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Conference on Comparative Cognition 2005 - Spoken Presenations

Acerbo

Martin J. Acerbo (University of Michigan) and Juan D. Delius (Universität Konstanz)

Sensitization to Apomorphine in the Pigeons: Effects of Dizocilpine NMDA Receptor Blockade

The dopamine agonist apomorphine (Apo) elicits context-specific sensitization in pigeons. We investigated whether this learning involves dopamino-glutamatergic interactions by inducing NMDA receptor blockade with the antagonist dizocilpine (Diz). In the first experiment, we found that 0.10 mg/kg of Diz co-administered with a standard dose of 0.5 mg/kg of Apo impaired both the development and the expression of the conditioned pecking response. A second experiment found that only Diz plus Apo co-treatment affected the sensitization; the presentation of Diz alone had no effect. The last experiment examined whether the administration of Diz had an immediate effect on the Apo sensitization and on the conditioned response shown by already sensitized pigeons. First treatment produced no effect, but there was a marked response inhibition with second treatment. Thus, NMDA receptors play an important role in Apo-induced sensitization in pigeons that is compatible with the Pavlovian conditioning account of sensitization.

Adachi

Ikuma Adachi (Kyoto University Japan Society for the Promotion of Science)

Cross-modal representations in squirrel monkeys (Saimiri sciureus)

In present study, we tested two squirrel monkeys with a symbolic matching to sample procedure. In the training phase, we trained them to discriminate photographs of two caretakers of them. After reaching the criterion, they were exposed to two test sessions. In these sessions, 32 all-reinforced test trials were interspersed among the training trials. In the test trials, a voice, either matching(match condition) or mismatching(mismatch condition) to the sample photos, was played back after the sample stimulus disappeared. Their performances in mismatch condition were significantly lower than that in match condition. This suggests that our subjects have recalled the caretaker's representation upon hearing his/her voice, and that broke in on the subjects' memory of the preceded sample stimulus in mismatch condition.

Bateson

Melissa Bateson (University of Newcastle upon Tyne)

Can energetic state explain apparent rationality violations in hummingbird foraging decisions?

Hummingbirds' relative preferences for two flower types differing in nectar volume and concentration are altered by the addition of a third, less profitable flower type. We have interpreted this apparently irrational behaviour as evidence that hummingbirds use comparative evaluation mechanisms when making foraging decisions. However, Schuck-Paim, Pompilio & Kacelnik (2004) have argued that the change in preference we observed may be reinterpreted as a rational response to a change in energetic state caused by the introduction of the third flower type. We test this hypothesis by analysing the rate of energy intake of hummingbirds faced with two versus three flower types. We show that hummingbirds compensate for foraging bouts resulting in greater energetic intake with longer subsequent inter-bout intervals. This behaviour has the effect of equalising long-term rate of energy intake in the two and three flower treatments. Therefore, our data do not support the state-dependent hypothesis in the hummingbird system.

Bauer

Gordon B. Bauer (New College of Florida), Joseph C. Gaspard III, Debborah E. Colbert, Jennifer B. Leach (Mote Marine Laboratory), Roger Reep (University of Florida)

Tactile Discrimination of Textures by Florida Manatees, Trichechus manatus latirostris

Knowledge of the sensory abilities of the endangered Florida manatee is important for management and conservation of the species. As part of a program to broadly survey the manatee's sensory abilities, we studied discrimination of textures by two males in a two-choice discrimination task. A modified staircase method was used. Stimuli consisted of acrylic plates with vertical gratings of ridges and grooves. The standard stimulus, present on every trial, had 2 mm gratings and the comparison stimuli had wider gratings. The blindfolded subjects were trained to demonstrate discrimination by pressing the target with wider gratings. Performance at a level of seventy-five percent correct indicated the discrimination threshold. Ongoing testing currently suggests a threshold of 2.18 mm for both subjects. This threshold corresponds to a Weber fraction of .09, which is somewhat lower than the closely related Antillean manatee, *Trichechus manatus manatus*, and similar to the harbor seal.

Blaisdell

Aaron P. Blaisdell (University of California, Los Angeles), Kosuke Sawa (Japan Society for the Promotion of Science, Nagoya University; University of California, Los Angeles), & Michael Waldmann (University of Göttingen, Germany)

Seeing versus doing: Two modes of assessing causal models by rats

Waldmann and Hagmayer (in press) found that people make different predictions from an observationally-acquired causal model, depending on whether they believe that an event within the model has been merely observed ("seeing") or was actively manipulated ("doing"). In a replication with rats, subjects received three types of training trials: a) Stimulus A followed by Stimulus X (i.e., A --> X); b) Stimulus A followed by sucrose (i.e., A --> sucrose); and c) simultaneous presentations of Stimulus Y and sucrose (i.e., Y+sucrose). Subsequently, levers were made available and Stimulus X or Y was delivered either contingent on lever pressing (Doing) or noncontingently (Seeing). Reduced nosepoking was observed to Stimulus X in the Doing versus the Seeing condition, while the rate of nosepoking to Stimulus Y was similar in both conditions. This replicates the effect demonstrated in humans and suggests that rats discount a previously established cause (A) when presented with an intervening cause (lever pressing).

Bloomfield

Laurie L. Bloomfield, Tiffany T-Y. Lee, Marc T. Avey & Christopher B. Sturdy (University of Alberta)

Call-based species classification by black-capped and mountain chickadees

Black-capped and mountain chickadees were trained in an operant discrimination task using exemplars of each species chick-a-dee calls as discriminative stimuli to determine: (1) whether birds memorized or classified the calls of conspecifics and heterospecifics and (2) for black-capped chickadees, whether experience with heterospecific chick-a-dee calls improved their performance. The task consisted of two simultaneous discriminations. For the within-category discrimination, calls of one species served as S+ (rewarded) and S- (unrewarded) stimuli. For the between-category discrimination, calls of the other species served as S-s. Overall, birds discriminated between call categories faster than within a call category, and in two subsequent experiments, birds showed transfer to novel calls and, following a contingency reversal procedure, propagation back to between-category calls. The results provide converging evidence that the acoustically similar calls of these two chickadee species constitute separate open-ended categories and are perceived as such by members of each species, regardless of experience.

Bodily

Bodily, K. D. & Sturz, B. R. (Auburn University)

Virtual open-field: Evidence for integration of spatial maps in humans and pigeons?

An interactive 3-D computer-generated analogue of the Blaisdell & Cook (2005) open-field task was constructed for humans. Participants used keyboard keys and a mouse to search a virtual environment for a goal hidden in 1 of 16 raised cups. In Phase 1, the goal was consistently located between two landmarks, a blue T and a red L. In Phase 2, the goal was consistently located down and left of a blue T. To test for integration of spatial information, the red L was presented alone with no goal following two Phase 2 trials (Test 1) or a Phase 1 and a Phase 2 trial (Test 2). Results did not differ from those found with pigeons, suggesting integration of spatial information. Additional analyses, however, suggested that an accumulation of non-reinforced choice responses resulted in a shift in search behavior across tests that was not accounted for by integration.

Bohn

Sandra Bohn & Stan Kuczaj (University of Southern Mississippi)

Vocal Development in a Bottlenose Dolphin Calf: Examples of Imitation and Possible Vocal Play

Imitation and vocal play are an important part of vocal development in many species. The vocalizations of a stranded bottlenose dolphin (Tursiops truncatus) calf were recorded over the course of six months after she was introduced into a captive population of bottlenose dolphins. The calf imitated both the trainer's whistle and the signature whistle of another dolphin. The calf also appeared to be engaging in vocal play similar to babbling found in human infants. On multiple occasions she produced a series of whistles with different contours which could be analogous to an infant producing a series of different syllables. All examples were recorded when the calf was swimming alone. These examples suggest that vocal play may play a role in the vocal development of bottlenose dolphins.

Braaten

Richard F. Braaten (Colgate University)

Song Memory During the Sensitive Period in Zebra Finches

Previous studies of bird song learning have relied primarily on song production or operant discrimination procedures to assess song memory. However, song production assays confound memory with other cognitive processes that may be involved in song learning, and operant discrimination procedures do not necessarily reveal what birds would learn in

the absence of reward and punishment. In this study we exposed male and female juvenile zebra finches to conspecific and heterospecific songs presented through a loudspeaker over a period of nine days during their sensitive period for song learning. After song exposure, birds were trained to discriminate a subset of the songs in a novel vs. familiar operant discrimination task. Probe testing with untrained songs revealed that both males and females memorize songs presented passively through a loudspeaker, they memorize both conspecific and heterospecific songs, and they memorize songs that are not later used for production.

Brooks

Daniel Brooks (Tufts University), Kazuhiro Goto (University of Nebraska-Lincoln), Robert Cook (Tufts University)

Emergent Perceptual Structure in Pigeons

In order to attempt to isolate and understand the mechanisms responsible for processing emergent perceptual structure, pigeons were tested in a two-alternative choice task that required global integration of organized local information. Stimuli consisted of two random distractor backgrounds generated from black and white square elements, one of which contained a structured target (e.g., stripes, checkerboard, squares). These stimuli were tested at four levels of spatial granularity (i.e., element sizes). Experiments using new targets made of randomly generated "mosaic" patterns examined the roles of repetition and symmetry in globally mediating target localization. Results indicate that pigeons can perceive and discriminate emergent visual structure and suggest they do so using a generalized pattern-detection rule rather than a rule for recognizing stimulus specific elements present in the original targets.

Brown

Stephanie Brown, Stan Kuczaj (University of Southern Mississippi), & Moby Solangi (Institute for Marine Mammal Studies)

Social Learning Facilitates the Development of Play Behavior in a Bottlenose Dolphin Calf

A wild-born bottlenose dolphin calf was stranded and rescued at approximately six months of age. When this calf was first introduced to a group of captive dolphins, both she and the captive animals evidenced considerable interest in one another. The dolphin calf often oriented at other dolphins, and slowly learned to engage in behaviors similar to those she observed. For example, the calf initially avoided contact with balls left in her pool, but did observe other dolphins play with balls. As she became integrated into this group of dolphins, the calf began to interact with balls in ways similar to those she had observed. These observations suggest that social learning influenced the ball play of this dolphin.

Brown

Michael F. Brown, Robert Farley, Haley Solodky, & Rachel Bachrach (Villanova University)

Oh, The Places You've Been!: Social Memories for Spatial Locations

We will present preliminary evidence suggesting that choices in laboratory spatial tasks (the Radial-arm Maze and the Pole Box) can be controlled by the locations of choices make earlier in the trial by another rat. This control is apparently based on observations of the choices made by the other rat. It can be expressed as either an increase or a decrease in the probability of visiting locations previouly visited by the other rat. This control is interpreted in terms of working memory for the choice behavior of a foraging companion. Such memories increase foraging efficiency and might be expected in animals that forage socially.

Caetano

Marcelo Caetano (Brown University)

Factors Affecting the Speed of Learning of Temporal Discriminations

The speed of learning temporal discriminations depends on the training procedure used. Training different intervals in a multiple cued interval (MCI) procedure produces faster learning when one of the intervals is changed daily, compared to when the interval is held constant. The goal of this study was to determine whether daily changes contribute to faster learning, and to identify procedural factors involved, such as amount of training and transfer. Twelve rats were trained with two constant intervals (30 and 120 sec), and one interval that varied daily (30, 60 or 120 sec). The speed of learning of the temporal intervals was assessed. In a second experiment, four groups were trained with different proportions of the changed interval (1, .67, .33 and 0), and the speed of learning under each condition was assessed. The results suggest that the faster learning occurred because of positive transfer from the amount of overall training.

Castro

Leyre Castro, Olga F. Lazareva, Shaun P. Vecera, & Edward A. Wasserman (University of Iowa)

Figure-Ground assignment in pigeons: The effect of different sizes

One of the well-known cues for figure-ground assignment in humans is area: smaller regions are more likely to be perceived as figure than larger regions. Are also pigeons sensitive to this cue? After training our pigeons to discriminate whether a small target spot appeared on a colored figural shape or on a differently colored background, we

varied the figure's size so that it could be smaller or larger that the trained figure. As the size of the figure was reduced, pigeon's performance improved: accuracy was higher on both figure and background trials. In addition, although pigeons were faster to detect the target when it appeared on the figure in all of the conditions, when the figure was small they were even faster in detecting the target on the figure and even slower in detecting the target on the background.

Cheng

Ken Cheng (Macquarie University)

Pigeon spatial cognition: some common principles

Spatial cognition has been a long standing interest of Bill Roberts. I started work on spatial cognition in pigeons as a postdoctoral fellow with Bill. I present here four themes that stemmed from that work, themes common to many areas of animal cognition.

Theme 1: quantity representation - Pigeons seem to represent vectors to landmarks, a form of quantitative representation.

Theme 2: generalization and discrimination - In the spatial domain, pigeons exhibit both spatial generalization and peak shift. Generalization obeys Roger Shepard's universal law.

Theme 3: averaging multiple sources - Often, information from different sources is averaged in a weighted fashion to direct behavior. Sometimes, even information from different domains of experience (e.g., spatial and temporal dictates) can be averaged.

Theme 4: cue competition - Cue competition, such as blocking and overshadowing, is sometimes found.

Church

Russell M. Church & Paulo Guilhardi (Brown University)

A Turing Test of a Timing Theory

A quantitative theory of timing or conditioning can be evaluated with a Turing test in which the behavioral results of an experiment can be compared with the predicted results from the theory. An example is described based upon an experiment in which 12 rats were trained on three fixed-interval schedules of reinforcement, and a simulation of the predicted results from a Packet Theory of Timing. An objective classification rule was used to determine whether a sample from the data or a sample from the theory was more similar to another sample from the theory. The probability of a correct classification was 0.6. This was substantially better than the worst possible theory in which correct classification would always occur (1.0), but reliably worse than an ideal theory in which correct classification would occur at chance (0.5). A Turing test provides a graded metric for the evaluation of a quantitative theory.

