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C03 - 2009 Program Summary

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.

Wednesday Evening

6:50 PM **Opening Remarks - Marcia Spetch**

7:00 PM **Spatial Cognition** (Chair - Marcia Spetch)

7:00 PM Jerome Cohen, Marium Arain, and Caitlin Siu (University of Windsor)
Rats' Search Patterns in the Eight-Arm Radial Water Maze

1 We examined rats' search patterns in an eight-arm water maze as a function of the stability of the within-maze distal (end-of-arm) cue configurations. Rats learned to swim to a submerged platform signalled by the same distal (safety) beacon from among five distally cued arms in each four-trial session in the first series of experiments and to a different distal safety beacon over different sessions in the second series. During each series, the location of the safety beacon with respect external visual and acoustic room stimuli sometimes remained constant and sometimes was rotated over trials within a session. We co-varied configuration stability with this safety beacon location factor by exposing rats sometimes to the same configuration and sometimes to a different configuration over the trials within a session. How easily rats found the safety beacon and their search patterns as a function of these two factors allowed us to determine how they use extra-maze and intra-maze distal cues.

7:14 PM Bradley R. Sturz (Armstrong Atlantic State University), Debbie M. Kelly (University of Saskatchewan), and Michael F. Brown (Villanova University)
Facilitation of Learning Spatial Relations Among Goal Locations Does Not Require Visual Exposure to the Configuration of Goal Locations

2 Human participants searched in a virtual-environment open-field search task for four hidden goal locations arranged in a diamond configuration located in a 5 x 5 matrix. Participants were randomly assigned to one of three groups: Pattern Only, Landmark + Pattern, or Cues + Pattern. All participants experienced a Training phase followed by a Testing phase. During Training, visual cues were coincident with goal locations for the Cues + Pattern group, and a single visual cue at a non-goal location maintained a consistent spatial relationship with the goal locations for the Landmark + Pattern group. All groups were then tested in the absence of visual cues. Presence of the visual cue(s) during Training facilitated acquisition of the task, but the Landmark + Pattern group and the Cues + Pattern group did not differ when their visual cues were removed during Testing and performed superior to the Pattern Only group. Results suggest learning based upon the spatial relations among locations may not be susceptible to cue-competition effects and facilitation of learning spatial relations by visual cues does not require visual exposure to the configuration of goal locations.

7:28 PM Christine Muller (University of Nebraska--Lincoln)
Functional deception in pinyon jays

3 Highly social food-storing birds must protect their caches from conspecific theft. In this cache-recovery experiment, we allowed pinyon jays (Gymnorhinus cyanocephalus) to cache food by themselves or with a conspecific present. Individuals engaged in several types of functionally deceptive behaviors, including false caching and re-caching seeds. These behaviors were highly consistent within individuals regardless of treatment, but varied between birds, indicating that personality may play a role in cache management. In a second experiment, pilferers were able to successfully recover another's caches via observational memory, but were less accurate than cachers recovering their own caches, demonstrating that memory for another's caches is less accurate than memory for one's own. Pilferers preferentially probed in false-cache sites over non-cache sites, and an increase in false-caching rate caused a decrease in pilferage accuracy. These findings reveal that false-caching functionally deceives pilferers.

7:35 PM Valeria Zamisch & Jennifer Vonk (The University of Southern Mississippi)
Spatial Memory in the American Black Bear (Ursus americanus)

4 Remembering the location of ephemeral and patchily distributed resources is adaptive for American black bears, a species that must ingest large amounts of high quality foods in order to survive hibernation. We investigated the spatial memory and foraging strategies of four captive black bears. During the exploration phase four out of eight landmarks were baited with a preferred food and subjects were released individually and allowed to search for the food. After a four-hour retention interval, the same locations were re-baited and subjects were released again and allowed to relocate the baits. It is predicted that subjects will remember which sites were baited during the exploration phase and will organize their search efficiently, minimizing the total distance traveled. A second experiment will determine whether foraging with a competitor influences search patterns.

7:42 PM Eric L. G. Legge, Marcia L. Spetch, Katherine J. Talbot, & Vadim Bulitko (University of Alberta)
Hiding and Searching Strategies of Adult Humans in a Virtual and a Real-Space Room

5 Adults searched for or cached three objects in nine hiding locations in a virtual room or a real space room. In both rooms, the locations selected by participants differed systematically between searching and hiding. Specifically, participants moved farther from origin and dispersed their choices more when hiding objects than when searching for hidden objects. In addition, in both virtual and real-space rooms, prior experience in the hiding task increased the distance participants traveled from origin and the dispersion of their choices during searching. Overall, the results suggest that strategies used by adult humans for searching and caching are consistent with those seen in non-human animals and children.

6 7:49 PM W. David Stahlman & Aaron P. Blaisdell (UCLA)
The Effect of Reward Probability on Foraging Variability

Recent operant research has demonstrated a strong negative relationship between expected reward probability and response variability. An animal will typically increase the level of variability in its actions with decreasing probability of reward. We investigated the relationship between reward probability and behavioral variability in a more ecologically valid context – an open field. We trained rats to search for a food reward in the presence of two landmarks on separate trials. One landmark was associated with a 100% probability of food availability, while the other was associated with a 20% chance of food. We found that certain measures of variability increased with reduced expectation. This study provides evidence for the connection between reward expectation and variability in a new experimental context, and demonstrates a possible adaptive reason for the relationship.

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8:01 PM **Canine Cognition I** (Chair - Clive Wynne)

8:01 PM Clive D. L. Wynne, Monique A. R. Udell & Nicole R. Dorey (University of Florida)
Can Canids Read Human Minds? The Implications of Seeing Sight
We present data from domestic dogs (Canis familiaris – both human-home and shelter-living individuals) and captive human-raised wolves (Canis lupus) given a choice of two people to beg from. In each condition one person could clearly see the canid and the other had her vision obscured. The visual occluders were Backturned; Bucket on head; Book over face; or Camera in front of face. All groups of canids preferentially approached a person looking at them rather than a human with her backturned. Only dogs living in human homes showed any sensitivity to a book over the face or bucket over the head. No canid group was sensitive to a camera as visual occluder. These results suggest that the circumstances of a canid's daily life, rather than its status as domesticated or wild-type, are critical in its success in reading human intentions as revealed by human gaze.

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8:15 PM Nicole R. Dorey, Monique A.R. Udell & Clive D.L. Wynne (University of Florida)
Effect of Ontogeny: When do puppies start to understand human points?
The current study is a replication of Reidel et al., 2007, in which puppies between the ages of six and 24 weeks were tested for their ability to follow human pointing gestures to find hidden food. In our study we placed two sham baited cups on either side of a kneeling experimenter. Once the experimenter had the puppy's attention, she pointed to one of the cups. Preliminary data show that puppies not given explicit training do not follow human points until the age of 20 wks. These findings contradict the Riedel et al.'s (2007) claim of spontaneous point following in pups as young as eight weeks.

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8:29 PM Mark Petter, Evanya Musolino, William A. Roberts, & Mark Cole (University of Western Ontario)
Can Dogs Detect Human Deception?
Dogs were tested for sensitivity to human deception in a paradigm based on the Woodruff and Premack (1979) experiments with chimpanzees. Dogs could choose between two containers, one of which contained food. On separate trials, a human cooperator cued the baited container or a human deceiver cued the empty container. Dogs learned to regularly approach the container cued by the cooperator but often chose the alternate (baited)container or refused to make a choice when cued by the deceiver. Two alternative accounts of these findings are discussed: Theory of mind versus associative learning.

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8:43 PM John W. Pilley & Alliston K. Reid (Wofford College)
Border Collie Demonstrates Referential Understanding of Words
Three experiments investigated the ability of a dog to acquire the referential understanding of words, which requires learning that words refer to things and that people give verbal cues about the referents of their words. Experiment 1 demonstrated that Chaser, a 4-year-old border collie, learned over 1000 proper nouns, 25 common nouns, 70 verbs, 12 adverbs, and 10 prepositions. Chaser's behaviors indicated that words were semantic, and Chaser demonstrated understanding of combinatorial wording in phrases – responding correctly to combinations of words that she had never experienced. Experiment 2 demonstrated word-world mapping in a single trial with associative learning procedures. Experiment 3 demonstrated that Chaser could map names upon objects by exclusive learning, inferring the referent of a novel word in the absence of an external or physical cue. Thus, some of the procedures for teaching young children the referential understanding of words also work for border collies.

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8:50 PM Monique A. R. Udell, Nicole R. Dorey & Clive D. L. Wynne (University of Florida)
Canid sensitivity to human points: A test of the domestication hypothesis
The domestic dog's (Canis familiaris) sensitivity to human gestures, such as pointing, is widely documented. The past failure of wolves (Canis lupus) on this same task has led to the proposal that the ability to understand others' intentions is a derived character in dogs, not present in the ancestral population (wolves). We demonstrate that highly socialized wolves can use a human point to identify target objects without explicit training and that some dogs do not follow human points. Our findings indicate that domestication is not a prerequisite for human-like social cognition in canids, and demonstrate the need for additional research on the role of rearing conditions and environmental factors in the development of higher-level cognitive abilities.

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8:57 PM Kirsti Rinkus & Lucas Alexander Haley Commons-Miller (University of California at Irvine)
Dogs Attain Sentential Stage 5
This paper illustrates that dogs can perform at the sentential stage. The name "sentential" stage is used because this is when children differentiate the order of words in an utterance, i.e. sentences. They follow commands that reflect the order of the commands. Karen Pryor, who does clicker training with dogs, reports that with training, dogs differentiate between two or three word commands that depend on the order of words within them. For example, dogs correctly execute either: Sit - lie down - stay; or Lie down-sit-stay. They also can lie down-roll over, sit; and sit, lie down and roll over. This places dogs among crows and parrots as animals who act at the sentential stage

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9:09 PM **Communication, Auditory Discrimination, and Social Learning** (Chair - Bill Roberts)

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9:09 PM Ronald Weisman (Queens University), Laurie Bloomfield, Marisa Hoeschele, Michele Moscicki, and Christopher Sturdy (University of Alberta)
The phylogeny of absolute pitch: An exception that tests the rule.
Our research group has shown that mammals and birds have quantitatively different absolute pitch (AP) abilities. One test is a frequency-range discrimination in which animals sort 40 tones into 8 ranges based on pitch similarity. Humans and rats are mediocre at the task but several species of birds are expert. This corresponds to their use of AP in nature. Here we report that in a frequency-range test of AP, black-capped chickadees were expert but boreal chickadees much less accurate. Both species tracked repeated reversals in reinforcement contingency over frequency ranges, which is what sets avian AP apart from mammalian AP. Boreal chickadees, however, were less skilled at tracking reversals and failed completely at frequencies over 4000 Hz. This suggests a deficit in hearing not in AP. Thus, the rule that phylogeny determines the accuracy of AP holds against this apparent exception.

9:16 PM Julie J. Gros-Louis (University of Iowa)
Comparative social function of vocalizations in nonhuman primates and prelinguistic infants
Traditional comparisons of nonhuman primate vocalizations and human language focus on “semantic” properties of calls, such as the meaning and underlying representation of alarm calls. However, the majority of vocalizations in nonhuman primates are not alarm calls, but intragroup calls produced in close-range, dyadic interactions. These calls have been shown to mediate social interactions, such as facilitating reconciliation and affiliation. I describe results of a recent study of food-associated calls in capuchin monkeys combining naturalistic and experimental observations that reveal that even this traditionally “semantic” call influences social interactions involving the signaler. I further report results of studies of prelinguistic vocalizations in human infants that reveal parallel social functions of vocalizations, such as facilitating social interactions involving objects. Results
14 suggest that potentially fruitful comparisons for exploring language origins may be in the social function of vocalizations, rather than “semantics,” focusing on the prelinguistic period when vocalizations lack semantic content.

9:30 PM Elise Nowbahari, Alexandra Scohier, Jean-Luc Durand (UMR CNRS 7153, Université Paris Nord, France), & Karen L. Hollis (Mount Holyoke College)
Rescue behavior in Cataglyphis cursor ants
Although many animals can identify their relatives and deliver altruistic behavior in their favor, rare are the studies reporting the behavior of saving or securing a nestmate in distress. Here we show, for the first time, that a desert ant, Cataglyphis cursor, attempts to secure only their relatives that become entrapped and buried under the sands, not the other individuals in the same distress conditions. Furthermore, using a novel experimental technique to bind victims, we show that entrapped nestmates can elicit a broad range of precise rescue behaviors. That is in addition to digging and limb-pulling behavior they also excavate the debris, transporting it to a safe distance. Finally they attempt to extricate victims by biting and tugging at the snare used
15 to bind the victims. Thus the ants engage in highly precise object-directed behavior to free their entrapped relatives.

9:44 PM Marisa Hoeschele, Lauren M. Guillette, Tara M. Farrell, & Chris B. Sturdy (University of Alberta)
Biologically relevant stimuli and operant discriminations in black-capped and mountain chickadees
Black-capped chickadee fee bee songs are characterized by a reliable relative frequency interval between the songs’ two tonal notes. We tested if birds’ GO/NOGO operant discrimination performance varied according to whether S+s and S-s, modeled after the song, contained a biologically relevant (BR) interval or not (BR). We trained birds on three different discriminations: (1) BR S+ and BR S- (2) BR S+ and BR S- (3) BR S+ and BR S-. Our findings suggest that female black-capped chickadees outperform male black-capped chickadees and mountain chickadees of both sexes in the BR S+
16 group but were hindered in the BR S- group. Thus, perhaps females attend to, and are influenced by, the BR interval, as black-capped males’ ability to accurately and reliably produce this interval in the wild is an indicator of male quality.

9:51 PM Carl Hagmann & Robert Cook (Tufts University)
Rhythmic auditory grouping in pigeons
Auditory grouping is a fundamental property of the processing and production of language and music. Some theorists believe that the ability to perceptually group sounds is limited to humans. Four pigeons were trained to discriminate three- or eight-element rhythmic beats created with a drum machine using two different timbres. Transfer tests suggested that timing, counting, and grouping controlled behavior depending on the individual bird.
17 Results and comparative implications for perceptual grouping are discussed.

9:58 PM Lauren M. Guillette, Adam R. Reddon, Peter L. Hurd & Christopher B. Sturdy (University of Alberta)
Bold birds learn faster: Exploration style and learning speed are related
Personality, behavioural differences between individuals consistent across time and context, has been demonstrated in a diverse array of animal species. Understanding the evolutionary antecedents and ecological consequences of this individual variation is an active research area within animal behaviour. Here we investigate whether different exploration styles exhibited by black-capped chickadees in a novel environment are related to how quickly these birds learn an acoustic discrimination task. We find that birds with a bold exploration style learn an acoustic discrimination task faster than shy birds.
18 This result is contrary to previous work in great tits suggesting no correlation between exploration style and learning. We suggest that our results are potentially due to the greater cognitive complexity of our task.

