

SQAB 2009 at a Glance



Thursday Evening, May 21
Sheraton Phoenix Downtown: Valley of the Sun Ballroom

5:00- 8:00 Registration, 1st Poster Session / Cash Bar

8:00- 9:00 “Drilling the Stars”: an academic discussion organized by the SQAB Student Council: Everyone’s welcome!

Friday Morning, May 22
Valley of the Sun Ballroom

7:15 *Registration, Coffee and Pastries*
8:25 Randolph Grace
 (President’s Introduction)

8:45 Mark E. Bouton
9:20 Mika L. M. MacInnis

9:55 *Coffee Break (20 min)*

10:15 Douglas Elliffe & Michael Davison
10:50 Greg Jensen & Allen Neuringer
11:25 J. Mark Cleaveland

12:00 - 1:45 *Lunch Break*

1:45 Jay Moore
2:20 Federico Sanabria & Jada Hill
2:55 Christopher Podlesnik & Timothy Shahan

3:30 *Coffee Break (20 min)*

3:50 Bruce Curry, Gordon Foxall & Valdimar Sigurdsson
4:25 Steven Hursh & Ralph Spiga
5:00 Ido Erev

5:45 *Business Meeting*

6:30 *2nd Poster Session / Cash Bar*
 until 9:00 pm

Saturday Morning, May 23
Valley of the Sun Ballroom

7:00 *Registration, Coffee and Pastries*

8:30 Ronald Weisman et al.
9:05 K. Geoffrey White & Glenn Brown

9:40 *Coffee Break (15 min)*

9:55 Introduction by John E. R. Staddon

SQAB Keynote Address
 Gerald M. Edelman, M.D., Ph.D.

From Brain Dynamics to Consciousness:
 How Matter Becomes Imagination

11:00 **End of SQAB -Beginning of ABAI**

Saturday Afternoon, May 23
Phoenix Convention Center - North 120D

SQAB Invited Preeminent Tutorials
 From Basics to Contemporary Paradigms

1:00 Timothy A. Shahan - *Conditioned Reinforcement*

2:00 Steven C. Stout - *Cue Competition in Pavlovian Conditioning*

3:00 William C. Baum - *Dynamics of Choice*

4:00 Joel Myerson - *Cognitive Aging: A Behavior Theoretic Approach*

SQAB



Society for the Quantitative Analyses of Behavior
Phoenix



32nd Annual Conference
Sheraton Phoenix Downtown, Phoenix, Arizona
May 21-23, 2009

SQAB

The *Society for the Quantitative Analyses of Behavior*, SQAB, was founded in 1978 by J. A. Nevin and M. L. Commons to present symposia and publish material which bring a quantitative analysis to bear on the understanding of behavior. This can be defined as the development and use of mathematical formulations to characterize one or more dimensions of a data set, derive predictions to be compared with data, and generate novel data analyses. This International Society holds its annual meeting in conjunction with the *Association for Behavior Analysis International*, ABAL.

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Thursday Evening Reception & Poster Session 5:00-8:00 pm	Abstracts for the Thursday evening poster session begin on page 14.
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8:00-9:00 pm	“Drilling the Stars” - An informal, moderated discussion organized by the SQAB Student Council. Everyone’s welcome!
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Welcome to SQAB 2009!



Friday Morning:

7:15-8:25 Registration, Coffee and Pastries

8:25-8:40 Welcome to **SQAB 2009**: President’s Introduction

Randolph C. Grace
University of Canterbury (New Zealand)

8:40-8:45 Remembering John Falk

Peter Killeen
Arizona State University (USA)

8:45-9:20 Toward an Associative Analysis of Temporal Learning

Mark E. Bouton

University of Vermont (USA)

We have discovered two asymmetries in how rats use temporal intervals to predict whether or not a Pavlovian signal will be paired with food. First, when rats are given either long or short intervals between successive extinction trials, extinction with long intervals generalizes to a short retention interval, but extinction with short intervals does not generalize to long. Second, when a long intertrial interval predicts that the next signal will be reinforced, and a shorter interval signals that it will not be reinforced, rats learn this “long+/short-” discrimination rapidly. But when the short interval predicts that the signal will be reinforced and the long interval predicts that it will not (“short+/long-”), the discrimination is learned very slowly. The passage of time can be conceptualized as a series of hypothetical

elements, such that a short interval involves exposure to one element, A, and a longer interval involves exposure to two stimuli, A then B. To test and extend this view, we have run parallel experiments in which explicit conditional stimuli (CSs), rather than temporal interval, played the role of A and B. These experiments produced the same asymmetries, whether A and B were presented simultaneously or sequentially. Thus, AB+/A- discrimination learning occurs more rapidly than A+/AB- (a feature-positive effect), just as long+/short- is faster than short+/long-. And even more interestingly, extinction with AB- generalizes more to A than extinction with A- generalizes to AB, just as extinction with a long ITI generalizes more to a short retention interval than a short ITI generalizes to long. The results are consistent with the temporal element view of timing, and provide new challenges for timing and associative learning models.

9:20-9:55 A 100-Year-Old Confound: A Reexamination of Classical and Instrumental Conditioning

Mika L. M. MacInnis

Brown University (USA)

Almost 100 years ago Thorndike observed that if a response was followed by something pleasant, the likelihood of that response occurring again would increase. About the same time, Pavlov documented his observation that if you paired a neutral stimulus with a reinforcer like food, the stimulus would come to elicit the same response the food did. In the years following, psychologists focused on the differences between these two types of procedures: instrumental conditioning, a response-contingent procedure in which a response-reinforcer association is learned, and classical conditioning, a

procedure with no response contingency, in which a stimulus-reinforcer association is learned. The general consensus was that response contingent procedures produce higher response rates. However, recent data suggests that response contingency alone is not enough to produce a difference in performance. We looked at the behavior of rats on a range of procedures that varied in response contingency, response type, and number of stimulus cues. When cues to the rats are equated across procedures, behavior is similar, regardless of response contingency.



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9:55-10:15

Break - Refreshments

10:15-10:50

Four-Alternative Choice

Douglas Elliffe & Michael Davison
The University of Auckland (New Zealand)

Six pigeons responded on a four-key concurrent variable-interval schedule. The ratio of reinforcer rates on the keys was always 27:9:3:1, but the allocation of these reinforcer rates to the four keys changed every ten reinforcers. The proportion of responses on each key quickly came under the control of the reinforcer rate on each key. Choice between different pairs of keys arranging the same reinforcer ratio was not constant, but became more extreme

with increasing overall reinforcer rate, suggesting that the constant-ratio rule does not hold. Differential preference pulses quickly developed on at least the three keys arranging higher reinforcer rates. The probability of switching between pairs of keys was graded and apparently controlled by the reinforcer rates on each key. In this complicated procedure, the degree of control over behavior and the speed with which it was acquired surprised us.

10:50 - 11:25

Extending Generalized Matching

Greg Jensen & Allen Neuringer
Reed College (USA)

When the consequences of individual choices cannot be predicted, as under concurrent schedules of reinforcement, choice distributions are often described by power-function relationships to reinforcers (e.g., W. M. Baum); and/or by exploitative strategies to obtain or maximize reinforcers (e.g., C. P. Shimp); and/or by variable or stochastic response emission (e.g., J. A. Nevin). We extended the study of choice when outcomes were uncertain. In one study with pigeons, we varied the probability that a reinforcer, once “set up,” would remain available until collected. As in most natural-world situations, where competitors, storms, and chance might cause a reinforcer to

disappear, potential reinforcers in our study also had some probability of disappearing. In a second study, involving rats choosing among two levers and three keys, we examined the effects of bias. In a third, we required rats’ choices to vary in a stochastic-like manner while reinforcer probabilities were systematically manipulated across the five operanda. Our results support contributions by each of the above-mentioned characteristics – power-function relationships, exploitative strategies, and stochastic generation – to the description and explanation of choices under conditions of uncertainty.

11:25 - 12:00 The Active Time Model of Concurrent Choice

J. Mark Cleaveland
Vassar College (USA)

In this talk I describe the Active Time model (ATM) of concurrent VI VI choice behavior (Cleaveland 1999, 2008). ATM makes three assumptions. First, the model assumes that concurrent choice behavior is sensitive to dynamic changes in reinforcement probability densities. Second, the model assumes that switches and stays are the response classes that accrue reinforcement value. Finally, the model assumes that a response clock determines when an animal responds. These three assumptions are captured by a continuous-time Markov chain with a renewal process.

In a continuous-time Markov chain, the transition probabilities between states are not static, but rather change with the amount of time that the organism resides in a given state. A renewal process is an event that resets a state’s clock. Through data and simulations, I show that ATM unites a range of anomalous data in a single framework. The model accurately produces data that supports momentary maximizing and data that contradicts momentary maximizing; data that contradicts melioration and data that contradicts a version of scalar expectancy theory

12:00 - 1:45 Lunch Break

The SQAB Executive Committee and Board
will meet during lunch

1:45 - 2:20 Some Effects of Procedural Variables on the Dynamics of Operant Choice

Jay Moore
University of Wisconsin-Milwaukee (USA)

This presentation will review data from several studies showing how procedural variables influence the outcome of operant choice experiments. The studies involve the way the subjects receive reinforcement distributed over time in simple concurrent and concurrent chain schedules. Often these studies explain their data using such parameters as overall rate of reinforcement as an independent variable and develop quantitative models using such parameters. An important theoretical issue raised by these data is whether

researchers have correctly identified independent variables that they incorporate into their quantitative models. Assuming that researchers want to maximize the generality of their independent variables and theoretical concepts, it seems important that their conceptions of those independent variables and theoretical concepts not be limited to only particular procedures. The meaning of rate of reinforcement is examined to provide a case history.

