

Posters

Poster Session I – Thursday Evening

- P1** **Do young rhesus monkeys know what others see?: A comparative developmental perspective**
Alyssa M. Arre, & Laurie R. Santos (Yale University)
Humans undergo robust ontogenetic shifts in theory of mind capabilities. It is still unknown whether this is a unique feature of human development or shared with other animals. As such, we tested a population of 240 infant and juvenile rhesus macaques (*Macaca mulatta*) using a looking-time method to explore what developing monkeys know about others' perceptions. Specifically, we explored whether younger monkeys predict that a person will reach for an object where she last saw it. Preliminary data analysis indicated that infant rhesus monkeys (younger than one year of age) do not show longer looking when an agent acts inconsistently with what she has seen regarding the location of a hidden object. On the contrary, juvenile monkeys (between two and five years of age) do look longer when an agent acts inconsistently with what she has seen than when she acts consistently. Further analyses will pinpoint the age at which this ability comes online, and will seek to further illustrate the developmental trajectory across the entire juvenile period (under five years of age). Our findings suggest that despite divergent socioecology, rhesus macaques show some delayed, but human-like, developmental parallels in their understanding of others' perceptions.
- P2** **Creating a morphological atlas for *Canis Latrans***
Katherine Athanassiades, & Gregory Berns (Emory University)
Limited research has been conducted on the brain of *Canis Latrans* (coyote). Much of the known information are comparisons in size, shape, and weight to other mammalian brains. Due to the lack of previous research, little is known about the relationship between a coyote's behavior and neurological structure. What is lacking is a comprehensive atlas for the various regions and structures of the coyote brain. The purpose of this research is to create a comprehensive atlas that provides locations for various structures in the brain. From there, further research can be done that analyzes the brain structures and organization, with a goal of better understanding the complex natures of coyotes.
- P3** **Personality and Cooperative Task Performance in Bottlenose Dolphin (*Tursiops truncatus*) Dyads**
Kimberly C. Bagley, Preston Foerder (University of Tennessee at Chattanooga), Kelley Winship, & Teri Bolton (Dolphins Plus Marine Mammal Responder)
Although cooperation is a common tactic amongst social animals for survival, under research conditions, not all animals cooperate with each other. Although there are increasing amounts of research, into personality, the exact traits across two animals that combine to produce cooperation have not been studied. Dolphins exhibit cooperation in the wild in food and mate acquisition. This study examined the relationship between cooperation and personality in bottlenose dolphin (*Tursiops truncatus*) dyads. Eleven bottlenose dolphins at the Roatan Institute for Marine Sciences (RIMS) were paired and presented with an apparatus that encouraged the dyads to cooperate by simultaneously pulling in opposite directions in order to release a food reward. Personality profiles of each dolphin were completed by the caretakers, in particular noting two different categories of interactions: dolphin-dolphin and dolphin-object. Although none of the dolphin pairs solved the problem, we are able analyze these categories in relation to the dolphins' mutual interactions with the apparatus. We hypothesize that these mutual interactions are related to the similarity of personality traits between dolphins and their individual willingness to interact with objects. These results could guide future research on the relationship between personality and cooperative problem-solving across species.
- P4** **Effects of Enrichment on Long-Term Captivity in European Starlings (*Sturnus vulgaris*)**
Sidney Beecy, Suzanne Gray, Muhammad Qadri, Brenna Gormally, Michael Romero, & Robert Cook (Tufts University)
Undomesticated animals are prone to developing abnormal behaviors in captivity, such as stereotypies, but the physiological stress profiles of these animals can vary widely. This study examines the effects of social and environmental enrichment on the stress levels of eight starlings in long-term captivity. Originally, the starlings were housed in individual bird cages that were attached to experimental apparatuses. Enrichment was provided using an aviary approximately 9x larger in volume than a home-cage, containing perches, toys, food, and water. Two groups of four starlings spent three hours in the aviary twice a week. Blood was sampled at regular intervals to determine CORT profiles using a three-part measurement (baseline, stress-induced, and negative feedback) related to physiological stress. Additionally, the birds were video recorded weekly in their home-cages and in the aviary in order to examine behavioral effects. These methods are designed to identify a relationship between CORT profile and stereotypic presentation in these starlings and to determine if the implementation of the enrichment aviary reduces physiological stress, reduces behavioral stress, or both.
- P5** **Rule-Based and Information Integration Visual Category Learning in Rats**
Matthew B. Broschard, Jangjin Kim, Edward A. Wasserman, & John H. Freeman (University of Iowa)

The COVIS (COmpetition between Verbal and Implicit Systems) model postulates two systems in humans that learn new categories: a declarative system that mediates rule-based (RB) tasks and a non-declarative system that mediates information integration (II) tasks. Humans and monkeys, but not pigeons, learn RB tasks faster than II tasks; however, it is unknown whether this advantage is unique to primates. Therefore, we trained rats on RB and II tasks using circular stimuli with black and white gratings that differed in spatial frequency and orientation. For the RB groups, category distributions were calculated according to the relevant dimension (either spatial frequency or orientation). These distributions were rotated 45 degrees for the II tasks. Similar to pigeons, no difference in learning rate was observed between RB and II groups. Testing sessions used broader distributions to assess category generalization. For all groups: accuracy decreased as the distance from the category mean moved toward the decision boundary, whereas accuracy increased as the distance from the category mean moved away from the decision boundary. These findings indicate that rats do not exhibit an advantage for RB learning and therefore might not utilize executive function in visual category learning to the same extent as primates.

Discrimination training and odorant concentration influence scent detection performance of *Cricetomys ansorgei*

Sydney M. Brotheridge, Haylee Ellis, Kate Sears, Cynthia D. Fast, & Christophe Cox (APOPO)

P6

APOPO's African giant pouched rats (*Cricetomys ansorgei*) sniff out tuberculosis (TB) in human sputum samples to increase detection of TB by >40% in resource-poor areas of Africa. The concentration of mycobacterium tuberculosis and other non-TB-related odors varies substantially across samples, making generalization across a range of TB-related odors crucial to the rat's TB-detection success. Using pure odorants, we investigated how training samples impact the rat's ability to generalize across a range of odorants. Experiment 1 trained rats to respond to a high (H+) or low (L+) concentration of an odorant. Probe trials across a range of concentrations revealed peak responding at the trained concentration. In Experiment 2, some rats were reinforced for responding to high, but not low, concentrations of the odor (H+/L-), while others received training with the reverse contingencies (H-/L+). Although H-/L+ was empirically more difficult to solve, these rats demonstrated superior generalization across a range of odor concentrations when tested. Experiment 3 further examined this relationship while controlling for stimulus magnitude effects by varying the ratio of two odorants appearing in a mixture. The results of this project have implications for olfactory learning mechanisms and could inform best training practices to optimize rat scent detection applications.

Variations of the Odor Span Task used to Study In-Context Remembering in Rats

Shandy A. Nelson, Sarah Krichbaum, Nick Blackburn, Kyle Chenevert, Katherine Dyer, Haily Kelliher, Aliana Raulerson, MacKenzie Wantje, Nicole Webster, Bobbie Wolff, Mark Galizio, & Katherine Bruce (University of North Carolina Wilmington)

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The Odor Span Task (OST) is an incrementing non-match to sample procedure used to study remembering in rodents. In this task, responding to a novel odor stimulus is reinforced, but responding to a stimulus previously encountered within the session is not reinforced. The task can be adapted to study in-context memory in rats by adding a "where" component and presenting scents in more than one context during a session. Responding to scents the first time they are presented in either context is reinforced, and subsequent responding to those scents in each context is not. In several experiments, rats received OST training with some trials conducted in a circular arena (Context 1) and others in a modified Radial Arm Maze (Context 2). Probe trials were presented in which an odor was repeated, but in a context different from its initial presentation. On some probe trials, both familiarity and in-context memory could account for responding, but in other probes, only in-context memory would be effective. The results of these studies showed evidence for in-context memory in some conditions, but only familiarity-based responding in others. These results support further research to assess the critical determinants of in-context responding in the OST.

