairs play an important role in the manatee's exquisite tactile sensitivity. Subsequent testing indicated similar sensitivity for the postcranial vibrissae. We will report the tactogram, a graphic representation of the relation between vibration frequency and particle velocity threshold, for facial and postcranial areas of the body. In the dimly lit, turbid manatee habitat the sensory hairs that cover the manatee's entire body (a unique arrangement among mammals) may act as a three-dimensional array for orientation and navigation.

2:58 PM **69**

Testing Pigeons with an Immersive Reality?

Muhammad A. Qadri (Tufts University, Sean Reid (Clark School), Robert G. Cook (Tufts University)

The opportunity to use controlled digital immersive environments to explore aspects of animal cognition and behavior is highly attractive. To explore this approach, pigeons were tested in a conditional visual search task using animation software that continually presented a dynamic three dimensional environment to the animal. The perspective moved forward through the environment past various potential target 3-D objects. The correct object choice was conditionally contingent upon various context cues within the environment. Pigeons accurately pecked and tracked correct targets and suppressed pecking to non-target objects. Their ability to succeed in the discrimination indicates that pigeons correctly processed contextual cues from the rendered environment. These results hold promise in potentially using immersion in digital realities to advance our understanding of cognition and behavior in various domains.

3:05 PM **70**

The role of nucleus rotundus in figure-ground, color, and shape discrimination

Martin Acerbo (Drake University), Olga Lazareva (Drake University), Amy Poremba (University of Iowa), & Edward Wasserman (University of Iowa)

Recently, we found that figure-ground assignment in a nonmammalian species, pigeon, is analogous to primates, at least at the behavioral level (Lazareva et al., 2006). We used the same behavioral paradigm to pinpoint areas in the avian brain that are critically involved in figure-ground assignment. Using the same stimuli, three group of pigeons were trained to perform figure-ground discrimination, color discrimination, or shape discrimination. Once their discriminative performance reached the asymptote, the birds were injected with 1-[14C]-2-deoxy-D-glucose and required to perform discrimination for 45 minutes. The fourth, control group, was not required to perform any discrimination; instead, these birds were placed into dark operant chambers where they received food pellets according to VI schedule. We then compared metabolic levels in the nucleus rotundus in different groups to locate the brain areas responsible for figure-ground assignment.

3:19 PM *Snack Break*

4:15 PM In Honor of the Contributions of Alex Kacelnik (Chair: Sara Shettleworth)

4:15 PM **71**

The cognitive mechanisms of optimal sampling

Stephen E. G. Lea, Ian P. L. McLaren (University of Exeter), Susan M. Dow (Bristol Zoo Gardens), & Donald A. Graft (STMicroelectronics)

In Alex Kacelnik's first publication bringing together animal cognition and behavioural ecology, Krebs et al (1978) exposed great tits to different durations of access to two unequally profitable, probabilistic sources of food (the "two-armed bandit" situation). They showed that, in response to the total access time, the birds could adjust the amount of time they spent sampling from both sources before focusing on the apparently better one, in a way that was qualitatively consistent with an optimal sampling theory. We subsequently demonstrated similar performance in pigeons. The present paper paper reports simulations of performance in the two-armed bandit situation that seek to establish what kind of learning mechanisms could underlie the performance birds have shown, within two frameworks: Dynamic versions of the matching law (the approach we took at the time), and more modern associative learning models.

4:30 PM **A comparative analysis of decision making: Sturnus vulgaris vs. Benjamin Franklin**
Marco Vasconcelos, Tiago Monteiro, Justine Aw, & Alex Kacelnik (University of Oxford)
72 Charles Darwin famously decided whether or not to marry by writing a list of points under two columns: "Marry" and "Not Marry". This reflects an intuitive conception of choice, under which individuals compare the relative merits of simultaneously present opportunities and integrate the comparison into a decision to act. This is what Benjamin Franklin called Moral or Prudential Algebra. An alternative view (the Sequential Choice Model, SCM) proposes that when two or more options are met simultaneously, each is processed separately, with no direct comparisons at the time of choice. Instead, independent samples are drawn from latency distributions formed during single-option encounters and the shorter latency is expressed as a choice. In this view, latencies are a function of the value of each option relative to background opportunities, according to rate maximising foraging models. Thus, behaviour in simultaneous choices reflects adaptations to contexts with sequential encounters, in which the choice is whether to take an opportunity or let it pass. We describe these alternative models and present data from a variety of studies supporting the SCM and therefore suggesting that mechanisms adaptive for sequential encounters may be sufficient to explain behaviour under simultaneous choices.

4:45 PM **Cognitive biases in honeybees: The stressed bee's glass is half empty.**
Melissa Bateson, Suzanne Desire, Geraldine Wright (Newcastle University)
73 Measurement of negative affective states in animals is crucial for identifying poor welfare and testing therapeutic drugs. Since unlike humans, animals can't report their feelings, we rely instead on measuring physiological, cognitive and behavioural components of emotion to identify negative states. The presence of pessimistic cognitive biases is a reliable objective correlate of negative affect in humans and has been promoted as a novel measure of affective state in animals. Mounting evidence shows that mammals and birds judged to be experiencing poor welfare also display increased 'pessimism', defined operationally as an increased expectation of punishment. However, we do not currently know whether such cognitive biases are restricted to sentient vertebrates. Here we show that stressed honeybees display 'pessimistic' judgment biases very similar to those observed in vertebrates. After learning to associate one odour with sucrose reward and another with quinine punishment, honeybees stressed by being shaken vigorously for 1 minute altered their responses to odours predicting punishment. Our results suggest that bees have an increased expectation of punishment when stressed similar to recent observations in rats, sheep, pigs, dogs, starlings and chicks. By demonstrating a cognitive component of emotion in honeybees we show that bees have an 'emotional' response more similar to that seen in vertebrates than previously thought. Our results lead us to question the utility of pessimistic cognitive biases as an indicator of mental suffering in sentient animals.

5:00 PM **Translating Cognition from the Field to the Clinic in Drug Discovery**
Daniela Brunner (PsychoGenics Inc., Columbia University)
74 Many human diseases have core or comorbid cognitive deficits, now recognized and prioritized for preclinical research in drug discovery. This priority has been clear for some diseases such as Alzheimer's and Mild Cognitive Impairment, for which clinical cognitive readouts have been central endpoint measures. For others diseases, including Schizophrenia (Sch), Parkinson's (PD) and Huntington's Disease (PD), the focus is relatively new as priority was given in the past to features such as positive (Sch) or motor symptoms (PD, HD). The burden on the cognitive preclinical scientist is thus, pretty heavy, as proof of efficacy is necessary to bring a drug candidate into the very expensive toxicology and clinical studies. After considerable failures in clinical trials big Pharma has moved away from preclinical research in many of these areas, thus assuring lack of funding for serious unmet medical needs. On the other hand, novel mutant rodent tools are continuously developed, providing new opportunities for research. Finding homologous cognitive processes that bridge the gap between rodents, the preferred preclinical subjects, and humans is a daunting task. The relevance (or irrelevance) of different types of validity will be discussed, and examples of cognitive tasks in animal models of disease will be presented.

5:15 PM **Behavioral plasticity of Shiny Cowbirds when they parasitize hosts of different size**
Juan C. Reboreda, Diego T. Tuero & Vanina Fiorini (University of Buenos Aires), Ros Gloag & Alex Kacelnik (University of Oxford)
75 The Shiny Cowbird, Molothrus bonariensis, is an extreme generalist brood parasite that uses more than 200 hosts that differ greatly in body size (range 10-80 g.). Female cowbirds (body mass 40-45 g) synchronize parasitism with host laying and peck and puncture host eggs when visit host nests. This virulent behavior may be adaptive when they parasitize large hosts, as they eliminate stronger competitors. However, cowbird chicks may also benefit from sharing the nest with smaller host chicks because begging by host chicks solicits a higher provisioning rate by the parents that could be monopolized by the parasite. We studied the plasticity of shiny cowbird parasitic behavior in two hosts that differ greatly in body mass (13 vs. 75 g). Cowbird females laid larger eggs, improved synchronization between parasitism and host laying and punctured more host eggs per parasitic event when they parasitized the large host. In addition, cowbird chicks raised in nests of the large host had higher begging intensity, longer begging bouts, spent more time begging and had shorter latency to beg than those raised in nests of the small host. These differences between hosts indicate that shiny cowbirds may adaptively adjust parasitic behaviors to host characteristics.

5:30 PM **Tool Use and Culture in Wild New Caledonian Crows**
Christian Rutz (University of Oxford)
76 The New Caledonian crow (Corvus moneduloides) is endemic to a remote, tropical island in the South Pacific, where it habitually uses tools for extracting invertebrate prey from deadwood and vegetation. New Caledonian crows exhibit a remarkable degree of behavioural sophistication: they manufacture at least three different tool types (including the most sophisticated animal tool yet discovered); they can modify and combine tools to achieve a goal; they occasionally invent new tool designs to solve novel problems; and perhaps most intriguingly, they may progressively refine their tool technology in the wild through culturally accumulating innovations (a phenomenon hitherto believed to be uniquely human). In this paper, I will try to put experimental findings on the species' cognitive abilities into perspective by discussing results of my ongoing field research on the the evolutionary, ecological and social context of these birds' unusual tool-use behaviour.

5:55 PM Introduction - Sara Shettleworth

6:00 PM Master Lecture - Alex Kacelnik (University of Oxford)
Ain't Misbehavin'

7:30 PM Banquet

Saturday Afternoon

1:00 PM Business Meeting of the Comparative Cognition Society
All Invited to Attend - CCS Members May Vote on any Motions Made

2:10 PM (: Group Photo Shoot - SMILE :)

2:45 PM Cognitive Processes (Chair: Stephen Fontaine)

2:45 PM **77**

Renewal cannot account for how rats distinguish between explicit and ambiguous absence of a US in Pavlovian extinction
Jared Wong, Aaron P. Blaisdell (UCLA), Martina Schmid, & Michael R. Waldmann (University of Göttingen)
We previously reported evidence that rats distinguish between the explicit absence and the ambiguous absence of a US during Pavlovian extinction. After pairing a light CS with sucrose US, rats received extinction of the CS. For Group Extinction-Cover, a metal plate blocked access to the food niche during extinction treatment. For Group Extinction-NoCover, there was no cover. Subsequent tests of the CS with the food niche uncovered revealed higher rates of responding in Group Extinction-Cover compared to Group Extinction-NoCover, suggesting that rats distinguish between the explicit absence and the ambiguous absence of events. Alternatively, it could be argued that the presence of the cover during extinction and then its absence during testing resulted in a renewal of the conditioned response in Group Extinction-Cover. We tested the renewal account by placing the metal plate next to the food niche during extinction treatment so as not to block access to the food niche. At test with the plates absent, only the rats for which the cover was present AND blocked the food niche during extinction showed higher conditioned responding to the CS, thus failing to support the renewal account.

