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Wednesday Evening

6:50 PM **Opening Remarks - Mike Brown**

7:00 PM **Spatial Cognition I** (Chair - Mike Brown)

7:00 PM Jody L. Lewis (University of Wisconsin –Stevens Point), Alan C. Kamil (University of Nebraska –Lincoln), & Kate Webbink (University of Nebraska -Lincoln)

Landmark cues are important for nutcracker spatial memory

Clark's nutcrackers (Nucifraga Columbiana) are susceptible to proactive interference when remembering serial lists of locations. We tested each bird's memory for two serial lists in an open room. During each list, they were shown a series of locations, given a 5 minute retention interval, and were then required to locate the seeds in the list using the cluster method. Memory for locations was poorer for the second list. We found that changing the landmark array between list 1 and list 2 decreased proactive interference, but changing the wall cues in the room did not.

7:14 PM Francis Bartlett and Fred Dyer (Michigan State University)

When do honey bees use snapshots during navigation?

Previous studies suggest that honey bees store an image of local landmarks near a rewarding goal location. This memory is then used in a sequential image matching process to generate steering commands that lead to the goal upon their return. Evidence for image matching during honey bee navigation comes from search distribution data collected when foragers were very near the goal location. Our experiments examined whether honey bees use a similar image matching strategy from more remote locations outside a familiar landmark array. We found that honey bees prefer to use a single landmark as a beacon to get near a familiar landmark array even over very short distances. Our results indicate that if bees use a snapshot to guide flight it is primarily during the final search in a small region surrounding the goal.

7:28 PM Jerome Cohen, Xue Han, Anca Mateir, & Varakini Parameswaran (University of Windsor)

Estimating Rats' Working Memory Capacity for Objects in a Foraging Task

We developed a method for estimating the number of objects a rat can retain in its working memory as follows. After allowing a rat to obtain food under each object during a 'study' segment in foraging arena, we return it to the foraging arena for the 'test' segment to search for one or more new baited objects that replace one or more of the original objects. We analyzed the effects of varying the size of the patch (number of objects) on a trial and the proportion of new objects replacing original objects on rats' accuracy in finding the new objects. We estimate each rat's retention capacity by comparing its number of choices it made to find the new object(s) over many trials with hypothetical number of choices based on chance to perfect retention. We examine how our preparation addresses problems concerning measurement of memory in non-verbal organisms (e.g., Thorpe et al., 2004) and compare our estimates of rats' working memory capacity for objects with that in verbal organisms (e.g. Olivers et al., 2006).

7:42 PM Michael F. Brown & Karen Doyle (Villanova University)

Social effects on spatial choice: Social stimuli and social memories produce different effects

We have recently reported several experiments in which pairs of rats made choices together in a radial arm maze. In those reports, the previous choices of another rat sometimes produced an increase in the probability of spatial choice and sometimes produced a decrease in the probability of spatial choice. Here we report more detailed analysis of the

data which resolve the discrepancies. A consistent facilitation of spatial choice is found when a foraging partner is physically present in a maze location. However, working memory for the earlier choices of the other rat results in avoidance of those maze locations.

7:56 PM Ruey K. Cheng, Christopher J. MacDonald, Christina L. Williams, & Warren H. Meck (Duke University)

Organizational and activational effects of photoperiod on spatial and temporal memory in laboratory rats

Spatial and temporal memory were studied in adult Sprague-Dawley rats that were conceived and reared in either short day (SD–8:16 light/dark) or long day (LD–16:8 light/dark) photoperiods. Both male and female LD rats showed an increased capacity of spatial memory as indexed by a lower number of choices to criterion in a 12-arm radial maze task compared to the performance of SD rats. In contrast, when trained in the peak-interval procedure, SD rats displayed a distortion in the content of temporal memory by showing a proportional rightward shift in the 20 and 60s temporal criteria, a pattern that is consistent with reduced cholinergic function in normal rats. Taken together, our results suggest that both spatial and temporal memory processes are sensitive to photoperiod variation in laboratory rats in a manner similar to that previously observed for reproductive behavior.

8:03 PM Cassandra Gipson, Kelly DiGian, & Thomas Zentall (University of Kentucky)

Evidence for Retrospective and Prospective Spatial Coding by Pigeons may Result from Faulty Assumptions

In a radial maze task, when a delay is interpolated at different points in the trial (over trials), rats show evidence of both retrospective and prospective memory (Cook, Brown, & Riley, 1985). This effect has been replicated in pigeons but it relies on the assumption that subtracting control-trial errors from delay-trial errors results in errors solely attributable to the delay. In the present research, this assumption was avoided by including a binary choice involving one already visited and one not yet visited alternative following each point of delay interpolation and also pigeons were prevented from selecting the order of the stimuli chosen. We found that relative to control trial accuracy, on delay trials there was a constant error rate attributable to the delay (i.e., there was a general memory loss attributable to the delay). Thus, the findings from earlier research may have resulted from inappropriate assumptions.

8:15 PM Time, Number, and Sequence Learning (Chair - Bill Roberts)

8:15 PM Angelo Santi, Neil McMillan, & Patrick Van Rooyen (Wilfrid Laurier University)

Rats' memory for event duration in delayed matching-to-sample with nonspatial comparison response alternatives.

Studies which have examined rats' memory for event duration in delayed matching-to-sample have produced retention biases which are less consistent than those obtained with pigeons. Procedural factors which affect this variability will be reviewed. An experiment will be presented in which moving versus stationary levers are used as the nonspatial response alternatives. The results indicated that rats acquired the duration discrimination task faster than with previous methods, but they exhibited a choose-long bias, not a choose-short bias, when delay tested. Despite extensive training with variable delay intervals ranging from 1 – 4s, the rats continued to exhibit a tendency to time from onset of the signal until entry of levers into the chamber. Additional procedural modifications designed to discourage timing through the delay interval will be presented.

8:29 PM Joshua Beckmann & Michael Young (Southern Illinois University at Carbondale)

Effects of Stimulus Dynamics on Temporal Discrimination

The present study examined the functional relationship between stimulus dynamics and stimulus duration judgments in humans. Stimulus dynamics were defined by how quickly a sphere rotated on its Y-axis. A bisection task was used to divide short stimulus durations (500 ms to 1700 ms) into two categories, short and long. In Experiment 1, duration judgments were longer the faster the sphere was rotated. In Experiment 2, the impact of contextual dynamics on temporal judgments was examined by accompanying one of the sphere rates with either two faster or two slower rates. The results indicate that stimulus dynamics influence the point of subjective equality and the sensitivity of the discrimination function. The results are discussed within the context of a proposed "time as change" model.

8:36 PM Gin Morgan and Herbert S. Terrace (Columbia University)

A Comparison of Numerical Representation in Rhesus Macaques (Macaca mulatta) and Humans

Recent research on numerical representation in nonhuman primates has focused on possible mechanisms, their similarity to those used by humans, and their limits. We have conducted a series of experiments comparing performance of rhesus macaques (Macaca mulatta, n=2) and humans on a delayed, non-identical numerical matching-to-sample task. The ranges of numerical values used were 1-9 and 1-15. Results indicate that rhesus macaques use a parallel enumeration mechanism contrary to the iterative mechanism humans employ. Due to the presence of a robust end effect on both ends of the stimulus continuum, but a lack of scalar variability in responses, rhesus macaques appear to use a single estimation mechanism for all stimuli that is influenced heavily by relative continuum position. When humans are given limited time to complete the task, reaction times reflect a similar influence of continuum position. Accuracy for human subjects appears to reflect an ability to subitize smaller values but response patterns for larger values appear similar to those

obtained from monkeys. Thus, while human subjects may use more than one enumeration mechanism to complete the task, estimation appears to be similar in both species.

8:43 PM Kazuhiro Goto (Keio University), Alan C. Kamil, & Alan B. Bond (University of Nebraska, Lincoln)

Interactions between associative and sequential priming

Facilitative effects of associative and sequential priming have often been reported in the literature, but little is known about their relationship. In this study, we examined how these two types of priming might interact. Blue jays were trained to search for two types of target among distractors. At the beginning of each trial, either informative or uninformative prime was presented as a start key; pecks to the start key initiated the trial. The four conditions tested were: 1) Only primes predicted target types (associative priming), 2) only trial sequence (i.e. AAA...BBB...) predicted target types (sequential priming), 3) both primes and trial sequence predicted target types (combinational priming) or 4) Neither primes nor sequence predicted target types (control). The conditions 1) and 4) and the conditions 2) and 3) were paired and tested in alternative sessions to examine whether the effect of associative priming is conceivable when sequence priming is present/absent.

8:57 PM Stephen B. Fountain, Denise P. A. Smith, Amber M. Chenoweth (Kent State University), James D. Rowan (Wesleyan College), Melissa D. Muller (Mount Union College), Laura R. Glass, & Shannon M. Kundey (Kent State University)

Distinct Behavioral and Brain Processes Subserving Serial Pattern Learning

Our recent studies have shown that different aspects of serial pattern learning and performance can be disrupted by different drug and brain lesion manipulations. We will summarize the differential effects of a) acute systemic administration of the drug, MK-801, an NMDA-receptor antagonist, b) dorsal hippocampal lesions, c) medial caudate-putamen lesions, d) acute administration of the muscarinic cholinergic antagonist drugs, atropine and scopolamine, and e) acute and chronic nicotinic cholinergic agonists and antagonists. The differential effects of these neurobiological manipulations fit well with claims that serial pattern learning involves multiple concurrent psychological processes including stimulus-response learning, multiple item memory, counting or timing, chunking, and rule learning. Taken together, the results of the foregoing studies show that the serial pattern learning paradigm is an excellent model system

for examining the contribution of multiple cognitive and neural processes that contribute to performance in a single task.

9:11 PM Chuck Locurto (College of the Holy Cross)
Implicit Chaining in Cotton-Topped Tamarins
In human cognition implicit learning refers to procedures in which subjects learn a task that includes patterned information, although successful performance does not depend on mastery of the pattern. We studied a nonhuman analog of this procedure by arranging for cotton-topped tamarins (Saguinus oedipus) to observe a five-item patterned string that consisted of the same icon presented serially at different locations on a touchscreen. Tamarins had to touch the icon when it appeared to advance the pattern and receive reinforcement at the end of the string. Following training they were tested for their knowledge of the pattern using the same type of pair-wise item tests that are common in transitive inference and chaining experiments (e.g., B-D). The intent of the testing was to ask what the tamarins learned about the pattern when they didn't have to learn anything.
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9:30 PM

Associative Learning (Chair - Aaron Blaisdell)

9:30 PM Heather T. Sissons, David Guez, and Ralph R. Miller (SUNY – Binghamton)

Blocking and Pseudoblocking: The Reply of Ratus norvegicus to Apis mellifera

Blaser, Couvillion, and Bitterman (2006), studying conditioned foraging by honeybees, reported pseudoblocking. Pseudoblocking is a blocking-like effect in which, unlike conventional blocking treatment, the target (blocked) CS is omitted in Phase 2 of treatment, and a deficit in responding at test is observed relative to a control group that received presentations of the US alone in Phase 2. The occurrence of pseudoblocking suggests that traditional accounts of blocking are incorrect. In Experiment 1, we obtained conventional blocking but failed to observe pseudoblocking using a control procedure that was similar to our usual blocking control treatment. In Experiment 2, we obtained the pseudoblocking effect in rats using a fear conditioning preparation relative to Blaser et al.'s control treatment, but only when we modeled what Blaser et al. called the training context with a punctate stimulus. Our results are consistent with a simple account of pseudoblocking within the framework of conventional associative models. Pseudoblocking does not challenge traditional accounts of blocking.

9:37 PM Gonzalo P. Urcelay and Ralph R. Miller (SUNY-Binghamton)

A Comparator View of the Overtraining Effect

In Pavlovian conditioning, an often unnoticed phenomenon is a loss of conditioned responding with extended reinforced training (e.g., Millenson & Hendry, 1967; Pavlov, 1927). We investigated a source of this effect in two experiments using rats as subjects in a fear conditioning preparation. In Experiment 1 four groups of rats received 5, 10, 20, or 50 reinforced trials. As reinforced training trials were increased, behavioral control decreased. We reasoned that the training context gains associative strength with extended training and competes at the time of testing with responding to the target cue. In Experiment 2 we trained rats with 5 or 50 reinforced trials and orthogonally extinguished or did not extinguish the training context. The groups that did not experience context extinction replicated those of Experiment 1. After context extinction the groups showed a recovery of conditioned responding, presumably because the training context no longer interfered with responding to the target cue. These results will be discussed in the framework of the comparator hypothesis and alternative

explanations.

9:44 PM Singer, R. A. & Zentall, T. R. (University of Kentucky)

[A Direct Test of Contrast and Delay Reduction Hypotheses to Account for Preference for Stimuli Following Relatively Aversive Events]

Humans often prefer rewards that follow greater effort over rewards that follow less effort, a phenomenon known as justification of effort. Similar behavior, when seen in pigeons, has been interpreted as a form of contrast, within-trial contrast, in which the relative value of a reward depends on the value of the event immediately prior to the reward (Clement, Feltus, Kaiser, & Zentall, 2000). However, the delay reduction hypothesis (Fantino, 1969) which proposes that the value of a signal for food depends on the degree to which it is a better predictor of food than its absence can also account for many of these effects. The current experiments provided a direct test of the delay reduction and contrast hypotheses by manipulating the response requirement while holding trial duration constant. Consistent with the contrast hypothesis, pigeons showed a significant preference for the signal for food associated with their less preferred schedule.

9:51 PM Michelle Finn, Karl G. Lutterloh, & James C. Denniston (Appalachian State University)

Analysis of Mechanisms Underlying Renewal of Conditioned Responding

Two experiments using rats as subjects were designed to investigate mechanisms underlying the context specificity of extinction (i.e., the renewal effect). Experiment 1 provided training in which each of three CSs (A, B, and C) were followed by a shock US in Context C. These trials were interspersed with nonreinforced exposure in CS A in Context A and CS B in Context B. At test, weak responding was observed to CS A in Context A, but not Context C, and weaker responding was observed to CS B in Context A than in Context C, thereby demonstrating occasion setting and transfer of occasion setting by context, respectively. Experiment 2 was designed to examine mechanisms underlying the renewal effect. In Experiment 2, training analogous to that of Experiment 1 was provided phasically (i.e., acquisition followed by extinction). At test, equivalent renewal was observed to CS B when testing occurred in either another extinction context (A) or a neutral context. This failure to observed transfer of control by context questions whether occasion setting is the

primary mechanism underlying the renewal effect.