Enriching Tigers Young and Old: The Behavioral Effects of Environmental Enrichment and Age in a Large Sample of Captive Tigers (*Panthera tigris*)

Kate M. Chapman, & Chase Holiman (University of Arkansas)

P8

Environmental enrichment is typically used in zoos, laboratories, and refuges to reduce negative behaviors (e.g. stereotypy) and increase positive behaviors in captive animals. While previous studies have examined the effects of environmental enrichment on captive felids, significant effects are rare due to small sample sizes and the inclusion of multiple felid species. This study evaluated the efficacy of several types of enrichment in an age-diverse sample of 55 captive tigers (*Panthera tigris*) at Turpentine Creek Wildlife Refuge. Using focal-animal and time sampling, tiger behavior was assessed in both enriched and baseline conditions. The within-subjects paradigm included scent-only, scented organic object, scented inorganic object, unscented inorganic object and feeding enrichment. Tigers engaged in more active behaviors during three specific types of enrichment compared to baseline sessions; scent only, scented organic object, and food enrichment. Food enrichment generated the highest levels of activity. Lack of significant effects for other enrichment types may be due to high degrees of within-subjects and between-subjects variability. There was no correlation between age and activity level overall, which may reflect compensatory mechanisms in geriatric tigers and/or individual differences. However, group level comparisons revealed that juveniles were significantly more active than adult and geriatric tigers overall, as expected.

P9

Individual and Group-Level Differences in Stereotypy in a Large Sample of Captive Tigers (*Panthera tigris*)

Chase Holiman, & Kate M. Chapman (The University of Arkansas)

Animals often experience increased levels of stress in captivity, resulting in stereotyped behaviors (e.g. pacing) and reduction in species-typical behaviors. Environmental enrichment is used to reduce negative behaviors and increase positive behaviors in captive animals, but stereotyped behavior often remains. Anecdotal observations from researchers and care staff indicate that dramatic individual differences in stereotypy exists, even among siblings or co-housed individuals. This study used focal-animal and time sampling to assess individual and group level differences in stereotypy in a sample of 55 captive tigers (*Panthera tigris*) at Turpentine Creek Wildlife Refuge. Tigers of varying ages and phenotypes (i.e. orange, white) were observed during environmental enrichment sessions and baseline sessions over the course of several years. Rates of stereotypy were very low in this sample; mean stereotypy across all individuals and sessions was 3.14%, though the minimum/maximum stereotypy rate for a single subject/session ranged from 0%-37%. Fewer than half of the subjects exhibited stereotypy at all. Despite the low rates of these behaviors, more stereotypy occurred in baseline than enrichment sessions. This suggests that even in a comparatively low-stress population, the use of enrichment can further reduce stress-related behaviors and individual differences must be considered when developing animal management plans.

Same/Different Visual Discrimination using a Differential Outcomes Procedure with Rats

Lauren Cleland, Cheyenne Elliot, Sydney Wilson, Sarah Jones, & Kenneth Leising (Texas Christian University)

P10

In an instrumental differential outcomes procedure, different responses result in unique outcomes (e.g., R1-O1; R2-O2). This procedure facilitates performance in discrimination tasks. The current experiment examined the effect of differential outcomes on performance in a same/ different task with rats. In the task, a sample stimulus was displayed on an iPad and after a delay of 1000, 1500, 3000, or 6000-ms was followed by either the same or a different stimulus. After a touch to the second stimulus, two response locations were presented on the screen. One location represented a “same” response, while the other represented a “different” response. The experimental group was reinforced with one outcome for a correct “different” response and another outcome for a correct “same” response. The control group of rats was reinforced with only one outcome for both correct “same” and “different” responses. After training, rats were tested with novel exemplars to examine transfer of a same/different concept. No differential outcomes effect was found, but interestingly, both groups performed better with longer delays.

Using Raspberry Pi to explore cheaper alternatives of operant chambers and discrimination learning in rats

Daniel Crafton, Andrew Goetz, Mark Kate Moore, & Dr. Rebecca Rayburn Reeves (Armstrong State University)

P11

Non-human animal research, especially in rats, most commonly uses the remarkable operant chamber created by B.F. Skinner as the backbone for experiments. These chambers are prevalent in the majority of rat labs throughout the country. The problem that has surfaced with the increased popularity of these chambers, along with the associated software package, is that the costs of a single chamber equipped with basic hardware is extremely high. A simple startup for lab-based research using eight of these chambers, available from only a handful of companies, comes at a cost of several thousand dollars. We set out to explore alternatives of creating a more affordable, updated, apparatus for conducting cognitive and behavioral research with rats. We used a single board computer, called a Raspberry Pi, to create a program that measures operant responses using touchscreen technology. This allows researchers to conduct the same types of experiments conducted in the old operant chambers at a fraction of the cost. Preliminary data suggest that the touch screen apparatus provides a highly comparable method for generating behavioral patterns indicative of those obtained with operant chambers in rats.

Spatial Information Processing in Japanese Quail

Chelsey Damphousse, Diano Marrone, & Noam Miller (Wilfrid Laurier University)

P12

Location-specific expression of immediate early genes (IEGs) support the brain’s representations of space. Within the mammalian hippocampal formation (HF), different patterns of IEG expression encode different environmental contexts. Little is known about how or whether the avian HF performs similar functions. To address this, we examined *Egr1* expression in a non-flying species, Japanese quail, following controlled exploration of a novel environment. We find that *Egr1* expression is both upregulated by spatial experience and that the pattern of *Egr1* expression closely resembles that observed in mammals. *Egr1* expression also varies across regions of the avian HF in a manner consistent with their proposed mammalian homologues. To assess the spatial memory capabilities of quail, we developed a testing battery with tasks assessing one or more of the three components of episodic-like memory: object identity, location, and context, with the final task involving a combination of all three elements. Quail succeed at object recognition but failed when the task required remembering more than one element. By determining the boundary conditions for spatial information that quail can reliably use to solve tasks, we are able to establish the groundwork for further examination of functional homologues between the avian and mammalian hippocampal formations.

Visual Discrimination in Archerfish: Development of Instrumentation and Protocols

Adam Davila (Villanova University), Alexander Brown (Lafayette College), & Michael Brown (Villanova University)

P13

Archerfish (*Toxotes* spp.) are known for their ability to accurately spit streams of water to down aerial prey. This spitting behavior has been trained as a response to stimuli, analogous to nose-poking, pecking, or pointing in other laboratory animals. This poster will detail some of our efforts to develop procedures to experimentally investigate archerfish choice behavior and cognition. There is little existing literature to draw upon when building apparatus, achieving appropriate motivational states (i.e., food deprivation), reinforcer preferences, automating data collection, and other factors that are well known in common laboratory animals. Over the last year, we have used a variety of procedures to elicit and measure spitting responses in archerfish. These include shaping fish to spit at water sensors so

that we could automate the data collection process. The techniques we have used to train fish and preliminary results from visual discrimination procedures will be presented.

A Search for Symmetry in Rats Using a Go, No-Go Procedure

Katherine Dyer, Sarah Accattato, Logan Richardson, Katherine Bruce, & Mark Galizio (University of North Carolina Wilmington)

P14

Evidence of equivalence relations, especially the symmetry relation, has been difficult to find in animals. Urcuioli (2008) reported a successful search for symmetry in pigeons using successive matching-to-sample procedures that trained both identity and arbitrary relations. However, Prichard et al. (2015) were unable to replicate these results in rats with odor stimuli. One possible reason for that failure is that successive odor presentation may have produced compound odors that were different in training and testing. The current study was a replication of Prichard et al. with the insertion of a masking odor between the sample and comparison odors to prevent such compound formation. Five rats completed baseline training under these conditions and four of them showed potential evidence of emergent symmetry, with higher response rates on positive symmetry probe trials than on negative trials. However, after the first two probe sessions, responding to all probe trials decreased with no evidence of differential responding to the probe trials. These results provide some support for Urcuioli's (2008) theory of class formation, but suggest that extinction of responding on probe trials may limit the use of this strategy in rats.

