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On Comparative Cognition

Talks
Posters

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Comparative Cognition Society

March 24 to March 27, 2010
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Melbourne Beach, Florida

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C03 - 2010 Program Summary

	Time	Page
Wednesday		
Welcome Reception and Check-In	3:30 - 5:00	1
Opening Remarks	6:50	1
Associative Processes	7:00	1
Canine Cognition	7:54	2
Communication, Auditory Discrimination, Social Learning	8:48	3
Thursday		
Concept Learning	12:00	5
Discrimination Learning & Perception	1:08	6
Tool Use & Problem Solving	3:03	7
Geometry, Orientation, Numerosity, & Serial Processes	4:19	8
Causality & Change Detection	5:34	9
Poster Session I	8:00 - 10:30	19
Friday		
Spatial Cognition & Temporal Processing	12:00	11
Cognitive Processes I	1:13	12
Memory	2:21	13
In Honor of the Contributions of Donald A. Riley	4:20	14
Master Lecture – Donald A. Riley	6:00	15
Banquet	7:30	15
Saturday		
Business Meeting of the Comparative Cognition Society	1:00	16
Group Photo Shoot	2:10	16
Cognitive Processes II	2:44	16
Choice	3:17	17
Metacognition	3:50	17
Closing Remarks	4:46	18
Poster Session II	8:00 - 10:30	25

PROGRAM NOTE

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

3:30 PM *Welcome Reception & Light Snacks*

Wednesday Evening

6:50 PM *Opening Remarks - Marcia Spetch*

7:00 PM **Associative Processes (Chair - Marcia Spetch)**

7:00 PM **What is contingency learning for?**
Helena Matute (Deusto University, Spain), Fernando Blanco (Leuven University, Belgium), Miguel A. Vadillo, Ion Yarritu, & Cristina Orgaz (Deusto University, Spain)
All animals extract contingency information from their environment. Presumably, they use it to infer the predictive and causal value of cues, which in turn are used to predict important events and to prepare for them. This assumption, however, has scarcely been tested in a direct manner and prediction and predictive value have often been taken as synonyms. The very few studies that have explored this issue have been conducted with humans and have shown that they use contingency to infer the causal and the predictive value of cues, but not to predict the outcomes, or to prepare for them. If this were confirmed, it would make little sense that humans (and perhaps other animals) invest resources in learning contingency information. This research further explored this issue with humans and found that they predict the outcome on the basis of contiguity, not contingency. However, we also found that people do only prepare for outcomes that are contingent with cues that are present. Indeed, even when people are certain that an outcome will occur they will not prepare for it unless they infer a high causal or predictive value for the present cue.

1

7:14 PM **Function and mechanism, or the race between the cart and the horse.**
Alex Kacelnik (University of Oxford)
The optimality approach typically starts by modelling ecological problems, proceeds to identify optimal strategies and advances to propose behavioural rules that would allow the subjects to deploy such strategies without using goal-directed optimality analyses. Often simple rules are hypothesised, tested in simulations, and contrasted with elements of real behaviour. Thus, mechanistic research is subordinate to functional analysis. I argue that the reverse protocol, namely using knowledge about behavioural mechanisms to make inferences about the problems they have been evolved to solve is often preferable. This is because mechanisms can be more precisely identified than ecological selective forces and because behaviour is more likely to be controlled by a limited set of broad-domain mechanisms than by a vast repertoire of problem-specific rules of thumb or heuristics. The ubiquity of three behavioural phenomena (Associative Learning, Weber's Law and Choice by Latency Competition) illustrates my point. From their ubiquity I infer that detecting correlations, managing information spreading over vast quantitative ranges, and sequential choices were major selective forces. This contrasts with the a-priori choice of energy rate maximisation and/or risk sensitivity as the currencies of optimal foraging models, and fosters ever closer identification between functional and mechanistic behavioural research.

2

7:28 PM **Additive effect of extinction in multiple contexts and massive extinction in attenuating recovery.**
Mario A. Laborda & Ralph R. Miller (State University of New York – Binghamton, USA)
In two fear conditioning experiments with rats, we showed that combining two recovery-attenuating treatments reduced recovery of extinguished conditioned responses more than either treatment alone. In Experiment 1, renewal and spontaneous recovery manipulations were combined to demonstrate that the two recovery-from-extinction effects summate and produce larger recovery of extinguished conditioned responses than either manipulation alone. We used this relapse model in Experiment 2 and showed that the combination of massive extinction and extinction in multiple contexts greatly attenuated recovery from extinction more than either recovery-attenuating treatment alone. These results are congruent with related observations by Rosas and Bouton (1998) and Thomas, Vurbic, and Kovac (2009).

3

7:35 PM **An inverted-U function relating stimulus control to footshock intensity**
Cody W. Polack, James E. Witnauer, & Ralph R. Miller (SUNY Binghamton)
The purpose of the present experiments was twofold. First, we sought to document that suppression in fear-conditioning is an inverted-U function of footshock intensity as suggested in cross-publication comparisons of prior research. Second, we tested the sometimes competing retrieval (SOCR; Stout & Miller, 2007) model's predictions concerning the effect of US intensity on conditioned suppression and the role of the context in determining the relationship between US intensity and suppression. Experiment 1 measured suppression after training with either 0.3-, 0.8-, 1.3-, or 1.8-mA footshocks. The results demonstrated that responding after training with the most intense shock was less than with moderate intensity shock. Experiment 2 replicated the critical result of Experiment 1, demonstrating that high intensity footshocks produce less suppression than moderate footshocks. Compound conditioning attenuated suppression following the moderate footshock, but not high intensity footshocks. Additionally, posttraining extinction of the context improved responding in the high intensity footshock condition. SOCR's account depends on the context acquiring associative strength more rapidly with a high intensity US. Extinguishing the associative status of the context reduces the context's role as a comparator. During compound conditioning, the overshadowing cue acts as a second-order comparator which counteracts the context, attenuating its influence on suppression.

4

7:42 PM **Acquisition-extinction interval determines the time course of spontaneous recovery of conditioned fear**
Justin S. Johnson & Martha Escobar (Auburn University)
Previous research has indicated that the long-term efficacy of extinction of conditioned fear is affected by the acquisition-to-extinction interval. However, the relative benefit of immediate vs. delayed extinction has been inconsistently reported in the literature, with some reports suggesting that immediate extinction is more resistant to spontaneous recovery than delayed extinction and other reports suggesting the opposite. An analysis of the variables that differ among these reports suggested that the recovery functions for immediate and delayed extinction may vary. Rat subjects received either immediate (10 min post-acquisition) or delayed (24 hr post-acquisition) extinction, and were assessed for spontaneous recovery either 1 or 7 days after extinction (acquisition controls received a dummy stimulus during extinction). Regardless of acquisition-extinction delay, extinction proceeded to comparable levels for all groups. Although all groups exhibited spontaneous recovery, extinction appeared to be more effective in the delayed than the immediate condition if the test was conducted 1 day post-extinction. However, extinction appeared to be more effective in the immediate than the delayed condition if the test was conducted 7 days post-extinction. These results reconcile the seemingly inconsistent previous reports and suggest that acquisition-extinction intervals may determine the time course of spontaneous recovery.

5

7:54 PM **Canine Cognition (Chair - Bill Roberts)**

7:54 PM

6

Functional Analysis: An old method with a new purpose.
Nicole R. Dorey, Monique A.R. Udell, & Clive D.L. Wynne (University of Florida)
Behavioral problems in dogs account for more than one third of the reasons given for relinquishing them to shelters and have been labeled a significant animal welfare issue. A successful method to manage these problems demands an understanding of the mechanisms that control these behaviors. However, for some of the most commonly cited behavioral problems, like jumping up on people, available treatments are not prescribed after a systematic assessment of environmental contingencies. The current study assesses the use of a functional analysis, which traditionally has been used with problem behavior in humans, to determine the controlling variables in dogs that jump up on people. The results show that this methodology is accurate in determining the maintaining variables for a particular individual, leading to more effective treatment.

8:08 PM

7

Object Permanence in Dogs and Wolves
Sylvain Fiset (Université de Moncton in Edmundston)
In this study, five grey wolves were compared with nineteen domestic dogs to determine whether they were able to infer the position of prey and/or social partners that continue to move when out of sight. Unlike previous works in which animals were required to sit-and-stay during the manipulations, the displacement of the object was performed while the animal was moving, mimicking the natural conditions under which tracking of disappearing objects usually take place. The results revealed that wolves and dogs are unable to mentally represent invisible displacement of objects. This study suggests that wolves' and dogs' cognitive limitations to track disappearing objects emerged from a common ancestor and are possibly exhibited by all other canids.

8:22 PM

8

Do all dogs follow points? What pound dogs can teach us about human-canine interaction
Monique A. R. Udell, Nicole R. Dorey, & Clive D. L. Wynne (University of Florida)
Pet dogs living in human homes far outnumber other populations of domestic dog (Canis familiaris) in studies of social cognition. While almost all claims about the species' social skills are based on data from this demographic, world-wide pet dogs living in human homes make up only a small minority of the population. Unfortunately environmental and experiential factors have often been overlooked in the design and interpretation of studies on canine cognition. In our current study we tested 22 shelter dogs in an object-choice task utilizing a momentary distal point. Only two subjects were spontaneously successful on the task, bringing into question domestic dogs' universal and spontaneous sensitivity to human stimuli. With only a small amount of additional experience, however, 14 of the remaining 20 dogs were able to learn to follow the difficult point at above chance levels. Naïve shelter dogs were able to follow an easier human point if given the opportunity to do so. Looking beyond the pet population can begin to bring environmental factors into focus and may provide us with opportunities to study the acquisition of a behavioral response taken for granted in enriched home environments.

8:29 PM

9

Taking the "self" out of self control: What dogs can teach us about inhibiting behavior.
Holly Miller, Kristina F. Pattison, Rebecca Rayburn-Reeves, C. Nathan DeWall, Thomas Zentall (University of Kentucky)
Self-control constitutes a fundamental aspect of human nature. Yet there is reason to believe that human and non-human self-control processes rely on the same biological mechanism—the availability of glucose in the bloodstream. Two experiments tested this hypothesis by examining the effect of available blood glucose on the ability of dogs to exert self control. Experiment 1 showed that dogs that were required to exert self-control on an initial task, compared to those that were not required to exert self-control, persisted for a shorter time on a subsequent unsolvable task. Experiment 2 demonstrated that providing dogs with a boost of glucose eliminated the negative consequences of prior self-control exertion on persistence, as it appears to do for humans. These findings provide the first evidence that self-control relies on the same limited energy resource among humans and non-humans, with broad implications for the study of self-control processes in human and non-human species.

8:36 PM

10

The shape of things to come? Sorting strategies in the domestic dog
Catriona M. E. Ryan, Joanne Gilbert, & Stephen E. G. Lea (University of Exeter, UK)
Four dogs were trained in a discrimination task where the discriminanda differed in three perfectly correlated dimensions, consisting of a blue star with a spotty surface pattern and an orange circle with a hash pattern. Three of the dogs successfully learned this discrimination and were then tested with probe stimuli in which one of the three stimulus dimensions (colour, shape or pattern) had been reversed while the others remained the same as in training. All three dogs had a strong tendency to respond to transfer stimuli in accordance with the shape dimension, with colour exerting a much smaller influence and texture none. This is in sharp contrast to other species tested with these stimuli (humans, grey squirrels, pigeons and Vasa parrots), all of which were most strongly controlled by the colour dimension. The implications of these findings are discussed.

8:48 PM

Communication, Auditory Discrimination, and Social Learning (Chair - Suzanne MacDonald)

8:48 PM

11

Patterns in Sequences of Dolphin Vocalizations
Joshua T. Abbott (Darwin College, University of Cambridge), Heidi E. Harley (New College of Florida; The Seas, Epcot®, Walt Disney World® Resorts), Jenna Clark (New College of Florida), & Wendi Fellner (The Seas, Epcot®, Walt Disney World® Resorts)
Bottlenose dolphins (Tursiops truncatus) vocalize frequently and produce a wide variety of sounds. To date, very few studies have addressed all the categories of dolphin vocalizations within a single analysis or the sequences in which they are produced. We used a multi-hydrophone array to record vocalizations produced by 4 male dolphins interacting in the interconnected pools at Disney's The Seas. Vocalizations were categorized by type (whistles, burst pulses, echolocation click trains). The whistle category was further sub-divided using frequency contour. Another subcategory included simultaneously produced broadband and narrowband sounds. Vocalizations were also labeled by producer when possible. We analyzed sequences of vocalizations using multiple measures including occurrence of vocalizations by category and transitional probabilities (via Markov chain analysis) of pairs of vocalizations. Click trains occurred most frequently; burst pulses occurred least frequently. The most commonly produced whistles were very short (< 150 ms). Sequences of broadly categorized vocalizations appeared to be randomly structured, but inclusion of more fine-tuned information (subcategories) revealed patterns. Sequences began and ended with a well-defined set of vocalizations, and successive vocalizations were strongly correlated. Dolphin vocal sequences have structure.

12

9:02 PM

Black-capped Chickadee Dominance Signalled in Song
Christopher B. Sturdy, Marisa Hoeschele, Michele K. Moscicki (University of Alberta), Ken A. Otter, Harry van Oort, Kevin T. Fort (University of Northern British Columbia), Tara M. Farrell, Homan Lee, & Scott W.J. Robson (University of Alberta)
Males of many songbird species use acoustic ornaments (i.e., songs) to attract and retain females (i.e., mates). Similarly, females select males based on song characteristics (e.g., song complexity or dominance status). Bioacoustic analyses of male black-capped chickadee two note fee bee songs reveal a potential acoustic mechanism signaling male dominance status, with the relative amplitude of the two song notes more consistent in dominant males. Using laboratory playback of male fee bee song to female black-capped chickadees we show that females respond differentially to dominant and subordinate song exemplars such that females vocalize and are more active

during dominant song playback. Taken together, this set of studies points to an acoustic cue other than a pitch-related cue that indicates dominance status of the singer and that status, as signaled by this acoustic ornament, can be perceived by females.

13

9:16 PM

Word-Object Recognition in Psittacines: Associating Spoken Words with Three Dimensional Physical Referents
Stephanie E. Jett & Joan M. Sinnott (University of South Alabama)
This study explored comprehension – the neglected aspect of communication - in four members of the Parrot (Psittacine) order. We used a modified two-alternative, forced choice identification task in which ten vocabulary words representing 3D animal figures were paired, creating five original pairs. In Phase I, the same two visual stimuli were always presented within a session with one (the S+) being paired with an auditory stimulus (label). The bird responded by orienting to either a left or right foot marker based on the position of the S+ at the sound of the label. After mastery of the original five pairs, in Phase II, the birds were tested on novel pairings of the original ten vocabulary words. Phase III utilized the same basic procedure but the S+ varied between trials. Preliminary analyses indicate that the subjects acquired all ten vocabulary words as measured by above chance performance in Phase II, and there do not appear to be significant differences between species.

14

9:23 PM

Micro- whistles: An overlooked category of vocalizations in Atlantic bottlenose dolphins (Tursiops truncatus)
Wendi Fellner (The Seas, Epcot®, Walt Disney World® Resorts), Jenna Clark (New College of Florida), Joshua T. Abbott (Darwin College, Cambridge University), & Heidi E. Harley (New College of Florida & The Seas, Epcot®, Walt Disney World® Resorts)
Dolphins produce a variety of whistles, including some very short whistles (< 150 ms) which are ignored in most analyses of the dolphin's vocal repertoire. However, dolphins possess a sophisticated auditory processing system that they can use to detect very small differences in frequency, amplitude, and time. For example, their auditory integration time is about 300 μsec compared to 7,000-10,000 μsec in humans Therefore, short whistles are likely salient to dolphins. In the current study, we used a multi-hydrophone array to record the vocalizations of 4 male dolphins interacting in a variety of contexts. Whistles were categorized by frequency contour, changes in frequency over time. We also identified whistles that were less than 150 ms in duration, i.e., micro-whistles. Of the 859 whistles in our sample, 35% were micro-whistles. There were 14 regularly occurring frequency contours, 11 of which were represented in the micro-whistle category. Whistles of short duration are an important component of the dolphin repertoire.

15

9:30 PM

Chord perception by songbirds and humans
Marisa Hoeschele, Lauren M. Guillette (University of Alberta), Daniel I. Brooks (University of Iowa), Robert Cook (Tufts University), & Christopher B. Sturdy (University of Alberta)
Human perception of music appears to be related both to musical experience and fundamental physical properties of sound. We replicated a study with pigeons (Brooks & Cook 2009) using both humans and black-capped chickadees as subjects to compare the way in which they perceive consonance in triad chords where all notes are played simultaneously. We found that the three species (pigeons, Brooks & Cook; humans and chickadees, current study) appeared to respond similarly to the chords overall, but showed differences in the ability to transfer to the same chords with a new root (i.e., played in a new key). We are currently investigating whether the species use similar or different mechanisms in order to process these stimuli, such as a stronger reliance on absolute or relative pitch, a commonly reported difference between humans and avian species.

16

9:37 PM

The Role of Memory in Sequential Auditory Same/Different Discrimination Processing in Pigeons (Columba livia)
Murphy, M. S. & Cook, R. G. (Tufts University)
Pigeons are sensitive to the degree of variability in a sequential auditory display. We conducted further testing to help determine if pecking behavior is controlled by the number of items accessible to memory. Pigeon (n=4) were trained in a go/no-go sequential auditory same/different task and tested with mixed sequences composed of a group of same notes followed by different notes, or vice versa. Data indicate that a memory window is not sufficient to account for response behavior, and an accumulator mechanism may aid memory.