2:52 PM **78**

What do we actually know about how birds build nests?
Patrick T. Walsh (University of Edinburgh), Mike Hansell (University of Glasgow), Wendy Borello,& Susan D. Healy (University of St Andrews)
Nest building occurs in almost all bird species, varying considerably in the size, shape and materials used as well as in the complexity of the resultant structure. We currently understand very little about why birds build the nests they do and whether cognition underpins the production of a complex outcome. In the absence of relevant data, it is assumed that nest building by birds is achieved through stereotypy or fixed action patterns without a cognitive contribution. We examined the nest-building behaviour and nests of male Southern Masked weavers, which build multiple intricately woven nests, to determine how useful simple rules are for explaining their nest building. Contrary to the predictions of simple rule-based building behaviour, the nests constructed and the behaviour used to construct them varied among individual males. Although these results do not confirm a role for experience, our findings challenge the assumptions about nest building in birds and leave open the possibility that cognition does play a role in nest building in birds.

2:59 PM **79**

Characterizing visual working memory across species
John Magnotti, Jeffrey Katz (Auburn University), Caitlin Elmore, & Anthony Wright (The University of Texas at Houston)
Change detection is a popular procedure to assess the structure and function of visual working memory (VWM). We have previously reported successful acquisition of object change detection in pigeons and nonhuman primates. Here we report results from humans and pigeons tested with similar procedures. In our task, participants view a multi-item (2-7 items, pigeons; 4-8 items humans) sample array of colored circles, followed by a brief blank interval, and an array containing two choice items. One circle in the choice array changes color. In order to detect a change, participants must rely on a comparison between the choice array and a stored representation of the sample array. Computations of VWM capacity using a variety of formulas suggest stronger qualitative similarities than might have been anticipated, despite some quantitative differences possibly due to species-specific strategies.

3:06 PM **80**

Individual differences in executive control of abstract relations by baboons (Papio papio)
Tim Flemming, Elodie Bonté & Joël Fagot (Université de Provence - Laboratoire de Psychologie Cognitive, CNRS)
Studies of executive control often reveal significant limitations in nonhuman primate performance relative to that of humans. As a measure of executive control, the Wisconsin Card Sort Task (WCST) provides a means by which several critical functions can be evaluated: the capacity to attend selectively to one stimulus dimension, inhibit the disruptive influences from other stimulus dimension as well as the capacity to switch response strategies, inhibiting previously rewarded responses. In the present study, 24 socially-housed baboons were tested on a computerized version of the WCST to assess individual differences in executive control. In a second experiment, the same baboons completed a version of the WCST with paired-relational stimuli rather than those that varied on a single dimension to evaluate their set-shifting abilities with abstract relations (same/different). All baboons completed the required shifts on the traditional WCST, but only 12 baboons succeeded in making relational shifts. Age was found to be a significant factor in the level of success on both tasks with younger baboons (mean age 4 years) outperforming older, albeit not aged, baboons (mean age 11.5 years). These results implicate an earlier decline in executive control processes for nonhuman primates with more pronounced effects for cognitive flexibility of abstract relations.

3:20 PM **81**

Behavioral epigenetics: genomic imprinting affects cognition
Valter Tucci (IIT)
Many classical neurodevelopmental disorders that lead to cognitive deficits are associated with ‘parent-of-origin’ genetic defects. Genomic imprinting results in allele-specific silencing according to parental origin. Imprinting genes have significant effects on body physiology and brain functions. Since this particular class of genes shows haploid expression even though two copies of each imprinted gene are present, it is reasonable to assume that there must be significant evolutionary advantage in monoallelic expression of imprinted genes to offset the risk of genetic disease if the single expressed copy of an imprinted gene is lost. Imprinted genes tend to occur in clusters and one such cluster, Gnas, is located on distal mouse chromosome 2. A specific non-coding region in the cluster is the Exon 1A that maintains the silencing of the Gnas gene. In order to test the role of the Exon 1A, we tested mice with a 2.3 kb targeted deletion, which results in double doses of Gnas maternally imprinted genes and we observed a series of cognitive deficits that correlates with specific neuronal abnormalities in areas such as hippocampus and olfactory bulb. Our data support the use of this particular mouse line in the investigation of psychiatric disorders with a particular reference to psychosis.

3:34 PM **Learning observable (motor-spatial) and unobservable (ordinal) rules in Orangutans: A test of the Unobservability Hypothesis**

Francys Subiaul (The George Washington University, Ape Mind Initiative, Smithsonian National Zoological Park), Elizabeth Price (Ape Mind Initiative, Smithsonian National Zoological Park)

82 Are observable (motor-spatial) rules easier to learn than unobservable (ordinal) rules? Three orangutans were presented with a task where they had to learn a new 3-item simultaneous chain (Terrace, 2005) and a 3-item motor-spatial chain (Subiaul et al., In Review). In both tasks subjects responded to three simultaneously presented picture items on a touch-screen in a specific order. In the simultaneous chain three different pictures appearing in a novel spatial configuration from trial to trial had to be touched in a specific order (A, B, C). In the motor-spatial task three identical pictures had to be touched in a specific motor spatial sequence (e.g., UP, DOWN, RIGHT) that remained constant from trial to trial. All subjects had received extensive training and met performance criterion on the simultaneous chaining task before starting the study. None had received training in the motor-spatial task. Despite this training history all three subjects performed better in the motor-spatial task than in the simultaneous chaining task. Results are consistent with the unobservability hypothesis (Penn & Povinelli, 2007), demonstrating that non-human animals spontaneously learn and recall observable (i.e., motor-spatial) rules significantly better than trained but unobservable (i.e., ordinal) rules.

3:48 PM **Association between sociosexual variables in a captive setting on computerized sequencing-task performance of zoo-living chimpanzees (Pan troglodytes) and gorillas (Gorilla gorilla gorilla)**

K.E. Wagner, S.R. Ross (Lester E. Fisher Center for the Study and Conservation of Apes; Lincoln Park Zoo)

83 In primates, the interaction between sociosexual behavior, physiology and cognitive processes indicates possible impacts on long-term and acute performance in cognitive tests. This factor may become important when interpreting interfacility, single-subject experimental results, but has been infrequently examined in a naturalistic social context. Eight zoo-living chimpanzee and gorilla subjects were tested on a computerized sequencing task using a touch-frame interface. We analyzed performance on the task in relation to the sexual state of female group mates. Chimpanzees exhibited a decrease in performance when the social group contained more than two maximally tumescent females ($F=2.97$, $p=0.006$). Gorillas exhibited no such performance sensitivity. Results indicate that ape performance on cognitive tests must be interpreted in the context of species-specific sensitivities to social profiles, including cyclical changes in behavior and physiological.

4:02 PM **Cognition mediated floral evolution: prospect theory drives mammalian pollinator**

York Winter (Humboldt University), Alan Kamil & Alan Bond (University of Nebraska),Vladislav Nachev (Humboldt University)

84 Floral reward systems have evolved under the selection of the decisions of flower pollinators made to maximise perceived profitability. Still, sugar concentrations of natural nectars fall well short of vertebrate pollinator preferences. We applied a virtual pollination ecology approach that allows the realistic, repeatable simulation of original processes involved in the evolution of phenotypic characters. Bats at real flowers selected for lower sugar content than at ad libitum feeders. The result was stable and independent of the starting condition of the selection process. Prospect theory can explain the outcome as the result of a decision making process based on multiplication of values obtained from utility functions. A theoretical simulation assuming only non-linear utility functions as the basis of the decision making algorithm could replicate the experimental results.

4:16 PM *Break*

4:21 PM Attention & Associative Processes (Chair: Aaron Blaisdell)

4:21 PM **The influence of age and gender on the visual side-bias in pigeons (Columba livia)**

Christiane Wilzeck, Debbie M. Kelly (University of Manitoba)

85 Humans, pigeons, and chicks (Gallus gallus) primarily attend to objects on the left side of space. For humans this is generally tested using cancellation tasks in which participants cross-out visual characters centred in front of them. In an adapted version, birds sample grains arranged in a regular pattern. Typically, a preference for the left side is found which likely reflects a right hemispheric specialization for spatial attention. However, little is known about the hemispheric distribution of attention across the lifespan. In humans, spatial attention is vulnerable to aging and models predict reduced hemispheric specialization and increased individual variability with age. To test aging effects on spatial attention young, adult and aged pigeons chose grains in an adapted cancellation task. Adult pigeons showed a strong leftward bias, preferring to choose grain on the left side of space, confirming former findings in this species. The bias was stable in this age group persisting at re-testing two years later. In contrast, young and aged birds showed a different pattern with more individual variation; indeed especially females over-selected grains on their right side. These findings indicate that maturation and aging processes may alter individual hemispheric contribution to spatial attention in birds.

4:35 PM **Auditory stimulation dishabituates anti-predator escape behavior in hermit crabs**

W. David Stahlman, Alvin Chan, Cynthia D. Fast, Daniel T. Blumstein, & Aaron P. Blaisdell (UCLA)

86 Responses to innocuous stimuli often habituate with repeated stimulation, but the mechanisms involved in dishabituation are less well studied. Chan et al. (2010b) found that hermit crabs were quicker to perform an anti-predator withdrawal response in the presence of a short-duration white noise relative to a longer noise stimulus. In two experiments, we examined whether this effect could be explicable in terms of a non-associative learning process. First, we delivered repeated presentations of a simulated visual predator to hermit crabs. Once the crabs failed to make a withdrawal response to the visual stimulus on a given trial, we presented an auditory stimulus prior to an additional presentation of the visual predator. In Experiment 1, the presentation of a 10-s, 89-dB SPL noise produced no significant dishabituation. In Experiment 2 we increased the duration (50 s) and intensity (95 dB) of the noise, and found that the crabs recovered their withdrawal response to the visual predator. This finding illustrates dishabituation of an antipredator response and suggests two distinct processes—distraction and sensitization—are influenced by the same stimulus parameters, and interact to modulate the strength of the anti-predator response.

4:49 PM **87**

Vigilance in a killer whale (Orcinus orca) mother during the calf's first month of life

Caitlyn Geraci & Heather Hill (St. Mary's University)

Cetaceans have developed a unique mechanism to sleep in which they alternate slow wave sleep patterns between hemispheres, which allows them to maintain constant vigilance while resting. An earlier study involving a killer whale mother-calf pair had suggested that the mother never slept following the birth of her calf for the first month (Lyamin et al. 2005), as suggested by the absence of floating. The sleep patterns of a mother-calf pair located at Sea World of San Antonio were investigated one month prior and one month post-parturition. As suggested by additional work on sleep patterns in dolphins, floating is not the only resting behavior exhibited by cetaceans. Samples of calf watch records and videos were analyzed. Following the birth of a calf, floating occurred less than 1% of the observation time. The mother engaged in active swimming approximately 64% of the first month, indicating an increase in vigilance pre- to post-parturition. However, the mother did appear to rest by slow swimming or swimming in pattern swims. The findings suggest that killer whale mothers may change their swim strategy based on the presence of a calf and replace floating with slow and pattern swims.