Emotion Labeling with Visual Stimuli: The Effects of Physiological Responses on Conditioning

Elliott Cheyenne, Willie Cassidy, White Jackson, & Leising Kenneth (Texas Christian University)

P15

Emotion labeling occurs when one learns to identify, discriminate, and act upon internal sensations caused by external events. Emotion labeling can be facilitated by language but can also be learned by nonverbal humans using visual labels. The focus of our current studies was to investigate whether or not typically developing humans could learn to label their physiological responses to the delivery or omission of a reinforcer (points) following a touch to a discriminative stimulus. Results indicated that participants failed to learn the task across three experiments, and instead chose between labels at random. We discuss potential causes of these failures to learn and future research using visual labels to facilitate emotional learning.

Meat or veggies? Assessing food preferences in domestic dogs with simultaneous choice tasks

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

P16

Establishing food preferences is a necessary step to many cognitive tests on canines, yet no work has so far compared a wide array of methodologies used to establish food preferences in simultaneous choice tasks. Such tasks involve simultaneous presentation of food items that are unequal in value and/or quantity, with subjects allowed to choose only one item. We provide the first systematic exploration of how different ways of presenting food items in a simultaneous choice task influence dogs' choice behaviour. In 4 experiments dogs chose between high-value (hot dog) and low-value (dried corn kernel) food items. Across studies we varied item presentation: resting in the experimenter's palms (Exp. 1), on plates (Exp. 2), contained in cups (Exp. 3), as large quantities contained in separate jars (Exp. 4). We did not observe differences in choice preferences across presentation forms. Further, each version of the simultaneous choice task revealed preferences at chance level when comparing high and low value food items, raising questions about the validity of simultaneous choice tasks. We discuss results in the context of methodological innovations for simultaneous choice tasks in canine cognition research, and the role of preferences in an individual's choices and behaviour.

Do Rhesus monkeys also experience face pareidolia?

Molly Flessert (Georgia State University), Jessica Taubert (Laboratory of Brain and Cognition (NIMH/NIH)), David A. Leopold (National Institute of Mental Health Section on Cognitive Neurophysiology and Imaging), & Leslie G. Ungerleider (Laboratory of Brain and Cognition (NIMH/NIH))

P17

Face pareidolia – the misperception of faces in inanimate objects – is an error of the face detection system and is often experienced by humans. Here, we tested five male rhesus macaques to investigate whether this phenomenon is unique to humans. During a looking preference task, 15 examples of face pareidolia, 15 content-matched object images, and 15 conspecific face images were presented in pairs to the subjects while we recorded their natural eye movement behavior. All subjects looked longer at illusory faces than at content-matched objects with no face-like configuration. Further analysis revealed that subjects frequently fixated on the “eye” and “mouth” regions for both illusory and conspecific face stimuli. This result is consistent with previous studies of primate gaze behavior when viewing real faces. On the other hand, content-matched object stimuli produced more variable patterns of fixation, resulting in a clear distinction between this category and the two “face” categories. Additionally, a support vector machine classifier successfully predicted, based on the fixation density patterns for each stimulus, whether each subject was viewing an object with an illusory face or not. Overall, these results indicate that monkeys, like humans, experience face pareidolia.

Assessing the SNARC Effect in Rhesus Monkeys and Capuchin Monkeys

Kristin French, Travis Smith (Georgia State University), Audrey Parrish (The Citadel), & Michael Beran (Georgia State University)

P18

The Spatial Numerical Association of Response Codes (SNARC) effect occurs when quicker responses are given to one side of a spatial array for small numbers and to another side for large numbers when making numerical judgements.

Evidence of the SNARC effect in nonhuman animals, including chimpanzees, rhesus macaques, and newborn chicks, suggests that it may have an evolutionary basis. The current study assessed the potential SNARC effect in capuchin monkeys and rhesus monkeys using methods adapted from the design of Rugani et al. (2015) and Diamond et al. (2015). Monkeys were first given a computer task in which they had to choose between identical quantities (2vs2, 8vs8, or 32vs32) placed at left and right on the screen immediately following error-free training with contacts to a centrally located set of 5 or 20 items. A second task required monkeys to choose either the smaller or the larger of two sets of 2 to 8 items. There were no SNARC effects found with either species during the first task, and only limited evidence of the SNARC effect in the second. These data indicate that the SNARC effect may not be a robust phenomenon in nonhuman primates.

Factors affecting Memory in an Incrementing Non-Matching-to-Sample Task in Rats.

Katherine Bruce, Sarah Accattato, Katherine Dyer, Haily Kelliher, Shandy Nelson, Logan Richardson, Thomas J. Wagner, Nicole Westrick, Bobbie Wolff, & Mark Galizio (UNC Wilmington)

P19

Available procedures to study working memory capacity in rodents generally use manual arena or maze tasks. For example, the odor span task uses an incrementing non-matching-to-sample procedure in which digging in cups scented with novel olfactory stimuli results in reinforcement on each trial, while responses to previously presented stimuli are not reinforced. The present study modified this procedure for use in an automated operant chamber using a 15-channel olfactometer. Rats were trained on a go, no-go procedure to make nose-poke responses in a port through which odorants were delivered. Responses to each odorant were reinforced on an FI 5-s schedule the first time it was presented, but once an odor had been presented, responses to that odor were no longer reinforced. Rats rapidly learned to differentiate between session-novel and session-familiar odors and responded at high rates to new stimuli and much lower rates to repeated stimuli. Determinants of remembering were assessed by manipulating a number of variables including frequency and recency of repeated odors, a mid-session delay, and a distractor task. Accuracy was affected by all these variables, but the greatest disruption was observed after a mid-session delay, with or without a distractor task.

Walking Direction and Attentional State Effects on Predator Avoidance Behavior in Eastern Gray Squirrels

Kristy Gould, Anika Hansen, Grant Goss, & Nicole Weber (Luther College)

P20

Two students each led multiple teams of students enrolled in an Animal Cognition psychology course in collecting behavioral data from Eastern gray squirrels on the campus of Luther College over two semesters. The research was based on Bateman & Fleming (2014) who investigated the role of humans as potential “predators” on squirrels in a public park. Direction walked and attentional state of the “predators” were manipulated in both the 2014 study and our study. Our study included walking either directly toward the squirrel or at a 45-degree angle while looking down, at a cell phone, up, or directly at the squirrel. The distance from the “predator” to the squirrel when it became alerted, the distance from the “predator” to the squirrel when the squirrel fled and the distance fled were measured. A significant effect of walking type was found, but no effect of attentional state. Attentional state was found to be a significant factor in the 2014 study. Results are discussed both in terms of what they say about squirrel avoidance behavior and in terms of the project being a good way to introduce students to research methods and data collection in animal behavior and cognition.

Orangutan health and behavior: Implications for nutrition in captivity

Rachel Hamilla (Kent State University)

P21

Zoo-housing of great apes is beneficial to conservation efforts, and captivity provides valuable research opportunities. However, captive life is inherently different than wild, as specifically seen in dietary content and general behavior. The present study aims to explore this by examining the effects of diet on the health and behavior of captive Bornean orangutans. High-starch/low-fiber commercial biscuits largely supplements the diet of zoo-housed orangutans, creating a wide discrepancy between the fiber content of captive and wild diets. This discrepancy may play a role in the weight problems and cardiovascular/respiratory issues common of captive apes. Subsequently, these health issues may be linked to behavioral abnormalities. This study will implement a diet change to eliminate the biscuit and increase fiber content. Data collection will include: blood samples to monitor physiological markers of potential health problems, observations recorded using an ethogram to monitor undesirable behaviors and overall time spent active, and weigh-ins throughout the course of study to ensure all subjects maintain a healthy weight. This study hopes to find that the diet manipulation and increased opportunities to forage will lead to decreased undesirable behaviors, increased time spent active, and a lower risk of disease.