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– MARCH 2009 –

Takayuki Tanno, Alan Silberberg, and Takayuki Sakagami. Single-sample discrimination of different schedules’ reinforced interresponse times

Federico Sanabria and Eric Thraillkill. Pigeons (*Columba livia*) approach Nash Equilibrium in experimental matching pennies competitions

Michael E. May and Craig H. Kennedy. Aggression as positive reinforcement in mice under various ratio- and time-based reinforcement schedules

James E. Mazur and Dawn R. Biondi. Delay-amount tradeoffs in choices by pigeons and rats: Hyperbolic versus exponential discounting

Matthew L. Locey and Jesse Dallery. Isolating behavioral mechanisms of inter-temporal choice: Nicotine effects on delay discounting and amount sensitivity

Lanny Fields and Michelle Garruto. Optimizing linked perceptual class formation and transfer of function

– TECHNICAL NOTE –

Berton Slotnick. A simple 2-transistor touch or lick detector circuit

– PERSPECTIVE ON BEHAVIOR –

Timothy D. Hackenberg. Token reinforcement: A review and analysis

– MAY 2009 –

William Buskist. Remembering Peter Harzem: Teacher-scholar extraordinaire

Carlos F. Aparicio and William M. Baum. Dynamics of choice: Relative rate and amount affect local preference at three different time scales

K. M. Banna and M. Christopher Newland. Within-Session Transitions in Choice: A Structural and Quantitative Analysis

Edmund Fantino and Arthur Kennelly. Sharing the wealth: Factors influencing resource allocation in the sharing game

Mihela Erjavec, Victoria E. Lovett and Pauline J. Horne. Do infants show generalized imitation of gestures? II. The effects of skills training and multiple exemplar matching training



Hiroto Okouchi. Response acquisition by humans with delayed reinforcement

– BOOK REVIEW –

Timothy D. Hackenberg. Realism without truth: A review of Giere’s *Science without Laws and Scientific Perspectivism*

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Friday Afternoon	Paper Session	Valley of the Sun Ballroom
<hr/>		
2:20 - 2:55 The Dynamics of Conditioning and Extinction		
<hr/>		
Federico Sanabria & Jade Hill <i>Arizona State University (USA)</i>		
<p>Despite their elegant mathematical form, modern models of learning dynamics are almost always limited to qualitative predictions of speed of acquisition based on training parameters. We aimed at constructing a dynamic learning model that yielded predictions in terms of response rate. We report a series of experiments in which partially reinforced (2.5 – 20%) sign-tracking in rats and pigeons revealed continual shifting in and out of</p>		<p>a response state. Out of the response state, no responding was observed; in the response state, response rate was Weibull-distributed. A dynamic analysis identified the relative contribution of historical responding and historical feeding to current responding. We discuss the effects on learning dynamics of ITI and CS duration, CS localization, reinforcement probability, and housing conditions, along with informative differences across species.</p>
<hr/>		
2:55 - 3:30 Extinction, Relapse, and Behavioral Momentum		
<hr/>		
Christopher A. Podlesnik & Timothy A. Shahan <i>University of Michigan & Utah State University (USA)</i>		
<p>According to behavioral momentum theory, resistance of operant behavior to disruption is positively related to the rate of reinforcement across stimulus contexts. The present series of experiments examined whether relapse of extinguished operant responding also is modulated by reinforcement rate. Different rates of food reinforcement were presented across components of a multiple schedule. Relative resistance to extinction was greater in components presenting higher reinforcement</p>		<p>rates. Following extinction, relapse of operant responding under conditions of food priming, reinstatement, resurgence, and context renewal was relatively greater in components associated with higher reinforcement rates. These findings suggest that behavioral momentum theory may provide a useful framework for understanding how reinforcement context affects both relative resistance to disruption and relapse of operant behavior.</p>
<hr/>		
3:30 - 3:50 Break - Refreshments		
<hr/>		

3:50 - 4:25 The Tautology of the Matching Law in Consumer Behavior Analysis

Bruce Curry, Gordon Foxall, & Valdimar Sigurrdsson
Cardiff University & Reykjavik University (U.K. and Iceland)

Although matching analysis has been successfully employed in behavior analytical research for decades it has always attracted criticisms that it is formally tautological and hence empirically unfalsifiable. These charges have not gone unanswered, but the possibility that matching is tautological and unfalsifiable still hangs over applied research which promises to extend behavior analysis into new areas of investigation. One such case is research on consumer choice where application of matching in natural consumer settings is allied with the necessity of inferring a ratio schedule relationship between amount purchased and amount spent. This gives rise to the argument that the inferred relationship is an artifact of the way in which the alleged independent and dependent variables have been defined and measured. The paper examines this charge and demonstrates that the amount matching law, in this applied setting, would only be tautological in extreme circumstance. For amount matching in the analysis of consumer behavior we demonstrate formally the existence

and structure of an error term in the matching function. The error term arises in fact because of aggregation: In particular this is through aggregation over brands. Even without an error term, however, a tautological relation for amount matching would still be useful as a diagnostic tool for the identification of substitutability, complementarity and independence of alternative commodities because it provides a test for under- and over-matching as well as for matching and anti-matching. Cost matching is a viable alternative to amount matching. It is not tautological except in so far as there is a risk of a tautology in the matching law in general, and we argue that this is not the case. Nevertheless, we suggest that for matching in general there are still statistical issues to be resolved. One such issue concerns the precise functional form to be used. Our theoretical analysis suggests for example that the matching function may not have constant parameters over the whole data set. In general, the fact that there are doubts about the functional form itself implies the absence of a tautology.

4:25 - 5:00 Exponential Demand and Cross-Price Demand Interactions: Extensions for Multiple Reinforcers

Steven R. Hursh & Ralph Spiga
Institutes for Behavior Resources & Johns Hopkins University (USA)

A fundamental tenant of behavior analysis is that operant behavior is strengthened by its consequences and that the strength of a reinforcer determines the strength of the behavior it supports. Behavioral economics provides a framework for understanding and measuring reinforcer strength. Reinforcer consumption is measured as a function of the requirements to obtain the reinforcer (price), a relationship called the demand curve. An exponential equation models demand curves and the rate constant of the exponential scales the strength or essential value of

a reinforcer. Essential value can be used to assess abuse liability of drugs. Progressive changes in essential value with increasing reinforcer experience may be the defining property of drug addiction. The exponential demand model has now been extended to account for interactions between concurrently available commodities and cross—price changes in consumption. Ratios of demand curves equate to the sums of exponentials, providing a general economic model of choice.

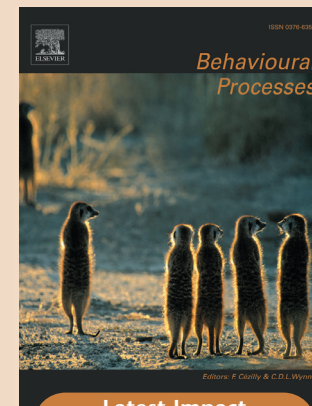
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Friday Afternoon

Paper Session

Valley of the Sun Ballroom

5:00 - 5:35

Learning and Decisions from Experience

Ido Erev

Technion (Israel)

The paper reviews the recent study of decisions from experience. The results highlight five robust deviations from maximization. Decision makers tend to (1) underweight rare events; (2) explore too much when the number of alternatives is small (exhibit the payoff variability effect); (3) explore too little when the number of alternatives is large (converges to local maximum); (4) exhibit the hot stove effect (prefer the safer options when the feedback is limited to the obtained payoff); and (5) overreact to attractive forgone payoffs. The main results can be captured with models that assume best reply to small

samples of experiences. Examination of relationship of decisions from experience to decisions from description (as summarized by Kahneman and Tversky, 1979) highlights two surprising observations. First, decision makers deviate from linear weighting in the opposite direction in the two tasks; they overweight rare events in decisions from description (exhibit the certainty effect, and tend to buy insurance and lotteries), and underweight rare events in decisions from experience (exhibit the reversed certainty effect, and behave as if “it wont happen to me). Second, there are no evident for “pure” loss aversion in neither task. In violation of the common belief, direct tests of the assertion that “losses loom larger than gains” reject this hypothesis.

5:45-6:30

Business Meeting - All **SQAB** members are welcome

6:30-9:00

2nd Poster Session/Cash Bar

Abstracts for the Friday evening poster session begin on page 25 of this program booklet.

The SQAB Student Council will meet for dinner after the Friday poster session.

SQAB thanks the Association for Behavior Analysis (ABA) International for generous support that helped to make this meeting possible, and encourages SQAB participants to take advantage of the ABA convention that begins immediately following the SQAB program. The ABA program includes many presentations on experimental and applied behavior science. A separate registration fee and badge are required to attend the ABA meeting.

- 9 -

7:15-8:30

Registration, Coffee, Pastries

8:30 - 9:05

A Quantitative Analysis of Absolute Pitch in Birds

Ronald Weisman, Douglas Mewhort, Laurie Bloomfield, & Christopher Sturdy
Queen’s University & University of Alberta (Canada)

Absolute pitch perception (AP) refers to the ability to identify, classify, and memorize pitches without use of an external reference pitch. The acoustic frequency ranges in birdsongs and human speech are known to provide important AP cues for recognition. Here, in operant discrimination tests of AP, we trained several avian species to sort contiguous tones into eight frequency ranges, based on correlations between responding to tones in each frequency range and reinforcement. Songbirds: three species

of chickadees, white-throated sparrows, and zebra finches, and also a parrot species, budgerigars had accurate AP in the frequency-range task. Pigeons (a species that does not learn its calls) also discriminated shifts from reinforcement to nonreinforcement from frequency range to range across all 8 ranges. In some species, discrimination was noticeably less accurate in the higher frequency ranges. Using connectionist models of the avian tonotopic map, we obtained reasonable fits to the results across species.