17

9:44 PM

Spontaneous point following behavior of Megachiropteran bats
Nathaniel J. Hall, Monique A.R. Udell, Nicole R. Dorey, Allyson L. Walsh, Clive D.L. Wynne (University of Florida)
Spontaneous point following behavior is generally considered an important marker of social cognitive development in human infants. Recently, domestic dogs have shown to be highly successful in similar tasks involving the following of a human point to a target location. The domestication hypothesis, which proposes that enhanced social cognitive skills have been selected for during domestication, endowing domesticated species with the ability to follow human points, is often used to explain dogs' sensitivity to human gestures. To test if domestication is a necessary component for spontaneous point following, we tested a suborder of non-domesticated social species, five untrained Megachiropteran bats, for the ability to follow human points. We show that three bats were highly successful in following an unfamiliar human's point to a target location. In addition, bats born in captivity were more successful than those introduced to captivity as adults. Thus, domestication is not a requirement for the ability to follow an unfamiliar human's point. Human experience and a phylogenetic proclivity for social interaction may be better predictors of spontaneous point following than domestication. We hope Megachiropteran bats will be better represented in future studies of animal cognition.

18

9:51 PM

An investigation of cognitive abilities of the Glaucous-winged Gull in their natural habitat: observational learning
Tanya Obozova, Anna Smirnova, & Zoya Zorina (Lomonosov Moscow State University)
An experimental approach to investigate some cognitive abilities of the Glaucous-winged Gull in their natural habitat has been developed. Some pilot experiments were carried out in a gull breeding colony on Toporkov Island (the Commander Islands Nature Reserve, Russia). In particular, an experiment with 26 gulls showed that the birds can acquire behavior by observing other conspecifics. Untrained gulls (observers) watched conditioned gulls (demonstrators) performance of two tasks which are not within the range of their natural capacities. Six demonstrators were trained to obtain a food placed into an opaque box. 15 – 41 trials were necessary for them to learn the task. 13 from 14 observers started to obtain a food from the box in the first 3 trials. Other two demonstrators were trained to choose one of four boxes that were differed only in color. 12 – 15 trials were necessary for them to reach a criteria. 3 from 4 observers performed the task correctly in the first trial. These results suggest that observational learning is one of possible ways to transfer skills from one to other individual in a gull colony.

19

9:58 PM

Pinyon jays exhibit consistant caching behaviors over time and across situations
Christine Keefe & Alan Kamil (University of Nebraska)
Spatial cognition in food hoarding species has been well studied, but much less is known about the effect of social experience on food hoarding behaviours. Previous studies of caching birds, including corvids and parids (Order Passeriformes), have shown that individuals often alter caching behaviour when conspecifics are present which effectively decreases cache pilferage. To evaluate the generality of these findings for highly social birds, we tested pinyon jays (Gymnorhinus cyanocephalus) in an open-room cache-recovery experiment in which they cached either alone or in the presence of an observer. By contrast to findings of studies of other caching animals, pinyon jays did not modify their behaviour as predicted in the presence of an observer. There were, however, consistent individual differences among birds across replications of the experiment and in different social contexts. These findings indicate that behavioral type may influence cache survival and, in turn, could affect fitness in pinyon jays.

Thursday Afternoon

12:00 PM ## Concept Learning (Chair - Olga Lazareva)

12:00 PM

20

Identity and Category Matching-To-Sample in Pigeons
Edward A. Wasserman, Leyre Castro, & Joe K. Lancaster (The University of Iowa)
We trained four pigeons on a simultaneous matching-to-sample task with three alternatives in which the correct choice could either be: (a) identical to the sample (identity trials) or (b) nonidentical to the sample, but a member of the same category (category trials). We showed three natural categories: dogs, fish, and flowers, with six exemplars from each. Pigeons learned to match based on both identity and category; learning rate was similar for identity and category trials. Later, we introduced delays of 0, 1, 2, or 4 s between offset of the sample and onset of the choice stimuli; accuracy progressively decreased as the length of the delay was increased, but there was no disparity in accuracy between identity and category trials. Matching two identical items or matching two nonidentical items from the same category seem to be similar for pigeons.

12:14 PM

21

Does the 'profound disparity' in analogical reasoning still stand? Analogical humans, apes and paleological monkeys revisited.
Roger Thompson (Franklin & Marshall College), Joël Fagot, (CNRS, Universitie de Provence), Timothy Flemming (Georgia State University), & Erica Hoy-Kennedy (Frostberg State University)
Thompson & Oden (2000) argued that monkeys are paleologicians whose concepts are based on absolute and relational features bound by perceptual and/or associative similarity. Symbol trained apes, on the other hand, like humans, are analogical in the sense that they perceive abstract analogical similarities spontaneously and that symbol systems provide the representational scaffolding for explicit judgments of analogical identity in Relational Matching-to-Sample (RMTS) tasks. Does this 'Profound Disparity' (Premack, 1983) still stand? Maybe, then again, maybe not in light of recent evidence presented here for nonsymbolic scaffolding effects on the RMTS performances of capuchins monkeys (C. apella) rhesus macaques (M. mulatta) and baboons (P. papio).

12:28 PM

22

The effect of category structure on pigeons' category discrimination
Stephen E. G. Lea, Andy J. Wills, Lisa A. Leaver, Catriona M. E. Ryan (University of Exeter), & Emmanuel M. Pothos (Swansea University)
Pigeons learned conditional discriminations between circles that differed in both hue and diameter. Three different stimuli signalled reinforcement to the left and three signalled reinforcement to the right. Two training conditions differed in the way the positive and negative stimulus sets were arranged in the 2-dimensional space defined by hue and diameter values. The distances between stimuli (effectively, inter-stimulus similarities) within each set were identical in the two conditions, but the distances been stimuli in different sets were greater in one condition ("high simplicity") than the other ("low simplicity"). However if the space was collapsed to a single dimension, the inter-set distances were identical in both conditions. Thus if the pigeons' behaviour was controlled by both dimensions, the high-simplicity condition should give faster learning than the low-simplicity condition, but if it was only controlled by a single dimension, learning rates under the two conditions should be identical. Learning rates did not differ between conditions, suggesting unidimensional control over behaviour. However data on transfer to novel combinations of hue and diameter showed that the pigeons had come under the control of both stimulus dimensions. We conclude that stimulus similarity, however defined, may act in different ways under training and generalization conditions.

12:42 PM

23

Action Category Discrimination by Pigeons
Yael Klein & Robert G. Cook (Tufts University)
Detecting the behaviors and intentions of other animals is an important skill for pigeons. While noun category discriminations have been well established in pigeons, verb categories have received less attention. We trained four pigeons to discriminate digitally rendered videos of walking and running animals. This discrimination was easily acquired and transferred to novel representations of walking and running in a variety of animals, camera angles, and orientations. The results support the possibility that pigeons can form action categories. The relevance of speed of motion will be discussed.

12:49 PM

24

Matching Emotion and Activity Categories: Testing Social versus Physical Reasoning in a Chimpanzee
Tamra Beckman, Alex Biondillo, & Jennifer Vonk (University of Southern Mississippi)
An adult male chimpanzee was tested in a match to sample (MTS) paradigm in which he was required to match images based on whether the individual depicted was either a) displaying the same emotion as the individual in the sample or b) engaged in the same physical activity as the individual in the sample. Four different emotion and activity categories were used in each test. The experiment was designed to differentiate between reasoning about an element of the social or mental environment (emotions) versus an element of the physical environment (activities). After twenty 12-trial sessions of each type of task, with images involving humans, the chimpanzee did not perform above chance on either the social or physical MTS tests, and did not perform differentially between the two tests. Testing on chimpanzee-specific images is currently underway.

12:56 PM

25

First Order Relational Matching in Chimpanzees (Pan troglodytes)
Jennifer Vonk (University of Southern Mississippi)
Two adult male chimpanzees were presented with a match-to-sample task on a touch-screen computer in which they were required to match images based on whether they were the same shape or color as the sample. Each session consisted of 18 trials, nine color-match and nine shape-match trials, in random order. The stimuli were three different geometric shapes in three different colors each. Incorrect comparison images did not match the sample on either color or shape. Criterion was set at 83.33% correct for four consecutive sessions, which neither chimpanzee achieved in over 175 sessions. This result is in contrast to Vonk (2003) in which four orangutans and one gorilla performed above chance on a first and second order relational matching task in fewer than twenty sessions. However, the result is consistent with other research showing that relational matching with only two items in the stimulus array is extremely difficult for non-humans. The results indicate that both chimpanzees found it easier to match based on color than shape. Overall, they performed at about 70% accuracy on color match trials, and at chance on shape match trials, suggesting that they used a perceptual process rather than matching based on relations.

1:08 PM ## Discrimination Learning and Perception (Chair - David Stahlman)

26 **1:08 PM**

The effect of reward magnitude and delay to reinforcement on behavioral variability
W. David Stahlman & Aaron P. Blaisdell (UCLA)
Recent studies have demonstrated that the expectation of reward delivery has a negative relationship with operant behavioral variability (Gharib, Gade, & Roberts, 2004; Stahlman, Roberts, & Blaisdell, in press). Research thus far has been narrowly focused on one aspect of

reinforcement – namely, the likelihood of food delivery. In two experiments with pigeons, we examined the effect of two other aspects of reinforcement: the magnitude of the reward and the temporal delay between trial termination (determined by the operant peck response) and outcome delivery. In the first experiment, we found that a large reward magnitude resulted in reduced spatiotemporal variability in pigeons' pecking behavior. In the second experiment, we found that a 4-s delay between trial termination and reward delivery increased operant variability. Importantly, each of these factors significantly interacted with reward probability, such that magnitude and delay manipulations were only effective in modulating behavior at certain levels of reward probability. These results suggest that a central construct is mediating behavioral variability.

27

1:22 PM

Use of stimulus relations to solve a visual discrimination task by Eastern box turtles (Terrapene carolina)
Katherine A. Leighty, Margaret A. Maloney, Victoria L. Pittman-Courte, & Tammie Bettinger (Animal Programs and Environmental Initiatives, Disney's Animal Kingdom)
Little is known of the cognitive and perceptual abilities of chelonians (and of reptiles in general). We trained two Eastern box turtles on a simple two-choice discrimination task using black, white, and medium gray paddles. One turtle was initially trained to select the lighter choice and the opposite was true for the second turtle. On subsequent non-reinforced probe trials with added choices of a light gray and dark gray paddle, the turtles demonstrated responding in accordance with lighter/darker relations. Subjects then generalized knowledge of this relationship to an array of blue paddles. Results demonstrate that turtles can utilize stimulus relations in addition to stimulus value to guide their actions.

28

1:36 PM

Acquired Equivalence Between Stimuli Trained in the Same Context
Mikael Molet (University of Lille, North of France) Holly C. Miller, Jennifer R. Laude, & Thomas R. Zentall (University of Kentucky)
We investigated the role of the context in human and pigeon acquired equivalence. Both species were trained on four conditional relations in two different conditional discriminations. In both conditional discriminations each of two conditional relations was trained in one of two different colored background contexts. On test trials, when conditional stimuli from the two conditional discriminations were interchanged and presented in a neutral context, positive transfer resulted. Thus, stimuli that have shared a common context at different times can come to be treated as equivalent.

29

1:50 PM

Cognitive Processes Mediate Representation of Absent Events in Rats
Cynthia D. Fast & Aaron P. Blaisdell (UCLA)
We investigated the role of prior learning on discriminations involving ambiguous situations. We previously found in a Negative-Patterning discrimination (A+, B+, AB-) with visual stimuli, that covering one light (B) at test caused a difficulty in the subjects determining whether each trial on which A was presented was an elemental or compound trial. Covering B's light failed to significantly affect responding to A on a Positive-Patterning discrimination (A-, B-, AB+), however. We tested the hypothesis that the non-linear solution to Negative Patterning engaged representational processing capacities necessary for representing absent events, but that these processes were not engaged by the linear solution to Positive Patterning discrimination. Rats were trained concurrently on both Positive and Negative Patterning discriminations (with different stimuli). In contrast to our prior findings, rats tested on A in the Positive Patterning discrimination DID show sensitivity to covering B's light at test, thereby supporting our hypothesis. These results have interesting implications for representational processes engaged in problem solving.

30

1:57 PM

Effect of position of discriminative stimuli on discrimination learning in pigeons
Olga Lazareva, Jeremy Goh, & Joyce Yuen (Drake University)
Earlier, we have demonstrated that pigeons show robust relational learning after multiple-pair transposition training (Lazareva, Young, & Wasserman, 2005; Lazareva, Miner, Young, & Wasserman, 2008). These experiments, however, displayed discriminative stimuli in the same two locations providing an opportunity for the pigeons to employ a lower-level, perceptual strategy instead of learning the relation among the stimuli. In the present experiment, we used a 3 x 3 array of locations to display the discriminative stimuli. We first trained pigeons to discriminate two pairs of circles displayed horizontally: 1+ 2- and 2+ 3- or 1- 2+ and 2- 3+ (digits denote circle diameters and plus and minus signs denote reward and nonreward, respectively). Then, the pigeons were given the same pairs in diagonal and vertical orientations and any choice was nondifferentially reinforced. Pigeons were selecting the correct stimulus in novel orientation significantly above chance, indicating no reliance on alternative, perceptual strategy.

31

2:04 PM

Pigeons Discriminate Angle Size
James F. Reichert and Debbie M. Kelly (University of Saskatchewan)
In a forced choice discrimination task, pigeons searched for a food reward hidden in front of one of two wooden objects located inside an experimental room. Each object consisted of two identical pieces of wood joined together with a hinge so that the pieces could expand or contract to form an angle of varying degrees. Pigeons were divided into groups based on the size of their training angle: group 60° or group 120°. During training the pigeons were rewarded for searching at their trained angle (S+) and avoiding searching at the unrewarded angle (S-). During non-reinforced testing, the pigeons were presented with their trained angle and a transformed angle that was either larger or smaller than their trained angle. Choices revealed a trend toward responding to angles beyond the S+ in a direction away from the S-. This effect was stronger for pigeons in group 60° compared to pigeons in group 120°.

32

2:11 PM

Simultaneous vs successive generalization and transposition by the infant chicken
Viktor Sarris & Jeanne Poci (Frankfurt University)
In our former studies we investigated the role of absolute versus relative training on the generalization gradients of baby chicks; relational responding was found to be more frequent under relative training, and vice versa (Hauf, Prior & Sarris, 2008). In our present study the successive, instead of the simultaneous, training and generalization-testing procedure (2AFC method) was used with still other groups of infant chicks for 2 different dimensions, size and color, to test the context-dependent performance of this much harder task. The results of this follow-up study will be presented in the light of our former relational psychophysics paradigm.

33

2:25 PM

Touch, Hearing, and Vision of the Florida Manatee, Trichechus manatus latirostris
Gordon B Bauer (New College of Florida; Mote Marine Laboratory), Joseph C. Gaspard (Mote Marine Laboratory; University of Florida), Debborah E. Colbert (Association of Zoos & Aquariums), Roger L. Reep (University of Florida), & David Mann (University of South Florida)
Manatees are tactile/auditory specialists with limited visual acuity, a pattern consistent with the frequently turbid underwater environment these herbivores inhabit. Using the vibrissae-rich facial area, manatees demonstrate fine discrimination of texture gratings at levels comparable to human index finger performance. They are exquisitely sensitive to low frequency vibrotactile stimulation, detecting particle displacement less than a micron within the 15 Hz – 150 Hz range, presumably through hydrodynamic sensation involving the vibrissae that cover their bodies, an arrangement unique among mammals. Anatomical evidence suggests that the vibrissae form a three dimensional array for detecting subtle changes in water movement, analogous to the lateral line of fish. The manatee auditory temporal processing rate is high, exceeding that for humans by a factor of 10, but less than that of dolphins, which are active echolocators. Their hearing extends up to 90.5 kHz, with peak sensitivity from 8 – 32 kHz. They have good ability to hear masked tones in this peak range, which encompasses vocal frequencies potentially relevant to individual recognition. Directional hearing for

broadband stimuli is excellent, but localization of tonal sounds is poor. They have dichromatic color vision, unique among marine mammals, but visual acuity is probably no better than 20 arc minutes.

2:39 PM

34

The role of real-life experience on visual processing in the pigeon
Anna Wilkinson & Ludwig Huber (University of Vienna)
Humans process faces quite differently from the way they process most other stimuli and rely on the configuration of features for recognition; this results in unusual behavioral effects, such as delayed recognition when a face is inverted. It has been proposed that this is the result of a special facial processing area in the human brain. However, there is evidence to suggest that the effect may be the result of expertise; humans are experts at discriminating faces. To test this, pigeons were trained to be experts in categorizing complex natural images that they did not evolve to discriminate: human faces. Two groups of pigeons were used; one group was housed in a normal aviary set up whilst the other was visually isolated and had no real-life experience of human faces. The pigeons were presented with 24 images of male faces, half of which were positive and half negative (arbitrarily assigned). Both groups of pigeons had difficulty learning the task, but this did not differ on the basis of real-life experience. They were then presented with inverted versions of the trained images. The differences in processing between the face familiar and the face naïve pigeons will be discussed.

2:53 PM

35

Interaction between identity and emotional expression in pigeons' perception of human faces
Fabian A. Soto & Edward A. Wasserman (University of Iowa)
The human visual system appears to process the individual identity of faces independently of their emotional expression. One possible explanation for this finding is that identity is processed by an independent, modular perceptual system. A second possibility is that this finding results from general principles of perceptual processing working over stimuli with a specific structure. Studying animals which are not believed to have a specialized perceptual system for discriminating faces may shed particular light on this issue. Here, eight pigeons were trained on a go/no go discrimination involving black-and-white photographs of 4 people displaying 4 different facial emotions. For each pigeon, responding to only one identity-emotion combination was reinforced and responding to all 16 possible combinations was measured. A spatial model of multidimensional generalization was fit to these data in order to analyze the interaction between individual identity and emotional expression in pigeons' perception of human faces. For all pigeons, a Euclidean metric best fit the data, suggesting integral processing of the two dimensions.