Dissociation of Explicit and Implicit Memory in Rhesus Monkeys (*Macaca mulatta*)

Thomas C. Hassett (Emory University), Benjamin M. Basile (National Institute of Mental Health), & Robert R. Hampton (Emory University)

P22

Human memory taxonomies distinguish between explicit and implicit memory systems in part by the degree to which these systems are accessible to memory monitoring. The degree to which nonhuman memory systems also differ in accessibility to memory monitoring is understudied. We compared the accessibility of long-term habit and short-term working memory to monitoring in rhesus monkeys. We parametrically instilled weak, medium, and strong habits by biasing the presentation of specific stimuli within 144 image quads in a matching-to-sample paradigm. In addition, we parametrically modulated the usefulness of working memory by varying the duration of the retention interval. As intended, monkeys were more accurate on trials where habit was strong, and less accurate on non-habit trials where the delay interval was long. Critically, memory monitoring robustly tracked changes in accuracy due to retention interval,

but only weakly tracked changes in accuracy due to habit. These results imply a dissociation between implicit and explicit memory in nonhuman primates, and thus that this aspect of the human memory taxonomy is phylogenetically conserved among Old World primates.

Persistence in an unsolvable task is associated with working dog performance

Lily Strassberg, Lucia Lazarowski, Sarah Krichbaum, Paul Waggoner, & Jeffrey S. Katz (Auburn University)

P23

Dogs' tendency to look at humans when faced with an unsolvable task has been interpreted as a socio-cognitive and communicative mechanism in domestic dogs. Alternatively, perseverating on the unsolvable task instead of looking to humans for help has been suggested as a measure of persistence and resistance to extinction (Hall 2017). We tested 40 detection dogs-in-training ranging from 3 to 10 months old on an unsolvable task (toy inside a locked transparent container) in the presence of a human experimenter and measured persistence (time spent interacting with the apparatus) and human-directed social behavior (gazing at and interacting with the human). We found that persistence increased with age while human-directed behaviors decreased. Additionally, individual level of persistence was correlated with several measures of dogs' training evaluations indicative of desirable detection dog performance. Our results suggest that training, in particular for roles in which dogs work more independently from humans, may increase persistence on the unsolvable task. Further, our findings indicate the utility of the unsolvable task in measuring persistence in dogs, which may be used to develop more objective definitions of traditionally subjective working dog behavioral characteristics as well as for identifying and selecting appropriate dogs for working roles.

Walden - a new way to make behavioral research at the laboratory

Alejandro Rodrigo, Laurent Avila-Chauvet, José-Natividad Moreno, & Yancarlo Ojeda (Centro de Estudios e Investigaciones en Comportamiento - Universidad de Guadalajara)

P24

There are many limitations in the third world countries to develop valuable behavioral research. Among them, the high costs of purchasing laboratory equipment and the lack of resources to support science restrict the improvements in this field. Due to this issue, many researchers have developed their own equipment to resemble traditional apparatus such as the Skinner box. Unfortunately, there are many experimental questions that cannot be answered with this device. Many studies that include the record of locomotion patterns, such as foraging behavior or spatial behavior are outside the scope. Besides monetary restrictions, other factors can interfere with the evolution of behavioral research. Between them, the absence of companies developing innovative equipment -at a low cost- to study the mechanisms behind the animal behavior and also the lack of flexibility within the equipment to adjust to specific necessities of behavioral researchers. A possible solution to this matter is

Double Alternation Learning in C3H Mice: Transfer from Non-Correction to Correction.

Deidre Inabnett, Dy-Onna Stith, Kayla Isom, Asia Cooks, Elizabeth Wells, Holly Boettger-Tong, & James D. Rowan (Wesleyan College)

P25

This experiment examines the effects of non-correction pre-training of a double alternation (DA) pattern on the subsequent learning of the pattern with correction. Kunder and Rowan (2008) demonstrated that rats were able to learn DA patterns but only if each incorrect response required the rat to then generate a correct response before advancing to the next trial. CH3 mice, in this experiment, were first trained for 21 days on a DA pattern without correction and then were transferred to a DA pattern with correction for 10 days. A second group of mice were only trained for 10 days using the correction procedure. The no correction pre-training group showed no significant learning of the pattern in the Training Phase and were still at 50% errors overall on Day 21. When transferred to the DA with correction (10 days), the mice showed improved performance and learned faster than the group without a pre-training phase. This indicates that, even though performance in Phase 1 was never above chance, the mice in this group possibly learned something about the DA structure in pre-training.

The development and implementation of a simple free-operant maze navigation apparatus

E. Carlos Ramirez, & W. David Stahlman (University of Mary Washington)

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Traditionally, the collection of spatial navigation data in animal learning preparations has typically been some combination of arduous, inefficient, inflexible, and costly. Standard appetitive preparations involve conducting trials in a serial fashion, necessitating a great deal of handling on the part of experimenters. Such preparations are also by necessity limited in the types of reinforcement schedules that may be employed (typically FR-1 and extinction). We outline an inexpensive and simple apparatus that allows for the implementation of a much wider array of conditions, including a variety of reinforcement schedules and controlled variation of the delivery of multiple reinforcers within a single session. This apparatus can be installed in a variety of maze types, is highly modifiable, and dramatically reduces the need for handling individual animals, as iterative opportunities for reinforcement are automatically presented depending on the animal's performance. We present cumulative performance records on several schedules of reinforcement and highlight possibilities for future research.

Personality and problem solving in zebra finches

Lisa Barrett (University of Wyoming Program in Ecology and University of Wyoming Department of Zoology Physiology), Jessica Marsh (University of Wyoming Department of Zoology Physiology), & Sarah Benson-Amram (University of Wyoming Program in Ecology and University of Wyoming Department of Zoology Physiology)

P27

Individual differences in how animals respond to their physical and social environments represent a new and exciting area of research within the field of behavioral ecology. Animal personality, defined as individual behavioral responses that are stable over time or context, is pervasive across the animal kingdom and has substantial fitness effects. Personality may also interact with other traits, such as cognition, to impact how animals respond to and solve novel problems. For example, bolder individuals may solve a novel task more quickly than shyer individuals. Previous studies have shown an effect of both personality and cognition on mate choice and reproductive success. Zebra finches are a model species for studies of personality, cognition, and mate choice, yet we lack an understanding about how personality and cognition interact in this species. We present preliminary results of birds' performances on personality and problem-solving assessments. We investigate whether there is evidence of repeatable individual differences in personality assessments, examine sex differences in personality and cognitive abilities, and identify which personality traits influence performance on problem-solving tasks. We conclude by describing future research, which will investigate performance of dissimilar and similar personality pair-bonds of zebra finches on cognitive tasks requiring coordination of pair members.

Poster Session II - Saturday Evening

Fiddler Crabs (*Uca pugilator*) Learn Locations of Conspecifics in an Opaque Circular Maze

Frank W. Grasso Ezra Isaacs (BCR Lab)

P28

Fiddler crabs live in colonies containing individual burrows. They depart their burrows to forage and find mates and they return with great accuracy. We tested the spatial abilities of 48 male fiddler crabs to assess the generality of their spatial memory. The crabs were placed in an opaque circular maze with a target location opposite the start location where a size-matched male fiddler crab was tethered. The target location was divided to require the crabs to choose a direction when placed in the maze. The experiment, with 15 10-minute training followed by 5 test trials, was designed to evaluate the crabs' use of allocentric (visual) and egocentric (path-integration) cues. ANOVA did not detect the effects anticipated by our experimental design. However, in the test phase the crabs showed a strong preference for the side with their conspecific $t(15)=19.40$ $p<0.001$, Cohen's d 10.36. The attraction for conspecifics is not surprising in this gregarious species. However, the discovery that conspecifics could lead to a learned location preference is new. Non-homing place-preference-learning in fiddler crabs, could inform our understanding of the evolution of spatial memory because crustaceans are phylogenetically basal to eusocial, homing arthropods (e.g., ants and bees).