Thursday Afternoon

12:30 PM Category and Concept Learning I (Chair - Jeff Katz)

12:30 PM Stephen E.G. Lea, Andy J. Wills & Catriona M.E. Ryan

Category Organisation in Free Classification by Pigeons: A Comparison with Human Subjects

In a free classification task using compound stimuli, humans will usually categorise exemplars according to a single dimension of the stimulus. Under certain conditions, however, they will sort according to the overall similarity of the exemplar to a prototype. The present experiment was designed to see if pigeons would behave in a similar way. Eight pigeons were trained to discriminate between two variants of each of four stimulus dimensions using a go-left-go-right procedure. When they had learned this they were switched to a new discrimination, where the stimuli consisted of triangular arrays of either the left-positive or the right-positive variants of three of the original dimensions. They were then given a series of test trials, in which one dimension in each array was exchanged for the one of the opposite type. All dimensions were found to have some control over the birds' responding, though one of them tended to predominate for four birds. Three more birds showed significant control by more than one dimension. The results support the view that birds are
more likely than humans to respond to variant stimuli in terms of overall similarity rather than a single dimension, which may reflect an associationistic rather than a rule-based determination of responding.

12:44 PM Jennifer M.B. Fugate (Emory University)

Categorical Perception of Emotional Expressions in Chimpanzees (Pan troglodytes)

Categorical perception reflects a process by which linear physical changes of a stimulus are perceived nonlinearly. Behavioral studies have shown that humans are better able to identify morphed facial expressions between categories of emotions compared to those within the same emotional category. The current experiments investigate if chimpanzees also perceive emotional expressions categorically. Experiment I used visual morphs of seven well-studied expressions in chimpanzees in a match-to-sample paradigm. Six chimpanzees first identified each of the morphs as one of the two expression endpoints, and then performed an ABX discrimination. Overall, the majority of subjects were better able to match morphed expressions within the same emotional category. Experiment II presented the same visual morphs for identification with the addition of the vocalization normally produced in concert with either of the two visual expression endpoints. Adding the congruent vocalization to visual morphs lowered the threshold at which each expression was

perceived.

12:51 PM Carole Parron, Christine Deruelle, & Joël Fagot (CNRS, Marseille)

Processing of Biological Motion Point-Light Displays by Baboons (Papio papio)

Humans apply complex conceptual judgements to biological motion point-light displays (Johansson, 1973) but the comparative literature leaves uncertain how such displays are processed by animals (Blake, 1993;Dittrich et al., 1998). In this research, four baboons had to categorize several kinds of biological and non biological point-light displays in a conditional matching to sample task. Depending on the test condition, displays could be presented upright or inverted to assess processing strategies. Results of three experiments converge to demonstrate that our baboons failed to consider the biological content of the stimuli during the experiment, and solved the tasks by focusing their attention on the configural properties of stimulus' sub-parts. Limits in perceptual grouping and restricted abilities in picture object-equivalence might explain why baboons did not map such degraded displays to what they represent.

1:05 PM Julie Martin-Malivel (Yerkes National Primate Research Center, Emory University) & Kazunori Okada (San Francisco State University)

Human and Chimpanzee Face Processing in Chimpanzees

The respective influences of exposure and inborn neural networks on conspecific face processing remain unclear. In the present study, we show that chimpanzees having a greater exposure to human than to chimpanzee faces are better at discriminating human than chimpanzee faces. A computational simulation was developed to evaluate the similarity among the stimuli of each category and to model subjects' performance. It showed that the average similarities among human pictures and among chimpanzee pictures were comparable. Chimpanzees' scores were significantly correlated with the computed similarity-coefficients. After taking into account the similarity-coefficients as covariate, the results show that performance with human pictures is still significantly higher than with chimpanzee pictures. The existence of categorical perception effects was tested using continua of morphed faces generated between chimpanzee or human individuals. A categorical perception effect emerged only for human faces, the category for which the chimpanzees had the highest level of expertise.

1:19 PM Darren Burke & Fiona Russell (Macquarie University)

Conditional Same-different Categorisation in the Short-beaked Echidna

Short-beaked echidnas, ant-eating monotremes, have surprisingly large brains with particularly well-developed frontal lobes, characteristics that are indicative of complex cognitive processing in Eutherian mammals. To see whether this sophisticated neurophysiology was correlated with cognitive sophistication, we examined the echidna's ability to learn relational categorisation tasks. Using a t-maze, performance was significantly above chance (and above 75%) for a basic shape discrimination (triangle vs circle), a conditional shape discrimination (triangle on black, circle on white), a same-different discrimination (with 4 identical icons on each same stimulus), transfer to novel same–different exemplars, and on a conditional same-different discrimination (same on black, different on white). This level of discrimination performance has, to our knowledge, only previously been demonstrated in primates.

1:38 PM

Discrimination Learning (Chair - Chuck Locurto)

1:38 PM Sheila Chase (Hunter College of the City University of New York)

Decision Processes in Pigeons

In our work together Eric G. Heinemann and I developed a computer model that provides a quantitative description of the choice behavior of pigeons. We have shown that the relationship between stimulus discriminability and the length of the presolution-period reflects an optimal procedure for detecting statistically significant differences in contingencies, that acquisition consists of gradual replacement of less precise information in long-term-memory with such information, that choices are based on optimal use of records of remembered contingencies. Our earlier work dealt with lights and sounds varying only in intensity and choices between two clearly distinguishable response manipulanda. Since then we have shown that the same basic mechanisms account for categorization of dot-matrix patterns, choice among multiple alternatives, and the limits on absolute identification. We called our model the Natural Intelligence Model in recognition of insights the study of living organisms brings to understanding of the evolution of intelligence.

2:02 PM Emily D. Klein (Language Research Center, Georgia State University)

The Waiting is the Hardest Part: The Effect of Delay on Stimulus Preference

The present experiment investigated whether rhesus monkeys (Macaca mulatta) would prefer stimuli that followed a delay over those that followed no delay. Following presentation of a green square (No Delay Trial), two comparison stimuli (S+ND, S- ND) were immediately presented. Following presentation a red square (Delay Trial) the computer screen went white for 5-s before different comparison stimuli appeared (S+D, S-D). Monkeys were trained until they completed four consecutive blocks of 20 trials with at least 80% correct on each trial type. Following completion of training, probe test trials were randomly inserted into training blocks giving monkeys a choice between the two S+s and the two S-s. The training and testing procedure was repeated two different delays (5s and 10s) and 20 sets of unique stimuli. Overall results demonstrate that monkeys preferred the S+ that had been associated with delays during training.

2:09 PM Kenneth J. Leising, Michael Parenteau, Dennis Garlick, & Aaron P. Blaisdell (UCLA)

Development of an Automated Open Field for Examining Cognitive Processes in Pigeons

Last year we reported on the development of a wireless apparatus that automates open-field experiments. We now are reporting on the first set of behavioral studies using this Automated Remote Environmental Navigation Apparatus (ARENA). First, pigeons were successfully autoshaped to peck at either a lit or unlit module which was paired with grain reinforcement. Second, pigeons learned a simultaneous discrimination task in which each of two ARENA modules was illuminated by a different color. Pecks to one of the colors (S+) were reinforced while pecks to the other color (S-) were not. Pigeons learned to respond preferentially to the S+. Third, pigeons were presented with a conditional discrimination task in which two ARENA units were simultaneously lit with one of eight colors on separate trials. Pecks to the unit in one location were reinforced for half of the colors, and pecks to the unit in the other location were reinforced for the remaining colors. Pigeons successfully learned to use the color to respond to the correct location. ARENA provides a
three-dimensional format for behavioral experiments, and thus presents a more ecologically valid alternative to the touchscreen.

2:16 PM Joseph Gaspard (University of Florida), Gordon B. Bauer (New College of Florida), Roger Reep (University of Florida), Debborah Colbert, David Mann (University of South Florida), Kimberly Dziuk & Adrienne Cardwell (Sensory Biology and Behavior Program, Mote Marine Laboratory & Aquarium)
Detection of Hydrodynamic Stimuli by Florida Manatees, Trichechus manatus latirostris

Manatees have relatively poor visual acuity and neuroanatomy suggests that chemoreception is of limited importance. Although manatees have good hearing abilities, they do not echolocate. Thus, it is not clear how they navigate in the turbid waters they frequently inhabit. Anatomical investigation suggests that they might be able to use the vibrissae that cover their bodies to sense hydrodynamic stimuli. To test this hypothesis, two Florida manatees were tested in a

go/no-go paradigm to assess their ability to detect water movements created by a sinusoidally oscillating sphere generating a dipole field. The subjects were stationed 10 cm from the sphere with the stimuli directed towards the facial region. Frequencies below the apparent functional hearing limit were presented (5 - 50 Hz). Preliminary results demonstrated the ability of

both subjects to detect the water movements.

2:23 PM Kelly Caffery (University of Southern Mississippi)

Scent Discrimination in Lions and Tigers

Chemical communication has been intensely studied among smaller mammalian species; however few experiments have been conducted with larger mammals. In large felids, specifically lions and tigers where scent marking and flehmen behaviors are routinely observed, it is obvious that chemical communication serves some functionality in their life. The purpose of this study was to investigate the ability of these species to discriminate between various urine samples including inter and intraspecies urine, novel and familiar urine, self and other urine, kin and non-kin urine and urine scent versus no scent (the control). Overall differences in lion and tiger scent discrimination abilities were also compared. Results indicated that lions and tigers do discriminate various urine samples. Significant differences were shown between behaviors of lions and tigers and the results suggest that tigers are more likely to investigate urine scents than lions.

2:35 PM Snack Break

3:25 PM Spatial Cognition II (Chair - Sara Shettleworth)

3:25 PM Brett M. Gibson (University of New Hampshire), Tyler J. Wilks, & Debbie M. Kelly (University of Saskatchewan)
Rats Encode the Shape of an Array of Discrete Objects
In order to navigate efficiently a traveler must establish a heading using a frame of reference. A large body of evidence has indicated that humans and a variety of non-human animals utilize the geometry, or shape, of enclosed spaces as a frame of reference to determine their heading. An important and yet unresolved questions is whether the way shape information from arrays of discrete objects and enclosed environments are represented and utilized in the same way. Here, rats were presented with a reference memory task in which they had to find water that was hidden in one of four discrete and unique objects placed at the vertices of a rectangle. The results indicated that rats could utilize both feature and geometry cues to locate the hidden goal.

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3:39 PM Danielle Sulikowski & Darren Burke (Macquarie University)

Win-shift Learning is Sensitive to Food Type in the Noisy Miner Bird

The tendency of nectarivorous birds to better learn to avoid previously rewarding locations (to win-shift) than to return to them (win-stay), has been explained as an adaptation to the depleting nature of nectar. This interpretation relies on the previously untested assumption that the win-shift tendency is not associated with food types possessing a different distribution. To test this assumption we examined the specificity of this bias to different food types in an omnivorous honeyeater, the noisy miner (Manorina melanocephala). As predicted, we found that the win-shift bias was sensitive to foraging context, manifesting only in association with foraging for nectar, not with foraging for invertebrates.

3:46 PM Bradley R. Sturz (Auburn University), Debbie M. Kelly (University of Saskatchewan), & Jeffrey S. Katz (Auburn University)

Evidence against integration of spatial maps in humans: Generality across search tasks

In an open-field analogue of Blaisdell and Cook's (2005) pigeon foraging task, human participants searched for a hidden goal located in one of 16 bins arranged in a 4 x 4 grid. In Phase 1, the goal was hidden between two landmarks (blue T and red L). In Phase 2, the goal was hidden to the left and in front of a single landmark (blue T). Following training, goal-absent trials were conducted in which the red L from Phase 1 was presented alone. Bin choices during goal-absent trials assessed participants' strategies: association (from Phase 1), generalization (from Phase 2), or integration (combination of Phase 1 and 2). Results were consistent with those found using a virtual environment by Sturz, Bodily, and Katz (2006). Specifically, participants used a generalization strategy followed by a shift in search behavior away from the test landmark, and these results were confirmed by a control condition.

3:53 PM Debbie M. Kelly & Dason V. Harker (University of Saskatchewan)

Encoding of Geometric Information by Clark's Nutcrackers

Several experiments have shown that animals can use an environment's shape to orient. Two geometric properties that may be used for orientation within an environment are the relative length of the enclosure's walls and the angle subtended when two walls join to form a corner. We investigated the encoding of these two geometric properties by Clark's nutcrackers. Nutcrackers were trained to locate a hidden goal in one corner of a fully enclosed parallelogram-shaped enclosure. Once the birds were accurately locating the goal they were presented with three sets of non-reinforced transformation tests. Two sets of transformation tests were designed to examine whether the birds could use wall length ratios or angular information alone, whereas the third set of transformation tests were designed to examine how nutcrackers would weigh the two geometric properties when they provided conflicting information as to the correct search location.

4:00 PM Anna Wilkinson, Hui-Minn Chan, & Geoffrey Hall (University of York, UK)

A study of spatial learning in the tortoise (Geochelone carbonaria)

Mammals, birds and reptiles have all evolved from a common amniotic ancestor and it is likely that they share behavioural and morphological traits; few controlled experiments with reptiles have tested this assumption. The mammalian and avian hippocampus plays a critical role in navigation, but almost nothing is known about this ability in reptiles, who do not possess a hippocampus. Here we report the findings of an experiment examining spatial learning in the red-footed tortoise. The subject was trained to navigate an eight arm radial maze. He rapidly learnt the task, and by the second training session performed consistently above chance. Further tests confirmed that his performance was not based on the use of non-spatial cues.