Clayton

Nicola Clayton, Nathen Emery & Anthony Dickinson (University of Cambridge)

Mental Time Travel by Food-Caching Western Scrub-Jays (Aphelocoma californica): Prospective Cognition

The mental time travel hypothesis claims that only humans are capable of retrospective cognition by travelling backwards in time to recollect specific past events (episodic memory) and prospective cognition by travelling forwards in time to anticipate future needs (future planning). Our studies of food caching by Western Scrub-Jays have challenged the retrospective component by demonstrating that cache recovery is mediated by an episodic-like memory for the caching episode. We have also investigated the prospective component by demonstrating that the jays can anticipate the condition of their caches at future recoveries on the basis of past recoveries and adjust their caching strategies accordingly. Moreover, the jays engage in a number of cache protection strategies if – and only if - another bird has observed the caching event. Taken together, these results suggest that jays can take action now for future eventualities on the basis of past experience (future planning).

Cohen

Jerome Cohen, Sean Nicholson, Tim Frigon (University of Windsor)

Blind Rats Bluff or Testing Parallel Map Theory in the Enclosed Radial Arm Maze

Parallel Map Theory (Jacobs & Schenk, 2003) maintains that organisms only effectively use spatial maps of local landmarks when they integrate them with a directional map from distal landmarks or a compass cue. We test this idea in the enclosed 8-arm radial maze in which rats were made 'blind' to the direction of proximally-cued arms in the maze after being able to see all arms during initial training. During subsequent "blind" training, rats had to open an opaque door to enter arms with all doors closed at the beginning of each run. As expected, rats exposed to a consistent configuration of arms were no more accurate as measured by re-entries (macro-choices) but made fewer partial entries of only opening a door (micro-choices) than rats exposed to varying configurations over trials. Rotating arms or varying their configuration within a trial during post-training probe trials also only disrupted the consistent group's

performance as predicted. To further test Parallel Map Theory (PMT), we are adding a specific directional cue in decision chamber which should only enhance the consistent group's performance. We also present data from this manipulation.

Cook Robert Cook, Richard Chechile, & Daniel Brooks (Tufts University)

Wait! Wait! Don't Tell Me

The working memory of pigeons was tested using concurrent recognition and a recall-analog tasks. Multinomial process tree modeling was used to obtain estimates of successful retrieval, sufficient storage, partial storage, and no storage of sample information. Further, on probe trials, pigeons were given additional opportunities to make correct choices after initially committing an error. These post-error second and third choices were well above chance. The choice and memory processes critical to these different effects are presented and the implications for understanding the structure of avian memory systems discussed.

Crystal Jonathon D. Crystal (University of Georgia)

Short-Interval Timing is Based on a Self-Sustaining Endogenous Oscillator

A defining feature of a circadian oscillator is that periodic output from the oscillator continues after the cessation of periodic input. In contrast, a defining feature of a pacemaker-accumulator system is that elapsed time is measured with respect to the presentation of a stimulus; consequently, the output of a short-interval system is periodic if presented with periodic input. However, periodic output ceases if the periodic input is discontinued. Rats were trained to time short intervals (e.g., 96 seconds); periodic delivery of food produced periodic behavior. Next, delivery of food was suspended. Behavior was periodic after the termination of periodic input. These data suggest that short-interval timing is based on a self-sustaining, endogenous oscillator.

de Kort Selvino R. de Kort, Lucie Salwiczek, Anthony Dickinson and Nicola S. Clayton (University of Cambridge)

The prospective cognition of caching

The recovery of caches by Western scrub-jays shows aspects of retrospective mental time travel (MTT). According to the MTT hypothesis retrospective and prospective cognition are controlled by common processes and so predicts that caching should also be under cognitive control. In two experiments we tested whether the scrub jays are sensitive to the future state of their caches. In the first experiment the jays rapidly learned to avoid caching in the location where their caches degraded, suggesting that they are sensitive to the future states of their caches. However, in a second experiment, we found that as long as the jays were able to recover fresh food items, they continued caching this type of food even though their own caches were consistently degraded at recovery. This finding suggests that caching may not be directly controlled by the expectation about the state of specific caches at recovery.

DeLong Caroline M. DeLong (Brown University), Whitlow W. Au (Hawaii Institute of Marine Biology), & Sarah Stamper (New College of Florida)

Echo Features Used by Human Listeners and Echolocating Dolphins to Discriminate Among Cylinders with Different Wall Thicknesses

Echolocating dolphins extract object feature information from the acoustic parameters of echoes. However, little is known about which object features are salient to dolphins or how they extract those features. To gain insight into how dolphins might be extracting feature information, human listeners can be presented (via headphones) with echoes from the objects used in a dolphin's discrimination task. In two recent studies, human listeners were able to identify objects varying in size, shape, and material using echoes (M = 88% correct) and reported using cues such as loudness, pitch, and timbre. In this study, human listeners were presented with echoes from hollow cylinders with varying wall thicknesses (+/- 0.8 mm). The dolphin was able to discriminate between cylinders that varied by 0.3 mm. The cues reported by the human participants in this task will give insight into the types of cues that were available to the dolphin.

Dickinson Ulrike Klossek & Anthony Dickinson (University of Cambridge)

Assessing Goal-Directed Action in Children by Outcome Devaluation

Contemporary learning theory assumes that instrumental behavior is controlled conjointly by two processes, one mediating habitual responding and the other mediating goal-directed action. We investigated development of instrumental behavior by training children to perform two responses for different outcomes. The responses were the manipulation of stimuli on a touch screen, whereas the outcomes were the presentation of brief, animated cartoon clips. Following instrumental training, one of the cartoons was devalued by repetitive presentations to induce specific satiety in the absence of the opportunity to perform the instrumental responses. When subsequently tested in extinction, the

older (> 27 months), but not the younger (< 27 moths) children performed the response trained with the valued outcome more than that trained with devalued outcome. In the case of arbitrary response-outcome contingencies, the capacity for goal-directed action appears to develop between 2-3 yr of age with instrumental responding by younger children being primarily habitual.

DiGian

Kelly A. DiGian & Thomas Zentall (University of Kentucky)

When pigeons are uncertain, how do they choose?

In two experiments, pigeons were trained with matching-to-sample to match a frequent sample (80% of the trials), S1, to one comparison, C1, and an infrequent sample (20% of the trials), S2, to another comparison, C2. Number of reinforcements was equated by reinforcing 25% of responses to C1 and 100% of responses to C2. Thus, ideally there would be 20 reinforcements associated with each comparison but C1 would be chosen four times as often as C2. A delay was inserted to determine whether under conditions of uncertainty pigeons would choose based on the number of reinforcements per comparison (they should be indifferent), number of comparison choices during training (preference for C1), or the probability of reinforcement given a response (preference for C2). The results suggest that pigeons chose the comparison associated with the frequent sample (C1). Thus when uncertain, the pigeons chose the comparison that had been chosen most often.

Dorrance

Brigette Dorrance, Andrew Meyer, Karen Mason, & Jennifer Polcyn (Augustana College)

Two-Action Observation by Budgerigars: Imitation or Affordance Learning?

Experiments testing for imitation in animals often fail to control for the possibility that animals can learn to perform a behavior by watching the movement of the object being manipulated (affordance learning), rather than learning to imitate the specific behavior of the demonstrator. In this experiment, budgerigars observed demonstrator budgerigars use their beaks to remove a stopper from a food container, either by pulling up or pushing down. To test for affordance learning, another group observed an experimenter using fishing line to move the stopper up or down. Subjects that observed the demonstration by a budgerigar showed a significant tendency to remove the stopper using the same method, whereas subjects that observed the stopper move with the fishing line did not. As the budgerigars failed to show any evidence of affordance learning, imitative learning is the most likely explanation.

Fiset

Sylvain Fiset & Valérie Leblanc (Université de Moncton, campus d'Edmundston)

Object permanence in domestic dogs: The influence of the experimenter

The purpose of this study was to determine how the presence of an experimenter influences the search behaviour of dogs in visible and invisible displacement problems of object permanence. On visible condition, the dog saw the experimenter behind the hiding boxes. On hidden condition, a large panel hid the experimenter. On both conditions, two types of problems were given: visible and invisible displacement of object. On visible displacement problems, the performance was very high. On invisible displacement problems, however, the performance was slightly over chance and it was higher in the visible than in the hidden condition. The analysis of errors also revealed that the dogs searched primarily as a function of the transport container in the invisible displacement problems. This experiment suggests that dogs do not understand invisible displacement problems and that the presence of the experimenter increases the performance of dogs in invisible displacement problems.

Gibson

Brett Gibson, Michelle Leichtman, Mike Simpson & Debbie Kung (University of New Hampshire)

Use of geometric and featural cues during a 2-D search task by adults and children

Adults and children were presented with an array of three landmarks on a computer screen. A cartoon type character “hid” behind one of the landmarks during the first phase of a trial. During the second phase of a trial the landmarks reappeared and the participant was required to point to the landmark that the character was hiding behind; the position of the array could be translated and rotated between phases of each trial. During half the trials the geometrical configuration of the three landmarks could be used to locate the correct hiding location of the character; during the other trials only the features of each landmark could be used to locate the hidden character. All 48 of the adult participants readily used both geometry and feature cues, the data from the children will be forthcoming.

Goto

Kazuhiro Goto, Alan C. Kamil, Alan B. Bond (University of Nebraska)

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. Four groups of five

blue jays each were trained to search for two types of cryptic moth. At the beginning of each trial, green horizontal lines or red vertical lines were given as primes; pecks to the prime initiated the trial. The four conditions were: 1) Only primes predicted target types (associative priming), 2) only trial sequence (i.e. AAAA...BBBB... etc.) 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 effects of the different combinations of associative and sequential priming will allow assessment of the nature of any interactions between the two types of priming procedure.

Guilhardi

Paulo Guilhardi (Brown University)

Predicting Random Interval Choice on Basis of the Behavior on the Alternatives

The goal was to determine whether choice behavior between random interval alternatives could be predicted from the summation of behavior on each of the alternatives. Twenty-four rats were trained with two stimuli, each with a mean duration of 120s that could be presented simultaneously or successively. With probability 0.5, food was delivered at a random interval of 15s during one stimulus and at a random interval of 60s during the other stimulus. Half of the rats were trained with a single lever, and the other half were trained with different levers for the two intervals (choice procedure). The same simple quantitative rule based on the summation of the alternatives that accounted for behavior in a previous experiment with fixed interval alternatives, accounted for the choice performance. These results suggest that common principles determine behavior on a wide range of procedures such as fixed and random interval, peak, and choice.

Hampton

Robert R. Hampton (Emery University)

Does Test-Related Frustration Indicate Metamemory in a Rhesus Monkey (Macaca mulatta)?

Humans can predict with some accuracy whether or not they know the correct answer to a question before responding. In some cases the capacity to make such predictions depends on metamemory, the ability to make introspective judgments about memory states. In this unplanned retrospective analysis of video taped behavior we asked whether a monkey's apparent frustration predicted his accuracy in a matching-to-sample task on a trial by trial basis. The monkey was likely to make his test response by aggressively slapping the computer touch screen on error trials, whereas he generally touched the screen more gently when selecting a response on correct trials. This difference in behavior, which occurred before the monkey received feedback on the accuracy of his choice, suggests that he knew whether or not he remembered the correct response.

Supported by the NIMH-IRP.

Hattori

Yuko Hattori.,Hika Kuroshima.,& Kazuo Fujita.(Kyoto University)

Pointing and sensitivity to the human attentional states in tufted capuchin monkeys (Cebus apella)

Previous reports suggest that nonhuman primates can use pointing gestures differentially for obtaining food based on the experimenter's directions of body and face but not on eyes, although neurophysiological studies suggest that they have a sensitivity to the state of eyes. We investigated whether a New World monkey species, tufted capuchin monkeys (Cebus apella), respond differentially to several human states of the face and eyes for obtaining food, by analyzing both frequency of pointing gestures and duration of gaze toward the experimenter. The results showed that the monkeys looked at the experimenter differentially according to the attentional states, but did not point differentially. This suggests that the previous failure for nonhumans to differentially respond based on eyes may not be due to their lack of sensitivity to eyes but to the lack of communicative function in their pointing gestures to request food from humans.

Hernández

Michelle Hernández & Jeffrey S. Katz (Auburn University)

Pigeons Learn the Function of Directional Arrows in a Touch Screen Monitor Task

Three pigeons learned to use directional arrows (left, right, down, up) to move a target to different goal locations on a touch screen monitor. In a series of experiments the complexity of the task was manipulated by increasing the number of directional arrows, distance to the goal, location of the goal, and position of a barrier. Performance was assessed by the number of responses to reach the goal. The pigeons often used the shortest path to the goal, but were not always optimal. In trials with two arrows (left, right), performance decreased as the distance between the target and goal increased, but was influenced by the position of the barrier. In trials with four arrows, performance was most disrupted when the barrier was placed between the target and goal but improved as the distance between the target and goal increased.

Himmanen

Sharon Himmanen (Lehman College/CUNY) & Karyl Swartz (Great Ape Trust of Iowa and Lehman College/CUNY)

A Spatial Strategy May Facilitate Recognition Memory

Strategies for executing lists were examined in monkeys (Macaca mulatta) and orangutans (Pongo pygmaeus spp.). List items were presented individually on a touch-sensitive video monitor, followed by the simultaneous presentation of those items as well as distractor items. Subjects were rewarded for correctly touching all list items, in any order, without touching a distractor item. Two orangutans and one monkey developed a right-to-left pattern of responding, which emerged as the cognitive demands of the task increased (during 5-item lists for orangutans and 3-item lists for the monkey). This simple spatial strategy decreased cognitive load by reducing working-memory demands associated with remembering previously searched locations.