9:05 - 9:40

A Reinforcement-Context Model for Remembering

K. Geoffrey White & Glenn Brown
University of Otago (New Zealand)

The model for remembering proposed by White and Wixted (1999) is based on trial by trial determination of choice by the ratio of reinforcers previously obtained given a particular stimulus value. In order to predict the effects of overall reinforcer probability and magnitude on delayed matching-to-sample performance, Brown and White (2009) added a reinforcement context term to the model, giving the model three parameters, representing

stimulus disparity, distribution variance, and reinforcement for extraneous behavior. The present paper explores further predictions from the model. A broader question is whether short-term memory phenomena typically described in terms of cognitive mechanisms can be explained in terms of the effects of task reinforcers and extraneous reinforcers for other behaviors

9:40 - 9:55

Break - Refreshments

DVD and Videotape ORDER FORM	
Quantity:	
_____	M. Jackson Marr
_____	What Good is Mathematics in Behavior Analysis (2004)
_____	James E. Mazur
_____	Choice and the Hyperbolic Decay of Reinforcer Strength (2004)
_____	Jack J. McDowell
_____	Fitting Equations to Data (2004)
_____	Mining Wolfram’s “A New Kind of Science” (2008) pending
_____	Joel Myerson
_____	Cognitive Aging: A Behavior Theoretic Approach (2009) pending
_____	Allen Neuringer
_____	Variability of the Operant (2002)
_____	M. Christopher Newland & Wendy Donlin
_____	Applied Modeling and the Identification of Behavioral Mechanisms of Action (2006)
_____	John A. Nevin
_____	Behavioral Momentum (1998)
_____	Michael Perone
_____	Behavioral Variability: Control, Description, and Analysis (2004)
_____	Howard Rachlin
_____	Matching (1996)
_____	Alliston K. Reid
_____	Understanding Response Sequences (2003)
_____	Timothy Shahan
_____	Conditioned Reinforcement (2009) pending
_____	Charles P. Shimp
_____	Explicit Methods and Implicit Human Value in Quantitative Behavioral Models (2006)
_____	Murray Sidman
_____	The Scientist/Practitioner in Behavior Analysis: A Case Study (1998)
_____	John E. R. Staddon
_____	Dynamics (1996)
_____	Behavior Analysis Since 1960 (2008) pending
_____	Steven Stout
_____	Cue Competition in Pavlovian Conditioning (2009) pending
_____	William Timberlake
_____	Behavior Systems (2001)

DVD and Videotape ORDER FORM	
Quantity:	
_____	Gregory Galbicka Response Shaping and Percentile Schedules – or “How I Stopped Worrying and Learned to Love Rank Orders” (2005)
_____	C. R. Gallistel Hierarchical Organization of Behavior (2008) pending
_____	Randolph Grace Quantification Part 1 (2001)
_____	Quantification Part 2 (2002)
_____	Choice and Value (2005)
_____	Introductory Series on Quantitative Analysis of Behavior (2007)
_____	Leonard Green The Discounting Function (2001)
_____	Gene M. Heyman The Matching Law (1997)
_____	Jennifer Higa Timing (2000)
_____	Philip N. Hineline Aversive Events and Behavior (1997)
_____	Steven R. Hursh Behavioral Economics (1998)
_____	Alex Kacelnik Facts and Theories I Decision Making: <i>Sturnus vulgaris</i> vs. Benjamin Franklin (2008) pending
_____	Peter Killeen Timing (Parsing Sagely Rosemary’s Time) (1999)
_____	Analyses of Response Times, IRTs, Rts, and ts (2003)
_____	The Law of Affect (2007)
_____	The St. Petersburg Paradox at 300: Roots, Ramifications and Resolutions (2007)
_____	Geoffrey R. Loftus Hypothesis Testing: Curse or Abomination? (2002)
_____	James S. MacDonall Getting Started in Quantitative Analyses of Behavior (2007)
_____	Armando Machado Probability: Basic Ideas, Techniques, and Applications (2003)
_____	John C. Malone Radical Behaviorism in the History of Psychology (2000)
_____	Radical Behaviorism is All Around Us (2000)

Saturday Morning	SQAB Keynote Address	Valley of the Sun Ballroom
<hr/>		
9:55 am	SQAB 2009 Keynote Address	
	Introduction by John E. R. Staddon <i>Duke University</i>	
	From Brain Dynamics to Consciousness: How Matter Becomes Imagination	
	Gerald M. Edelman, M.D., Ph.D.	
	<i>The Neurosciences Institute</i>	
	<p>Prevalent views of higher brain functions are based on the notions of computation and information processing. These views suggest that the brain is a Turing machine. Various lines of evidence appear to be incompatible with this position and suggest instead that the brain operates according to a set of selectional principles. A theory addressing these principles, called Neural Darwinism, will be discussed. Neural Darwinism has a direct bearing on the search for neural correlates of consciousness. Most approaches to the understanding of consciousness are concerned with the contributions of specific brain areas or groups of neurons. By contrast, I will consider what kinds of neural processes can account for key properties of conscious experience such as its unity and its diversity, and I will present supporting evidence on the neural correlates of consciousness obtained from MEG studies of human subjects.</p>	
11:00	SQAB 2009 Closing Remarks	
	Randolph C. Grace <i>University of Canterbury (New Zealand)</i>	

The **SQAB** Preeminent Tutorials will be held in the Phoenix Convention Center: North 120D

The Society is committed to simplifying the transition to quantitative analyses for both researchers and students. To this end, the Society sponsors a set of tutorials, *From Basic to Contemporary Paradigms*, given by preeminent researchers/teachers in the field. Inexpensive videotapes and DVDs of these tutorials for classroom use are available (see pages 37-40).



1:00-1:50 Conditioned Reinforcement

Timothy A. Shahan
Utah State University (USA)

Introduction: Marc N. Branch
University of Florida (USA)

The notion that stimuli associated with primary reinforcers may themselves come to function as reinforcers has served a central role in the analysis of behavior and its applications outside the laboratory. However, a long history of research has raised the possibility that stimuli associated with primary reinforcers may have their effects by some other means. This tutorial will provide an overview of the concept of conditioned reinforcement, review the role of conditioned reinforcement in quantitative theories of choice, and discuss remaining questions about how putative conditioned reinforcers have their effects.

2:00-2:50 Cue Competition in Pavlovian Conditioning

Steven C. Stout
Jacksonville State University (USA)

Introduction: William L. Palya
Jacksonville State University (USA)

BACB CE Offered. CE Instructor: Steven C. Stout, Ph.D

In recent decades researchers in the field of Pavlovian conditioning have focused on how conditioned responding to a target conditioned stimulus (CS) is affected by the presence of nontarget CSs. A common observation is that target and nontarget CSs compete for control over conditioned responding in the sense that their response potentials are inversely correlated. In the three and a half decades since the theoretical model of Rescorla and Wagner inspired a wealth of research into cue competition, investigators have uncovered a number of interesting empirical regularities. Unfortunately, the dissemination of these regularities to a wider community outside associative learning circles has been obscured by the tendency of Pavlovian investigators to discuss their research in a heavily theory-laden language. The purpose of this tutorial is to introduce undergraduates to the field of cue competition who have been otherwise put off by constructs such as positive and negative associations, memorial representations, and comparator processes. In particular, I will consider what happens to conditioned responding when nontarget CSs are presented before, interspersed among, or after the target CS-US pairings, and whether those nontarget CSs are discrete or contextual. Conditions under which cue competition, or its opposite, cue facilitation, are observed will be discussed.

Society for the Quantitative Analyses of Behavior
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Each DVD or videotape is \$8.00 (\$5.00 if you order any 20 or more titles)
Shipping is the actual shipping cost plus \$3.00 for handling.

Quantity:

Paul Andronis

Evolution (1999)

Peter Balsam

Pavlovian Conditioning (2000)

Associators, Accumulators, and Cartographers (2000)

Time, Uncertainty, and Anticipation (2007)

William M. Baum

Choice (1998)

Dynamics of Choice (2009) pending

Marc Branch

Behavioral Pharmacology (2000)

Gordon Burghardt

Evolution, Behavioral Variation, and Plasticity (2000)

José E. Burgos

Neural-Network Modeling in Conditioning Research (2006)

A. Charles Catania

Creating Artificial Behavior: A Tutorial on Modeling (2006)

Daniel Cerutti

Temporal Regulation of Choice (2005)

Russell Church

Simulation of Quantitative Models of Behavior (2005)

Robert Cook

Stimulus Control (2007)

Michael Davison

What Reinforcers Do to Behaviour (2001)

John Donahoe

Neural Networks (1999)

Edmund J. Fantino

Delay Reduction (1997)

3:00-3:50 Dynamics of Choice

William M. Baum
University of California, Davis (USA)

Introduction: Michael Davison
University of Auckland (NZ)

This tutorial examines the centrality of choice to the understanding of behavior. By reexamining the concept of reinforcement and relating it to behavioral allocation, the dynamics of choice may be seen as the process of shifting allocation. Skinner’s assertion that the law of effect is not a theory was correct, even if his theory of reinforcement was incorrect. Research of the last forty years suggests that the events called “reinforcers” affect behavior in two ways: induction and contingency. Reinforcers induce activities related to them by life history or phylogeny, and reinforcers add value to the situations in which they occur. By linking particular activities with particular results, contingencies both constrain behavior change and add value to those activities. Seen this way, the dynamics of choice may be construed as optimization, a tendency to move toward the highest value possible. These dynamics may be seen sometimes on a short time scale and sometimes on a longer time scale. Some recent research by Davison and Aparicio and myself, as well as some earlier experiments, support these ideas.

4:00-4:50 Cognitive Aging: A Behavior Theoretic Approach

Joel Myerson
Washington University, St. Louis (USA)

Introduction: Celia Wolk Gershenson
University of Minnesota (USA)

BACB CE Offered. CE Instructor: Joel Myerson, Ph.D

As people get older, their behavior on many different kinds of tasks tends to become slower, less accurate, and more variable. I will describe a theoretical framework that focuses purely on the behavior emitted by younger and older adults performing response-time and memory span tasks. Our findings support some distinctions in the cognitive psychology literature but not others, and our approach provides empirical bases for deciding which distinctions need to be made and which do not. For example, data on age-related behavioral slowing support the distinction between verbal and visuospatial processing, with the latter being much more sensitive to the effects of age. Within the verbal and visuospatial domains, however, there is little support for distinguishing between different kinds of information-processing operations, at least from an aging perspective. Similarly, data on age-related declines in working memory are also consistent with greater effects of age on memory for visuospatial information, but within each domain performance on simple span tasks declines as rapidly as performance on complex span tasks. Finally, the increased variability in older adults’ performance turns out to be an indirect consequence of the fact that they are slower, and not a direct effect of aging at all.