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Thursday Afternoon

18 12:00 PM

Category and Concept Learning I (Chair - Olga Lazareva)

12:00 PM Kristy Lindemann-Biolsi (St. Francis College & UC Santa Cruz), Colleen Reichmuth, & Ronald J. Schusterman (UC Santa Cruz)
A test for cross-modal symmetry in a California sea lion
The present experiment explored the emergence of cross-modal symmetry with an experimentally experienced California sea lion named Rio. Rio had previously demonstrated cross-modal transitivity using auditory samples with visual comparisons in a traditional two alternative matching-to-sample (MTS) paradigm. In the current experiment two phases were used to instruct Rio on a variant of her usual MTS procedure. She was trained to go to the comparison that matched the sample or go to the opposite side when there was no match. First, Rio was tested and then trained with this procedure using previously established visual-visual discriminations. Next, she was tested and trained in the same procedure with the previously established auditory-visual discriminations. Finally, Rio was presented with symmetry trials which required her to match an auditory comparison, to a visual
19 sample, the reverse of her previous matching experience. Her performance on the first exposure of the novel symmetry trial combinations was significantly better than predicted by chance (75% correct, 117/160 trials), but did not remain stable during successive presentations.

12:14 PM Anna Wilkinson, Hanna Specht & Ludwig Huber (University of Vienna)
The Concept of Familiarity in the Pigeon (Columba livia)
Pigeons were asked to categorize photographs on the basis of familiarity using a two-choice touch screen procedure. Two groups of birds were presented with photographs of conspecifics. For the experimental group half of the pictures were of familiar pigeons with whom they shared an aviary, the other half were of unfamiliar pigeons who they had never seen. The control group were unfamiliar to both sets of birds. The pigeons mastered the task, and tests revealed that most could generalize to novel views of the training stimuli. A second, critical, test presented photographs of pigeons that had not been used as training stimuli. Two were aviary-mates of the experimental group and two were unfamiliar. Two of the five experimental birds
20 were able to classify these stimuli correctly whereas the control group could not. Thus pigeons possess the ability to categorize on the basis of familiarity.

12:28 PM Catriona M. E. Ryan, Stephen E. G. Lea, & Elizabeth Nicholls (University of Exeter)
Discriminating multi-dimensional categories: Do pigeons use single features or family resemblances?
Pigeons were trained to discriminate between photographs of houses and cars in which the roofs and windows respectively had been manipulated to produce a highly salient artificial feature. Only one of 11 pigeons appeared to discriminate solely on the basis of the manipulated feature: car-positive birds tended to rely on the manipulated feature plus some other feature(s) of the stimuli while house-positive birds tended to rely on family resemblances. In a second experiment, we used four-dimensional artificial stimuli, in which one dimension (varied between birds) was 100% predictive of reinforcement while the other three predicted correctly in 75% of trials. Supporting the results of the first experiment, only five of 16 pigeons were
21 controlled only by the reliable dimension: most birds were controlled by a combination of features.

12:42 PM Stephen E. G. Lea, Andy J. Wills, Lisa A. Leaver & others (University of Exeter)
Unidimensional vs Overall Similarity discrimination of multi-dimensional stimuli by pigeons, gray squirrels and undergraduates
Squirrels, pigeons and students learned go/no-go discriminations using multiple simultaneous presentations of stimuli composed of three spatially integrated, highly salient dimensions. In training, all three dimensions predicted reinforcement perfectly. In tests, the stimulus included anomalous dimension values so the dimensions were in conflict. Most subjects of all three species categorized test stimuli including anomalous dimension values unidimensionally rather than by overall similarity to the training stimuli. We conclude that unidimensional categorization of multidimensional stimuli is not diagnostic for a uniquely human kind of analytic cognitive processing, and that differences in behavior between humans and pigeons in such
22 tasks are not due to special features of avian visual cognition.

12:56 PM Stephanie Jett (University of South Alabama), Valeria Zamisch, and Jennifer Vonk (The University of Southern Mississippi)
Natural Concept Discrimination at Varying Levels of Abstraction in Two Chimpanzees (Pan troglodytes)
Two adult male chimpanzees were tested at five different levels of abstraction using a two-choice concept discrimination paradigm on a touch screen monitor. The five levels were as follows: concrete level – images of chimpanzees versus humans; concrete/intermediate level - orangutans versus other apes; intermediate level - carnivores versus hoofstock; intermediate/abstract level - primates versus non-primate animals; abstract level - animals versus non-animals. One subjects' acquisition and performance with transfer stimuli varied according to the level of abstraction and experience with the particular discrimination, while the other subject performed more randomly. Thus, there is some evidence that more abstract discriminations were
23 more difficult to acquire.

1:03 PM Matthew S. Murphy (Tufts University), J. David Smith (State University at Buffalo), F. Gregory Ashby , Brian J. Spiering (University of California, Santa Barbara), Robert G. Cook (Tufts University)
An Evaluation of Multiple Learning Systems in Pigeons (Columba livia)
Evidence from multidimensional discriminations have suggested that humans may use different cognitive systems for learning different types of categorizations. Rule-based discriminations may involve explicit verbal declarative learning and memory systems, whereas more complex categories that have no simple verbal description may involve only implicit procedural memory. To see if this theoretical division could be applied to pigeons, we tested birds with unidimensional discriminations (angle; spatial frequency) and an information-integrative discrimination that measure this proposed
24 difference in humans. Unlike humans tested with the exact same stimuli, the pigeons show no learning difference between these two types of discriminations. The results suggest that pigeons may only possess a procedural learning system. Comparative implications are considered.

25 1:10 PM Alex Kacelnik & Justine Aw (University of Oxford)
Further test of the Sequential Choice Model: The Time Left Procedure
The Sequential Choice Model states that foraging choices occur without a direct cognitive comparison at the time of choice. Instead, subjects assign a state-dependent subjective value to each alternative in their environment and this generates a latency to accept it. When options are encountered sequentially, the greater an option's latency, the higher the probability of rejecting it in favour of pursuing stochastic background opportunities. When

facing two or more simultaneous options, choice occurs by temporal cross-censorship: the shorter latency constitutes a choice. Thus, contrary to alternative models, preferences are not constructed at the time of choice, and latency to choose is shorter than latency to accept a single option. We offer further evidence supporting this model using the Time-Left procedure in starlings.

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1:29 PM **Change Detection and Discrimination Learning** (Chair - Kim Kirkpatrick)

1:29 PM Jeffrey S. Katz (Auburn University), Anthony A. Wright, (U Texas Med School-Houston), John F. Magnotti (Auburn University), & L. Caitlin Elmore (U Texas Med School-Houston)
Change Detection by Pigeons

26 Pigeons were trained in a change-detection task using different colored shapes. Trials consisted of a two-item sample array followed by a two-item test array. The correct response was to peck the stimulus that changed between the two arrays. Detailed analyses of sample pecks (when, frequency, and where), array location, and choice reaction time were analyzed. These analyses indicated that: 1) pecking the sample was not critical to learning the task, 2) pecking frequency was greatest at the offset of the sample array, and 3) pecking the to-be-changed stimulus during the sample array was more beneficial than pecking the unchanged stimulus. These results are discussed in terms of how pigeons solved the change-detection task.

1:36 PM L. Caitlin Elmore, Anthony A. Wright, Jacquelyne J. Rivera (The University of Texas Medical School at Houston), & Jeffrey S. Katz (Auburn University)
Change Detection by Rhesus Monkeys

27 Two rhesus monkeys were trained in the popular change detection task which is frequently used to study visual working memory in humans. The monkeys were required to detect changes in color in a 2 item display and acquired this task with relative ease. After acquiring the task, they were tested with new colors at different retention delays and other types of changes (e.g., shape and location). The results indicate that this task is readily adaptable for use with non-human primates, thereby allowing comparison between species.

1:43 PM Kenneth J. Leising (U Texas Med School at Houston), Anthony A. Wright (U Texas Med School at Houston), Jeff S. Katz (Auburn University), & John F. Magnotti (Auburn University)
Location Change Detection by Pigeons

28 Change detection has been used to determine the capacity and nature of human visual working memory. In previous research with pigeons, one of two stimuli changed color and subjects were trained to select the item that had changed. Although performance transferred to novel colors and shapes, it did not transfer to items that changed in location. In this experiment, pigeons were trained with only a location change, but otherwise the stimuli were the same as in the color-change task. The location changes were of intermediate distances on a 4X4 matrix. Following learning subjects were tested on location changes greater and less than training distances. The results are discussed in terms of the role of location in the pigeon's visual working memory.

1:50 PM Robert Gerlai (University of Toronto Mississauga)
Can zebrafish learn?

29 Zebrafish has been in the forefront of genetics for the past three decades. This small and prolific species is particularly amenable to high throughput and large scale mutation screening. Interest is increasing in the analysis of its brain function and behaviour. Mutagenesis screens may allow one to discover novel genes and unravel mechanistic details of such complex processes as learning and memory. However, cognitive characteristics of zebrafish are not well studied and behavioural paradigms are rare. Here I describe a number of learning tasks including a non-spatial and spatial learning test and an automatable shuttle box paradigm, and discuss the issue of different reinforcers that may be efficiently employed with zebrafish. I conclude that although zebrafish is a challenge due to its novelty, it appears to be a promising subject with which behaviour genetic analysis of learning and memory will be possible.

2:04 PM Sarah Cook & Katherine, L. Robertson, (Westminster College)
Dark-reared Drosophila melanogaster adapt to their environment by Acetylcholine-driven changes in olfactory sensitivity

30 We use Drosophila melanogaster to explore the mechanisms of brain plasticity. Drosophilae use both visual and olfactory cues when foraging. Here we show that Drosophilae adapt to being reared in darkness by foraging more efficiently using olfaction alone, than do their dark-light cycled counterparts. Their enhanced olfaction is accompanied by changes in Acetylcholine concentration in the olfactory processing centers of the brain, demonstrating that the molecular components of the brain are plastic and are affected by external stimuli. Conversely, disruption of Acetylcholine during a critical period of development causes a loss of their ability to detect and respond to olfactory cues, suggesting that proper Acetylcholine regulation is required for normal brain development. Our work serves to complement and support studies done in other insects, as well as to provide a base for further studies into the neurobiology of brain plasticity in Drosophila.

31 2:18 PM Margaret A. Maloney & Katherine A. Leighty (Disney's Animal Kingdom)
Investigating the cognitive abilities of mandrills using a touchscreen system

Research on mandrill cognition (Mandrillus sphinx) has been surprisingly absent from the literature. We have been working with our collection of 9 adult mandrills (3 males, 6 females) on an automated series of touchscreen tasks. Subjects were initially trained to touch blue squares of decreasing size and varied location. During testing, task 1 required selection of the blue square from a varying number of white distractor squares, task 2 required a color discrimination of the blue square from other colored squares, and task 3 required a shape discrimination of the blue square from other blue shapes. Subjects demonstrated decreased reaction times and error production with experience across all tasks. Interesting trends in error production will be discussed. We are currently training these subjects on MTS procedures to investigate their knowledge of their social partners and to provide them with a means by which they can make choices about their environment.

2:25 PM Tanya Obozova & Anna Smirnova & Zoya Zorina (Lomonosov State University)
Cognitive tests can be carried out with birds in their natural habitat: an approach exampled by experiments with the Glaucous-winged Gull (Larus glaucescens) on the Toporkov Island
An experimental approach to investigate some cognitive abilities of the Glaucous-winged Gull in their natural habitat has been developed. The features of the gull's behavior in breeding period allowed us to work with individually recognized birds directly in their nesting sites. Four pilot experiments were carried out. In particular, an experiment with 16 gulls showed that the approach can be used to evaluate the ability of the birds to learn relationship between stimuli differing in a size. As a result of two - pair discrimination training, 8 gulls learned to choose the larger box and 8 gulls – the smaller one from each pair. In the transfer test, when both the stimuli in a pair were previously either positive or negative, the gulls responded to the relationship between the stimuli. When the stimulus relationship was opposed to their absolute values, most of the birds from both groups responded to the absolute value, not to the relationship.

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2:32 PM Rebecca Rayburn-Reeves & Thomas Zentall (University of Kentucky)
Animal Memory: Avoiding a Fundamental Artifact in the Delayed Conditional Discrimination
Working memory research with animals has typically used delayed conditional discriminations in which each of two samples indicates which of two comparison stimuli is correct. Following acquisition with no (0-s) delay between the offset of the sample and the onset of the comparison stimuli, delays of variable duration are introduced. The resulting retention functions are taken as a measure of memory. We suggest that the comparison of matching accuracy at the 0-s training delay with novel test delays may produce a bias attributable to a generalization decrement that may vary as a function of delay and produce an artifactually steep retention function. We tested this hypothesis by training pigeons with a mixed delay procedure from the start. We found that the retention functions for these pigeons were significantly shallower than those for a control group trained with 0-s delays and tested with longer delays. We propose that a more accurate measure of animals' working memory can be obtained if they have received comparable training with all of the delays that are tested.

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2:44 PM

Development (Chair - Debbie Kelly)

2:44 PM Patrice Marie Miller (Harvard Medical School and Salem State College)
What Animal Performances are Sentential Stage 5?
Sentential stage 5 actions organize nominal stage 4 names of concepts, words or representations. This paper will illustrate the difference between Sentential Stage 5 and Nominal stage 4 actions using examples from human and non-human animals. The stage of performance of an action is based on the hierarchical complexity of the task being addressed. Two-year olds imitated a sequence of actions performed by a model (Kagan, 1981). African grey parrots uttered and understood two-word sentences indicating a meaning that could not be expressed with one word (Pepperberg, 2000). Alex the parrot also counted objects, for example, by saying "One, two." Weir, Chappell and Kacelnik (2002) observed New Caledonian crows sequencing two nominal stage 4 representations to obtain food from a tube.

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2:58 PM Michael Lamport Commons (Harvard Medical School)
Preoperational Stage 6 Performances in Animals
Preoperational stage 6 actions organize sentential order 5 actions. Some animals or preschoolers count by applying ordinal sequences to novel sets of objects placed in a line order. This is elementary counting. In children, the objects in rows may be counted out loud. The last count may be called 5, five, cinco, etc. Brannon & Terrace (1999) trained Rhesus Monkeys to respond to the larger number of symbols (e.g. square, circle in a two line display; displays of different numbers of objects ranged from 1 to 4. Chimpanzees put nuts onto flat anvil stones, and hit them with smaller hammer stones to crack them. This is a (story-like) sequence of sequences that is tied to reality: 1a) Get a stone that might work as a hammer stone; 1b) Get a stone that might work as an anvil stone; 2a) Put nut on the anvil stone; and 2b) Whack it with the hammer stone.

