EXPERIMENTAL ANALYSIS OF HUMAN BEHAVIOR BULLETIN

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THE EXPERIMENTAL ANALYSIS OF HUMAN BEHAVIOR BULLETIN

The *EAHB Bulletin* is published twice yearly, in the Spring and Fall, by the Experimental Analysis of Human Behavior Special Interest Group (EAHB SIG), a group organized under the auspices of the Association for Behavior Analysis (ABA). Articles in the *Bulletin* represent the views of the authors. They are not intended to represent the approved policies of the SIG or ABA, or the opinions of the membership of the SIG or ABA. The inside back cover has information about joining the SIG. Publication costs are paid by the dues of the SIG members and by the Parsons Research Center of the University of Kansas.

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Submit brief reports and technical information by September 1 and all other materials by October 1 for the Fall, 1994 issue.

SUMMARIES OF STUDENT PAPER COMPETITION WINNING PAPERS

THE TRANSFER OF CER ELICITING AND EXTINCTION FUNCTIONS VIA STIMULUS EQUIVALENCE

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How respondent functions might transfer across stimuli is highly relevant for our understanding of emotional responses, especially given the inability of existing theories to adequately explain the acquisition and generalization of anxiety responses in humans. Extinction is also a phenomenon that is important to our understanding of emotional responding as it clearly plays a significant role in a variety of behavioral treatments. Stimulus equivalence may offer an important explanatory mechanism that can help to account for the emergence of seemingly unexplained maladaptive behavior in humans in that respondent eliciting functions and extinction may transfer via stimulus equivalence. Previous research in our laboratory has demonstrated that respondent eliciting functions and avoidance behavior can transfer within stimulus equivalence classes. The present study sought to replicate our previous findings that respondent eliciting functions could transfer via stimulus equivalence and extend our investigation to include the possible transfer of extinction.

Four undergraduates (two female and two male) taking introductory psychology courses at the University of New Mexico served as subjects for this study. The study consisted of four phases. The first involved the training of 2-4 member stimulus equivalence classes through a conditional discrimination task. During the second phase, subjects received CS-US pairings for which each symbol from the first class served as a CS+ and each symbol from the second class served as a CS-. Brief mild electric shock applied to the outside of the right forearm served as the US. Peak response for Skin Conductance Level (SCL) at the offset of the stimulus was used as the measure of conditioning and transfer of functions. During the next phase, B1 and B2 were presented in semi-randomly dispersed extinction trials. Each of the remaining members of both classes were then presented to test for the transfer of extinction. The transfer of extinction was said to have occurred when a decrease in SCL from that demonstrated during the conditioning phase was noted along with the absence of a consistent pattern of differentiation between class one and two stimuli.

The fourth phase was the test for transfer of the respondent function. B1 was reconditioned by pairing it with the US with interspersed presentations of B2 alone. Subjects were then exposed to the other members of each class in the absence of the US. The criterion for the demonstration of transfer of conditioning was defined as a greater response to all of the tested members of the class of which B1 was a member than to any member of the class to which B2 was a member.

All four subjects demonstrated the formation of two 4-member classes. All four subjects also met the criterion for transfer of both extinction and the respondent function.

The present results demonstrate that the acquisition and extinction of classically conditioned respondent functions can transfer through stimulus classes which were based not on physical stimulus characteristics, but on arbitrary relationships. That is, stimuli can acquire and lose fear eliciting functions via their membership in a stimulus class. This would seem to address some of the limitations in conditioning theories of anxiety disorders and may further our understanding of how behavioral treatments are effective. When combined with conditioning theories, the present results may offer a model and possible mechanisms for explaining many real world events without the need to rely on cognitive mediation or psychoanalytic constructs. This area of literature as a whole is beginning to coalesce into a potentially powerful model for explaining complex real world behavior, including that involved in psychopathology.