4:56 PM **88**

A modular theory of simple conditioning

Russell M. Church, Mika L. M. MacInnis, & David M. Freestone (Brown University)

There has been an enormous amount of research on simple classical and operant conditioning. This has led to a concern that behavior is complicated, and that no general theory of learning will be successful. Different computational models of conditioning are typically developed for different procedures. The proposal is that a modular theory of simple conditioning provides a framework for a general theory with the appropriate features, e.g., good fits to the primary data, simplicity, and generality. It applies to a wide range of procedures (input generality) and a wide range of summary measures (output generality). A comparison of the results of many well-known studies on a range of psychological processes and the predictions of the model will be shown, and some suggestions will be made about the value of such a general model.

5:10 PM **89**

Simple and complex forms of associative learning in zebrafish

Robert Gerlai

The zebrafish has been in the forefront of genetics for over three decades. By now the large number of genetics tools developed for this species makes it highly attractive for behavioral neuroscience. The zebrafish has been utilized particularly successfully in high throughput screening applications including forward genetics and drug screens. Such screens have the ability to tackle complex biological problems and unravel a range of underlying molecular mechanisms. Although learning and memory have been extensively studied, only a small fraction of genes involved in these processes have been discovered. The main limitation for the use of zebrafish in this research is the paucity of appropriate behavioral test paradigms and lack of characterization of the cognitive and mnemonic abilities of this species. In this talk I will present behavioral paradigms that can test the acquisition, consolidation and recall of simple CS-US association, and more complex forms of associative learning including spatial and contextual learning. In addition, I will show how MK801, a non-competitive NMDA-R antagonist impairs certain aspects of these processes. Based on the results I argue that zebrafish learning and memory tests have face, construct and predictive validity, criteria important for translational relevance.

5:24 PM **90**

Production of center embedded structure by baboons (Papio papio)

Joel Fagot, Arnaud Rey, & Pierre Perruchet (Laboratory of Cognitive Psychology, Marseille and LEAD, Dijon, France)

The ability to process center-embedded (CE) structures and the more general capacity for recursion is currently claimed to be human specific. Here we demonstrate that after intensive paired-associate training with arbitrary visual shapes, baboons spontaneously responded to a choice stimulus consistent with a recursive CE structure. This result suggests that the human ability for recursion might partly if not entirely originate from fundamental processing constraints already present in non-human primates.

5:38 PM Closing Remarks

Poster Session II (8:30 - 11:00)

See Poster Abstracts Starting on Page 26

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

Posters

Poster Session I - Thursday Evening

P1

The discrimination of ultrasonic vocalizations in CBA/CaJ mice

Erikson G. Neilans, Kelly E. Radziwon, & Micheal L. Dent (Department of Psychology, University at Buffalo, SUNY, Buffalo, NY 14260)

Previous studies have found that both male and female mice produce ultrasonic vocalizations (USVs) under a variety of circumstances, but the function of these USVs remains unclear. In addition to emitting many USVs, mice also produce a wide array of call types, hinting that unique information is conveyed to listeners by different call types. However, it is not clear whether mice can actually discriminate between these different call types. The present study sought to determine the acoustic cues that are most salient to the mice when differentiating between call types. CBA/CaJ mice were trained using operant conditioning procedures on a discrimination task to detect change in a repeating background. The repeating background consisted of calls that were previously recorded from female and male mice. The target stimuli were a variety of originally recorded and manipulated USV call types. The mice responded differently to each manipulation, suggesting that certain parameters of the call are important in perceiving that particular call type. There were also certain manipulations which appeared to be difficult to discriminate across a variety of stimuli. These results suggest that mice are using different calls to convey meaning, and that certain changes in calls are more meaningful than others.

P2

Training diving ducks for behavioral audiograms

Sara Therrien, Catherine Carr, Robert Dooling, Arthur Popper (University of Maryland), Ronald Therrien and Alicia Wells-Berlin (USGS Patuxent Wildlife Research Center)

Lesser Scaup (Aythya affinis) are a species of diving duck that dive to depths of up to 20 m to forage on crustaceans, mollusks, and fish. Currently, there are no measures of underwater hearing on any diving bird because of the inherent difficulties of training a bird to respond to sound underwater. Lesser Scaup in a captive colony at USGS Patuxent Wildlife Research Center in Laurel, Maryland are being trained to participate in in-air and underwater behavioral audiograms. Ducklings were hand-reared to respond to trainers, auditory signals, and mealworm rewards. The ducks were then trained on a go/no-go task to respond to varying frequencies and intensity levels by pecking an LED-lit target. All targets and acquisition devices were designed to follow similar procedures in-air and underwater. Previous Auditory Brainstem Response (ABR) tests demonstrated an in-air maximum sensitivity at 2-3 kHz. These behavioral audiograms will provide a measure to compare ABR and psychoacoustic thresholds, as well as a measure of underwater thresholds, which would be difficult to implement using only the ABR.

P3

Recognition of auditory self-similarity by pigeons

Ryan Oliveira & Robert Cook (Tufts University)

We investigated the factors that influence the ability of birds to detect self-similarity in complex sounds across time. Four pigeons (Columba livia) were tested for their ability to detect sameness using different sounds (various man-made, natural sounds & bird songs). They were tested in a same/different go/no-go discrimination task. Birds showed a correlation among themselves in the complex sounds that were easiest to recognize as being repeated. In general, bird songs were easier to recognize as same trials than either natural or man-made sounds. Various acoustic factors influencing the relative perception of this self-similarity were analyzed. The results help us to elucidate further the mechanisms of auditory discrimination and recognition in pigeons.

P4

Understanding economic decision making during coordination games in humans, apes, and monkeys

Audrey E. Parrish, Michael J. Beran (Georgia State University), Bart Wilson (Chapman University), & Sarah F. Brosnan (Georgia State University)

We know little about how strategic decision-making in humans evolved. Although humans and nonhuman primates share many of the same decision-making characteristics, there are also areas in which they seem to diverge. However, methodologies often differ between species, and thus direct comparisons are needed that present the same tasks and attempt to carefully equate training and pretesting histories. This study investigated how humans, chimpanzees, and capuchin monkeys responded to the Assurance (or Stag Hunt) game, a coordination game. If both individuals made a "Stag" response, both received the maximum payoff, but if one made the "Hare" response (for a lower payoff) then the other received nothing unless they, too, chose “Hare.” Humans were the most likely to cooperate, outperforming both non-human primates by achieving the payoff dominant outcome. Chimpanzees typically matched their partners, but even they failed to consistently find the maximizing solution. Capuchins showed the least structured behavior, with only one pair playing the payoff dominant outcome, one pair matching their partner, and the remaining pairs failing to find a strategy. Thus, we found some evidence for continuity in decision-making processes across the Order Primates, but also clear differences in the extent to which those species cooperated.

P5

What Cognitive Mechanisms Underlie Transitive Inference Performance in Monkeys?

Regina Paxton, Nicholas Chee, & Robert R. Hampton (Emory University)

Knowing that Ben is taller than Emily and that Emily is taller than Dina, we readily infer that Ben is taller than Dina. This is known as transitive inference, the ability to infer the relations between two items based on their shared relation with a third item (if A>B and B>C then A>C). Transitive inference has historically been seen as a hallmark of logical thought. Many nonhuman animals show patterns of performance matching those predicted by transitive inference, but these patterns can result from mechanisms other than logic, such as associative strength. Despite considerable research effort, it is still not clear what mechanisms account for performance in transitive inference tasks. We presented 12 rhesus macaques (Macaca mulatta) with multiple variations of transitive inference tasks designed to elucidate the cognitive mechanisms controlling choice. First, we required them to link two independently learned lists based on experience with only one linking pair of items. Monkeys linked these two smaller lists into one large list, a result that is difficult to account for by reinforcement history alone. Additional experiments will manipulate and measure reinforcement strength of individual stimuli to determine the role of associative strength in determining monkeys’ choices in inference tasks.

Double doses of Gnas affect behavior, cognition and thermogenesis in mice

Glenda Lassi & Valter Tucci (IIT)

P6 The Gnas genomic cluster is made up of a series of imprinted protein-coding and non-coding transcripts. Gnas is biallelically expressed in most tissues but is predominantly maternally expressed in brown adipose tissue (BAT), well known for its role in body thermoregulation. Within this cluster, the Exon 1a transcript is unmethylated on the paternally derived allele but methylated on the maternally derived allele. It is approximately 2.5 kb in size and contains the promoter for a non-coding RNA that maintains the silencing of Gnas. To test the role of the Exon 1a we tested mice with a 2.3 kb targeted deletion which interrupts the silencing of Gnas. On paternal inheritance of the deletion, Gnas was derepressed on the paternal allele in BAT. The Exon 1a mutation is sufficient for impairment in fundamental thermogenesis responses that the animal exert when facing cold environment or intense physical exercise. Similar thermoresponses were observed following footshocks (fear conditioning); these mutants, tested 24h later, presented a contextual memory deficit. They showed also a poor performance in a spatial memory test (Barnes maze). Furthermore, Exon 1a mutants present a reduction of c-fos expression in the preoptic area/anterior hypothalamus that regulates thermoregulation and other physiological behaviors.

Serial reversal learning in bumble bees

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

P7 Bumble bees and honey bees are capable of complex discriminations and learning tasks. In our study, we tested bumble bees' (Bombus impatiens) performance on a serial reversal task. In serial reversal learning, animals are trained on an initial discrimination between two differentially rewarded stimuli and are then subjected to multiple reward contingency reversals. A reduction in errors with repeated reversals is considered a measure of behavioural flexibility and indicates a 'learning-to-learn' strategy. Bees were tested during foraging flight and returned to their colony to deposit nectar after each trial. This design allowed numbers of trials and reversals not attainable using the proboscis extension reflex (PER) protocol. Bees were trained to perform a simultaneous discrimination between two colours for a nectar reward and given nine reversals. Reward contingencies were reversed at the start of each session. Results show that under certain conditions bumble bees are capable of reducing perseverative errors and improving performance on a serial reversal task.

Visual Learning set in a California sea lion

Molly McCormley, Peter Cook, Madison Miketa, & Colleen Reichmuth (University of California Santa Cruz)

P8 Can sea lions "learn to learn"? The learning set approach, pioneered by Harlow, has shown that a broad range of species become increasingly efficient at solving successive discrimination problems of a similar type. Here we present data on trail-and-error learning for an experimentally naive two-year-old California sea lion trained to perform a two-alternative simple discrimination task using fish rewards. The stimuli are two-dimensional black-and-white patterns that are comparable in size and brightness. Each unique stimulus pairing is presented until the sea lion reaches a criterion of ten consecutive correct responses. Thus far, errors to criterion have ranged from 132 to 0, and have generally decreased with successive discrimination problems. The sea lion has shown one-trial learning— reaching criterion with either one or zero errors—on a number of pairings. The sea lion's preliminary learning curve is similar to those found in rhesus monkeys and cats on similar criterial visual learning problems. Further study will help to determine at what point the sea lion's inter-trial improvement plateaus, and will contribute to comparative data on general learning across species. This experiment is also serving as a stepping-stone to more complex cognitive procedures in this subject, such as cross-modal matching-to-sample.