3:03 PM

Tool Use & Problem Solving (Chair - Kelly Jaakkola)

3:03 PM

36

Cognitive cooperation in Asian elephants
Joshua M. Plotnik & Frans B.M. de Waal (Living Links, Yerkes Primate Center and Emory University)
Cooperative behavior is expressed through various evolutionary mechanisms in the animal kingdom, but the cognition underlying complex cooperation is not well understood. Studies on non-human primates, including capuchins and chimpanzees, seem to indicate some level of understanding of the need for a partner in cooperative tasks. Here, we demonstrate that Asian elephants (Elephas maximus) have a similar understanding. We used a modified apparatus originally designed for use with chimpanzees that consists of a single rope fed through a table that is placed at a distance from the animals. Both rope ends (which, unlike the table, are available to the subjects) must be pulled simultaneously to retrieve the food rewards placed on the table. In our study, elephants not only learned to coordinate their behavior by waiting for the arrival of a partner before pulling, but also learned that both the presence of and action by the partner was necessary to successfully pull in the table. This work suggests that research on elephant behavior may yield further insight into the convergent cognitive evolution of socially complex species.

3:10 PM

37

Chain of Thought?: Problem-solving in Asian Elephants (Elephas maximus)
Preston Foerder (The Graduate Center of the City University of New York) & Diana Reiss (Hunter College of the City University of New York)
Few studies have investigated elephant problem solving abilities but it has been speculated that they do not demonstrate insightful behavior. Based on an experiment from Wolfgang Köhler's landmark chimpanzee studies, a problem solving task was presented to three elephants at the Smithsonian National Zoological Park, Washington, D.C. A chain anchored at one end was positioned on the floor outside the bars of the elephant's stall with a piece of fruit attached partway up. The chain was placed at an angle so that the elephant could reach the free end through the bars but pulling on it from that position did not move the fruit within reach. To reach the food, the elephant needed to pull and release the chain and reposition itself further down the bars to the newly reachable part of the chain, repeating this pattern until the fruit could be obtained. All three elephants solved the task, two using trial and error. In terms of "insight", the third elephant did not attempt to pull the chain or obtain the food until the third session. In this session, the elephant solved the problem on the first trial, and showed increased efficiency in the task in the following trials.

3:17 PM

38

How do capuchins stack up against chimpanzees and humans? Assessing combinatory manipulation in a block stacking task
Brian W. Stone, Tephillah Jeyaraj, & Dorothy Fragaszy (University of Georgia)
Combinatory object manipulation, a prerequisite for common forms of tool use, has been assessed in human infants and chimpanzees using a block stacking task (Hayashi 2009). Monkeys have not been tested using this paradigm, yet capuchin monkeys (Cebus apella) are a dexterous, tool-using species that frequently combine objects. In this study, we first demonstrated that with shaping two capuchins could stack four cubic blocks. In the test phase, we manipulated the spatial relations involved in the task by replacing one or two of the cubic blocks with novel asymmetrical blocks (cubes with large bumps on two sides) which could only be stacked in particular orders or orientations. Subjects were given 10 trials per session, one session per day, with an inter-trial interval of approximately 15 seconds, and were non-contingently reinforced in the test phase. Both subjects quickly became proficient in stacking the asymmetrical blocks. Their performance was videotaped and coded to test whether the subjects corrected for the added spatial-relational complexity with planful object rotations and placement order, and to investigate individual differences in strategy. This study sheds light on combinatory manipulation skills in capuchins and allows direct comparison of this species with chimpanzees and humans on the same task.

3:29 PM

Snack Break

4:19 PM

Geometry, Orientation, Numerosity, & Serial Processes (Chair - Kent Bodily)

4:19 PM

39

Influence of age on the use of features and geometry for orientation in the domestic chicken
Inga Tiemann & Debbie M. Kelly (University of Saskatchewan)
Orientation is a critical first step of navigation. Studies examining human orientation suggest that development may strongly influence how spatial cues are used for orientation. Studies using adult rats, adult pigeons or young chicks suggest that the integration of geometric and featural information may differ across species. However, differences in developmental stages may also be an important variable. We trained two groups of domestic chickens (Gallus gallus f.d.), differing in ages, in a rectangular arena to find food consistently located in one corner. The birds were either trained with distinctive features present at each corner or without distinctive cues requiring them to use only the geometric properties of the arena. Our results suggest that the weighting of cues for reorientation changes across the lifespan. Furthermore, in comparison to previous studies that used a different chicken breed, our results suggest that cue use may differ among chicken breeds.

4:33 PM

40

Encoding of relative enclosure size in a dynamic three-dimensional virtual environment by humans
Debbie M. Kelly (University of Saskatchewan) & Bradley R. Sturz (Armstrong Atlantic State University)
Human participants searched in a dynamic three-dimensional virtual-environment rectangular enclosure for a distinctly colored bin located in one of the four corners. During test trials, all bins were rendered identical in color, and the shape of the rectangular search space either remained the same or was modified to a relatively-sized contracted rectangle, an expanded rectangle, or a square. Participants made one choice response during test trials. In the rectangular enclosures, more of participants' choice responses were allocated to the geometrically correct corners than to the geometrically incorrect corners. In the square enclosure, participants' choice responses were allocated equivalently to each of the four corners. Results replicate previous enclosure size studies demonstrating encoding of enclosure geometry with human and non-human animal subjects conducted in real environments and extend these results to include encoding of relative enclosure geometry.

4:47 PM

41

How robust is the geometric module? Impact of age and sex on the orientation behaviour of domestic pigeons
Mareike Fellmin (Heinrich-Heine University), Inga Tiemann, & Debbie M. Kelly (University of Saskatchewan)
Homing pigeons are selected for outstanding relocation abilities. Studies using a rectangular arena have examined the ability of pigeons to encode geometric and featural properties of an environment. Whether geometric information is represented in an orientation-free manner and if these abilities are subject to the individual's ontogeny was examined. We trained young (30 days), mature (3-5 years) and aged (9 years and older) pigeons to locate food at a consistent corner, containing a distinctive feature, within a rectangular arena. After successful training, the features were removed; thus requiring the pigeons to use geometric information exclusively. In one testing condition, the birds used the same entrance points as during training (Geometry Only test), whereas in another testing condition, the birds used a novel entrance point (Geometry Novel Entry test). The results from the Geometry Only test confirm those of previous studies and show that pigeons encode geometric information of the environment across all ages. However, the results from the Geometry Novel Entry test showed a different pattern of choices. The pigeons did not choose the geometrically correct corners significantly more often than the geometrically incorrect corners. Further effects of age and sex will be discussed.

4:54 PM

42

Wild spotted hyenas show spontaneous numerical assessment when played calls from unfamiliar conspecifics
Sarah Benson-Amram, Virginia Heinen and Kay Holekamp (Michigan State University)
The ability to assess numerical advantage should be prevalent among species with intergroup contests. This is especially true for species in fission-fusion societies, which encounter greater numerical imbalances than species with other social systems (Wrangham 1999). Previous playback experiments demonstrated that lions and chimpanzees spontaneously exhibit basic numerical abilities (McComb 1994; Wilson 2001). We hypothesize that spotted hyenas will show comparable abilities as all three species live in fission-fusion societies, demonstrate coalitionary aggression, hunt cooperatively, and have potentially lethal intergroup conflicts (McComb 1994; Wilson 2001; Holekamp 2007). We conducted playback experiments to test whether wild spotted hyenas can spontaneously assess numerical advantage. We played lone hyenas consecutive non-overlapping calls from 1, 2, or 3 unfamiliar conspecifics. We used the long-distance vocalization of spotted hyenas, which contain information on individual identity. Hyenas spent a significantly greater proportion of the playback period oriented to the hidden speaker during the playback of calls from multiple versus a single hyena. Thus far we have found no evidence that spotted hyenas respond differentially to calls of 2 versus 3 unfamiliar conspecifics. The results support our hypothesis that spotted hyenas show comparable abilities to assess numerical advantage as those demonstrated in playbacks with lions and chimpanzees.

5:01 PM

43

Tests of implicit chaining in Cotton-top tamarins (Saguinus oedipus) III
Charles Locurto, Meaghan Collins, Maura Conway, Taylor Cormack, Kate Cunningham, & Laura Radville (College of the Holy Cross)
Three experiments examined characteristics of implicit chaining in Cotton-top tamarins when reinforcement was randomly delivered across elements of the chain. The procedure presented tamarins with a five-element chain in which an icon was presented serially on a touchscreen according to a spatial pattern. Tamarins had to touch the icon each time it appeared to advance the chain to the next element, but knowledge of the pattern was not necessary for reinforcement. Across the three experiments, delay to reinforcement for individual elements was varied by manipulating both the inter-stimulus intervals within the chain (ISIs), and the intertrial intervals (ITIs) between successive presentations of the chain. Results indicated that tamarins learned something about the chain even when delay to reinforcement was equated.

5:15 PM

44

Performance of zoo-living chimpanzees and gorillas on a computerized sequencing task
Katherine E. Wagner & Stephen R. Ross (Lester E. Fisher Center for the Study and Conservation of Apes, Lincoln Park Zoo)
Multiple primate species have demonstrated a propensity for sequence learning across different contexts. Analyses suggest an understanding of serial order that differs from many tested non-primates along several dimensions. However these reports often exclude acquisition, during which responses may be differently influenced by individual and species traits compared to skilled performance. Furthermore, many tests are limited to a single subject-species – with small sample sizes - introducing facility and methodological differences that challenge the validity of cross-species comparisons. To explore serial acquisition across two ape species, gorillas (n=3) and chimpanzees (n=3) learned to sequence 3,4, and 5-item progressively-long lists of arbitrary stimuli on a touchscreen computer. Across list length, gorillas exhibited higher performance ($F_{(1,944)}=149.1$, $p<0.001$) and longer response latencies ($F_{(1,944)}=89.2$, $p<0.001$) compared to chimpanzees. However, both chimpanzees and gorillas performed more accurately on longer lists – at the level of the complete sequence ($F_{(2,944)}=20.1$, $p<0.001$) and at each position ($F_{(2,1832)}=130.56$, $p<0.001$). Additionally, both species more accurately selected the correct symbol in the first position, compared to the second ($F_{(1,1832)}=124.30$, $p<0.001$). Within the context of a primate-typical sequencing strategy, these results point to potential species differences in serial order acquisition which may stem from social, attention, and arousal-related differences.

5:34 PM

Causality & Change Detection (Chair - Chris Sturdy)

5:34 PM

45

Causal learning in rats
Ralph R. Miller, Cody W. Polack, & Bridget L. McConnell (SUNY-Binghamton)
Some researchers have argued that humans have a unique ability to learn causal relationships. This is illustrated by our throwing a switch to turn on a light, but not calling the weatherman to ask that it not rain. Thus, behavior differentiates between causal learning and mere signaling of outcomes. Based on this distinction, we assessed the ability of rats to learn causal relationships between paired exogenous stimuli. Graphical surgery techniques were used to determine whether rats learned that one exogenous stimulus 'caused' another exogenous stimulus, as evidenced by their manipulation of the candidate cause. First, barpressing was paired with a tone. Then, with the bar absent, the tone was followed by an aversively loud noise. Finally, the bar was returned and the rats were observed to barpress less relative to various control conditions, including those for which the noise was devalued and those for which the tone was extinguished. The behavior of the different groups within and across experiments indicated that the rats viewed the tone as the cause of the noise. Control conditions demonstrated that the tone was not a second-order conditioned stimulus. Thus, rats appear to have a sense of causality that is qualitatively like that of humans.

5:58 PM

46

Causal Reasoning in Rats in an Aversive Preparation
Jared Wong & Aaron P. Blaisdell (UCLA)
Blaisdell, Sawa, Leising, and Waldmann (2006) reported evidence of causal reasoning in rats. A Light was established as a common cause of Tone and Food (Tone<--Light-->Food) by first giving rats Light-->Tone pairings in Phase 1 of training, followed by Light-->Food pairings in Phase 2. During testing, rats that observed the Tone looked for food in the magazine more than rats that intervened on the Tone with a lever press. This suggests that they attributed the intervened-on Tone to their own action rather than the Light, which resulted in discounting of Light and therefore of food. We tested the generality of this effect by replicating the Blaisdell et al. (2006) design using a conditioned-suppression procedure that substituted footshock for food. Thus, Rats received Light-->Tone pairings in Phase 1, and Light-->Footshock pairings in Phase 2 of training. Rats that intervened on the Tone at test through a lever press were less fearful of the Tone than were rats that merely observed the Tone at test. This replicates and extends the effect of an intervention on causal reasoning in rats to an aversive paradigm.

6:05 PM

47

Change Detection by Monkeys and Pigeons
Caitlin Elmore (U Texas Med School-Houston), Anthony A. Wright (U Texas Med School-Houston), John Magnotti (Auburn University), Jacquelyne J. Rivera (U Texas Med School-Houston), Jeffrey Katz (Auburn University)
Monkeys and pigeons were compared on visual change-detection tasks in terms of: learning rate, asymptotic performance, object & location transfer, and number of memory items. Both species learned at a similar rate and monkey asymptotic and transfer performance was higher than pigeons. These initial findings indicate a quantitative difference but qualitative similarity in how these species detect change.

6:12 PM

48

Role of pre-sample responses during acquisition of 2-item change detection task
John Magnotti (Auburn University), Jacquelyne Rivera, Caitlin Elmore, Anthony Wright, (U Texas Med School-Houston), Jeffrey Katz (Auburn University)
Change detection (CD) is a popular procedure for determining the capacity and nature of human visual working memory (VWM). Experiments in our laboratories have demonstrated the paradigm is viable for studying VWM in nonhumans. In our task, pigeons view a two-item sample array of colored circles, followed by a brief blank interval, and finally a two-item comparison array of colored circles, with one circle changing in color. In order to detect a change, subjects must rely on a comparison with the stored representation of the sample array. During acquisition, we noted observing-like responses to the sample array, which the schedule did not require. Because responses to the comparison array may bias choice responses, the current analysis explores the relationship between these responses during acquisition, using contour plots to show any peck biases. Our results suggest that early in acquisition subjects were biased by sample-peck location, and the reduction of this bias was crucial for acquisition of the CD task. The results also show that the contour plots are a useful mid-acquisition diagnostic and may provide more insight into strategy usage than dependent measures based solely on final-choice responses (e.g., accuracy or response time).

8:00 PM

Poster Session I (8:00 - 10:30)
See Poster Abstracts Starting on Page 19
Poster Presenters: Please set up your posters between 7:30 and 8:00

Friday Afternoon

12:00 PM

Spatial Cognition and Temporal Processing (Chair - Jeff Katz)

12:00 PM

49

Keeping an eye on things: A neighbour's spatial location influences arousal in vervet monkeys
Petra McDougall (University of Lethbridge)
Self-directed behaviours (SDB) were used as an indicator of arousal in free-ranging vervet monkeys (Chlorocebus aethiops) to determine whether an individual's level of arousal was influenced by their neighbour's spatial location. 468 hours of focal data were collected from 11 free-ranging female vervet monkeys inhabiting the Karoo region of South Africa. Results indicated that a female's rate of SDB when her nearest neighbour was behind her was significantly lower than baseline (i.e. no neighbours within five metres), and this trend held regardless of whether her nearest neighbour was dominant, male or female, or an associate or non-associate. All other conditions (i.e. nearest neighbour in front, or to the left or right) did not differ from each other, nor from the focal individual's baseline rate of SDB. These results are consistent with the hypothesis that female vervet monkeys are aware of neighbours which are out-of-sight (behind them), and that they may only turn their backs on neighbours when the need for social monitoring is low.

12:07 PM

50

Local and Global Cue Use in Children
Amanda Y. Funk, Alexandra D. Twyman, & Nora S. Newcombe (Temple University)
For many mobile organisms, it is important to be able to remember a goal location, such as a cache of food, or a nesting location. One way of improving accuracy in remembering a goal location is to encode multiple sources of information. The use of multiple cues reduces error, and is also good back-up system, in case a particular cue is no longer available due to changing environmental conditions. Past research with pigeons (Columba livia) has asked how the encoding of multiple cues is integrated and organized in spatial memory. Initial studies demonstrated a hierarchy of local and global cues (Spetch & Edwards, 1988). We have extended this research by comparing the performance of pigeons and children. In the current study, children 36-41 months of age were trained to find a goal location in relation to redundant global and local cues. After initial training, probe tests were conducted to determine which cues children encoded, and their relative weighting. Initial data suggests that children, like pigeons in an open-field experiment, weight local cues more heavily than global cues.

12:14 PM

51

The role of landmark-goal distance on spatial control in pigeons
Dennis Garlick, Cynthia D. Fast, & Aaron P. Blaisdell (UCLA)
Pigeons were trained to peck to a grid of dots presented on a touchscreen, with one of these dots being the goal and leading to reward. The screen location of the goal dot varied from trial to trial. Different landmarks signaled the location of the goal as being either near to, at an intermediate distance, or far from the landmark (only one type of landmark appeared on each trial). We found that pigeons showed significantly lower spatial variance when responding to the near location, while spatial variance to the medium and far locations did not differ significantly from each other. This suggests that longer landmark-goal spatial relationships result in less precision in the spatial control of responding. This finding has important implications regarding how spatial information is integrated in spatial maps.

12:21 PM

52

Latent Learning in Zebrafish (Danio rerio)
Luis M. Gómez-Laplaza (Universidad de Oviedo) & Robert Gerlai (University of Toronto Mississauga)
The zebrafish may have utility in the analysis of the biological mechanisms of learning and memory. Although learning and memory have been extensively studied and hundreds of underlying molecular mechanisms have been identified, this number may represent only the fraction of genes involved. Large scale mutagenesis screens thus may have utility. In order for such screens to succeed, appropriate screening paradigms must be developed. The first step in this research is the characterization of learning and memory capabilities of zebrafish and the development of automatable tasks. Here we show that zebrafish are capable of latent learning, i.e. can acquire memory of their environment after being allowed to explore it. Experimental zebrafish that experienced an open left tunnel or an open right tunnel of a maze during the unrewarded exploration phase of the test showed the appropriate side bias during a probe trial when they had to swim to a group of conspecifics (the reward). Given that exploration of the maze does not require the presence of the experimenter and the probe trial, during which the subjects are video-recorded and their memory is tested, is short, we argue that the paradigm has utility in high throughput screening.