Hultsch Henrike Hultsch (Freie Universität Berlin)

Imitation and Sequencing of Songs by Nightingales Follows Contextual Cues at the Time of Auditory Acquisition

Hand-reared juvenile male Nightingales (Luscinia megarhynchos) were exposed to song stimuli during temporally distributed tutoring sessions under two regimes. Under the Strobe regime (SR) strobe lights were paired to the playback of strings of master songs, while under the Control regime (CR) there were no additional cues during exposure to master songs. Subjects experienced a single song string under one of the two regimes per day in the following order: CR1-> CR2-> SR3-> CR4-> SR5-> SR6-> CR7-> SR8. Singing recorded 11 months later revealed that males had preferentially acquired SR songs. In addition, they sequentially clustered imitations of song-types from either regime (eg. SR3-> SR8 or CR2-> CR4) regardless of sequencing at the time of tutoring. The findings suggest that intermodal stimulus pairing affects stimulus selection and memorisation through attentional mechanisms. Performance characteristics, in addition, suggest that birds stored song stimuli as a set reflecting contextual cues from the tutoring sessions.

Inagaki Tomoko Inagaki(CUNY Graduate Center, Hunter C.), Josephine Choe(Fordham Uiversity)

Relative judgments of quantitative information by pigeons using visual display

What do pigeons learn when quantitative information is represented as different numbers of discrete items or as parts of a continuous area? Two groups of 3 pigeons each, were tested with a row of 5 rectangles (discrete group) or a horizontal bar (continuous group). The proportion of red to green elements or area of the bar varied from all red to all green in 5 steps. Under both conditions, the proportion of choices correct for red (or green) increased as the number or proportion of red (or green) increased. These functions were virtually unchanged when the arrangement of the colors was changed and when the rectangles were changed to disks. However, when the discrete group was tested with the horizontal bar and the continuous group was tested with the 5 rectangles, two birds, one from each group, failed to respond differentially to the stimuli. These data suggest that different mechanisms may be involved when quantitative information is presented in discrete or in continuous form.

Johnson P. Taylor Johnson, Angie C. Koban, & Robert G. Cook (Tufts University)

Categorical Same Different Discrimination in the Pigeon (Columba livia)

The ability of pigeons to learn a categorical same different task was investigated by presenting subjects with 4 items: three distractors and one target item to which the pigeon had to locate and respond. The three distractor items consisted of different pictures of one category (i.e. 3 different pictures of cats), while the fourth item was that of a different category (i.e. car). An identity-based same different task was also examined for control conditions. This condition consisted of three distractor items that were identical such that the pigeon simply had to differentiate the odd item. Acquisition of the task (Identity > Categorical) and transfer data will be discussed as well as possible implications for the origins of analogical thinking.

Kacelnik Alex Kacelnik, Alex Weir, Christian Rutz & Ben Kenward (University of Oxford)

Tool manufacture by naïve hand-reared New Caledonian Crows

New Caledonian crows (Corvus moneduloides) are the most prolific avian tool-users, and regional variation in the shape of their tools may be the result of cumulative cultural evolution — a phenomenon considered to be a hallmark of human culture. We show that hand-raised juvenile New Caledonian crows spontaneously manufacture and use tools, without any contact with adults of their species or any prior demonstration by humans. Our finding highlights the importance of developmental studies for producing informed models of cultural transmission in this species, and in animals in general. The talk will be illustrated with relevant video clips.

Kamil

Alan B. Bond and Alan C. Kamil (University of Nebraska, Lincoln)

Effects of Background Heterogeneity on the Evolution of Cryptic Prey

In this experiment, we used our virtual ecology paradigm to evaluate the effects of background heterogeneity on the evolution of polymorphism. In nthis paradigm, blue jays hunt for cryptic prey whose appearance is controlled by a virtual genome. Moths that escape detection are more likely to breed than those which are detected, resulting in the evolution of the appearance of the moths. In this experiment, jays hunted moths on three different backgrounds, which varied in heterogeneity. Results clearly show that variation in background affects the evolution of prey, especially the evolution of phenotypic diversity.

Katz

Jeffrey S. Katz, Kent D. Bodily, Michelle Hernandez, & Bradley R. Sturz (Auburn University), & Anthony A. Wright (The University of Texas Health Science Center at Houston)

Comparing Concept Learning in Matching-to-Sample and Same/Different by Pigeons

Abstract concept learning in matching-to-sample and same/different tasks was compared using a set-size expansion procedure. In separate groups (matching-to-sample, same/different), training began with a small set size and was systematically doubled until a high level of concept learning was attained. To measure concept learning, transfer tests with novel stimuli were conducted after each set size increase. Transfer performance increased with set size. Matching-to-sample and same/different concept learning were compared by plotting transfer performance at each set size by the total number of display configurations with the training stimuli. Under the conditions of these experiments, the set-size functions were similar for both tasks. The processes of abstract concept learning in these two tasks are discussed in terms of their similar functions relating concept learning to set size and the high level of concept learning ultimately achieved by the subjects in both these tasks.

Keen

Richard Keen (Converse College) & Russell Church (Brown University)

Simultaneous Timing: Combination Rules

The purpose of this study was to determine how multiple timing cues affect timing behavior. During training, rats were reinforced for the first head entry response after 120 s following the previous food. Four groups differed in when a 1 s stimulus was presented: 0, 30, 60, or 90 s following the previous food. During testing, four types of trials were presented: 1) normal trials were those in which food and a stimulus were presented, 2) food only trials, 3) signal only trials, and 4) empty trials, neither food nor stimuli were presented. Normal trials were presented on the odd trials and the four trial types had an equal probability of occurring on the even trials. Results showed that both the food-to-food and signal-to-food intervals were learned. Response patterning is well characterized by the Packet Theory of Timing.

Kelly

Debbie M. Kelly & Alan C. Kamil (University of Nebraska, Lincoln)

Effects of Landmark Configuration on Search Accuracy by Clark's nutcrackers

Several experiments have shown that Clark's nutcrackers use objects surrounding the cache site as landmarks for successful cache retrieval. The Multiple Bearings Hypothesis (Kamil & Cheng, 2001) predicts that the specific configuration of available landmarks will strongly influence search accuracy. The purpose of our experiment was to test these predictions by measuring the effect of landmark configuration on search accuracy on the estimation of distance and direction. Four groups of nutcrackers were trained to locate a hidden goal at a fixed distance (i.e., 90 cm) from either one, two or three available landmarks. The configuration of the landmarks differed between the groups. Upon completion of training, the groups were given non-reinforced tests in which one of the landmarks was shifted by 30 cm in one of four directions (i.e., north, south, east or west). The results confirm several predictions of the multiple-bearings hypothesis, but also suggest that the hypothesis provides an incomplete account of how landmarks are used to re-locate positions in space.

Klein

Emily D. Klein, Dustin J. Stairs, & Michael T. Bardo (University of Kentucky)

Acquisition, Extinction and Reinstatement of Operant Responding in Differentially Reared Rats

The current study examined the effect of differential rearing on acquisition, extinction, and reinstatement of responding for a sucrose reward. Rats reared in either an enriched (EC) or impoverished (IC) environment were trained to lever press for sucrose on an FR 1 schedule of reinforcement. Rats were then tested for response persistence during extinction. A “prime” of 1 or 10 sucrose pellets (counterbalanced for order of presentation) was given at the beginning of extinction sessions 11 and 14. During acquisition, EC rats made significantly more lever presses than IC rats. However, during extinction, this trend was reversed, with IC rats making significantly more lever presses than EC rats. The 10-pellet prime increased lever pressing significantly more than the 1-pellet prime in EC, but not IC, rats. The results suggest that EC rats are more sensitive to changes in response contingencies than IC rats.

Koban

Koban, A.C., Beale, K. & Cook, R.G. (Tufts University)

Motion categorization by Pigeons

Pigeons were tested in a go/no-go task requiring the classification of 40 different video objects based on their rate of rotation (fast versus slow) around their central axis. After acquisition, pigeons transferred this rate discrimination to novel objects and novel directions of rotation. The nature of the discrimination was further examined by varying the speed of rotation. The results suggest that pigeons can form a motion-based concept based on the rate of object motion. Implications for the development of motion and action categories and the use of video stimuli to portray motion will be discussed.

Kuczaj

Stan Kuczaj (University of Southern Mississippi), Leslie Popiel, Chris White, & Chris Bellows (SeaWorld San Antonio)

Beluga (Delphinapterus leucas) Use of Echolocation to Perceive Actions

Recent evidence suggests that dolphins can relate visual and acoustic information about objects, but nothing is known about the ability of cetaceans to use information about actions learned in one perceptual system (e.g., vision) with information subsequently received in another perceptual system (e.g., echolocation). We asked a female beluga to respond to underwater gestures that she could not see, but could use echolocation to perceive. The gestures were ones to which the beluga had earlier been trained to respond when presented visually above the surface of the water. She proved adept at translating what she had learned visually about these actions to a new modality (echolocation), providing further support for the notion that cetaceans' representations of their world may be abstract rather than modality specific.

Kundey

Shannon M.A. Kundey & Laurie R. Santos (Yale University)

Can capuchin monkeys (Cebus apella) use non-arbitrary relationships to make inferences about the world?

Call (2004) examined whether après, like humans, use non-arbitrary cues to make inferences about the world. He baited one of two cups and provided either visual or auditory information about the baiting. Auditory cues included either shaking (non-arbitrary) or tapping (arbitrary) the cup. Great apes spontaneously use non-arbitrary relationships to make inferences in this task. Based on these findings, we questioned if a monkey species, the capuchin, could similarly use non-arbitrary cues in this task. Subjects selected the baited box when given visual information but performed at chance when given no information. When presented with auditory information, only subjects given the non-arbitrary cue correctly chose the baited box. Experiment 2 presented subjects with information about only 1 box. Subjects successfully used visual information but succeeded only when provided auditory information about the baited box.

Kuroshima

Hika Kuroshima, Yuko Hattori, Kazuo Fujita(Department of Psychology Kyoto University, JSPS)

Spontaneous food exchange with human caretakers by a capuchin monkey: Recognition of the opportunity and the rates of exchange

One male tufted capuchin monkey spontaneously began to hand his food to caretakers. We investigated his rule of this exchange. In experiment 1, he was given opportunities to exchange his chows with various foods from the caretaker. As the results, he came to hand his chow only when the experimenter showed her food. When an unfamiliar person worked as the experimenter, the monkey didn't apply this acquired rule. In experiment 2, we investigated how the subject rated the value of each food. We found that he had stable values for each kind of foods. In experiment 3, the food that the monkey kept was changed. When he kept his favorite food, he exchanged at lower rates than the original situation. These results indicate that he recognized the opportunity to exchange and spontaneously attributed differential values to each food according to the situation.

Lazareva

Olga F. Lazareva, Shaun P. Vecera, and Edward A. Wasserman (University of Iowa)

Figure-Ground Assignment in Pigeons

We trained four pigeons to discriminate whether a target spot appeared on a colored figural shape or on a differently colored background. The birds first had to peck the target. The birds then had to report the location of the target—on the figure or on the background. We recorded three dependent measures: target detection time, choice response time, and choice accuracy. A figural advantage was seen in all three dependent measures: The birds were faster to detect the target, to report its location, and to learn the correct response on figure trials than on background trials. This figural advantage emerged in acquisition and it was retained after prolonged training. However, when four other birds were

required to detect and peck the target without making a choice report, no figural advantage appeared in target detection time. Thus, pigeons' attention to foreground figures may be affected by task demands.

Lea

Stephen E. G. Lea (University of Exeter), Kazuhiro Goto (University of Nebraska-Lincoln) and Andy J. Wills (University of Exeter)

Theoretical analysis of concept learning

In concept discrimination learning tasks, multiple instances of defined positive and negative stimulus categories are presented. Acquisition is usually measured in terms of overall performance at discriminating the categories. In this paper, we present stimulus-by-stimulus analyses of acquisition of such discriminations in both birds and humans. The analyses show that (i) Learning about individual stimuli can be well represented by a process involving abrupt transitions between a small number of states, but (ii) the transition points for different stimuli are not independent.

Leising

Kenneth J. Leising (University of California, Los Angeles), Kosuke Sawa (Japan Society for the Promotion of Science, Nagoya University; University of California, Los Angeles), and Aaron P. Blaisdell (University of California, Los Angeles)

Extinction and spontaneous recovery of spatial information using a touchscreen task with pigeons

Extinction and spontaneous recovery of spatial information was investigated using a landmark-based spatial-search task on a touchscreen in pigeons. Four visual landmarks were separately established as signals to a hidden goal location on the screen. The goal was located above Landmarks (LMs) A and C and below LMs B and D. After conditioning, LMs A and B were extinguished. Responding to LMs A and C was assessed on subsequent tests two days following extinction, while LMs B and D were tested fourteen days after extinction. Finally, all LMs were tested 42 days after extinction treatment. Extinction of spatial control over search by a visual landmark was observed after two days, while spontaneous recovery was observed at longer delays.

Lewis

Jody L. Lewis & Alan C. Kamil (University of Nebraska -Lincoln)

Changing the landmark array decreases proactive interference in Clark's nutcrackers, Nucifraga columbiana

Previously, we have demonstrated that Clark's nutcrackers are susceptible to proactive interference when given a serial spatial memory task. That is, nutcrackers make more errors when given two lists a day versus one. In this experiment, the effects of proactive interference were alleviated by changing the landmark array between list one and list two.

Locurto

Chuck Locurto (College of the Holy Cross)

Mice learn a win-shift but not a win-stay contingency under water escape motivation

In foraging situations animals generally prefer win-shift to win-stay learning, that is, they learn more quickly to visit new locations compared to returning to already-visited locations to obtain food. This preference is typically explained by appeal to some form of optimal foraging. The complementary preference under aversive motivation has been less well studied although extant interpretations appeal to the common sense idea that in escape situations animals would prefer to return to a formerly safe location rather than visit a new location, that is, they would prefer win-stay to win-shift learning. Three experiments using mice examined the acquisition of either a win-shift or a win-stay contingency under water escape motivation. Results were contrary to this common sense notion. Mice uniformly preferred win-shift to win-stay learning to the extent that while win-shift learning was rapidly acquired, few subjects exceeded chance performance even after extended exposure to a win-stay contingency.