Rewarding and attentional effects of conspecific infant in chimpanzees

Yuri Kawaguchi, & Masaki Tomonaga (Kyoto University)

P29

There are many human studies about cognitive mechanism underlying infant care, but very few in nonhuman animals. We aimed to investigate chimpanzee's preference (Study 1) and attentional bias (Study 2) for infants. Study 1 examined the reward value of conspecific infant in chimpanzees. We adopted a simple discrimination task. There were two types of trials: food reward trial and sensory reinforcement trial. In the latter, the video clip of chimpanzee infant was played back after a correct choice and adult one after an incorrect choice. The results show that participants learned the discrimination of food-reward pair but not video-reward pair. However, most participants, especially elders looked at infant longer than adult. This may be because infant stimuli attract attention, but they are not more rewarding compared with adult ones. In order to investigate attentional aspect of infant stimuli further, we conducted "gap-overlap task", in which infant face, adult face or control stimulus was presented as distractor before the target. If the distractor holds attention stronger, the response time was expected to be longer. However, the response time was not different among distractor types.

Selective Attention and Peck Tracking in Pigeons' Category Learning

Deja Knight, Leyre Castro, & Edward Wasserman (University of Iowa)

P30

In prior categorization experiments, pigeons have been shown to track stimulus features that are relevant for category discrimination (Castro & Wasserman, 2014, 2016). Those experiments utilized complex, multi-colored stimuli, with four features per category exemplar. In the present experiment, we simplified our experimental paradigm by using simple-patterned, black-and-white stimuli, and category exemplars with just two features: one relevant and one irrelevant for the category discrimination. We examined categorization accuracy and whether pigeons pecked at the relevant or irrelevant category features. Overall, we saw a positive correlation between categorization accuracy and the percentage of pecks at the relevant category feature. Furthermore, when the pigeons pecked at the relevant category feature, their categorization accuracy was higher than when they pecked at the irrelevant category feature. These findings indicate that pigeons were indeed tracking the relevant category features. This task with simple, black-and-white stimuli is a promising paradigm for animals with poorer eyesight such as rats. Experiments that are now underway with rats will allow us to conduct neurobiological manipulations to examine the underlying brain regions involved in selective attention during category learning.

Rating on illegal trade: Using African giant pouched rats (*Cricetomys ansorgei*) to detect contraband wildlife products.

P31

Kate Webb, Dian Kuipers (APOPO), Kelly Marnewick (Endangered Wildlife Trust), Cynthia D. Fast, & Christophe Cox (APOPO)

APOPO is a non-profit humanitarian organization that trains African giant pouched rats (*Cricetomys ansorgei*) to save lives by detecting landmines and tuberculosis. In addition to conducting research aimed at optimizing these operations, APOPO's Research and Development division explores new ways for the rats to save lives. In collaboration with Endangered Wildlife Trust of South Africa, we investigated the potential for rats to combat illegally smuggled wildlife. As proof-of-principle, we trained rats to detect the odor of pangolins (the most widely trafficked endangered mammal in the world) and African hardwoods (slow growing trees that are targets of illegal logging). Rats were required to identify these targets from an array of items commonly used to mask the odor of wildlife products during shipping. Future steps of this project will explore how the rats are best suited to search for these contraband items, such as in shipping containers at busy international ports (where smuggling of wildlife contraband frequently occurs), or stationed at the perimeter of national parks. Due to their keen olfactory abilities, short training time, long lifespan, flexibility to work with multiple handlers, and mobility even within confined environments, rats may offer a practical, cost effective alternative for addressing wildlife smuggling.

Working memory in Tiger Salamanders' (*Ambystoma tigrinum*)

Shannon M. A. Kunder, Alexander Sexton, Aleyna Fitz, Anne Lessard, Roberto Millar, & Danielle Ali (Hood College)

P32

We explored tiger salamanders' (*Ambystoma tigrinum*) ability to retain information in working memory over various durations. In a first phase, salamanders were trained that one of four possible compartments would lead to reward (return to the home cage) on each trial. The rewarded compartment, which varied pseudorandomly between trials, was indicated by a symbol as salamanders watched from a holding area with a window that was centered across from the four compartments. During the first phase, the symbol remained visible during choice. All salamanders learned to approach the compartment marked by the symbol. During a second phase, salamanders again watched from a holding area as a symbol indicated the rewarded compartment. In the second phase, the symbol was only present for 10 s. Following the symbol's disappearance, salamanders were released from the holding compartment after increasing delays to evaluate their working memory. As the delays increased, salamanders were less likely to locate the rewarded compartment correctly. The maximum delay tolerated varied across individuals.

Development of executive function and its relation to detector dog performance

Lucia Lazarowski, Sarah Krichbaum, Lily Strassberg, Paul Waggoner, & Jeffrey S. Katz (Auburn University)

P33

Executive function (EF) is important for maintaining attention, flexible responding, and behavioral inhibition. In humans, EF predicts life outcomes in various domains. The socio-cognitive abilities of dogs have been widely reported and compared to humans, but investigations of canine EF are lacking. Working dogs present an ideal opportunity for the study of EF and its prediction of future performance because many cognitive tasks have been adapted for canines and working dogs' training program outcomes can be easily tracked. Further, working dogs are a neglected population in the canine cognition literature that may provide important comparisons to pet dogs regarding effects of experience on cognitive abilities. We tested a group of detection dogs-in-training at 3, 6, and 10 months old (n=20 per group) on three tasks of EF measuring attention, behavioral flexibility, and inhibitory control. Group performance on each task was assessed for developmental effects and correlated with training evaluations/program outcome. EF measures showed improvements with age during development, and some aspects were associated with behavioral evaluations of detection dog performance. These results suggest that higher-order cognitive processes are involved in detection dog performance, which may be used to objectively define and identify working dog traits and improve working dog selection.

Episodic-like memory in dogs: solving what-where-when tasks

Ka Ho Lo, & William A. Roberts (Western University)

P34

Episodic memory is a unique, personal memory that contains what happened, where it happened, and when it happened. Although initially thought to be unique to humans, more recent research has revealed episodic-like memory (ELM) in non-human animals using what-where-when (WWW) memory paradigms. Although WWW memory has been shown in some animals, it has not yet been reported in dogs. Dogs are highly domesticated and may have acquired human-like traits throughout evolutionary time, making them interesting candidates for studying ELM. Taking advantage of dogs' innate heightened olfactory acuity, we developed a WWW task that involved memory for odours as one component of a WWW memory. In a series of experiments that involved temporally and spatially unique odour presentations, we asked if dogs could remember the odours (what), their locations (where), and their sequence of presentation (when). Preliminary results show that dogs successfully learned the WWW memory task. This study provides evidence for ELM in dogs, shows how dogs encode WWW memory, and demonstrates how flexible dogs' WWW memory is. Our findings show the usefulness of utilizing olfactory cues when studying ELM in dogs, a procedure which may be extended to other areas of dog cognition research.