12:35 PM

53

Rats' memory for the standard duration in a duration-comparison procedure.
Angelo Santi, Claire Hoover, & Sabrina Simmons (Wilfrid Laurier University)
Eight rats were trained in a duration-comparison task to press one lever if the comparison duration (c) was 1.2-s shorter than a standard duration (s), and another lever if c was 1.2-s longer than s. The interval between the s and c duration was 1 s. The ten duration pairs used during training controlled for the absolute duration of c and the total duration of an s-c pair. The total duration of an s-c pair was not predictive of the correct choice. Four of the rats exhibited a significantly greater percentage of long responses (i.e., c > s) when the comparison duration was longer than the standard than when it was shorter. On equal duration pair test trials as the interval between s and c was increased from 1 s to 4 s, the number of long responses (i.e., c > s) did not significantly increase. This is the first study to demonstrate that rats can acquire a relational duration discrimination. However, unlike humans and pigeons tested with a similar methodology, rats do not exhibit subjective shortening of the standard duration as the s-c interval is increased.

12:49 PM

54

Temporal "Extrapolation" by rats in the Peak-Interval Procedure
Matthew S. Matell, Matthew Hughes, & Allison Kurti (Villanova University)
We have previously demonstrated that rats trained on a peak-interval procedure with two different modal signals associated with two different durations (e.g., tone = 10s, light = 30s) will peak at the geometric average of these durations when tested with the simultaneous compound (tone+light) in extinction. In the present experiment, we evaluated whether rats would "reverse" this averaging process, or extrapolate, after being trained that one cue (tone or light, counterbalanced) indicated reinforcement availability at 10s while the simultaneous compound indicated reinforcement availability at 20s. Results revealed a modality-duration relationship effect, with robust responding to the untrained light (10s tone-trained group), but weak, temporally variable responding to the untrained tone (10s light-trained group). In the group tested with the light cue, responding peaked at 36s, in an approximately scalar manner (CVs of the peaks did not significantly differ across cues). Remarkably, this time was not significantly different from 35s, the time expected if the rats were extrapolating the appropriate time of reward based upon the compound peak occurring at the geometric mean of the component cues (i.e., long peak time = compound peak time^2/short peak time). We will also present data resulting from the reverse training condition (long duration and compound trained).

1:03 PM

55

Chimpanzees and orangutans plan for future exchange
Mathias Osvath (Lund University), Tomas Persson (Lund University)
Planning for future, perceptually uncued, events has been studied in great apes in recent years. Most results have been positive, with the exception of one study (Dufour and Sterck, 2008) which suggested that chimpanzees are unable to plan for a future exchange event with a human - a specific item is exchanged for a food reward. Our study suggest that it is premature to conclude that chimpanzees are unable to plan for such events. Moreover it appears that such planning is also within the capacity of the phylogenetically more distant orangutans. Our study relied on a set up where the subject had the opportunity to select one item among four; only one item being the exchangeable (established in prior training). After a delay an experimenter, different from the one in the selection procedure, conducted the exchange. We conclude that the exchange act itself might be non-trivial to an ape, and that prior extensive experience with such events might be necessary for them to succeed. The results also support the idea that great apes can plan for social acts.

1:13 PM

Cognitive Processes I (Chair - Jonathon Crystal)

1:13 PM

56

Modulation of decision-making by affective state
Michael Mendl & Elizabeth Paul (University of Bristol)
The interface between cognition and emotion has been extensively studied in humans but much less so in non-human animals. A robust finding is that background affective state influences attention, memory and decision-making. For example, people in negative states attend to threats, retrieve negative memories, and make negative judgements about ambiguous stimuli more than happier people. We have developed a novel paradigm to investigate whether such affect-induced 'cognitive biases' also occur in animals. Animals are trained that one cue predicts a positive event and another cue predicts a less positive / negative event, and are then presented with ambiguous (intermediate) cues. The hypothesis is that animals in a negative affective state will be more likely to respond to these ambiguous cues as if they predict the negative event (a 'pessimistic' response) than animals in a more positive state. Recent experimental studies on a range of species (rats, dogs, monkeys, starlings, sheep) provide face-value support for this hypothesis. The approach allows us to start investigating the role that affect may play in guiding animal decisions. It also allows us to use objective measures of cognitive performance as indicators of the more elusive and less easily measured affective states that influence them.

1:27 PM

57

The voodoo bucket: Dolphins' consistent but unexplained response pattern in a spatial cognition task
Kelly Jaakkola, Emily Guarino, Mandy Rodriguez, & Linda Erb (Dolphin Research Center)
Over several studies, we trained and tested 4 dolphins on multiple versions of a find-the-object task. Across all versions, an object was hidden in one of three containers while the dolphin watched, and the dolphin was asked to select the container that held the object. Although the dolphins performed well on most versions of this task (with the exception of invisible displacement versions; Jaakkola et al., in press), all of them evidenced a peculiar response pattern when certain changes were introduced (e.g., when lids were put on the containers, when the hiding trajectory was changed, or when the interval between hiding and response was increased). This pattern ("the voodoo bucket") was characterized by a high level of correct responding coupled with complete avoidance of a particular container. Notably, dolphins varied on which particular container they avoided, and which changes triggered this response pattern.

1:41 PM

58

Mental rotation in a dolphin?
Stan Kuczaj (University of Southern Mississippi), Adam Pack (University of Hawaii - Hilo), Lou Herman (University of Hawaii)
Previous work using a match-to-sample paradigm has demonstrated that dolphins can discriminate and recognize two-dimensional designs as well as three-dimensional objects. In the present study, we asked a dolphin to match a 2-D shape to one of two alternatives, with the alternatives being unrotated, rotated 90°, or rotated 180°. The dolphin was able to correctly choose the correct alternative in all conditions, although rotated alternatives did result in fewer correct choices. Although it is possible that the dolphin's performance resulted from some form of stimulus generalization, her pattern of responding is consistent with the notion that she used mental rotation when faced with rotated alternatives.

1:55 PM

59

Environmental Effects on Great Ape Cognition
Heidi Lyn (Agnes Scott College), Jamie L. Russell, Jennifer Schaeffer (Yerkes National Primate Research Center), and William D. Hopkins (Agnes Scott College and Yerkes National Primate Research Center)
While many researchers look at cognitive and behavioral differences between species, diverse experiences also can produce differential abilities, even within the same species. We recently showed that apes with enriched socio-communicative environments out-performed those with standard rearing in an object-choice task (Lyn, Russell, and Hopkins, in press). Here we explore the differences between cognitive, communicative, and behavioral abilities in bonobos and chimpanzees from distinct rearing environments. All of the apes were tested on a series of tasks, modeled after the tasks in Hermann et al, 2007, to test their understanding of the physical world, tool use, social cognition, and communication. Results suggest that apes reared in an enriched environment perform significantly better on communicative tasks and quantitative tasks, but not on tasks that measure their understanding of the physical world or on tasks that measure social cognition. These results suggest that apes' numerical and communicative abilities may be more subject to environmental adaptation than other cognitive processes. From an evolutionary perspective, these findings may reinforce the idea that language and mathematical abilities in humans are more socially supported than other cognitive processes.

2:09 PM

60

Will chimpanzees delay gratification by accepting tokens in lieu of rewards?
Theodore A. Evans, Michael J. Beran (Language Research Center, Georgia State University), & Daniel Hoyle (Department of Biology, Georgia State University)
Tokens inherently introduce an element of delay between behavior and reward. For this reason, token studies may help us understand how animals process delays and anticipate future events. In this light, we presented 4 chimpanzees with choices between visible food items that were immediately available for consumption and tokens that could be later exchanged for food items on a one-to-one basis. In one test in which chimpanzees were allowed to exchange tokens for rewards after each choice trial, they were willing to choose tokens over food items when there were more tokens than visible rewards, and given that delay to reward was equated across response options. However, when chimpanzees were presented with repeated choices between two different token amounts and were allowed to exchange tokens for rewards only once at the end of each session, they quickly learned to collect at least a moderate number of tokens before ending the session and exchanging the tokens. Therefore, chimpanzees were willing to delay gratification by selecting and holding tokens, but only when no visible food items could be selected and immediately consumed.

2:21 PM

Memory (Chair - Jennifer Vonk)

2:21 PM

61

Episodic memory in human toddlers tested on a what-where-context task
Frances Balcomb, Nora S. Newcombe, Katrina Ferrara, & Amanda Y. Funk (Temple University)
The developmental origins of episodic memory (EM) are poorly understood. Children don't show compelling evidence of EM until 2-3 years, although in infancy they show complex, but arguably semantic, declarative memory. In humans, EM is typically tested verbally. In non-human animals, EM has been explored by testing memory for combinations of bound associations, e.g. what-where-when, or what-where-context. In two experiments adapted from animal work (Eacott and Norman, 2004) children's ability to remember bound associations (what-where-context) was tested at 16-24 months. Children learned that a toy was hidden in one of four containers in two different rooms, each room containing the same containers but varying in contextual cues including features and spatial configuration. Although the containers in both rooms were the same, the toy was hidden in a different container per room, requiring children to remember the unique context to find the toy. After 1 familiarization trial per room, children's recall for the toy's location was tested in each room. Data from both experiments suggest that the ability to make bound contextual associations emerges at about 20 months, but only when children are provided with explicit (Exp 1) vs. indirect (Exp 2) recall cues.

2:35 PM

62

Rapid Change-Detection Learning
Anthony Wright, (U Texas Med School-Houston), John Magnotti (Auburn University), Almut Carolus (U Texas Med School-Houston), Jacquelyne Rivera (U Texas Med School-Houston), Sarah Baum (U Texas Med School-Houston), Caitlin Elmore (U Texas Med School-Houston), Jeffrey Katz (Auburn University)
Pigeons were trained to observe, but not respond to object pictures in a sample array. They readily learned to choose the changed object in a test array. They learned change-detection in a fraction (1/10) of the time, performed at a substantially higher accuracy, and transferred considerably better to new objects than pigeons not trained to withhold responding to sample objects.

2:49 PM

63

Array Location Stability and Object Variability Affect Rats' Working Memory for Missing Object
Marium Arain, Jouseph Barkho, Jerome Cohen (University of Windsor)
We report a series of experiments in which rats have to remember a missing object from an array of objects arranged in a square (four objects) or a rectangle (six objects) in a foraging chamber. Various types of information rats might use to retain the missing object are investigated by systematically manipulating array locations and within- array object positions. We report that rats' accuracy for finding the missing object is greater when array location and object positions are maintained than when either is varied between 'study' and 'test' segments of a trial. Varying the orientation of the rectangular array has a greater disruptive effect when the array consists of identical than different objects.

64

3:03 PM

Rats retrieve episodic memory when their memory is probed
Wenyi Zhou & Jonathon D. Crystal (University of Georgia)
The objective was to document that rats retrieve episodic memories when their memory is probed. Rats encountered chocolate at one and chow at three randomly selected radial-maze arms in a daily study phase. After a 2-minute retention interval, all doors were opened and chow was available at previously inaccessible locations. The replenishment of chocolate (at its study-phase location) depended on two factors: time of day (morning vs. afternoon) and the presence or absence of chocolate pellets in the central hub at the start of the test phase. Because replenishment could not be decoded until the test phase, rats could not use differential encoding at study to solve the task. Instead, to predict chocolate replenishment, the rats had to retrieve a memory about the study episode at the time of test. The rats revisited the chocolate location more in replenishment than non-replenishment conditions, which documents episodic-memory retrieval. Next, we transferred the rats to an unfamiliar time of test while maintaining the familiar time of study and observed immediate transfer,

which documents memory of when the study episode occurred. We conclude that rats retrieved episodic memories of the study episode when their memory was probed.

3:10 PM

Delayed alternation by California sea lions with naturally occurring hippocampal damage
Peter Cook & Colleen Reichmuth (University of California Santa Cruz)
The hippocampus is essential for memory function. Its exact role, however, and those of the surrounding medial temporal brain areas, has not been determined in humans or animals. New research suggests that the hippocampus may support explicit recollection and the surrounding brain areas a feeling of familiarity; further, stimulus recognition, which has been the paradigm of most of the hippocampal ablation work in animals to date, may be supported independently by both memory mechanisms, thus accounting for spared recognition ability in ablated animals. By contrast, performance in a delayed alternation procedure in a T-Maze should be supported predominately by recollection, not familiarity. Restricted hippocampal damage does not interfere with rats' ability to acquire this basic alternation task, which is likely supported by procedural learning, but damage strongly impairs delayed testing. In the present experiment, stranded California sea lions with naturally occurring hippocampal damage, and control animals without damage, were tested on alternation in a T-Maze at two delay durations. MRIs were conducted on each subject following testing. Training and testing is remote and does not interfere with potential release. More than 12 sea lions have successfully completed testing, and preliminary findings indicate that the paradigm is sensitive to hippocampal damage.

65

3:17 PM

Source Memory in Rhesus Monkeys: Distinguishing Between Performed and Observed Events
Megan L. Hoffman (Georgia State University)
The comparative study of episodic memory has provided compelling evidence that various species are capable of episodic-like memory that meets several behavioral criteria of episodic memory, including the integration of multiple components (what-where-when) in memory and retrieval from long-term memory. However, one defining feature of episodic memory is that retrieval involves a sense of agency and personal ownership of the memory (i.e., the person recalling the event remembers this as an event that they performed, not an event that they observed). Therefore, another component that might be useful in examining event memory in animals is to determine whether they can discriminate between performed and observed events. In the present study, we examined whether rhesus monkeys were able to discriminate between events that they performed on a computer screen (using a joystick to move an object to a pre-determined location) and events they observed (the same event occurring independent of their own involvement). The monkeys were significantly above chance (50%) at discriminating between performed and observed trials, even when joystick speed, cursor path, and the monkey's hand position were all equated across trials, suggesting that monkeys encode the source of event memories in terms of their own involvement in the event.

66

3:26 PM

Snack Break

4:20 PM

In Honor of the Contributions of Donald A. Riley (Chair - Mike Brown)

4:20 PM

Maladaptive Choice Behavior by Pigeons: An Animal Model of Human Gambling Behavior
Thomas R. Zentall & Jessica P. Stagner (University of Kentucky)
Contrary to optimal foraging theory, pigeons show maladaptive choice behavior by choosing an alternative that provides 20% reinforcement over another that provides 50% reinforcement. They choose the 20% reinforcement alternative when that choice results in a stimulus that always predicts reinforcement (20% of the time) or another stimulus that predicts its absence (80% of the time), compared with the 50% reinforcement alternative that results in a stimulus that predicts reinforcement half the time. This suboptimal choice behavior does not depend on the certainty of reinforcement associated with the low frequency (20%) stimulus. If the probability of reinforcement associated with that stimulus is reduced to 80% pigeons still prefer that alternative. Nor does it depend on the uncertainty of reinforcement associated with the 50% reinforcement alternative. If the choice is between a 100% probability of receiving 3 pellets and a 20% probability of receiving 10 pellets or an 80% probability of receiving no pellets, the small (20%) chance of receiving 10 pellets is still preferred. This maladaptive choice behavior mimics human monetary gambling behavior because it overemphasizes the infrequent occurrence of the winning event and underemphasizes the more frequent occurrence of the losing event.

67

4:35 PM

Species differences in the cognitive representation of symbolic hierarchies in jays
Alan B. Bond, Alan C. Kamil, & Cynthia A. Wei (University of Nebraska, Lincoln)
In operant transitive inference, subjects train on adjacent pairs in an implicit, linear stimulus hierarchy, where responses to higher ranked stimuli are rewarded. The task entails two contrasting forms of cognitive representation. Direct representation derives from associative memory for the proportion of responses to each stimulus that have previously been rewarded. Relational representation derives from configural memory, producing a linked list in which each stimulus representation is connected to the next one down in the sequence. Life history features that demand higher use of configural memory, such as social complexity or reliance on cached food, should theoretically promote greater use of relational representation. To test this evolutionary hypothesis, we trained individuals of four corvid species with contrasting natural histories on the transitive inference task. Simulation of a simple associative process found three accuracy measures that were reliably indicative of direct representation. We extracted the three measures for each subject and used principal components analysis to obtain the best aggregate measure of reliance on each type of representation. Regression of component scores against rankings of life history features indicated that both social complexity and caching reliance were significantly and independently associated with greater use of relational representation in operant transitive inference.

68

4:50 PM

Spatial pattern learning and transposition
Michael F. Brown (Villanova University)
Spatial pattern learning is the control of spatial choice by abstracted spatial relationships among otherwise hidden goal locations (Brown & Terrinoni, 1996; Brown, 2006). It requires discriminative responding to stimulus elements depending on the presence of other stimulus elements with different values (locations) but of the same type. The control by relations among stimuli at the core of spatial pattern learning is reminiscent of transposition (Kohler, 1918; Riley, 1968). Using data from spatial pattern learning experiments with rats and humans, some empirical and conceptual similarities of spatial pattern learning and transposition will be described and examined, with an eye toward exploring the possibility that common mechanisms may be involved in the two phenomena.

69

70

5:05 PM

Developing an operant analog of episodic-Like memory in Western scrub jays
Alan C. Kamil & Alan B. Bond (University of Nebraska-Lincoln)
One of the major contributions of Al Riley and his collaborators was the development of operant matching-to-sample (MTS) procedures to explore animal cognition. We have recently followed Al's lead, developing a version of MTS as a direct analog of procedures developed by Clayton and Dickinson for the study of What-When-Where memory in scrub jays. In our paradigm, jays are shown a trial-

unique sample stimulus, followed by either a 2- or 7-s retention interval. The retention interval is followed by a choice test; two stimuli are presented, the sample in the original location and another trial-unique stimulus in a different location. The birds are required to match after one retention interval and nonmatch after the other (counterbalanced across jays). Five of the six scrub jays learned this task rapidly, to high levels of asymptotic performance, clearly demonstrating the feasibility of our approach. Probe tests are currently underway to determine the extent to which behavior is controlled by the what and where components of the sample. Additional experiments will soon begin in which scrub jays are required to separately track what and where during acquisition.