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3:17 PM Snack Break

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4:15 PM Geometry and Orientation (Chair - Mike Brown)

4:15 PM Izabela Szelest (University of Saskatchewan), Cinzia Chiandetti (University of Trento), Giorgio Vallortigara (University of Trento), & Debbie M. Kelly (University of Saskatchewan)
Encoding of Geometric Information by Pigeons and Chicks: Use of Principal or Medial Axes?
Animals rely on geometric information to navigate within their surroundings. Despite the widespread use of geometry by the many species studied to date, it is not clear which geometric properties are relied upon. Early theories have proposed that animals might be encoding the principal axes of a spatial environment. However, recently, researchers have suggested that symmetry and medial axes may be encoded. Our study investigated whether pigeons and chicks encode an environment using principal axes or medial axes. Birds were trained to locate a hidden reward located in two geometrically identical corners of a rectangular enclosure. Once the birds were accurately finding the reward, non-reinforced test trials were conducted in an L-shaped arena. Our results suggest that the two species may differ as to how they encode geometric information from a rectangular environment.

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4:22 PM Rebecca Singer (Georgetown College) & Carley Faughn (University of Louisiana)
Sex Differences in Cognitive Mapping in Rats
Cognitive mapping is the ability to navigate based on an internal map of the relationship of objects in a familiar environment. Singer, Zentall, & Abroms (2006) demonstrated that rats can form simple cognitive maps and that landmarks are important for their formation. Male rats have typically been used in spatial navigation studies so in the current experiment, we investigated whether male and female rats (n=80) used cues differently to form a cognitive map. Preliminary results suggest that female rats learn to navigate the maze as well as male rats if landmarks are present during the training phase but not if they are absent; however once the cognitive map is formed, male and female rats perform similarly. This finding is consistent with the literature on human sex differences in spatial navigation.

4:36 PM Inga Tiemann (Heinrich-Heine University) & Debbie M. Kelly (University of Saskatchewan)
Development influences chickens' (Gallus gallus) use of cues for orientation.

38 Adult pigeons and young chickens have been shown to use features and geometry for orientation during a rectangular arena task. However, the two species differ with regard to how features are encoded. Pigeons have been shown to rely on distant features when cues near the goal are removed. In contrast, young chicks do not seem to encode these distant features. In our study, adult chickens were trained to locate a hidden goal in a rectangular arena. Distinctive features were available for one group (group Feature) but not for the second (group Geometry). Chickens in group Feature showed preferential use of geometry during initial training, but soon learned to use the distinctive features. When tested with the removal of all features, chickens visited the two geometrically correct corners more often than the two geometrically incorrect corners. The birds were also able to use the distant features to locate the positive corner when the cues in the two geometrically correct corners were removed. In conclusion, similar to adult pigeons, but unlike young chicks, mature hens could use distant features to locate the goal. Our results suggest that for chickens, cue use changes with development.

4:50 PM Toru Betsuyaku (Kyoto University), Noriyuki Nakamura (Kyoto University, JSPS), & Kazuo Fujita (Kyoto University)
Use of beacon and geometric cues in Syrian hamsters(Mesocricetus auratus)

39 We examined how Syrian hamsters would use beacon and geometric information in a spatial learning task. The apparatus was a semicircle-like arena with 3 goals. One of the goals was unlocked, whereas the others were locked. An object (beacon) was placed near the unlocked goal. Hamsters were allowed to use either or both beacon and geometric information. In the training, the hamsters were able to get food if they pass the unlocked goal within 3 minutes. In the test, all 3 goals were unlocked and the beacon was relocated near the goal that was locked in the training. If they primarily use geometric information, they would choose the same goal as the training. If they primarily rely on the beacon, they would choose the goal having the relocated beacon. Choice should be random if they use neither cue. Five out of 11 hamsters chose the goal with the relocated beacon, and the other 6 chose the same goal as the training. The result suggests that hamsters may use either information as the cue in spatial navigation.

4:57 PM Batty, E. R., Hoban, L., Spetch, M. L. & Dickson, C. T. (University of Alberta)
Rats' use of geometric, featural and orientation cues to locate a hidden goal

40 Over the past 20 years, a great deal of research has examined how animals can use the geometric properties of the environment to determine their heading. Less well studied is how rats use the geometric properties of an environment to navigate when it is not necessary to establish heading. Specifically, it is unclear to what extent rats still rely on or, more specifically, prefer geometric cues when they are not disoriented. In the current study, rats were trained to find food in one corner of a rectangular environment under either oriented or disoriented conditions. Probe tests placed geometric, featural and orientation cues in conflict. Results showed that featural cues exert little control over the rats' search preferences. Rats trained in the disoriented condition preferred geometric cues to orientation cues, whereas rats trained in the oriented condition showed more equal preference for orientation and geometric cues.

5:09 PM

Arthropod Learning Symposium (Chair - Ken Cheng)

5:09 PM HJ Gross, M Pahl, J. Tautz (University of Wuerzburg, Germany)
A Si, H Zhu, SW Zhang (The Australian National University, Australia),
Count us in! A demonstration of numerosity discrimination in the honeybee

41 Honeybees, Apis mellifera, by virtue of their other impressive cognitive feats, are a prime candidate for investigations of the numerical ability. We used the well-established delayed match-to-sample paradigm, to test the limits of honeybees' ability to match two visual patterns solely on the basis of the shared number of elements in the two patterns. We found that bees can not only differentiate between patterns containing two and three elements, but can also use this prior knowledge to differentiate three from four, without any additional training. However, bees trained on the two versus three task could not distinguish between higher numbers, such as four versus five, four versus six, or five versus six. Control experiments confirmed that the bees were not using cues such as the colour of the exact configuration of the visual elements, the combined area or edge length of the elements, or illusory contours formed by the elements.

5:24 PM Paul Graham & Tom Collett (University of Sussex)
The Binding and Recall of Navigational Memories in Ants

42 Individual ant foragers learn complex routes along which they guide themselves using learnt information about visual landmarks. The robustness and reliability of visually guided navigation depends on the accurate recall of the appropriate visual memory at the appropriate time. We present the results of two lab experiments with wood ants which address the question of the recall of navigational memories. In both cases individual foragers learn to pinpoint a food location using retinotopic views of the world. We show that the retinotopic information required for spatial guidance is associated with visual cues that are independent of precise retinotopic position. We show how such a strategy enables ants to identify ambiguous landmarks and select the correct memory from a large set of route memories.

5:39 PM Karen L. Hollis, Heather Cogswell, Kenzie Snyder & Lauren M. Guillette (Mount Holyoke College)
Further Studies of Learning in Pit-building Antlions (Neuroptera: Myrmeleontidae)

43 Pit-building antlions, the larvae of a winged adult insect, capture food by digging funnel-shaped pits in sand and then lying in wait, buried at the vertex, for prey to fall inside. The sedentary nature of this sit-and-wait predatory behavior and, especially, antlions' innate ability to detect prey arrival, do not fit the typical profile of insects that possess learning capabilities. Nonetheless, previous studies in our lab have shown that learning can play a critical role in this unique form of predation. Here we report recent work that, once again, demonstrates the fitness advantages of associative learning. In addition, we show how the form of that learning is well-adapted to antlions' need to conserve energy.

44 5:54 PM Elizabeth Jakob (University of Massachusetts Amherst)
Learning in Spiders

Spider species are diverse in behavior, ranging from web-builders that rely primarily on vibrational information in their interactions with the world to ground-hunting spiders that rely on visual input. I will briefly review the (very patchy) state of our knowledge about learning in spiders. Then I will focus on one of the better-studied families, the Salticidae, or jumping spiders, which have excellent vision and a type of eye unique in the animal kingdom. My students and I have found that spiders can learn about visual cues when foraging, looking for their nests and in order to avoid aversive stimuli. I will show how we use their ability to learn in order to better understand their perceptual abilities.

45 6:09 PM Discussant - Ken Cheng

Poster Session I (8:00 - 10:30)

8:00 PM

See Poster Abstracts Starting on Page 20

Poster Presenters: Please set up your posters between 7:30 and 8:00

Friday Afternoon

12:00 PM

Category and Concept Learning II (Chair - Jeff Katz)

12:00 PM Joël Fagot (CNRS-LPC, Marseille)
Relational matching in baboons

46 Thus far, only apes succeeded in the 2- by 2-items relational matching (RMTS) analogy problem, with potential benefits of language- (Premack, 1983) or token-training procedures (Thompson, Oden, & Boysen, 1997). Six baboons were initially trained in a RMTS task in which the SAME and DIFFERENT relations were illustrated by patches of colors. Learning occurred and transferred to a new set of colors and to news stimlus sizes (Experiment 1-2). Performance deteriorated to chance level when a gap was introduced in between the two elemental features (Experiment 3), but this effect of gap size can be overcome by training (Experiment 4). It is suggested that early failures to demonstrate RMTS in monkeys derived from local mode of processing limiting consideration of the stimuli as pairs in the RMTS task, rather than as independent objects.

12:14 PM Jennifer Vonk (The University of Southern Mississippi) & Stephanie E. Jett (University of South Alabama)
Natural Concept Discrimination in an American Black Bear (Ursus americanus)

47 An adult American black bear discriminated between color photographs presented on a touch-screen monitor in a two-choice discrimination paradigm at various levels of abstraction. At the concrete level, Brutus was reinforced when he selected photos of black bears and not humans. At the concrete/intermediate level he was reinforced for selecting photos of polar bears versus photos of a variety of other bear species, and at an abstract level, he was reinforced for selecting photos of animals versus non-animals. Brutus showed significant positive transfer to novel stimuli at the concrete levels but not at the abstract level discrimination. At each level, his performance was comparable or superior to that of two chimpanzees being trained on analogous discriminations.

12:28 PM Daniel I. Brooks & Edward A. Wasserman (The University of Iowa)
A Measure of Pigeons' Continuous Discrimination in the Simultaneous S/D Task

48 Discrimination in a two-alternative forced-choice task, such as the simultaneous same/different discrimination, is usually measured by the pigeon's pecking one or the other of two report keys. However, incipient discriminative responses are actually made to the display screen throughout the Fixed Ratio observing period prior to the presentation of the report keys. By carefully analyzing the spatial distribution of these incipient discrimination responses, we can track the development of the discrimination throughout the trial, revealing continuities in the upcoming categorical choice response. We first describe the emergence of this continuous discrimination at different points in task acquisition. We then describe an experiment in which we experimentally manipulated the variability of the items in the S/D display to further investigate the continuous nature of this response.

49 12:35 PM Dennis Garlick & Aaron P. Blaisdell (University of California, Los Angeles)
Examining Same versus Different responding by pigeons using a procedure based on the Raven's Progressive Matrices task

The simplest version of Raven's Progressive Matrices – a test used to assess fluid intelligence in humans – involves applying a same-different rule to elements in an array. We adapted this task for pigeons using just a single row and consistent same or different rules. After pecking to two sample stimuli, the pigeon was given a choice between two comparison stimuli. Pecking to the correct stimulus resulted in reward. In the Same condition, the two sample stimuli and the rewarded stimulus were the same. In the Different condition, the two sample stimuli and the rewarded stimulus were

different. Performance in the Same condition exceeded 80% during training with similar performance on a novel transfer test. Performance in the Different condition was considerably lower. These results conflict with the outcomes of prior same-different studies in pigeons.

12:42 PM Fabian A. Soto & Edward A. Wasserman (University of Iowa)
A common-elements model of visual category learning in pigeons
A large body of experimental research in animal visual categorization has accumulated involving photographs of real-world objects. These complex stimuli foster rapid category learning and they are more ecologically valid than artificial categories; but, they are difficult to manipulate experimentally and to represent in formal models of behavior. We present a solution to the representation problem in modeling natural categorization by adopting a common-elements representation and combining it with a competitive learning rule, which allocates differential behavioral control to each element in the representation. The model effectively reproduces several key experimental outcomes, including: the learning of open-ended categories; category size effects; stimulus repetition effects; feature-positive effects; within-category generalization effects; and, the dynamics of behavioral control by categorical and individual stimulus properties. More importantly, the model leads to novel, testable predictions about the conditions that foster visual category learning and generalization to novel exemplars from the trained categories.

50

12:49 PM Edward A. Wasserman & Fabian A. Soto (University of Iowa)
Blocking of categorical control by prior individual exemplar learning
The present experiment tested the hypothesis that different stimulus attributes—exemplar and category—compete for control of performance in the categorization of natural images by pigeons. Birds were trained to sort photographs of natural objects according to two rules. In the pseudocategorization task, each photograph was randomly assigned to one of two response keys. In the true categorization task, all members of the same natural category were assigned to the same response key. Each pigeon was trained with a pseudocategorization task alone during the first experimental phase. In the second phase, the pigeons were exposed to two categorization tasks, one of them involving stimuli from the previous pseudocategorization task (Blocking) and the other involving completely new stimuli and categories (Control). A test with novel exemplars from each category showed less transfer of performance in the Blocking condition, suggesting that exemplar memorization fostered by this task blocked learning of an open-ended category.

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1:01 PM **Cognitive Processes** (Chair - Jonathon Crystal)

1:01 PM Alan C. Kamil and Alan B. Bond (University of Nebraska-Lincoln)
General Process vs. Adaptive Specialization: A False Dichotomy
The cognitive abilities of animals are often conceptualized as the result of either general processes or specialized adaptations. Many adaptive traits, however, are a complex mixture of the general and the specialized. For example, it is meaningless to ask if the haemolglobin molecule of a particular species is general or adaptively specialized because it is both! Better appreciation of this aspect of this aspect of the evolution of adaptations has important implications for research strategies for students of comparative cognition.

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1:25 PM Gema Martin-Ordas1, Daniel Haun2, Fernando Colmenares3 and Josep Call1
1Max Planck Institute for Evolutionary Anthropology Leipzig, Germany
2Department of Psychology University of Portsmouth, UK
3Departamento de Psicobiologia, Universidad Complutense de Madrid, Spain
Keeping track of time: evidence for episodic-like memory in apes
Some authors have suggested that episodic memory is a uniquely human phenomenon. However, recent experiments have shown that birds and rats form integrate memories for the where, what and when of an event. This capability fulfils Tulving's behavioural criteria for episodic memory and is referred to as episodic-like memory because it does not assess subjective experiences. Here we show that apes meet the behavioural criteria for episodic-like memory. We adapted the paradigm developed by Clayton and Dickinson (1998) for use with apes. In the experimental phase, subjects were presented with preferred but perishable food (frozen juice) and less preferred but non perishable food (grape). After the food was hidden, they were allowed to choose one of these items either after a short (5 minutes) or a long (1 hour) retention interval. They prefer frozen juice to grapes, so when given a choice between the two food types they would choose frozen juice. After 1 hour, the frozen juice melts and becomes unobtainable, but it is still edible if chosen after 5 minutes. We tested six chimpanzees (Pan troglodytes), three orangutans (Pongo pygmaeus) and two bonobos (Pan paniscus). Overall, we found that apes chose the frozen juice significantly more after the short interval than after the long interval. Moreover, they showed a significant increase in their choices of grapes after the long retention interval compared to the short interval. This result is a critical evidence for episodic-like memory because it requires recognizing where a particular food was hidden and the relative time that has elapsed between baiting and choosing.