I would like to express the Society’s appreciation to each of the presenters, our advertisers, and to the following journals and societies:

Behavioural Processes
The Society for the Advancement of Behavior Analysis
Journal of the Experimental Analysis of Behavior
Journal of Applied Behavior Analysis
The Comparative Cognition Society
The Association for Behavior Analysis International

The Psychonomic Society

Alliston Reid
(SQAB Program Chair)

Testing a model of delayed matching to sample

John A. Nevin, Timothy A. Shahan, Amy L. Odum, & Ryan D. Ward
University of New Hampshire, Utah State University, & Columbia University (USA)

The effects of reinforcer probability on steady-state forgetting functions in delayed matching to sample (DMTS) are similar in two related procedures. In one, reinforcer probabilities are consistent for a series of trials within multiple-schedule components; in the other, reinforcer probabilities vary from trial to trial and are signaled within trials. A model of DMTS performance (Nevin, Davison, Odum, & Shahan, 2007) predicts that the effects of various disruptors differ between paradigms. Specifically, operations that disrupt attending to the sample should reduce accuracy less in the high- than in the low-probability component in multiple schedules, but should have similar effects in high- and low-probability signaled trials. Conversely, operations that disrupt attending to the comparisons should have similar effects in high- and low-probability multiple schedule components but should reduce accuracy less on high- than in low-probability signaled trials. These predictions were tested by training five pigeons on each procedure until stable forgetting functions were obtained. In baseline, the levels of forgetting functions were directly related to reinforcer probabilities, and the differences between forgetting functions for high and low reinforcer probabilities were nearly identical across paradigms. When DMTS performances were disrupted by presenting novel distractors during the samples or the comparisons, by prefeeding, or by extinction, decreases in accuracy depended on the paradigm as predicted by the model.

The effect of extended access to *d*-amphetamine self-administration on impulsive choice in a delay discounting task in rat

Gipson, C. D. & Bardo, M. T.
University of Kentucky (USA)

Impulsive choice, or preference for immediate over delayed gratification, has been indicated in stimulant abuse. *D*-amphetamine is a widely prescribed ADHD medication, but little is known about its effects on impulsive choice when use becomes dysregulated. We examined the effects of long and short access to *d*-amphetamine on a delay discounting task, in which rats chose between a smaller sooner reward (one sucrose pellet immediately) and a larger later reward (three sucrose pellets after an adjusting delay). Preference for the immediate smaller reward was considered more impulsive, whereas preference for the larger, delayed reward was considered more self-controlled. Following choice stability in delay discounting, all rats received 15 1-hr sessions of *d*-amphetamine self-administration (0.1 or 0.03 mg/kg/infusion); self-administration sessions began 45 min after each delay discounting session. Rats were then either maintained on the short access (ShA) self-administration session or were switched to a long access (LgA) 6-hr session for 21 days. Rats in the LgA groups at both unit doses showed decreased mean adjusted delays (sec) during the 21-day escalation period compared to the ShA groups, indicating that long access to *d*-amphetamine increases impulsive choice. Following completion of the 21-day escalation period, all rats received a 7 day withdrawal period. LgA groups returned back to baseline mean adjusted delays, indicating the effect on impulsivity was reversible. LgA rats in the 0.03 mg/kg dose escalated in total number of infusions across the 21-day escalation period. These results show that extended use of *d*-amphetamine produces a transient loss of inhibitory control, which may play a role in the dysregulated escalating pattern of drug intake that characterizes the process of addiction.

Responding by *Betta splendens* under CRF and FR with no explicit response location or response feedback stimuli

Thais Sales & Joseph J. Pear
University of Manitoba (Canada)

For contacting a virtual cylinder located near the centre of the experimental tank, three Siamese fighting fish (*Betta splendens*) received food reinforcement on CRF and FR schedules. Ten times per second a tracking system recorded in three dimensions the location of the fish in the experimental tank. Despite no explicit stimulus associated with the location of target responses and no feedback stimulus for responses not followed by a reinforcer during FR, responding was conditioned and maintained. During baseline sessions, prior to conditioning, swimming was predominantly along the walls of the experimental tank. CRF and FR were associated with the concentration of swimming pattern between the target response location and the feeder. Results indicate that responding may be conditioned and maintained on CRF and FR schedules when there is no explicit stimulus associated with the target response location and not all responses are followed by a feedback stimulus.

Response allocation and relative terminal-link immediacy in three-alternative concurrent chains

Andrew D. Hucks, Anthony P. McLean & Randolph C. Grace
University of Canterbury (New Zealand)

Four pigeons responded in a three-alternative concurrent-chains procedure in which the initial link was a VI 15 s schedule that arranged equal access to the terminal links. Across two conditions, the average terminal-link duration was constant (20 s) while the range of values varied. Specifically, in Condition A the terminal links were FI 3 s FI 12 s and FI 45 s, while in Condition B they were FI 24 s FI 12 s FI 24 s. According to the contextual choice model (CCM; Grace, 1994), sensitivity of initial-link response allocation to relative terminal-link immediacy should be constant in the two conditions. However, for all pigeons, response allocation was more sensitive to relative immediacy in Condition B. This result implies that the relationship between response allocation and relative immediacy is nonlinear over the range of values studied. A recently-proposed decision model for concurrent chains (Christensen & Grace, 2008) predicted this result, whereas current models for choice including CCM and Mazur’s (2001) hyperbolic value-added model did not.

Methamphetamine and timing: Effects of baseline training length

Robert N. Johnson, Ryan D. Ward, & Amy L. Odum
Utah State University & Columbia University

The length of baseline training influences how methamphetamine administration disrupts temporal performance under the peak interval schedule. Acute methamphetamine produces overestimation of time following relatively brief training. Following extended training, methamphetamine produces more general loss of stimulus control. The current study extends the study of training length on the effects of methamphetamine administration to performance in an interval bisection procedure. Eight pigeons responded on a symbolic matching to sample task in which relatively short or long sample durations were followed by choice of left or right keys to receive food. One group of four pigeons received baseline training that was short (60 sessions), while another group received long (180 sessions) baseline training prior to methamphetamine administration. Methamphetamine produced generalized reductions in stimulus control that was more pronounced in the short training group. There was no evidence, however, of overestimation of time in either group.

Environmental enrichment increases self-control in spontaneously hypertensive rats

Dennis J. Hand & Mark P. Reilly
Central Michigan University (USA)

Variables outside of the experimental context, such as housing conditions and feeding regimen, can impact behavior within the experiment. The present study sought to investigate the effects of one of those variables, enriched housing, on self-control. Spontaneously hypertensive rats chose between one immediate pellet and three pellets following a delay which increased within each session (0, 5, 10 & 20 s). Rats were initially housed individually in wire cages (impoverished condition) and then housed communally with manipulable objects that were rotated daily (enriched condition). Choices for the large alternative decreased hyperbolically across delays, but did so to a lesser extent during the enriched housing arrangement. The increase in self-control following enriched housing replicates previous research and extends the findings by showing the effect within-subjects and for a strain of rats known for its high degree of impulsivity.

Preference pulses: During extinction?

Michelle Banicevich, Michael Davison, & Douglas Elliffe
The University of Auckland (New Zealand)

Preference pulses are short-term and often extreme changes in choice following reinforcement, often towards the just-reinforced alternative in a two-alternative choice procedure. While initially interpreted as a local effect of the last reinforcer location, recent research reported pulses towards the not-just-reinforced alternative when a signalled extinction period was introduced. Inserting an extinction period can change the direction of a preference pulse. When responding is recorded during the extinction period will we still see a preference pulse following reinforcement? If so, will it reflect the just-reinforced alternative or the richer alternative, as responding after extinction does?

Effect of network size on resistance to Pavlovian extinction in artificial neural networks

José M. Sánchez & José E. Burgos
University of Guadalajara – CEIC (Mexico)

Pavlovian extinction is a substantial decrease in the conditioned response (CR) when the conditioned stimulus (CS) ceases to be reinforced. Such decrease is rarely, if ever, immediate. Usually, several unreinforced CS trials are necessary for extinction to occur, a phenomenon known as resistance to extinction. This paper describes simulations of this phenomenon with a neural-network model, using network size as the independent variable. Naïve networks that differed in size were given 150 trials of a forward-delay procedure that promoted a high stable CR, followed by 150 unreinforced CS trials. Resistance to extinction was directly proportional to network size. This result can be explained as a stochastic effect of the random asynchronous update procedure that is used in the simulator.

Effects of the intertrial interval in explicitly-unpaired procedures in artificial neural networks.

Beatriz Robayo & José E. Burgos
University of Guadalajara – CEIC (Mexico)

In explicitly unpaired procedures, the conditioned stimulus (CS) and unconditioned stimulus (US) are temporally distant. In these procedures, the CS becomes more inhibitory with the duration of the ITI. The present paper describes a simulation of this phenomenon in artificial neural networks. Two groups of naïve networks received 70 CS occurrences explicitly unpaired with 70 US occurrences, with a CS-US interval of 30 ts, and an inter-CS and inter-US interval of either 60 or 390 time-steps (ts), followed by an acquisition test with a forward-delay procedure where the CS-US interval was 5 ts and the ITI was 60 ts. In agreement with the evidence, acquisition was slower in the group that first received the explicitly-unpaired procedure with the longer ITI. Logarithmic- and power-based scales of number are compared and discussed.

Effects of CS intensity and number of CS-US pairings on second-order conditioning in artificial neural networks

Juan M. Galeazzi & José E. Burgos
University of Groningen (Netherlands) & University of Guadalajara – CEIC (Mexico)

Second-order conditioning depends on the intensities of the conditioned (CS1, CS2) and unconditioned stimuli (US), and the number of CS1-US and CS2-CS1 pairings. This paper describes simulations of these dependencies in feed-forward partially-connected artificial neural networks. In Simulation 1, second-order conditioning was successfully simulated in a control network that received 300 CS1-US pairings, followed by 300 trials of CS2-CS1 pairings, with maximal CS1, CS2, and US input activations (1.0). Second-order conditioning failed to occur with lower input activations (0.5). In Simulation 2, second-order conditioning failed to occur with the maximal input activations, but 150 CS1-US and CS2-CS1 pairings. These results are consistent with those reported in the literature with animals.

Peak trial performance in reln deficient mice: Does age matter?

Ruth Hurst, Morgan Throckmorton & Rachael Cushing
University of North Carolina Wilmington (USA)

Reln deficiency has been associated with genetically based neural cell migration disorder and psychopathologies in humans. However, behavioral abnormality has not been clearly substantiated in the heterozygote reeler mouse which is haploinsufficient for reln expression. Since coordination of behavior in time is a problem common to a number of human neurodevelopmental psychopathologies, this research is examining reln deficient mice in a series of experiments using a peak trial procedure to determine whether they, too, will show some timing abnormality. Data suggest that mice which are haploinsufficient for reln expression perform differently on peak trials than controls. More specifically, in a cohort of older mice, reln deficient mice showed poorer temporal precision than did normal mice; for a younger cohort of mice, reln deficient mice tended to show poorer temporal accuracy. Possible age effects and future research plans are discussed in light of the current findings as well as the potential implications for the reln mouse model as a behavioral model for genetically-based neurodevelopmental disorder.