Error-Reduction in Matching-To-Sample Learning: Gradually Delayed Removal of the S-Minus

Peter Sanneman, Anne Neuendorf, James MacDonall (Fordham University)

P9 The experiment explored an "error-reduction" procedure designed to eliminate or reduce errors during acquisition of the matching-to-sample task, which is an animal analogue of training for patients undergoing language rehabilitation. Pigeons first peck at a sample which presents comparisons; pecking the correct comparison is reinforced. Pigeons acquiring matching-to-sample behavior usually make hundreds of errors. Two pigeons were first trained to peck a red or green center sample stimulus. Then, pecking the sample produced a comparison of the same color; pecking this was reinforced. Next, pecking the sample produced both red and green comparisons. After 0.1 sec, the incorrect comparison disappeared. Across sessions, the duration of the incorrect comparison increased until it always remained for the entire trial. The two pigeons made 9 and 21 errors during acquisition. In the control condition the same pigeons were trained on an amber and purple matching-to-sample task by first training pecking the sample and then presenting both the comparisons. The pigeons made 29 and 301 errors during acquisition. Finally, the first error-reduction procedure was used again to train a burgundy and blue matching-to-sample task. Fewer than 10 errors were made by each pigeon. The procedure was effective in reducing errors during matching-to-sample acquisition.

Recollection and familiarity in monkey memory: Evidence from a direct comparison of recall with recognition and an analysis of recognition errors

Benjamin M. Basile & Robert R. Hampton (Emory University)

P10 Human memory includes recollection and familiarity. Recollection is comparatively slow, but provides detailed information about the remembered item. Familiarity is fast, but only provides a vague sense of whether an item has been seen before. In recognition tests, where the studied item is re-presented at test, both recollection and familiarity contribute to performance. In recall tests, where the studied item is not re-presented, only recollection contributes to performance. To assess the contributions of recollection and familiarity to monkey (Macaca mulatta) memory, we compared memory for the same stimuli in two different tests: a recall test in which monkeys reproduced part of a studied shape from memory, and a recognition test in which they indicated whether a particular shape had been studied. Recognition accuracy was higher than recall accuracy under precisely matched conditions, consistent with the idea that recognition tests measure both familiarity and recollection, whereas recall tests measure only recollection. Analysis of recognition test errors also supported a two-process model: short-latency errors were disproportionately false alarms, indicating false familiarity, while long-latency errors were guesses. This suggests that familiarity in monkeys is faster than recollection and that recollection more effectively distinguishes studied from unstudied items when all items are somewhat familiar.

A parametric analysis of the olfactory span procedure

Andrew Hawkey, Brooke Poerstel , Melissa Deal, Rachel Eure, Lucia Lazarowski, Tim Lefever, Heather Ward, Luke Watterson, Kate Bruce & Mark Galizio (University of North Carolina Wilmington)

P11 The olfactory span task is used to determine the number of stimuli that rodents can remember within a given session. The procedure is an incrementing non-match-to-sample task (INMS) in which the number of stimuli (samples) controlling responding increments by one on each consecutive trial. This task has generally been viewed as a rodent model of working memory capacity; however, the procedural parameters are not well understood. The present study manipulated the number of comparison stimulus choices (2, 5, or 10), the number of sample stimuli to remember (12, 24, or 36), and the amount of training (5 rounds of 9 session conditions) using six rats and olfactory stimuli. Performance was most accurate when the number of stimuli to remember was low and the number of comparison stimuli was few. Across all conditions, accuracies increased as experience in the task increased. In conclusion, this study helps validate the use of the olfactory span task for exploring remembering in non-human subjects and begins to clarify the underlying factors associated with performance on such tasks.

Memory for sequences of unique events in rhesus monkeys (Macaca mulatta)

Victoria L. Templer & Robert R. Hampton(Emory University)

P12 One important aspect of episodic memory is the ability to remember the order in which unique sequences of events occurred. We developed a test that examines memory for sequences of unique visual events. At the beginning of each trial, monkeys studied five successively presented images. At test, they were presented with two images and were required to select the image that had occurred earlier in the study list. Monkeys were first trained with images that were not temporally adjacent in the study list, and then successfully transferred to adjacent items. Subjects showed two effects that are diagnostic of the cognitive mechanism used to remember order over time: a symbolic distance effect and a recency effect. Subsequent probe tests were designed to determine the extent to which temporal order, list position, and relative familiarity control performance.

Cooperation and interference of event memory and habit in rhesus monkeys (Macaca mulatta)

Hsiao-Wei Tu & Robert R. Hampton (Emory University)

P13 Memory takes different forms. Studies in humans have shown a distinction between an automatic system that supports slow habit formation and a cognitively controlled event memory system that supports rapid encoding. Both systems may be involved in solving a given task, which prevents establishing a simple one-to-one correspondence between performance in a specific task and the operation of a particular memory system. By arranging for the two systems to cooperate or interfere with each other on different trial types, process dissociation procedures (PDPs) quantify the relative contributions of automatic habit and controlled event memory processes within a single cognitive task. Here we apply PDP to monkeys in a match-to-sample paradigm to parallel the way it is used in humans. The acquisition of habits was closely monitored through “no sample trials” in which no memory was formed, while the strength of event memory was manipulated by varying retention interval. Pilot data indicate that monkeys may strategically use habit or event memory depending on the payoff associated with them. The results lay the groundwork for comparative studies using a “decline test response” that will determine the extent to which the “automatic-controlled” distinction made in PDP with humans also applies in monkeys.

The Encoding of Self Involvement and Environmental Context in Rhesus Monkeys

Megan L. Hoffman, Michael J. Beran, & David A. Washburn (Georgia State University)

P14 In studies of episodic-like memory with animals, the focus has typically been on the integration of spatial and temporal information in memory. However, in this process another essential characteristic has been overlooked; episodic memory also involves a sense of agency and knowledge that the self played a particular role in a past event, as well as additional source information concerning the specific environmental context at encoding. In the present study, rhesus monkeys were presented with delayed matching-to-sample (DMTS) tasks to assess their ability to encode agency and environmental context from past events. The monkeys were presented with trials in which they either had to perform an event themselves or observe as the event occurred, independent of their own involvement. The events were presented within a particular spatial-temporal context, as well as within a specific environmental context and monkeys were then tested for their ability to retrieve these components from working memory.

Large-billed crows (Corvus macrorhynchos) do not prospectively monitor memory but retrospectively monitor their level of confidence

Kazuhiro Goto (Kyoto University), & Shigeru Watanabe (Keio University)

P15 Monitoring ones’ own memory, termed metamemory, is the foundation of many forms of learning and complex thinking. Recent evidence suggests that some primates can monitor their own memory states and avoid taking subsequent memory tests when they have forgotten information, suggesting that they share aspects of such sophisticated cognition with humans. We examined whether crows are capable of monitoring their own memory states in two paradigms. First, crows performing a memory test were given an escape option to decline taking the test. Second, crows were given the escape option as a “not confident” report after completing the test. Accurate memory performance yielded a reward with a higher probability, whereas inaccurate memory performance resulted in no such recompense. The escape option yielded it with a lower probability. In the first test, crows escaped the memory test more frequently with longer than shorter delay intervals but no more frequent in the sample-omission than sample-present trials. In contrast, in the second test, the crows escaped more frequently when their memory test response was incorrect than correct and in the sample-omission than sample present trials. These results suggest that crows at least retrospectively monitor their level of confidence in the memory test.

Spontaneous number representation in prosimians

Sarah M. Jones & Elizabeth M. Brannon (Duke University)

P16 The ability to select the larger of two numerosities has been demonstrated in a variety of nonhuman primates, including monkeys and lemurs. The main finding from research on numerical discrimination studies in animals is that discrimination is ratio dependent and not limited by set size. Only one study with nonhuman primates has shown a set-size limit characteristic of the object file system (Hauser, et al, 2000). The current experiment was designed to specifically address the claim that number discrimination is limited by set size rather than ratio when primates' spontaneous numerical knowledge is assessed in animals with no training. We tested numerically naive lemurs from multiple lemur genera (Eulemur, Lemur, Propithecus, and Varecia) in a foraging paradigm to determine whether their spontaneous numerical discriminations followed Weber's law or instead reflected the set size limitations characteristic of the object-file system.

The earliest stages of estimation and counting

Michael L. Commons (Harvard University)

P17 The Theory of Measurement argues that counting is based on a one-to-one correspondence between disordered, non-identical objects and symbols (words or icons) that represent that order. A sequence of symbols are applied to different numbers of objects. This is different from estimation, in which quantities are roughly compared. In order to further elucidate the differences, the current paper will present evidence about how nonhuman and human animals deal with numbers at the earliest stages. At the sensory or motor order, different kinds of objects can be perceptually differentiated including displays containing different numbers in them. The basis for the differentiation may be numerical estimation or in some cases simply other perceptual characteristics of the displays. At the circular sensory motor order, comparisons of sizes of objects or arrays results in numerical estimation. Claims of ‘addition’ or ‘subtraction’ have been made (Winn, 2002), These can only be estimations. Also, humans point out objects to others. At sensory-motor order, concepts such as “size”, “shape” , “color” are seen - animals quickly can switch back and forth between these concepts. One can get what appear to be rudiments of equivalence and transitivity, a weak and insufficient definition for true arithmetic.

Counting and estimating at Nominal and Sentential orders

Patrice M. Miller (Salem State University)

P18 At the Nominal and the Sentential Orders, two behaviors that are necessary for counting are shown to develop further. At the nominal order, organisms acquire representations, including actual or virtual labels for concepts. Representations come in two forms: Gestural (and other concrete representations such as visualizations) and truly arbitrary representations. The arbitrary representation may be letter, number or picture labels. These are not said or discriminated as part of a sequence, at least not a sequence longer just than one or two such labels. In other species, other kinds of symbols can be acquired that could stand for concepts. Humans begin to do simple one-to-one correspondence tasks (as seen in Kagan, 1981). For example, they can appropriately label a larger block "The Daddy" and a smaller block "The Baby". At the Sentential order, humans can say letters or numbers in a sequence. They also can point to objects or numbers in a sequence. They do not put these two actions together. Animals such as dogs and African grey parrots can do the sequence part to a small extent as shown by following a single command to do two actions in sequence.