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1:39 PM Chikako Suda-King (Smithsonian National Zoological Park)
Do Orangutans and Gorillas Know When They Do Not Remember?
Metacognition refers to the ability to monitor and control one's own cognitive activities such as memory. Five orangutans and four gorillas were tested whether they were able to escape spatial memory tests when they did not remember the location of preferred reward. The orangutans as a group significantly more likely quit the test when the baiting was invisible (as compared to when it was visible) and when the hiding locations of the reward were switched (as compared to when they remained unchanged). The gorillas performed similarly although their use of escape response seemed to be less effective. Even when the escape option was presented before the final presentation of the memory test, one orangutan was successful at prospectively avoiding the test in which she would likely err. These findings indicate that at least some great apes appear to tell when they do not remember correct answers.

54

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1:53 PM Damian Scarf & Michael Colombo (University of Otago)
Eye movements during list execution reveal no planning in monkeys
When trained on a serial-order task to respond to five simultaneously displayed stimuli, monkeys show an elevated latency to respond to the first item (A) or the first two items (A and B) followed by short and uniform latencies to respond to the remaining items. This pattern has been interpreted as evidence of planning, with the long initial latency reflecting the animal planning their responses, and the subsequent short and uniform latencies reflecting the execution of the planned responses. An analysis of eye movements, however, revealed no evidence of planning. The elevated latency to item A is likely an artefact of the method of stimulus display.

2:00 PM Qing Liu & Dorothy Fragaszy (University of Georgia)
Wild Capuchin Monkeys Explore Novel Anvils to Select Sites for Cracking Nuts
Wild bearded capuchins crack nuts using stone hammers at pitted anvils. The current study examined how 9 wild monkeys explored the dimension and depth of the pits in new anvils prior to selecting one to use to crack nuts (4 x 6 cm). In Experiment 1 the monkeys preferred the widest pit (9 cm) from among three; $p < 0.001$, Friedman test). In Experiment 2, the monkeys preferred the shallowest pit (1 cm) from among three; $p < 0.001$, Friedman test). In both experiments, all the monkeys explored more than one pit while cracking a nut. Exploratory actions included placing a nut in the pit, striking the pit with the nut and striking the nut in the pit with a stone. These familiar actions can provide information about the affordance of an unfamiliar pit. Selecting appropriate cracking sites involves perceptual learning, as does selection of nuts and hammers and skilled cracking actions.

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2:07 PM Kate M. Chapman & Daniel J. Weiss (The Pennsylvania State University)
Motor Planning in Lemurs: The end-state comfort effect
Anticipatory motor planning abilities have been posited to scaffold to higher level cognitive features, such as tool use (Johnson-Frey, 2004). The present work investigates the capacity to adopt an unusual position or posture when grasping an object in anticipation of future positions or postures. This type of planning, termed the end-state comfort effect has been evidenced in humans (Rosenbaum et al., 1990) and tamarin monkeys (Weiss et al. , 2007). Here we investigate whether these abilities exist in lemurs, prosimian primates that branched off from simians long before monkeys. Our findings indicate lemurs share such anticipatory abilities, suggesting the possibility that this capacity was characteristic of ancestral primates. We conclude by speculating how motor planning and insight learning may have facilitated the emergence of tool use and complex cognitive abilities in primates.

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2:19 PM

Learning and Serial Processes (Chair - Lorraine Allan)

2:19 PM Walter Herbranson (Whitman College)
The effect of cue validity on serial response learning in pigeons (Columba livia)
Serial response learning experiments typically show a robust facilitation effect: Response times are faster when targets appear in locations according to a predictable sequence than when they appear in unpredictable locations. Previous research on response sequence learning in both humans and animals has compared performances across conditions. The present experiment compares response times to predictable and unpredictable target locations randomly interspersed within the same condition by systematically manipulating cue validity. Validly cued targets (those appearing in a predictable location) would be expected to produce faster response times than invalidly cued targets (those appearing in an unpredictable location). This basic response time facilitation effect was obtained when cue validity was high (80-90%), but deteriorated at lower values.

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2:33 PM Shannon M. A. Kundey (Hood College) & Stephen B. Fountain (Kent State University)
Rats Abstract Rules from a Response Series Lacking a Consistent Motor Sequence
Research shows rats can learn rule-based response sequences by pressing levers in a circular array according to a consistent motor pattern. Learning a sequence under these conditions does not necessarily require rats to learn abstract rules; rats can potentially learn such sequences via simpler associative motor learning processes. We explored rats' sequence learning when they could not succeed by repeating 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. Only rats in the structured group learned their pattern. Sequential structure in nonadjacent elements mediated superior pattern learning even when the rule relating those elements could not be abstracted from a set motor pattern.

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2:47 PM Katherine E. McNutt (Marlborough School) & Aaron P. Blaisdell (UCLA)
Is associatively-mediated object permanence in rats due to hidden-event cognition or simply a context shift?
Blaisdell et al. (in press) found that rats distinguish the explicit absence of an event from its ambiguous absence. After learning the sequence Tone-->Light-->Food during sensory preconditioning, the Tone was tested. Conditioned nose poking to the Tone was observed only when the Light's lamp was removed at test. This suggests a form of hidden-event cognition. Or, perhaps removing the light produced a context change that allowed the Tone's excitatory properties to generalize more than its inhibitory properties. To test these alternatives we replicated the design and tested the tone in the same or different context as training. We replicated Blaisdell et al.'s results in the same context, while overall responding was low in the different context. Thus, context change is not a likely account of the effect of removing the light at test.

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2:54 PM Jared Wong, Aaron P. Blaisdell (UCLA), Martina Schmidt, & Michael R. Waldmann (University of Göttingen)
The Effect of Hiding the Absence of the US on Pavlovian Extinction
We manipulated the information rats had about the absence of the US during Pavlovian extinction. After a light CS was paired with a food US, the CS was extinguished by presenting it in the absence of the US. For a group of rats, the food niche was covered by a metal plate so as to render it inaccessible. For another group of rats, the food niche was uncovered. All rats were subsequently tested on the CS with the niche uncovered. Responding to the CS was higher when the food niche had been covered than when it had been uncovered during extinction. Responding in the covered group was also higher than in a context-exposure control group (Experiment 1), but lower than an acquisition control group (Experiment 2). Our data suggest that rats distinguish between the explicit absence of an outcome from its ambiguous absence in contingency learning.

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62 3:01 PM Snack Break

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62 4:00 PM In Honor of the Contributions of Herbert S. Terrace

4:00 PM Introduction - Elizabeth Brannon

4:05 PM Peter Balsam (Barnard College and Columbia University)
Introduction
One line of Terrace's work has shown that animals are capable of learning serial orders in lists of arbitrarily stimuli. Furthermore, this knowledge can be used quite flexibly. If animals learn an order-map in different lists they are capable of inferring correct ordering when lists are combined. Animals also learn temporal maps containing quantitative temporal information about relations between events. They can also infer correct timing by integrating information from separate temporal maps that contain common elements. The serial presentation of stimuli facilitates the integration of temporal maps suggesting that order information may be an important and independent determinant of how animals use temporal knowledge.

4:20 PM Elizabeth Brannon, Melissa Libertus (Duke University) & Jessica Cantlon (Carnegie Melon)
Evolutionary and Developmental Precursors to a Concept of Number
Adult humans quantify, label, and categorize almost every aspect of the world with numbers. The ability to use numbers is one of the most complex cognitive abilities that humans possess and is often held up as a defining feature of the human mind. I will present a few studies that are representative of a body of data that demonstrates that there are strong developmental and evolutionary precursors to adult mathematical cognition that can be seen by studying human infants and nonhuman primates. I will illustrate the similarities in the psychophysics of numerical discrimination in adults, monkeys, and human infants by a) describing new studies that compare the computational capacities of monkeys and humans and b) introducing new methods and data that reveal that Weber's Law applies to human infant numerical discriminations.

4:35 PM Dustin Merritt (Duke University), Daniel Casasanto (Max Planck Institute for Psycholinguistics) & Elizabeth Brannon (Duke University)
The Effects of Space on Time Judgments in Rhesus Monkeys and Humans
Most languages use spatial metaphors to describe temporal relationships more frequently than the reverse. It is unclear whether this asymmetry reflects how time and space are fundamentally conceptualized, or simply how these relationships are expressed in language. To test this, we trained two rhesus monkeys and 13 adult humans to classify the spatial length or temporal duration of a line as "long" or "short". We then gave a within-dimension bisection test with intermediate values, and subsequently, gave a between-dimension bisection test with time and space crossed. In humans, space manipulations affected time judgments, but not the reverse. In monkeys, time and space showed large symmetrical effects on one another. These findings suggest that relationships between space and time exist nonverbally, but that asymmetrical mapping may occur through language development.

4:50 PM Janet Metcalfe (Columbia University) & W. Jake Jacobs (University of Arizona)
Metacognitively Guided Study in the Region of Proximal Learning: Is it Information Foraging?
Considerable research indicates that adult humans use their metacognitions to direct their learning efforts to their own Region of Proximal Learning. They attempt to exclude items that they have already mastered as well as those that are overly difficult, and to focus their efforts initially on materials that are as easy as possible while still being unlearned. Only once these have been studied do they turn to more difficult items. They stop studying a particular item when their perceived rate of learning approaches zero. We will review research indicating that people use this strategy. We will then propose that such a learning strategy may have been exapted from more primitive foraging behavior. Similarities between food foraging and metacognitively guided information 'foraging' will be outlined. The differences between such strategies, which at some level entail a win-shift strategy, and reinforcement learning, which entails a win-stay strategy, will also be discussed.

5:05 PM Lisa K Son (Barnard College) & Nate Kornell (UCLA)
The virtue of ignorance
Ignorance is not generally considered a virtue. Knowing that you are ignorant, on the other hand, can lead to many virtuous decisions (as well as many adverse decisions, unfortunately). For instance, suppose during study, a learner judges a particular topic as unlearned. That learner can then decide to seek more information about that topic by allocating more study time to it. Conversely, if the learner did not know about his lack of knowledge, one can expect that he would discontinue study, and consequently risk performing poorly on an upcoming exam. Recent data relevant to the importance of knowing what you do not know will be presented, both from monkey and human participants. In addition, results revealing why people choose to make particular metacognitive decisions will be described.

5:20 PM Robert R. Hampton (Emory University)
Declarative cognition in rhesus monkeys?
It is widely accepted that memory consists of multiple systems that serve distinct functions. The most conspicuous (though likely not the most common) forms of human memory are described as declarative. In humans, declarative memory is often inferred from our ability to talk about memory, although declarative memory arguably has other distinctive functional properties. I will describe alternative approaches to detecting declarative cognition that are suitable for use with nonverbal species, including metacognition paradigms and methods for dissociating among memory systems.

5:35 PM Francys Subiaul (The George Washington University)
Cognitive Imitation
Subiaul, Cantlon, Holloway and Terrace (2004) demonstrated that rhesus monkeys, a population that historically has failed to evidence imitation learning (Tomasello & Call, 1997), can successfully copy novel cognitive (ordinal) rules. Since then, it's been demonstrated that monkeys and children have identical error signatures when learning novel cognitive rules by trial and error and imitation (Subiaul et al., 2007). Originally, it was hypothesized that the success of rhesus monkeys in the cognitive imitation paradigm was the result of controlling for motor confounds, inherent in all motor imitation studies. However, more recently, Subiaul (2007) has proposed that two distinct and dissociable mechanisms mediate the copying of ordinal and motor rules. Here, data is presented in support of this content-specific view of the imitation faculty; Specifically, demonstrating a dissociation between motor-spatial and cognitive imitation among typically-developing children. Dissociations between learning type (individual versus observational) and content type (motor-spatial versus ordinal) will be explored in the broader context of developmental and comparative psychology.

6:00 PM Master Lecture - Herbert S. Terrace (Columbia University)

7:30 PM Banquet

Saturday

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 :)

2:30 PM Temporal Processing (Chair - Jerome Cohen)

2:30 PM Angelo Santi, Allison Adams, & Julia Bassett (Wilfrid Laurier University)
Does pecking during filled intervals contribute to the empty-filled timing difference in pigeons?
Pigeons were trained in a within-subjects design to discriminate empty intervals (bound by two 1-s visual markers) and filled intervals (a continuous visual signal). The intervals were signalled by different visual stimuli and they required responses to different sets of comparison stimuli. Empty intervals were judged longer than filled intervals. The difference between the point of subjective equality (PSE) for the empty intervals and the PSE for filled intervals increased as the magnitude of the anchor-duration pairs increased. While there was more pecking during filled intervals than during empty intervals, there was no significant correlation between pecking during filled intervals and the value of the PSE. Key pecking per se does not appear to play an important role in the empty-filled timing difference.

2:44 PM Matthew S. Matell & Dale N. Swanton (Villanova University)
Stimulus Compounding in the Peak Procedure
Rats were trained on a two-duration peak procedure in which one modal stimulus (e.g., a tone) indicated probabilistic food availability after one duration (e.g., 4s), and a different modal stimulus (e.g., a light) indicated probabilistic food availability after another duration (e.g., 12s), counter-balanced. Across five different duration relations (4s:12s - 5s:30s), mean responding to the stimulus compound (tone+light) peaked at a time in-between the anchor durations. The timing and form of these compound peaks differed as a function of the modality-duration relation. In the tone-short condition, compound responding was scalar, and compound peak times were accurately predicted by a weighted geometric mean of the anchor durations. In the light-short condition, compound responding was asymmetrical and peak times were not well predicted by the arithmetic, geometric or harmonic means of the anchors.