Effects of absolute terminal-link duration on response allocation dynamics

Elizabeth Kyonka & Randolph Grace
University of Canterbury (New Zealand)

Four pigeons responded in a concurrent chains/peak procedure in which terminal-link delays changed unpredictably across sessions. Absolute terminal-link duration was either relatively short (left and right delays summed to 15 s) or relatively long (delays summed to 45 s). Multiple-regression analyses showed that pigeons’ initial-link response allocation was determined by immediacy ratios from the current session but not by those from previous sessions. Generalized-matching scatterplots showed that log response ratios fell into two clusters determined by whether the subject preferred the left or right alternative. Comparisons of parameter estimates for 3- 5- and 6-parameter piecewise linear models showed that between-cluster sensitivity to relative immediacy was greater when delays were long than when they were short. However, within-cluster sensitivity was similar across clusters and terminal-link durations. This characterization extends our understanding of the terminal-link effect that response allocation is more extreme with longer delays to choice in transition with a different pair of terminal-link delays in effect each session.

Precise time cues lead to low response rates in rats

Andrew Marshall, Mika L. M. MacInnis, & Russell M. Church
Brown University (USA)

The goal was to determine whether a signal (e.g., a click) at food availability (prime) affected timing behavior in rats. Twenty-four rats were trained on an appetitive lever-press procedure that varied on two dimensions: “shape” of the interval distribution (i.e., fixed-interval 60s or random-interval 60s) and number of signals (i.e., the presence or absence of a click at the time of reinforcer prime). The rats were randomly partitioned into one of four groups (each group had six rats): Fixed-No Signal, Fixed-Signal, Random-No Signal, and Random-Signal. The shape of the interval distribution affected the response pattern. The presence of the signal greatly affected response rate. The rats in the signaled groups showed a mean response rate that was only approximately 5% and 10% of the unsignaled groups for the Fixed and Random conditions respectively. Not only do these results provide support for a simultaneous temporal processing account of timing behavior, they suggest that to make an instrumental procedure produce classical type results, all you have to do is add a click.

Post-reinforcement pausing in a multiple fixed-ratio yoked-interval schedule of reinforcement

Andrew T. Fox & Mark P. Reilly
Central Michigan University (USA)

Fixed-ratio (FR) schedules of reinforcement typically engender a pause-and-run pattern of responding, with pauses occurring immediately after reinforcer delivery. Pause length tends to vary directly with FR size, as does responding that terminates a stimulus associated with the FR contingency, which suggests the possibility that such a stimulus is a conditioned negative reinforcer because of its association with work. Research on pausing in multiple FR schedules has shown that pausing is affected by both the preceding and upcoming ratio size or reinforcer magnitude. Specifically, pausing tends to be longest upon a transition from the most desirable to the least desirable ratio size or reinforcer magnitude. The present study asked whether transitions between strict (FR) and loose (yoked-interval) work requirements would yield a similar effect, providing evidence that work requirements have aversive properties.

Velocity discrimination in pigeons: psychometric function and contrast effects

Andreia Costa, José Bentes, Jorge Santos, & Armando Machado
University of Minho (Portugal)

The goal of the present experiment was twofold: to study the psychometric function for velocity discrimination in pigeons and the effects of background luminosity on that discrimination. In the training phase, two stimuli moved horizontally across a touch-sensitive screen at speeds of 0.2cm/s and 5cm/s. Only responses to the faster stimulus were reinforced. In a subsequent phase, non-reinforced trials were added during which the speed of the slower stimulus was varied systematically. The effect of background luminosity was studied by presenting simultaneously two stimuli moving at different speeds and with distinct contrast levels with respect to the background.

A model of matching-to-sample assuming four-term contingencies of reinforcement and response selection

B. M. Jones

University of Massachusetts Medical School (USA)

This model asserts that matching-to-sample tasks involve conditional discriminations between stimuli in 4-term contingencies of reinforcement. The samples are conditional stimuli that signal which of two conflicting 3-term contingencies (or “signal-detection” tasks) is operating, comparison-stimulus arrays are discriminative stimuli in the 3-term contingencies, and responses are defined in terms of their spatial locations. The common finding that one comparison is chosen more often than the other when samples are associated with different reinforcer rates is viewed here not as response bias but as different comparison-discrimination accuracies after the samples. These different discrimination accuracies are assumed to result from different probabilities of attending to the comparison array whenever the samples can effectively signal different frequencies of prior reinforcement for discriminating comparisons.

Evidence of residual excitation after converting a cocaine excitator into a conditioned inhibitor

Stanley J. Weiss, David N. Kearns & Chesley J. Christensen

American University (USA)

A light signaled that cocaine was not available for barpressing in two groups of rats, but it previously occasioned cocaine self-administration only in the History Group. When the light was presented simultaneously with a tone SD that occasioned drug seeking on a summation test, cocaine seeking was almost totally eliminated in the No-History Group. In comparison, the light reduced drug seeking by only 50% in the History Group. This reveals that the light still contained residual excitation from its drug history even though it was able to essentially eliminate drug seeking on baseline after A+/AB- conditioned inhibition training. The implications these findings have for the treatment of drug abuse are discussed.

On the relation between k and area under the curve as measures of delay discounting

Stephen Pickford & Todd L. McKerchar

Jacksonville State University (USA)

The present analysis examined the relation between two measures of delay discounting, “k” and “area under the curve.” Fifty-six college undergraduates made repeated choices involving hypothetical monetary rewards and losses at two magnitudes (\$1,000 and \$25,000). As expected, we observed the characteristic magnitude and sign effect. Strong negative correlations between k (derived from Mazur, 1987) and area under the curve were observed at all four combinations of magnitude and sign (r = -0.92 to -0.97). However, visual inspection of the corresponding scatterplots revealed that although the relation between k and area under the curve was linear for much of the data (i.e., at mid-range values), the relation between them was nonlinear towards the extremes.

d-Amphetamine decreases the rate of Pavlovian and operant conditioning of rats in a novel continual reconditioning paradigm, but has bitonic effects on behavioral momentum

Joshua Beckmann, Michael Bardo & Peter Killeen

University of Kentucky & Arizona State University

We investigated the dynamics of conditioned lever pressing in an automaintenance task with probabilistic food reinforcement. A linear operator model characterized evolving response probabilities based on momentum, Pavlovian conditioning and operant conditioning. Increases in response probability were mediated primarily by response momentum and operant conditioning; Pavlovian contingencies had influence only when reinforcement probability was low. Decreases in response probability were mediated primarily by momentum of quiescence. Following d-amphetamine pretreatments, response momentum increased at 0.3 mg/kg and decreased at 1.0 mg/kg. The influence of Pavlovian and operant contingencies decreased at both doses. The results indicate that model parameters were differentially sensitive to the effects of d-amphetamine. This paradigm may be useful for investigating responding to drug-associated cues. (Supported by NIH grants P50 DA05312 and R01 DA12964).

Methylphenidate as an i.v. reinforcer for rats: Evidence from progressive ratio schedule and non-contingent administration

Julie A. Marusich & Michael T. Bardo

University of Kentucky (USA)

Methylphenidate (MPH) is the most widely prescribed drug treatment for attention deficit hyperactivity disorder (ADHD). MPH has been found to be a reinforcer for children who are prescribed it, and there are increasing reports of MPH abuse. Little research has examined MPH as an intravenous reinforcer in rats. In experiment 1, eight rats were given access to intravenous MPH (0.56 mg/kg/infusion) on a fixed ratio 5 schedule of reinforcement. Subjects were then switched to non-contingent MPH administration with the number of infusions held constant. The switch from contingent to non-contingent MPH administration produced a drastic decrease in the number of lever presses. This indicated that the direct effects of MPH were not the cause of lever pressing on the active lever, which shows support for MPH as a reinforcer for rats. In experiment 2, ten rats were given access to intravenous MPH (0.3 mg/kg/infusion) on a progressive ratio schedule. Subjects were then given access to a range of doses of MPH (0.056-1.0 mg/kg/infusion) and saline on a progressive ratio schedule. Subjects earned more infusions of each dose of MPH as compared to saline, and had higher breakpoints at each dose of MPH than saline. These data were also supported by a behavioral economics analysis. Data combined from both experiments provide evidence that MPH serves as an intravenous reinforcer for rats.

The effect of the number of paired-stimulus or matching-to-sample trials on the formation of equivalence relations

Jennifer Kinloch, T. Mary Foster, & James McEwan
The University of Waikato, Hamilton (New Zealand)

Participants received matching-to-sample or paired stimulus trials with nonsense syllables before testing for equivalence relations. If the criterion of 90% correct on each symmetry and equivalence relation was not met further training and testing followed. Two sets of participants completed 60 matching-to-sample or paired stimulus trials, and two sets completed 120 matching-to-sample or paired stimulus trials before the first test. The 60-trial condition continued for 8 blocks of training and testing with no participants meeting the criterion. With 120 trials, 11 participants met the criterion within 2-6 training and testing blocks, and nine participants had not reached it after 8 blocks. It appears that larger blocks of trials before testing, rather than the total number of trials, resulted in more participants reaching criterion for both procedures.

Fluid intelligence across the adult life span:
Contributions of speed, working memory, and learning

Elaine Tamez, Joel Myerson, & Sandra Hale
Washington University in St Louis (USA)

Three-term contingency learning correlates highly with fluid intelligence (Williams & Pearlberg, 2006) and predicts fluid intelligence in younger adults above and beyond working memory ability (Tamez et al., 2008). Age-related differences in adults' fluid intelligence are often thought to reflect age-related declines in speed and working memory, but the role of learning has not been examined. Sixty-five adults (ages 30-80) were tested on measures of learning, processing speed, working memory, and fluid intelligence. Overall, learning ability accounted for 60% of the variance in fluid intelligence. Together, speed, working memory, and learning accounted for all of the age-related differences in fluid intelligence. These results highlight the importance of learning in predicting fluid intelligence in both younger and older adults.

The gambler’s fallacy as foraging: Two tests

J. Mark Cleaveland, Camille Paul, Caitlin Schattman, & Elissa Wolfson
Vassar College (USA)

The gambler’s fallacy is defined as the avoidance of a previously rewarded outcome when all outcomes occur with an equal, unchanging probability. One means of accounting for the gambler’s fallacy is in terms of foraging heuristics. For example, when animals forage within a patch, it makes sense to move to a nearby location after obtaining an item of food. This is because in naturally occurring environments, food items typically require time to replenish after they have been collected. Using a six-choice procedure and human subjects, we tested the replenishment hypothesis. Although our data shows the gambler’s fallacy, it does not lend support to the foraging hypothesis.