Lyn

Heidi Lyn (Wildlife Conservation Society) & Diana Reiss (Wildlife Conservation Society and Columbia University)

Similarities in Use and Comprehension of Symbol Systems in Apes and Dolphins: Analogies in Cognition

Studies of symbolic competency in nonhumans have been well documented. Many researchers have focused on nonhuman primates under the assumption that human symbol use is primarily biological and therefore similar abilities would most likely be found in our closest evolutionary relatives. However, published and new data from two long-term studies with bottlenose dolphins (Tursiops truncatus), one investigating the learning and productive use of an interactive keyboard (Reiss and McCowan, 1993) and one investigating the comprehension of artificial symbol systems (Herman et al., 1984, 1993), suggest representational and conceptual abilities which are strikingly similar to both humans and apes. New analyses reported here show parallels in acquisition of associations, behavioral concordance, rule learning, and predominance of error types between dolphins and great apes that support the hypothesis that the abilities of primates and dolphins may result from analogous cognitive evolution.

MacInnis Mika L.M. MacInnis (Brown University)

The Effect of Stimulus State and Probability on Behavior

The goal was to determine how the type of stimulus (a brief pulse or a filled interval of white noise) and probability of stimulus presentation interact to influence behavior. Each of 42 rats was trained on one of seven instrumental appetitive head entry procedures, in which food was available every 120 s and a stimulus was presented 30 s prior to the next food delivery (either a brief pulse, or a filled 30-s interval). The stimulus was presented with a probability of 0 (where the stimulus was never presented), 0.33, 0.67, or 1 (either the brief pulse or the filled interval). The extent of use of the time cue provided by the stimulus was inversely related to the probability of stimulus delivery. The results were modeled using a Packet Theory of Timing, with a linear averaging rule to combine the differential influences of the stimulus and food cues.

Makecha Radhika Makecha & Stan Kuczaj (University of Southern Mississippi)

Changes in a Dolphin's Preferential Play Partners

Recent work has suggested that young dolphins prefer to play with other young dolphins rather than adults (including their mothers). We expand on this work by investigating changes in a young female dolphin's preferential play partners during the first four years of her life. Initially, the dolphin played most with an older calf (during this period, the older calf was the only other calf in the tank). As new calves were born, she played more with the new calves and less with her once almost constant companion. In addition, her early play consisted mainly of object play and social play, but her later play incorporated more allomaternal behaviors, suggesting that the dolphin began to use play to acquire and perfect maternal behaviors as well as to enrich her life.

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

What is Geometry and When is it Used?

It is now well established that rats, chicks, goldfish, monkeys, and humans can learn to use the overall geometric shape of an enclosure to find a goal. In such studies subjects are usually deprived of information about their location in the world outside the enclosure. We asked whether idiothetic cues (path integration) and landmarks outside the enclosure affect the learning of geometric information. Rats were trained with both geometric and either idiothetic or extra-enclosure landmark information available and then tested on whether they learned both and which they used in case of conflict. We also tested the hypothesis that geometric information is encoded as the principal axes of a space by training rats in an enclosure of one shape and then deforming it in ways that maintained some of the sides and angles while changing their relationship to the long or short axes of the enclosure.

Miller Tom Beckers (University of Leuven), Ralph R. Miller (SUNY-Binghamton), Jan De Houwer (University of Ghent), and Kouji Urushihara (SUNY-Binghamton)

Reasoning Rats: Inference-like Processing of Information Concerning Effect Additivity and Ceilings

According to contemporary associative learning theories, forward blocking arises directly from a hard-wired basic learning algorithm that governs the acquisition and expression of associations. Seemingly contrary to this view, recent research has yielded evidence of inference-like information processing in humans confronted with both Pavlovian and causal assessment tasks. Here we demonstrate that blocking in rats is also seemingly sensitive to constraints of logical causal inference, such as violation of causal additivity and ceiling considerations. This argues for similar information processing in rats and humans and suggests that complex cognitive processes akin to causal inferential reasoning are involved in animal conditioning phenomena commonly attributed to the operation of basic associative processes.

Nagasaka Yasuo Nagasaka (University of Iowa), Koji Hori, & Yoshihisa Osada (Rikkyo University)

Recognition of depth relationship between surfaces unveils amodal completion in pigeons

Some studies have obtained evidence that various animals can recognize partly occluded objects in the same manner as humans. However, there is no positive evidence for amodal completion in pigeons. We assume the reason for such negative results lies in the tasks used in prior studies, which requires the subject to discriminate the object itself. In our study, therefore, we investigated the perception of amodal completion together with perceptual transparency in pigeons by using a task that probes the depth relationship between objects. If subjects can discriminate the depth relationship between surfaces, then such evidence would suggest that the observer completes the occluded object. Our results indicate that the pigeons can discriminate the depth relationship between opaque and transparent surfaces, suggesting that pigeons are also capable of amodal completion.

Neiworth Julie Neiworth, Alison Lewis, & Maren Sonstegard (Carleton College)

Assessment of Number by Tamarins

Two different methods were employed to determine the abilities of a new world monkey species, cotton top tamarins, to assess number. In a visual simultaneous assessment task, monkeys were presented with 2 3 X 3 matrices containing 2 and 4 sweetened cereal O's placed in unique patterns, and were trained to select the matrix containing "4". They were then tested with different novel amounts compared with 4 (e.g., 1 vs. 4, and 4 vs. 6) to determine if they had learned the discrimination by subitizing, or were using a numerosity assessment of "greater than" to make their selection. In a visual successive task, tamarins observed the sequential dropping of sweetened cereal into 2 different inverted cups (of the amounts 3 vs. 6 and 0 vs. 6) and were allowed to tip over a single cup to obtain rewards. The number "6" was rewarded, and others were not. Following correct performance, the monkeys were tested with various "addition" problems in which the same total amounts were tested, but the quantities were presented as 2 different dropping visits (e.g., 1+2 vs. 3+3 or 2+1 vs. 5+1). Their behaviors indicated the kinds of assessment of which they are capable, ranging from numerosity, to subitizing, to numeric abstractions such as summation.

Otovic Pete Otovic, Michael Rogers & Sarah Partan (University of South Florida)

Salience of Multi-Sensory Stimuli in Pigeon Courtship Sequences (Columba livia)

By analyzing courtship behavior sequences of male and female pigeons, we investigated the effects of certain male stimuli, such as the bow and coo, on the female pigeon's behavior. In addition we investigated the degree of redundance observed in auditory and visual components of the male's behavior. We tested six female pigeons using video playback methodology and lag sequential data analysis. The data indicated that the female was more likely to walk in a circle after the male's bow and coo than during her baseline behavior. We also found that the combination of auditory and visual stimuli, in the male bow-coo behavior, elicited more frequent female walk-circle behavior than either auditory or visual conditions alone. We conclude that video playbacks are effective tools for eliciting responses in female pigeons and conducting sequential analyses, and that the multisensory audio and visual signal from the male carries an enhanced message.

Patton Tadd B. Patton, Gabrielle M. Kellner, & Toru Shimizu (University of South Florida)

Is there something about her eyes? Significance of the Head Region on Preference Behaviors in Pigeons (Columba livia)

Laboratory studies have shown that pigeons can recognize conspecifics and select potential mates even when only visual information is available. Specifically, these studies indicate that information in the head and/or neck is important for conspecific recognition. However, it is still unclear whether specific features of the face (e.g., eyes, beak) are more important than others (e.g., shape of the head). In order to answer this question, the current study measured male pigeons' preference for various photographs of female pigeons. Some of the photographic images were modified so that specific features were exaggerated or reduced (e.g., large or small eyes). In other photographs, configuration of features was altered (e.g., removal of high frequency information). The results will be discussed in relation to the perceptual and cognitive strategies that pigeons use for conspecific recognition.

Rowan James D. Rowan, Amanda R. Willey, Eric P. Nolley, and Brian M. Kelley (Bridgewater College)

Adolescence exposure to Fluoxetine (Prozac) impairs adult serial-pattern learning in rats.

This experiment examines the effects of early exposure to Fluoxetine (Prozac) on adult higher cognitive function. Weanling rats were injected 5 days a week for 5 weeks with equivalent volumes of 4mg/kg or saline based on body weight. After 5 weeks off, all subjects were trained on a violation trill pattern (123 234 345 456 567 678 781 818) for 28 days receiving 5 patterns a day. The Prozac exposed group learned the pattern at approximately the same rate as the saline group but the pattern of errors for the two groups greatly differed. Rats in the Prozac group made more errors in the violation chunk. Also, the Prozac group produced more errors at chunk boundaries and less errors within chunks when compared to the control group.

Santi Angelo Santi, Jennifer Lellwitz, and Stephen Gagne (Wilfrid Laurier University)

Pigeons' Memory for Sequences of Light Flashes: Control by Temporal Rather than Numerical Features

The question of whether pigeons use the same or different processes to discriminate time and number has been of continuing interest to Bill Roberts. Bill's initial research on memory for number suggested that similar processes were involved, but his more recent work provides evidence of different processes. Studies of memory for light flash sequences in our lab involved training pigeons match two sets of sample sequences each consisting of two light flashes in 4s and four light flashes in 4s. The duration of a flash was varied so that neither individual flash duration nor total flash duration could serve as a reliable cue for responding to all of the sample sequences (i.e., 2f x 400 ms, 4f x 200 ms,

2f x 800 ms, and 4f x 400 ms). Data will be presented which suggests that several temporal features of these light flash sequences controlled responding rather than number.

Schmajuk

Nestor Schmajuk and Jose Larrauri (Duke University)

A neural network model that describes super latent inhiition

It was recently demonstrated that a delay interposed between conditioning and testing results in an increased latent inhibition effect, a phenomenon termed super-latent inhibition. We show that an existing neural network model of classical conditioning (Schmajuk, Lam, and Gray, 1996), which includes an attentional mechanism that controls both storage and retrieval of associations, is able to describe many of the properties of super-latent inhibition.

Schneider

Susan M. Schneider and Robert Lickliter (Florida International University)

Auditory Generalization Gradients in Bobwhite Quail Chicks

Bobwhite quail chicks respond differentially to a variety of species-typical calls and can discriminate small changes in the repetition rate of a maternal call. To further explore their auditory sensitivity, newly hatched chicks were trained nondifferentially to peck a touchscreen on a variable ratio heat reinforcement schedule while a beep was repeated at an intermediate rate; initial autoshaping with this training stimulus facilitated quick learning. We obtained typical individual generalization gradients over seven beep rates in extinction from chicks at 3 to 5 days of age. Sometimes mirror-image inhibitory gradients occurred. Stimuli associated with aversives produce inhibitory gradients, so these chicks may be reporting their hedonic states. Our findings with quail neonates extend research with older populations suggesting that generalization operates similarly across reinforcers and aversives. Results will be compared with those from chicks trained on the same schedule but without the auditory stimulus, and from chicks trained differentially.

Schwartz

Bennett L. Schwartz (Florida International University), Megan L. Hoffman (Georgia State University), Melinda Allen (Florida International University), Jonathan D. Lane (Florida International University), & Heather Cherry (Miami-Dade College)

Working memory in Lar Gibbons (Hylobates lar)

Working memory refers to an animal's ability to remember stimuli or events presented during a single trial. We used a delayed-response task and a delayed match-to-sample task (DMTS) to test the working memory of two lar gibbons (Hylobates Lar). In our first experiment, a spatial delayed-response task, the gibbons were required to remember the location of hidden grapes. The male gibbon performed above chance at retention intervals that averaged over 90 seconds. In our next two experiments, the female gibbon showed above-chance performance at remembering the placement of a grape in one of three cups placed directly in front of the gibbon. In a fourth experiment, the female gibbon performed above chance on an object-identity DMTS with a retention interval averaging 11 seconds. In all four experiments, with little prior training, at least one gibbon performed at above-chance levels, suggesting the ability to represent past events in working memory.

Shettleworth

What-Where-When Memory in Pigeons

Shannon I. Skov-Rackette, Noam Miller, and Sara J. Shettleworth (University of Toronto)

An animal that encodes the identity, location, and time of an event should respond correctly to any of the three questions, "what was it?", "where was it?", or "when was it?" when it cannot anticipate which will be asked. We developed a novel approach to testing "episodic-like" memory based on this assumption. Pigeons were trained to match the identity of a 3-s sample on a touchscreen, to match its location, and to report on the length of the retention interval (2s or 6s). The three tasks were trained in separate, interleaved, sessions until the birds reached a criterion of 80% correct on all of them at both RIs. Then blocks of "what", 'when", and "where" trials were intermixed within each session. Performance on "when", but not "what" or "where" initially decreased dramatically in these sessions, suggesting that the birds do not simultaneously encode all three features.

Singer

Rebecca A. Singer & Thomas R. Zentall (University of Kentucky)

Formation of Cognitive Maps in Rats

We examined the ability of rats to develop and use cognitive maps. Rats were trained to retrieve food rewards from two of the three goal boxes of a three-arm maze. Each arm, but not the goal box, was uniquely textured, which allowed rats to orient themselves within the maze. On test trials, rats were allowed to choose between two novel pathways from the center goal box, one of which led to the goal box that had been baited in training and the other which led to the goal box that had been empty. Rats chose the novel shortcut that led to the arm that had been baited in training significantly more than the novel shortcut that led to the arm that had not been baited. These results suggest that rats were able to navigate along a novel path using an internal map of their environment.

Stahlman W. David Stahlman (University of California, Los Angeles), Seth Roberts (University of California, Berkeley), and Aaron P. Blaisdell (University of California, Los Angeles)

Response Variability is Inversely Related to Probability of Reward: A Demonstration in Instrumental Screen Pecking in Pigeons

Gharib, Gade, & Roberts (2004) have shown that variability in the duration of bar pressing behavior in rats increases as a function of decreasing reward probability signaled by the discriminative stimulus. We report a replication of this result in pigeons pecking a visual stimulus on a touchscreen. On a given trial, a single red or blue circle was presented on the touchscreen. Pigeons were required to peck at the stimulus to proceed to the next trial. One stimulus (e.g., red) was always followed by reinforcement, while the other (e.g., blue) was reinforced only once in every four or eight trials. Most subjects showed greater spatial variability of pecks on trials with the low-probability than with the high-probability stimulus, consistent with the findings of Gharib et al. However, we also report some surprising individual differences and counterintuitive observations.