2:58 PM Cerutti, D., Delgado, M., Wendel, L. (University of California, East Bay), Jozefowiez, J. (Universidade do Minho), & Staddon, J (Duke University)
Time and reinforcement in the temporal-bisection task: A test of behavioral versus cognitive hypotheses
A simple behavioral economic model (BEM) predicts that the indifference point in the temporal bisection task will be inflected by differences in reinforcement associated with different temporal judgments. BEM assumes a Weber-law-compliant logarithmic representation of time; payoffs for each response are associated with each represented time value; finally, at a given real time, the response with the highest payoff is emitted. We are presently carrying out two tests of the temporal-bisection prediction of the model with pigeons: the first test presents temporal-stimulus durations equally but with a different payoff probability; the second test presents each temporal stimulus with different frequencies but equal payoffs. In each case, BEM predicts a shift in the temporal-indifference point toward the higher reinforcement probability or more frequent presentation, while cognitive timing accounts predict no effects of reinforcement manipulations.

3:12 PM Robert Cook (Tufts University)
Temporal Control of Rule-Based Internal States in Pigeons
We have previously reported that pigeons can learn time-based visual conditional discriminations. In these experiments, pigeons learned to temporally separate sequences of matching and oddity trials involving the same stimuli within a session. We found that at the temporal transition between these competing tasks pigeons perform at chance. The current experiment attempted to discriminate whether this chance performance represented generalized task confusion or a temporal competition between different rule-based cognitive structures. Using a 3-alternative conditional discrimination involving the same three colors, pigeons were tested with sequences of symbolic discriminations within a session. The analysis of the errors made within a session supported the temporal competition hypothesis.

3:26 PM Yael Klein & Robert G. Cook (Tufts University)
Time-Based Matching/Oddity Task Reversal in Pigeons
Recent studies in our laboratory have shown that pigeons can learn time-based visual conditional discriminations. In these tasks, pigeons learned to switch from matching to oddity involving the same colored stimuli using time within a session to determine correct responses. In the current experiment, three pigeons previously trained using a matching/oddity sequence within a session were reversed to an oddity/matching sequence. This reversal was quite difficult in comparison to other types of published reversal results, with the pigeons switching behavior more easily over the second part of a session than the first part. Implications for the cognitive structure of rule-based behavior and time-based contextual cues will be discussed.

3:33 PM Cody W. Polack (SUNY-Binghamton), Jeremie Jozefowiez (Universidade do Minho), & Ralph R. Miller (SUNY-Binghamton)
Economic Factors Determine Human Temporal Judgments in a Bisection Task

The Behavioral Economic Model (BEM) makes several predictions about the effect of motivational variables on temporal judgments in a bisection procedure. BEM predicts that indifference points will shift based on relative presentation frequencies, reinforcement rates, and reinforcement magnitudes. Experiment 1 found that greater frequency during training of one of the two durations biased temporal judgments toward the more frequent duration. Experiment 2 demonstrated a similar effect of the relative rates of reinforcement of the two durations during training. In contrast, in Experiment 3 differences between magnitude of reinforcement of the two durations failed to have an effect on temporal judgments although participants showed that they could discriminate between the two reinforcer magnitudes.

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3:45 PM

Associative Processes (Chair - Matt Matell)

3:45 PM Olga F. Lazareva (Drake University) and Edward A. Wasserman (University of Iowa)
Transitive Inference in Pigeons: Measuring the Associative Values of B and D

To study nonverbal transitive inference, animals are often trained to discriminate four pairs of overlapping visual stimuli: A+ B-, B+ C-, C+ D-, and D+ E-. When novel pair BD is presented, animals must select B in order to demonstrate transitive competence. Associative theories explain this outcome by proposing that, as a result of discrimination training, the associative values of the training stimuli form an ordered series: A > B > C > D > E. To our knowledge, this proposal has not been tested empirically. We employed resistance-to-extinction and resistance-to-reinforcement methods to assess the associative values of stimuli B and D after the "forward" training procedure (e.g., Wynne, 1997), after the "backward" training procedure (e.g., Steirn et al., 1995), and after the forward and backward training procedures plus the "bias reversal" procedure (e.g., Lazareva & Wasserman, 2006). Implications of the results for associative theories of transitive inference will be discussed.

77

3:59 PM Cynthia D. Fast & Aaron P. Blaisdell (UCLA)
The Role of Hidden Events in Positive and Negative Patterning in Rats.

Blaisdell, Leising, Stahlman, & Waldman (in press) demonstrated that rats discriminate between the ambiguous and explicit absence of an excitatory CS. The present experiment was designed to replicate this finding and extend it to inhibitory CSs. Rats first received positive (A-, B-, AB+) or negative (A+, B+, AB-) patterning training with two visual CSs (A and B). Subjects were subsequently tested on A-alone probe trials, during which B's lamp was either covered (ambiguous absence) or uncovered (explicit absence). When uncovered, performance on test trials with A-alone should be the same as during training, while with B's light covered, performance should be intermediate between levels shown on A-alone trials and on AB compound trials during training. This pattern of results would support and strengthen the prior findings from our lab regarding hidden-event cognition in rats.

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4:06 PM Mario A. Laborda, James E. Witnauer, & Ralph R. Miller (State University of New York – Binghamton, USA)
Contextual associations in extinction

We used rats in a lick suppression preparation to assess the contribution of CS-context and context-US associations to extinction. Exp 1 addressed whether strengthening the CS-context association enhances extinction by contrasting AAC extinction with ABC extinction. Less post-extinction responding was observed in the former than in the latter condition. Exp 2 assessed the contribution of the context-US association to extinction by examining the effect of post-training extinction of the conditioning context on responding to an extinguished CS. Exp 3 addressed the contribution of the CS-context association to extinction by examining the potential of a neutral stimulus, presented in compound with the target CS during extinction treatment, to overshadow this association. Both manipulations enhanced responding to the extinguished CS in an AAC, but not an ABC design.

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4:18 PM

Canine Cognition II (Chair - Tom Zentall)

4:18 PM Anna Waisman, Amy Cook, Alison Gopnik, and Lucia F. Jacobs
Causal Inference in the Domestic Dog (Canis familiaris) and preschool age children

Recent research by Blaisdell et al (2006), suggests that rats can make more complex causal inferences than previously thought, but there is no evidence about animals' abilities to infer interventions from observation. Adult domesticated dogs are able to learn complicated tasks from association, trial and error, and perhaps, imitation. Therefore, in a series of studies, we tested whether dogs were able to use inferred causal relationships, from observation of a series of events, to make the appropriate interventions. Given that we know that human preschool age children can use observational information to make causal inferences and design new interventions, we tested them in the same task to determine whether the task was a reliable assessment of this ability. Preliminary results suggest that while 4 year olds had no difficulty with this task, dogs and 3 year olds did.

80

4:25 PM Akiko Takaoka & Kazuo Fujita (Kyoto University)
To follow or not to follow, that is the question: Behavior of dogs in a socially cued object choice task

Dogs have been reported to be sensitive to human social behaviors and good at finding hidden food indicated by human pointing. However, their choices are not completely controlled by such human social cues; they refuse to choose the container deceptively indicated by humans when they know which container has food. In this research, house dogs were tested in three phases in sequence. In the first phase, a human experimenter pointed the baited container in a standard socially-cued object choice task. Second, they were tested after observing which container had food whereas the experimenter indicated the empty container. Finally they were retested in the first task. The dogs reliably followed human pointing in the first phase. But in the third phase after they were deceived in the second phase, dogs were much less likely to select the container the human pointed. The results indicate that dogs flexibly change their choice whether to obey a human social cue or not, depending on their own brief experience of the reliability of the social cues provided.

81

82

4:32 PM Kristina F. Pattison, Holly Miller, Rebecca Rayburn-Reeves & Thomas Zentall (University of Kentucky)
Dogs' Memory for Occluded Objects

To assess dogs' memory for an occluded object, a gaze duration procedure was used similar to one often used with nonverbal infants. A dog biscuit was placed behind a solid screen that then rotated in the depth plane through an arc front to back and dogs were shown either of two test events. In one ("possible event"), the screen rotated until it reached the biscuit and then stopped (about 120°); in the other ("impossible event"), the screen rotated through a full 180° arc, as though it had passed through the biscuit. The dogs looked significantly longer at the impossible event. No difference in looking time was found when the screen moved 120° or 180° but the biscuit was not placed behind the screen. Results suggest that dogs remember physical details about an occluded object.

4:39 PM Holly C. Miller, Rebecca Rayburn-Reeves, Thomas R. Zentall (University of Kentucky)
Imitation and Emulation learning in Domestic Dogs

83 A successful procedure for studying imitative behavior in non-humans is the bidirectional control procedure in which observers are exposed to a demonstrator that responds by moving a manipulandum in one of two different directions (e.g., left vs. right). Imitative learning is demonstrated when observers make the response in the direction that they observed it being made. This procedure controls for socially mediated effects (the mere presence of a demonstrator), stimulus enhancement (attention drawn to a manipulandum by its movement), and if an appropriate control is included, emulation (learning how the environment works). Recent research with dogs has found that dogs may not demonstrate imitative learning when the demonstrator is human. In the present research, we found that when odors were controlled for, dogs imitated the direction of a screen push demonstrated by another dog more than in a control condition in which they observed the screen move independently while another dog was present. Furthermore, we found that dogs would match the direction of screen push demonstrated by a human and they were equally likely to match the direction in which the screen moved independently while a human was present.

83

83 4:51 PM Perception, Causality & Contingency (Chair - Chuck Locurto)

4:51 PM Lorraine G. Allan, Samuel D. Hannah, & Shepard Siegel (McMaster University)
Age-Related Changes in Contingency Assessment: A Signal-Detection Approach

84 At previous CO3 meetings, we described our application of signal detection theory (SDT) methodology to understanding contingency assessment. SDT isolated effects resulting from the participant's sensitivity to the contingency between the events being judged from effects resulting from the participant's bias for a particular response. We suggested that SDT importantly supplements associative accounts of contingency assessment. Almost from its first introduction into psychology, SDT was applied comparatively (to compare humans and nonhuman animals) and developmentally (to compare different age groups). At this meeting, we will present research demonstrating the utility of applying SDT to understanding differences in contingency assessment seen in older participants (seniors) compared with university students.

5:05 PM Justin Scott Johnson, Martha Escobar, Francisco Arcediano, & Scott Bragan (Auburn University)
Number of alternatives and situation plausibility as determinants of over- and under-prediction of causality judgments

85 We have previously reported that causal judgments made in the predictive direction (i.e., from cause to effect) are significantly higher that the objective cause-effect contingency, which is consistent with previous reports that people tend to overestimate cause-effect contingencies. However, causal judgments made in the diagnostic direction (i.e., from effect to cause) tend to conform to the contingency. In the present experiments, we demonstrate that over-prediction of causal judgments can be observed in the diagnostic direction if the alternate cause for the effect does not seem to be causally plausible. The implications of these results for causal model theory (CMT) will be discussed.

5:12 PM Christopher Harshaw & Robert Lickliter (Florida International University)
A "Temporal Blindspot" for Contingency Learning in Northern Bobwhite Hatchlings

86 Learning requires the coordination of a number of different processes, including perception, orienting, attention and memory. Findings from psychophysics and cognitive neuroscience indicate that there is considerable interaction and potential conflict between these processes. Few studies to date have, however, investigated possible time-specific perceptual deficits (e.g. sensory saltation, attentional blink) in non-human species. We present evidence that quail chicks experience a significant deficit in auditory learning at specific temporal delays following their operant behaviors that may be analogous to the phenomenon of "attentional blink." This learning deficit appears to be caused by a conflict between attentional and orienting processes that occurs specifically at such delays, but only when the location of operant playback is uncertain and unpredictable.

5:19 PM Sota Watanabe, Noriyuki Nakamura, & Kazuo Fujita (Kyoto University)
Do pigeons perceive Zöllner illusion? – An analysis using a gap discrimination task–

87 We examined whether pigeons perceive Zöllner illusion in which parallel lines look non-parallel due to numbers of short hatches superimposed on the lines. First, we used a pair of non-parallel lines and trained 2 birds to peck the narrower (or wider) of the two gaps at the ends of the lines. After adapting the subjects to the target lines having random-oriented hatches (which cause little illusion at least to humans), we tested the pigeons' responses in randomly inserted probe trials, in which hatches that should, in human standards, induce Zöllner-like illusion replaced the random-oriented ones. The tentative results suggest the possibility of pigeons' perception of Zöllner illusion.

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5:26 PM Closing Remarks - Marcia Spetch

Poster Session II (8:00 - 10:30)
See Poster Abstracts Starting on Page 26

8:00 PM Poster Presenters: Please set up your posters between 7:30 and 8:00

Posters

Poster Session I - Thursday Evening

P1

Paul Graham (University of Sussex) & Ken Cheng (Macquarie University)
Which Portion of the Natural Panorama is Used for View Based Navigation in the Australian Desert Ant?
Ants that forage in visually cluttered environments use panoramic visual landmarks for guidance and place recognition. Here we ask which portions of natural visual scenes are essential for visually-guided navigation in the Australian desert ant Melophorus bagoti, whose foragers navigate through a habitat containing grass tussocks, shrubs and trees. We captured M. bagoti foragers after they had returned to their nest from a feeder, but before they had entered their nest, and tested their ability to home accurately from a series of release locations. Results show that the lower portion of the visual panorama is more important for accurate visually guided homing than the upper portion. Analysis of panoramic images suggest that important visual information is provided by the panoramic contour, where terrestrial objects contrast against sky.

P2

Michael F. Brown & Toni-Moi N. Prince (Villanova University)
Going My Way?: Similarity of Rat Foraging Partners' Spatial Choices is Produced by Social Influence
Several sets of experiments completed in our laboratory show a relationship between the choices made by one rat in the radial arm maze and choices made by a second rat simultaneously making choices in the same maze. Under some conditions, rats are less likely to visit locations that were previously visited by the other rat (an inhibitory effect). Under other conditions, rats are more likely to visit locations that were previously visited by the other rat (a facilitative effect). We have interpreted both effects in terms of social memory for the choices made by another rat. However, it is possible to explain the apparent facilitative effect as resulting simply from the two rats having common preferences for arms of the maze. Here we present evidence that social memory is necessary to explain the facilitative effect.

P3

Matthew Keller & Michael F. Brown (Villanova University)
Observe, Remember, Avoid? Social Spatial Memory in a Foraging Task
Social spatial memory refers to the ability of an animal to remember the locations visited by another animal within a group. This experiment tested the ability of rats (Rattus norvegicus; focal rat) to remember the locations visited by a conspecific (another rat) in an open field task. There were two experimental conditions. In one, the focal rat was allowed to observe, but not forage with, the conspecific. In the other, the focal rat was not allowed to observe the conspecific. In both conditions, the focal rat was allowed to forage in the open field and its choices were coded in terms of whether the location had been chosen by the other rat. The focal rat avoided the locations it observed being visited by the conspecific. However, if the focal rat did not observe the other rat's visits, it tended to visit the same locations visited by the conspecific.