Counting and estimating at Preoperational and Primary orders

Nicholas H. K. Commons-Miller (Tufts University), Michael L. Commons (Harvard University)

P19 At the preoperational order, most criteria for true counting are met: a) saying the sequence of numbers or using number symbols in a sequence, and b) indicating which object is currently being counted when items are in a line. At first, one can count, but one does not stop. Learning to stop is a final subtask. At the Primary Order, the first task is to count disordered objects and then with "any" objects. This true counting is made possible by having a way of marking that an object has already been counted, such as moving it into a separate pile. The first use of accurate counts is addition/subtraction and short multiplication. This is true adding because they are using symbolic markers to insure that they have counted an item, and this can as easily and accurately be done with numbers greater than 10. Organisms do not exactly estimate differences between adjacent large numbers of objects. Just Noticeable Difference between quantities is too large to match the actual number (by Weber's Law). Another test for actual counting rather than estimating is to show that 2 sets with exactly the same number of very different objects are reported as equivalent.

Examining Pets and the People Who Own Them: The Interpersonal Circumplex As A Potential Model of Animal Personality

Lauren Highfill (Eckerd College), Virgil Zeigler-Hill (University of Southern Mississippi)

P20 The present study examined the viability of the interpersonal circumplex, which was designed to examine human social behavior, as a model for considering the behavioral styles of dogs and cats. Over 500 pet owners reported on the behavioral styles of their pets as well as their own interpersonal styles. The instrument used to assess the behavioral styles of household pets conformed to the expected circular structure for both dogs and cats which suggests that the instrument is suitable for use with these non-human species. The results of hierarchical multiple regression analyses found that owners reported more positive attitudes toward their pets when the behavioral styles of their pets complemented their own interpersonal styles. The owners of both dogs and cats were more satisfied when they perceived their pets as exhibiting a level of warmth that was similar to their own but this tendency was especially strong for cat owners. For dominance, however, cat owners reported more positive attitudes toward their pets when there was reciprocity between their own interpersonal styles and the perceived behavioral styles of their pets (e.g., dominant cat owners reported more positive attitudes toward their pets when they perceived their pets as submissive).

CBA/CaJ mice vocalize to auditory playbacks of mouse USVs

Kelly E. Radziwon, Erikson G. Neilans, & Micheal L. Dent (SUNY, University at Buffalo)

P21 Although previous studies have found that both male and female mice produce ultrasonic vocalizations (USVs) under a variety of circumstances, the exact function of these USVs remains unclear. Male mice will readily produce many USVs when in the presence of a female mouse or when placed in female-soiled cage shavings. Female mice in diestrus are also known to vocalize to other females. It is not known, however, if either male or female mice would emit USVs in response to auditory playbacks alone. In the present study, solitary male and female CBA/CaJ mice were placed into a sound-proof booth. The mice were kept in their own cage and bedding, to avoid introducing any novel olfactory stimuli. Previously recorded USVs from male and female conspecifics were played back to the mice on a continuous loop. These recordings were edited so that each contained the same number of calls per three-second interval. A microphone recorded any vocalizations by the subjects in response to these playbacks. Both the males and females called to these mouse recordings, demonstrating that USVs can be elicited solely by auditory cues and suggesting that they are important in mouse interactions, possibly even facilitating reproductive and/or social behavior.

A primacy effect in the perception of birdsong by budgerigars (Melopsittacus undulatus) and zebra finches (Taeniopygia guttata)

Erikson G. Neilans, Thomas E. Welch, & Micheal L. Dent (Department of Psychology, University at Buffalo, SUNY, Buffalo, NY 14260)

P22 The current study examines the relative importance of the position of information available to birds when identifying only pieces of birdsong, such as what might happen naturally to birds in noisy environments when the beginning or the end of the song is obscured by noise. Four budgerigars and two zebra finches were trained to identify three separate target zebra finch songs embedded in a chorus masker of multiple simultaneous zebra finch songs. Following training, the birds identified individual syllable and combined syllable stimuli as either 1) target or 2) masker, by pecking the corresponding category key. The individual syllables elicited very few 'target' responses, suggesting that small pieces of the song alone are not enough for identification. However, when several combined syllables from the beginning or the end of the song were presented, songs were readily identified. Moreover, it appears that less information in the beginning of song is needed for identification of the birdsong as compared to information from the end of the song. That is, there appears to be a primacy effect in the perception of birdsong, suggesting that the perception of communication signals in birds follows similar rules as the perception of speech in humans.

Picture processing in orangutans (Pongo abelii)

Catherine Reeve, Heidi Marsh, & Suzanne MacDonald (York University)

P23 In this set of experiments, we investigated whether orangutans perceived pictures as a referent of a real object, as the real object itself, or as a series of independent features unrelated to the object it represented. In Experiment 1, we replicated the method of Parron et al. (2008), and examined orangutans' choices between photographs and real objects of desirable and undesirable items, respectively. In Experiment 2, a reverse contingency task was used. The orangutans again chose between two stimuli: a photograph of a desirable item and one of an undesirable item. . However, choices of the undesirable photograph were reinforced with the real desirable object, and choices of the desirable photograph resulted in the delivery of the real undesirable object. If orangutans perceive photos as referents of real, desired objects, or as real objects themselves, they should have difficulty inhibiting their choice of those pictures, whereas if they do not perceive the photos in this way, they should have no trouble with this reverse-contingency task. The results of this experiment, taken together with those of Experiment 1, suggest that at least two of the seven orangutans perceived photographs as referents of a real object. We also found evidence to suggest a possible developmental factor in picture perception.

Age-Related Differences in Rat Serial Pattern Learning

Jeremy D. Meduri, Timothy J. Burkholder, Laura R. G. Pickens & Stephen B. Fountain (Kent State University)

P24 Research from several laboratories has shown that a rat's age affects performance in hippocampal-dependent learning and memory tasks such as passive avoidance, food-conditioned place preference, Morris water maze, contextual associative learning using olfactory stimuli, and conditioned flavor preference. The current study examined whether age-related differences would likewise be observed in rat serial pattern learning. Beginning on either postnatal day 65 (P65), P95, or P165, male Long Evans rats (12 per group) trained for 28 days on a serial pattern of eight 3-element chunks with a violation element at the end, 123-234-345-456-567-678-781-818. Here digits indicate the clockwise position of successive correct nose poke receptacles arranged in a circular array on the walls of an octagonal operant chamber. Older rats that started training on P165 learned chunk-boundary and violation elements slower than P65 and P95 groups, with learning for within-chunk elements unaffected. The results add to the literature showing age-related differences across learning paradigms. The results are also consistent with those of other studies indicating that the cognitive rule-learning processes thought to be involved in learning within-chunk elements may depend on different psychological and neural processes than the rote memory processes thought to be involved in learning chunk-boundary and violation elements.

Target Pattern Acquisition is Affected by Interleaved Element Structure and Cueing in Rat Serial Pattern Learning

Karen E. Doyle & Stephen B. Fountain (Kent State University)

P25 This study examined how rats learn a target pattern with interleaved elements and what characteristics of interleaved elements promote better target pattern learning. All rats received the structured target pattern, 1-2-3-4-5-6, where digits indicate the successive clockwise positions of correct responses in a circular array of 8 nosepoke receptacles. On target pattern elements, all receptacle lights were illuminated and rats learned with correction to choose the correct receptacle. Interleaved elements composed either a structured 7-8-7-8-7-8 trill pattern or random presentation of elements 7, 8 that changed with each pattern. Interleaved elements were also either cued by lighting the correct receptacle only or were uncued as in the target pattern. Rats in different groups received the target pattern with either structured+cued, structured+uncued, or random+cued interleaved elements. Target pattern acquisition was significantly faster for structured+cued than for structured+uncued rats, and was worst for random+cued rats. Thus, target pattern acquisition was better with interleaved elements that were structured rather than unstructured when both were cued. Also, target pattern acquisition was better with interleaved elements that were cued rather than uncued when both were structured. This suggests that both interleaved element structure and distinctive cueing can affect rule induction of a target serial pattern.

String-Pulling Behavior in a Captive Harris Hawk (Parabuteo unicinctus)

Desiree I. Sharpe, Erin N. Colbert-White, & E. Monteen McCord (University of Georgia)

P26 String-pulling in avians requires the subject to access food attached to a vertical string. This problem-solving task demands a precise sequence of behaviors (i.e., repetitions of pulling up with the beak and stepping down on the string), indicating subject recognition of the means-end properties of both the string and the string manipulation sequence. Species that use their feet during feeding, such as ravens and parrots, have demonstrated an advantage over beak-only feeders, such as finches. The purpose of this study was to investigate string-pulling in another foot-using species, the Harris hawk. One captive hawk was presented with three simultaneous choices: 1) an empty string, 2) a string with a non-food item attached, and 3) a string with a meat reward attached. The subject was left alone with the apparatus to explore by himself. Observations were videotaped and analyzed for use of a typical string manipulation sequence. Data collection and analysis is on-going; preliminary review of coded tapes indicates the hawk was successful at accessing the meat using a pull-up and step-down technique.

How do chickadees remember when?

Miranda C. Feeney, William A. Roberts & David F. Sherry (University of Western Ontario)

P27 We examined memory for what, where, and when in black-capped chickadees (Poecile atricapillus) in a procedure that dissociated memory for elapsed time (How Long Ago) from memory for a point in time, the sense of 'When' usually assumed in episodic-like memory. Chickadees searched for food in a two-phase procedure. In Phase 1, birds found preferred mealworms in sites on one side of an aviary and less preferred sunflower seeds in sites on the other side. In Phase 2, following a retention interval, birds searched in the aviary with fresh sunflower seeds placed in sites that held seeds in Phase 1 but either fresh or degraded mealworms in sites that held mealworms in Phase 1. Whether mealworms were fresh or degraded depended on either when during the day Phase 1 had occurred (Group When), how long ago Phase 1 had occurred (Group HLA), or both (Group When + HLA). Chickadees in all three groups learned where worms were to be found in Phase 2, although there were limits to the use of HLA and When + HLA that were not found for the use of When alone. These results show chickadees have at least two different ways of remembering 'when'.

Domesticated Dogs' (Canis familiaris) Response to Dishonest Human Points

Shannon M.A. Kundey (Hood College), Andres De Los Reyes (University of Maryland at College Park), Erica Royer, Sabrina Molina, Rebecca German, Brittany Monnier, Meghan Tomlin (Hood College)

P28 Humans utilize pointing to direct others' attention. Some suggest pointing has special meaning for humans starting in early life as evidenced by children having difficulty interpreting unconventionally directed points. Recent research suggests domestic dogs also show sensitivity to human gestures. Indeed, dogs show difficulty interpreting dishonest (contradictory) human points. We explored dogs' use of gestures when the information given by the deceiver directly contradicts the information visually available to the dogs. Dogs watched an experimenter display a food reward and visit two clear containers. The experimenter deposited the reward into one container, but acted equally on each. After visiting each container, the experimenter stood equidistant from both before exhibiting one of four cue types: static pointing to the unbaited container (static point), momentarily pointing to the unbaited container (momentary point), moving to stand behind the unbaited container (stand), or exhibiting no cues (no cue). Dogs approached the unbaited container indicated by a deceptive static point over the baited container. However, dogs used a deceptive momentary point or deceptive standing location to find food when the reward was visible during choice, as well as in later trials when placement and location of the food reward was hidden.