5:20 PM

71

Findings from a random-walk model of discriminative reaction-times
Donald S. Blough (Brown University)
In several discrete-trial experiments pigeons discriminated among colored spots that varied in their similarity to each other and in their association with reward. A random-walk model was used to fit the resulting RT distributions. This model says that stimulus-related information accumulates until, upon reaching a threshold, it triggers a response. Simulations showed that changes in stimulus hue altered the speed with which the input information accumulates, whereas changes in reward altered the amount of information needed to trigger a response. This sort of model may be a way to broaden our understanding of animal discrimination: (a) the finding that separate parameters go with similarity and reward suggests that the random-walk can instantiate the "sensitivity" and "bias" parameters of signal detection; (b) the random-walk and related models have been widely used to explore human discrimination and cognition; (c) the random-walk can be linked to existing memory and associative models of animal discrimination.

5:35 PM

72

Comparative Pro Musica: An Avian Perspective
Robert G. Cook (Tufts University)
Music is an almost defining characteristic of our species. The universal production and perception of music is foundational to human culture, and it has powerful effects on our thoughts and emotions. Nevertheless, the melodic, harmonic and rhythmic components that form music must have had some cognitive precursors in non-human animals. This talk will review recent experiments conducted in our lab examining how pigeons process different musically-related features, including the perception of chords, consonance and dissonance, musical intervals, rhythmic and melodic grouping. Speculations about the comparative origins of music will be considered.

5:55 PM   # Introduction - Mike Brown

6:00 PM   # Master Lecture - Donald A. Riley (University of California, Berkeley)
Relational Responding in Animals

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 :)

2:44 PM   # Cognitive Processes II (Chair - Roger Thompson)

2:44 PM

73

Adventures in comparative cognition: training wild elephants in northern Kenya
Suzanne E. MacDonald and Marc Dupuis-Desormeaux (York University)
Elephant crop raiding behavior is a pervasive problem throughout Africa, one which is difficult to predict and expensive to defend. Subsistence farmers that suffer crop raiding are less likely to support local conservation efforts, and so eliminating this behavior is important in order to maintain viable elephant populations. Most efforts to minimize crop-raiding have used deterrents such as noise, chili peppers and bees to punish unwanted behavior, which often results in counterproductive frustration and aggression in the elephants. We are exploring the use of positive reinforcement in the form of elephant attractants to mitigate crop-raiding behavior. We conducted a two-phase food preference study on wild elephants in northern Kenya during an extended drought. In the first phase, we found that elephants preferred Fever tree to other available food sources. In the second phase, we added vanilla extract and found that all elephants showed considerable interest in this novel scent. We discuss the next steps of this on-going study and the implications for training elephants to use a newly created migratory corridor.

2:51 PM

74

Prospective memory in the rat
A. George Wilson & Jonathon D. Crystal (University of Georgia)
Prospective memory is defined as remembering to carry out an intended action at an appropriate time in the future. Studies with human participants have found that intended future actions have a deleterious effect on ongoing performance. Our study sought to determine whether a time-based intention in rats creates task interference. To this end, we examined performance in an ongoing activity (duration discrimination) and a prospective task (the future onset of a small meal). Twenty rats were trained to judge short (2 seconds) vs. long (8 seconds) gaps between brief white noise pulses in daily 90-minute sessions. Immediately after completing each duration discrimination session, half of the rats earned a small meal (8 grams of food in 30 minutes) by breaking a photobeam in the food trough; the other rats remained in the boxes but did not receive meals. Anticipation of the meal impaired time perception as the upcoming meal became imminent. We propose that the intention to collect the meal was associated with the temporal context. Thus, allocation of limited attentional resources between ongoing duration discrimination and anticipation of the meal interfered with performance in a time-based fashion.

75   **2:58 PM**

The Perception of Goal-Directed Actions by Cotton-top Tamarins
Kate M. Chapman, Angela Hill, Stephanie Bay, & Daniel J. Weiss (The Pennsylvania State University)
Human children and adults readily interpret action sequences with respect to their intended goal. Research with a variety of nonhuman

primate species suggests that this type of action perception may have a lengthy evolutionary history. In a series of experiments, we investigated this ability in cotton-top tamarins, a highly social primate species. In Experiment 1, we replicated previous research by Wood and colleagues (2007), by presenting our subjects with a two-alternative forced choice task in which they chose between two bowls: one contacted in a goal-directed manner by a human experimenter and one contacted incidentally. In Experiment 2, we conducted a similar experiment, using a less canonical hand gesture to contact the bowls. Unlike Experiment 1, subjects were at chance in their selection of bowls. In Experiment 3, we failed to replicate findings suggesting that tamarins infer goal structures based on the actor's rational constraints. In Experiment 4, we trained the monkeys to use a marker to indicate the location of a food reward, and then varied the method of placement (e.g., Call and Tomasello, 1998). Overall, our experimental results suggest that the tamarins' abilities to infer the goal structure of human actions are less sophisticated than previously supposed.

3:05 PM

The role of body orientation in the assessment of visual attention by Western lowland gorillas
Amanda E. Bania & Erin E. Stromberg (Smithsonian's National Zoological Park)
Six Western lowland gorillas were tested in a visual attention task that aimed to investigate not only the apes' understanding of what a human experimenter sees, but also what information they used to make these judgments. Based on Reaux et al.'s (1999) series of experiments in which chimpanzees were asked to choose between an attentive and inattentive experimenter under six different conditions, we tested the gorillas' ability to appropriately select a "seeing" experimenter to receive a food reward. The gorillas were able to use body and head orientation as cues to attention, but not the 'face rule' or 'eye rule' proposed in previous studies. In addition, the gorillas were more successful in naturalistic, or socially relevant conditions, that did not include the use of a prop (i.e. buckets, screens, blindfolds). Based on these results, a second experiment was conducted to further examine the gorillas' use of an experimenter's body posture in their judgment of attention. The gorillas showed that they were not able to make appropriate judgments of the face and eyes when in the presence of an overt body orientation. In a third experiment, when faced with a more neutral body orientation, gorillas showed significant improvement in their performance.

76

3:17 PM # Choice (Chair - Matt Matell)

3:17 PM

Do pigeons fall prey to the Concord effect?
Kristina F. Pattison & Thomas Zentall (University of Kentucky)
The Concord (or sunk cost) effect involves staying with an alternative even when there is a better alternative available ("should I stay or should I switch"). At various points during responding on a Fixed Ratio (FR30) schedule (5, 10, 15, 20, 25 pecks) we gave pigeons a choice between completing the FR30 schedule and switching to an FR15 schedule in which the "cost" of staying or switching was exactly the same. Pigeons that were sensitive to the changing conditions showed a bias to stay, consistent with a Concorde effect. Other pigeons were insensitive to the changing conditions (they always stayed or always switched independent of where in the FR30 the choice occurred).

77

3:24 PM

Pigeons' Acquisition of a Simultaneous-Discrimination Midsession Reversal: Anticipation of the Switch and Perseveration After the Switch
Rebecca Rayburn-Reeves, Thomas Zentall (University of Kentucky), & Mikael Molet (University of Lille)
When pigeons encounter a food source, they typically will return to that location, a strategy that has been termed win-stay. As a direct test of a win-stay strategy in pigeons, a discrete trials procedure was used with a simple, simultaneous color discrimination with one color correct for half of the session and the other color correct for the remainder of the session. If the pigeons acquire a win-stay strategy they should demonstrate control by local feedback (i.e., the absence of reinforcement following the switch). Results indicate, however, that the pigeons began to switch prior to the contingency shift and tended to perseverate (choose the originally correct stimulus) after the shift. When testing humans under similar conditions, similar anticipatory errors were found but not perseverative errors. Neither pigeons nor humans showed a clear win-stay strategy and only humans showed a clear lose-shift strategy. Taken together, these results point to a difference between human and pigeon reversal strategies.

78

3:31 PM

Mechanisms of Change Detection in Pigeons and Humans
Carl Erick Hagmann & Robert Cook (Tufts University)
Change and event detection involve a combination of perceptual and memory mechanisms. When changes in visual events occur too slowly for perceptual mechanisms to detect, working memory is used. To help understand how these two mechanisms interact, we tested pigeons and humans with varying numbers of changing and non-changing elements to manipulate working memory load. This made changes that require working memory more difficult to detect, while perceptually available changes were less severely affected. The pigeons were tested with a go/no-go choice task that measured peck rate. Humans were tested with a choice task that measured reaction time. Similarities and differences between the tasks and the performance of the two species will be discussed.

79

80 **3:38 PM**

A Bigger House or a Shorter Commute? The Decoy Effect and Primate Decision Making
Emily D. Klein, Michael J. Beran, & Theodore A. Evans (Language Research Center, Georgia State University)

Posters
Poster Session I - Thursday Evening

P1

Wolf Performance on Utilizing Diverse Range of Novel Human Point Types in an Object-Choice Task
Jessica M. Spencer, Monique A.R. Udell, Nicole R. Dorey (University of Florida)
One existing argument is that dogs may be responsive to a more diverse range of human stimuli than other species, including wolves. While it is true dogs can utilize a wide range of human gestures in object-choice tasks, prior studies conducted with wolves have utilized a restricted range of stimuli preventing an accurate assessment of the range of human gestures socialized wolves may be responsive to. The present study investigated wolves' performance on an object-choice task involving a wide range of novel gestures that have not been previously tested. Wolf performance was compared to that of pet dogs on the same task using the same human stimuli. The results indicated that there were no significant differences between wolf and dog performance, but there were significant differences across point types. This lends support to the hypothesis that dogs are not unique in their ability to utilize a diverse range of human gestures. Prior experience with specific human gestures likely influences whether or not dogs and wolves learn to follow specific points in a communicative context.

P2

To click or not to click: Positive reinforcement methods on the acquisition of behavior.
Alexander G. Blandina, Nicole R. Dorey, Erica Feuerbacher, & Clive D. L. Wynne (University of Florida)
Dog training has a history dating back centuries, yet very few studies have compared different training methods. One currently popular method of training is clicker training. In clicker training a click is produced when the correct behavior occurs and is followed immediately with food. The purpose of this study is to investigate whether the clicker is effective in decreasing training time when compared to other positive reinforcement methods without a clicker. Using naive puppies (aged 2 to 3 months) the current study compares the efficacy of clicker training with 1) the delivery of food alone and 2) the use of a verbal marker. We hypothesize that because both clicker and verbal commands mark the behavior and are discriminative stimuli for food; there will be no differences between these two stimuli. However, delivering the primary reinforcer alone may cause a delay in the acquisition to the target behavior because of an increase in the delay between the target behavior and the delivery of the food reward.

P3

Domesticated dogs' (Canis familiaris) use of the solidity principle
Andres De Los Reyes (University of Maryland – College Park), Shannon M. A. Kundey, Chelsea Taglang, Ayelet Baruch, Rebecca German, Sabrina Molina, Erica Royer, & Rebecca Allen (Hood College)
A variety of species maintain representations of hidden objects over time. Yet, little is known of the factors underlying predictive reaching, searching, and looking for such objects. We explored adult domestic dogs' knowledge and use of the solidity principle (i.e., one solid object cannot pass through another) by evaluating search behavior. Dogs watched as a small food treat rolled down a clear inclined tube into an opaque box. On some trials, a solid dividing wall was inserted into the center of the box, which divided it in half and blocked the treat's trajectory (i.e., Wall Trials). On other trials, the wall was not inserted into the box (i.e., No Wall Trials). To find the treat, subjects were required to modify their search behavior based on the wall's presence or absence. Results indicated that dogs correctly modified their search behavior to accord with whether the wall was present or absent. Subjects searched near where the tube entered the box on Wall Trials and at the far end of the box on No Wall Trials. Dogs displayed this behavior from the first trial and performed correctly when trial types were intermingled, suggesting dogs directed their searches in accordance with the solidity principle.

P4

Stimulus properties of human pointing: Learning in object choice tasks
James Morrison, Nathan Hall, & Monique Udell (University of Florida)
Domestic dogs have been shown to follow human social cues like the pointing of arms as well as nodding and bowing to find hidden food in object choice tasks. Sixteen dogs were tested on nine different point-types to determine the effects of learning through prior exposure to human social cues. To establish a baseline comparison, 8 dogs were tested on each individual point. Of the 16 dogs tested on all points, half of them were tested from easiest to most difficult while the others were tested from most difficult to easiest point. Those tested from easiest to most difficult point types performed much better than the other test group on the more difficult points. The baseline group performed similarly to the group tested from most difficult to easiest point type.

P5

Learning effects on interspecific communication between humans and domestic dogs
Angel M. Elgier, Adriana Jakovcevic, Gabriela Barrera, Alba E. Mustaca, & Mariana Bentosela (PSEA-IDIM-CONICET)
Domestic dogs have shown to be successful at following human cues to solve the object choice task. The question is what are the mechanisms involved in these communicative abilities. Many authors proposed that these skills are a domestication product, independent from learning processes. This work present studies considering the effects of associative learning upon these skills. In the first two experiments we aim to evaluate the effect of extinction and reversal learning procedures on the use of the pointing gesture. Also two experiments where dogs' performance in following physical or social cues are presented. The results showed that dogs stopped following the pointing cue in the extinction and that they learned to choose the not pointed container in the reversal learning. Furthermore, the presence of the owners improved the performance of the dogs during the reversal procedure, but delayed the extinction. On the other hand, the training of a colour cue reverses the preference for the social one, concluding that the dogs fundamentally follow those cues that allowed them to obtain reinforcers in their previous learning history. This suggests that instrumental learning plays an important role in interspecific communication between humans and dogs.

P6

Progressive elimination task in dogs: The effect of both the intermediate target's visibility and inter-target distances in the implementation of the visible rule.
Jacinthe LeBlanc & Claude Dumas (Université du Québec a Montréal)
The visible rule (VR) refers to selecting the visible targets first in a 3-choice progressive elimination task (PET) in which there are visible and hidden targets. Dogs implement the VR when the intermediate target differs from both the external left and right targets in terms of visibility (perceptually distinct) but not when one of the external targets is perceptually distinct. Recent empirical evidence has shown that when the perceptually distinct intermediate target is no longer in line with the dogs' body axis and placed closer to one of the external targets the VR is no longer implemented. This could be linked to the fact that the perceptually distinct intermediate target is no longer in line with the dog's body axis or to the fact that interbowl distances are modified. In the present experiment, dogs (n=10) were administered a PET in which one of the two external targets was placed closer to the perceptually distinct intermediate target which was in line with the dog's body axis. Data showed that the dogs still implemented the VR when the intermediate target was hidden but not when it was visible. The discussion emphasizes the effect of conflicting parameters in dogs' decision-making.

P7

Breed differences in domestic dogs' (Canis familiaris) emission of communicative signals.
Adriana Jakovcevic, Angel M. Elgier, Gabriela Barrera, Alba E. Mustaca, & Mariana Bentosela (IDIM-CONICET-UBA)
Breed differences in dogs' comprehension of human communicative signals have been reported recently. The present studies were performed to evaluate breed differences in the production of gazing to the human face in a conflictive situation with food at sight but out of reach. Three different breed groups were evaluated (Retriever, Sheepdog and Companion). Two studies were performed, one involving the training and extinction of the gaze response and the other a gazing test without previous training. In Study 1 breed differences were observed during extinction, Retrievers gazed significantly more than Sheepdogs and Companions. Same results were found in Study 2. One possible explanation for the fact that Retrievers gazed more even when no food was obtained, is that another reinforcer was at play during the tasks. The presence of the experimenter, who directs her gaze toward the animal, may work as a social reinforcer that maintains the response. A positive correlation between gaze duration during extinction and duration of physical contact with an unknown human in a sociability test supports this hypothesis. Taking together, results suggest that dogs' communicative abilities involve the interaction of learning, genetics and differential selection of traits in the different breeds.

P8

"Unwilling" vs "Unable": Domestic Dogs Understand Intentions
Puja A. Buch & Ellen E. Furlong (The Ohio State University)
Domestic dogs have evolved social skills, such as sensitivity to communicative cues like eye gaze and pointing, which help them navigate human society (Bruer et al., 2006; Hare et al., 2002; Miklosi et al., 2003). Such social skills are among the foundations of theory of mind, which includes reasoning about intentions and beliefs. Since dogs have mastered foundational theory of mind skills (i.e., eye gaze and pointing), they may be capable of more complex thought, such as understanding intentions. To test this hypothesis, eleven dogs encountered an experimenter unable or unwilling to provide food, a paradigm often used to explore reasoning about intentions (Call et al., 2004; Phillips et al., 2008). The dog's position relative to the experimenter was recorded for each one-minute trial. When the experimenter was unable to provide food, dogs stayed close (within 18 inches; $t[20] = 3.72$, $p < .01$); however, when the experimenter was unwilling to provide food, dogs spent more time in proximity (19 – 36 inches; $t[20] = 2.12$, $p = .04$) or away from the testing location (37 or more inches; $t[20] = 2.45$, $p = .02$). Dogs differentiate between an unwilling and an unable experimenter, demonstrating capacity to reason about intentions.

P9

Trying to tease apart backward blocking and interference between cues phenomena
Cristina Orgaz, Miguel Ángel Vadillo (University of Deusto), David Luque, Joaquin Morís, Pedro Luis Cobos (University of Málaga), & Helena Matute (University of Deusto)
Backward blocking (BB) and interference between cues (IbC) are two important effects in associative learning which share some common features suggesting that they could be explained in simmilar ways. During an IbC experiment the participants see two differents associations between a cue and an outcome, both sharing the same outcome (i.e., X-O trials followed by A-O trials). The association learned during the last phase(A-O) hinders the expression of the previously adquired association (X-O). The main methodological difference between IbC and BB is that during the first phase, BB requires the simultaneous presentation of both A and X. Some researchers have obtained both effects in the same experiment, but with differences in the size on the effects. We suggest that the difference between these experiments might be due to a common variable: both of them used a task that suggests a causal relationship between cues and outcomes. The aim of the present experiment is to explore both effects in a non-causal scenario. The use of a neutral scenario should avoid promoting one effect over the other on the basis of causal reasoning processes. The results showed significant effects of both BB and IbC with similar sizes.