4:07 PM Alisha A. Brown, Marcia L. Spetch & Peter L. Hurd (University of Alberta)

Growing in Circles: Rearing Environment Alters Spatial Navigation in Fish

Animals of many species use the geometric shape of an enclosed rectangular environment to re-orient, even in the presence of a more informative featural cue. Manipulating rearing environment affects performance on spatial tasks, but its effect on the use of geometric versus featural navigational cues is unknown. Our study varied the geometric information available in the rearing environment (circular vs. rectangular rearing tanks) of convict cichlids (Archocentrus nigrofasciatus) and tested their use of navigational cues. All fish used geometric information to navigate when no features were present. With features present, fish used geometric and featural information separately. When cues were in conflict, fish raised in a circular tank showed significantly less use of geometric information than fish raised in a rectangular tank. Thus, the ability to use geometry to navigate does not require exposure to angular geometric cues during rearing, though rearing environment affects the dominance of features and geometry.

4:19 PM Cognition and Metamemory (Chair - Jon Crystal)

4:19 PM Melinda R. Allen & Bennett L. Schwartz (Florida International University)

Self-Recognition in a Gorilla (G. gorilla gorilla)

Recognition of self is one of the first complex cognitive abilities to develop. Of the great apes only Bonobos, Chimpanzees and Orangutans have shown clear evidence of self-recognition. The data for Gorilla self-recognition has been insufficient to determine their abilities. Given that gorillas are in the same cognitive class as the other great apes and perform similarly in other cognitive tasks we argue that gorillas also show evidence of self-recognition. Using the mirror self-recognition task developed by Gallup (1970) we assed the ability of a captive raised gorilla (Otto) to identify himself in the mirror. We measured mark-directed behaviors, mirror directed behaviors, contingent movements, and mirror-guided behaviors. We saw evidence of self-recognition during the mark test, however few other mirror directed behaviors were seen. Our results suggest that gorillas are able to identify themselves without engaging in additional external behaviors.

4:26 PM Bill Roberts (University of Western Ontario)

Tests for Metamemory of Sample Information in Pigeons

In Experiment 1, pigeons were given a choice between seeing a sample stimulus before taking a memory test (choice between two comparison stimuli) or going immediately to the memory test. In Experiment 2, pigeons were shown the sample stimulus for 1 or 5 s and then chose between seeing a 5-s sample reminder or going immediately to the memory test. The question of interest is whether pigeons would choose to see the sample when they have no memory or only weak memory of the correct choice. Data will be presented that answer this question about metamemory in the pigeon.

4:40 PM Jennifer E. Sutton (University of Western Ontario) and Sara J. Shettleworth (University of Toronto)

Pigeons Still Don't Have Metamemory

Metamemory, the ability to report on memory strength, is clearly established in rhesus macaques, with converging evidence from several paradigms and multiple tests within some of them. Inman & Shettleworth (1999) found no conclusive evidence of metamemory in pigeons, however. We report further experiments with pigeons in three paradigms, each of which afforded multiple tests of metamemory. Pigeons were presented with a safe alternative to completing a test of memory either before or concurrently with a test of memory in matching to sample. Choices of the safe option did not vary consistently with matching accuracy in the way predicted for an animal with metamemory nor change as predicted in tests with omitted samples. In other tests, "confidence ratings" following completion of the matching test also did not vary consistently as predicted by metamemory. The study of animal metamemory can be instructively compared with attempts to demonstrate episodic memory in animals.

4:54 PM Alexandra Rosati (Max Planck Institute for Evolutionary Anthropology), Jeffrey Stevens (Max Planck Institute for Human Development), Brian Hare (Max Planck Institute for Evolutionary Anthropology), & Marc Hauser (Harvard University)

The Evolutionary Origins of Human Patience

Although humans account for both the immediate and future consequences of behavior when making inter-temporal decisions, animals appear to ignore rewards that are delayed even a few seconds. However, this phylogenetic conclusion depends upon two untested assumptions: (1) great apes should make temporal decisions like other nonhumans, and (2) human patience should generalize to contexts beyond monetary rewards. Our results here lead us to reject both assumptions: bonobos and chimpanzees exhibit a degree of patience not seen in other animals, and humans are not only less patient for delayed food rewards than they are for money, but are also less patient for food than are chimpanzees. Therefore, a basic capacity for self-control and future-oriented decisions may have evolved before the human lineage diverged, suggesting that the extreme levels of patience that humans sometimes exhibit may be driven by fundamental

differences between biological and abstract rewards.

Poster Session (8:00 - 10:00)

8:00 PM

See Poster Abstracts Starting on Page 24

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

Friday Afternoon

12:30 PM Category and Concept Learning II (Chair - Debbie Kelly)

12:30 PM Leyre Castro, Haley Kemp, & Edward A. Wasserman

Nonidentical items from the same category: Are they same or different?

Nonidentical items from the same category can be considered same, because of their similar categorical properties, or different, because of their dissimilar perceptual properties. We investigated people's discrimination of arrays containing identical items (Same), nonidentical items from the same category (Category), and nonidentical items from different categories (Different). In Experiment 1, three groups were presented with two training arrays (Same vs. Category, Category vs. Different, Same vs. Different), and were tested with the remaining array. In Experiment 2, a single group of participants was given a 3-choice task in which they had to discriminate all 3 types of arrays. Overall, accuracy and confusion errors revealed that Category arrays are more similar to Same arrays than to Different arrays. In contrast, reaction times revealed that it is especially difficult to discriminate Category from Different arrays. Implications for same-different discrimination theories are discussed.

12:44 PM Andrea J. Frank & Edward A. Wasserman (University of Iowa)

Factors Affecting Pigeons' Processing of Items and Relations in Multi-Element Visual Arrays.

Stimulus control can be either quite specific (e.g., particular items presented) or more general (e.g., relations between or among items). Here, we gave pigeons icon set (Set 1 versus Set 2) or relation (Same versus Different) report keys after presenting them with a same or different display containing 12 visual icons. This training method forced the pigeons to attend to both icon set and relation on every trial. After the pigeons mastered this task, we tested them with displays containing 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, and 22 icons. Additionally, the icons in the displays could either be distributed (items shown randomly in 25 possible locations) or clustered (items grouped in the middle of the display). Pigeons' ability to flexibly report set or relation information strongly depended on the numbers of items, but was more weakly affected by item spacing.

12:51 PM Daniel I. Brooks & Edward A. Wasserman (University of Iowa)

A Connectionist Account of Item Set and Relation Discrimination in Multi-Element Arrays

Developing a model of Same/Different discrimination behavior will aid in understanding the interaction between memory for individual exemplars and the ability to detect interevent relations. A multilayer connectionist network was trained to report both the item set (Set 1 versus Set 2) or the relationship (Same versus Different) present in a multi-element array. This training was similar to how pigeons have been taught such a task. After the network met a similar discrimination criterion to that of pigeons, it was similarly tested with varying numbers of items in various spatial arrangements. Implications for the ability of such a network to learn this complex discrimination will be discussed.

12:58 PM Matthew S. Murphy & Robert G. Cook (Tufts University)

Investigation of Entropy in Auditory Sequence Same/Different Discrimination in Pigeons (Columba livia)

Discrimination of same/different sequences may be a gradated discrimination of varying levels of sameness and differentness (entropy) instead of a discrimination between two discrete categories. Three pigeons (Columba livia) were differentially reinforced in a go/no-go sequential auditory discrimination task based on pitch, timbre, or redundant cues, or using complex stimuli. Sequences were composed of varying number of differing elements and transitions between differing elements in the sequence. We found gradated discrimination that may be based on number of transitions and elements or on entropy. Further explanations will be discussed.

1:05 PM Olga F. Lazareva, John Doyle, and Edward A. Wasserman (University of Iowa)

Pigeons' Perception of Similarity Among Different Basic-Level Categories

Certain cerebral pathologies in humans produce dissociated deficits in recognizing living and non-living objects. Some researchers have proposed that these categories may be represented in a qualitatively different manner; others have suggested that high between-category similarity for living objects and low between-category similarity for non-living objects accounts for this dissociation. We have explored how pigeons perceive similarity among different basic-level categories by using multiple go/no-go training. Birds were trained to respond to stimuli from one category (e.g., cars) and to refrain from responding to stimuli from other categories (e.g., chairs, flowers, and people). Error analysis revealed that pigeons perceived flowers and people as being more similar to each other than to either cars or chairs, whereas cars and chairs were perceived to be as different from each other as from flowers or people. Follow-up research replicated these findings using eight categories: people, flowers, birds, frogs, cars, chairs, hats, and handbags.

1:19 PM Dana J. Gant, Dennis Garlick, & Aaron P. Blaisdell (UCLA)
Attributional versus Relational Processing in Pigeons in a Matching to Sample Task
Pigeons were trained to on a matching to sample task using stimuli composed of a pair of elements presented on a touch screen monitor. They were reinforced for selecting the comparison that matched the sample on both the color of the elements and the spatial relationship between the elements in the sample pair. After pigeons had learned to select the matching comparison, they received non-reinforced probe trials on which one of the comparisons matched only the color of the sample elements and the other comparison matched only the spatial relationship between the elements. Pigeons overwhelmingly preferred the color-match to the relational match. This suggests that pigeons attended more to attributional properties of the sample (e.g., color) than relational properties (e.g., spatial relationship between elements).
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1:31 PM Communication, Song, and Auditory Discrimination (Chair - Jerry Cohen)

1:31 PM Eduardo Mercado III (University at Buffalo, The State University of New York)

Learning to Localize in Auditory Space: The Origins of Vocal Imitation Abilities

Whales and dolphins use acoustic cues to determine the locations and identities of conspecifics and other environmental stimuli within their underwater habitats. Many of the cues that terrestrial mammals use to localize sounds in air are less well suited for localizing sounds underwater. Nevertheless, cetaceans can localize sounds as well as or better than most terrestrial mammals. How do they do it? The mechanisms underlying sound localization traditionally have been assumed to involve real-time comparisons of differences in signals received at the two ears. Recent evidence suggests, however, that auditory recognition of incoming sounds may be critical for accurate localization. In light of this evidence, it is suggested that vocal learning and imitation capacities may have developed in various species to facilitate sound localization rather than as a result of sexual selection.

1:45 PM Laurie L. Bloomfield, Tara M. Farrell, & Christopher B. Sturdy (University of Alberta)

Species' Discrimination of "Chick-a-dee" Calls by Cross-fostered Chickadees

We previously reported that black-capped and mountain chickadees treat each other's "chick-a-dee" calls as belonging to separate open-ended categories, and that the terminal "dee" portion of the call appears to control species' discrimination. Here we use a true-category/pseudo-category discrimination paradigm to test for species' classification of chick-a-dee calls by normal black-capped and mountain chickadees and by black-capped chickadees cross-fostered with either black-capped or mountain chickadees. Preliminary findings revealed that (1) all birds learned the true-category discrimination faster than the pseudo-category discrimination, with no differences among the groups in their speed of acquisition, (2) there appeared to be no differences among the groups in the speed of acquisition of the pseudo-category discrimination, and (3) there appeared to be no rearing- or species-specific advantage to either discrimination. Further analyses will focus on the speed of acquisition on a stimulus by stimulus basis and the mechanisms by which the discriminations are performed.

1:52 PM Katherine A. Leighty, Joseph Soltis, Anne Savage (Disney's Animal Kingdom), Kirsten Leong (Cornell University)

Elephant Vocal Communication Research at Disney's Animal Kingdom

African elephants (Loxodonta africana) live in matrilineal societies and adult females produce "rumble" vocalizations to mediate social interactions. Due to the infrasonic components of these rumbles, determination of the identity of the "rumbler" has been difficult in the wild. We have employed a unique collar system that allows us to document the vocal stream of each female in our herd at Disney's Animal Kingdom. We will discuss the acoustic characteristics of these rumble vocalizations as well as briefly review our recent findings regarding the repertoire of African elephants, antiphonal calling among affiliated females, the impact of the reproductive cycle on vocal production, and the ontogeny of infant vocalizations.

2:06 PM Henrike Hultsch (Freie Universität Berlin)

Stimulus primacy in the auditory song acquisition of the nightingale (Luscinia megarhynchos)

The clear temporal segregation of perceptual learning and motor performance makes song imitation by lab tutored birds an excellent paradigm to study how subsequent exposures to learning stimuli contribute to memory formation and retrieval. In an experiment with young nightingales subsequent exposures to song types were labeled by slightly different acoustic variants of the model patterns. Besides labeling 'early' versus 'late', I also tested for 'few' versus 'many' stimulus presentations. During later singing, subjects imitated more song-type versions from the early trials than from trials experienced later. Not only had males acquired the early variants in higher proportion, they also sung them more frequently than the later variants. Primacy of the first exposures occurred although subjects had heard the early song-type variants less often than those ones presented in the later trials. This experiment confirms that, in contrast with long held views, the role of stimuli in bird song learning is not confined to eliciting the performance of genetically inherited templates, that

of stimuli in bird song learning is not confined to eliciting the performance of genetically inherited templates, that memories from early exposures are not overwritten by stimuli experienced more frequently, and that performance as well as acquisition is affected by early experience.

2:20 PM Helen Karpouzos (York University)

Great Ape Gestural Communication: An investigation of intentions

The notion of understanding intentions and mental states in others is argued to be a uniquely human capacity. Intriguing evidence from great ape studies however, has suggested otherwise. This study then asks whether our great ape counterparts, namely orangutans and gorillas at the Toronto zoo, have the cognitive capacity to understand the intentions of others. By using the same behavioral criteria that human infancy researchers use to attribute this capacity to prelinguistic human infants, and controlling for possible methodological confounds of previous investigations of nonhumans, the aim is to more accurately test whether great apes understand the intentions of their conspecifics during communicative interactions. It is predicted that both orangutans and gorillas will behave analogously to prelinguistic human infants, indicating a capacity for intentionality. Second, it is predicted that intentional communication will be limited
primarily to juveniles, adolescents and lower socially ranked adults who may be more highly motivated to use intentional communicative acts.

2:27 PM Lauren Highfill, Stan Kuczaj (University of Southern Mississippi) & Harald Schwammer (Zoo Vienna)

Can sea lions understand communicative cues during an object-choice task?