The effect of holding reinforcement rate constant on delay discounting of hypothetical and real money

Nicholas Mui Ker Lik, Mark R. Dixon, Leonard Green, & Joel Myerson
Southern Illinois University & Washington University in St. Louis (USA)

We examined the effect of holding reinforcement rate constant on delay discounting of hypothetical and real money when delays are actually experienced. Subjects participated in one of five conditions. In four conditions, subjects actually had to wait for the delayed reward, and in two of these, reinforcement rate was held constant by adding blackout periods after immediate rewards: (1) hypothetical money/blackout; (2) hypothetical money/no blackout; (3) real money/blackout; (4) real money/no blackout. The fifth condition was standard discounting of hypothetical rewards in which delays were not experienced. Typical discounting was observed with the standard procedure and when there were no blackouts following immediate rewards, but not when reinforcement rate was constant. No differences were observed between real and hypothetical money.

Can sensory preconditioning account for the Baldwin effect?

Catarina Vales & Armando Machado
Universidade do Minho (Portugal)

The Baldwin Effect describes the fact that two year-olds can associate a new verbal label with an unnamed object when they are presented separately in time. The original work (Baldwin, 1993) interpreted the effect as an ability to understand referential cues provided by the speaker, and some later work (e.g. Smith, 2006) showed that the place where the object is presented also can be used as a cue. We propose a Sensory Preconditioning account of the Baldwin Effect. As in Sensory Preconditioning, the Baldwin Effect depends on the initial pairing of two stimuli. If the account is correct, then manipulating critical variables in the task such as the number of preconditioning pairings should produce more robust learning. In this poster we present preliminary data to test the hypothesis.

Effects of temporal variables and stimulus presentation on self-controlled eating behavior

Raul Avila, Juan C. Gonzalez, & Hilda Palacios
Universidad Nacional Autónoma de México (Mexico)

Self-controlled eating was studied in three food-deprived pigeons that were exposed to pairs of 3-s food presentations, which could occur within and at the end of a 64-s time cycle, respectively. Trying to eat during the first food presentation interrupted it and cancelled the second food presentation. Otherwise, eating during the second food presentation could occur. In different experimental conditions, the temporal position of the first food presentation and the concurrent presentation of an illuminated key were manipulated. It was found that when food presentations were contiguous, self-controlled eating was facilitated by stimulus presentation and this stimulus effect decreased as the interval between food presentations was lengthened. The implications of this self-control eating procedure for self-control theory are discussed.

Discounting of probabilistic monetary rewards over a wide range of amounts and probabilities

Joshua Morris, Joel Myerson, & Leonard Green
Washington University, St. Louis (USA)

Individuals discount the value of delayed and probabilistic rewards according to a hyperboloid function: $V=A/(1+bX)^S$. With delayed rewards, as amount increases, the value of the rate parameter (b) decreases but the exponent (s) remains constant. The goal of the current study was to determine how increases in amount of probabilistic reward influence these parameters. Subjects discounted 9 probabilistic amounts ranging from \$20 to \$10 million. In contrast to the discounting of delayed rewards, as amount of probabilistic reward increased, s increased but amount had little systematic effect on the value of b. Thus, although the same mathematical function describes both delay and probability discounting, the differential effects of amount argue that the processes underlying probability and delay discounting are different.

A comparison of hyperboloid models of discounting delayed and probabilistic monetary rewards

Todd L. McKerchar, Leonard Green, & Joel Myerson
Jacksonville State University & Washington University, St. Louis (USA)

McKerchar et al. (2009) compared four common delay discounting models and found that both a hyperboloid in which the denominator is raised to a power (Green & Myerson, 2004) and one in which delay is raised to a power (Rachlin, 2006) provided superior fits to the data from undergraduates discounting one delayed amount (\$1,000). The present study extended this comparison to include probability as well as delay discounting at two reward amounts (\$200 and \$25,000). Both hyperboloid models provided excellent fits to the data from 171 undergraduates discounting delayed and probabilistic rewards at both amounts. These findings support Rachlin’s suggestion that when alternative models provide excellent fits, model selection may need to be based on theoretical grounds.

Global and focal search in the radial arm maze

Felipe Cabrera & Roberto P. Maciel
University of Guadalajara (Mexico)

According to a behavior-systems view (Timberlake, 1983) animals searching for food engage diverse activities as the food is approaching. At extended durations from the food organisms enter into a general search mode characterized by locomotion. Otherwise, when food is forthcoming organisms enter into a focal search mode that is characterized by behaviors around the patch. In two experiments we show that in the radial arm maze, with an eight-concurrent fixed interval schedule of reinforcement, different kinds of locomotion were involved at different stages of food delivery. The ‘walking around’ locomotion occurred at early stages since food delivery, and ‘traveling to the goal’ peaked at late stages since food. Results are discussed in terms of the behavior-systems approach.

Choice in multi-alternative environments

Monteiro, T., Vasconcelos, M., Aw, J., & Kacelnik, A.
University of Oxford (UK)

According to functional models of choice, behaviour should maximize expected fitness or some proxy such as the ratio of returns over time. Contrary to most psychological models of choice and the pervasive empirical presence of partial preferences, maximization predicts exclusive choice of the best available option. In this experiment, European starlings trained in a multi-alternative environment faced binary choices between the six possible pairs of options out of four concurrently trained FIs (FI 3, FI 6, FI 12 and FI 24). Most birds exhibited exclusive preferences. We discuss these results in terms of optimality models, the sequential choice model and scalar expectancy theory.

The Sequential Choice Model and risky choice

Aw, J., Vasconcelos, M., Monteiro, T., & Kacelnik, A.
University of Oxford (UK)

According to the Sequential Choice Model (SCM), latencies during single-option trials capture the relative attractiveness of options, with simultaneous choices resulting from cross-censorship between latencies to respond to alternatives. We tested these predictions in a risky choice task, offering European starlings choices between a fixed (F) and a risky option (R). R offered a mixture of two equi-probable delays (D_{RS} and D_{RL}), while F offered a fixed delay (D_F) which varied across treatments from D_{RS} to D_{RL} . Both latencies and choices revealed preferences for risk when $H(D_{RS}, D_{RL}) \leq D_F$, where H denotes the harmonic mean. The predictions of the SCM were supported.

Behavioral momentum of cocaine self-administration: Effects of frequency of reinforcement on resistance to extinction

Stacey L. Quick & Timothy A. Shahan
Utah State University (USA)

Previous research has extended behavioral momentum theory to alcohol self-administration, but not to IV drug self-administration. This experiment extended behavioral momentum theory to cocaine self-administration by examining the effects of frequency of cocaine reinforcement in a context on resistance to extinction. Rats self-administered 0.32 mg/kg infusions of cocaine in a multiple-schedule of reinforcement arranging two distinct contexts. Responding in a Rich context was reinforced by cocaine infusions at a higher frequency (i.e., variable-interval 120 s) and in a Lean context at a lower frequency (variable-interval 360 s). Following establishment of responding in the two contexts, resistance to extinction was examined. Pre-extinction response rates for cocaine were similar in the Rich and Lean contexts. Nonetheless, relative resistance to extinction was greater in the Rich context than in the Lean context. The difference in resistance to extinction in the two contexts was well described by a quantitative model of behavioral momentum. These results suggest that the frequency of drug reinforcement in a context contributes to the persistence of drug seeking in that context, and that behavioral momentum theory might be useful for understanding how drug-associated contexts contribute to the persistence of drug seeking.

The organization of behavior in time

Daniel Hutchison & William Palya
Jacksonville State University (USA)

Many models have been advanced to explain the temporal organization of behavior. None of the current models successfully predict the responding in a clocked interfood interval. Five experiments are presented which examine mechanisms which control responding throughout an IFI. The first three experiments were used to determine if responding could best be explained with partial reinforcement, the IFI, or an S min to S max gradient. A follow up experiment assessed the ability of each stimulus to function as a reinforcer. The final experiment compared predictable and unpredictable delays to food presentation. The results help partition the roles of contingency and contiguity; relative and absolute delays; and unipolar and bipolar models.

Peak trial performance in reln deficient mice: Does age matter?

Ruth Hurst, Morgan Throckmorton, & Rachael Cushing
University of North Carolina Wilmington (USA)

Reln deficiency has been associated with genetically based neural cell migration disorder and psychopathologies in humans. However, behavioral abnormality has not been clearly substantiated in the heterozygote reeler mouse which is haploinsufficient for reln expression. Since coordination of behavior in time is a problem common to a number of human neurodevelopmental psychopathologies, this research is examining reln deficient mice in a series of experiments using a peak trial procedure to determine whether they, too, will show some timing abnormality. Data suggest that mice which are haploinsufficient for reln expression perform differently on peak trials than controls. More specifically, in a cohort of older mice, reln deficient mice showed poorer temporal precision than did normal mice; for a younger cohort of mice, reln deficient mice tended to show poorer temporal accuracy. Possible age effects and future research plans are discussed in light of the current findings as well as the potential implications for the reln mouse model as a behavioral model for genetically-based neurodevelopmental disorder.

Risky choice in spontaneously hypertensive rats

Vladimir Orduña & Ana García
Universidad Nacional Autónoma de México (Mexico)

Spontaneously hypertensive rats (SHR) and Wistar rats were evaluated in the successive encounters procedure (an operant simulation of natural foraging) with the idea of assessing differences between them in risky choice behavior. After satisfying a schedule of reinforcement associated with search time, the subjects could “accept” or “reject” another schedule of reinforcement associated with handling time. Two schedules of reinforcement were available: a fixed interval (FI), and a variable interval (VI) with the same mean value. The results indicated risk preference in both strains, suggested by the observation of the VI always being accepted while the FI was often rejected. The difference in FI acceptability by both strains was not statistically significant, a result which is of relevance for the current debate of SHR as an adequate animal model of Attention Deficit Hyperactivity Disorder.