P4

MB Pesendorfer (University of Nebraska, Lincoln), T Gunhold, L Huber, F Range (University of Vienna)
Social conformity has been suggested as a maintenance mechanism for traditions in non-human animals. After an initial spread by social transmission, a tradition can stabilize by individual habit formation, leading to a uniform group pattern superficially resembling social conformity.
Using a two-action apparatus, we established alternative behavioural patterns in six family groups of wild marmosets (Callithrix jacchus). These groups experienced one technique during a training phase and were later tested with two techniques available. The monkeys maintained the trained method, despite discovering the alternative technique. In three control groups with both methods available, animals with a different preference from the groups majority did not adjust towards the group norm. Rather, animals that discovered both techniques remained with the action with which they were initially successful – habit formation.

P5

Jeffrey R. Stevens (Max Planck Institute for Human Development), Alexandra G. Rosati, & Sarah R. Heilbronner (Duke University)
Expectations and delayed gratification in bonobos
Organisms may discount delayed rewards because the future is uncertain--they may not receive delayed rewards. Therefore, the expectations that an individual has for the likelihood of receiving the future reward should influence how they respond to delayed payoffs. Here, we offered bonobos (Pan paniscus) a delayed gratification paradigm in which food slowly accumulated over time. Once subjects chose to consume the reward, food stopped accumulating. We tested delayed gratification with a reliable and an unreliable experimenter to vary the subjects' expectations. Subjects showed higher discounting for the unreliable experimenter, with individual differences across subjects. These data suggest that the expectations generated about the reliability of receiving future rewards strongly influence how individuals value the future.

P6

Roger K. R. Thompson (Franklin & Marshall College) & Timothy M. Flemming (Georgia State University)
Analogical reasoning and the differential outcome effect: Getting a conceptual feel
Rhesus monkeys completed a standard relational matching to sample (RMTS) paradigm infused with a differential reward (pellet ratio) and/or punishment (timeout ratio) system. Monkeys in the reward- and punishment-only conditions performed according to chance. Monkeys in the both condition, however, achieved and overall accuracy significantly greater than chance. In post tests, with the contingencies removed of any differential outcome, all monkeys returned to performing at levels consistent with chance. We posit that these differential reward and punishment systems, when salient enough, allowed for the emergence of an analogical rule. That the monkeys did not retain an analogical rule in post tests without differential outcomes in place likely means that their behavior was implicit, due to what we call a "conceptual feel."

P7 Michael J. Beran (Georgia State University)
Judgments of Continuous and Discrete Quantities by Chimpanzees
Chimpanzees compared two amounts of poured liquids, using a variety of presentation methods, and performance was compared to other experiments with discrete quantities. First, chimpanzees compared two clear containers holding differing amounts of juice. Next, they compared different quantities that were dispensed from opaque syringes held 12 inches above opaque containers. Then, one quantity was poured it into an opaque container whereas the other quantity was visible in a clear container. Finally, the heights at which the opaque syringes were held above opaque containers differed for each set, so that sometimes sets with smaller amounts of juice were dropped from a greater height providing a possible visual illusion as to the total amount. In all cases, chimpanzees exceeded chance levels of performance, although performance was lower than in some previous experiments with discrete quantities.

P8 Thomas E. Welch & Micheal L. Dent (University at Buffalo, SUNY)
The effects of time and intensity on the auditory Franssen Effect illusion in birds and humans
The Franssen Effect (FE) has been characterized in humans, cats, and more recently in birds. To elicit the FE, listeners are presented with a signal comprised of two simultaneously-presented, spatially separated components: a transient component with an abrupt onset and ramped offset, and a sustained component with a slowly rising onset and longer overall duration. When the FE is operating, the perception is that of a single long-duration steady state tone at the location of the transient component, even though the sound is no longer there. The current experiments manipulated aspects of time and intensity of the two stimuli to more precisely determine the influence of these parameters on the incidence of the FE in humans, zebra finches, and budgerigars. Some manipulations strengthened the illusion, while others reduced it.

P9 Wenyi Zhou & Jonathon D. Crystal (University of Georgia)
Episodic-like Memory: Rats Know “When” Based on Time of Day
Roberts et al. (2008) argued that episodic-like memory in rats is different from human episodic memory because rats learned how long ago, rather than remembering when, an event occurred. To facilitate memory for when an event occurred, we eliminated how-long-ago cues. Rats completed study-test trials in a radial maze, with 2-min retention intervals; one randomly selected location in the study phase provided chocolate. Chocolate locations replenished in the test phase in the morning (7 am) or afternoon (1 pm), counterbalanced across rats. Chocolate revisits tracked the replenishment contingency (Exp 1). We advanced light onset by 6 h and conducted a test in the morning to put in conflict time of day and time since light onset. The rats treated the phase-shift test as a ‘morning’ trial, suggesting the use of a circadian oscillator (Exp 2). Discrimination of what-where-when was based on time of day.

P10 Julia E. Meyers-Manor and J. Bruce Overmier (University of Minnesota)
Remember When: The Search for Episodic-like Memory in Pigeons
Controversy over the ability of animals to express episodic memory has led to the search for features of episodic-like memory in animals; common tests involve remembering an event in terms of what happens, where it happens, and when it happens. Evidence for the ability of animals to show episodic-like memory has been increasing. Here, pigeons were tested in an operant paradigm in which they had to recall which keys to peck in order to get two types of food. They also had to track how long ago they had previously been tested (1 hour or 4 hours prior) in order to determine whether the food was good to eat or was bad from being covered in soap ("rotten"). Pigeons showed the ability to track foods that "rotted" over time as well as foods that "ripened" over time to accurately peck the key that previously produced good food based on how long ago they experienced that food in the chamber.

P11 Dale N. Swanton & Matthew S. Matell (Villanova University)
Characterization of temporal averaging using single-trials analysis
Rats were trained using a two-duration peak-interval procedure, in which one modal stimulus (e.g. tone) predicted reward availability following an 8s delay and another modal stimulus (e.g. light) predicted reward availability following a 24s delay. Stimuli/duration relations were counterbalanced producing a tone-short group and a light short-group. When presented with a tone/light compound stimulus in extinction, tone-short rats exhibited behavior equivalent to temporal averaging (Swanton, Gooch & Matell, 2008). Conversely, light-short rats produced a non-scalar, asymmetrical response distribution, inconsistent with temporal averaging. We attempt to characterize the nature of this responding by analyzing data from individual trials using a standard single-step function, a multi-step function and a cumulative rate algorithm (Gallistel et al, 2004).

P12 Allie Kurti & Matthew Matell (Villanova University)
Modality Effects in a Delay Discounting Task
Previous research has demonstrated a modality effect for clock-speed in rats and humans (e.g., tones drive an internal clock faster than lights). As a consequence, auditory stimuli appear longer than visual stimuli (e.g., Wearden et al., 1998). The present research examines whether this modality effect produces a difference in the rate of delay discounting. In an adjusting delay procedure, rats choose between a standard duration providing one food pellet and a longer, adjusting duration providing two. The indifference point (i.e., the delay when standard and adjusted durations are chosen with equal frequency) provides a measure of temporal discounting, and will be assessed using standard durations of 1, 2, 4, 8, and 16 seconds to calculate hyperbolic delay curves. We will examine whether the rate of discounting is influenced by the modality of the standard and/or adjusting delay.

P13 Tiffany Galtress (University of York, U.K.) & Kimberly Kirkpatrick (Kansas State University)
Reinforcer Magnitude Effects on Temporal Discrimination.
Rats were trained on a temporal discrimination procedure with a single food pellet delivered for responding correctly to a short or long duration signal. Following training, testing with a range of novel durations produced a psychophysical function relating the probability of long response to test duration. Increasing the reward to four food pellets on either the short or long duration, while maintaining the one-

pellet reward on the alternative duration produced a flattening of the psychophysical function. This disruption in temporal discrimination is discussed in terms of response bias and the effects of motivation on stimulus control.

P14

Neil McMillan and Bill Roberts (University of Western Ontario)
Blocking and Overshadowing Effects on Timing in Pigeons
The effects of cue competition on timing were studied in both overshadowing and blocking operant procedures. A white center key delivered reward when pecked 30 s after a red side key was presented, and 10 s after presentation of a green side key on the other side. In Experiment 1, key presentations were concurrent during training trials for overshadow-condition pigeons, while side key presentations were separated across training trials for control birds. In Experiment 2, blocking was studied by preexposing experimental pigeons to either red or green side key training trials prior to training with concurrent stimuli. Peak time curves were compared between experimental and control conditions. The findings revealed evidence for blocking of timing accuracy but no evidence for overshadowing of timing accuracy.

P15

Cody W. Polack, Heather T. Sissons, & Ralph R. Miller (SUNY-Binghamton)
Determinants of the Overexpectation Effect
Three conditioned suppression experiments with rats were conducted to determine if trial spacing influences the overexpectation effect. Massing of reinforced trials with elemental stimuli impaired responding (trial massing effect) as did reinforced spaced trials of the target cue in the company of another conditioned excitor (overexpectation). Alternatively, massed reinforced trials of the compound stimulus produced less of a decrement than either of these decremental treatments alone. This effect was observed in both first-order conditioning and in sensory preconditioning. Subsequent extinction either of the companion stimulus or the training context found that these effects are mediated in part by the associative status of the training context at the time of testing.

P16

Regina Paxton and Robert R. Hampton (Emory University)
Choice by mutual exclusivity in rhesus macaques (Macaca mulatta)
Mutual exclusivity is the ability to associate a novel word with a novel object presented among familiar objects. It has been suggested that this skill is limited to word learning in humans, but evidence from nonhumans suggests it may occur in other contexts. In the present study, monkeys learned four stimulus-stimulus (S-S) associations. On two types of test trials three images from the known S-S pairs and one novel image were presented as comparisons. On exclusivity trials, the sample was a novel image and monkeys were required to select the novel comparison image. On control trials, the sample was a known image and monkeys were required to select its known associate. Monkeys learned to select the novel comparison image only on exclusivity trials, suggesting choice by mutual exclusivity. Additional experiments evaluated whether choice by exclusivity facilitated learning new S-S pairs.

P17

Caroline G. Strang, Leigh C. P. Botly, & Eve De Rosa (University of Toronto)
Probing Inhibitory Control in Rats
Two important components of inhibitory control are the ability to suppress: (1) a prepotent response and (2) processing of a task-irrelevant stimulus. These distinct inhibitory abilities are confounded in standard measures of inhibitory control, such as reversal learning. We examined the contributions of these two components in rats using conditional simultaneous odour discriminations in a within-subject design. A response reversal task required both inhibiting a prepotent response and responding to a previously task-irrelevant stimulus. A proactive interference task required inhibiting a prepotent response and responding to a novel stimulus. A learning-to-ignore task required responding to a previously task-irrelevant stimulus without any prepotent response inhibition. Although rats showed negative transfer in all conditions, it was greatest when inhibition of a prepotent response was required.

P18

Aya Hashimoto & Sadahiko Nakajima(Kwansei Gakuin University)
Contextual control of rats' conditioned taste aversion based on wheel running
Wheel running endows rats with conditioned aversion to a paired taste (see Boakes & Nakajima, 2008, for a review). This paper presents a successful demonstration of contextual control over such a running-based taste aversion in male Sprague-Dawley rats. In one physical context (e.g., a dark-silent room) a 15-min access to a salt-MSG solution was followed by a 30-min voluntary wheel running, while in the other context (e.g., a lighted-noisy room) the same solution was presented without the wheel running. Consumptions in these contexts were differentiated over the training days to show smaller intake in the running context than in the non-running context. Post-training manipulations including context extinction and transfer tests with another taste revealed that both occasion setting and simple context-running association were involved in the mechanism of this contextual control effect. Another intriguing finding of this research is that Wistar rats did not show robust evidence of contextual control.

P19

Takatoshi Nagaishi, Sadahiko Nakajima, & Madoka Nakanishi (Kwansei Gakuin University)
Overshadowing of rats' conditioned taste aversion based on wheel-running
In many Pavlovian conditioning preparations, conditioned responding to a target stimulus could be attenuated if the target stimulus were reinforced in compound with another stimulus (associative overshadowing). The present study demonstrated overshadowing of conditioned taste aversion by another taste in two experiments with wheel running as the aversion-inducing agent. Training rats with serial presentations of two taste solutions before confinement in an activity wheel (X -> A -> running) resulted in weak aversion to taste X, compared to the training procedure without presentation of A. This overshadowing effect was shown by an overnight one-bottle test in Experiment 1 and by daily 15-min two-bottle (X vs. water) tests in Experiment 2. Such an overshadowing effect has been reported in other Pavlovian conditioning preparations including poison-based taste aversion learning. Thus, the demonstration of overshadowing effect in this study provides another similarity between running-based taste aversion learning and other Pavlovian conditioning preparations.

P20

Tori Vratanina, Desiree Sharpe, & Irwin Bernstein (University of Georgia)
Quantity Discrimination and Token Summation in Western Lowland Gorillas
Gorillas are able to perform successfully on quantity discrimination and summation tasks involving primary reinforcement. Other primate species have demonstrated the capacity for quantity discrimination and summation with secondary reinforcement in the form of tokens (e.g., token A = 1 reward, token B = 3 rewards). We examined this capacity in nine gorillas. Six of the nine gorillas were able to successfully make quantity discriminations with tokens. Data collection is ongoing for the summation phase of the experiment, which only two of the six gorillas have reached at this time. Preliminary data analysis indicates that these two subjects are performing successfully at the summation task (i.e., are choosing the larger sum of two choices above chance). We expect similar performances from the remaining subjects.

P21

Shannon M. A. Kundey (Hood College), Andres De Los Reyes (University of Maryland, College Park), & Chelsea M. Taglang (Hood College)
Humans' Learning of Structured vs. Unstructured Subpatterns within a Random Subpattern
Recent evidence showed rats learned a structured (12345678) but not an unstructured subpattern (17356428) interleaved with responses on randomly presented levers (X) in a circular array: 1X2X3X4X5X6X7X8X or 1X7X3X5X6X4X2X8X. This suggests the rule-based nature of nonadjacent elements aided superior pattern learning even when the rule relating them was motor response independent. However, structured rats' learning was slower than expected based on studies using structurally more complex patterns. Here, we explored humans' performance in an analogous computer-based task using the same interleaved patterns. With a mouse, humans chose spatial locations in a circular array in proper sequential order. Like rats, only the structured group learned their pattern and learning was slower than expected.