Comparative decision making of rats amid varying methodologies

Mary-Kate Moore, Kelly Marden, Thea Smith, Daniel Crafton, Kimberly Prescott, & Rebecca Rayburn-Reeves (Armstrong State University)

P35

The current studies examined decision-making strategies in rats across two distinct methodologies which differed with respect to work effort. In Experiment 1, rats were given reinforcement for completing a choice task involving pushing a wheel down one of two runways presented at the onset of each trial. The wheels were placed at differing intervals along the runways, requiring choice of pushing a wheel a short or long distance. As the weight of the wheels increased,

the rats showed a preference for less work, choosing the path with the wheel set further from the starting point and indicating an effect of choosing optimally. In Experiment 2, rats were tested in operant chambers for a choice between two fixed-interval (FI-seconds) schedules, whereby the rats chose between the completion of a short followed by a long ratio schedule (FI 5 to FI 15) or the inverse (FI 15, FI 5). Results showed differences in choice based on varying methodological approaches adding to the growing knowledge of decision-making processes in rats.

Serial Pattern Learning in a Touchscreen Serial Multiple Choice (SMC) Task for Rats: Hierarchical versus Interleaved Patterns

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

P36

Rats can learn complex serial patterns of responses in a circular spatial array in an octagonal operant chamber (e.g., Fountain et al., 1995a, b), and pigeons can learn similar patterns in a much smaller circular array of spots on a touchscreen (Garlick, Fountain, & Blaisdell, 2017). We investigated whether rats could learn hierarchical and interleaved patterns in an analog of the pigeon touchscreen task. Male rats were trained for 1200 trials per day to nosepoke a circular array of 8 or 9 spots for brain-stimulation reward. One group of rats nosepoked a hierarchical pattern with a violation element, 123-234-345-456-567-678-781-818, where digits indicate the clockwise position of spots in an 8-spot circular array. Another group nosepoked an “interleaved” pattern, 010203-020304-030405-040506-050607-060708-070801-080108, where rats made a forced-choice response to a “0” spot centered in the circular array between each pair of elements of the hierarchical pattern. The interleaved group learned slower than the hierarchical group. This result replicated work showing that chunking from nonadjacent serial positions increases pattern learning difficulty. The results also suggest why touchscreen procedures involving food or water reward that require animals to leave an array for reinforcement produce significantly slower learning than procedures that do not.

Sweet Tooth: The Role of Glucose and Saccharin on Self Control

Maggie Oimoen, Micaela Rivera, & Julia E. Meyers-Manor (Ripon College)

P37

Ego depletion of self-control and the role of glucose in reversing it have been a hotly debated topic in human research (e.g., Lange & Eggert, 2014). There is however evidence in dogs that animals can show ego-depletion and that the depletion can be reversed by glucose (Miller et al., 2010). We created a model of ego depletion in rats using a mild stressor to reduce self-control. Furthermore, we were able to reverse that self-control depletion by administering glucose but not by administering saccharin or water. Rats could provide an excellent model for testing mechanisms of ego-depletion.

Using a novel motor task to assess sub-lethal effects of imidacloprid exposure on complex motor learning in bumblebees (*Bombus impatiens*)

Jordan Phelps, Caroline Strang, & David Sherry (Western University)

P38

It has been shown that bumblebees exposed to neonicotinoid pesticides collect less pollen on foraging trips than unexposed bees, but the reason for this is unclear. Bees often must learn complex motor patterns to extract pollen from flowers. The ability to learn, remember, and execute motor patterns is therefore crucial for successful pollen foraging. Few studies have investigated whether neonicotinoids affect learning of complex motor patterns in bumblebees. We investigated this question using a novel motor task to model flower handling. Bumblebees (*Bombus impatiens*) exposed to imidacloprid at 0, 2.6 or 10 ppb were trained to enter a plastic tube leading to a sucrose reward. A plastic, petal-shaped barrier was inserted in the tube in front of each bee. Bees had to learn to turn upside down and lift the barrier to access sucrose. They were trained on 10 trials of this task for three successive days to assess short and long-term memory. Preliminary data show that bees exposed at 10 ppb take longer than bees exposed at 0 or 2.6 ppb to learn the correct motor strategy, and that they do not reach the same level of efficiency. These results may help explain why exposed foragers collect less pollen.

Effects of Visitor Density on Habitat Use in Zoo-housed Pigs

Audrey Robeson, Molly McGuire, Zoe Johnson-Ulrich, & Jennifer Vonk (Oakland University)

P39

Past research has shown that increased zoo visitor density is associated with increased rates of aggression and abnormal behaviors and decreased affiliative behaviors in various captive species (e.g., domestic pigs, chimpanzees, and gorillas). Previous research conducted with captive pigs has been restricted to a petting zoo setting. The current study examined whether pigs housed in a typical zoo setting avoid human areas and alter their use of enrichment as a function of visitor density. Five pigs of three different species housed at the Detroit Zoo were observed during the months of September to November in 2016. Number of visitors present per minute of observation and pigs' proximity to visitors, exact location were coded on video. We predicted that pigs would spend less time along the fence near the visitor area with larger numbers of visitors. It is also possible that visitors have positive impacts on pigs such that they spend more time closer to the visitor area when visitors are present.

Can humans use local landmarks in a virtual environment?

Alejandro Rodrigo, Jonathan Buriticá, & Laurent Avila-Chauvet (Centro de Estudios e Investigaciones en Comportamiento - Universidad de Guadalajara)

P40

It is well known that mammals can use landmarks present in their environment to locate sites of biological relevance, such as reinforcement areas. Especially, in humans, it has been observed that the proximity and the prominence of the landmark in relation to a target area, define the strategy used to situate themselves in space. There is little-known

information that highlights if humans are guided by a single landmark or by multiple. The aim of this research was to establish whether humans follow one or multiple cues presented in a virtual environment. Six groups of 10 participants (± 3) were formed. Each group was trained to locate one of three reinforced areas (A, B, C), which maintained a close relationship with a particular landmark. The landmarks were arranged in a hexagonal arrangement just as in Pritchard, et al. (2016). In the test phase, the landmarks were expanded and the participants were evaluated to locate the reinforced area between to the proximity or the total arrangement of visual cues. The results show that the groups trained in the reinforced area "A" follow the landmarks as a "whole", unlike the groups "B" or "C" which follow a more local arrangement.

Representations of Serial Patterns in Human Subjects: Violations of Lower and Higher Order Rules.

Liuruimin (Amy) Xiang, Chelsea Robbins, Morgan Lami, Kaitlin VanRyswyk, Sriharshini Chitluri, & James D. Rowan. (Wesleyan College)

Restle (1970) was one of the first to define a notation to describe serial-patterns. This notation, presumably, describes the actual cognitive representation of the pattern. He assumed that all new elements are compared to the first element. Rules that link these individual elements together are 1st order, rules that link chunks of 1st order elements are 2nd order, rules that link chunks together are 3rd order, etc... Restle assumed that if there was a 3rd order rules, where the pattern on both sides was the same overall but reversed mirror rule), the subject would be sensitive of this and the lower order rules could be "hierarchically nested" to reduced memory load. This experiment compares acquisition of a perfectly nested pattern, to ones (3 additional patterns) that have violations to both the 1st and 3rd order rules. If subjects are nesting the pattern, violations in the second half should impair learning in the first half. The 1st halves (non-violation) of all patterns were learned equally well, bringing into question the assumption that subjects actually use 3rd order rules or simply look at patterns as sequential chunks of information expressed by 1st and 2nd order rules.