Several species have demonstrated an ability to apprehend the attention of others, but the basis of such abilities is controversial. A relatively naïve South American sea lion was tested in an object choice task in which she had to use one of the following experimenter-given cues to target the correct object for a reward: (1) experimenter pointed and gazed at object, (2) experimenter pointed only at object, (3) experimenter gazed only at object, (4) experimenter placed a marker on object, (5) experimenter presented a replica of one of the objects. The sea lion was able to successfully use all five cues. The results indicated that relatively little experience with human trainers was necessary for the animal to perceive and act on attentional cues given by a human experimenter.

2:39 PM Choice (Chair - Brett Gibson)

2:39 PM Alex Kacelnik (University of Oxford)

State-dependent valuation learning: fitness, state, reinforcement and choice.

Behavioural ecologists model choice as a function of fitness gains, while associative learning researchers model learning as a function of reinforcement. While the former typically by-pass the issue of how the subject learns which option confers higher fitness gains, the latter typically ignore the functional implications of learning mechanisms, or even how associative strength translate into choice. I try to bridge this gap with models and experiments in starlings and locusts that assume that preference at the time of choice is a function of state improvement at the time of learning the properties of each option.

3:03 PM Marco Vasconcelos & Peter J. Urcuioli (Purdue University)

The Role of Initial Investment in the Sunk Cost Effect in Pigeons

We used a behavior-analytic analogue to study the maladaptive sunk cost effect in pigeons. In a mixed schedule procedure, a given fixed ratio (FR) was expected but, on some trials, the ratio was exceeded. Pigeons had the option of escaping the trial and start a new trial in which a smaller FR was again expected. Previous research shows that the greater the difference between the expected ratio given escape and the expected ratio given persistence, the less likely pigeons are to persist (i.e., the lower the probability of observing the sunk cost effect). However, greater differences in

expected ratios were confounded with smaller FRs in the mixed schedule (particularly the first component). In this experiment, we kept the difference constant but varied the smaller FR and found evidence that the size of the initial investment mediates the effect.

3:10 PM Dennis Garlick & Aaron P. Blaisdell (UCLA)

Exploration by Pigeons on an N-Armed Bandit Problem

The n-armed bandit problem involves a choice between n-options or actions, where the probability of reward varies based on the option or action chosen. In a situation where the perceived distribution of probabilities is uncertain, an optimal strategy to maximize reward must both exploit existing knowledge of reward values to select the action that currently possesses the highest reward value, and also explore other options to increase knowledge of the probability distribution as a whole. Pigeons were presented with this task on a touch screen where 8 disks of different colors were associated with different probabilities of reward. The association between color and reward was consistent across trials within a single session, but was varied across sessions. It was found that the pigeons would neither systematically nor randomly explore all disks, and would instead perseverate to a limited number of disks. Various manipulations were made to examine whether exploration across the full complement of disks could be induced.

3:17 PM Holly Miller & Thomas Zentall (University of Kentucky)

Effects of Differential Biologically Neutral Outcomes Following Correct or Incorrect Comparison Choices in Delayed Matching to Sample

In matching-to-sample when different outcomes are associated each sample-correct comparison-response sequence, animals often learn faster and have improved retention over delays, effects known as the differential outcomes effect (DOE). This effect has been explored primarily using outcomes that are differentially hedonic such as food versus no food. Such differential outcomes may elicit different emotional states and the different emotional states may be used as cues for comparison choice. The question is can a differential outcomes effect be obtained when the differential outcomes have the same presumed value. Earlier research using non-hedonically different differential outcomes suggests that they can. The present experiment examined the differential outcomes effect using non-hedonic differences in outcome (a colored houselight vs. a tone). Additionally, we examined the differential outcomes effect when the incorrect comparison choices were followed by differential non-hedonic outcomes. A DOE was found on the retention test but only when the

differential outcomes followed correct choices.

3:24 PM Walter T. Herbranson (Whitman College)

Pigeons perform optimally in a version of the "Monty Hall Dilemma"

The “Monty Hall dilemma” (MHD) is a well known probability puzzle in which a player tries to guess which of three doors contains a prize. After an initial choice is made, one of the remaining doors is opened, revealing no prize. The player is then given the option of staying with their initial guess or switching to the other unopened door. Most people opt to stay with their initial guess, despite the fact that switching doubles the probability of winning. Three experiments investigated if pigeons, like most humans, would fail to maximize their expected winnings in a version of the MHD. Birds completed multiple trials of a standard MHD, with the three response keys in an operant chamber serving as the three doors, and access to mixed grain as the prize. Across experiments, the probability of gaining reinforcement for switching and staying was manipulated. Results indicate that unlike most humans, pigeons do perform optimally on the MHD by either switching from or staying with their initial choice, depending on whether switching or staying results in a higher likelihood
of reinforcement.

3:45 PM Snack Break

4:50 PM In Honor of the Contributions of Ronald Weisman

4:50 PM Introduction - Chris Sturdy

4:55 PM Christopher B. Sturdy, Michael R.W. Dawson, Carly M. Nickerson, Laurie L. Bloomfield (University of Alberta) and Isabelle B. Charrier (Université Paris Sud)

Using artificial neural networks to understanding songbird perception

Here we report two series of studies in which we used artificial neural networks to understand songbirds' perception of note-type categories. We first modeled empirical data obtained from black-capped chickadees by training perceptrons to discriminate between two call note types and then testing network generalization to novel notes that were shifted in their entirety either up or down in frequency. Perceptron results were highly similar to those obtained with birds trained in an analogous task. In a second study we trained perceptrons with notes in which individual acoustic features, both frequency and temporal, had been modified. Plots of network responses revealed that some acoustic features had significant effects on network responses, while others did not. Moreover, the context in which the network was trained determined network responses to test notes. The implications of using artificial neural networks for understanding empirical data and generating

testable hypotheses for songbird perception will be discussed.

5:10 PM Edward A. Wasserman, Olga F. Lazareva (University of Iowa), and Irving Biederman (University of Southern California)

Pigeons are more sensitive to nonaccidental than to metric changes in visual objects

Changes in nonaccidental properties (e.g., concave sides vs. straight sides) have been hypothesized to be critical for object classification (Biederman, 1987). In contrast, changes in metric properties (e.g., degree of concavity) are affected by rotation in depth, making them less reliable for object classification. We studied pigeons' sensitivity to metric and nonaccidental changes by using a three-alternative forced-choice task. The birds were trained to discriminate a target stimulus from a metrically-changed shape and a nonaccidentally-changed shape. The dependent measure was the percentage of total errors that the birds committed to the nonaccidentally-changed shape. All birds made more errors to the metrically-changed shape, suggesting that they perceived it to be more similar to the target stimulus than was the invariantly-changed shape.

5:25 PM Leslie Phillmore (Dalhousie University)

A Review of Discrimination Learning: From Behaviour to Brain

Discrimination is an important skill used daily by many organisms to make decisions about such problems as what food to ingest or which mate is the most desirable. Discrimination relies on an organism's ability to differentiate stimuli using available features and make decisions based on this information that will lead to survival of the individual and, ultimately, the species. To determine what cues or features a particular organism may use to perform a discrimination task, researchers can set up contingencies based on discrimination of cues; it may then be inferred that an animal successful at earning reward or avoiding punishment can discriminate among stimuli distinguished by the specific features provided. This presentation will review and compare the use of discrimination paradigms in organisms such as birds and mammals. Further, the review will include recent work that has begun to look at the neural systems involved in learning, examining what changes may occur in the brain as a result of performing discrimination tasks.

5:40 PM Robert Cook & Matthew Murphy (Tufts University)

Competitive Control by the Absolute and Relational Properties of Auditory Stimuli

A long-term focus of Ron Weisman's research has been on the contribution of absolute and relative factors in song perception and recognition by birds. We have recently focused on the contributions of these different factors in a non-songbird, the pigeon. Using a modified same/different task, our studies were designed to determine how absolute (pitch) and relational (same/different) properties spontaneously controlled responding in a sequential auditory discrimination. Both properties were found to be relevant and determined by the relative discriminability of each of these properties. Implications for stimulus control by these factors in several areas will be considered.

6:00 PM **Master Lecture - Ronald Weisman (Queen's University)**

Thinking Outside the Box: Advice to Young Scientists

This talk is my one opportunity to speak at length to our young colleagues about how they should conduct their careers. Other researchers may disagree but here I will share what I have learned about how to conduct our science. Research in Comparative Cognition tends to occur inside one box or another, often an operant conditioning chamber. Young researchers, especially, should think about conducting research about animal cognition outside that box. Also we need to know more about the real world tasks, outside the box, to which our research applies. This does not mean discarding your conditioning equipment. What I am suggesting is using your experiments to explain how animals think in the world in which they evolved.

7:30 PM **Banquet**

Saturday

12:00 PM **Business Meeting of the Comparative Cognition Society**

All Invited to Attend - CCS Members May Vote on any Motions Made

1:10 PM **(: Group Photo Shoot - SMILE :)**

1:30 PM **Perception and Attention** (Chair - Angelo Santi)

1:30 PM Tomokazu USHITANI (Chiba Univ) & Masaki TOMONAGA (Kyoto Univ)

Object-based attention and visual organization in chimpanzees (Pan troglodytes)

Chimpanzees were investigated in a cuing task whether they possessed object-based attention. Chimpanzees were rewarded by touching a target after a brief presentation of a cue at one end of two rectangles arranged in parallel (Experiment 1). If object-based attention activating the cued rectangle as a unit works, chimpanzees' reaction time would be shorter when the target appeared at the other end of the cued rectangle (WITHIN condition) than at one end in the other rectangle (BETWEEN condition), even though the distance from cued location to each target location was the same in both conditions. We could not find the evidence of such within-object benefit in Experiment 1. In Experiment 2, we arranged the rectangles horizontally in line to control the distance from the fixation stimulus to each target location; this time, we could find within-object benefit, suggesting that object-based attention process is shared by chimpanzees and humans.

1:44 PM Stephen E. G. Lea, Catriona M. E. Ryan, Catherine Bryant, and Andy J. Wills (University of Exeter)

Stopping rules in pigeons' information acquisition in multidimensional discrimination

Pigeons are being trained in a go-left/go-right conditional discrimination task in which, on each trial, stimulus information is revealed gradually so long as the bird continues to peck at a central zone of a touchscreen. Left and right choice response zones are available throughout the trial, and pecks made to them at any time during a trial halt the process of adding more information to the central zone. The stimuli contain multiple equally valid cues, which are revealed in varying orders. Earlier choice responses do not lead to more immediate reinforcement. Humans in comparable situations tend show "one-reason decision making", withholding response until a particular type of information appears, and then responding immediately. Initial indications are that pigeons make a more equal use of the different types of information, though they still tend to make a choice response before all information is available.

1:58 PM Caroline M. DeLong, Sarah A. Stamper, & James A. Simmons (Brown University)

Object Perception in Clutter by Echolocating Bats

In previous psychophysical experiments, big brown bats detected or discriminated objects (monopole and dipole targets comprised of 15 mm diameter cylinders) presented standing on smooth surfaces with little clutter. In this experiment, a two-alternative forced choice paradigm was used to train bats to discriminate between a two-cylinder dipole target presented within a clutter field and a clutter field with no target. Different clutter fields were used, each with a different number of beads (4, 8, 12, or 16) presented at various aspect angles. The bats' performance varied as a function of the number of beads. The bats were able to detect the dipole even when the total energy of the echoes from the dipole plus clutter field was only 1.5 dB greater than the total energy of the echoes from the clutter field alone. The results have implications for how bats isolate beetles against a backdrop of foliage.

2:12 PM Sarah A. Stamper, James, A. Simmons, & Caroline M. DeLong (Brown University)

Perception of Targets in Scenes by Echolocating Bats

Big brown bats (Eptesicus fuscus) are able to catch insects in open air and cluttered environments using sophisticated biosonar. We have conducted a series of psychophysical experiments to examine the ability of these bats to detect and discriminate objects presented in simple and complex acoustic scenes. Using a two-alternative forced choice paradigm, bats were trained to detect a two-cylinder dipole stimulus that was inserted into holes (14mm deep and 20mm in diameter) in foam pads (25mm thick). The top of the dipoles' surfaces were positioned at 13, 5, or 2mm above or 1mm below the surface of the foam. The bats' performance varied as a function of protruding height. We found that for successful detection the target must protrude above the surface of the foam by 1-2mm, yielding an energy threshold difference between the target and clutter of approximately 2dB.

2:19 PM Martin J. Acerbo, Olga F. Lazareva, Andrea Frank, Amy Poremba, and Edward A. Wasserman (University of Iowa)

Metabolic Mapping of Brain Structures Involved in Figure-Ground Assignment in Pigeons

Recently, we found that figure-ground assignment in a nonmammalian species, pigeon, is analogous to primates, at least at the behavioral level (Lazareva et al., 2006). We used the same behavioral paradigm to pinpoint areas in the avian brain that are critically involved in figure-ground assignment. Using the same stimuli, three group of pigeons were trained to perform figure-ground discrimination, color discrimination, or shape discrimination. Once their discriminative performance reached the asymptote, the birds were injected with [C14] 2-deoxyglucose (2-DG) and required to perform discrimination for 45 minutes. The fourth, control group, was not required to perform any discrimination; instead, these birds were placed into dark operant chambers where they received food pellets according to VI schedule. We then compared metabolic levels in the tectum opticum, nucleus rotundus, and the entopallium in different groups to assess the neural correlates of

figure-ground assignment.

2:33 PM Michael Lamport Commons & Patrice Marie Miller (Harvard Medical School)

What Animals Never Operantly Coordinate Actions with Sensory Input

In most developmental stage models, Stage 1 describes that organisms either act or sense, but do not coordinate the two. Is there any empirical evidence for the existence of animals that never progress further than Stage 1 in any area? Even very primitive animals differentially respond to stimuli, rejecting non-food items. Animals change their behavior and learn to the extent to which consequences modify the control of behavior by stimuli. The consequences lead to them to Stage 2 behavior where they coordinate action with sensory input. But some very simple single-celled animals, e.g. zooplankton, may not operantly hunt for prey or forage. Are such animals, and other simple multi-celled animals, coordinating actions with sensory input, or are their behaviors just directly elicited by only a specific stimulus in a manner independent of consequences? This paper examines possible evidence for the existence of animals performing at Stage 1only.