Physical vs social cognition for hidden objects: Similarities between domestic dogs and 2- to 4-year-old children

Vickie Plourde (Université Laval), & Sylvain Fiset (Université de Moncton in Edmundston)

P29 The objective of this study was to determine whether domestic dogs and young children prefer to use physical or social knowledge to infer the position of an object that continues to move when out of sight. In four experiments, different invisible displacement tasks (e.g. spatial translations) were administered to 20 dogs or 18 2- to 4-year-olds. In each experiment, the participants were randomly assigned to a physical or a social condition. In the physical condition, the participants were solely given perceptual cues to infer that an object has been moved to a new location. In the social condition, a human briefly signalled the new hiding location with her hand. The results observed in each experiment revealed that dogs and human children failed the invisible displacement tasks in the physical condition but easily succeeded them in the social condition. This study showed that dogs and human share a preference for social cues provided by humans when facing a demanding cognitive problem. This study, therefore, supports the hypothesis that social cognition for human signals overwhelms limited knowledge provided by physical cognition in dogs and human children. The origin of this social bias is explored in the general discussion.

Inequity and reciprocity modulate prosocial tendencies in capuchin monkeys (Cebus apella)

Malini Suchak & Frans B. M. de Waal (Emory University)

P30 A negative reaction to an inequity, known as inequity aversion (IA), is a universal human response to a violation of expectations. Recent studies have demonstrated that capuchin monkeys exhibit IA when they receive qualitatively lower rewards than a conspecific. Since social relationships do not always entail an equal exchange of benefits at any given time, individuals must develop a way to cope with inequities. Reciprocity may be one such mechanism whereby temporary inequities are balanced out by benefits over time. We tested whether capuchins could overcome IA through reciprocity using a two choice paradigm where a selfish option rewarded only the chooser and a prosocial option rewarded both the chooser and a partner. In the equal reward condition a prosocial choice gave both individuals the same reward, but in the unequal condition a prosocial choice gave the partner a better reward than the chooser. When only one monkey was choosing for the entire test session, IA interfered with prosocial behavior. When both individuals took turns making choices, the number of prosocial choices significantly increased, particularly in the unequal reward condition. These results suggest that taking turns giving and receiving favors may facilitate prosocial behavior even in the presence of IA.

Do Rhesus monkeys (Macaca mulatta) recognize and prefer humans who copy them?

Alexandra Protopopova (University of Florida), Melinda A. Novak (University of Massachusetts Amherst)

P31 A recent Nature Neuroscience paper shows that capuchin monkeys prefer to interact with humans, who copy them. The authors suggest that copying may lead to the development of social bonds and possibly explain why monkeys prefer their human copiers. In this study, we determined if this phenomenon was peculiar to capuchin monkeys or if it was present in other nonhuman primates, such as rhesus macaques. Our hypothesis was copying another's motor activities facilitates social interaction in macaques. The prediction tested was that the subjects would prefer to take treats from and look at experimenters who copied their motor activities versus ones who did not. In contrast to the findings with capuchins, rhesus monkeys do not prefer to look at or interact with someone who copies them. The present study suggests that rhesus monkeys are not influenced by copying, and thus copying may not be an important factor in forming social bonds in rhesus monkeys.

Poster Session II - Saturday Evening

P32

Skinner box for bees: A testing system for the study of bee learning and cognition

Justin M. Sayde & Michael F. Brown (Villanova University)

A new testing system for bumblebees or honey bees will be described along with some preliminary data that validate the system. Programmed visual stimuli are displayed on a horizontal color LCD monitor placed at one end of the enclosed testing arena. Bees respond to the stimuli by approaching one of a series of gated ports leading into a separate reinforcement chamber, where sucrose solution is provided. A video capture system detects and records bees' choices, allowing the gates to be controlled, contingent on a bee's response. The system can collect choice data from multiple bees continuously and automatically. In effect, the system functions as a "Skinner box for bees" by permitting the researcher to collect large amounts of data in a relatively controlled environment. Commercially available bumblebee colonies adapt well to this system, and we have collected preliminary data in color and form discrimination tasks. The data indicate that this system has great promise for expanding the scope of behavioral research with bees.

P33

The effect of stimulus salience on retrospective revaluation in taste aversion paradigm

Akira Kurihara & Kosuke Sawa (Senshu University)

Retrospective revaluation, where post-training episode affects on previously acquired associative knowledge, has been confirmed mainly in fear conditioning paradigm, but, as far as I know, not in taste aversion paradigm. Although it has been unclear why this trend of results was obtained in taste aversion learning, recently, it is reported that extinguishing more salient element of a previously reinforced compound stimulus, not less salient element, cause retrospective revaluation in appetitive conditioning (Liljeholm & Balleine, 2006). In present experiment, the effect of extinguishing more salient stimulus, which was measured by overshadowing and potentiation effects, was applied to taste aversion paradigm. Subjects received presentation of two flavored taste stimuli, sucrose and ethanol with flavors, followed by LiCl. After confirming potentiated aversion in flavor compounded with ethanol, extinction procedures to two taste stimuli were conducted. On testing, presenting each flavor stimulus by one bottle procedure on two days yielded the trend of retrospective revaluation by extinguishing less salient stimulus (i.e., sucrose) and mediate conditioning by extinguishing more salient stimulus (i.e., ethanol). Although these results do not correspond with previous study, this result suggested that it is important to emphasize stimulus salience for retrospective revaluation.

P34

Development of a Human Escape/Avoidance Task in a Virtual Shuttle-Box

Zachary Kilday, Martha R. Forloines, Connie Clements, Quashondra Battle, & Kent D. Bodily (Georgia Southern University)

The purpose of this study was to develop a virtual-environment analog of the traditional shuttle-box task to investigate escape/avoidance learning in human subjects. Undergraduate students served as participants. The environment consisted of two circular rooms (15 m diameter) with a connecting doorway. Each room contained randomly located invisible orbs, and participants were awarded one point for each orb with which they came in contact. After 20 seconds of searching in one room, the walls of the room changed color (CS), the door was "unlocked" (meaning the Ps could approach the door to open it), and after 2 seconds a 75 dB alarm (US) sounded. Passing through the door prior to the alarm sounding prevented its occurrence (avoidance), while passing through after the alarm sounded turned it off (escape). Several aspects of the virtual environment (e.g. orb feedback, P's knowledge of orb availability, and absence of the alarm) were manipulated between groups to determine their effect on response latency. Results and implications will be discussed.

P35

A Simple Graphical User Interface for Behavioral Simulations

David Freestone (Brown University)

A graphical user interface (GUI) for simulating a Modular Theory is presented. Modular Theory is a mathematical model of timing and conditioning that has several equations and parameters which combine to create bouts of responses in time. While analytical solutions exist for some behavioral measures, simulations provide a method of obtaining raw response time data from which a large number of measures can be obtained. The GUI is easy to use: users provide one input –the behavioral procedure, and are provided with the raw time-event data along with various data processing and figure options. All of the model's parameters are fully user-controllable, although default parameters can also be used. The source code and the compiled code are freely available for download and use.

P36

Visual Search for Exemplars of a Human-Face Category by Pigeons

Midori Ohkita & Masako Jitsumori (Chiba University)

Four pigeons were trained to search for exemplars of a category created from the faces of five Japanese male students. A face arbitrarily selected for each pigeon (the common component) was morphed with the remaining four faces and the 50% morphs of pairs of these faces (the item-specific components). Each display included a single exemplar and identical distractors selected from a set of eight faces that had not been used to create the category. The pigeons then successfully searched for novel exemplars that possessed new item-specific components, although a slight superiority for the familiar targets was found for both the accuracy and RT measures. When the proportion of the common component decreased, RTs increased. Detection accuracy decreased only when the proportion decreased to 0%, but the pigeons still showed high levels of accuracy with these item-specific component faces. When the proportion of the common component increased, it had no significant effect on either measure. The pigeons responded to the common component face as accurately as and as fast as to the targets used for training. The findings suggested that the pigeons attended more to the common component features and less to the item-specific component features to search for category exemplars.

P37

Training Attention in Rhesus Monkeys

Jessica Bramlett, David Washburn (Georgia State University)

Attention is typically defined as the process of focusing on one environmental aspect while ignoring others. Inhibition, a key component of attention, requires active restraint of an innate response in lieu of another target response (e.g. the Stroop task). Many researchers have studied the training of attention in children and adults using attention inhibition tasks with documented success and generalization, but little information is available on the training of attention in nonhuman primates. In the current experiment, task savvy Rhesus monkeys (Macaca mulatta) were given 10 computerized blocks of 1000 trials of a spatial incongruity task followed by 100 trials of a numerical Stroop task to determine if attention could be trained in nonhuman primates. Reaction time improved across blocks, suggesting improved inhibitory ability, but generalization to other attention tasks was not observed.

Can capuchin monkeys (Cebus apella) be influenced by a conspecific to change their preference on a binary choice task?

Tephillah Jeyaraj (University of Georgia)

P38 Whether overtly or more subtly, animals living in social groups tend to exert an influence on the decision making process of other group members. We predicted a change in preference after a monkey watched a conspecific select the non-preferred option, specifically when he received a higher payoff for that same option than the subject did. We presented each subject with two choices - a low, consistent payoff versus a high, inconsistent one. An inverted blue cup always concealed one cheerio, a red cup two cheerios half the time. When tested alone, all five subjects preferred the low, consistent option (blue cup). The subject then watched a conspecific trained to only pick the non-preferred option (red cup). The rewards for the conspecific were either higher (4 cheerios) or lower (1 cheerio) than the subject's two cheerios. Following 10 observation trials, the subject did 10 test trials, a total of 100 trials over 10 days per condition. Only one monkey significantly switched preference. We speculated that initial experience with the choices overrode any effect of the conspecific. We are currently testing the subjects on novel cups and expect to see them follow the conspecific's choices in the absence of prior information regarding the choices.

Individual differences in impulsive choice behavior

Tiffany Galtress, Angela Crumer, Ana Garcia, & Kimberly Kirkpatrick (Kansas State University)

P39 Rats were trained to choose between a fixed-interval (FI) 60-s delay and a progressive-interval (PI) 15-s delay. The reward for the FI delay changed over phases, whereas the reward for the PI remained at 1 pellet throughout. In Experiment 1, the FI reward magnitude was increased from 1 to 2 to 4 pellet(s) across phases. PI choices decreased accordingly; however, 22% of variance in choice behavior was a result of individual differences between the rats, regardless of the shift in reward magnitude. In Experiment 2, the FI reward was decreased across phases from 4 to 2 to 1 pellet(s) resulting in an increase in PI choice in most of the rats. Here, individual differences accounted for 29% of the total variance. In both experiments, individual differences were more pronounced when the FI reward was 1 pellet compared to when the FI reward was 2 or 4 pellets. These large and persistent individual differences in choice behavior have potential implications for behavioral, pharmacological, and neuroscientific research.