Stevens Jeffrey R. Stevens, Alexandra G. Rosati, and Marc D. Hauser (Harvard University)

The value of space and time for two New World monkeys

Trading off small, immediate rewards for large, delayed rewards is a common dilemma facing all animal species. Often animals discount the future, exhibiting a preference for immediate rewards. Animals must discount not only over time, but also over space—closer rewards should be more valuable than distant rewards. These types of choices that require travel over a distance often reflect more naturalistic foraging techniques than strict temporal discounting tasks. We tested two primate species—common marmosets (Callithrix jacchus) and cotton-top tamarins (Saguinus oedipus)—in a spatial discounting task in which subjects chose between small, close rewards and large, distant rewards. Tamarins traveled farther distances than marmosets contradicting previous findings in the temporal discounting context. These findings, however, match the foraging and daily travel patterns of both marmosets and tamarins, suggesting that the species' ecology can play an important role in shaping decision making.

Sturdy Tiffany T.-Y. Lee, Isabelle Charrier, Laurie L. Bloomfield, Christopher B. Sturdy (University of Alberta), & Ronald G. Weisman (Queen's University)

Frequency range discriminations in chickadees and finches

The pitch, or frequency, of many songbird vocalizations plays an integral role in species recognition. Here we trained male and female black-capped and mountain chickadees, along with male zebra finches, to sort frequencies into contiguous rewarded and non-rewarded ranges. Following discrimination training we conducted a transfer test to determine whether birds categorized tones by range or instead memorized individual tones. In line with previous studies, finches performed at a high level and outperformed both species of chickadees on some performance measures. In contrast to prior results with zebra finches, male and female chickadees did not differ in their absolute pitch perception abilities. Results of the transfer test suggest that all three species of songbirds categorized rather than memorized novel stimuli. The possible causes of the relatively poor performance of chickadees compared to zebra finches and potential proximate mechanisms underlying the lack of sex differences in chickadees will be discussed.

Sturz Sturz, B. R. & Bodily, K. D. (Auburn University)

Virtual open-field: Evidence against integration of spatial maps in humans

In a previous study, human participants navigated a virtual, open-field analogue of Blaisdell & Cook (2005). Results were consistent with those found in pigeons. Additional analyses suggested an accumulation of non-reinforced choice responses (not integration) was responsible for changes in responding across tests. A follow-up study eliminated the critical stimulus for integration in pigeons (i.e., reintroduction of Phase1 trials during Test 2). Phase 1 and Phase 2 training were identical to the previous study, but during transfer, Phase 2 trials were substituted for Phase 1 trials. Thus, testing blocks were comprised of Phase 2, Phase 2, and red L alone. The results were not different from those obtained when Phase 1 "reminder" trials were included for both humans and pigeons. Overall, the findings provided evidence that changes in cup choices were not due to an integration of spatial maps.

Subiaul Francys Subiaul (University of Louisiana, Lafayette) & Herbert S. Terrace (Columbia University)

Is Learning from Observation as Good as Learning from Triral and Error?

Do we learn best from individual experience? Or, is imitation learning just as good? Research from the cognitive neurosciences suggests that the mechanisms through which observation contributes to learning a motor skill are very similar to the mechanisms underlying individual trial-and-error learning. Here, we re-analyzed data collected from two adult rhesus macaques tested on a cognitive imitation study (i.e., Subiaul et al., 2004) to test whether learning by cognitive imitation was as robust as learning resulting from individual trial and error experience. Our data suggests that among rhesus macaques ordinal knowledge acquired by cognitive imitation doesn't significantly differ from ordinal knowledge that results from individual trial and error [Horatio: $F(4,98) = .84$; Oberon: $F(4,116) = .20$, One-Way ANOVA]. These results support the hypothesis that the mechanisms mediating learning by trial and error are the same as the mechanisms mediating learning by imitation.

Suits

William T. Suits, Rebecca Doak & Janice N. Steirn (Georgia Southern University)

Transitive Inference with Commonly Coded Stimuli

This experiment examines whether stimuli that are commonly coded through association with similar outcomes will be treated differently when used in a transitive inference (TI) task than stimuli not commonly coded. A TI task was used in which stimuli were presented to the pigeons as pairs (A+B-, B+C-, C+D-, D+E-), and a single pair of stimuli were presented as a test (BD). For the Within Common Coding Group, the outcomes were arranged so that B and D both received the same outcome (when positive in their respective pairs). For the Between Common Coding Group, the outcomes were arranged so that B and D received different outcomes. Random outcomes were assigned to B and D stimuli in the Control Group. Performance on the TI test will be examined to determine whether commonly coded stimuli enhance or interfere with TI performance relative to a non-commonly coded pair of stimuli.

Tamo

Tamo Nakamura, Anthony A. Wright, Jacquelyne J. Rivera (The University of Texas Health Science Center at Houston), Jeffrey S. Katz, Kent D. Bodily, & Bradley R. Sturz (Auburn University)

Training with Different Initial Set Sizes and Same/Different Concept Learning in Pigeons

Four groups of pigeons were trained initially with 8, 32, 64, and 1024 stimuli. Following transfer to novel stimuli, set sizes were successively doubled for each group to 1024 items. Learning rates (initial and overall) did not differ appreciably across groups. Initial transfer at successive set sizes varied directly with initial training set size (e.g. the 32-item group transfered better than the 8-item group at the 32-item set size and the 64-item group transfered better than the 32-item group at the 64-item set size). All groups achieved a high level of transfer and concept learning (~80 % correct) by the time they completed training with the 1024-item set. The results are discussed in terms of similarities and differences in how these four groups of pigeons learned the same/different task.

Treichler

F. Robert Treichler and Mary Ann Raghanti (Kent State University)

Monkeys linking serial lists: A test of episodic memory

One issue in comparative testing of episodic memory is whether serial lists are retained as multiple associations or as organized cognitive arrays. In animals and children, such serial memory tests have been employed to assess the development of transitive (but not logical) inference. Terrace (and others) have reported that monkeys retain information about the positions of items in serial lists and organize these as a set of ordinal rankings. These rankings subsequently determine choice when between-list pairs appear as tests. In our experiments, monkeys seem to generate integrated ordinal memorial arrays via simple training of pairs that link between previously learned serial lists. We will discuss procedures, outcomes, appropriate measures and limitations of serial list-linking methodology with the goal of encouraging its use and application in further tests of cognitive performance.

Vonk

Jennifer Vonk, James E. Reaux & Daniel J. Povinelli (University of Louisiana at Lafayette)

Determinants of Individual Differences in Cognitive Tasks with Chimpanzees

Archived data from seven chimpanzees who have participated in a variety of cognitive tasks throughout their lifetimes were analyzed to examine individual differences in performance. Tasks designed to tap into diverse abilities, such as tool use, concept representation, self recognition, and visual perspective-taking, were classified according to multiple dimensions, such as social versus physical problems, choice versus action tasks, prediction versus explanation paradigms, and competitive versus co-operative tasks. By ranking the chimpanzees according to multiple measures of task performance, such as trials to criterion, first trial, transfer and overall performance, we determined whether individuals displayed consistent strengths and/or difficulties according to the measures of performance, parameters of the tasks, and the core knowledge domains presumably tapped into by each task. Results from these analyses will determine whether performance on various tasks is best predicted by the overall skill of individuals or whether chimpanzees as a group perform similarly according to task domains and parameters.

Weisman Andrea Friedrich, Thomas Zentall (University of Kentucky), and Ronald Weisman (Queen's University),

The Specifics of Absolute Pitch Perception in Pigeons.

Absolute pitch perception (AP) refers to the ability to identify, classify, and memorize pitches without use of an external reference pitch. In previously published tests of AP, several species of birds and mammals were trained to sort contiguous tones into frequency ranges, based on correlations between responding to tones in each frequency range and reinforcement. Here we report the specifics of our results with pigeons, a species not known for its auditory expertise. We studied pigeons in three and eight frequency range discriminations across higher and lower acoustic frequency regions. Our results suggest that pigeons have AP sorting abilities that are broadly similar to other avian species. However, pigeons acquire frequency range discriminations more slowly and with greater variability between individuals than we have observed in other birds.

Whitlow Bill Whitlow (Rutgers University - Camden)

Configural learning in a social reasoning task

Associative approaches to causal learning in humans have suggested that people often rely on configural cues rather than elemental cues in making their judgments. This suggestion was investigated with a social reasoning task in which associative relations of positive and negative strength can be mapped onto social relations of active support for or active antipathy against a target individual. Social reasoning, about which people may be presumed to be relatively sophisticated, is compared to reasoning about food allergies, a more conventional reasoning task.

Williams Douglas A. Williams, Rachel Cook, Carla Lawson, & Kenneth W. Johns (University of Winnipeg)

"When" Trumps "Whether" in Pavlovian Appetitive Conditioning

Under a deeply negative contingency, food-restricted rats (rattus norvegicus) anticipated the arrival time of a single food pellet US presented at a fixed time after the onset of an extended 2 min white noise CS. Conditioned food-magazine entries by rats peaked above ITI levels at the scheduled arrival time of the pellet US, either 30- or 90-s after CS onset, in separate groups, when pellets occurred four times more frequently on a probabilistic basis during the intertrial interval (ITI). Some have said that conditioning involves learning both "whether" the CS signals an increase in the probability of the US, and if so, "when" the US is scheduled to arrive. These results show that "when" trumps "whether", challenging accepted doctrine that a positive contingency between the CS and US is necessary for CR generation.

Yeater Deirdre Yeater, Stan Kuczaj (University of Southern Mississippi) & Moby Solangi (Institute for Marine Mammal Studies)

Cognitive and Social Influences on Dolphin Regurgitation

A young captive dolphin began to exhibit voluntary regurgitation shortly after she was moved to a pool containing two other dolphins that regurgitated at will. In an attempt to better understand the reasons for such behavior, each dolphin was systematically observed for a twelve week period. These results suggested that both cognitive and social factors influenced voluntary regurgitation. Some dolphins appeared to regurgitate in order to alleviate boredom. In such cases, voluntary regurgitation may be a form of self-enrichment. However, social rank and modeling of more dominant animals also influenced the frequency of regurgitation, particularly for the young target dolphin. Thus, both cognitive and social factors affect voluntary regurgitation by dolphins, and most likely explain why some animals are prone to regurgitation while others are not.

Yi Linlin Yi (Brown University)

The Combination Rule for Simultaneous Timing of Two Independently Reinforced Fixed-Intervals

When animals time more than one interval at the same time, a combination rule is supposed for the simultaneous timing process. Twelve rats were used in an instrumental appetitive lever press procedure that involved two independently reinforced fixed-intervals indicated by a long stimulus (120 s) and a short stimulus (60 s). Results showed that the short stimulus and the first reinforcement played dominant roles in the simultaneous timing. Three possible combination rules are discussed: the short-stimulus-dominance rule, the first-food-dominance rule, and the weighted sum rule. Analyses suggested that rats used a weighted sum of the effects of the stimuli, rather than relying exclusively on the short stimulus or the first reinforcement.

Young Michael E. Young, Joshua S. Beckmann (Southern Illinois University at Carbondale) & Edward A. Wasserman (University of Iowa)

The pigeon's discrimination of Michotte's launching effect

In the present study, pigeons learned to discriminate a Michotte launching animation from three other launching animations using a go/no-go task. Each pigeon was reinforced for pecking at one of the interactions but not for pecking at the other three. The four animations constituted two classes: causal (direct launching) and non-causal (delayed, distal, and delayed & distal). Two birds learned to peck at the causal interaction but not at non-causal interactions whereas two different birds learned to peck at a distal and delayed interaction but not at the other interactions. Both discriminations were very difficult for the pigeons and subsequent tests revealed a tendency to solve the discrimination by attention to subtle stimulus properties. These results suggest that causality in observed object interactions is not as salient for pigeons as it is for people.

Zentall

Thomas R. Zentall & Rebecca A. Singer (University of Kentucky)

Episodic Memory in Animals Requires the Answer to an Unexpected Question

For animals, the answer to an expected question can be framed as a rule or a semantic memory (e.g., in matching-to-sample; if the sample is red choose the circle). To distinguish between episodic and semantic memory it is important that the question asked (e.g., what color was the sample?) be unexpected. To accomplish this, the test should involve the transfer of training. Maki (1979) found that pigeons can retrieve memories of food and the absence of food when unexpectedly requested. And we have found that pigeons can retrieve examples of their own differential behavior (pecking or not pecking, Zentall, Cement, Bhatt, & Allen, 2001). We are also investigating whether pigeons can retrieve a location where they have pecked when unexpectedly asked. We believe that the ability of pigeon to retrieve hedonic, behavioral, and spatial events when unexpectedly requested is analogous to human episodic memory (e.g., the answer to the question, “What did you have for breakfast this morning?).

Conference on Comparative Cognition 2005 - Poster Presentations

Babb — Stephanie J. Babb & Jonathon D. Crystal (University of Georgia)

Discrimination of What, When, and Where in Rats is Not Based on Time of Day

We investigated discrimination of what, when, and where in rats (n=6) on the radial maze, and controlled for time of day. Phase 1 consisted of four choices, one of which contained chocolate. In Phase 2, all eight arms were available. After a short (1 hour) retention interval (RI), the four arms not available in Phase 1 provided food. After a long (25-h) RI, the four arms, plus the chocolate arm, provided food. The rats visited chocolate more after the long RI than after the short RI. Chocolate was then paired with lithium chloride after Phase 1, during the 25-h RI. Following the taste-aversion manipulation, the rats visited chocolate after the long RI less often than before LiCl. These data demonstrate knowledge of what, when, and where that cannot be based on time of day. The data also suggest flexibility to update memory based on information acquired in a new situation.