P22

Mario A. Laborda, James E. Witnauer, & Ralph R. Miller (State University of New York – Binghamton, USA)
Contrasting overexpectation and extinction
Three conditioned suppression experiments with rats compared overexpectation and extinction. Experiment 1 replicated the basic overexpectation effect, responding in Group Overexpectation (which was exposed to reinforcement of X in compound with another excitor) was reliably less than responding in Group Control (which was merely exposed to further reinforcement of X in the presence of a neutral stimulus). Experiment 2 found that extinction was disrupted by context postexposure, whereas overexpectation was unaffected by context postexposure. Experiment 3 indicated that large numbers of extinction trials augment extinction but large numbers of overexpectation trials had no impact on the overexpectation effect. These results are inconsistent with the view that overexpectation and extinction are driven by a common mechanism.

P23

A. George Wilson (University of Georgia), Matthew S. Matell (Villanova University), & Jonathon D. Crystal (University of Georgia)
Mixed Temporal Memories in the Peak-Interval Procedure
The objective was to develop a procedure in which rats mixed short and long temporal memories. The reinforced duration was randomly selected to be either 8 or 21 s at the start of each daily session (8-21 group). For other rats, the duration was always 21 s (21-only group). At the beginning of sessions with 21-s durations, the 8-21 rats produced a peak at approximately 15 s, which was reliably earlier then in the 21-only group; the spread of the response rate distributions were the same, suggesting that the 8-21 group timed the intermediate value in a non-scalar manner. At the end of sessions with 21-s durations, the groups timed 21 s and were indistinguishable. The results suggest that in an ambiguous situation, rats mix temporal memories but then use a single memory when the reinforced duration is apparent.

P24

John F. Magnotti & Jeff S. Katz (Auburn University)
Orientation Feature Binding in Pigeons
Manipulating conditions under which humans search for a target is a standard approach for studying perceptual errors. Conjunction errors occur when participants incorrectly respond "target present" when only parts of the target are present. We adapted a framework from the human perception literature to test for feature binding in a conditional discrimination task. Pigeons responded to a yellow clover in the presence of a plus sign (+) and to a cyan pentagon in the absence of a plus sign (e.g., vertical line, horizontal line). We compared the false alarm rates on trials that contained all parts of the plus sign to trials that did not. The preliminary results of our study place stricter constraints on the conditions under which conjunction errors arise and influence responding.

P25

Sarah Jones, Jessica Cantlon, Monica Carlson, Elizabeth Brannon (Duke University)
Numerical Sensitivity of Lemurs
Previous work with primates has shown that accuracy in ordinal numerical tasks is modulated by the ratio between two numbers, as predicted by Weber's Law. This study was designed to estimate numerical sensitivity in multiple species of lemurs by estimating the Weber fraction (WF). Blue-eyed black (Eulemur macaco flavifrons), Mongoose (Eulemur mongoz), and Ring-tailed (Lemur catta) lemurs were trained to order the pairs 2-4, 4-8, and 2-8 on a touch-screen and then tested with all possible pairs of the values 1-9. WFs were estimated with the equation from Pica, et al (2004). Preliminary results indicate that the WF for lemurs is twice as large as the WF reported for rhesus macaques, and nearly 3 times as large as the WF reported for humans. Although all species are capable of ordinal numerical judgments, lemurs may form less precise numerical representations than those of monkeys or humans.

P26

Matthew J. Pizzo (Bucknell University), Kimberly Kirkpatrick (Kansas State University), & Pamela Blundell (University of Leeds)
Changes in criterion value alter performance on DRL schedules
The differential reinforcement of low rate (DRL) schedule is commonly used to assess impulsivity, hyperactivity, and the cognitive effects of pharmacological treatments on performance. The DRL schedule requires subjects to withhold responding for a certain amount of time between responses to obtain reinforcement. Often, the DRL criterion time is shifted towards increasingly longer values over the course of training, but the effect of this procedure is poorly understood. Two experiments examined the effects of shifts in DRL criterion. Both an abrupt shift in the criterion and a gradual incremental progression in criterion were compared with longer maintained criteria on different measures of DRL efficiency and inter-response time (IRT) production. The results illustrate that both types of criterion shifts produced

deficits in learning a longer DRL criterion. Additionally, this effect was more pronounced with a sudden shift. The combined results argue against using procedures that involve changing the DRL criterion.

P27

Karen E. Doyle & Stephen B. Fountain (Kent State University)
Two New Methods for Studying Serial Pattern Learning in Rats
In a serial multiple-choice (SMC) task like Fountain & Rowan's (1995), rats learned to choose successive correct positions from a circular array of six nose poke receptacles on one wall. Rats learning a structured pattern showed differential acquisition rates for different elements types. When rats had to make a "start" response for each trial on a receptacle centered in the circular array, the same pattern of results was obtained. In a serial reaction time (SRT) task in the same apparatus, rats learned to track the shifting position of a light presented as either a structured or unstructured series. Although the groups made similar chunk-boundary and within-chunk errors, rats learned to make fewer errors on a violation element in the structured series compared to the comparable item in the unstructured series. Differences between results from the SMC and SRT procedures will be discussed.

P28

Joseph Gaspard (University of Florida; Mote Marine Laboratory), Gordon B. Bauer (New College of Florida), Roger Reep (University of Florida), and David Mann (University of South Florida)
The Manatee Audiogram and Auditory Critical Ratios
A behavioral audiogram indicated that manatee auditory frequency detection for tonal stimuli ranged from 0.25 to 90.5 kHz with peak sensitivity extending from 8 to 32 kHz. Critical ratios, thresholds for tone detection in the presence of background masking noise, were determined with one-octave wide noise bands, 7 – 12 dB (spectrum level) above the thresholds determined for the audiogram under quiet conditions. Manatees appear to have quite low critical ratios, especially at 8 kHz. This suggests that manatee hearing is sensitive in the presence of background noise, which also suggests that they have relatively narrow filters in this frequency range. Interestingly, many manatee vocalizations are tonal harmonic complexes that often include a tonal component in the 4-8 kHz range.

P29

Laura R. G. Pickens & Stephen B. Fountain (Kent State University)
Adolescent Nicotine Exposure Procedures and Adult Rat Serial Pattern Learning
Adolescent nicotine exposure via osmotic pump at 6 mg/kg/day over postnatal days (P) 30-48 produces neurophysiological changes in the brains of adult rats (Trauth et al., 1999). We examined whether nicotine delivered in this manner during adolescence would produce cognitive deficits like those seen after daily injections in a study by Fountain et al. (2008). After adolescent exposure via the osmotic pump method, adult rats learned serial patterns beginning on P95 in the cognitive task of Fountain et al. (2008). Whereas Fountain et al. (2008) found that daily nicotine injections of 1 mg/kg over P25-59 caused impairments in adult rat serial pattern learning, adolescent exposure via osmotic pump did not produce cognitive deficits in adult rats. We will compare these two studies that used the same cognitive paradigm and propose possible reasons for the differing results.

P30

James D. Rowan and Ying (Joy) Tang (Wesleyan College)
The Effects of Phrasing Cue Placement in the Last Chunk of a Perfect Runs Serial Pattern.
Earlier research found that when human subjects learned a violation runs pattern (e.g. 123, 234,…, 818) with a 3s phrasing cue placed at either directly before the violation, the trial before the violation, or 2 trails before the violation, that all 3 groups learned the violation at the same rate but the group that received the cue the trial before the violation performed more poorly on the rest of the pattern. This experiment examined whether the effect was the result of phrasing cue placement or if there was an interaction between the misplaced cue and the violation. Subjects learned the same patterns as in the previous experiment but without the violation. Subjects in all three groups learned the pattern equally well, indicating that the disruption in the previous experiment was an interaction between the placement of the phrasing cue and the violation element.

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Poster Session II - Saturday Evening

P31 Kelly E. Radziwon, Kristie June, Matthew Xu-Friedman, Richard J. Salvi, & Micheal L. Dent (University at Buffalo-SUNY)
Behaviorally Measured Audiograms and Gap Detection Thresholds in Mice
Mice (Mus musculus) have become useful models in the study of hearing, although behavioral studies in these animals are still rare. We measured audiograms and gap detection thresholds using a Go/No-Go operant conditioning procedure requiring the mice to nose poke for a liquid reward, and the psychophysical Method of Constant Stimuli. Both experiments yielded consistent between-subject results. In the audiogram detection task, the mice were sensitive to frequencies ranging from 1 to 48 kHz, with peak sensitivity around 10 kHz. In the gap detection task, mice showed discrimination thresholds of 1-2 ms for 800 ms broadband noise bursts. These results add to the wealth of behaviorally-measured comparative data on hearing in mammals.

P32 Henrike Hultsch (Freie Universitaet Berlin)
Constraints in Song Retrieval in the Singing of Nightingales.
The hierarchical organization of singing by tape-tutored nightingales reflects the organization of auditory input experienced early in life. In particular, birds tend to sequentially associate imitations of those song-types that, as models during the tutoring, were experienced together in a coherent string of stimulus songs . To understand the process of retrieval of acquired songs, I examined the performance length of bouts of imitations developed from tutored song strings of various lengths (range: 3 to 40 songs). Sequentially coherent performances of imitations from shorter song strings (e.g. 3songs) were longer (i.e. contained more song renditions from that string) and those from longer strings (e.g. 40songs) were shorter (i.e. contained less song renditions)than expected from experience of the 'originals'. These findings suggest that retrieval of stored song is constrained by an equivalent to working memory.

P33 Benjamin M Basile, Michael R Ortiz, & Robert R Hampton (Emory University)
Effects of image set size and practice on the serial position curve in rhesus monkeys (Macaca mulatta)
The combination of primacy and recency produces a U-shaped serial position curve typical of memory for lists. Using serial probe recognition, we evaluated the effects of image set size and practice on the serial position curve in rhesus monkeys. Monkeys studied lists of five images on a touchscreen. At test, they saw one image and a "non-match" symbol. They were required to touch the image if it was from the list and the non-match symbol if it was not. In Experiment 1, we tested lists drawn from large, medium, and small sets of images, in that order. We observed primacy only with the latter two, smaller image sets. In Experiment 2, we distinguished between the effects of set size and practice by using the three set sizes concurrently. The role of image familiarity and practice on primacy and recency will be discussed.

P34 Chuck Locurto, Matthew Gagne, & Lauren Nutile (College of the Holy Cross)
Tests of Implicit Chaining in Cotton Top Tamarins (Saguinus oedipus) II
Tamarins were shown a five-element serial chain that consisted of an icon presented at different locations on a touchscreen. Learning the chain's pattern was not necessary for reinforcement. Tests were conducted following training to determine what the tamarins had learned, two of which were new to this procedure. One new test involved occasionally replacing the training icon with new icons at each serial position. The second test, termed "running start," gave the tamarins the beginning of the chain (e.g., A->B), and then gave them a choice between the next item in the chain and the subsequent item (C or D). The subsequent item was closer to food in procedures in which food came at the end of the chain. The choice, then, was between the next element in the chain (C) versus one that was temporally closer to food (D).

P35 Lauren Highfill (Eckerd College), David Hanbury, Rachel Kristiansen, Stan Kuczaj, & Sheree Watson (University of Southern Mississippi)
The Use of Personality Assessments in Designing Environmental Enrichment for Garnett's Bushbabies (Otolemur garnettii)
The personality traits of ten bushbabies were assessed using a variety of behavioral and cognitive tasks. Each subject was also exposed to five different enrichment interventions to assess the relationship between personality and enrichment effectiveness. All interventions improved animal welfare by increasing the frequency of species-typical behaviors, but some forms of enrichment differentially benefited individual subjects based on their personality. For example, after participating in a simple training exercise, subjects which scored high on Openness to Experience significantly decreased their maladaptive behaviors. These results have implications for using personality as a tool for improving the cognitive well-being of animals.

P36 Rebecca Greenberg & Dorothy Fragaszy (University of Georgia)
Decision-Making Strategies of Wild Capuchin Monkeys

Wild bearded capuchin monkeys (Cebus libidinosus) use stone tools to crack open tough palm nuts to ingest the kernel. Optimal foraging theory recognizes alternative strategies that individuals adopt in complex foraging circumstances. Nine monkeys from a well-documented group of wild bearded capuchins were studied over a four-week period in Piauí, Brazil. We gave the monkeys a choice of two nuts differing in resistance and two manufactured stones of same volume but different mass. Other experiments allowed the choice of two manufactured stones with one hard nut so that the choice of stone was more important. Monkeys consistently selected the nut that was easier to crack and the heavier stone when the stones differed in weight by at least 500 grams. This study suggests that capuchins are sensitive to properties of stones and nuts, as reflected in their choice of materials for cracking nuts.

P37

Radhika Makecha (Stephen F. Austin State University), Stan Kuczaj (University of Southern Mississippi), & Otto Fad (Busch Gardens, Tampa)
An investigation of the use of touch in the social interactions of a group of Asian elephants (Elephas maximus)
Elephants use a variety of sensory modalities to communicate, including touch. However, little is known about the role of touch in their social interactions. The tactile interactions of six Asian elephants were examined to better ascertain how touch is used in social contexts. Elephants differed in their initiation of general tactile behaviors, as well as in their initiation of aggressive and nonaggressive tactile behaviors, with dominance rank being one of the influencing factors. Further analysis revealed the trunk as the body part playing the largest role during tactile interactions. Touch seems to be an important part of elephant social interactions, but much remains to be discovered about its role in communication.

P38

Anna Wilkinson (University of Vienna) and Kimberly Kirkpatrick (Kansas State University)
Tracking and capture of constant and sinusoidal velocities in pigeons and humans
Pigeons and humans were trained on identical motion-tracking and capture tasks using a touch screen apparatus. A 0.5-cm yellow circle entered the viewing screen and moved directly across on either a horizontal or vertical path. The mean speed was 3.4 cm/s and could either be a constant velocity or a sinusoidal velocity which varied systematically over the motion path. Both pigeons and humans were slightly worse at capturing a sinusoidal velocity, but both species were able to learn to capture both types of motion. On special test trials where the stimulus suddenly and unpredictably stopped, both species made many errors and demonstrated an "overshoot" effect in which their errors were in front of the target position. This indicates that both species were anticipating ahead of both the constant and the sinusoidal velocities. The results suggest general similarities in the tracking and capture of motion by humans and pigeons.

P39

Jessica Crast (University of Georgia)
A Pilot Study of the Social Facilitation of Foraging Activity
Capuchin monkeys (Cebus apella) are social foragers that specialize on embedded foods. Young capuchins require years of practice before reaching adult foraging proficiency. I propose that foraging activity is socially facilitated and that the social facilitation of practice contributes to learning foraging skills. Thus, during several 10-minute sessions I presented eight adult male capuchins with a foraging task and recorded latencies to make contact with and solve the task, duration of investigative contact prior to first solve, and overall duration of movement of the functional parts of the task. Subjects were divided into two groups: Alone (four subjects were presented with the task alone) and Social (four subjects were presented with the task in the presence of a working partner). Results show that subjects in the Social group contacted and solved the task faster than subjects in the Alone group.