CONTEXTUAL CONTROL OVER THE TRANSFER OF FUNCTION THROUGH STIMULUS EQUIVALENCE CLASSES

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The present study investigated whether transfer of function through stimulus equivalence classes can be brought under contextual stimulus control. Wulfert and Hayes (1988) demonstrated higher order conditional control over equivalence class membership and over transfer of function through equivalence classes to all equivalence class members. The present study differs from the Wulfert and Hayes study in that we demonstrated differential contextual control (background color) over the transfer of a sequencing response within the same equivalence class. In the present study, subjects sequenced the B stimuli in the same manner, regardless of background color, and sequenced the C and D stimuli (trained) and E stimuli (tested) differentially depending on background color while equivalence classes remained intact.

Although stimulus control over transfer of function through equivalence classes appears to be adaptive, there are contexts where transfer through equivalence classes is maladaptive. It may be adaptive to react fearfully and run from a live snake, but it is not adaptive to become fearful and run from a picture of a snake. The snake and snake picture are in an equivalence relation and share many stimulus functions, but the context dictates which functions appropriately transfer. The transfer of fear reactions through equivalence classes might explain the development of anxiety reactions to stimuli that have never been directly conditioned, and lack of contextual control over transfer may be responsible for the maintenance of such reactions.

In the present study, 10 experimental subjects were first taught three 5-member equivalence classes (e.g., A1, B1, C1, D1, E1 is one 5-member class) and then learned to sequence selected members from each of the three different equivalence classes in the same order (i.e., B1, B2, B3) in two different background colors (red and black). Then, in an effort to establish contextual control over sequencing, subjects were trained to sequence two of the three remaining members of the equivalence classes (C and D stimuli) differentially, depending on the background color of the screen (i.e., red C1, C2, C3; black any sequence except C1, C2, C3). During this training, undifferentiated B stimuli sequencing (B1, B2, B3 in both red and black) was randomly interspersed. Subjects were then tested for the transfer of contextual control over sequencing of the final members of the equivalence classes (red E1, E2, E3; black any sequence except E1, E2, E3). Subjects then received a test of B stimuli sequencing and a partial retest of equivalence. All 10 subjects demonstrated contextual control over transfer of sequencing, undifferentiated B sequencing in the two background colors and intact equivalence classes.

Four of the 10 experimental subjects received further training to reverse the differential color control acquired in the experimental condition (the sequence C1, C2, C3 was correct in black and wrong in red, etc.). All four subjects demonstrated contextual control over the transfer of the reversed sequencing response. Three control subjects received identical equivalence and sequence training for the B stimuli but no differential sequence training in the color backgrounds. They demonstrated that without a differential training history, a sequencing function will transfer regardless of background color.

Further studies could investigate higher order contextual control and generalization of contextual control over transfer of function. The present findings have implications for our general understanding of contextual control over transfer of function and for the role this may play in clinical disorders.

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A CONTINGENCY-SHAPED BASE-RATE ERROR: CONDITIONAL AND UNCONDITIONAL PROBABILITIES IN HUMAN MATCHING TO SAMPLE

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Two experiments tested college students in a delayed matching-to-sample procedure, exploring how multiple competitive sources of control interact in matching behavior. The primary sources of potential control were the frequency with which each of two colors was correct (base rates) and the accuracy of a sample in predicting the correct choice (accuracy rate), creating an analog to the base-rate error of the judgment-decision literature. This effect has been demonstrated using the following problem (Kahneman & Tversky, 1972):

> A cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city. You are given the following data:
> (a) 85% of the cabs in the city are Green and 15% are Blue.
> (b) A witness identified the cab as Blue. The court tested the reliability of the witness under the same circumstances that existed on the night of the accident and concluded that the witness correctly identified each one of the two colors 80% of the time and failed 20% of the time. What is the probability that the cab involved in the accident was blue rather than green?

The correct answer to this question is 41%, but the most typical response is 80%, which matches the witness' accuracy and ignores the base rate of incidence of cabs of the two colors in the city.

This problem can be studied as a response to real probabilities of events, rather than as a response to a question (Rachlin, 1989), by employing a delayed matching-to-sample design. Here, subjects repeatedly choose between green and blue forms after seeing a sample of one of those colors. Each trial serves, by the analogy, as an accident to be assessed, and each sample is a witness' report. After each choice, the subject is told either that the choice was "correct" (garnering one point) or that it was "incorrect" (not earning a point). The base rate and witness accuracy emerge as aspects of the contingencies of reinforcement: The base rate is how often each color is the correct response, irrespective of the sample; and the witness' accuracy is how often the sample corresponds to the correct response.