Factors influencing impulsive choice behavior in different strains of rats

Ana Garcia, Marina Vilardo, & Kimberly Kirkpatrick (Kansas State University)

P40 The present experiment evaluated Wistar (WIS), Lewis (LEW), Wistar Kyoto (WKY) and Spontaneous hypertensive rats (SHR) in a discrete-trial delay discounting task. In the first phase of the experiment, rats could chose a lever associated with a Smaller sooner (SS) reward of 1 pellet delivered after 10 s and a Larger-later (LL) reward of 2 pellets delivered after 30 s. Subsequently, the rats were exposed to different phases, where the reward on the LL choice was increased to 3 and 4 pellets in separate phases and where the delay to the SS choice was increased to 15 and 20 s in separate phases. The strains did not differ in their timing performance on peak trials, suggesting that there were no differences in timing processes in the four strains. The WIS adapted most readily to the changes in the delay and magnitude, whereas the SHR showed the weakest adjustment to changes in LL magnitude and the LEW showed weak adjustment to changes in both LL magnitude and SS delay. Overall, the results suggest that the SHR and LEW strains may be a possible candidate for specific sub-types of ADHD, but not for the combined sub-type.

Differential rearing environment effects on impulsive action and impulsive choice in rats

Andrew Marshall, Jacob Clarke, Angela Crumer, Mary Cain, Kimberly Kirkpatrick (Kansas State University)

P41 Eighteen rats were partitioned into two groups (n=9) and were housed in different environments. The enriched condition involved daily handling and group housing in a large cage with toys that were changed daily; the impoverished condition involved minimal handling and individual housing in a hanging metal cage with no toys. Impulsive choice behavior was examined in a delay discounting task in which rats chose between a smaller-sooner reward (SS; 1 pellet, 10 s) and a larger-later reward (LL; 2 pellets, 30 s). There were no major effects of environmental rearing on the preferences in the delay discounting task. However, when the SS delay was later increased to 30 s – to assess reward discrimination in the absence of differential delays – the enriched condition displayed an indication of weaker preference for the LL reward that was particularly evident in the trial-initiation latencies on forced-choice trials. Impulsive action was examined in a differential reinforcement of low rate schedule of reinforcement with a criterion of 30 s that was later increased to 60 s. The two rearing conditions produced similar IRT functions and similar reward-earning rates to both DRL criteria, suggesting that environmental rearing did not affect impulsive action in this experiment.

Gestural communication of captive orangutans (Pongo pygmaeus)

Susan A. Keenan & Caroline M. DeLong (Rochester Institute of Technology)

P42 This project was an observational study of the gestural communication system of a family group of orangutans at the Seneca Park Zoo in Rochester, New York. Three orangutans were observed: Kumang (32 years), Dara (10 years), and Datu (6 years). The experimenter observed one individual for 15 minute time periods and recorded the gestures the orangutan used and the context in which the gestures were used. Across a total of 30 days from June 15, 2010 to October 8, 2010, 212 observation sessions were conducted. Video recordings were made of 10% of the observation sessions. Recorded gestures could be tactile (e.g. 'hold tight'), visual (e.g. 'shake object'), or auditory (e.g. 'raspberry'). The results showed 'hold tight' as the most common gesture for Datu (26% of all gestures) and Kumang (15%). Dara gestured 'lip offer' (11.2%), 'hold tight' (10.5%), and 'push' (9.9%) most often. Gestures were performed most often in the context of ingestion and play. Some differences were observed between this group and other groups of captive orangutans, (e.g. this group used auditory gestures not seen in other captive groups). These differences between groups could be explained due to species, age, group structure, location, environment, or time of year.

Individual Differences in Vocalizations of Isolated Bottlenose Dolphins

Jenna Clark (New College of Florida), Wendi Fellner (The Seas, Epcot®, Walt Disney World® Resorts) & Heidi E. Harley (New College of Florida, The Seas, Epcot®, Walt Disney World® Resorts)

P43 Dolphins produce unique narrowband sounds called signature whistles when isolated from their conspecifics. These whistles have been heavily studied, but little research has examined broadband vocalizations in the same context. Four dolphins were recorded in multiple instances of isolation, forced or voluntary, and their vocalizations analyzed for type and contour in the case of whistles. Three of the four demonstrated similar patterns, with 20-30% of their vocal production being click trains, 20-30% burst pulses and approximately 40% whistles. The fourth dolphin, Khyber, produced noticeably fewer burst pulses (13%) and more whistles (66%). Khyber also produced the fewest number of unique whistle contours, representing 9 categories in 88 whistles, and the highest prevalence of signature whistles (48% of total whistles). These data suggest that dolphins show individual differences in vocalizations, both broadband and narrowband, at least while in isolation.

Production of Combination Vocalizations by Bottlenose Dolphins (Tursiops truncatus)

Wendi Fellner (The Seas, Epcot), Heidi E. Harley (New College of Florida, The Seas, Epcot), Jenna Clark (New College of Florida)

P44 Bottlenose dolphins produce three broad categories of vocalizations: narrowband frequency modulated whistles, broadband echolocation clicks, and broadband burst pulses. Dolphins are capable of producing some of these vocalizations simultaneously but little is known about the dolphin's repertoire of combination vocalizations. We recorded the vocalizations of four, male dolphins across four contexts with a multi-hydrophone array that enabled us, in many cases, to determine which dolphin produced the vocalization. From the recordings, we extracted groups of vocalizations that were produced by a single individual and overlapped in time. Forty-five percent of identified whistles were overlapped by another vocalization. Out of 80 single-producer combinations, the proportion of combination types varied by individual dolphin with both click-whistle (36-60% of combinations) and burst pulse-whistle (14-51% of combinations) being produced most frequently. Some variations of combinations included a whistle with a burst pulse embedded entirely within it and a sequentially overlapped whistle/burst pulse. These findings suggest that combination vocalizations are an important component of the dolphin communication system.

Pigeons transfer concept learning across reversals of "same" and "different" responses

Adam M. Goodman, Jeffrey S. Katz (Auburn University), & Anthony A. Wright (University of Texas Medical School at Houston)

P45 Reversal learning is a common procedure for studying discrimination learning, but has yet to be studied in a same/different abstract-concept learning task. The ability of 4 pigeons in a two-item same/different task was assessed with repeated contingency reversals. Correct responses were pecks to the lower picture if the items were the same and a rectangle if they were different. Once steady-state performance was obtained, the contingency was reversed. Upon reaching criterion with the reversed contingency, the initial contingency was reinstated followed by subsequent reversals. After 12 reversals, a transfer test was given to assess responding to novel stimuli. Pigeons flexibly learn reversals and fully transfer to novel stimuli indicating they continue to solve the same/different task relationally.

Transitive inference in rats using odor stimuli

Kate Bruce, Marybeth Pacewicz, Brooke Poerstel, Leah Jordan, Rachel Eure, Carrie Branch, Andrew Hawkey, Tim Lefever, & Mark Galizio (University of North Carolina Wilmington)

P46 Rats have been shown to demonstrate transitive inference using four overlapping simple odor discriminations (AB or BC, etc; A>B>C>D>E; Davis 1992; Dusek & Eichenbaum 1997). In the present study, we extend these findings to two novel apparatus and add a list-linking procedure similar to that studied by Treichler et al. (1996) in monkeys. Rats are trained on two separate lists of odor pairs (A-E and F-J) and then the lists are linked though training on EF. Using two lists allows testing for transitive inference using many novel combinations of pairs (probes) across and within lists. In our manual procedure using movable lids scented with household spices, 3 rats have demonstrated over 90% correct on novel combinations of pairs within lists, as well as above chance performance on between list probes after list linking. We have extended this work using an operant olfactometer with nose-poke response and scented oils as stimuli. Five rats have shown above chance performance on transitive pair discrimination but responding is more variable than with the manual apparatus.

Exploring list learning in rats using olfactory stimuli

Carrie Branch, Catie Nealley, Brooke Poerstel, Allison Bradley, Lauren Goldstein, Alyson Mack, Mark Galizio & Kate Bruce (University of North Carolina Wilmington)

P47 The Nonmatch-to-Sample (NMTS) task has been used to study concept learning in rodents. Following presentation of a sample odorant, responses to a nonmatching comparison are reinforced. The goal of the current research is to develop an effective procedure to assess list learning in rats using a variation on NMTS. Six male rats were trained in a modified operant chamber, using household spices as odor stimuli. A "list" of sample odors is presented, each requiring an observing response. Following list presentation, pairs of comparison stimuli were presented, always including one member (S-) and one nonmember (S+) of the list. After mastery of lists lengths of 2, 3, and 4, each rat was tested with a 5 item list and a 10 item list. There was little evidence of either primacy or recency effects with a 5 item list; however, some evidence of a recency effect was obtained with a 10 item list.

Can horses categorize based on motion cues?

Tammy McKenzie & Chantel Fouillard (Brandon University)

P48 The object of this research was to study whether horses can categorize objects based on motion. Many elements of the environment that are relevant in an animal's life are in motion. For example, an animal may be able to distinguish quickly between two predator types based on differences in their movement and be able to respond appropriately to the threat. This ability should be adaptive for the animal. Loidolt, Aust, Streurer, Troje, and Huber (2006) argue that motion should play an important role in categorization of objects. This particular ability may be especially relevant to highly mobile animals as they will be constanly dealing with moving objects in their environment either because of their own movement or movement of the object itself. One species that is highly mobile is the horse. They can move at relatively high speeds and are agile. Thus, this ability may be important for them. The ability to categorize based on motion was examined in horses using a two-key reponse choice task utilizing computer monitors. Horses had a difficult time with this task. Possible methodilogical issues with the use of motion cues presented on computer screens to horses will be discussed.

Relational Nonmatching to Sample: Dissociation between acquisition of skill, rule and relational knowledge in Capuchin Monkeys (C. apella).