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Cognitive judgment bias determines vulnerability of rats to chronic stress and antidepressant treatment

Rafal Rygula, Michal Rychlik, & Robert Drozd (Institute of Pharmacology Polish Academy of Sciences)

Pessimistically biased judgment has been associated with the etiology and recurrence of depressive disorder in humans. In the present studies we investigated how biased judgments, measured as stable and enduring behavioural traits, could determine vulnerability of laboratory rats to chronic stress and antidepressant treatments. For this, initially, in a series of ambiguous-cue interpretation tests, we identified animals displaying 'pessimistic' and 'optimistic' traits. Subsequently, we tested, in naïve, chronically stressed, and antidepressant treated individuals, how these traits interacted with cognitive flexibility, sensitivity to feedback, and motivation to avoid stressful situation. We report significant differences between 'optimistic' and 'pessimistic' rats in vulnerability to chronic stress and sensitivity to antidepressant treatments. The results of our studies are discussed in terms of neurobiological mechanisms of the observed effects and their possible implications for establishing novel cognitive biomarkers of affective disorders. Supported by the National Science Centre (UMO-2014/13/B/NZ4/00214)

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Spaced Training Speeds Serial Pattern Acquisition in Female but not Male Rats

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

In human learning tasks, distributing training over multiple sessions often improves acquisition compared to massing training in fewer sessions. To examine possible spacing effects in rats, male and female rats were trained to nosepoke the serial pattern, 123-234-345-456-567-678-781-818, where digits represent clockwise positions of successive correct receptacles in a circular array and dashes indicate pauses that served as "phrasing cues." The pattern consisted of three element types: chunk-boundary elements, within-chunk elements, and the terminal violation element "8" that was inconsistent with pattern structure. Rats trained to criterion on the violation element, the hardest element to learn. Rats were assigned to one of three conditions: either spaced training on 5 patterns/day, spaced training on 5 patterns twice daily (5x2 patterns/day), or massed training on 10 patterns/day. Female rats learned to anticipate the violation element of the pattern fastest on 5 patterns/day spaced training, significantly slower on 5x2 patterns/day spaced training, and significantly slower still when trained on 10 patterns/day massed training. Male rats learned the pattern faster than females, but male rats learning rates were not affected by the spacing of training. These results demonstrated spacing effects in female rats like those observed in humans.

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Individual differences in sociability in Eastern garter snakes

Morgan Skinner, & Noam Miller (Wilfrid Laurier University)

Social cognition in reptiles is poorly understood. Snakes prefer to aggregate with individuals from different litters and with individuals that have different diets. In addition, it is possible that snakes may avoid individuals with whom they have previously fought over food. Controlling for all these factors, we placed groups of juvenile Eastern garter snakes (each consisting of one litter) in an enclosure that had four hides. Snakes were shuffled twice a day, their hides were replaced, and the areas around the hides were cleaned. To shuffle the snakes, we either returned them randomly to the center of the enclosure, or placed them in particular hides based on four different pre-determined release patterns. During all 12 hours of light, the snakes' positions were recorded every 5 seconds, for 8 days. We find that some individuals are consistently more likely to aggregate than others, and that patterns of aggregation are rarely stable. Aggregation in a captive environment is common in Garter Snakes but the reasons for aggregating, and drivers of individual differences in inclination to aggregate, are unknown. In our lab, juvenile Eastern Garter Snakes appear to have distinct patterns of sociability, even in the absence of variation in diet or relatedness.

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The effect of a 5-HT antagonist on navigation of a successive T-maze under aversive environmental conditions in pill bugs (*Armadillidium vulgare*)

Greg Genuardi, Kristina Haskins, Taylor Wiseman, & W. David Stahlman (University of Mary Washington)

P45

Pill bugs (*Armadillidium vulgare*) engage in spontaneous turn alternation in a successive T-maze. This behavior is considered to be an adaptive response to adverse environmental conditions. Research indicates that, under certain circumstances, the administration of a serotonin antagonist can reduce sensitization and speeds the rate of habituation to noxious stimulation. We examined the impact of the administration of methysergide, a nonselective 5-HT antagonist, on pillbugs' performance in a successive T-maze under both light (i.e., aversive) and dark conditions. We hypothesized that animals given an antagonist would respond less quickly and engage in less spontaneous alternation than control animals, particularly under aversive conditions. Though we found little evidence for these hypotheses, we did find that pill bugs engaged in more abortive turns (i.e., backtracks) in dark conditions. We discuss these results in the context of past literature and make suggestions for future research.

Differential Space-Use Between Wild-Caught and Laboratory-Reared Octopus bimaculoides

Ian Strieter (The Graduate Center Brooklyn College), & Frank Grasso (CUNY)

P46

Octopus is well known for its highly derived neural and sensory systems, rapid learning capabilities, and remarkable behavioral flexibility. Most, if not all, previous research into the behavioral and cognitive characteristics of octopuses has been conducted using wild caught animals of uncertain age and unknown life histories. The present study is one of few explorations of behavior in *O. bimaculoides* which were raised from the egg under laboratory conditions, and thus have known life histories. Animal locations within identical individual housing units were recorded daily (for 20-74 days). A measure of information entropy was calculated for each animal (lower values reflecting greater fidelity to particular locations) on the observed proportions of time spent per location. A statistically significant difference was identified ($t(4.41)=-3.56$, $p=0.02$; Cohen's $d=2.15$; 95% CI[-0.257, -0.037]) between the two groups, with the laboratory-raised animals ($N=12$) displaying greater entropy than wild ($N=4$). An entropy pattern across time, possibly reflecting habituation, common to both wild and laboratory-raised animals was identified ($R^2=0.14$, $F(4, 152)=6.27$, $p<0.001$). Although potential confounds were present in this dataset, we believe these results underscore the previously underappreciated importance of early experience for studies of spatial learning and cognition in Octopus.

How Early Life Immune Challenges Affect Behaviors of Adult Zebra Finches

Ahmet Kerim Uysal (University of South Florida), Nathan Burkett-Cadena (University of Florida), Lynn Martin, & Toru Shimizu (University of South Florida)

P47

Early-life immune challenges (ELIC) are known to have long-term effects on adult brain and behavior. Avian ELIC studies are epidemiologically important since adult birds are primary hosts of many mosquito-borne viruses. In this study, Polyinosinic: polycytidylic acid (Poly I:C, a virus mimicking agent) was administered in nestling zebra finches. When birds became sexually mature, their general activity (i.e., hopping, feeding behavior) in their housing cages and defensive behaviors to mosquitos were analyzed to compare with control birds. Following behavioral measurements, brains were collected for anatomical and histochemical analyses. Results showed that Poly I:C had effects on general activity and mosquito defense behaviors of female birds, but not males. Poly I:C injected females hopped less often, but fed more compared to control females. Injected females also showed more defensive behavior (hopping) to mosquitos while control birds did not show such differences. The nucleus taeniae of the amygdala of Poly I:C injected males was smaller in size, yet had more immediate-early gene positive neurons, suggesting that these neurons were more active than control group. These results suggest that infected birds became less active and more defensive to mosquitos and that these changes might be related to the smaller, but active amygdala.

Partially occluded action discrimination in pigeons.

Amy Vasquez, Suzanne L. Gray, Muhammad A.J. Qadri, & Robert G. Cook (Tufts University)

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Identifying predators stalking behind obstacles or partly hidden courting mates can be critical for an animal's survival. However, previous studies on amodal completion have shown pigeons use local features to identify partially occluded objects. To assess what features are necessary for partially occluded action discrimination to occur, we trained six pigeons in a go/no-go task to discriminate the actions of digital animal models walking or running behind a series of columns so that the actor was never fully visible at any given moment. The discrimination transferred to novel stimuli. Reducing the size of the gap between the series of occluders proportionally decreased the accuracy of the pigeons' discrimination. These results suggest that the pigeons were able to categorize occluded walking from running actions, and that they need little momentary information in order to discriminate between these partially occluded actions. This setup will allow us to understand how these segments are integrated into a whole action.