2:52 PM

Social, Symbolic, and Cognitive Processes (Chair - Roger Thompson)

2:52 PM M.Kiley-Worthington (University of California, Berkeley & Centre d'Eco-Etho Recherche, Bezaudun sur Bine, France)

A multidisciplinary approach to assessing equine and elephant subjectivity.

The most difficult question of animal subjectivity is the first personhood of individual experiences. A multi disciplinary study involving anatomy , physiology, field and laboratory ethology, experimental psychology, philosophy of mind, and folk knowledge is the key to beginning to answer this question, although there are large gaps in our knowledge. A brief summary of similarities and differences between the subjectivity of equines, elephants and a human is given. The interesting questions are what do they know, what can they learn and what do they think? Many people here are of course attacking these problems, but the result of some 15 years research, produces evidence that the suggested multi disciplinary has an important part to play in understanding another species cognition.

3:16 PM Emma Ware & Niko Troje (Queen's University)

Pigeon courtship is sensitive to social contiguity but not social contingency

Joint action is behaviour that requires coordination between animals to achieve a desired goal. We investigated the perception of social feedback in mutual courtship of the pigeon, Columba livia, in a double closed-loop teleconferencing setup. Pigeons could interact in real time with the life-sized video image of the other bird. We manipulated social feedback in two ways; 1) by altering temporal contiguity by three delays of 1s, 3s and 10 s and 2) by altering social contingency, by playing back a video of the subject's partner from a previous interaction. Courtship intensity decreased in all three temporal delay conditions. Courtship intensity did not differ between a zero-delay condition and the non-contingent playback condition. We conclude that pigeon courtship is sensitive to temporal contiguity in social feedback, implying visual coordination in joint action. Pigeons did not show social contingency perception, and may lack a representation of social causality.

3:23 PM Wendi Fellner, Barbara A. Losch (The Seas, Epcot®), & Gordon B. Bauer (New College of Florida & Mote Marine Laboratory)

Synchronous Relationships among Four Male Bottlenose Dolphins

Synchronous movement is a frequently observed behavior among bottlenose dolphins. In addition to potentially providing hydrodynamic and predator-avoidance advantages, synchrony may have important implications in the formation and maintenance of pair bonds among male dolphins. For over 1 year, we observed synchrony characteristics in a population of 4 captive male dolphins in which 2 newcomers were introduced to 2 long-time residents. The amount of time spent in synchrony for the original 2 residents was 0% prior to the introduction of the new dolphins. Their post-introduction levels of synchrony changed from 5% in the early months to as high as 55% in the presence of one of the socially dominant newcomers. Synchrony may be an easily observable indicator of changing social relationships.

3:30 PM Annika Paukner, Matthew Novak & Stephen Suomi (National Institute of Child Health and Human Development)

Learning to inhibit: social environment and self-control in infant rhesus macaques

Inhibitory control processes are thought to play an important role in the organization and regulation of social groups. Furthermore, social status within a group appears to affect an individual's ability to exhibit self-control. We evaluated the importance of social influences on self-control in a cohort of infant rhesus macaques raised in differential social environments. Each infant underwent multiple cognitive assessments, all thought to be a measure of self-control.

Results indicate that the early social rearing environment may have a profound impact on self-control abilities. In addition, infants did not show consistent performance between tasks, suggesting that self-control is a multi-level construct.

3:37 PM Nicole R. Dorey, Stephen E. G. Lea (University of Exeter), & Vicky Melfi (Field Conservation and Research Department, Whitley Wildlife Conservation Trust, Paignton Zoo Environmental Park, UK)

Object movement imitation in Sulawesi black crested macaques (Macaca nigra)

After a 10 session baseline, we trained a demonstrator (adult male Sulawesi macaque) to perform five topographically different behaviours to an apparatus on a command. The commands were directed only to the demonstrator; they were in the form of different coloured shapes which were associated with each behaviour. A duplicate apparatus was set up 56cm away. The other 10 macaques in the group (observers) had access to and could freely manipulate this second apparatus. Both the demonstrator's and the observers' behaviours were recorded. For two of the observers, there was a non-significant increase in the likelihood of expressing at least one of the trained behaviours shortly after the demonstrator performed them. However, one observer performed three of the trained behaviours at significantly increased frequency shortly after the demonstrator had performed them. These findings suggest that imitative learning occurred in some members of this

group of macaques.

3:44 PM Sylvain Fiset (Université de Moncton at Edmundston)

Spatial rotation of hidden objects in domestic dogs

The present study was aimed at investigating whether domestic dogs understand invisible displacement of objects in a spatial rotation task. The dogs faced a rotating platform. Two containers were placed at both ends of the platform and an attractive object was visibly put in one of the containers. Experiment 1 revealed that dogs did not understand spatial rotation of hidden objects when the two containers were opaque. In Experiment 2, dogs succeeded when the target container was transparent but failed when the target container was opaque. Additional testing sessions revealed that dogs gradually learned to find the target object hidden in the opaque container, suggesting that they might be able to understand some rudiments of spatial rotation of hidden objects.

4:03 PM Category and Concept Learning III (Chair - Gordon Bauer)

4:03 PM Heidi E. Harley (New College of Florida & The Seas, Epcot®), Wendi Fellner, & Kim Odell (The Seas, Epcot®)

Object-Photo/Photo-Object Matching by the Bottlenose Dolphin

Dolphins can accurately interpret two-dimensional video images and discriminate two-dimensional figures, but their ability to recognize an identity relation between three-dimensional objects and their static two-dimensional representations has not been documented. In this study, two dolphins (Ranier & Toby) performed a 3-alternative matching-to-sample task with objects and photographs. Ranier matched visually in three conditions: object to object (OO), photo to object (PO), and object to photo (OP). Immediate transfer occurred to photographs. Performance accuracy was comparable in all conditions within object sets of varying difficulty on five 3-alternative 18-trial sessions in each condition: Set 1, 97% OO, 94% PO, 97% OP; Set 2, 82% OO, 90%, PO, 89% OP; Set 3: 68% OO, 67% PO, 72% OP. Toby matched photographs to echoic alternatives. Performance accuracy with three different familiar object sets averaged 100%, 87%, 54%. Apparently, dolphins can instantly recognize an identity relation between objects and their photographic representations.

4:17 PM Kristy Lindemann, Colleen Reichmuth, & Ronald J. Schusterman (University of California, Santa Cruz)

The Role of The Reinforcer in Equivalence Class Formation: Evidence From Work With a California Sea Lion

Differential outcomes effect, or DOE, has been studied in various species and across a range of learning contexts. The findings of these studies have illustrated that discrimination learning occurs more rapidly when responses to different stimuli produce different reinforcers. There are a number of theories that have been proposed to explain DOE but no single theory or mechanism has been established. We propose that Sidman's (2000) theory of equivalence offers a possible explanation of DOE by including the reinforcer as a stimulus class member. Our past and current work on equivalence classes with a California sea lion provides evidence that the differential reinforcement of two stimulus classes facilitates class formation but is not necessary for equivalence performances to emerge. We hypothesize that the reinforcer is an equivalence class member and we discuss our current work which further investigates the relationship between the
reinforcer and the auditory and visual class members.

4:24 PM Timothy M. Flemming (Georgia State University) and David A. Washburn (Georgia State University)

Focus!: Enhancement of Relational Matching in Rhesus Monkeys (Macaca mulatta) with Increased Attentional Demands

Compared to results from static presentations of a relational match-to-sample paradigm, presentations of moving stimuli in the same paradigm yielded higher rates of accuracy. In the static condition, one pair of identical or nonidentical stimuli was contacted with a cursor, subsequently presenting choice stimuli randomly in one of two corners of the computer screen. In the moving condition, stimuli were presented in pairs that moved together at a slow rate in random directions, with random starting locations around the computer screen. After contacting the first moving relational pair, two moving choice pairs appeared at random locations on the screen. Correct choices were made by contacting the moving pair that exemplified the same relation (identical/nonidentical) as the sample pair. Increased attentional demands on the composition of the moving pairs is likely responsible for the enhancement of relational matching.

4:31 PM Gabrielle Szafranski, Ketan Bakriwala, & Toru Shimizu (University of South Florida)

Conspecific Recognition Based on Biological Motion Cues in Pigeons

Humans have the ability to perceive the biological motion of other humans, even when most of the form information is absent. Can highly visual animals, such as pigeons, also perceive the biological motion patterns of conspecifics when only limited form information is presented? To address this issue, male pigeons were exposed to videotaped footage of female pigeons that were actively engaged in courtship. By manipulating spatial frequency, the form information of the footage was either limited (i.e., blurred) or left intact. Compared to the intact stimuli, the courtship response of male pigeons to the blurred stimuli was diminished, but still present, as long as the motion cues were presented. However, the response was almost entirely absent when the stimuli were motionless blurred images. The results suggest that when form information is limited, pigeons can use biological motion cues to recognize conspecifics.

4:38 PM Sue J. Chapman (University of Exeter)

Multi-dimensional Concept Discrimination in Non-human Mammals in an Ethologically Relevant Paradigm

Grey squirrels, Sciurus carolinensis, were trained to discriminate three dimensions, colour, shape and pattern, in their natural environment.

The squirrels were first trained to discriminate between two prototype stimuli. Biscuits were coloured either blue or orange, shaped into either stars or circles, and were piped with either dots or cross-hatched iced lines. The negative training stimuli contained salt in both the icing and the dough. 20 biscuits, 10 negative and 10 positive, were placed in a computer generated random pattern in a tray beneath a mirror, and details of the squirrel subject in each trial was recorded photographically.
After reaching criterion, testing with both prototypes and stimuli resembling the prototypes (all unsalted) but with one of the dimensions changed took place, for example a blue star with dots prototype has three one-aways e.g. a blue circle with dots. All six possible one-aways were included in test trials. Video recordings were made to establish the order the stimuli

were taken in. The results of this discrimination will be compared to human studies of multi-dimensional selection.

Posters

Poster Session 1 - Thursday Evening

Erica Hoy Kennedy (Frostburg State University) & Dorothy M. Fragaszy (University of Georgia)

Evidence for Analogical Problem Solving in a Capuchin Monkey (Cebus apella)

Analogical reasoning involves recognizing similarities among object relations when the objects themselves are dissimilar. It has been argued that apes, but not monkeys, are capable of analogical reasoning. This study investigated whether capuchin monkeys can use analogical reasoning in order to solve a three-dimensional search task. The task involved hiding food under one of two (and later three) opaque cups of different sizes and allowing the subject to search for food under the cup of analogous size in their own stimulus set. Four monkeys were first trained to criterion on basic MTS. Next they were exposed to two pairs of cups and required to search for food based on physical or relational similarity. One of the four monkeys reached criterion on all variations of the relational matching task, suggesting that analogical reasoning is within the capacity of a member of New World monkey species.

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

Can pigeons learn to complete an analogy?

Analogical reasoning is considered to be characteristic of humans and to be beyond the abilities of non-language trained apes. However, from an evolutionary point of view, rudiments of analogical reasoning may be evident in other animals as well. The present study tried to see whether pigeons could learn to complete an analogy. The birds were first shown two pictures that could be the same as or different from one another (A-A or A-B). Then, along with a third picture, two choice alternatives appeared (C-C/D); pigeons had to select the picture that matched the relation displayed in the first place. After extensive training, pigeons reached 60% accuracy—not very high, but significantly above chance. Transfer tests suggested that the level of accuracy reached in training was, in part, due to learning of specific stimulus combinations rather than to learning of the relations between the displays.

Kuroshima H. (University of Georgia, JSPS), Leighty A. Katherine (Disney's Animal Kingdom), Fragaszy M. Dorothy (University of Georgia) & Fujita Kazuo (Kyoto University)

Capuchin monkeys can understand the context of other's action.

We investigated whether capuchin monkeys can discriminate between situations in which a person is unable versus to do and in which she is unwilling to perform a particular action. We compared the reactions of 6 subjects under four conditions; (1) Experimenter 1 (E1) tried to deliver a raisin through an opening of the test cage but failed because the opening was too small (physical-unable), or (2) because a second experimenter 2 (E2) blocked the opening (social-unable). (3) E1 began to give the raisin to the subject but retracted it despite no physical interference (physical-unwilling) or (4) no social interference (social-unwilling). The subjects protested against E1 and E2 significantly more often in the social situation than in the physical situation. Moreover, they protested against E2 significantly more often in the social-unable condition than in the other conditions. These results suggested that the monkeys interpreted the other's action according to its context.

Jennifer Vonk & Francys Subiaul (University of Southern Mississippi, The George Washington University)

What Chimpanzees (Pan Troglodytes) Understand About Others' Capabilities

We tested chimpanzees' ability to predict which of two human experimenters could deliver a food tray. In the "floor" condition, legs were needed to push the tray toward the subject. In the "lap" condition, arms were needed to hand the tray to the subject. Initially, chimpanzees preferred to beg to an experimenter whose arms were not visible rather than one whose legs were not visible regardless of the task. We manipulated factors that might have affected the chimpanzees' preferences, such as distance between experimenter and subject, amount of

occlusion of experimenters' body, contact with the tray and positioning of constraints that either impeded movement of the limbs or did not. The chimpanzees' performance was best explained by attention to irrelevant cues such as distance and contact. When we eliminated the discriminative role of such cues, performance fell to chance levels, indicating that chimpanzees do not reason about capability as humans might.

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

Working Memory for What-Where-When Information in Rhesus Monkeys (Macaca mulatta)

In recent years there has been an increased interest in whether nonhuman animals possess elements of episodic memory, including the integration of what, where, and when information in memory. In the present study, a computerized task was used to assess working memory for what-where-when information in joystick-trained rhesus macaques (Macaca mulatta). In Experiment 1, the macaques were trained on three separate tasks: an identity DMTS task, a spatial DMTS task, and a symbolic-temporal DMTS task. The macaques were then presented with a task in which they were required to report what, where, and when the event took place and another task in which they were required to report only one randomly selected component of the event. The results indicated that the macaques were above chance at remembering what, where, and when information, but that accuracy was affected by variables also observed in the human literature.