Batson — Michael C. Hendrix & John Batson (Furman University)

Restrained Honeybees Can Use Odors to Predict the Location of Reward

The classically conditioned proboscis extension reflex (PER) of honeybees typically is studied by pairing an odor (CS) with sucrose (US) reinforcement. Bees are usually restrained firmly and are able to move only antennae and proboscis, resulting in a conditioned response that is scored as a simple digital event. In this study, honeybees were loosely restrained, allowing for extensive head movements, and were presented two odors from the same location, each of which was followed by sucrose either to the right or left of the animal. The animals learned to anticipate the direction where sucrose would appear, as evidenced by head turns (with PER) in the correct direction. This additional component of the PER may enhance the usefulness of this procedure in the study of invertebrate learning.

Beckmann — Joshua Beckmann, Michael Young, & Olga Nikonova (Southern Illinois University @ Carbondale)

Stimulus Dynamics and Duration Judgments

The purpose of the present study was to observe the functional relationship between stimulus dynamics and stimulus duration judgments in humans. Stimulus dynamics were defined by how quickly the sphere rotated on its Y-axis. A bisection task was used to divide stimulus durations into two categories, short and long. Sphere rotation involved three levels: slow, medium, and fast. Participants' duration judgments were longer the faster the sphere was rotated. In the second experiment, durations were created using a logarithmic scale. Sphere rotation involved four levels: static, slow, medium, and fast. Participants' duration judgments were again longer the faster the sphere was rotated with the exception of the static condition; participants' duration judgments under the static condition were more similar to judgments under the medium condition. The results indicate that stimulus dynamics influence the point of subjective equality and the slope of the discrimination function.

Boisvert — Michael J. Boisvert & David F. Sherry (University of Western Ontario)

Interval Timing in an Invertebrate

Learning to adjust behavior to the temporal structure of the environment is expected to be an important and phylogenetically widespread capacity. However, interval timing - responding to elapsed temporal durations - is known to occur only in vertebrates. In two experiments bumble bees (Bombus impatiens) were trained to extend their proboscis through a hole in a chamber wall, with reward available on fixed interval (FI) 12 and 24 second schedules. Bumble bees showed pauses in responding immediately following reward, with longer pauses occurring on the longer schedule. Maximum rates of responding occurred at or near the end of the interval. These results suggest that bumble bees timed the intervals. To our knowledge these data are the first indication of interval timing ability in an invertebrate.

Chapman — Kate M. Chapman (New College of Florida, Lemur Conservation Foundation) & Heidi E. Harley (New College of Florida)

Multiple Measures of Handedness & Laterality in Three Species of Lemur: Lemur catta, Eulemur mongoz and Eulemur fulvus rufus

Handedness has been considered an indicator of lateralization of hemispheric function in many primate species. Semi-free-ranging lemurs were assessed for hand/limb preference over multiple behavioral measures: (1) reaching for food, (2) foraging, (3) walking/climbing and (4) in a sequential food extraction task. In discrete food presentation, about half of the lemurs preferentially used their right hands, and the other half, their left. In food-related tasks, dominant hand preference increased as posture shifted from a quadrupedal to a bipedal stance. While foraging, lemurs tended to use the hand closest to the food item; therefore, hand preferences were lacking in this measure. A population-level weak left preference was expressed for leading limb in walking. For the sequential tube task, all subjects exhibited strong right preferences, indicating a left-hemisphere specialization for sequential hand movements. Stability was not found across tasks; individuals did not always express the same lateral bias for each behavioral measure.

Chenoweth Amber Chenoweth, Melissa D. Muller, Jessica Owens, Zach Moore, Denise P. A. Smith, & Stephen B. Fountain (Kent State University)

Contextual Coding in Rat Serial Pattern Learning: Serial Position as Context for Temporal Phrasing Cues

In serial behavior, a common finding is that the transitions to new chunks of a serial pattern are more difficult to anticipate than elements within chunks. Providing "phrasing cues" at chunk boundaries facilitates learning about these transitions in humans and rats. Past studies have indicated that temporal phrasing cues chunk sequences by overshadowing interitem associations, but that rats also learn about the serial position of chunk boundaries. To further examine the mechanisms underlying this effect, rats learned a pattern of responses on a circular array of 8 levers with temporal phrasing cues at chunk boundaries. Two phrasing cue removal manipulations revealed that serial position cues served as occasion setters for the use of temporal cues at chunk boundaries. These results help clarify how phrasing and serial position cues chunk patterns and suggest an explanation for the nature of sequential learning deficits following hippocampal lesions in rats.

Dally Joanna Dally, Nathan Emery & Nicola Clayton (University of Cambridge)

Cache protection strategies by western scrub-jays (Aphelocoma californica): who is watching and what have they seen?

The first experiment shows that western scrub-jays differentiate between the risks that different observers pose to their caches. In the presence of observers, storers cache predominantly in distant sites, reducing the transfer of information to potential thieves. If unobserved 'near' and 'far' sites were used equally. During unobserved recovery periods, after being observed by a dominant or subordinate conspecific during caching, storers re-cached items in new sites. However, if the observer was the storer's partner, or if caching occurred 'in private', few items were re-cached. In a second experiment, we found that the jays appeared to be sensitive to what an observer had or had not seen. If the same bird that watched them cache was present at recovery, storers used strategies to protect cache safety. If watched by a different bird, they did not re-cache, thus withholding information as to the location of the remaining caches.

Emery Nathan D. Emery (University of Cambridge, UK)

Visual Co-orienting With Humans and Conspecifics in Common Marmosets

Gaze following using conspecific or heterospecific cues has been demonstrated in monkeys, however most species tested have a competitive rather than cooperative social system. Visual co-orienting was investigated in 8 common marmosets. In Experiment 1, a human experimenter provided Eye, Head or Point cues to subjects, who oriented more frequently towards the attended location after Point cues and looked longer at the correct object after all cues. Subjects also used social information from their partner. In Experiment 2, a Tap cue was included. Two subjects oriented more frequently and looked longer at the correct object after Tap cues. Latency to respond was shorter to the correct object and percentage of trials where the correct object was inspected first was higher than the incorrect object after all cues. Marmosets use social cues to orient towards an object attended to by a heterospecifc, however these results suggest reflexive orienting rather than understanding.

Feeney Miranda C. Feeney & William A. Roberts, University of Western Ontario

Impulsivity and Self-control in rats During Bouts of Foraging

Traditional assessments of "impulsivity" observed in animals in self-control experiments focus on two hypotheses: either animals lack the ability to foresee future consequences of choices or they discount uncertain events rather than retain value for rewards subject to delay. Impulsivity is not considered a strategic, beneficial choice. Typical self-control experiments require animals to make choices about accessing food, essentially foraging, but the research most frequently involves either operant chambers, or runway mazes, neither of which can be effectively used to model environmental factors such as patch density and spatial distinction, accessibility of food sources, or availability of shelter and escape routes. The current research will focus on the phenomenon of impulsivity, in the context of foraging choices, using the radial maze. Data will be reported from experiments in which rats chose between small immediate rewards on some arms and large delayed rewards on other arms.

Fiset

Sylvain Fiset & Nathalie Malenfant (Université de Moncton, campus d'Edmundston)

Searching in the center: Domestic dogs encode absolute distance from edges of a frame

The objective of this study was to determine whether domestic dogs encode absolute or relative distance to locate a ball hidden in the middle of a frame. In Experiment 1, the ball was surrounded by a square frame. In Experiment 2, it was surrounded by a circular frame. During training, the frame was moved about in the room from trial to trial. During testing, training and test trials were mixed. On control tests, the ball was removed and the frame remained at the same location. On expansion tests, the ball was removed and the size of the frame was double. On both experiments, data revealed that on control tests, domestic dogs searched accurately at the center of the frame. On expansion tests, however, dogs searched at the training distance from edges of the frame. This suggests that dogs encode absolute distance from edges of a frame to locate a spatial position.

Flemming

Timothy M. Flemming & David A. Washburn (Georgia State University)

Same vs. Different or Uniformity vs. Chaos?: Perception of Abstract Relations by Rhesus Monkeys (Macaca mulatta)

In this study, we investigate the postulation that monkeys are incapable of abstract relational processing (Thompson & Oden, 1996) by presenting five rhesus monkeys with several computerized relational matching paradigms. After failing to meet criterion discriminating among pairs of same and different objects in studies 1-3 of our project, monkeys were presented with rows of several objects in a two-choice discrimination (between rows) paradigm, rather than pairs. From 8-3 stimuli per row, we see a pattern of slight degrading accuracy that corresponds to the number of objects presented. Our results suggest that monkeys rely, as pigeons do, on entropy in their discrimination of these abstract relations (Wasserman, Frank & Young, 2002). So, to monkeys, it may be more appropriate to use terms such as uniformity and chaos, rather than same and different because it is clear that they do not perceive these constructs in a manner identical to humans.

Fowler

Facilitating and Inhibiting "Insightful" behavior in Pigeons (Columba livia)

Catherine M. Fowler and Robert G. Cook (Tufts University)

We looked to expand the current understanding of what cognitive processes underlie the production of novel behaviors. We replicated and extended Epstein,Kirshmit, Lanza, and Rubin's (1984) pigeon experiments looking at Kohler's classic insight task involving the novel combination of boxing pushing and banana pecking. Epstein et al. outlined a successful recipe for the synthesis of these previously learned behaviors; but what remains unclear is exactly how the training procedures are processed by the pigeons. We sought to determine what specific past experiences are required to produce this apparently "insightful" behavior by testing pigeons with both functional and non-functional box alternatives as solutions to the problem.

Frank

Andrea J. Frank, Edward A. Wasserman (University of Iowa), and Michael E. Young (Southern Illinois University at Carbondale)

Item and relation control in same-different discrimination

We trained four pigeons on conjoint same-different and item discriminations in which collections of 16 visual icons were either all identical or all nonidentical and comprised icons either from Set 1 or Set 2. The birds had to peck one of four buttons, each corresponding to one of the four combinations of these two independent factors: same-different relation and item set. We tracked control by same-different relation and item set during initial acquisition and during a later phase, in which the number of items was decreased from 16 to 2. Both same-different relation

and item set discriminations were learned to high levels, but control by item set developed faster. Control by the same-different relation fell as the number of displayed items was decreased, whereas control by item set did not. This interplay suggests joint control by relation and item information in pigeons' same-different discrimination behavior.

Gerrard Leslie L. Gerrard, William R. Pfleger, & James C. Denniston (Appalachian State University)

The Renewal Effect: Occasion Setting by Context?

Two experiments using human participants investigated the mechanisms underlying the renewal effect. Experiment 1 provided negative occasion setting training in which reinforced presentations of CSs A, B, and C (in Context C) were interspersed with nonreinforced A and B presentations in Contexts A and B, respectively. Testing with CSs A and B in Context A revealed occasion setting and transfer of occasion setting by context. Experiment 2 provided training analogous to Experiment 1, except that all training was provided phasically (i.e., acquisition followed by extinction). Testing with CSs A and B in Context A revealed extinction and a prevention of the renewal effect, respectively. The results of Experiment 2 suggest that the extinction context can function as a negative occasion setter which can transfer its modulatory control to other target CSs. Results will be discussed in terms of occasion setting and other theories of renewal.

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Gray Emily R. Gray, Laurie L. Bloomfield, Anne Ferrey, Christopher B. Sturdy & Marcia L. Spetch (University of Alberta)

Mountain Chickadees use of geometric and featural information in a spatial environment

Encoding of the global geometric shape of an enclosed environment seems to be a ubiquitous and predominant means of orienting in humans and various other animals. Twelve wild-caught mountain chickadees (Poecile gambeli) were trained to retrieve a mealworm that was hidden in one corner of rectangular enclosure. Separate groups of chickadees were trained either with features adjacent or opposite to the correct corner, or without any featural information. All three groups were then tested with and without the featural information available. Both feature groups were also tested in conditions that placed the featural and geometric information in conflict. The chickadees did not learn the geometric properties of an enclosure when salient featural information was adjacent to the correct corner during training. In contrast, chickadees that were trained in the absence of features or with distal features only were able to utilize geometric information.

Harley Heidi E. Harley (New College of FL & Disney's Living Seas), Wendi L. Fellner, Kim Odell, & Erika Putman (Disney's Epcot's Living Seas)

Representation of Acoustic Rhythms by the Bottlenose Dolphin

In a previously reported study of rhythm discrimination, a bottlenose dolphin could discriminate among six different acoustic rhythms with high accuracy (94%). The dolphin maintained the discrimination across frequency shifts (across two octaves), but his performance across tempo shifts (at intervals from halving to doubling) dropped significantly at most new tempos. In the current study, the dolphin was exposed to rhythms at a variety of tempos before being tested in a transfer test with unfamiliar tempo-shifted stimuli. Performance accuracy was significantly better (66% vs. 41%; chance = 17%) after the dolphin had general experience with rhythms presented at different tempos. To determine the information that the dolphin was using, a comparison of performance accuracy across

rhythms at different tempos and an analysis of the dolphin's reaction times in some contexts were conducted. The results suggested that the dolphin was using a combination of absolute and relative characteristics of the rhythms.

Harshaw Chris Harshaw & Robert Lickliter (Florida International University)

Stimulus Contingency and Intersensory Redundancy: Effects on Perinatal Learning

Previous research on early perceptual learning has generally utilized non-contingent, passive presentation of stimuli to infants. The learning obtained in such studies does not necessarily mirror the course of most learning during early development. The present study presents results demonstrating highly amplified auditory learning following a short (5 minute) contingent presentation of naturalistic auditory stimuli (an individual bobwhite maternal call) in bobwhite quail chicks. Chicks receiving contingent presentation of the maternal call based on the production of their own vocalizations at 24 hr following hatching remembered and preferred this familiar call over a novel maternal call when tested at 48 hr of age, whereas chicks receiving 5 min of non-contingent presentation did not. Data on the interaction of this contingency effect with the previously demonstrated effect of intersensory redundancy on early perceptual learning will also be discussed.

Herbranson Walter Herbranson (Whitman College)

Pigeons learn visual categories based on angle of movement, but not angle of orientation

Pigeons learned to categorize visual stimuli presented on a computer monitor. When categorizing moving objects based on speed and angle of travel, pigeons divided attention across both stimulus dimensions and performed nearly optimally. When categorizing objects based on size and angle of orientation, pigeons selectively attended to size, even when attention to orientation was required for optimal performance. Results indicate that categories based on angle can be relatively easy or difficult for pigeons to learn, depending whether angle represents an orientation or a direction of travel.