Roach Lab: Using cockroaches to increase learning outcomes in undergraduate psychology

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

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Nonhuman animal models have been used for many years to teach learning and animal behavior. Research has consistently shown that these types of active learning experiences provide students with better learning outcomes. Frequently, this is done in the traditional rat or pigeon lab setting. However, many universities no longer support these traditional labs due to the expense of maintaining vertebrates as well as ethical concerns over the treatment and disposal of animals. To remedy this situation, we propose using a novel and inexpensive invertebrate animal that could illustrate

many of the same classic principles of learning and behavior, the discoid cockroach (*Blaberus discoidalis*). Using cockroaches avoids many ethical issues as most people would not hesitate to step on them and there are few if any regulations governing the housing and use of this model. Here, we will present our initial findings about using this model in undergraduate psychology classes to illustrate principles such as classical and operant conditioning. We believe that roach labs could be a viable manner to bring back animal labs to universities, thus improving student learning outcomes. Additionally, these laboratory experiences may further our knowledge of the cognitive processes in a relatively understudied species. Keywords: cockroaches, learning

Broadening the life-saving repertoire of African giant pouched rats: Rapid re-training and maintenance of multiple odor discriminations

Kate Webb, Caterina Caneva Saccardo, Cynthia D. Fast, & Christophe Cox (APOPO)

APOPO, a Belgian non-profit organization based in Tanzania, trains African giant pouched rats (*Cricetomys ansorgei*) for humanitarian purposes. Operationally, APOPO's rats detect buried landmines in post-conflict zones and *Mycobacterium tuberculosis* (TB) in resource-poor countries. Although the rats have a proven track record on these tasks, the potential humanitarian impact of each rat is limited by the training duration required and constraint to only one target odor. We sequentially trained rats to indicate the presence of five novel and unrelated odor targets while disregarding 12 non-target odors. The rats successfully mastered all five odor targets in significantly fewer sessions ($M = 102.63$, $SD = 10.47$) than APOPO's operational rats currently require to master a single odor target ($t(7) = 20.90$, $p < .001$). Importantly, all rats maintained strong detection of the five odor targets, despite the potential for interference caused by each new odor and the passage of time between initial training and test, suggesting that African giant pouched rats can be trained to identify at least five different odors simultaneously. In practice, this could allow operational rats to search for more than one target, such as multiple forms of explosives, thereby expanding the life-saving impact of each rat.

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Defining creativity and confirming understanding of the concept in dolphins

Deirdre Yeater (Sacred Heart University), Heather Hill (St. Mary's University), Kathleen Dudzinski (Dolphin Communication Project), Teri Bolton (Roatan Institute for Marine Sciences), & Holli Eskelinen (Dolphins Plus)

Many facilities demonstrate dolphin cognitive abilities by training animals to "execute a unique and/or distinct behavior." Testing the degree of creativity of dolphins has required the establishment of a concept-oriented cue, the "innovate" SD. The subtle intricacies of training the innovate SD have not been studied systematically across facilities. Moreover, there are differing criteria for what is considered novel behavior in the research examining it to date. Our goal is to establish a training and research protocol for using the innovate SD to assess the creative abilities in non-human species. We compared training methodologies used with dolphins for the innovate behavior. Our review, and discussions with trainers, indicated that a number of potential pitfalls occur when training this cognitive task (e.g., avoiding shaping a chained behavioral response). There were also issues with dolphin(s) understanding that resulted in superstitious behavior and frustration. Knowledge gained from this review will allow a clear definition of the criteria accepted as novel behavior as well as to better understand creativity, as measured by human-influenced constructs: fluency, flexibility, originality, and elaboration. This application of human-based measures will facilitate cross-species comparisons.

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Sequential decision-making in pigeons (*Columba livia*): The secretary problem

Walter T. Herbranson (Whitman College)

The secretary problem is a decision-making puzzle in which one attempts to select the best candidate from a finite pool of variable-quality options. An individual views one candidate at a time, and must either hire or reject each before seeing another. The mathematically optimal strategy involves viewing and rejecting a set number of candidates and then setting a selection threshold based on the quality of those viewed candidates. Seven pigeons learned an adaptation of the secretary problem in operant chambers. Birds saw sequences of colored stimuli with colors corresponding to different probabilities of reinforcement. They could select or reject each in turn by pecking either the stimulus or an alternate reject key. Results indicate that like humans, pigeons made selections too soon, and in doing so received a lower average probability of reinforcement than the optimal strategy. Subsequent conditions varied the size of the candidate pool. Larger pools led to more rejections per trial and a higher rate of reinforcement, though both remained suboptimal. Thus, while their performance was suboptimal, birds were sensitive to pool size. Furthermore, while pigeons failed to maximize, their suboptimal approach paralleled that of humans.

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Surprise!! Not so much...investigative responses of dogs following (un)expected events

Kimberly Brubaker, Michele Chaky, Kaitlyn Willgohs, Krysta Mochi, Ryan Alaimo, & Lauren Highfill (Eckerd College)

For the current study, dogs ($N = 38$) were either shown an event that violated expectations about object behavior or an event that was nearly identical but did not violate expectations. Specifically, in one event (the possible event), a toy was placed behind one of two opaque screens, then both screens were lifted and the object remained behind the screen it was originally placed. In the second event (the impossible event), a toy was placed behind one of two opaque screens, then both screens were lifted and the object "magically" appeared behind the other screen. After viewing the event, the toy used in the demonstration plus a novel distractor toy were presented to the subject. All trials were video-recorded and coded to examine which toy the subjects approached first, and which toy the subject investigated more. We hypothesized that dogs would demonstrate more information seeking behaviors with a toy if it violated

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expectations. Overall, there were no statistically significant differences between the two groups, but we believe more investigation is warranted.

Sociability and Problem-Solving in Domestic Cats (*Felis catus*)

Mary Howard, & Preston Foerder (The University of Tennessee at Chattanooga)

Animal personality has been shown to be an important source of variation that may affect cognitive performance. According to the social intelligence hypothesis, which states that intelligence evolved due to complex social environments, sociability should result in higher cognitive abilities. Domestic cats are capable of leading both solitary and social lives. I conducted a study to examine the relationship between sociability and problem-solving ability in domestic cats. I hypothesize that more social cats will solve a food acquisition problem-solving task more often than less social cats. Eighty-five cats from the McKamey Animal Shelter in Chattanooga, TN were used for this study. Each cat's sociability was assessed by McKamey employees using a modified Feline Spectrum Assessment developed by the ASPCA. The cats received a letter grade (A, B, C, D, F) based on the number of socialized behaviors they exhibit. A puzzle box was placed in their cage for 10-minute sessions and the cats were analyzed for problem-solving success, latency to approach, and duration of interaction. Behaviors are correlated with each cat's sociability score. These results will not only provide knowledge about cat's sociability and problem-solving but also be useful for cat adoption.

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North American River Otters (*Lontra canadensis*) use Shape and Color to Discriminate Between 2D Objects

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We explored the ability of two North American river otters (*Lontra canadensis*) to visually discriminate between 2D objects. This project is part of an ongoing study at the Seneca Park Zoo (Rochester, NY). The goal of the current experiment is to determine whether otters trained to discriminate between objects varying in both shape and color can use either feature alone, and to determine which feature may be more salient for otters. Otters were trained in a two-alternative forced choice task to discriminate between a red circle and a blue triangle to a criterion of 75% correct. Test sessions contained probe trials (always reinforced) containing novel shapes, colors, or shape-color combinations. Heather chose the probe stimulus with the same shape as her training stimulus 82% of the time, and the same color as her probe stimulus 71% of the time. Sailor chose the probe stimulus with the same shape as his training stimulus 67% of the time, and the same color as his probe stimulus 69% of the time. These results suggest that otters can use either color or shape to discriminate among objects. This research can be used to support future conservation efforts for this species.

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Red River Hog (*Potamocheirus porcus*) Performance on a Spatial Memory Task

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The current study tested the basic spatial memory ability of red river hogs (*Potamocheirus porcus*). The subject was taught to associate log sections with food, and then six log sections were placed around the enclosure, three with a reward and three without a reward. The rewards were always placed at the same locations over the course of the trials. Time required to find all three rewards, along with the number of errors incurred before successfully finding the three rewards, was recorded. Results indicate that the subject met the criteria for the initial protocol. This study examined spatial memory in one individual, but is the first ever cognitive study with this species. This study examined spatial memory in one individual, but is the first ever cognitive study with this species. Plans for future studies will be discussed.

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