Development of key-pecking, pause, and locomotion on a fixed-interval schedule of reinforcement

Meredith S. Berry, Brian D. Kangas, & Marc N. Branch
University of Florida (USA)

Six pigeons engaged in key pecking under a fixed-interval 3-minute schedule of food presentation. The experiment was conducted in a modified operant-conditioning chamber with the floor divided into 6 equal-area panels mounted on microswitches to detect locomotion. The behavior of each pigeon was studied for 200 daily sessions with 15 intervals per session (3000 total food presentations). Analyses included the examination of latency to first peck, mean key-pecking, and locomotion. Specifically, within and across session analyses were conducted in order to investigate the development of and relationships among each measure of behavior. Results include systematic development of a temporally organized pattern of key-pecking, a negative lag-1 correlation in pause durations across successive intervals, and differential steady-state development across measures during extended exposure.

Internalization of stimulus control during skill learning: When can the coach leave?

Alliston K. Reid, Chelsea A. Nill, & Brittney R. Getz
Wofford College (USA)

In two experiments, rats were trained to complete a left-right sequence of lever presses guided by the onset and offset of panel lights over the respective levers. In Experiment 1, once sequence accuracy was high and stable, the lights were eliminated without changing the response contingency. Sequence accuracy decreased in all subjects, but accuracy was always higher than that predicted by random chance, demonstrating internalization of stimulus control. Experiment 2 controlled for potential generalization decrement by presenting the lights in reversed order. Sequence accuracy immediately plummeted and did not recover. S-R associations involving external stimuli apparently overshadowed internal cues. This work provides an animal model of the internalization of guiding cues provided by coaches and instructors.

Within-session changes in the licking behavior in common marmosets

Taku Ishii & Shigeru Watanabe
Keio University (Japan)

We conducted 30-min sessions wherein common marmosets (*Callithrix jacchus*) were allowed to freely lick the nozzle of a bottle containing sucrose solution. Different concentrations of sucrose solutions (1%, 5%, and 25%) were randomly used in separate sessions. We found that the licking rate decreased as the cumulative number of licks within a session increased. These within-session changes in licking behavior were expressed well with linear functions. The linear function slopes were steeper when the marmosets were offered the 1% solution than when offered the 5% and 25% solutions. Moreover, the total number of licks was greater for the 5% and 25% solutions than for the 1% solution. These results may be useful for planning future operant research involving common marmosets.

Spontaneous recovery from interference between cues but not from backward blocking

David Luque, Joaquín Morís, Pedro L. Cobos & Francisco J. López
Universidad de Málaga (Spain)

Recent comparisons of Interference between Cues (IbC) and Backward Blocking (BB) have shown that both effects are empirically indistinguishable. These results open the possibility for common process underlying both effects. We further analyzed this possibility in the present experiment. Specifically, we wondered to what extent processes underlying IbC are also responsible for the BB effect. We applied a Spontaneous Recovery (SR) treatment to an IbC and BB designs. While associative models of IbC predict SR, models of BB remain silent about the influence of time passage over BB. Our results showed a reliable SR of the response only in IbC. This result indicates that BB is not produced by interference processes, being its underlying mechanism more resistant to time passage.

Two different priming paradigms show further evidence of associative phenomena in human contingency learning during and after training

Joaquín Morís, Estrella González-Martín, David Luque, & Pedro L. Cobos
Universidad de Málaga (Spain)

Verbal judgments have traditionally been the main dependent variable used in human contingency learning. The shared assumption is that those judgments indirectly reflect the magnitude of the associative link between the probed cue and its associated outcome. However, it has also been shown that these judgments can be modulated by other psychological processes, like reasoning. Priming paradigms have already been used as a strategy to obtain more direct measures of the strength of associative links and, thus to show the involvement of associative processes in human contingency learning. In previous studies with priming, we have found excitatory conditioning and blocking. We present further evidence of other associative learning phenomena and a new procedure to measure these processes during training.

An Active Time account of Belke’s 1992 result

Andrew T McKenzie & J Mark Cleaveland
Vassar College (USA)

Two experiments explore whether an Active Time model can account for an anomalous result from multiple schedule, concurrent variable-interval (VI) VI experiments. The model assumes that 1) during concurrent VI VI training pigeons learn a function that relates the current interresponse time, i.e., active time, to changeover probabilities and 2) that aggregate, observed preference is the result of an interaction between interresponse time frequencies and the learned active time changeover functions. Pigeons were trained under a concurrent VI 30-s VI 60-s schedule and a concurrent VI 60-s VI 120-s schedule, with varied use of a changeover delay. Unreinforced probes were then conducted in which the two VI 60-s stimuli were paired to investigate the predictions of the Active Time model.

Two models of discounting: sensitivity and adjustment

Christensen, D. R., Ganev, J., Montagu, A., & Grace, R. C.
University of Arkansas for Medical Sciences (USA) & University of Canterbury (NZ)

Forty-nine participants completed two discounting tasks where a hypothetical \$1000 was probabilistically available (0.95, 0.9, 0.7, 0.4, 0.1, and 0.05%) and temporally delayed (1, 6, 12, 36, 60, and 120 months). Results showed that present value declined as both odds against and delay increased. Two hyperbolic models of discounting were fitted to the data: one included a sensitivity parameter in the denominator, whilst another included a subjective adjustment to the discounting variable (odds against or delay). Both models described probability discounting equally well, although the sensitivity model obtained a greater fit to the delayed data than the adjustment model. However, residual analyses appeared to show the adjustment model to have less residual variance when the sum of squared deviations were compared. The novel adjustment model appears to show some ability to describe discounting data and suggests typical discounting over a sufficient range of probabilities and delays can be categorized into two broad response patterns.

The importance of the reinforcer as a time marker

David Freestone & Russell M. Church
Brown University (USA)

Shifts in the psychometric function in the Free Operant Psychophysical Procedure (FOPP) have traditionally been explained by assuming the pacemaker rate is proportional to the reinforcement rate (BeT), or by direct associative competition between the two responses (LeT). Both explanations assume that stimulus onset is the relevant time marker. In a variant of the FOPP, and in secondary data analysis of the FOPP, we show that these explanations are insufficient. Head-entries were reinforced on random interval schedules in the first half of 120s stimulus (s1), and in the second half of a different 120s stimulus (s2). Then, responses were extinguished in both s1 and s2. Relative to training, extinction produced a leftward shift in response times in s1 only, contrary to BeT. In addition, a strong single cycle correlation between the last food delivery and the time the rat stopped responding in s1 suggests that rats used the food deliveries as time markers. This correlation was also present in the FOPP data. These findings have implications for the application of models to the FOPP in particular, and to random interval procedures in general.

Choice in a variable environment: Effects of *d*-amphetamine

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Four pigeons responded in sessions that consisted of seven unsignaled components in which concurrent VI schedules were arranged with programmed reinforcer ratios (left:right) ranging from 27:1 to 1:27. The order of components was randomly determined, and each component lasted for ten reinforcers. Effects of several doses of *d*-amphetamine on overall sensitivity to reinforcement were tested. Analyses at a reinforcer-by-reinforcer level and a response-by-response level also were conducted (see Davison & Baum, 2000; 2003). Non-drug baseline data replicated those reported by Davison and Baum (e.g., increasing sensitivity to reinforcement across successive reinforcers in a component, “preference pulses”). Administrations of *d*-amphetamine had no systematic effect on overall sensitivity, but for all birds, at least one dose attenuated preference pulses.

Behavioral contingency analysis of deception in finance

Francis Mechner
The Mechner Foundation (USA)

Applying a formal language for the analysis of behavioral contingencies to certain economic phenomena helps explain why and under what conditions they occur and suggests ways to control them, with implications for public policy. The behavioral contingencies that define property, property transfer, value, risk, and consensus are shown to be at the core of such phenomena as the formation and bursting of bubbles or the behavioral dynamics of Ponzi schemes. The concept of property is a set of behavioral contingencies – potential consequences of certain acts by “owners” and “non-owners” with respect to an entity. Property transfers are changes in the contingencies for all of the involved parties. The property transfers analyzed include money laundering, aggregation (the “bundling” of properties into larger units, e.g., the creation of derivatives, funds, conglomerates), partitioning (creation of currencies, stock issues, subdivisions), and Ponzi schemes. All of these affect consensus regarding value. Consensus consists of a number of parties making the same prediction. All such property transfers permit obfuscation of the contingencies that defined the original properties, including their values. Some are deceptive practices and some provide beneficial synergies. The conditions that lead to the formation and bursting of bubbles are analyzed. Bubbles burst when a consensus regarding value splinters into divergent consensus groups.

Bias in delay discounting

Wilhelm, C. J. & Mitchell, S. H.
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Delay discounting procedures are designed to assess a subject’s sensitivity to delayed reinforcement. In general, these procedures allow animals to choose between one response alternative yielding smaller sooner reinforcers and one yielding larger later reinforcers. We assume that preference is determined by a combination of the animal’s position bias coupled with that animal’s sensitivity to delay. Much attention has been paid to sensitivity to delay, and factors associated with it. Significantly less attention, however, has been given to the role of bias, which may be influenced by the subject’s previous experience of delays in the procedure. The purpose of this study was to examine the role of bias in delay discounting more closely. We used Long-Evans rats (n = 8) in a modified adjusting amount procedure comparing preference for 150 µl of 10% sucrose solution and an alternative, which varied systematically in amount of sucrose delivered. Bias is generally calculated based upon a subject’s indifference point when rewards are delivered immediately from both alternatives. We examined indifference points when rewards from both alternatives were equally delayed (2 s, 4 s, 8 s, or 16 s) as well as the traditional delay discounting function. Indifference points were similar across delays and larger than 150 µl, indicating that animals were biased toward the fixed, non-adjusting, response alternative. This difference was statistically significant when delays were 2 s and 16 s. This indicates a relative aversion for the adjusting alternative which may be due to the variability in reward size associated with that alternative.

Conditioning history effects on fixed-interval responding: Response transference of temporal control from fixed-time to fixed-interval reinforcement schedules

Marina Menez & Florente López
Universidad Nacional Autónoma de México (Mexico)

Development of temporal control under fixed interval (FI) schedules seems to speed up as a result of prior training on fixed time (FT) schedules of the same value (López & Menez, 2005). In order to evaluate whether such facilitation was related to the temporal distribution of reinforcers or to the mere non-contingent delivery of them during the prior FT training, groups of rats were maintained for 45 sessions under FT or variable time (VT) schedules, then a FI schedule of the same value (30 or 90 s) as the prior training was introduced for 60 additional sessions. Head entries (HE) were registered on both phases and Lever Presses (LP) on the second phase. Several measures of temporal control indicated that it developed in fewer sessions on FI when preceded by FT than by VT. The pattern of HE during training indicated that temporal learning had already occurred in FT and that this learning could be involved on the facilitated temporal control acquisition of LP on FI, through the mediation of learning developed during the conditioning history. The general pattern of results suggests that temporal learning transfers or generalizes from one response to another, in congruence with an adaptive view.