P40

Tamra Beckman, Jennifer Vonk (University of Southern Mississippi) & Stephanie Jett (University of South Alabama)
Cognitive Dissonance in Birds
Six members of the parrot (Psittacinae) family were presented with a cognitive dissonance paradigm modeled after Egan Santos & Bloom (2007). In experimental trials subjects were given choices between two equally preferred food items. In control trials subjects were presented with one accessible and one inaccessible option from another triad of equally preferred food items. Next, the unchosen or previously inaccessible item and a novel equally preferred item were presented. The birds showed no significance preference for the novel versus the unchosen option on experimental trials, suggesting that they did not resolve dissonance by devaluing the unchosen option from previous trials. This result is consistent with a previous study in which monkeys, but not black bears, exhibited cognitive dissonance, which suggests that this phenomenon may be unique to primates.

P41

Tammy L.B. McKenzie & Sierra King (Brandon University)
Do hormones influence categry learning in horses?
It is extremely important to many species to be able to categorize stimuli. Categorization reduces cognitive strain and allows for organisms to organize their world. In nonhuman animals, a substantive amount of research has been done on category learning in pigeons and non-human primates. Despite the plethora of knowledge gained from research conducted with pigeons and non-human primates much still remains to be discovered about category learning in non-human animals, in particular the effects of a wide variety of factors on category learning including androgen levels, pregnancy, etc. The present research, conducted with horses, provides insight into the potential influence of androgen levels on category learning in non-human animals. Stallions performed better on a categorization task than did geldings.

P42

Kara A. Tyler (New College of Florida), Kate M. Chapman (Pennsylvania State University), Caitlin O'Brien (New College of Florida), & Gordon B. Bauer (New College of Florida, Mote Marine Laboratory).
Behavioral Lateralization in the Florida Manatee (Trichechus manatus latirostris)
Limb preferences and scar locations in animals are used to infer lateralization of the brain in many species. The flipper uses of 10 captive and 31 wild Florida Manatees were recorded and analyzed for individual and population-level flipper preferences. The manatees displayed an overall population- level bias for the left flipper. This may indicate underlying hemispheric lateralization. Additionally, 47 watercraft-related scars were analyzed for the side of the body on which they occurred and were found significantly more often on the left side of the body than on the right side of the body or down the center implying possible lateralization of evasion behavior in the manatee.

P43

Hyangsun Chin, Sadahiko Nakajima (Kwansei Gakuin University) & Michihiro Taki (Kobe City Suma Aqualife Park)
Reaction of captive bottlenose dolphins to their mirror images
We exposed five female bottlenose dolphins (Tursiops truncatus) in an aquarium to a mirror for recording their responses with a single-case reversal design over 7 test days (one test day per week). Each test day consisted of three 30-min sessions with the inter-session interval of 60 min. The dolphins could see either a blue acrylic board (the baseline condition) or an acrylic mirror (the mirror condition) attached behind the underwater window of their home pool. The frequency of window-related behaviors (e.g., approaching the window) was higher in the mirror condition than in the baseline condition, suggesting their interest in the mirror. Displaying the food (squid) and tongue-protruding were observed exclusively in the mirror condition. One of them also showed threatening behavior against the mirror. Further research is required to elucidate whether their behaviors reflect self-recognition.

P44

Sarah Benson-Amram*, Alan Bond (Univ. of Nebraska) and Kay Holekamp* (*Michigan State Univ.)
Problem-solving in Captive and Wild Spotted Hyenas
We designed a Thorndike-like puzzle box to study problem-solving in captive and free-living spotted hyenas (Crocuta crocuta). A rebar box contained meat that hyenas accessed by sliding a bolt. Overall, captives were more successful at solving the puzzle, and more innovative, than wild hyenas. Innovation was measured as the number of different exploratory behaviors individuals emitted in their first trial. Five hypotheses might explain difference in success between captive and wild adults. Higher success among captives might be due to 1) greater motivation, 2) shorter time between trials, 3) more undisturbed time with the box, 4) extra energy or 5) more experience with man-made objects. Hypotheses 1-4 were not supported by our data. Our results therefore suggest that higher success and innovation among captives may be due to more experience with man-made objects.

P45

Danielle Sulikowski & Darren Burke (Macquarie University)
Movement analyses reveal food-specific search patterns in the omnivorous Noisy Miner bird
In a previous study we allowed noisy miner birds to forage for either nectar or invertebrates in an open-field analogue of the radial arm maze. Introducing a manipulation that disrupted the birds' movement had a greater detrimental effect on performance when birds were foraging for invertebrates than when they were foraging for nectar. In the study reported here, we allowed birds to forage in a larger maze to facilitate more detailed analyses of their movement. These data show clear differences between the search patterns used by nectar foragers and those used by invertebrate foragers. These findings lend further support to the notion that a movement-based strategy is used while birds are foraging for invertebrates, while a spatial memory strategy is employed for nectar.

P47

Kosuke Sawa & Yuka Abe (Senshu University)
Effect of landmark salience on spatial learning in hamsters
Many species tend to use spatial landmarks as cues to explore the location of biologically significant goal (e.g., food patch). In present research, we explored the contents of spatial knowledge based on landmarks in Djungarian Hamster (Phodopus sungorus). Search area was round arena and twelve candidates of goal were located on the circumference of arena. During training, two identical landmarks were put on both adjacent sides of goal. In testing, landmarks were moved along circumference. Subjects showed different trends of performance in testing based on the size of landmark used in training, which suggested that landmark salience affected on the contents of spatial knowledge.

P48

Takaaki Kaneko & Masaki Tomonaga (Primate Research Institute, Kyoto University)
Perception of self agency in chimpanzees
We investigated the cognitive capacity of chimpanzees to distinctly recognize the action caused by themselves from the action caused by the other factors. We used a track ball and a touch panel monitor as input devices. In each trial, two cursors are shown on the display. One is manipulated by the chimpanzees using the track ball and the other is replayed motion of "past action of the same chimpanzee". The chimpanzees are required to touch the cursor they manipulated. Three chimpanzees participated in this experiment, and successfully discriminated the cursor they moved from the other. Furthermore, the results from one of the chimpanzees can not be attributed to only a simple visual discrimination but a matching between visual feedback and her own action. We are further investigating their specific strategies by focusing on effects of temporal and spatial contingency.

P49

Erin N. Colbert-White, Dorothy Fragaszy, & Betty Jean Craige (University of Georgia)
An African Gray Parrot's Use of Language to Regulate Social Relationships
Captive African gray parrots bond socially with their human caregivers. This study examines how one parrot uses language to regulate her social relationship with her owner. We videotaped the parrot in four social contexts (home alone, owner in the room, owner out of the room but within hearing range, and owner and company present but parrot ignored). Preliminary results include frequent non-word vocalizations when alone or ignored, phrase choice and placement that are arguably similar to human persistence and persuasion, re-occurring phrases referencing subject and owner location with frequent requests for interaction when owner not in the room, and possible behavioral indications of frustration at being ignored. These results suggest the subject deliberately uses language as a tool to regulate the owner's attention and physical proximity.

P50

Frank Fishburn and Toru Shimizu (University of South Florida)
Male Pigeons Discriminate Real-Time and Pre-Recorded Self-Videos
Male pigeons attempt to engage in courtship-like behavior with unfamiliar individuals regardless of sex. Accordingly, we studied whether males react differentially to real-time views of the self compared to pre-recorded views of the self. Subjects reacted strongly to pre-recorded video images of the self and those of unfamiliar males. Their responses were weaker to the real-time views of the self, including mirrored and horizontally or vertically flipped images. The results suggest that they discriminated between the real-time and pre-recorded stimuli. The discrimination might be simply based on certain physical characteristics of the stimuli or the specific behaviors of the stimulus birds at a certain location relative to the subject. It is also possible that the subjects discriminated these stimuli based on congruence with real-time proprioceptive or reafferent signals.

P51 Pierre Blacher, Dominique Fresneau & Elise Nowbahari (UMR CNRS 7153, Université Paris Nord, Villetaneuse, France)
Investigation of individual discrimination and social status capacity of ants Pachycondyla apicalis
In workers of Pachycondyla apicalis, the egg-laying is regulated through the establishment of a dominance hierarchy. Models of social hierarchy suggest that, to avoid costly fights, workers may have developed cognitive abilities to distinguish superior rivals. Indeed, individuals recognize individually each nestmate and/or their corresponding social status. We observed in three queenless colonies, the establishment of the hierarchies in order to determine the rank of each worker. Then we tested the two alternatives using an habituation/discrimination paradigm. Our study does not show an individual recognition of nestmates of P. apicalis workers, but clearly demonstrates that they can discriminate their social and reproductive status. Therefore, within the scope of a reproductive hierarchy, such capacity may have evolved to reduce costly conflicts among workers, thus enhancing colony efficiency.

P52 Lisa K Son (Barnard College), Gin Morgan, Tamar Kornblum (Columbia University), Damian K. Scarf (University of Otago), & Herbert Terrace (Columbia University)
Metacognitive assessments of implicit memories
Metacognition has become a buzzword in the field of cognitive and educational psychology. For the most part, data revealing fairly good metacognitive abilities have come with assessments of what people know and don't know explicitly. For instance, how certain are you that you remember your own phone number? A question that has been largely ignored, however, is whether or not people have an ability to make accurate assessments of implicit memories. Using a non-verbal betting procedure in which participants risk a high or low number of points as a measure of certainty, children were trained on an implicit memory test. Results implicate that (i) metacognition might not be dependent on explicit knowledge, and (2) metacognition may consist of an automatic component.

P53 Kent D. Bodily (Georgia Southern University) & Jeffrey S. Katz, (Auburn University)
Like Honeybees, Humans Estimate Distance via Optical Flow
Optical flow is a visual self-motion cue which provides velocity and rotational information to the observer. Srinivisan, Zhang, & Bidwell (1997) manipulated optical flow (i.e., floor and wall patterns) of a tunnel in which honeybees searched for a goal. Bees searched accurately only under optical flow conditions, suggesting that bees estimate distance via optical flow. The present study adapted the tunnel task to test human participants in a desktop virtual environment. The floor and wall patterns varied between two optical flow conditions and a non-optical flow condition. Movement speed was manipulated to rule out timing. Distance estimates were highly accurate in optical flow conditions, but not in the absence of optical flow, irrespective of movement speed. Results suggest that, as for honeybees, optical flow alone is sufficient for distance estimation in humans.

P54 Fabian A. Soto & Edward A. Wasserman (University of Iowa)
Pigeons' discrimination of identity and emotion in photographs of human faces
In two experiments, eight pigeons were trained with a go-no go discrimination involving black-and-white photographs of people displaying different facial emotions. The first experiment involved photographs of four people (two males and two females) showing the emotions of happiness, disgust, anger and surprise, whereas the second experiment involved a different group of people showing happiness, anger, sadness and fear. For each subject, responding to only one identity-emotion combination was reinforced, and generalization of responding was measured to all 16 possible combinations. All the pigeons readily learned the discrimination task, and the generalization results in both experiments consistently showed control of behavior by the two properties of the stimuli, with a tendency toward stronger control by identity than by emotion.

P55 Pamela J. Reid, Laura Davis & Kristen Collins (ASPCA Animal Behavior Center)
Do Dogs in Pairs Forage Efficiently?
The dog is a social species that, when living in a feral state, typically scavenge together in refuse dumps and on village streets. Given the social nature of dogs and their reliance on competitive opportunistic feeding, we were curious to know if they are capable of understanding when they should join a partner in exploiting a food source and when they should forage elsewhere. We investigated the behavior of pairs of dogs foraging in a room where food was hidden. In the first setup, food was available in twop adjacent locations, only one of which could be monopolized at a time. In a second setup, we permitted one dog to watch its partner forage first before gaining access to the feeding apparatus. Dogs avoid close contact with their partners while they are feeding, but, once absent, they find their partners' empty foraging locations irresistible.

P56 Alejandra Rossi & Colin Allen (Indiana University)
Intentional behavior in dog-human communication
In this paper I investigate under what conditions showing behavior (transferring of information in an active way from the dog to the owner) emerges in dogs (N=10). In order to study this, the dogs were observed under different experimental conditions where the presence of the humans and/or hidden food was manipulated. We think that dogs will show the aforementioned behavior. We also analyzed the relation between the owner-dog relationship and the way the dog behaves in the communication task by analyzing video tapes of free playing time. We hypothesize that if the owner-dog relationship is more interactive, the dogs will tend to do more showing behavior than if the relation is less interactive. The results support our hypothesis.

P57 Wendi Fellner (The Seas, Epcot®, Walt Disney World® Resorts) and Heidi E. Harley (New College of Florida, The Seas, Epcot®, Walt Disney World® Resorts)
Bottlenose dolphin (Tursiops truncatus) whistles vary by context
The signature whistles of bottlenose dolphins can vary in frequency and duration parameters between contexts. However, how and why contextual differences affect the whistles is not clear. We analyzed whistles across time and contexts (e.g., perceptual assessment sessions, medical exams). A naïve sorter correctly categorized whistle spectrograms with 95.0% accuracy. Stereotyped whistles can change over time and context, and whistles with similar contours have the capacity to carry contextual information.

P58

Gin Morgan & Herbert S. Terrace (Columbia University)

Further Demonstrations of Metacognitive Skills in Rhesus Macaques (Macaca mulatta)

Recent experiments conducted in our lab (Kornell, Son, & Terrace, 2007) have shown that rhesus macaques can learn to make retrospective confidence judgments using "low" and "high" risk icons and transfer that skill to new perceptual tasks and a memory task. We trained two rhesus macaques, both with experience making confidence judgments, on a new memory task, and both subjects showed immediate transfer of metacognitive skills when required to make retrospective confidence judgments. Using the same memory task, subjects also learned to make prospective confidence judgments. Last, results from a study involving the introduction of a third confidence level will be presented.

P59

Delgado, M., Wendel, L., & Cerutti, D. (University of California, East Bay)

Abstract. We have recently initiated a programmatic study of the inter-session behavior of 10 laboratory pigeons serving in experiments on operant behavior. Our first study involved filming the 12-hour “daytime” activity of caged birds. Interval observations of various activities reveal that the individually housed pigeons are very active in their home cages, pacing, preening, pecking, and so forth, for a large portion of the day. An unanticipated observation is that the pigeon’s behavior is inhibited when humans are present; we are now exploring the temporal distribution of their caged behavior in detail. A second experiment now in progress examines their behavior in an aviary with various “enrichment” features such as cubbies and perches. We anticipate that our findings will be relevant to concerns about appropriate housing for the laboratory pigeon.