Caitlin Knierim, Ellen Fonte, & Roger Thompson (Franklin & Marshall College)

P49 Spinozzi, Lubrano, & Truppa (2004) reported that capuchin monkeys (Cebus apella) acquire a generalized above/below (A/B) relational match-to-sample (RMTS) task in less than 600 trials. Attempts to replicate these results using the same test procedure occurred only in the absence of "Clever Hans" controls (Hagmann, Dotov, Templer, & Thompson, 2007). Macaques using an automated testing procedure also failed to acquire the A/B RMTS task in over 10,000 trials (Thompson, Fagot, Flemming & Hoy-Kennedy, 2010). In the present study, we trained capuchin monkeys on a relational non-match-to-sample (RNMTS) task using a backward chaining procedure and trial-unique exemplars of both A/B and two-item identity/non-identity (I/NI) relational stimuli. All animals rapidly acquired the requisite RNMTS response sequence, but showed no evidence of discriminative control by either I/NI or A/B relational stimuli over the same number of trials in which Spinozzi et al. (2004) reported success by their animals. Thus far, our results point to a dissociation between the acquisition of a skill, rule and relational knowledge within the same procedure similar to descriptions offered by human models of performance (cf., Rasmussen, 1983).

Exploring cross modal nonmatch to sample in rats

Rachel Eure, Carrie Branch, Lucia Lazarowski, Emily Berkey, Alyson Mack, Mark Galizio, & Kate Bruce (University of North Carolina Wilmington)

P50 The Nonmatch-to-Sample (NMTS) task has been used to study concept learning in rodents. Here, a sample is presented and, after an observing response, responses to the nonmatching comparison are reinforced. To demonstrate learning of the oddity concept, rats must be trained on one set of stimuli and tested using novel stimuli. If performances on the novel tests are equivalent to baseline levels, the rats can be said to show generalized NMTS. In our lab, a set size of ten odor stimuli has been sufficient to produce this kind of concept learning. However, previous research in other laboratories suggests that it is more difficult in rats to show relational control of behavior by visual stimuli. In the present research, we report that rats trained with odor stimuli show strong generalized NMTS with novel odors, but fail to transfer that learning immediately to a set of novel stimuli (3-D visual). With additional training, their behavior comes under relational control. Failure to find immediate cross-modal transfer suggests that there are limitations to the generalization of the oddity concept.

The Effects of Set-Size Expansion in an Oddity-to-Sample Task

Alex Daniel, Jeffrey Katz (Auburn University), & Anthony Wright (University of Texas Health Science Center at Houston)

P51 Pigeons were trained on oddity-to-sample utilizing a set-size expansion method previously used in matching-to-sample (Bodily, Katz & Wright, 2008.) Pigeons were trained with 3 cartoon stimuli (items). The animals were required to respond to the sample stimulus 10 times and then select which of the two comparison stimuli did not match the sample. Once subjects demonstrated consistent performance (85% accuracy) with this task, novel stimulus pairings were presented systematically in a series of 4 trial unique transfer sessions to test for abstract-concept learning. During these transfer sessions, 12 of the 96 trials presented the trial unique pairings. The set size was then systematically doubled (8 times), increasing from the initial 3-item set size to 768 items. The comparison of transfer as a function of set size highlights many of the similarities and differences between matching and oddity tasks.

The Effects of Feedback on Dead Reckoning Accuracy

Connie Clements & Kent D. Bodily (Georgia Southern University)

P52 Abstract Feedback has been shown to improve performance in multiple spatial tasks (e.g. angle estimation, distance estimation, mental rotation). However, the effects of feedback on dead reckoning, returning to a point of origin in the absence of landmarks, have not been assessed. In the present experiment, participants completed the triangle-completion task on a desktop computer virtual environment in order to assess whether error-corrective feedback improved dead reckoning performance. Additionally, the effect of training itineraries in blocks rather than random presentation was also examined between groups. Thus, participants were randomly assigned to one of five training groups: Feedback + Blocked Training, Feedback + Mixed Training, No Feedback + Blocked Training, No Feedback + Mixed Training, and Training Control. Dead reckoning accuracy was compared between groups on no-feedback test trials in the training virtual environment and a novel virtual environment. Results and interpretations will be discussed.

Pigeons (Columba livia) Encode Wall Length and Angle Amplitude in an Open Field Geometry Task

Danielle M. Lubyk & Marcia Spetch (University of Alberta)

P53 Pigeons were trained to locate food in two geometrically equivalent corners of a parallelogram-shaped arena. Both the angular amplitude of the corners as well as the length of the walls alone were sufficient for successfully completing the task. Following training, birds were tested in three separate conditions that manipulated the geometric information available for navigation. During tests in both a rectangular-shaped arena that preserved the wall length information but not the angular amplitude, and a rhombus-shaped arena that did the opposite, pigeons were still able to locate their goal corners, indicating an ability to use both types of geometric information in isolation. However, on a conflict test in a mirror parallelogram-shaped arena, in which the correct angular location was paired with an incorrect wall length location, birds showed a preference to the correct angular location. This suggests that angles may be weighted more heavily than wall lengths in this type of navigation task, which differs slightly from findings in a similar task conducted with the domestic chick.

Assessment of Human Spatial Blocking With Landmark Arrays in a Virtual Environment

Martha R. Forloines & Kent D. Bodily (Georgia Southern University)

P54 The purpose of the current experiment was to determine whether cue competition (blocking) occurs in the spatial domain with human participants in a desktop virtual environment. Beigler and Morris (1999) found that spatial blocking occurs in rats when trained to find a hidden goal relative to a landmark array. The present study adapted the Beigler and Morris methodology to human participants. In Phase 0, participants were trained to find a goal with an array of directionally ambiguous landmarks. In Phase 1, a disambiguating landmark (L1) was added to the array. In Phase 2, a second disambiguating landmark (L2) was added to the training array. Test trials consisted of the ambiguous array with only L2 present. Landmark preference scores, time spent at goal locations, mean differences across groups, and search areas across phases were analyzed to determine the extent to which participants had learned about L2. Results and theoretical implications will be discussed.

Follow the Leader?: Social Influences on Spatial Choices in Rats

Teagan A. Bisbing, Justin M. Sayde, Jared M. Batterman, & Michael F. Brown (Villanova University)

P55 In social foragers, the ability to use cues from conspecifics should improve foraging efficiency. Surprisingly few empirical studies have examined how animals form memories of conspecifics' behavior and later use social memory to guide behavior. The current study examines social influences on rat foraging and spatial choices in an open field task. Either individually or in pairs, rats chose from among covered pits to find hidden food pellets in daily trials. For model rats, one side of the choice arena was consistently baited over trials. In contrast, subject rats were yoked to model rats' pit assignments in pair trials. Thus, the location of baited pits was unpredictable for the subject rats over trials, but might be cued by the model rats' choices in the pair trials. Analyses will compare choices made during individual and pair trials to determine how the presence of a model rat modulates the choices of a subject rat.

Evidence for Place Responding with Rats in an Appetitive Spatial Task

Chad M. Ruprecht, Drew Taylor, John Weiss, Steven Drawdy, & Kenneth J. Leising (Texas Christian University)

P56 Animals navigate to a hidden goal using a variety of search strategies. Previous research has shown that the type of search strategy used varies as a function of the available spatial information, previous experience with a task, and the number of behavioral options. In our experiment, rats were placed in an open-field consisting of a 5x5 response grid. During training, food was always hidden at the same response location (i.e., the goal). The test phase involved shifting the entire apparatus one third of its length (Hamilton et al., 2008). This shift allowed us to evaluate which of two strategies (among others) was controlling previous search behavior. Rats employing place responding would search more often at the response location in the same absolute position in space as the goal during training (based on extramaze cues), whereas, rats using directional responding would search at a different location in space (but the same location relative to intramaze cues). Results indicate that rats used place responding to find the hidden goal. The results are discussed in terms of how behavioral options and spatial information provided by extramaze cues influence search strategy.

Exploring Sex Differences in Spatial Ability: Further Evidence for the Range Size Hypothesis in the Order Carnivora

Bonnie M. Perdue (Georgia Institute of Technology; Zoo Atlanta), Rebecca J. Snyder (Zoo Atlanta), Terry L. Maple (Georgia Institute of Technology; Florida Atlantic University; Palm Beach Zoo)

P57 The range size hypothesis predicts that sex differences in spatial ability will only occur in species in which the mating system selects for differential range size. Recent research found support for this hypothesis in the order Carnivora by testing giant pandas, a promiscuous species in which males inhabit larger ranges than females, and Asian small-clawed otters, a related monogamous species in which males and females share home ranges. Male giant pandas made fewer reference and working memory errors than did females on a spatial task, but no sex differences were observed in otters. The current research expanded on these findings and found sex differences in giant panda working memory errors for both depleted (Interval 1: $U = 12.0$, $p = .01$; Interval 2: $U = 10.0$, $p = .006$; Interval 3: $U = 8.0$, $p = .003$) and never baited (Interval 2: $U = 12.0$, $p = .01$; Interval 3: $U = 16.0$, $p = .03$) feeders, and a difference in the total number of responses made on the task (Interval 2: $U = 7.5$, $p = .002$; Interval 3: $U = 11.5$, $p = .008$). No differences were found for Asian small-clawed otters. These results bolster previous support for the range size hypothesis in the order Carnivora and broaden our understanding of the evolution of sex differences in spatial cognition.

The role of experience in nest construction in the zebra finch

Felecity Muth & Susan D. Healy (University of St Andrews)

P58 Nest building can result in structures that appear complex, although it is generally assumed that cognition is not involved. In the construction of tools, on the other hand, it is assumed that cognition is a requisite. Here we examined whether experience in nest construction by male zebra finches affected their choice of nest material. We assessed which of two colours of nesting material males preferred before they built a nest with material either of their preferred colour or of their non-preferred colour. We then manipulated their reproductive success by leaving or removing all the eggs in their nest. Following these manipulations, males that had built a nest using the colour of nest material they had originally preferred continued to prefer it after nesting, regardless of whether they had experienced successful or unsuccessful breeding. Males that built a nest with nest material of the colour they had not preferred increased their preference for that colour of material after nesting but only if they had experienced successful breeding. It appears that zebra finches will modify their choice of nest materials following appropriate experience. It seems plausible, then, that cognition may play some role in nest building in birds, contrary to current views.

The role of orientation in spatial learning by wild rufous hummingbirds Selasphorus rufus

I. Nuri Flores-Abreu (University of St Andrews), T. Andrew Hurly (University of Lethbridge) & Susan D. Healy (University of St Andrews)

P59 Most investigations into spatial memory have been done in the horizontal plane only and yet as many animals (e.g. invertebrates, fish, birds, bats) move through three dimensions it seems plausible that they might use vertical information as well. We addressed this question experimentally with flower arrays presented to a bird either vertically or horizontally until he learned the rewarded location. We then tested what (absolute location or relative position within the array) the bird had learned by displacing the flowers. Orientation makes a difference: birds do not learn locations in the vertical axis as readily as they learn them in the horizontal plane. In addition, the ease of learning in either orientation is related to the spacing scale within the array (30 cm apart but not 5 cm apart). In the horizontal plane at 30cm all birds learned the absolute location whereas at 5cm our results are not conclusive. In contrast in the vertical axis the birds never reached the learning criterion. However, analysis of all visits made by each bird show that in both orientations and at both scales, birds visit the rewarded flower more frequently than any of the other flower positions.