P10

The role of outcome inhibition in interference between outcomes
Cristina Orgaz, Miguel Ángel Vadillo (University of Deusto), David Luque, Pedro Luis Cobos (University of Málaga), Helena Matute (University of Deusto), & Francisco José López (University of Málaga)
Current associative theories of contingency learning assume that inhibitory processes take part in interference between outcomes. Inhibitory processes also seem to underlie some other effects, as, for example, retrieval-induced forgetting. However, inhibition is understood differently in those two research areas. The purpose of the present experiment is to test whether a similar inhibitory process to that seen in retrieval-induced forgetting takes place in interference between outcomes. Using a contingency learning task, we found that interference between outcomes reduces the retrievability of the target outcome even when tested with a different cue and some minutes after training the interfering association. This result has important theoretical implications for associative models of interference and shows that the empirical facts and theories developed in the study of retrieval-induced forgetting might be relevant in the area of associative learning.

P11

The detailed time course of appetitive delayed Pavlovian conditioning in the zebrafish
L. Curtis, M. Lawrence, M. Delgado, & D. T. Cerutti (California State University East Bay)
Four 90-day-old zebrafish were tested in an appetitive Pavlovian delayed conditioning task. After an intertrial interval of k*T s, a small, translucent vertical pole was illuminated (CS) for T s. Food (US) was automatically presented at T/2 s. Various measures of swimming activity were measured by video-tracking software. All four fish showed very abrupt, "step-like" learning of the CS-US pairing. Three fish showed acquisition in the 3rd session, the last fish in the 2nd session. Conditioned responding (CR) is evident in several measures, including increased velocity during the CS, and proximity to the CS. Averaged velocity and proximity CR's are temporally undifferentiated at the outset of training but become differentiated after about 3 sessions. We are presently doing parametric manipulations of trial and CS duration (T) with new fish to see if we can more precisely determine the co-variation between the initial appearance of the CR and temporal differentiation of the CR.

P12

Summation in human causal reasoning
Miguel A. Vadillo, Nerea Ortega-Castro, Pablo Garaizar, & Helena Matute (Universidad de Deusto)
All theories of causal induction include explicit or implicit assumptions about the way several causes combine to produce a given outcome. According to many associative and rule-based theories, the probability of the outcome given a set of independent and non-interactive causes should be equal to the (non-overlapping) addition of the probabilities of that outcome in the presence of each of those potential causes presented in isolation. However, the Power PC theory of causal induction assumes that the causal power of a compound cue should be computed as an overlapping probabilistic addition: That is, the causal power of the compound is equal to the addition of the causal power of each cue minus the overlap between them. In a series of decision-making experiments, we show that, contrary to this assumption of the Power PC theory, humans tend to combine the influence of several causes by means of a simple, non-overlapping addition.

P13

Chimpanzees (Pan troglodytes) understanding of weight
Carley Faughn & Daniel Povinelli (University of Louisiana at Lafayette)
Previous studies have argued that chimpanzees can engage in causal reasoning with regard to object weight (Hanus & Call, 2008). However, other studies examining chimpanzee "folk understanding" of weight suggest that chimpanzees do not have explicit knowledge about the effects of object weight. A series of tasks were implemented to further investigate chimpanzee's sensitivity to weight and their potential for any higher-order, cognitive, understanding. Our research suggests that chimpanzees appear to create sensori-motor expectations about object weight and the load forces necessary to lift objects after just one trial of experience. These expectations were observed through an overcompensation effect when chimpanzees lifted a light object that was visually identical to a previously-lifted, heavy, object. The light object was lifted significantly higher than the heavy object. No similar overcompensation effect was observed when chimpanzees were required to respond to an object's apparent weight based solely on visual and auditory cues in the absence of direct experience. In addition, we tested our chimpanzees' knowledge of weight and understanding of balance mechanics. We found that the chimpanzees were not able to infer the location of a reward based on its weight in a balance apparatus. Our results suggest that chimpanzee's representation of weight is restricted to their sensori-motor system and they do not appear to reason about weight as an object based property.

P14

Causal Roles as Determinants of Blocking
Laura Coursen & Martha Escobar (Auburn University)
Causal model theories propose that cue competition is affected by the causal roles of competing stimuli and occurs between causes but not between effects, whereas associative models propose that cue competition is unaffected by causal roles and occurs among stimuli presented in a common temporal location (antecedent or subsequent). We assessed the relative importance of causal roles and temporal location using a blocking preparation (A→C then AB→C). Subjects had to assess the relationship between fictitious blood substances and a fictitious disease, Midosis. In all conditions, the blood substances were the antecedent events and Midosis the subsequent event. During the first phase, blood substances were either causes or effects of Midosis. In the second phase, causal roles were reversed by informing subjects that the blood substances were now effects or causes of Midosis, respectively (Reversal condition). For control subjects, the causal roles of the stimuli were maintained (NoReversal condition). Blocking occurred only among causes and only if the causal role of the stimuli was maintained across phases. These results suggest that the causal role of competing cues is an important determinant of stimulus competition and that competition does not occur among stimuli with different causal roles.

P15

Understanding Value and Time in Static and Changing Schedules of Reinforcement
Nicholas Commons-Miller (Tufts University), Commons, Michael (Harvard Medical School), Gane-McCalla, Robin (Dare Institute), Alex Pekker (University of Texas), & Michael Woodford (Columbia University)

Delay discounting traditionally was studied using samples from schedules as consequences in two link simple concurrent schedules. Risk has been studied in both simple and chained concurrent schedules. The unified theory presented here integrates the initial value of outcomes with delay, risk and sensitivity to change in risk. Risk is defined as the derivative of Mazur's (1987) equation for delay: $-Aik/(kdi+1)2$. Sensitivity to change in risk, the second derivative of Mazur's equation is: $2k2Ai/(kdi+1)3$. In this study, unlike the concurrent chain studies, the schedule samples were used as discriminative stimuli. The discrimination procedure here consisted of trials made up of a two-link schedule with the presentation of one of a large number of samples from a t schedule (Schoenfeld & Cole, 1972), as the first link. The second link was a choice between a left key indicting a lean or the right key indicating a rich schedule sample. The perceived sample value was shown to be a quadratic function of how soon before choice a single reinforcer was (the first derivative). Three derivatives of immediate value with respect to time before a choice of a reinforcer describe many properties of discounting accounts of reinforcement schedules.

P16

Use of the Hick task to assess selective attention in a troup of baboons (Papio papio).
Elodie Bonté & Joël Fagot (CNRS-Université Aix-Marseille I, Marseille, France; INCM, CNRS-Université Aix-Marseille II, Marseille France)
The hick (1952) task was used to assess selective attention in 19 group maintained baboons tested with the ALDM test system presented in a companion poster (by J. Fagot). In that task, the baboons have to select (i.e., touch on a touch-screen) a target among a variable number of equidistant distractors. Scores, reaction times and movement times were analyzed as a function of an (1) number of distracters, (2) location of the target on the screen, (3) spatial organization of the distractor-target configuration, (4) social parameters including the social status and indexes of sociability. That research was supported by a PACA-region grant to EB. Hick, W (1952). On the rate of gain of information. Quarterly Journal of Experimental Psychology, 1952, 4, 11-26.

P17

Automatic tests of baboons maintained in their social group.
Joel Fagot (CNRS-Université de Provence, Marseille, France.)
Fagot & Paleressompoulle (2009) published an automated learning device for monkeys (ALDM) to test the cognitive functions of nonhuman primates within their social group, but the efficiency of the ALDM procedure with large groups remained unknown. This poster presents a new research plateform based at the CNRS-Rousset-sur-Arc primate center, nearby Aix-en-Provence, in which a set of 10 such ADLM systems are now freely provided to a large social group of 26 baboons maintained in a vast 700 m2 enclosure. I will present that research plateform and will highlight its efficiency to assess social and non social cognitive phenomenon in nonhuman primates. References, Fagot & Paleressompoulle (Behav Research Methods, 2009), Fagot & Bonté (Behav Research Methods, in press 2010). This project was supported by the PACA-region grant - Volet Exploratoire 2008.

P18

A chimpanzee (Pan troglodytes) shows human-like speech perception abilities
Lisa A. Heimbauer, Michael J. Beran, & Michael J. Owren (Georgia State University & The Language Research Center)
The human ability to understand incomplete or distorted speech is argued to reflect specialized, species-specific processing. To test this claim, experiments have examined perception of natural versus synthetic speech by a 23-year-old, language-trained chimpanzee named Panzee. This animal is of particular interest because she was reared from infancy by human caregivers in a language-rich environment, and can identify more than 100 spoken words using graphical symbols (lexigrams). Tests present one of 48 familiar words via computer on each trial, with Panzee choosing a corresponding lexigram from among four alternatives. Studies with words in natural versus incomplete "voiced-only" form (Experiment 1) and natural versus a strongly distorted "noise-vocoded" form (Experiment 2) are complete, while comparisons of natural versus "sine-wave" speech (Experiment 3) are in progress. Panzee's performance with all stimulus-types in Experiments 1 and 2 was well above chance levels (p < 0.001), similar to that of humans, and inconsistent with the claim that functional speech perception in the absence of traditional acoustic cues requires specialized processing. Preliminary outcomes suggest that results with sine-wave speech will be similar, although with lower overall performance, as shown by humans already tested with these stimuli.

P19

Comparative Analyses of Avian Visual Cognition: Shape from Shading in Starlings
Muhammad A. Qadri, Carl Erick Hagmann, & Robert G. Cook (Tufts University)
To test the generality of earlier results collected with pigeons (a columbiforme species), starlings (a passeriforme species) were tested in a two-alternative shape-from-shading choice task. Using live-in operant chambers, the starlings were shown two stimuli simultaneously and required to land on the appropriate perch to indicate which shaded surface was convex or concave in appearance. The choice-accuracy results were similar to earlier pigeon data, and comparisons between the two species and their acquisition will be presented. Task-specific and daily performance related to the live-in procedure will also be considered.

P20

Auditory brainstem response in the lesser scaup, a species of diving duck
Sara C. Therrien, Catherine E. Carr, Elizabeth F. Brittan-Powell (University of Maryland), & Alicia M. Wells-Berlin (USGS Patuxent Wildlife Research Center)
The auditory brainstem response (ABR) is an effective approach to describing auditory sensitivity in a variety of animals. In this investigation, we used the ABR to estimate the auditory sensitivity of a species of diving duck, the lesser scaup (Aythya affinis). The typical lesser scaup ABR waveform showed two to three prominent peaks that occurred within the first 5 ms after onset of the stimulus. Peak amplitude increased and peak latency decreased with increasing stimulus sound pressure level. Threshold was defined as 2.5 dB below the lowest SPL that evoked a visual response (visual detection method). The best range of hearing for this species was from 500 Hz to 5000 Hz, with sensitivity peaking between 1500 Hz and 3000 Hz. Both the waveform morphology and response characteristics of the peaks to changing stimulus intensity are similar to those found in other avian species, such as screech owls (Megascops asio) and budgerigars (Melopsittacus undulatus).

P21

Note-type based species classification by black-capped and mountain chickadees
Lauren M. Guillette, Marisa Hoeschele, Tara M. Farrell, Laurie L. Bloomfield, & Christopher B. Sturdy (University of Alberta)
Bloomfield et al. (2008) showed that black-capped and mountain chickadees sorted their chick-a-dee calls into species-level categories. In this task, the terminal "dee" portion was a more efficacious stimulus for species classification than the initial "chick-a" portion. In a separate study, linear discriminant analyses were able to classify notes by species with 100% accuracy using any call note type from either species' calls (Dawson et al. 2006). In the current, ongoing set of experiments, we aim to determine whether classification into species-level categories are mediated equivalently all call-note types, as suggested by the results of the linear discriminant analysis, or whether some note types are more well suited to aid in species classification to others using a go/nogo operant discrimination. Our results suggest that a simple (sounding) question does not necessarily lead to a simple answer and birds appear to be adopting several strategies to solve the task.

P22

A cross-species linguistic analysis of self-speech
Erin N. Colbert-White (University of Georgia)
Self-speech (talking while alone) is prevalent in young children and speech-trained African Grey parrots. Because parrots are the only nonhuman taxon that readily learns speech, they are an indispensable comparative model for investigating the relation between speech content and cognitive processes. I compared a 2.5-year old child and 6-year old African Grey parrot's self-speech. The goal was to identify parallels and dividing lines between the speakers' linguistic and cognitive abilities. Content similarities in the self-speech include (1) prevalence of sound-play and repetition, which are important features of self-speech in humans, and (2) interrogatories that require a second party to respond (e.g., "What's that?"). These similarities challenge critics who view parrot speech as random repetitions of mimicked phrases. The analysis also revealed that the parrot never uses the pronoun I in novel phrases and never uses the verb to know. This suggests that the child, but not necessarily the parrot, has developed a sense of self and an understanding of what she and others know and do not know to the extent that she freely talks about it. Overall, the linguistic analysis revealed that both speakers use self-speech in functionally similar ways but are at identifiably different cognitive levels.

P23

Context-Dependent Use of Signature Whistles in the Atlantic Bottlenose Dolphin (Tursiops truncatus)
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)

Signature whistles, defined as the most commonly produced whistle by an individual dolphin in isolation and categorized by the unique frequency contour produced by each dolphin, are some of the most well-studied vocalizations of dolphins. These whistles are usually studied in isolated animals but, given their likely purpose as identifiers and cohesion calls, could be expected to play a strong role in the introduction of new dolphins to a social group. We used a multi-hydrophone array to record vocalizations produced by 4 male dolphins at Disney's The Seas, both during the introduction of 2 new dolphins and comparison periods of similar activity 3 years later. All whistles were labeled by producer and categorized by frequency contour. We calculated the percentage of signature whistles in each file; results varied from 0% to 21%. An inverse relationship between rates of signature whistles and rates of short whistles (<150 ms) appeared in the comparison periods. Periods with fewer whistles had a lower incidence rate of signature whistles and a decreased variety of whistle contours, but signature whistles occurred most during periods when the dolphins were highly aroused whatever the condition. These data support previous findings that signature whistles are used as cohesion calls.

P24

Reducing Irrelevant Relations Facilitates Learning Rules from a Response Series Lacking a Consistent Motor Sequence in Rats
Shannon M. A. Kundey (Hood College) & Stephen B. Fountain (Kent State University)
Earlier we reported that rats could learn a response pattern in a circular array of levers that was not a set motor sequence. Rats learned either a structured (12345678) or an unstructured (17356428) subpattern interleaved with responses on randomly presented levers (X): 1X2X3X4X5X6X7X8X or 1X7X3X5X6X4X2X8X, respectively. The structured, but not the unstructured, group learned their pattern. In a new study, we hypothesized that irrelevant relations between random elements and fixed subpattern elements might have slowed learning in the earlier study, as they do in humans (Hersh, 1974). Using the same structured and unstructured subpatterns used earlier, we restricted the set from which random elements were drawn so that irrelevant relations were prevented. As before, rats learned the structured subpattern faster than the unstructured subpattern. However, learning by the structured group was facilitated. The results provide further evidence that sequential structure across nonadjacent elements can mediate better pattern learning even when the rule relating those elements cannot be abstracted from a set motor pattern. Furthermore, the results suggest that irrelevant relations in serial patterns interfere with detecting and encoding pattern structure in rats as they do in humans.

P25

Scopolamine dissociates cognitive processes responsible for phrasing effects versus violation element performance in rats
Amber M. Chenoweth & Stephen B. Fountain (Kent State University)
In serial pattern learning, "phrasing cues" positioned at chunk boundaries can facilitate learning transitions between chunks which are harder to learn than elements within chunks. We have shown before that disruptions in chunk boundary performance occur when phrasing cues are removed or when scopolamine, a muscarinic cholinergic antagonist, is administered. The present study examined the effects of both manipulations combined. Rats were trained to nosepoke one of two patterns in a circular array: Perfect: 123-234-345-456-567-678-781-812 Violation: 123-234-345-456-567-678-781-818 where digits indicate positions of correct responses, dashes indicate 3-s phrasing cues, intertrial intervals were 1 s, and the last element of the Violation sequence violated pattern structure. After acquisition, phrasing cues were removed concurrently with injections of either scopolamine (0.6 mg/kg) or saline. Scopolamine produced a large deficit in performance relative to saline at chunk boundaries where phrasing cues previously signaled responses, but produced no effect at the violation element. These results indicate that scopolamine dissociated the cognitive systems necessary for performing chunk boundary versus violation element responses. Given that we have already shown that these processes are dissociable from within-chunk rule learning, the results suggest that at least three dissociable cognitive processes are used concurrently in rat sequential learning.

P26

Serial Pattern Learning in Rats: Rule Induction and Pattern Tracking in Patterns Containing 2, 4, or 8 Interleaved Random Elements
Karen E. Doyle & Stephen B. Fountain (Kent State University)
In a serial pattern learning task, rats typically acquire a simple rule-based pattern rapidly whereas presentation of the same simple pattern with interleaved random elements severely retards acquisition. Since previous results have indicated that rats encode rules when learning a serial pattern presented in this manner, it is unclear why introduction of interleaved random elements impairs learning to such an extreme. One possible explanation for this impairment is that random elements increase the difficulty of parsing together related elements from the simple pattern in order to extract the rule. The present study was designed to examine whether performance would improve if more of the simple pattern were presented between interleaved random elements by altering the number and positioning of those elements. Rats learned to perform a simple pattern of responses in a circular array of 8 nosepoke receptacles. The simple pattern was 1-2-3-4-5-6-7-8, where digits indicate the successive clockwise positions of correct responses in the array. Random elements were interleaved after every 1, 2, or 4 elements of the pattern. Acquisition occurred faster when fewer interleaved elements were presented in the same simple pattern, suggesting that interleaved random elements interfered with rule detection.