Hoy Erica A. Hoy, Dorothy M. Fragaszy, Gene Brewer (University of Georgia), Julie Johnson-Pynne (Berry College), & Aeneas Murnane (Emory University)

A Comparison of the Ability of Chimpanzees (Pan troglodytes) and Capuchin Monkeys (Cebus apella) to Solve Two-Dimensional Detour Problems

Five chimpanzees and seven capuchin monkeys were presented with a series of 192 computer mazes. Three chimpanzees and three capuchins were presented with mazes in order of perceived difficulty, while the remaining subjects were presented with the mazes in random order. The number of choices within a maze varied between 1-5 and the number of "non-obvious" choices ranged from 0-3. Non-obvious choices were those in which the incorrect choice appeared to lead more directly to the goal than the correct choice. Performance was assessed by analyzing the frequency and type of errors subjects made while navigating through the mazes. Results showed that chimpanzees made fewer errors, corrected their errors more often, and solved more mazes without error than capuchins. Chimpanzees were unaffected by type of maze presentation (ordered vs. random), while capuchins performed significantly worse in the random condition. These results suggest inherent strategy differences used by these two species.

Jaime Mark Jaime & Robert Lickliter (Florida International University)

Prenatal Exposure to Temporal Synchrony Affects Postnatal Responsiveness to Spatial Contiguity in Bobwhite Quail Chicks

Evidence derived from neural and behavioral studies of animal infants suggests that temporal synchrony and spatial colocation play a key role in early intersensory development. Little is known about how sensory experience during prenatal development can contribute to postnatal responsiveness to the temporal or spatial contiguity of multisensory stimulation. This study manipulated late prenatal and early postnatal audio-visual experience available to bobwhite quail embryos and hatchlings. Results revealed that embryos exposed to temporally synchronous and spatially colocated bimodal stimulation prior to hatching subsequently preferred spatially colocated audio-visual maternal cues following hatching, despite being denied postnatal visual experience. In contrast, embryos not receiving prenatal synchronous and spatially colocated audio/visual experience failed to show a preference for the spatial contiguity of maternal cues following hatching. These results suggest that prenatal experience with amodal stimulus properties (such as synchrony) can sensitize chicks to other amodal properties in the days following hatching.

Kundey Shannon M.A. Kundey & Laurie R. Santos (Yale University)

Episodic-like memory in capuchins (Cebus apella)

Human memory combines what, when, and where information about personal events, a capacity referred to as episodic memory. Many have hypothesized that this capacity is unique humans. Here, we explore whether capuchin monkeys can represent episodes in memory. Capuchins were taught that a preferred degrading food hidden for 10 sec, but not 3 min, is edible and that a less preferred non-degrading food was always edible. Capuchins then watched as the preferred and less-preferred foods were hidden for 3 min or 10 sec. Capuchins failed to combine what, when, and where information successfully to choose the non-degrading food after 3 min and the degrading food after 10 sec. While capuchins failed to combine what, when, and where information, they successfully combined dyads (what/when, when/where, and when/what) of these components. Capuchins' limited ability to use this information suggests they may lack episodic memory.

Leighty Katherine A. Leighty (University of Georgia)

A Comparative Analysis of 2D Object Perception in Chimpanzees (Pan troglodytes) and Young Children

I examined human and nonhuman primates' ability to form complex object representations from 2D images and utilize these representations to work in 3D space. Adult chimpanzees along with 3 and 4 year-old children served as subjects. Subjects were presented with a live televised image of a series of hiding tasks. After viewing an event in 2D, subjects were allowed to search the 3D object for the hidden item. The titrated testing series required subjects to discriminate between objects using color, form, local features, and relative position, and to discriminate between locations within a single object without using distinctive local features. Adult chimpanzees and 4 year-old children successfully completed all titrations of the task, whereas three year-old children only made cross-dimensional discriminations using color, form, and local features. Results imply that adult chimpanzees and 4 year-old children form complex object representations from 2D images and use these representations to guide action.

Markham Rebecca Markham, Robert Lickliter, & Lorraine E. Bahrick (Florida International University)

Intersensory Redundancy Guides Selective Attention During Prenatal Development

Bobwhite quail embryos were exposed to a bobwhite maternal call under several conditions to assess the salience of intersensory redundancy on prenatal learning. An experimental group received redundant bimodal (audio-visual) exposure to the temporal features of a maternal call followed by unimodal (auditory) exposure to the same call. Three control groups received either the same exposure but in the reverse sequence, only unimodal exposure, or only bimodal exposure. Chicks from all groups were tested at 48 hr following hatching for their preference between the familiarized call and a novel bobwhite maternal call. The experimental group showed a significant preference for the familiar call over the novel call, whereas none of the control groups showed a preference. These results suggest that intersensory redundancy can direct attention to temporal properties of bimodal stimulation and this redundancy can educate attention to these temporal properties in subsequent unimodal stimulation where no intersensory redundancy is available.

McClure Erin A. McClure, K. Saulsgiver, & Clive D.L. Wynne (University of Florida)

Effects of d-amphetamine on stimulus control in pigeons exposed to duration discriminations

Two experiments used a matching to sample of durations procedure to examine changes in temporal discrimination evoked by d-amphetamine in pigeons. The sigmoid functions relating percent of choices of the key reinforced after long duration stimuli to the duration of stimulus presented were fit by a cumulative normal function. In addition to a parameter indexing the left/right position of the sigmoid curves (which indexes temporal perception), this function also provided estimates of the range and slope of the curve (measures of stimulus control). Results showed that, contrary to many published reports, amphetamine had no effect on the left/right positioning of the sigmoid curve. There was, however, an effect of amphetamine on stimulus control, as shown by the general flattening of the psychophysical function.

McKenzie Tammy L.B. McKenzie & William A. Roberts (The University of Western Ontario)

What strategies do pigeons use to form categories?

Pigeons received training with two classes of stimuli, houses and dogs. They were reinforced for pecking at one category and not reinforced for pecking at the other and were tested with novel exemplars from each training category and a novel category (flowers). Pigeons transferred the appropriate pecking behavior to the novel exemplars from each training category. However, behavior to the novel category was similar to that displayed to exemplars of dogs. Thus, pigeons responded in one way to exemplars of houses and responded in the opposite manner to all other items by exclusion. In Exp. 2, pigeons received training with a highly variable category and a low variability category. It was predicted that pigeons would categorize exemplars from a novel category into the highly variable category. Pigeon's did not use this strategy. They treated the novel category like the S- category, regardless of whether it was the high or low variability category.

Muller Melissa D. Muller, Zach Moore, Denise P.A. Smith, & Stephen B. Fountain (Kent State University)

Do Rats Use Rules or Associations in Serial Pattern Learning?

This experiment sought to determine the extent to which rats use rules versus associations to guide behavior in a serial learning task. Rats were trained on one of three highly structured patterns composed of chunks of various lengths: 123-234-345-456-567-678-781-818; 1234-3456-5678-7818; and 12345-45678-78121. The numbers identify the order of correct responses on 8 levers that were arranged in a circular array. Acquisition rates were measured for chunk boundary, within chunk, and violation elements. Rule learning theories predict faster chunk boundary and within chunk acquisition, because violations, by definition, cannot be anticipated by the pattern structure. Associative theories predict that acquisition should depend on cue factors such as discriminability and contingency. Results showed violation element acquisition was faster than within chunk acquisition for all three groups. Additionally, the violation element and chunk boundaries were learned equally fast in all three groups. These results support an associative view of serial pattern learning.

Nakata Ryuzaburo Nakata & Yoshihisa Osada (Rikkyo University)

Can monkeys utilize only their faces to identify each other?

We explored whether squirrel monkey (Saimiri sciureus) can utilize faces of their own species to identify themselves. Face stimuli were squirrel monkey faces and human faces both unfamiliar to two subject monkeys. These monkeys were trained to discriminate between two squirrel monkey faces and between two human faces. After monkeys could acquire a correction level of 80%, they were presented with a pair of new faces. Monkeys could easily discriminate between two human faces, but they had much difficulty in discriminating faces of squirrel monkeys. The results suggest that squirrel monkeys can identify individual humans more easily than in the case of identifying those of their own species. In the natural environment, monkeys may utilize olfactory or auditory cues for identification of individuals of their own species rather than faces.

Naqshbandi Mariam Naqshbandi & William A. Roberts (The University of Western Ontario)

Cognitive Time Travel in Squirrel Monkeys

Cognitive time travel refers to the ability to remember past events distinguishable in space and time and to anticipate future events. Previous research has suggested that squirrel monkeys (Saimiri sciureus) may be able to anticipate events at least 15 min into the future. However, the previous work involved a future goal that was relevant to the current need of the monkeys. Can squirrel monkeys show evidence of anticipation for the future when two different motivational states exist in a single experiment? The present experiments tested the Bischof-Kohler hypothesis that non-human animals are bound to the present by their current motivational state. Two experiments were conducted that involved choice between 4 and 8 peanuts with choice of 4 peanuts yielding a reward satisfying a different motivational drive (water in Experiment 1 and mealworms in Experiment 2) 30 min later. Proportion of trials on which the smaller quantity was selected was measured.

Nikonova Olga Nikonova, Michael E. Young, & Joshua S. Beckmann (Southern Illinois University at Carbondale)

Contingency versus Mechanism in Causal Comparisons

Effects should be contingent on the occurrence of their causes. It is thus not surprising that events with stronger contingency relations are typically judged to be more causal. It is also true, however, that judges believe that a causal mechanism should be present before causality can be established. In the present study, contingency and visible mechanism were placed in direct conflict to determine how weak must a contingency be before participants will favor a perfectly contingent causal candidate without a plausible mechanism over a less contingent causal

candidate with a more plausible causal mechanism? Participants preferred a much weaker (50% predictive) candidate with direct or mediated spatial contiguity over a stronger (100% predictive) candidate that lacked contiguity.

Nolley

Eric P. Nolley, Amanda W. Willey, James D. Rowan, and Brian M. Kelley (Bridgewater College)

Assessing adolescence drug exposure on adult serial-pattern learning in rats: Alcohol and Nicotine

Most current methods for assessing the effects of adolescent drug exposure in animal models are centered on simple behaviors. However, such methods provide no insight regarding impairments of higher cognitive functions. The purpose of this study was to investigate a serial-pattern learning as a method of evaluating drug exposure during adolescence. Rats were injected 5 days a week for 5 weeks with equivalent volumes of 0.3 mg/kg nicotine, 20 % alcohol, or saline based on body weight. After 5 weeks off, all subjects were trained on a violation trill pattern (123 234 345 456 567 678 781 818) for 28 days receiving 5 patterns a day. Although no significant differences were found, a recent study using Prozac found impairments in pattern acquisition. Overall, this methodology can serve as an effective screen for examining the pharmacological and toxicological effects of adolescent drug exposure on higher-cognitive functioning in adulthood.

Olthof

Anneke Olthof & Angelo Santi (Wilfrid Laurier University)

The Association of Time Intervals with Symbols by Pigeons Using the Touchscreen: Evidence for Ordinality but not Summation

Previous research has found that pigeons can sum symbols associated with various quantities of food rewards in a Modified Wisconsin General Test Apparatus. The present experiment examines whether pigeons can sum symbols associated with various time intervals in a touchscreen apparatus. Pigeons were initially trained to choose one of two symbols from the set X = {0, 1, 2, 3, 4, and 5}, and were tested with novel pairs, as well as a choice between two sums, each composed of two symbols. In Experiment 1, each symbol was associated with an X-second delay to a fixed duration of food access, while in Experiment 2, each symbol led to X-seconds of food access. The results indicated that although pigeons formed an ordered representation of the symbols, spatial proximity of two symbols on the touchscreen did not induce summation. Instead, pigeons based their decisions on the value of the individual symbols.

Oswald

Tasha Oswald and Daniel J. Povinelli (University of Louisiana at Lafayette)

Chimpanzees' Understanding of Suspension Physics

Seven peer-reared chimpanzees were given a choice task to test their understanding of suspension physics. After training the chimpanzees to successfully hang objects with holes from a dowel, the chimpanzees were presented with 18 different object pairs (one pair, consisting of a correct and incorrect object, per trial), from which they were allowed to choose one object to attempt to hang from the dowel. Only the correct object had features, such as a hook or a hole, which would allow it to successfully suspend from the dowel. Additionally, for nine of the object pairs the incorrect object contained a distracter feature (notch cut into the object). The subjects chose more accurately on non-distracter trials. Notably, one subject also showed transfer on both distracter and non-distracter trials. These results suggest that chimpanzees may have a rudimentary working knowledge of suspension physics that may be elaborated with experience.

Pizzo

Matthew J. Pizzo & Jonathon D. Crystal (University of Georgia)

Rats do not discriminate alternate days

We investigated the ability to discriminate the daily alternation of meal availability (i.e., a 48-hr intermeal interval). The discrimination could be based on daily alternation, interval timing, or an oscillator with a period greater than 24 hours; the discrimination could not be based on a circadian oscillator. Rats (n=14) were tested 7 days per week at a constant time of day in operant boxes; a 1-hour meal was available 1 hour after the start of the session on alternate days. Post-session rations were adjusted to maintain a constant amount of food per day. Although response rate increased during the first hour of testing, there was no difference in the response rate between food and non-food sessions. The data suggest that rats do not readily discriminate alternate days.

Rahn

Elizabeth J. Rahn, Tyson L. Platt, and Martha Escobar (Auburn University)

Inhibition of delay in appetitive conditioning: Summation and retardation tests

When the delivery of an outcome consistently occurs during the final segments of its signal (i.e., conditioned stimulus, CS), conditioned responding tends to be delayed until the expected time of outcome delivery (i.e., inhibition of delay). Rescorla (1967) reported that the initial segments of a CS signaling delayed delivery of electric shock became inhibitory, as assessed with summation and retardation tests. However, little research has been conducted to support this assumption. Two studies using an appetitive preparation provide summation and retardation tests for the development of conditioned inhibition during the initial segments of a CS that signals delayed delivery of an outcome.