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

Tests of Episodic-like Memory in the Black-capped Chickadee

Episodic-like memory in scrub jays has been described by Clayton and Dickinson (1998). We conducted similar a test for episodic-like memory in another species of food-storing bird, the black-capped chickadee. Chickadees found concealed sunflower seeds and mealworms in selected sites in a testing board within their home cage, and then searched these sites again after either short (3 hr) or long (123 hr) retention intervals. After the long retention interval, their preferred mealworms were degraded and inedible. Chickadees showed some memory for both what kind of food they had previously encountered and where, but showed no memory for when food had previously been found. In a second experiment, currently in progress, chickadees search for hidden sunflower seeds and mealworms in artificial trees set in an indoor aviary, increasing both the spatial naturalism of the task and the effort required to find food. The results of this study will also be presented.

Allison L. Foote & Jonathon D. Crystal (University of Georgia)

Metacognition in the Rat

A fundamental question in comparative cognition is whether animals have knowledge of their own cognitive states, termed metacognition. Recent evidence suggests that people and non-human primates, but not less "cognitively sophisticated" species, are capable of metacognition. Before taking a duration test, rats were given the opportunity to decline a test if they did not know the answer. On other trials, they were not given the option to decline. Accurate performance on the duration test yielded a large reward whereas inaccurate performance resulted in no reward. Declining a test yielded a small, but guaranteed, reward. If a rat possesses knowledge about whether it knows the answer to the duration test, it would be expected to decline most frequently on difficult tests and show lowest accuracy on difficult tests that cannot be declined. Our data provide evidence for both predictions and demonstrate that a non-primate has knowledge of its own cognitive state.

Hiromitsu Miyata & Kazuo Fujita (Kyoto University)

Future Planning in Pigeons On a Computerized Maze Task

Planning is the inner process of making decisions about a set of future actions in order to achieve a particular goal. We examined whether pigeons (Columba livia) plan the future steps on a maze task on the LCD monitor. In Experiment1, after training three pigeons to solve a +-shaped maze by moving a red square (the target) to a blue square (the goal), we found that they frequently moved the target toward the previous goal positions after the goal moved to another corner during task solution. In Experiment 2, using a syuriken (Japanese traditional throwing knife) -shaped maze we found that the pigeons frequently started by moving towards the previous goal directions when the goal position changed from the "preview" to the solution phase within a trial. These results suggest that pigeons do plan on the mazes, raising the possibility that future planning may be widespread among avian species.

Jing Pan, Thomas Pickering, Bettina von Ammon, Hika Kuroshima, & Dorothy Fragaszy (University of Georgia)

A Tufted Capuchin Monkey Becomes Proficient at Navigating Mazes

Capuchin monkeys are strongly predisposed to move directly toward a goal while navigating two-dimensional alley mazes. We examined if a capuchin monkey could learn to choose a path continuing indirectly to the goal (a Non-obvious choice, or NOC). One capuchin monkey solved multiple sets of orderly presented192 mazes containing both NOC's and other choices followed by 24 probe mazes drawn from the sets. Following the 7th to 10th replicates of the sets, the monkey achieved on average 79% correct choices on the probe mazes, better than 40% correct on its first performance on randomly presented 192 mazes. Subsequently the monkey achieved equivalent performances on 3 sets of probe mazes, each set composed of 8 novel, 8 familiar, and 8 rotated mazes (80% correct choices). Thus, the monkey developed flexible control at choice points to move either toward or away from the goal, in accord with the visual property of continuation.

Tyler Wilks & Brett M. Gibson (University of New Hampshire)
Use of Landmark Cues and Self-motion Cues in the Clark's Nutcracker
Numerous studies have demonstrated that the Clark's Nutcracker (Nucifraga columbiana) can locate a hidden goal in a laboratory setting using visual landmarks to establish its sense of direction. The role of self-motion cues has been largely unexplored in this species. In the current study the birds were trained to actively move from a position near the perimeter of an arena into a four-sided enclosure where a hidden goal was located. During training both self-motion cues and distinct visual landmarks inside the enclosure could be used to locate the goal. Subsequent tests were administered to determine the extent to which nutcrackers were using each type of cue. The results from these tests appear to indicate that the nutcrackers were able to use both landmarks and self-motion cues to return to the location of the hidden goal.

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

The Role of Perceptual Features in Categorization by Orangutans

Two experiments were conducted to identify the perceptual features used by orangutans when categorizing pictures, in terms of category relevance and feature specificity. In Experiment 1, subjects were trained and tested for transfer on a concrete discrimination (gorillas or orangutans vs. other primates). Irrelevant features that did not define the target category did not affect performance. Increased performance was noted on photos with faces, particularly close-ups. In Experiment 2, photos were systematically modified to test the effects of various features. Colour modifications caused decreased performance. Features seemed to be processed both locally and holistically, depending on the task. Error trials did not generally reflect mistaken categorization, but rather, photos that may have been attractive for other reasons, such as interesting colouring or novel morphology. Thus, the importance of analyzing performance on both the negative and target stimuli, and using direct manipulation to test the effects of features, was emphasized.

Pete Otovic (University of South Florida)
Reconciliation in mandrills?
One consequence inherent to group life involves conflicts of interest between the individuals in a group over valuable resources such as food and mates. In order to reduce the likelihood of an individual animal's potential loss of benefits associated with group living, conflict management strategies have evolved both to prevent conflicts and to repair damage after a conflict. Reconciliation is one type of post-conflict strategy, and is typically operationalilzed by affiliative contact, vocalizations, or proximity between former opponents shortly after a conflict. Reconciliation ostensibly functions to restore relationships between former opponents to baseline levels. However, observational data from captive mandrills (Mandrillus sphinx) are not consistent with this idea.

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conflict. Reconciliation ostensibly functions to restore relationships between former opponents to baseline levels. However, observational data from captive mandrills (Mandrillus sphinx) are not consistent with this idea.

Ikuma Adachi(Emory University), Wendy A. Suzuki(New York University), Benjamin M. Basile, Regina Paxton, & Robert R. Hampton (Emory University)

Assessment of social dominance concept formation using videos of artificial social interactions in rhesus macaque monkeys (Macaca mulatta)

Although it is widely thought that animals living in complex social groups garner knowledge of the relative dominance of group members, little is known about how they acquire this knowledge. We have attempted to develop the laboratory techniques needed to answer the question. Using video editing software, we created a set of video clips of artificial social interactions in which one monkey demonstrated dominance over another. Together the set of videos represented an artificial linear dominance hierarchy consisting of five stimulus monkeys. Subjects were trained to pick the dominant monkey in each video clip. After they mastered the task, we gave them probe trials to assess both the degree to which they had formed a dominance concept, and the extent to which they remembered the dominance relations of each pair of stimulus monkeys. Some monkeys performed significantly above chance in these probe tests.

Lisa M. Pytka, Heidi E. Harley (New College of Florida) & Rebecca L. Curtiss-Floyd (Florida State University)

O grape, where are thou? A study of spatial cognition in two lemur species (Lemur catta and Eulemur fulvus rufus) in a laboratory foraging setting

Non-human primates comprise an especially interesting taxon for spatial cognition study; they occupy diverse foraging niches in a wide range of habitats despite their close phylogenetic relatedness. Though still understudied in comparison with monkeys and apes, prosimians represent especially interesting opportunities for studying cognition due to their rapid speciation in small but geographically varied Madagascar. In this study, two species of lemurs (Lemur catta and Eulemur fulvus rufus) foraged for thirty-six hidden grapes in a three-dimensional apparatus similar to ones used in previous work with squirrel monkeys. An analysis of their search strategies revealed that the lemurs demonstrated use of spatial learning in the basic search task (i.e., they extracted all grapes when all holes were baited) and decreased in search efficiency and spatial search efficiency following a five-minute delay in a working memory task. A control study demonstrated that lemurs were not solving the task through

olfactory cueing.

Bradley R. Sturz & Jeffrey S. Katz (Auburn University)

Learning of relative distance between discrete visual landmarks by pigeons (Columba livia)

In an open-field search task devoid of orienting cues and informative geometry, pigeons were trained to find a goal located at the midpoint of the hypothetical line connecting two discrete landmarks positioned in a linear array. Pigeons searched in substrate for an initially visible but eventually invisible goal location containing food. The distance between the landmarks (interlandmark distance) was fixed throughout training. Pigeons learned to locate the goal and continued to search at this location in the absence of food. After reaching training criteria, food-absent trials were conducted in which the interlandmark distance either remained the same as in training or was manipulated by contraction or expansion. Search error and location on novel interlandmark distances were identical to those obtained on training trials. Results suggest pigeons learned to search at a relative distance between the landmarks. Implications of a stable frame of reference as critical in spatial learning are discussed.

Roger K. R. Thompson, Carl E. Hagmann, Dobromir G. Dotov, & Victoria L. Templer (Franklin & Marshall College)

Can Capuchin monkeys (Cebus apella), like Humans, Discriminate Relations-Between- Relations? Maybe…Maybe not.

Spinozzi, Lubranno, and Truppa (2004) reported that capuchin monkeys (Cebus apella) rapidly learned to match relations (same/different) between spatial relations (above/below) in 128 – 352 trials. A replication seemed worthwhile given the contrast between their results and those from prior studies with monkeys and birds. We tested the ability of capuchin monkeys (C. apella) and humans to discriminate either ‘above/below’ or ‘variability/uniformity’ relations in a non-matching to sample task. The near errorless performances of the humans on their initial discrimination tasks transferred to the alternative task. The monkeys’ performances on both relational tasks remained at chance after 624 trials, but increased to greater than 80% correct when tested in full view of the experimenter, as was apparently the case in Spinozzi et al. (2004). Performances subsequently dropped to chance again in the experimenter’s absence indicating that successes were prompted by either inadvertent experimenter

cuing or perhaps, more interestingly, social modeling.

Timothy M. Flemming (Georgia State University) and Roger K. R. Thompson (Franklin & Marshall College)

Deficits in Tool-Using Behaviors of Squirrel Monkeys (Saimiri sciureus sciureus)

In a comparative study of tool-using behaviors of squirrel monkeys and tufted capuchins (Cebus apella), several deficits in the manipulation of probe tools to obtain a food reward yielded an overall failure by squirrel monkeys. Within the first session of testing, several individuals in a socially-housed colony of capuchin monkeys successfully used probing tools to obtain honey from an enclosure. By comparison, squirrel monkeys not only touched the tools significantly fewer times, but never successfully obtained honey from the apparatus after six months of testing and exposure. In a second condition, both monkey species were presented with probing tools of differing lengths; some tools were not long enough to obtain honey from the enclosure. Squirrel monkeys manipulated the tools equally regardless of their affordance to success. Capuchins, by comparison, manipulated and correctly used longer tools at significantly greater rates.

Monique A. Rashid and Clive Wynne (University of Florida)

Modes of Interaction and Communication Between Humans and Domestic Dogs

Several studies demonstrate that domestic dogs have developed the ability to

use human social gestures and cues in their home environment to guide their behavior in beneficial ways. The current studies were designed to identify what it is about such gestures that allows the dog to identify and respond to the stimuli in a functional way. In addition, the limitations of visual acuity in domestic dogs were measured using a choice paradigm to address other possible factors that may explain differences between individual responding to particular social stimuli.

Kelly A. Schmidtke, Bradley R. Sturz, Jeffrey S. Katz (Auburn University) & Anthony A. Wright (University of Texas Health Science Center at Houston)

Observing Response, Set-Size, and Abstract-Concept Formation by Pigeons

For pigeons learning a matching-to-sample task, abstract-concept learning can depend on the observing response requirement (Wright, 1997); but, its role in the two-item same/different procedure is unclear. In the present experiment, groups of pigeons with different observing response requirements (FR1, 10, and 20) to the sample item acquired a two-item same/different task with increasingly larger training set-sizes (8, 16, 32, 64, 128, 256, 1024). Transfer tests with novel items were conducted after each set-size expansion was acquired. Observing response influenced the rate of acquisition across set-size expansion: FR20 < FR10 < FR1. However, the observing response requirement did not affect transfer performance between groups and all pigeons fully learned the abstract concept (evidence by transfer being equivalent to baseline performance). These results suggest that the effect of set-size is independent from the observing response requirement for abstract-concept learning within the present

parameters used in the two-item same/different procedure.

Jessica Crast (University of Georgia), Ingrid Kaiser (University of Georgia), Monique Dase (Morehouse School of Medicine), Dorothy Fragaszy (University of Georgia), Catherine Wallez (University of Rennes)

Capuchin monkeys (Cebus apella) learn to cope with task irregularities while using tools.

An ecological perspective on tool use suggests that an actor learns to use the affordances of objects and surfaces in instrumental activity. We investigated the ability of capuchin monkeys to cope with irregular surfaces while using tools. We predicted that capuchins' manipulation of a tool around aberrations (diamond and rectangular barriers and holes) at six locations in a surface would improve with practice. We assessed changes in two capuchins' skill at this task in three phases, each increasing in difficulty. Changes in success rate, efficiency and strategy were examined. For both monkeys, holes were consistently more challenging than barriers. The number of attempts per trial decreased across phases for barrier trials only, suggesting they learned more about barriers than holes. Success rates on each aberration type did not vary significantly across phases,

implying an ability to cope with increasing challenges. Differential improvement on different aberration-location combinations is currently being analyzed.

Qing Liu, Ingrid Kaiser & Dorothy Fragaszy (University of Georgia)

Development in Nut Cracking Skills of Young Bearded Capuchin Monkeys (Cebus libidinosus)

Wild capuchin monkeys (Cebus libidinosus) in Piauí, Brazil crack palm nuts on hard anvil surfaces using large stones. Young monkeys have been observed manipulating and striking stones and nuts against a substrate from 6 months of age. To investigate the development of nut cracking skills, we observed seven young monkeys at four time points over a period of one year and six months. Videos of activity at nut-cracking sites were collected at approximately 6-month intervals. We are coding behaviors involved in nut/stone manipulation, observing and scrounging from others, and the outcome of cracking actions. We will focus on the perceptual and motor contributions to developmental changes in activity with nuts and stones and the timeline of developing effective nut-cracking. Monkeys in Piauí crack nuts effectively at younger ages than wild chimpanzees or capuchin monkeys in other settings.