P27

Rat Basketball as a Class Project for Freshman Laboratory Courses
Alliston K. Reid (Wofford College)
We have developed a semester-long rat basketball project as a way of providing a fun, educational experience to freshman undergraduate students in their first laboratory course in behavior analysis. After rats are trained to play competitive one-on-one basketball, the project culminates in a championship tournament open to the public and the local media. The training process involves about 50 steps, and students learn to identify stimulus control, reinforcement contingencies, shaping, instinctive drift, tool use, and other basic behavioral principles that we want students to understand. Video clips of the tournament will be presented, and we will explain how this project can be implemented inexpensively in other schools.

P28

Sex Differences in Adult Rat Serial Pattern Learning
Laura R. G. Pickens, Kristen L. Kolar, & Stephen B. Fountain (Kent State University)
Several studies have demonstrated that males perform better than females in spatial learning tasks such as the radial and water maze in rats (cf. Williams & Meek, 1991; Jonasson, 2005). Male rats also exhibit greater contextual freezing than females in Pavlovian fear conditioning (Maren et al., 1994). We examined whether similar sex differences would appear in rat serial pattern learning. Male and female Long Evans rats (12 per group) were trained for 49 days on a 24-element serial pattern: 123-234-345-456-567-678-781-818, where digits indicate the clockwise position of correct receptacles within a circular array of an octagonal chamber. Acquisition analyses revealed a sexual dimorphism for chunk boundary and violation element types, with males learning significantly faster than females. We will also discuss trial-by-trial data and provide an analysis of error types to ascertain whether or not male and female rats differ qualitatively in how they encode their serial pattern. One conclusion from these results with perhaps far-reaching implications is that sex differences may be more common in different rat learning paradigms involving complex cognitive processes than has been previously appreciated.

P29

Housing and activity in the laboratory pigeon.
Delgado, M., Curtis, L., Wendel, L., & Cerutti, D. (University of California, East Bay)
We have recently studied the inter-session behavior of seven laboratory pigeons serving in experiments on operant behavior. A previous study found a difference in activity levels in their home cages to that in an aviary with various "enrichment" features such as cubbies and perches. We next measured this behavior in different sized aviaries to determine if there was a linear relationship between activity level and the size of the enriched space. Eating/drinking, grooming, walking (pacing when caged), ambulation and flying (attempting to flap wings when caged) were considered "activities." The percentage of observations where the pigeon displayed activity was calculated for each bird in each condition. A repeated measures ANOVA found a significant difference ($F(4, 24) = 4.096$, $p = .011$) between the activity level in the cages (which ranged from .15 to .65) from that in the aviaries (which ranged from .33 to .71), and that this difference followed a quadratic, not linear, function. There were some individual differences among the birds' patterns of behavior. We anticipate that our findings will be relevant to concerns about appropriate housing for the laboratory pigeon.

P30

Concurrent object learning in rats using a transitive inference paradigm
Diana B. Klimas (Bowling Green State University), Crosby Wilson, Thomas J. Budroe, & Matthew J. Anderson (Saint Joseph's)
Transitive inference is the ability to infer relationships about non adjacent items within a hierarchical list. The subjects are presented a list of objects as pairs, where one object in each pair is reinforced to create a hierarchy (A>B>C>D>E). After training, two objects which have been equally reinforced are paired to form a novel pair (B-D). If the subject chooses B>D, it has demonstrated transitive inference. The current study employed an object recognition based method analogous to procedures used previously in primate studies (Treichler & Van Tilburg, 1996). The specific goals included investigating the

mechanisms rats employ to learn lists of items, testing the rats' ability to demonstrate transitive inference in an object based task, as well as develop unified procedures to test learning across species. Rats were assigned to three groups and taught a list of five, ten, or fifteen items over a 30 day training period. After training, the rats were tested to see if they could infer indirect relationships between items in the list. Although the rats were unable to demonstrate transitive inference, all groups were able to exhibit learning of the pairs, suggesting they did not organize the objects as a list, but as individual pairs.

P31

Rhesus monkeys demonstrate the cognitive capacities necessary for learning dominance hierarchies by transitive inference
Regina Paxton and Robert R. Hampton (Emory University)
The social environments of many primate species are composed of linear dominance hierarchies in which transgressions result in aggression. Therefore, cognitive mechanisms that allow for learning hierarchies rapidly and safely through observation, rather than through many costly social encounters, would be advantageous for these species. One such mechanism may be transitive inference (if A>B and B>C then A>C). Using transitive inference, animals could observe a subset of possible interactions between individuals, then use that information to infer the full dominance hierarchy. If transitive inference in rhesus monkeys has been under selection pressures related to dominance hierarchy learning, then monkeys should 1) learn dominance relationships from observed social interactions, 2) recognize individuals visually, 3) be competent in transitive inference. In Experiment 1 monkeys viewed videos of artificially created dominance interactions. From the videos, monkeys were able to classify seven initially unfamiliar monkeys based on identity and simultaneously select the dominant individual. In Experiment 2 monkeys performed above chance on transitive inference tests and inferred the relationship between pairs of clip-art stimuli that had never been paired before. This work positions us to directly test for transitive inference in dominance hierarchy learning in monkeys.

P32

Environmental and social structuring, affect in the interactions in male vervet monkeys (Cercopithecus aethiops)
April D. Takahashi & Carling Nugent (University of Lethbridge)
The demands of social life are thought to have shaped the size and structure of the brain and the particular way in which monkeys, apes and humans think about the world. While much work has focussed on attempting to identify the kinds of high-level conceptual knowledge that primates hold, an alternative approach is to consider that primate social cognition is geared to producing flexible responses to unpredictable contingencies, and is both 'embodied' as well as 'embedded' in the environment. Using this latter framework, I have investigated the various ways in which male vervet monkeys regulate and control their signalling behaviours during the mating season. Interactions between males from two habituated troops in the Samara Game Reserve, South Africa were video recorded during the mating season (Apr-Jun09). These data were then notated and analyzed to test the hypothesis that male-male interactions fall on a continuum that ranges from expressive emotional responses detectable in movement to the strategic use of emotions to 'negotiate' social interactions in ways that serve an actor's immediate social goals.

Poster Session II - Saturday Evening

P33

Conceptual thresholds for same and different in old and new world monkeys
Timothy Flemming & Michael Beran(Georgia State University)
The judgment of relational information has proven difficult for several nonhuman animal species (e.g. Fagot, Wasserman & Young, 2001; Flemming, Beran & Washburn, 2007) hindering their ability to reason analogically. In the current study, we further examine the extent of this so-called difficulty by presenting old- (Macaca mulatta) and new world monkeys (Cebus apella) with relational discrimination paradigms of varying entropy across trials. 2 of 6 completely naïve capuchin monkeys succeeded at levels significantly above chance on a 2-item (two-choice same/different) discrimination within 500 trials. In experiment 2, we presented rhesus monkeys the same two-choice discrimination task but with the addition of a self-selecting measure of task difficulty at each level of entropy titration (8 to 2 items). At each subsequent level, reward was increased two-fold, raising motivation to maintain the current level of performance. While rhesus monkeys all successfully reached the most difficult level within 2000 trials, fluctuation between trials, specifically between 3-4 and 2-3-item thresholds may suggest a marked difficulty with lower entropy levels, further lending support to the notion of perceptual dependency in concepts for rhesus monkeys not observed to the same degree in capuchins.

P34

Does ontogeny play a role in horses' (Equus ferus caballus) ability to understand human points?
Alicia M. Hall, Nicole R. Dorey, Clive D. L. Wynne, Monique A. R. Udell (University of Florida)
Over a decade of research into the ability of dogs to follow human pointing gestures to locate food has led to controversy on the relative importance of genetic domestication and individual ontogenetic experience in this skill. To further explore the importance of domestication and experience we tested two groups of horses (Equus caballus). Unlike dogs, horses do not usually live in human homes, and the manner of typical human-horse communication is quite different between the two species. This study examines the role of ontogeny by testing horses that has been trained using two different methods: Parelli natural horsemanship and traditional. The results of this study show that horses trained using the Parelli method, which involves more exposure to different human social cues, learned how to follow a momentary distal point significantly faster than those that were trained by traditional methods.

P35

Natural concepts in domestic dogs
1. Erica Feuerbacher & Jesus Rosales-Ruiz (University of North Texas)
The current study investigated concept formation in domestic dogs, specifically that of a toy concept. The dog's differential responding (retrieval vs. non-retrieval) to two sets of stimuli suggested a toy concept. Differential responding occurred from the very first trial, indicating that the concept had been formed in the natural environment, not during the experiment. It was hypothesized that a common response may be responsible for the emergence of the class in the natural environment. The results demonstrated that it was possible to expand the class by adding previously non-retrieved objects to the toy class through a common response. It was also shown that the toy concept passed the more stringent criterion (transfer of function test) required to validate it as a concept.

P36

Same/Different Reversal Learning in Pigeons
Adam M. Goodman, Jeffrey S. Katz (Auburn University), & Anthony A. Wright (University of Texas Medical School at Houston)
Reversal learning is a common procedure for studying discrimination learning, but has yet to be studied in a same/different abstract-concept learning task. In the present study, the ability to learn a same/different task with repeated contingency reversals was assessed in 4 pigeons with extensive experience in a two-item same/different task. Subjects were shown a sample picture (FR 14), then, simultaneously presented below the sample, another picture and a white rectangle. If the two pictures were the same, the correct response was to touch the lower picture. If the two pictures were different, the correct response was to touch the rectangle. Once steady-state performance was obtained, the contingencies were reversed such that if the two pictures were the same, the correct response was to touch the rectangle. If the two pictures were different, the correct response was to touch the lower picture. Upon reaching criterion, a reversal back to the initial contingency was implemented followed by subsequent repeated contingency reversals. The results indicated pigeons can learn same/different reversals and continue to solve the same/different task relationally.

P37

Effects of Set-Size on Abstract Concept Learning in Rats Using Olfactory (N)MTS Procedures
Lucia Lazarowski, Rachel Eure, Mallory Gleason, Adam Goodman, Aly Mack, Alex McLean, Preston Stakias, Aaron Ward, Mark Galizio, & Kate Bruce (University of North Carolina Wilmington)
Match (MTS) and Non-Match-to-sample (NMTS) procedures are used to assess concepts of identity and oddity across species and are measured by transfer

performance to novel stimuli. Number of exemplars used in training (set-size) may affect learning; when set-size was systematically increased, performance on novel tests improved in pigeons (Bodily, 2008). Type of procedure (MTS vs. NMTS) may affect acquisition of conditional discriminations with mixed findings on which procedure is learned faster. We explored the effects of set-size and procedure on concept learning in rats using olfactory stimuli. Rats were trained to either MTS or NMTS with 2 or 10 stimuli, and then tested for concept learning by presenting 10 novel stimuli. No difference was found between MTS and NMTS, but rats trained with 10 stimuli performed better on novel tests than rats trained with 2. When set-size was expanded from 2 to 10 and rats were re-tested with 10 novel stimuli, performance increased demonstrating that training with multiple exemplars facilitates concept learning.

Contextual Equivalence
Jennifer R. Laude, Holly C. Miller, & Thomas R. Zentall (University of Kentucky), Mikael Molet (Université de Lille)

P38

Evidence for functional stimulus equivalence has been found with a transfer of training design using two matching-to-sample tasks. Training a novel association where an emergent relation is demonstrated confirms equivalence. Our current experiments aim to assess whether an emergent relation will form between two sample stimuli that share a common context despite never occurring together. We trained pigeons on two matching to sample tasks. In one task, the two samples, A and B, were each presented in a different context X and Y. In the second task, two different samples, C and D, were each presented in one of the two contexts, C in context X and D in context Y. On test trials, in a neutral context, we presented a sample from one task with the comparisons from the other task. We asked if context, not present on test trials, could serve to mediate an emergent relation between novel combinations of samples and comparison stimuli (A-C, B-D). That is, can context become the basis for an emergent relation and the formation of a functional equivalent class.

Monkeys show recognition, but not priming, in a categorization task
Benjamin M. Basile & Robert R. Hampton (Emory University)

P39

Humans show visual perceptual priming by identifying degraded images faster and more accurately if they have seen the original images before, while simultaneously lacking recognition memory for those same images. Priming is commonly thought, with little evidence, to be widely distributed phylogenetically. Following Brodbeck (1997), we trained rhesus monkeys (Macaca mulatta) to categorize photographs according to content (e.g., birds, fish, flowers, people). In probe trials, we tested whether monkeys were faster or more accurate at categorizing degraded versions of previously seen images (primed) than degraded versions of novel images (unprimed). Monkeys showed good categorization, but no benefit from having seen the images before. This finding was robust across manipulations of image quality (color, grayscale, outlines), type of image degradation (occlusion, blurring), levels of processing, and number of repetitions of the prime. By contrast, in probe trials using a matching paradigm, monkeys recognized the primes, even when the images were degraded. Monkeys could therefore remember the primes and discriminate them from other images in the same category under the same conditions used for categorization. Recognition without priming under the same conditions presents a puzzle.

Ordered list presentation may affect response patterns by an orangutan in an unrestricted report task.
Erin E. Stromberg (Smithsonian's National Zoo), Sharon A. Himmanen (Cedar Crest College), & Karyl B. Swartz (Great Ape Trust)

P40

In a list-learning task, two orangutans developed and used a right-to-left spatial response strategy when reporting items from lists that had been presented randomly on a touch-sensitive video screen. When list items from familiar lists were presented in a constant order, one animal abandoned the spatial response strategy but returned to using the response pattern when those lists were presented in random order (Stromberg, Himmanen & Swartz, CO3, 2007). In the present study we presented novel ordered and unordered lists to determine whether the previous return to the spatial response strategy during unordered presentation was a function of the familiarity of the lists. Two sets of novel lists were presented, one set with ordered presentation and the other with unordered (random) presentation. As before, the orangutan who had abandoned the spatial response strategy in the ordered presentation condition showed evidence of using the spatial response pattern less during ordered presentation than during random presentation. This shift in strategy, shown with familiar and novel lists, contrasts with the persistent use of the right-to-left response strategy by four other orangutans, three of whom had learned only ordered lists.

Memory Monitoring in Rhesus Monkeys (Macaca mulatta)
Victoria L. Templer & Robert R. Hampton (Emory University)

P41

Recently developed metamemory paradigms provide objective behavioral measures of the accessibility of memory in nonhumans. Animals that can monitor their memory should perform better on memory tests if given the choice to decline trials when memory is weak, compared to when there is no option to decline tests. There is growing evidence that rhesus monkeys selectively decline tests when memory is weak (Hampton, 2001; Smith et al., 2003), but such evidence is limited. The goal of the present study was to test the robustness of monkeys' ability to monitor their own memory using a new foraging-like spatial test with a decline-test response. Six rhesus monkeys performed a four choice delayed matching to location task. Monkeys performed significantly better on trials with the decline option available than on trials without it, indicating that they appropriately declined tests when memory was weak. Monkeys transferred appropriate use of the decline-test response under three conditions that assessed generalization: two transfer tests weakened memory and one transfer test enhanced memory. These results provide converging evidence that rhesus monkeys are able to monitor their memory.

Do orangutans know when they do not remember?
Chikako Suda-King & Francys Subiaul (The George Washington University, Smithsonian National Zoological Park)

P42

In a series of studies, we evaluated whether five orangutans escaped spatial and object recognition memory tests when they did not remember. In the study, two grapes were hidden in one of four containers (A, B, C, & D). The apes were allowed to choose one of the containers or an escape response, which resulted in one grape. This procedure was used in two types of trials: difficult and easy. During difficult trials, the ape witnessed the baiting in one of four different containers and after a delay, during which all containers were hidden from view, the subject was allowed to choose one of the four containers. During easy trials, the baiting occurred in front of the subject and the containers never left the sight of the ape. All the orangutans, at the individual level, were significantly more likely to decline difficult trials than easy ones, and they were significantly more successful at selecting the baited container when the escape option was available than when it was not. This result, together with earlier work (Suda-King, 2008), suggests that apes monitor their own attention and the strength of their memories.

Mirror-Induced, Mark-Directed Behavior in the Clark's Nutcracker, But Not the Western Scrub Jay
Kristy Gould, Andrew Hrvol, Karl Gilbertson, Corey Christensen, and Morgan Ames(Luther College)

P43

For many years, it was only thought that great apes could use a mirror to recognize a mark placed on an out-of-sight location on their body. Then two papers reported mirror-induced, mark-directed behaviors in dolphins and elephants. Finally, Prior et al. (2008) demonstrated this behavior in the European magpie. Magpies are members of the corvid family, which includes many species of birds that are good at cognitive tasks. Two examples are the Clark's nutcracker, which has a tremendous spatial memory, and the Western scrub jay, which demonstrates episodic-like memory and future planning. Therefore, we were interested in whether these two species of birds might also show mirror-induced, mark-directed behaviors. We directly replicated Prior et al. with six Clark's nutcrackers and six scrub jays. We found one nutcracker showed significant mark-directed behavior in the presence of a mirror when a colored sticker was placed on the nape of its neck, as compared to control conditions. This is similar to what Prior et al. showed in their study. None of the scrub jays in our study demonstrated this behavior. We plan to investigate if the remaining nutcrackers, given further mirror experience, may also demonstrate the same behavior.