In one condition of Experiment 1, subjects experienced a base rate of 67% of all correct responses being localized on one of the colors, and a sample accuracy of 50%. Under these conditions, when the color that was unconditionally correct only 33% of the time appeared as the sample, it was also the conditionally correct answer 33% of the time, so that optimal performance would have been never to match it. However, subjects neither maximized (0% matching) nor matched the probability (33% matching) but matched the sample 56% of the time. This approximates the overall sample accuracy of 50%, which is the hallmark of the base-rate error. Overall, the data from Experiment 1 adhered most closely to predictions of a base-rate error.

In a second experiment, manipulations to increase subjects' motivation did not significantly alleviate the error. Half the subjects were paid 10 cents for each point earned, which totaled more than $15 over 2 sessions. This did not substantially affect performance in any condition.

Together, these results suggest that the base-rate error may represent a broad behavioral pattern not restricted to verbal arenas.

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CHOICE, MATCHING, AND MAXIMIZING: THE CONCURRENT RATIO-INTERVAL LITERATURE

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Data from concurrent-choice experiments generally conform to the matching law, according to which relative responding should equal relative obtained reinforcement. Optimality theory attempts to explain matching at a molar level by assuming that choice is governed by reward maximization. As such, matching is the specific pattern of behavior that produces the greatest overall benefit (reward minus cost). Tests of Optimality typically assume that reinforcement rate is the optimized good, although factors like response cost and leisure have been considered.

To maximize reinforcement rate in concurrent ratio-interval schedules, subjects' choice must deviate from matching. If matching persists independently of reinforcement maximizing, then matching can't be caused by a maximizing strategy. Because interval schedules elapse with time, the probability of reinforcement increases regardless of whether the subject is currently choosing that alternative. Ratio schedules, on the other hand, advance only when subjects respond. Subjects can maximize reinforcement by allocating most behavior to the ratio alternative and only occasionally sampling the interval schedule; that is, by showing heavily biased preference for the ratio schedule.

Experiments using standard concurrent variable-interval (VI), variable-ratio (VR) schedules share some procedural artifacts. First, the higher local response rates evoked by a ratio schedule could produce VR response biases simply because the VR response unit may comprise more than one response. Thus, although allocation of behavioral units conforms to matching, a bias is measured. Similarly, time-allocation biases for the VI may be attributed to the low local response rates generated by that schedule. A greater portion of time spent not responding, "leisure time," is mistakenly assigned as VI time allocation, thus creating a VI bias. Some have argued that a maximizing VR bias may be obscured by the greater response cost associated with VR schedules.

To avoid such confounding factors, researchers have used response-independent VR, VI schedules, called variable-time (VT), variable-ratio-time (VRT) schedules. Reinforcers were delivered with elapsed time, and only changeover responses between the schedules were made. Pigeons in such studies showed data approximating matching and failed to maximize overall reinforcement rate. However, both studies also reported weak biases for the VRT, in the direction of, but much smaller than predicted by maximization. Similar results were obtained with VI, discontinuous-VI schedules (a discontinuous VI stops operating when the standard VI is chosen, thus emulating a VR schedule). Small biases for a VR-like alternative have also been shown in discrete-trial procedures with rats.

Unfortunately, only two studies have tested human performance. One showed response preference for a VR over a VI schedule. However, because no bias estimates were reported, it is unclear whether subjects maximized reinforcement. Additionally, the above noted problems with VR, VI schedules may have contributed to the response bias. The other study employed VT, VRT schedules and obtained a weak time-allocation bias for the VRT schedule, replicating most nonhuman experiments.

Reviewing the literature, both humans and nonhumans fail to maximize overall reinforcement in concurrent ratio-interval schedules. Although subjects roughly match behavior to reinforcement, the matching law did not predict the weak bias for the ratio schedule. This bias may also be explained as a procedural artifact. Note that the probability of reinforcement for choosing the interval schedule increases with time spent on the ratio schedule. Perhaps, choosing the ratio alternative is differentially reinforced by delayed interval reinforcers after a changeover to the interval schedule. These delayed reinforcers might generate a "bias" that simply reflects the increased ratio reinforcement. Although subjects may be using imperfect-maximizing strategies or optimizing some unknown "value," a matching analysis incorporating delayed reinforcers appears to parsimoniously describe the findings thus far.