Cynthia A. Wei, Alan B. Bond, & Alan C. Kamil (University of Nebraska, Lincoln)

List Linking in Pinyon Jays (Gymnorhinus cyanocephalus): a Test of Transitive Inference.

Treichler and Van Tilburg (1996) showed that macaques can perform transitive inference between two linked five-item lists, suggesting the use of linear representations. Based on the social complexity hypothesis and several previous studies, we predicted that pinyon jays (Gymnorhinus cyanocephalus) should also show transitive inference across linked lists. Following methods similar to Treichler and Van Tilburg, we trained pinyon jays on adjacent pairs in two five-item lists (e.g. list 1: A>B>C>D>E and list 2: 1>2>3>4>5). We then trained them on the linking pair (e.g. E>1 or 5>A) and subsequently tested the birds on probes of six novel pairs (for lists linked E>1, within list pairs= B>D, 2>4; between list pairs= D>1, E>2, B>2, C>3). Patterns of response will be discussed with respect to the nature of the cognitive representation.

Bauer, G.B. (New College of Florida; Mote Marine Laboratory), Colbert, D.E.(University of South Florida), Gaspard, J.C. III (University of Florida; Mote Marine Laboratory), Reep, R.(University of Florida), & Mann, D.(University of South Florida; Mote Marine Laboratory)

Sensory Processes of Florida Manatees: A Review

Manatees are tactile/auditory specialists, with limited visual acuity, a pattern consistent with the frequently turbid, underwater environment they inhabit. Neuroanatomical data suggest their chemical senses are of secondary importance. Using the vibrissae-rich facial area, manatees demonstrate tactile discrimination of texture gratings (Weber fraction = 0.05) at a level comparable to human index finger performance. Preliminary tests indicate manatees detect low frequency vibrations between 5 and 50 Hz, presumably through hydrodynamic sensation involving the vibrissae that cover the postfacial portion of their bodies. Their auditory temporal processing rate is high, exceeding that for humans by a factor of 10. Their evoked potential audiogram indicates detection of sound frequencies up to at least 40 kHz, with peak sensitivity around 24 kHz.

Directional hearing for broadband stimuli is excellent, but localization of tonal sounds is less accurate. They have dichromatic color vision, but visual acuity is probably no better than 20 minutes.

Carrie R. Rosengart (California University of Pennsylvania)

A Comparison of Spatial Search Task Performance of Capuchin Monkeys and Adult Humans

Capuchin monkeys and young children demonstrate perseverative searching. Initial spatial search trials are accurate, but performance declines on subsequent trials due proactive interference. In this experiment the spatial search patterns of adult male capuchin monkeys (n=4) was compared with that of adult humans (n=40). Each participant, regardless of species, was given five trials. On each of the first three trials, the participant watched the experimenter hide a piece of food in the same spot. There were 24 different potential hiding locations. After a delay period (0, 10, 30 or 120 seconds) the participants were allowed to retrieve the food. The distance of the first search attempt from the actual hiding location was recorded. On the next two trials, the reward was hidden in a different location. It is predicted that, like the monkeys, human search accuracy will decrease on the second set of trials.

Amber M. Chenoweth & Stephen B. Fountain (Kent State University)

Acute Nicotine Exposure Produces Only Mild Impairments of Adult Rat Serial Pattern Performance

We examined effects of nicotine, a nicotinic cholinergic agonist, on performance of a well-learned serial pattern. Rats were trained to press levers in a sequential pattern: 123 234 345 456 567 678 781 818, where digits represent the clockwise position of levers in a circular array, spaces indicate 3-s pauses, and other ITIs were 1 s. Once rats reached a high criterion, they received a relatively high dose of nicotine (0.4 mg/kg i.p.) for three successive days. On Day 1 but not thereafter, nicotine produced small but significant impairments on the first element of chunks and on the final "violation" element that was inconsistent with pattern structure. Nicotine never affected within-chunk performance. Because muscarinic cholinergic antagonists such as atropine and scopolamine cause severe deficits in pattern performance, these small nicotine effects add to the evidence that muscarinic cholinergic systems play a more important role in pattern performance than nicotinic systems.

Shannon M. Kundey (Kent State University), James D. Rowan (Wesleyan College), & Stephen B. Fountain (Kent State University)

Some Limitations of the Sequential Pairwise Associative Memory (SPAM) Model of Rat Serial Pattern Learning

Wallace and Fountain (2002, 2003) showed that the sequential pairwise associative memory (SPAM) model, a computational model based on pairwise associations and generalization, could simulate a variety of rat serial pattern learning phenomena for sequences composed of successive food quantities. In the present studies, we examined how well SPAM simulates earlier data from rat serial pattern learning studies in two different paradigms, namely, a stimulus anticipation paradigm in a 6-light linear array and a pattern production paradigm in which rats anticipated the successive positions of correct responses in an 8-lever circular array. In both paradigms, patterns were highly structured and extensively "branching" sequences of positions in the arrays (i.e., the sequences were characterized by cues that signaled different events at different points in the pattern). SPAM failed to simulate rats' performance in both these paradigms. We examine possible reasons for SPAM's failures in these

paradigms and suggest possible remedies.

Poster Session 2 - Saturday Evening

Justin S. Johnson, Whitney L. Kimble, & Martha Escobar (Auburn University)

Directionality of training, directionality of testing, and contingency estimation

Previous research from our laboratory has shown that subjects tend to overestimate cause-effect contingencies if training occurs in the predictive (cause-to-effect) but not the diagnostic (effect-to-cause) direction, regardless of testing direction (Wilhelmsen, Suits, Bray, & Escobar, CO3 2006). Three further experiments investigated the effects of nondirectional training, nondirectional testing, and noncausal test questions on contingency estimation. Participants were trained with a single cause and a single effect, and p was set at 0.5 for both the predictive and diagnostic relationships. Overestimation was again observed whenever training occurred in the predictive direction, but only if the test question implied causality. These results are consistent with theoretical approaches assuming intrinsic differences between predictive and diagnostic judgment.

W. David Stahlman (UCLA), Seth Roberts (UC-Berkeley), & Aaron P. Blaisdell (UCLA)

The Relationship Between Reward Probability and Operant Screen Pecking in Pigeons

We investigated the role of probability of reward on the rate and variability of operant responding in pigeons. Gharib, Gade, and Roberts (2004) previously found an inverse relationship between behavioral variability and probability of reinforcement in rats' operant lever pressing. In four experiments, we presented pigeons with a set of colored stimulus targets on a touch screen. Pecks to the stimuli were rewarded with grain. The color of a target signaled a specific likelihood that pecks would be rewarded. As expected, operant variability increased as a function of decreasing likelihood of reinforcement. We also report interesting response rate differences that appear to be inconsistent with contemporary theoretical accounts of behavior.

Oshri L. Hakak, Ruey K. Cheng, Christina L. Williams, & Warren H. Meck (Duke University)

Effects of sex and prenatal choline treatments on environmental and object exploration

Prenatal choline supplementation has been shown to enhance adult rats' performance on cognitive tasks. Recent studies have associated prenatal choline supplementation with increased gamma oscillations in the adult hippocampus, which in turn are suggested as important for memory consolidation during sleep states. In this study, we explored whether prenatally choline supplemented rats of both sexes would spend more time interacting with novel objects, and subsequently engage in more REM sleep. Local field potentials were recorded in the dentate gyrus of 36 rats of both sexes and different prenatal choline backgrounds (i.e., deficient, sufficient, and supplemented) during both interaction with novel objects and subsequent sleep. Preliminary analysis indicated that environmental and object exploration did not correlate with prenatal choline treatments. A significant sex difference was observed, however, for these two behaviors, suggesting that female rats interacted more with the novel objects and

environments than did males.

Rebecca M. Rayburn-Reeves, Laura A. Bullard, L. Brooke Poerstel, Katherine E. Bruce & Mark Galizio (University of North Carolina Wilmington)

Functional Equivalence in Rats with Olfactory Stimuli

Functional equivalence was studied in rats using a repeated reversals procedure with class-specific reinforcers and olfactory stimuli. Six rats were tested using scented sand as olfactory stimuli in a two-choice modified operant chamber and an odor arena. Stimuli were randomly assigned to one of two sets. Each set was baited with a specific reinforcer: sugar or grain. Responses to one set were reinforced until criterion levels of performance were reached; at this point, the contingencies were reversed. Contingencies were reversed each time criterion was met. Most rats showed a reduction in the number of sessions to reach criterion, as well as an increase in the percent correct on the first exposure to the reversed stimulus sets. Thus these data illustrate functional class formation with olfactory stimuli in rats.

Kenneth J. Leising (UCLA), Kosuke Sawa (Senshu University), & Aaron P. Blaisdell (UCLA)

Temporal integration in Pavlovian appetitive conditioning in rats

We used an appetitive sensory preconditioning procedure to investigate temporal integration in rats in two experiments. In Phase 1, rats were presented with simultaneous compound trials on which 10-s conditioned stimulus (CS) X was embedded within 60-s CS A. In Group Early, CS X occurred during the early portion of CS A, while in Group Late, CS X occurred during the latter portion of CS A. In Phase 2, CS X was paired simultaneously with sucrose. On a subsequent test with CS A, the rate of magazine entries peaked during the early portions of the stimulus in Group Early and in the latter portions of the stimulus in Group Late (Experiments 1 and 2). Similar response peaks were not observed on tests with a control stimulus that had been presented in compound with a stimulus that did not signal reward (Experiment 2).

Ikuma Adachi & Robert R. Hampton(Emory University)

Individual recognition of conspecifics in videos by rhesus macaques (Macaca mulatta)

The cognitive ability to identify group members is advantageous for animals living in social groups. While a variety of findings from the field setting demonstrate individual recognition, there are few studies of this capacity in the lab. We examined this ability in rhesus macaques using a delayed video-to-picture matching-to-sample procedure in which a 5-sec video clip of a familiar monkey was presented as a sample, followed by five still images as comparisons. Five stimulus monkeys were used for each subject: a cage mate and four monkeys living in the same room. We prepared twenty six video clips of each stimulus monkey. Subjects were trained initially with two video clips for each. Each time performance exceeded 75% in the two consecutive sessions, we added six new video clips of each of the stimulus monkeys. All subjects learned to generalize performance to new video clips on the first trial.

Dennis Garlick & Aaron P. Blaisdell (UCLA)

The Hitchhiker's Guide to Data Collection and Analysis using Visual Basic

Training in psychology typically does not include extensive instruction in computer programming. Modern programming languages, however, enable the almost instantaneous completion of tasks that might take researchers thousands of hours to complete manually. Not only can this time be better spent on other academic activities, but very labor-intensive procedures increase the likelihood of errors being made, and also limit the number of alternative analyses that are performed. A number of utilities programmed in Visual Basic for Windows will be described to illustrate the usefulness of computer programming. Utilities include automated administration of Med-PC IV test sessions, writing data directly to spreadsheets rather than text files, accessing current test session status across the internet from any web browser, and automatic graphing of current experimental data. The production version of the Automated Remote Environmental Navigation Apparatus (ARENA) will also be demonstrated. The possibility of sharing these tools with other laboratories will be discussed.

Suits, W. T., Wilhelmsen, S. R., & Escobar, M. (Auburn University)

Preexposure and inhibition effects in long-delay conditioning

In two experiments, rats were trained with an appetitive preparation to determine whether the initial segment of a long-delay conditioned stimulus (CS) that predicted delivery of an unconditioned stimulus (US) in its final segment could become inhibitory (i.e., inhibition of delay). Previous research from our laboratory had determined that, with this preparation, the initial segment of the long-delay CS passed a retardation but not a summation test for conditioned inhibition. Experiment 1 assessed whether CS preexposure of the initial segment of the long-delay CS resulted in its passing the retardation but not the summation test. Consistent with this hypothesis, changing the context between the long delay and retardation trials abolished retardation. In Experiment 2, evidence of summation was obtained when the absence of the US was made explicit through the use of a discrete excitor presented during the initial segment of the long delay CS.

Patricia A. Wilson & Herbert S. Terrace (Columbia University)

How do monkeys (Macaca mulatta) represent items in serial memory?

A variety of recent experiments, on both human and non-human primates, have reported distance effects. In each instance, subjects were tested on 2-item subsets that were derived from one or more lists on which they were trained (D'Amato & Colombo, 1988; Terrace, Son & Brannon, 2003). The general result was that accuracy of responding increased and reaction time decreased as the ordinal distance between the test items is increased. Such distance effects suggest that list items were represented spatially along a linear continuum. To investigate that hypothesis, we used monkeys (Macaca mulatta) with experience on the simultaneous chaining paradigm in our current study. On the original simultanous chaining paradigm, subjects received primary reinforcement if and only if they had responded, in a particular order, to an array of 4 photographs that were displayed simultaneously on a touch-sensitive video monitor. To insure that subjects couldn't learn the required sequence as a motor plan, the position of the list items varied randomly from trial to trial. In the current paradigm we used the same procedure with a few modifications. A simultaneous chain was displayed in one of four different configurations: linear (vertical [top to bottom] and horizontal [left to right] where the

spatial position matches the list order), probe linear (horizontal or vertical but spatial position does not match order position), and simchain (random spatial position). If subjects represented list items spatially, they might be able to use the hint provided on those trials on which the required sequence could be executed by following a spatial rule. Our results to date show that, on 4-item lists, monkeys benefited from trials on which they could respond to list in a linear manner. Positive transfer from linear trials to trials on which the spatial location of list items varied randomly support the hypothesis that subjects do indeed organize list items along a spatial continuum. This is the first step in a series of experiments targeted towards determining if presentation of a list with matching spatial and order positioning will increase the rate of acquisition and retention of a serial list.

Erin Stromberg (Smithsonian National Zoo), Sharon A. Himmanen (Lehman College/CUNY), & Karyl B. Swartz (Great Ape Trust of Iowa).

Does ordered list presentation affect response patterns in an unordered report task?