P44

Future anticipation in black-capped chickadees
Miranda C. Feeney, William A. Roberts, & David F. Sherry (University of Western Ontario)

Mental time travel (MTT) entails the ability to recall personally experienced past events and to envision or plan for possible future scenarios. We have previously observed retrospective, what-where-when memory (WWW memory) in black-capped chickadees (Feeney, Roberts, & Sherry, 2009). The current research encompasses two experiments designed to test the prospective, future anticipation abilities of black-capped chickadees. In Experiment 1, modeled after Flaherty & Checke (1982), chickadees exhibited anticipatory contrast between nutritive foods. That is, if access to less preferred sunflower seeds was followed some time into the future by the delivery of favoured mealworms, birds inhibited consumption of sunflower seeds in anticipation of

mealworms. Inhibition of sunflower seed consumption was observed over 5-, 10-, and 30-min delays prior to mealworm delivery. When tested in an aviary under naturalistic foraging conditions (Experiment 2), birds also anticipated future states of food patches based on current choices over a 30-min delay, making choices that ensured the future availability of favoured mealworms. Demonstration of WWW memory (Feeney et al., 2009), and now future anticipation, suggests that black-capped chickadees are capable of a form of MTT into both the past and the future.

P45

Blindfolded imitation in a bottlenose dolphin
Emily Guarino, Kelly Jaakkola, & Mandy Rodriguez (Dolphin Research Center)
This study investigated the ability of a bottlenose dolphin to adapt a previously learned do-as-I-do procedure to copy behaviors of another dolphin while blindfolded (i.e., wearing eyecups). Experiment 1 demonstrated that the dolphin could copy both vocal and motor behaviors, whether blindfolded or sighted. Although he echolocated during many of the motor behaviors while blindfolded, this echolocation did not correlate with the accuracy of his imitation. Experiment 2 showed that blindfolded human trainers were able to identify many of these same model behaviors on the basis of their characteristic sounds. While it thus remains unclear whether the dolphin recognized the motor behaviors via echolocation or their characteristic sounds, this is the first demonstration of such flexibility in using a new perceptual route to motor imitation in a nonhuman animal.

P46

Social learning and diffusion of novel foraging tasks in orangutans (Pongo pymaeus and Pongo abelii)
Marietta Dindo, Tara Stoinski, Francys Subiaul, & Andrew Whiten (The George Washington University and Smithsonian National Zoological Park)
The present study used a diffusion chain paradigm to investigate whether a novel foraging task could be observationally learned by zoo-living orangutans (Pongo pygmaeus x Pongo abelii) and then transmitted along a chain of individuals. Either of two methods(slide or lift) could be used to open the door of a foraging apparatus to retrieve food. One adult male was trained to exclusively slide the door and demonstrate this method to another orangutan in his social group. The observer then had the opportunity to manipulate the apparatus to gain access to food. If the observer was able to open the apparatus twenty times by either method, it then became the demonstrator for a new subject in the group, thus simulating the spread of a foraging tradition among 'generations' of group members. Observers in the slide group [n1=5] were all from the same group, while three smaller groups [n2=6] took part in the lift condition of the study. Since the groups did not always have complete visual access to demonstrations, video-tapes were used to demonstrate the model's actions. The model-seeded technique was successfully transmitted along both experimental chains with consistent preference for the respective method [n1=3, 59/60 slide, two-tailed binomial p<0.0001; n2=5; 100/100 lift; two-tailed binomial p<0.0001]. These results are consistent with claims for social transmission of foraging methods in wild orangutans.

P47

Orientation in Trapezoid-Shaped Enclosures: Determination of Geometric Features Controlling Spatial Choice
Taylor Gurley, Connie Clements (Georgia Southern University), Bradley R. Sturz (Armstrong Atlantic State University), & Kent D. Bodily (Georgia Southern University)
Human participants learned to select one of four distinctively marked corners (i.e., red, yellow, blue and green) in a rectangular virtual enclosure. After training, test trials were interspersed with training trials. On test trials, all markers were equivalent in color (i.e., white), and the geometric structure of the enclosure was manipulated. For each test trial, a single long wall or short wall of the enclosure increased twice as long or half as long as the training enclosure. These manipulations produced eight unique trapezoid-shaped enclosures and one rectangular enclosure (i.e., control). Participants were allowed to select only one corner during test trials. Selected corners during test trials revealed which geometric features of the enclosures were controlling choice behavior. For example, participants may have learned to approach 90° angles, a long-wall to the left or right, a short-wall to the left or right, a ratio of long-to-short walls, or some combination of these geometric features. Results and theoretical implications will be discussed.

P48

Encoding of variability of landmark-based spatial information
S. Paul Cooke, Stephanie M. Diemer, Caroline K. Eastman, Martha R. Forloines, Rebecca A. Hattaway, Sebastian N. Krzywanski, (Armstrong Atlantic State University), Kent D. Bodily (Georgia Southern University), & Bradley R. Sturz (Armstrong Atlantic State University)
In a three-dimensional virtual-environment open-field search task, we provide evidence that human participants encoded the variability of landmark-based spatial information. Specifically, participants searched for a hidden goal location in a 5 x 5 matrix of raised bins. Participants experienced five training phases in which they searched for a hidden goal that maintained a unique spatial relationship to each of four distinct landmarks. Each landmark was assigned an a priori value of locational uncertainty such that each varied in its ability to predict a goal (i.e, varied in number of potential goal locations). Following training, participants experienced conflict trials in which two distinct landmarks were presented simultaneously. Participants preferentially responded to the landmark with the lower uncertainty value (i.e., smaller number of potential goal locations). Results provide empirical evidence for the encoding of variability of landmark-based spatial information and have implications for theoretical accounts of spatial learning.

P49

Discrimination of Hidden Spatial Structures by Pigeons
Allison A. Cook (Clark School) & Robert G. Cook (Tufts University)
Three pigeons learned to discriminate invisible spatial structures in a fixed area of a computer monitor. The procedure used a go/no-go discrimination in which a variably located dot was moved around from trial-to-trial in the fixed area. The pigeons learned to discriminate the regularities in simple hidden structures, such as when only the locations on the left half of the screen were reinforced. Different possible accounts of their performance are considered.

P50

A novel assessment of object permanence in orangutans
Suma Mallavarapu (Kennesaw State University), Bonnie M. Perdue (Georgia Institute of Technology), Tara S. Stoinski (Zoo Atlanta), & Terry L. Maple (Georgia Institute of Technology, Palm Beach Zoo)
Object permanence (OP) is the understanding that objects continue to exist even when not perceived. Many species tested so far have failed one of the tasks in the standard OP test battery, namely, the non-adjacent double invisible displacement (DID). It has been hypothesized that this failure is because of an inability to inhibit sequential search when boxes are close together, and that performance might improve if boxes are far enough apart to require subjects moving around when making choices. The present study compared performance of orangutans (a species which has failed the non-adjacent DID in previous studies) on standard OP tasks and on tasks conducted in a large-scale locomotive space. As in previous studies, orangutans passed all standard OP tasks, except the non-adjacent DID. Testing in locomotive space did not improve performance on this task. Previous researchers have controlled for the possibility that subjects could be solving OP tasks by using certain simple search strategies, without a true understanding of object permanence. While the present study also controlled for these strategies, we found that an additional step in data analysis is required, before all possible strategies can be ruled out. This finding warrants a re-evaluation of previous studies of OP.

P51

Does Travel Time Affect Cognitive Maps?
Mary Carol Way, Steven Smith, & Kent D. Bodily (Georgia Southern University)
The present experiment tested novel shortcutting in a desktop-virtual environment Y-maze. Ps were trained to carry colored flags (Red, Blue) from the start room (Yellow) to the corresponding end room (Red, Blue). On test trials, Ps began in any of the three end rooms with a flag color which matched one of the other two end rooms. The training alleys were closed, and 15 novel alleys were available. The novel alleys radiated from the end room in a sunburst fashion, and which alley Ps chose was of interest. Additionally, Ps were assigned to one of three training groups: Control, Red Fast, and Red Slow. The movement speed for the Control group was constant. However, the movement speed for Red Fast was 150% faster than Control when approaching the Red end room, and the movement speed for Red Slow was 50% as fast as Control when approaching the Red end room. How movement speed affects novel alley choice suggests how travel time affects spatial representation. Results will be discussed.

P52

Landmarks Exert Greater Control Over Human Navigation Than Dead Reckoning
T. Alexander Daniel & Kent D. Bodily (Georgia Southern University)

Foo et al. (2007) suggested that humans rely on external landmarks (i.e., piloting) rather than an internal sense of direction (i.e., dead reckoning) when the two are put into conflict. In the present study, conducted in a desktop virtual environment, participants navigated from the center of a landmark cluster to a marker (8m), then rotated (105 deg) and navigated to a second marker (8m). All participants then navigated to where they estimated the start of the path to be. However, the cluster of landmarks that was centered on the starting point at the beginning of the path changed location to the left, right, forward, backward, or was absent when participants made their return estimates. Half of the participants were informed that the landmarks may change location and the other half were not informed. The results indicated that when the landmarks were not available, participants could accurately return to the start. However, when the landmarks were available, participants approached them even though they had changed location. That is, similar to what has been found in pigeons (Sutton & Shettleworth, 2005) and hamsters (Etienne et al., 2004), when landmark information conflicted with dead reckoning, landmarks were preferred.

P53

Capuchin monkeys (Cebus apella) Choose Efficient Routes Using a Laser Pointer Apparatus
Allison Eury (University of Georgia)
Choosing an efficient path through a series of goal sites is a problem with survival implications for nonhuman primates. In a laboratory setting, tufted capuchin monkeys (Cebus apella) were presented with a traveling salesman problem consisting of two goal sites. A laser pointer apparatus allowed stationary subjects to choose goal sites in sequence by manipulating a joystick controlling a laser dot. As the subjects are stationary, the perspective of the animal does not change with each subsequent choice. Distance ratios (i.e., 1:1, 1:2, 1:3, and 1:4) between the laser dot and the goal sites resulted in two potential path choices: efficient and inefficient. When both goal sites were equidistant from the subject, capuchin monkeys were capable of making efficient path choices at all distance ratios. The ability to make efficient choices when goal sites vary in their distance from the subject itself is discussed. The ability to make efficient route choices without a change in the perspective of the subject itself is essential to planning a future route.

P54

Pigeons' learning of target-related spatial cues in a high-resolution satellite map
Tomokazu Ushitani, Koki Makino, & Masako Jitsumori (Chiba University)
We trained pigeons in a simulated navigation task using a high-resolution satellite map presented on a computer monitor. The task was to move the target (a building on the map) to the goal (a circle superimposed on the center of the display). At the beginning of each trial, a section of the map was presented in the display, and the target was located to either the left or right of the goal. Whenever the pigeons pecked at the left half of the goal, the map scrolled to the left, and whenever they pecked at the right half of the goal, the map scrolled to the right. The pigeons were rewarded when the target reached the goal. When the error responses moved the target outside of the display for a specified time, an intertrial interval immediately followed. In a subsequent testing, the pigeons were able to move the target to the goal from its initial position outside of the display. These results suggest that the pigeons learned to use not only the target itself but also other target-related cues on the map.

P55

Concrete Order 8 organizes two or more binary actions
Michael Commons (Harvard Medical School)
Concrete Order 8 actions organize Primary Order 7 actions. The stage of performance of an action is determined based on the hierarchical complexity of the task being addressed. This paper illustrates how Concrete Order actions coordinate actions from the Primary order. For example, de Waal and Lanting (1997) describe the captive Bonobo chimpanzee Kanzi making stone flakes by throwing a rock against a hard surface, producing many flakes at once. First Kanzi made simple flake tools, a Primary Stage 7 action. Then, Kanzi tested each flake with his lips, rejecting non-sharp ones, another Primary Stage 7 action and finally used the sharp stone flakes. Thus Kanzi organized three Primary Stage 5 actions into a Concrete Stage 8 action. De Waal (1996) describes how a beta male chimpanzee broke up conflicts in an impartial manner. To act "impartially", the beta male considered the perspectives of the other chimps along with his own perspective. Whereas his awareness of each of these perspectives is a primary stage action, his ability to integrate all of these perspectives together was Concrete Stage 8 action.

P56

Primary Stage 7 performances in animals
Patrice Miller (Salem State College)
Primary Order 7 actions organize Preoperational Order 6 actions. The stage of performance of an action is based on the hierarchical complexity of the task being addressed. This paper illustrates the difference between these two orders using examples from some non-human animals and school aged children. Primary Order 7 actions may organize counts of organized objects from the Preoperational Order 6 tasks and apply them to very large numbers of random objects. Washburn and Rumbaugh (1991) trained Rhesus monkeys to select Arabic numerals associated with a number of food pellets. They reliably chose the numeral associated with the larger number of food pellets in a random array of up to 5 numerals. Rumbaugh, Hopkins, et al (1989) showed an adult female chimpanzee removing from a TV display the number of boxes appropriate to the value of a randomly selected Arabic numeral, 1, 2 or 3. Children count 100's of objects.

P57

Why the Abstract Order may not be reached in non-human animals and how it makes higher stage performances possible in humans
Lucas Commons-Miller (Dare Institute) & Michael Commons (Harvard Medical School)
In the Model of Hierarchical Complexity, Abstract Order 9 actions organize Concrete Order 8 actions. At the Concrete Order, actions consist of a small number of specific instances, such as making a particular gesture to close a deal. At the abstract order, actions consist of large or indefinite sized-sets of instances, often referred to as variables when ordered. For example, at the Concrete Order, one might have a hunting party of individuals who know each other. At the Abstract Order, a larger "war or hunting unit" may use symbolic representations to denote group membership. To do this, one must have arbitrary words, symbols or pictures to represent large sets. Language is the means most often used. Language with arbitrary words is acquired at the Nominal Order 4. This makes designations at Abstract Order 9 possible. Many animals successfully complete tasks at Nominal Order 4, not because they have language, per se, but they have some analogous mechanism. This analogous, representational mechanism lacks some key characteristics of language. In particular, language is more likely to become decontextualized and so is more likely to serve as a symbol as development proceeds, as will be shown in a number of examples.

P58

The potential relationship between personality and success on training and problem-solving tasks
Brooke Alexander, Erin Mahoney, Jessica Boucher, Elizabeth Flores, Sarah Nadler (Eckerd College), Monica Mogilewsky (Myakka City Lemur Reserve) Stan Kuczaj (University of Southern Mississippi), & Lauren Highfill (Eckerd College)
The study of animal personality has blossomed over the past few decades, and the possibility that individual animals exhibit distinct personality traits has been explored in a number of species. However, there is little research on the extent to which different personality traits covary with differences in cognitive abilities. This study used ethological coding and behavioral tests to assess the relationship between lemur behavior and personality traits. Behaviors of interest included level of activity, solitary and social tendencies, curiosity, and perseverance. Learning rates on a target training task and success rates on a problem-solving task were also measured. Preliminary data indicate that certain personality traits, such as curiosity, may be related to learning rates and problem-solving capabilities in lemurs.

P59

Multiple-pair transposition based on relative speed of rotation
Gwendolyn Carlson, 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. We will also explore whether relational disparity (i.e., the dissimilarity of the two testing stimuli) and novelty (i.e., Euclidean distance from the testing pair to the training pair) will affect relational responding as it was reported earlier.

P60

Differential stimulus control during acquisition, generalization, and discrimination in "Target-Training" of individual group-housed capuchin monkeys (C. Apella)
Lillian Basom, Caitlin Knierim, & Roger Thompson (Franklin & Marshall College)
Target-Training has become a popular application of conditioning procedures to facilitate 'voluntary cooperation' by captive animals in the conduct of husbandry practices and veterinary examinations by bringing their behavior under auditory or visual stimulus control. Target training was used here to control movement of individual capuchin monkeys (C. apella) to and from their group-housing enclosure to adjacent test chambers by rewarding them for approaching, following and touching their respective physical colored geometric target. In a simultaneous discrimination task paired individuals attempted to touch the other animal's target as often as their own suggesting that their behavior was not controlled by their target's specific features. However, when tested individually animals accurately discriminated their specific target from that of others and subsequently also with a novel stimulus set consisting of all possible shape/color combinations. The animals' above chance (>80%) performances transferred to differently sized targets presented physically behind mesh or glass or digitally on a touch-screen. The few errors that occurred were made to stimuli with neither shape nor color overlap with an individual's target revealing temporary preferences for stimulus novelty and, in rare cases, individual preferences for specific shapes &/or colors.

P61

Interval Timing Behavior in Response to Stimulus Compounds as a Function of Reinforcement Probability
Allison Kurti & Matthew Matell (Villanova University)
Previous studies investigating stimulus compounding on the peak-interval procedure have reported that scalar responding at the geometric mean of the anchor durations occurs on simultaneous compound trials (light+tone) in rats trained that an auditory stimulus (tone) signals a short duration, while a visual stimulus (houselight) signals a long duration. However, in the reverse training condition, rats respond in a non-scalar rightward skewed manner that began at the short duration, and ended at a time in-between the short and long peaks. In the present study, rats were initially trained on a two duration peak-interval (PI) procedure in which a tone signaled a short duration (4s) and the houselight signaled a long duration (12s). We provided reinforcement on 50% of short tone trials, and on 25%, 50%, or 75% of long light trials. In contrast to previous results, both scalar and non-scalar response patterns were seen on compound trials. However, the frequency of the non-scalar pattern was an inverse function of the reinforcement probability for the long trial. These findings suggest that reinforcement value influences the selection of memories for initiating and terminating temporally controlled responding.

P62

Associative learning in newborn babies
Paul Craddock & Mikael Molet (University of Lille North of France)
Associative learning is a determinant factor in adaptation to the environment in which we have to live and therefore should start very early in life. In order to test the ability of newborn babies to learn the association between two events in their environment, 32 two-day-old participants were exposed to eight repeated associations of a short sound immediately followed by a significant modification of brightness in the experimental room. Sucking was recorded through a non nutritive nipple connected to a pressure detector. The sound followed by the visual stimulus always occurred at the beginning of a sucking burst. Their first reaction to the visual event was a clear interruption of sucking though this response very rapidly habituated. Most interestingly, the same response occurred when the second event was "omitted" after only eight presentations of the association hence showing the ability of very young humans to learn, in only a few trials, to predict an expected outcome. These results are discussed in terms of how babies learn to adapt themselves to the new environment they have to learn.