Prospective time in pigeons

Ana Catarina Vieira de Castro & Armando Machado
Minho University (Portugal)

One procedure for studying temporal discriminations in animals is the time-left. In this procedure the subject chooses between two stimuli that signal different delays to reinforcement. Trials begin with one stimulus that signals 60-s to reinforcement and, at different moments since its onset, another stimulus, signaling 30-s to reinforcement, is introduced. Optimal performance consists of choosing the stimulus that signals less time to reinforcement. In the original procedure (Gibbon & Church, 1981), however, temporal sensitivity is confounded with the time markers used during the test trials. In the present experiments, we removed the confound. The results showed that pigeons chose the key associated with the least time left to food.

Memory and the choose-short effect: A study with pigeons

Carlos Pinto & Armando Machado
Minho University (Portugal)

To better understand short-term memory for time durations, we re-examined the choose-short effect in a delayed matching-to-sample task. In Experiment 1, pigeons learned to choose three comparison stimuli following three samples (2, 6 and 18 s). Then, retention intervals ranging from 0 to 20 s were used to contrast the predictions of two explanations of this effect: the subjective shortening and coding models. The results supported the coding model. In Experiment 2, the same samples were used, but to test the predictions of a third model (confusion hypothesis), the characteristics of the ITI and the retention interval differed. Evidence of a choose-short effect was obtained with dissimilar ITI and retention interval, contrary to what was predicted by the confusion hypothesis.

The natural intelligence model: An account of decision and memory processes in humans, monkeys and pigeons

Sheila Chase

Hunter College of the City University of New York USA)

The Natural Intelligence Model, a computer model developed by Eric G. Heinemann and Sheila Chase, provides an account of decision processes in the absence of verbal coding, among these selective attention, categorization and generalization, blocking and overshadowing, stimulus control by compounds of sound and light intensities, and choice among multiple alternatives. Differences among individuals and species are attributed to differences in the number of exemplars in working memory upon which the decision is based. The model, although developed for pigeons’ choices among simple stimuli, appears to be applicable to much more complex processes in pigeons and other species.

Time or pecks? Comparing independent-variable metrics on local analyses of choice

Nathalie Boutros, Michael Davison, & Douglas Elliffe

University of Auckland (New Zealand)

Preference pulses plot the changes in local response ratio following response-contingent events (usually food). These changes are measured either over successive responses or across successive time bins since the event. We investigated the differences between analyses according to time and analyses according to responses using data from an experiment that arranged both response-contingent food deliveries and non-food stimuli. The two ways of measuring preference pulses led to different conclusions about the effects of non-food stimuli relative to the effects of food. These differences were primarily due to differences in response latency and response rate following the two events. We suggest that, for most purposes, time-indexed preference pulses provide a better measure of the dynamic effects of response-contingent events.

Local preference is controlled by the next-reinforcer location

Sarah Cowie, Michael Davison, Douglas Elliffe, & Jason Landon

The University of Auckland (New Zealand)

Do changes in choice (preference pulses) on concurrent schedules following reinforcers reflect “reinforcement”? Recent research suggests that reinforcers may signal a future behavior-reinforcer contingency, rather than increasing the probability of the behavior that produced the last reinforcer. In the present experiment, overall concurrent VI reinforcers were kept equal on 2 alternatives, and the probability that the next reinforcer would be obtained sooner on the just-productive alternative, or sooner on the not-just-productive alternative, or sooner on a specific alternative, was varied. Preference pulses were jointly controlled by the likely time and location of the next reinforcer as signalled by the just-obtained reinforcer, and not by the location of the just-produced reinforcer.

Delay discounting with impulsive, risky, and sequential choice

Matt Locey

State University of New York at Stony Brook (USA)

Titrating amount and delay procedures were used to compare delay discounting under three distinct conditions: impulsive, risky, and sequential choice. In the impulsive choice condition, undergraduates chose between an adjusting amount of money right now and either \$100 or \$50,000 after various delays. In the risky choice condition, subjects chose between an adjusting delay and a variable delay to \$100 or \$50,000. In the sequential choice condition, subjects chose between an adjusting delay to \$100 (or \$50,000) and two consecutive delays to \$50 (or \$25,000) each (\$100 or \$50,000 total). Indifference points were fit to various derivations of Mazur’s (1984) hyperbolic delay discounting equation. Each subject experienced all three conditions allowing both within- and across-subject comparisons of the resulting discount functions.

Hamming cliffs in a computational model of selection by consequences

Andrei Popa & J. J. McDowell

Emory University (USA)

McDowell (2004) instantiated the Darwinian principles of selection, recombination, and mutation in a computational model of selection by consequences; the results are remarkably similar to those obtained in behavioral experiments with living organisms. The model animates a virtual organism with a repertoire of 1024 behaviors, behaviors’ genotypes being represented by strings of binary digits. This aspect raises the issue of Hamming Distances (the number of digits that must be “flipped” in order to obtain another string of equal length - Hamming, 1950). Data suggest that Hamming Distances may be the computational equivalent of the COD used in behavioral experiments with living organisms, as hypothesized by McDowell (2004).

Errorless transfer from a visual to an auditory discrimination

Joana Arantes, Andreia Soares, Tatiana Quintas, & Armando Machado

University of Canterbury (New Zealand) & University of Minho (Portugal)

Our goal was to observe pigeons’ responding in the double bisection task systematically, to explore the relationship between collateral behavior and temporal discrimination. During baseline training, pigeons were exposed to two temporal discriminations in which they had to choose the correct side key after the houselight was illuminated for a specific duration: 1 s vs. 4 s (red vs. green side keys) and 4 s vs. 16 s (blue vs. yellow side keys). During the last sessions of training, their behavior was digitally recorded and later analyzed by two independent observers. The observers described first the overall ongoing behaviors during each trial and then coded those behaviors in half-second bins. After baseline training on the task, the pigeons were exposed to a stimulus generalization test. During the test they were presented with signal durations from 1 s to 4 s and given a choice between red and green, and with signal durations from 4 s to 16 s and given a choice between blue and yellow. Results from the stimulus generalization test were then compared with the predictions based on the pigeons’ behaviors.

Numerical representation in a bisection procedure

Lavinia Tan & Randolph Grace
University of Canterbury (New Zealand)

The representation of number developed by pigeons was investigated in a numerical bisection task. Four pigeons were presented with a sequence of keylight flashes and were then required to peck either a blue or white key, if the number of flashes (n) was large or small, respectively, to obtain reinforcement. After baseline training, subjects were then tested with numbers inside and outside of the training range. The first condition involved the discrimination of n =2 and 6 flashes, and transfer tests involved values 0, 1, 3, 4, 5, 7 and 8 flashes. Subjects were then trained and tested in 4 versus 12 and 8 versus 24 discriminations, in a counterbalanced order, followed by a replication of the 2 versus 6 discrimination. Significant numerical control and positive transfer to novel numbers was obtained in all conditions. Obtained bisection points were located at the arithmetic, not geometric mean, and psychometric functions for the different scales superposed. Psychometric functions and response variability were also analysed to examine the nature of the underlying numerical scale.

Discrimination and memory in temporal sequences in rats

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The present experiment has as central axes: 1) the study of the ability to estimate temporal sequences of durations, and 2) the evaluation of the role that have the introduction of a retention interval (RI) between the signals that compose the sequences, and the end of the sequence. Ten rats were trained in a delayed conditional discrimination task, where the sample stimulus consisted of sixteen possible sequences of durations; each sequences could be short or long and was composed by two tones modalities (high and low). Once the discrimination criterion was met, the effect of a retention interval was assessed in two conditions, in one, it was inserted between the components that formed the sequence (Retention Interval Between Components, RIBC), in the other it was located at the end of it (Retention Interval at the End of Sequences, RIES). The results obtained allow us to conclude that the subjects discriminate sequences of durations perfectly. The location of the retention interval affected differently the discrimination in both conditions; being larger in the condition RIES. The index of the discrimination were asymmetric for the short and long sequences in condition RIES, not thus in condition RIBC.

Comparison of food presentation at regular or irregular times on the development of activity-based anorexia in rats

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Activity-based anorexia occurs when food availability is restricted to one hour a day and wheel running is freely available the rest of the time. Under such circumstances, rats run excessively and stop eating even during food availability periods. A defining characteristic of the excessive activity is that there is a peak of running in anticipation to food availability. The present study was designed to test if the occurrence of the food period at different times of the light part of the light-dark cycle (08.00 – 20.00 h) could be enough to impede or postpone the normal development of activity-based anorexia. Far from that, the presentation of food at irregular times during the day resulted in a pronounced body-weight loss, a low food and water intake, and an increase in locomotor activity. Excessive running occurred in anticipation to food availability. Animals showed a peak of running at the start of the dark cycle and again when lights were turned on in the experimental room. Regular or irregular food periods both resulted in the development of activity-based anorexia in rats.

Serial discrimination reversal learning: Signal properties during a reinforcement delay

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Pigeons learned a series of reversals of a simultaneous color discrimination with an intertrial interval of 8 s and a reinforcement delay of 0 s or 6 s. Condition Zero employed a reinforcement delay of 0 s. The other three conditions employed a reinforcement delay of 6 s but the signal properties during the delay differed. In Condition Unsignaled, the stimuli during the delay were identical to the intertrial interval (i.e., dark keylights, no signal). In Condition Signaled, responses to the correct choice (S+) were followed by a yellow key light on the center key whereas responses to the incorrect choice (S–) were followed by dark keys, identical to the intertrial interval condition. In Condition Nondifferential, the yellow key light was presented after both S+ and S– responses. The main findings were that there was no performance difference between Conditions Zero and Signaled and both yielded higher performance than Conditions Unsignaled and Nondifferential, which did not differ from each other. The implications are that a differential signal during the reinforcement delay compensates fully for the detrimental effects of the reinforcement delay, and that a nondifferential signal, even though it sets the reinforcement delay apart from the intertrial interval, does not undo the detrimental effects of an unsignaled reinforcement delay.