Rattermann Mary Jo Rattermann (University of Indianapolis), Alison Benowitz, Keren Mitchell & Nidhi Suri (Franklin & Marshall College)

Two, Six or Sixteen Icons: Identity is Still Special

Using the methodology developed by Wasserman and Young (Wasserman, Fagot & Young, 2001;Young & Wasserman, 2001) a touchscreen Imac was used to present human adults and 3-year-old children with either a display of 6 identical icons or a display of 6 non-identical icons. Subjects received an equal number of identity and non-identity trials, but were only rewarded for touching the screen in the presence of identity (or non-identity, depending upon condition). As was found in previous research, the adult subjects touched the screen more for identity displays, regardless of whether they were reinforced for responding to identity or non-identity. These findings suggest a predisposition in adults to respond based on identity. Previous research using two and sixteen icon displays also resulted in more identity responses, suggesting that this predisposition is robust to differing numbers of icons.

Rosati Alexandra G. Rosati, Jeffrey R. Stevens, & Marc D. Hauser (Harvard University)

The effect of Handling Time on Discounting in a New World Primate

Animals often discount or subjectively devalue future rewards. It is not clear, however, whether animals account for the handling time associated with consuming food rewards when making discounting decisions. We offered cotton-top tamarins, a New World primate species, choices between small, immediate rewards and larger rewards after various time delays. In addition, we experimentally manipulated the handling time of each monkey; subjects either received the entirety of the reward following the delay, or food pieces were dispensed incrementally with a small delay in between to simulate increased handling time. Preliminary analyses indicate that tamarins prefer the small, immediate rewards more in the incremental condition at larger delays, suggesting that they are sensitive to increases in handling time. This type of evaluation allows us to distinguish between different models of discounting such as rate maximization and hyperbolic discounting.

Rosengart Carrie R. Rosengart & Dorothy M. Fragaszy (University of Georgia)

Placement and Order Errors in a Seriation Task in Capuchin Monkeys (Cebus apella)

Three combinatorial methods (pair, pot and subassembly) can be used when combining nesting cups. Strategy preferences are based on relative hierarchical understanding of the properties of the cups. Subassembly is the method primarily used by adults. Two capuchin monkeys were trained to seriate nesting cups using the subassembly method. Both monkeys were able to seriate the cups in nearly half as many moves after subassembly training. The subassembly training procedure may have changed the type of errors. There can be errors due to incorrect placement (attempting to nest a large cup inside of a smaller cup) or due to an incorrect order (correctly nesting a smaller cup into a larger cup, creating a stable structure, but the cups are not adjacent to each other in sequence). An analysis of the individual moves showed the relative rates of placement and order errors after subassembly training.

Saulsgiver Kathryn A. Saulsgiver, Erin McClure, and Clive Wynne (University of Florida)

Effects of d-amphetamine on peak interval responding in pigeons

The Peak Interval (PI) procedure is a discrete trial Fixed Interval (FI) schedule in which a subset of intervals run for several times the normal FI duration and terminate without reinforcement. Previous studies have reported that the time of peak response rate on unreinforced trials (peak time) shortens with amphetamine treatment. We found dose-dependent reduction in peak time under d-amphetamine. In addition we found that wait times (times to first response on each trial) showed a dose-dependent reduction. Analysis of response rates revealed a rate dependent effect: low response rates early in each trial were increased and high rates decreased by administration of

amphetamine. We hypothesize that this rate dependent effect could be sufficient to cause the observed shifts in peak time and wait time without the need to assume effects of the drug on an underlying timing mechanism.

Seed Amanda M. Seed, Nathan J. Emery, Sabine Tebbich, & Nicola S. Clayton (University of Cambridge)

Investigating Causal Cognition in Rooks (Corvus frugilegis): A 'Two-Trap Tube' Task

Rooks are not reported to use tools in the wild, but in a previous study we demonstrated that they are capable of solving the trap tube task. In this study we further investigated their understanding of physical causality. We presented rooks with a 'two-trap tube', which had both a functional and non-functional trap, to avoid use of the simple rule 'pull away from the trap'. We investigated their understanding by looking for immediate transfer to a different design. 7 of the 8 rooks solved the initial problem, taking between 30 to 140 trials. All 7 birds showed transfer (within 10 trials) to a design with a different non-functional trap. One transferred to two further tubes, which set the previously non-functional traps against each other, each design making one of them functional. These results suggest that rooks appreciate the causal regularities of physical problems.

Shapiro Nileen B. Clark, Lisa J. Winter, & Martin S. Shapiro (California State University, Fresno)

The Effect of a Delayed Reward on Choice Behavior in the American Grasshopper.

Past research on learning in vertebrates has shown that animals prefer immediate to delayed rewards. While this has been an important parameter of associative learning in vertebrates, there has been very little work with an invertebrate model. Grasshoppers (Schistocerca americana) were trained in a two-sided Y-maze with scented arms offering food rewards after a 0 or 3 minute delay. In the first experiment (n=12), grasshoppers were given 14 choice trials with forced experience with both options. While the animals did prefer the immediately rewarded odor, there was some indication that further training would improve this preference. In the second experiment (n=12), training was extended to 20 trials, which did appear to increase choice proportions of the immediately rewarded option. This protocol should allow future research with delay of reward on learning and choice in designs such as self control, optimal foraging and risk-sensitivity.

Smith Denise P.A. Smith & Stephen B. Fountain (Kent State University)

Medial and Lateral Caudate Putamen Lesions and Rat Serial Pattern Learning

In prior research, MK-801, an NMDA receptor antagonist, disrupted serial pattern learning in rats when the serial pattern was a sequence of 24 response elements arranged in eight 3-element chunks. The final element of the sequence violated the overall pattern structure. MK-801 rats learned within-chunk elements as fast as controls, but showed permanent inability to learn the violation response, and to a lesser degree, chunk boundary responses. Dorsal hippocampus and medial frontal cortex lesions did not produce the same deficit seen with MK-801. In the present study, rats received either medial or lateral caudate putamen excitotoxic lesions. Rats were then trained on the same pattern as in previous studies. Both medial and lateral caudate putamen lesions caused learning deficits for within-chunk and the violation elements, but the deficits were less severe than those caused by MK-801.

Stollnitz Fred Stollnitz (National Science Foundation)

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Sutton Jennifer E. Sutton (University of Western Ontario) & Sara J. Shettleworth (University of Toronto)

Sense of Direction and Landmark Piloting in Pigeons

The relative importance of a sense of direction based on inertial cues and landmark piloting for small-scale navigation by pigeons was investigated in an arena search task. Two groups of pigeons learned the location of buried food in an arena containing stable landmarks but differed in whether they had access to visual cues outside the arena. After experience with two different entrances, pigeons with access to extra-arena visual cues transferred accurate searching to novel entrances. Pigeons without visual access relied on a response strategy when first entering from a novel direction but quickly learned to search accurately. Explicit disorientation before entering did not affect accuracy. In further manipulations, landmarks and inertial cues were put in conflict or tested one at a time. Pigeons tended to follow the landmarks in a conflict situation but could use an internal sense of direction based on inertial cues to search when landmarks were unavailable.

Thompson Dana J. Gant, Nidhi Suri, Norbelina Disla, & Roger K. R. Thompson (Franklin & Marshall College)

Unequal Pay or Violated Expectations? Capuchin Monkey (Cebus apella) Responses to Qualitatively Different Rewards

Brosnan & de Waal (2003) reported that pairs of Brown capuchin monkeys (Cebus apella) responded negatively to an unequal distribution of grape and cucumber rewards between them by a human. They interpreted their findings as evidence for, “an early evolutionary origin of inequity aversion.” Reports in the media further implied that the results showed monkeys have a sense of ‘fairness and justice’. Here, we report within- and between-session incentive contrast effects with grapes and cucumbers in capuchin monkeys. Thus far, our findings are consistent with a less anthropomorphic explanation of Brosnan & de Waal’s (2003) results. Rather than appealing to abstract concepts of inequity and fairness we suggest that a simple ‘violation of expectations” is a more parsimonious account of the animals’ behavior.

Tremblay Joseph Tremblay & William A. Roberts (University of Western Ontario)

The Role of Exploratory Experience in Rats' Formation of Cognitive Maps

One of the more enduring debates in animal cognition has been whether animals are able to form and use cognitive maps. The use of a novel shortcut between two previsouly visited locations can be taken as evidence of the existence of a cognitive map. Chapuis, Durup, and Thinus-Blanc (1987) found that when golden hamsters were exposed to a path connecting two previously visited subspaces they chose a shortcut significantly more often than hamsters not exposed to the connecting path. We report a study in which two groups of rats were exposed to a portion of a cross maze in the first phse. In the second phase, one group was exposed to a "connecting" path. The results allowed us to test the prediction that the group exposed to the connecting path would choose a shortcut more often than the group not exposed to the connectin gpath.

Urcelay Gonzalo P. Urcelay & Ralph R. Miller (SUNY-Binghamton)

Nonadditive effects of overshadowing and degraded contingency

A series of four experiments using rats as subjects investigated the effects of combining two treatments known for their response decrementing effects: overshadowing and degraded contingency. Experiments 1 and 2 demonstrated that subjects that experienced both treatments during training did not show any impairment at the time of testing, in contrast with subjects that experienced either treatment alone. Further studies demonstrated that extinguishing either the context in which training occurred or the overshadowing cue had detrimental effects on responding in subjects that experienced both overshadowing and degraded contingency treatments. However, extinction of the training context produced a recovery from simple degraded contingency and extinction of the overshadowing cue produced a recovery from simple overshadowing. The present results are problematic for current associative theories of learning, but are consistent with recent data showing that the basic principles of conditioning differ for cues trained together and cues trained apart.

Verbeek Eric L. Verbeek, Marcia L. Spetch (University of Alberta), Ken Cheng (Macquarie University), & Colin W.G. Clifford (University of Sydney)

Range Effects in Face Recognition: Complex Stimuli or Complex Dimensions?

The effects of test stimulus range on generalization gradients were assessed for discriminations between morphed faces (Experiment 1), or between faces that varied in brightness (Experiment 2) or orientation (Experiment 3). Consistent with a previous study, the range of stimuli presented in testing did not affect the generalization gradients

for the discrimination of morphed faces. However, a significant range effect in the direction predicted by adaptation level theory occurred when faces varied along the brightness or orientation dimension. These results suggest that resistance to range effects is due to the complex dimension produced by morphing rather than to the complex nature of face stimuli.

Vlasak Anna N. Vlasak (University of Pennsylvania)

The Relative Importance of Global and Local Landmarks in Navigation by Columbian Ground Squirrels (Spermophilus columbianus)

For efficient orientation animals can use environmental features that serve as landmarks on local or global scales. Although landmark-based navigation has been explored in many species, animals that have to remember locations of many burrows for successful survival have received little attention. I investigated landmark use by free-ranging Columbian ground squirrels (Spermophilus columbianus), burrowing mammals. Experiments tested squirrel's ability to locate burrows during escape when local or global landmarks were obstructed. Results suggest that squirrels rely on both local and global features of the environment for successful navigation. The lack of information from one type of landmarks (local or global) cannot be completely compensated by the other type. In addition, partial obstruction of global landmarks reveals that squirrel attend preferentially to the upper portion of the horizon, which potentially shows the most prominent and reliable features of the environment.

Werner Daniel C. Werner, Amanda R. Willey, Amanda C. Alexander, and James D. Rowan (Bridgewater College)

The effects of MK-801 on phrasing in rat serial-pattern learning in rats

One explanation used to explain the rats' deficits in learning of serial patterns is that MK-801 blocks the animals' ability to utilize the temporal phrasing cues used to parse the patterns. Thus, this experiment examines the effects of MK-801 on phrasing. Rats were assigned to one of three phrasing groups. The pattern was phrased for the separate groups by inserting a 3-sec pause (at all other locations there was only 1-sec between elements). In the Good Phrasing group, the 3-sec pauses were placed at the boundaries of the chunks determined by the formal structure of the pattern. In the Bad Phrasing group, the phrasing cues were placed in the middle of chunks. The No Phrasing received the pattern with no 3-sec phrasing. Overall, MK-801 impaired learning but the shape of the error profiles were similar, indicating that the effect by the drug is not due to the inability to utilize phrasing cues.

Willey Amanda R. Willey, James D. Rowan (Bridgewater College), and Stephen B. Fountain (Kent State Universtiy)

The role of correction in double alternation learning in rats

Traditionally, rats have shown great difficulty in learning a double alternation pattern. Recent experiments using a procedure originally developed to examine serial–pattern learning in rats failed to replicate this difficulty. One difference between this procedure and the traditional procedures is that the serial-pattern learning task uses a correction procedure. The goal of this experiment is to examine the importance of correction in the learning of double alternation patterns. In this experiment, rats were divided into two groups. Both groups were required a 24 element double alternation pattern in an octagonal operant chamber. Rats in one group were required to make the correct response (and received reinforcement) before progressing to the next trial while rats in the other group progressed to the next trial after any response and only received reinforcement for correct responses. The results support the hypothesis that correction dramatically improves acquisition.

Wilson Patricia A. Wilson, Janet Metcalfe & Herbert S. Terrace (Columbia University & NYPI)

Transforming Humans into Monkeys: A Memory Experiment

Two rhesus monkeys performed a Serial List Recognition (SLR) task in which 4 arbitrary photographs were presented successively and then presented along with 6-8 arbitrary distractors. Subjects were reinforced for selecting all items from the list, regardless of presentation order, without selecting distractors. A strong recency effect was obtained but no primacy effect. Human subjects that performed the same task showed both primacy and recency effects. When the arbitrary photographs were changed to black and white fractals that are more difficult to discriminate, the accuracy of human subjects decreased and output order began to mirror that of monkeys. An experiment in progress that decreases subjects' reaction time (to match that of the monkeys) is expected to result in monkey-like performance with respect to output order and recency effects.