Two orangutans developed and used a spatial response strategy when reporting items on a touch-sensitive video screen from a list that had been presented randomly. In a second study, when list items were presented in a constant order, one animal abandoned the spatial response strategy, but did not show evidence of a serial position effect. In a third study, when the list items from previously-ordered lists were presented in a random order, the spatial response pattern returned, suggesting that attributes of the list items, when presented in a constant order, may have contributed to response patterns.

Colin Ellard & Erica Stuart (University of Waterloo)

Anxiety, temperament, and anti-predator behaviour in the Mongolian gerbil

Some standard laboratory tests of anxiety are predicated on the idea that the construct of anxiety may be related to processes normally engaged by an animal to avoid predation (vigilance, thigmotaxis, freezing, etc.). There have been few studies in which the relationship between an animal's temperament and its ability to avoid potential predators have been examined directly. We carried out such a study by measuring the behaviour of Mongolian gerbils on a host of open field variables and on some standard and some custom measures of anxiety. Though we found some evidence for enduring temperament, and individual differences in 'anxiety', there was little or no correlation between these measures and the ability of an animal to conduct brisk and adaptive responses to imminent threat of predation. These findings suggest that anxiety and effective anti-predator behaviour may not be related.

Emily Ward (Franklin & Marshall College), Yuko Hattori (Kyoto University), Roger K. R. Thompson (Franklin & Marshall College), & Kazuo Fujita (Kyoto University)

Effects of Two-Dimensional Noise and Feature Configuration on the Recognition of Faces in Capuchin Monkeys (Cebus apella)

Face recognition in Old World monkeys is remarkably similar to that of humans, but relatively little is known about this ability in New World monkeys, such as capuchins (Cebus apella). In order to investigate capuchins' perceptual and cognitive ability to recognize faces, the animals were trained to spontaneously discriminate between grayscale pictures of both humans and nonhuman primates and non-face objects. Two-dimensional visual noise was then introduced into both images as a means to decrease face recognition (cf. Harmon & Julesz, 1973). The animals were able to make the discriminations even at a high level of image degradation. In order to minimize variations in the stimuli physical properties, the facial features of the face stimuli were randomly scrambled and paired with an original intact face. In this second spontaneous discrimination task, none of the animals could discriminate between the scrambled and intact face at a level significantly above chance.

L. Brooke Poerstel, Laura A. Bullard, Rebecca M. Rayburn-Reeves, Kelly Weiland, Katherine E. Bruce,& Mark Galizio (University of North Carolina – Wilmington)

Evaluating Olfactory Identity Matching-To-Sample (MTS) in Rats Using an Open-field Apparatus

Emergence of generalized identity matching-to-sample (MTS) was evaluated in rats using olfactory stimuli, multiple exemplars, and an open-field apparatus. Five subjects were presented a sample stimulus followed by multiple comparison stimuli. Responses to the comparison identical to the sample were always reinforced, whereas responses to the dissimilar comparison were never reinforced. Following criterion performances for a given set of stimuli, subjects were tested for generalized matching during the first presentations of a novel set of 'test' stimuli. The previous set of stimuli was removed from baseline and the novel test set was then trained to criterion. Using multiple exemplar training, subjects were repeatedly tested with new sets of novel stimuli. Acquisition of training discriminations and evidence for emergence of generalized matching was observed in most rats.

Janice M. Hassett (Emory University, Yerkes National Primate Research Center, Center for Behavioral Neuroscience), Julie Martin-Malivel (Emory University, Yerkes National Primate Research Center, Center for Behavioral Neuroscience), Henry Lange (Emory University), Andrew Fischer (Emory University, Center for Behavioral Neuroscience), & Kim Wallen (Emory University, Yerkes National Primate Research Center, Center for Behavioral Neuroscience)

Age and Rank Influences on Access to an Automated System for Cognitive Testing in Socially Housed Rhesus Monkeys

We developed an automated touch-screen system allowing rhesus monkey social groups continuous access to computerized tasks, with interactions individually identified. Monkeys are usually individually tested thus it was unknown whether monkeys of all ages and ranks would have access to the kiosk in a social context. Kiosk access was investigated using a task in which monkeys touched a small screen image to obtain a reward. Monkeys were not trained thus performance reflected spontaneous acquisition. In 3 days of testing, 94/132 monkeys accessed the kiosk and 66 completed the maximum 50 correct trials allowed. Age significantly affected access and completion, with older animals accessing and finishing

less. For rank, lower-ranked animals accessed and reached criterion significantly less. However, individuals from all ranks and ages successfully accessed the kiosk. There were no sex differences and aggression related to access was rare. Thus, the kiosk provides an unobtrusive method of collecting cognitive data.

MacQueen, D. A., Bullard, L. A., & Galizio, M. (UNC Wilmington)

Determinants of Olfactory Memory Span in Rats

The present study developed an incrementing non-match to sample procedure in rats designed to be analogous to memory span tasks used with humans. Rats were placed large arena with 18 food locations. In the initial trial of each session, one food cup marked with a distinct olfactory stimulus was present and responding to it was reinforced. Each subsequent trial added a new olfactory stimulus and responding to

the new stimulus was always reinforced (non-matching). The dependent measures were number of stimuli that incremented without error (span) and overall percent correct responses. Spans improved with successive testing and frequently exceeded 20 stimuli. However, errors were unaffected by the number of stimuli to be remembered, raising questions about the analogy to human memory span procedures.

Patchouly N. Banks & Eduardo Mercado III (University at Buffalo)

Memory for Shells in Hermit Crabs (Clibanarius tricolor)

Hermit crabs inhabit empty gastropod shells to protect their soft abdomens, and are thus continuously in search of the perfect fitting shell. In the current experiment, hermit crabs (Clibinarius tricolor) were tested on their ability to recognize previously encountered shells. A total of 48 hermit crabs were given three opportunities to investigate the same shell, and three opportunities to investigate three different shells. Crabs spent significantly less time investigating familiar shells than unfamiliar shells. When judging a new shell, a crab presumably compares the qualities of that shell with its current shell to determine which will provide better protection. To make this comparison, the crab must have retained some information acquired during its investigations of its current shell, possibly over an extended period. Further research should explore this idea, as well as the possible mechanisms by which hermit crabs recognize shells,including shell and self-recognition through chemical cues.

Debborah E. Colbert (University of South Florida, Sea Life Park by Dolphin Discovery), David Mann (University of South Florida), Joseph Gaspard (University of Florida), Gordon B. Bauer (New College of Florida), Kim Dziuk & Adrienne Cardwell (Sensory Biology and Behavior Program, Mote Marine Laboratory & Aquarium), & Roger Reep (University of Florida)

Sound Localization Abilities of Florida Manatees, Trichechus manatus latirostris

Two experiments measured the underwater sound localization abilities of two manatees. In a four-choice experiment, subjects selected from four speakers in a horizontal plane at -90o, -45o, 45o and 90o relative to the subject's head (0o). Three broad-band signals (0.2-20, 6-20, and 0.2–2kHz) were tested at four durations (3,000, 1,000, 500, and 200ms) and two tonal signals (4 and 16kHz) were tested at 3,000ms. All signals were tested at 100dB re:1 uPa (±1.5dB). Broad-band accuracy ranged from 93%-52%, well above the chance level of 25%. Tonal signal accuracy ranged from 49%-32%. In an eight-choice experiment, subjects were positioned at a depth of 1.5m at the center of equally-spaced speakers in the horizontal plane. Three broad-band signals (0.2-24, 18-24 and 0.2–1.5kHz) were tested at two durations (3,000 and 200ms). Preliminary results indicate that
the subjects are capable of accurately localizing the 3000ms test signals presented in this circular array.

Noam Y. Miller & Sara J. Shettleworth (University of Toronto)

An Associative Model of Geometry Learning

Cheng (1986) suggested that learning the geometry of enclosing surfaces takes place in a geometric module blind to other spatial information. Failures to find blocking or overshadowing of geometry learning by features near a goal seem consistent with this view. However, discussions of these effects have overlooked that spatial learning in an arena or watermaze is an operant task. We present an operant model in which learning spatial features competes with geometry learning, as in the Rescorla-Wagner model. Relative total associative strength of cues at a location determines choice of that location and thus frequencies of reward paired with each cue. The model shows how competitive learning of local features and geometry can appear to result in potentiation, blocking, or independence when choice is measured in a spatial task and how the results depend on enclosure shape and kind of features. It reproduces numerous findings from dry arenas and watermazes.

Anna Wilkinson & Kimberly Kirkpatrick (University of York, UK)

The effects of training history on pigeons' tracking and capture of moving objects

This experiment examined the effects of training history on tracking and capture of moving objects by pigeons. Two groups of birds were given a task where they had to capture a moving object on a touch screen monitor in a customised operant chamber. The first group had previously been trained on a stimulus that appeared on the left side of the monitor and moved across the screen in a rightward linear motion. The size of the stimulus systematically decreased and speed increased across phases. The second group did not receive any prior training with moving objects. All birds were then presented with a stimulus that was 12 pixels in diameter travelling at 68.8 pixels/s, which could appear from any side of the monitor and move directly across to the opposing side. It was found that prior rightward training lead to a rightward bias in pecking errors for all motion types. Acquisition of the four-motion task was slower and the rightward bias remained despite over 150 sessions of subsequent training. The implications for the mechanisms involved in capture and tracking will be discussed.

Krista Macpherson & Bill Roberts (University of Western Ontario)

Some Tests of Counting in Dogs

Domestic dogs were tested for their ability to count by placing different numbers of food items, one at a time, in each of two containers while a dog watched. The dog was then allowed to choose between the containers and to eat all of the food in the container chosen. In two experiments, no evidence was found that dogs preferred the container into which the greater number of items had been placed. This finding contrasts with chimpanzee experiments, in which chimps regularly took the larger number of food items (Beran & Beran, 2004). The possibility that these results may be explained by the recent evolutionary history of dogs is discussed.

Gin Morgan, Nicholas K. DeWind, and Herbert S. Terrace (Columbia University)

An Exception to Weber's Law in Numerical Representations by Rhesus Macaques

There is a considerable body of evidence supporting the hypothesis that, in nonhuman primates, representations of numerical stimuli obey Weber's Law, i.e., increasing variability of responding with increasing target magnitude. Using a delayed non-identical numerical matching-to-sample procedure with rhesus macaques (Macaca mulatta), we have found that while accuracy shows a distance effect, responses do not show scalar variability. Instead, they show strong end effects on both ends of the stimulus continuum. In this experiment, rhesus macaques (n=2) completed a numerical matching-to-sample task with three different stimulus continua of equal length (1-11, 3-13, and 5-15). Results compare response patterns and examine the contributions of absolute numerical value and relative position in the stimulus continuum to numerical representation in nonhuman primates.

Dobromir G. Dotov & Anthony Chemero (Franklin & Marshall College)

Detection of Entropy in the Array Allows Two-Layer Networks to Discriminate Same and Different

Measuring entropy is one way to quantify the amount of information in a set of bits (Shannon & Weaver, 1949). Animals could use entropy in the visual array for perceptual categorization tasks. Experiments with pigeons reveal strong positive correlation between entropy in the array and the ability to learn same-different discrimination (Young & Wasserman, 1997). We trained simulated networks to perform the same task in six conditions. We found that it became increasingly difficult for our networks to learn the categorization as the number of icons decreased from sixteen to two, that is, the range of possible entropy values shrunk. Furthermore, with only two layers, our networks are only capable of association, and so could not have computed the entropy values. This indicates that the networks simply detected entropy. The similarity in the performance of the networks and pigeons suggests that the pigeons might also be detecting, and not computing, entropy.

Christina Wesolek, Joseph Soltis, Anne Savage (Disney's Animal Kingdom), Kirsten Leong (Cornell University), & John D. Newman (NIH)

Emotional Arousal in the Voiced Sounds of the Rhesus Monkey and African Elephant

Emotional arousal is expressed in the mammalian voice, but there are no consistent acoustic measures used and few comparative analyses. We apply a representative set of source and filter features to rhesus macaque (Macaca mulatta) 'coos' and African elephant (Loxodonta africana) 'rumbles' produced in "low" and "high" arousal contexts. In both species, MANOVA showed that the 15 measures separated calls across arousal categories. In rhesus macaques, high arousal was associated with increased and more variable fundamental frequencies, increased amplitudes, and a shift in formant locations. In African elephants, increased arousal was associated with lower amplitudes. In addition, low ranking female elephants expressed a greater magnitude of acoustic change compared to high ranking females. These acoustic features may successfully characterize arousal state in a variety of mammals, but the specific acoustic features that reflect arousal and the specific pattern of acoustic response may vary by

species, individual and arousal context.

Faith E. Warner, Stephen E. G. Lea (University of Exeter)

Concept-Level Generalization in Monkeys Following Training on a Single Exemplar of a Familiar Category

Visual discrimination of biologically relevant concepts was tested in four non-human primates, following training on multiple copies of a single exemplar. The subjects were one Sulawesi black macacque (Macaca nigra), two white-throated capuchins (Cebus capucinus) and one mandrill (Mandrillus sphinx). A 'pokeboard' was used to test generalization to varying exemplars of a familiar category (conspecifics amongst allospecifics) and an unfamiliar category (tigers amongst other felids). Each subject was tested on both categories, and saw each test stimulus once only. The test stimuli varied in aspect, background, age and sex of individual depicted, but all were shown in natural orientation. Reliable generalization occurred in all cases for the conspecific condition (median Herrnstein ρ scores: 0.74, 0.66, 0.60, 0.88). Generalization to tigers amongst other felids was lower overall (0.51, 0.58, 0.70, 0.55). This difference may be due to prior conceptual knowledge of conspecifics or to an innate ability to process species-specific faces.

E. Hartmann & M. Kiley-Worthington. (Eco-Etho Research & Education Centre, France. & University of California, Berkeley)

Enhancing learning of verbal cues in horses (Equus caballus) through cooperative teaching

Studies investigating linguistic skills in mammals have indicated that these species can learn verbal cues. This is facilitated in horses by cooperative interaction between the animal subject and the human teacher. This can have considerable application for their welfare and teaching. The study tested a group 6 horses to discriminate colours by name using a cooperative teaching approach involving words & gestures, primary & secondary positive reinforcement. The tests showed that the horses recognized the colours by a verbal cue & learnt quickly. Implications for handling and teaching equines are discussed.