HUMAN CHOICE IN CONCURRENT RATIO-INTERVAL SCHEDULES OF REINFORCEMENT

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Concurrent ratio-interval schedules allow us to test whether humans maximize reinforcement rate. Because ratio schedules operate only when chosen and interval schedules elapse independently, a maximizing strategy involves responding mostly to the ratio schedule with only occasional sampling of the interval alternative. The matching law states that preference for a given alternative should be equal to the relative reinforcement obtained from that alternative. Thus, to maximize reinforcement rate, subjects must show a bias in preference for the ratio schedule that is not described by a matching relation. Alternately, if matching persists at the expense of overall reinforcement, then certainly maximization cannot be responsible for the observed matching phenomenon.

Our experiment assessed human performance in response-independent analogues to variable-interval (VI), variable-ratio (VR) schedules. These variable-time (VT), variable-ratio-time (VRT) schedules elapsed with time, and not responses. When the VT light was illuminated, only its schedule elapsed; when the VRT light was on, both ratio and interval-analog schedules operated, thus retaining the critical feature of VI, VR schedules. Subjects made changeover responses to choose between the VT or VRT light, but reinforcers were delivered independently of responding.

We also investigated stimulus conditions under which humans might respond optimally. Subjects were presented visual clock cues that correlated directly with the operation of each schedule. Specifically, when subjects chose the VT, a clock placed near that schedule's light operated. Alternately, when choosing the VRT, a similar clock near the VRT light elapsed along with the VT clock. If these cues shift choice toward maximizing, then the presence of salient discriminative stimuli correlated with the effective contingencies may be necessary for optimal behavior.

Our results showed that reinforcement maximization did not control human performance. Although subjects consistently allocated more time to the VRT than required by matching, the magnitude of this bias did not approximate that predicted by Baum's (1981) maximizing account. To maximize overall reinforcement, our subjects should have spent more time on the VRT than they actually did. Furthermore, although exposure to clock stimuli substantially increased one subject's bias for the ratio schedule, increasing the total number of obtained reinforcers, her bias lay midway between the predictions of matching and maximizing. The other subjects continued to respond even less optimally with clock cues.

Previous experiments with nonhumans show quite similar results (see Savastano, this issue, for review). The data resemble a matching pattern much more closely than a maximizing strategy. However, as in our study, the findings are not perfectly consistent with matching because of a small, but consistent, bias for the ratio alternative. What might account for the deviation from matching? In concurrent ratio-interval schedules, the longer a subject chooses the ratio alternative, the higher the likelihood of reinforcement for switching over to the interval schedule. Thus, choosing the ratio alternative is followed differentially by delayed (through a changeover delay) interval reinforcers after a changeover from the ratio schedule. Williams (1992) suggested that these delayed reinforcers might produce "bias" that simply reflects matching to increased ratio-schedule reinforcement. Our results are consistent with a view of matching that incorporates effects of delayed reinforcement.

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RESEARCH IN PROGRESS

A METHODOLOGICAL NOTE REGARDING HUMAN CLASSICAL CONDITIONING

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Over the past several years we have been involved in several projects using classical conditioning techniques with human subjects (e.g., Augustson & Dougher, in preparation; Augustson, Markham, Dougher, & Hackbert, 1994; Dougher, Augustson, Markham, Wulfert, & Greenway, in press; Hackbert, Markham, Dougher, & Augustson, 1994). Our experience has shown that it can often be difficult to achieve reliable conditioning effects with humans and these effects can be easily disrupted by a number of unforeseen factors. This difficulty seems to arise from a variety of constraints that occur in laboratory settings, including the necessity to use low levels of US intensity and a limited number of conditioning trials. After a number of years experimenting with these procedures, we have been able to reliably demonstrate conditioning with human subjects. Because this appears to be a promising research area, we offer the following suggestions to facilitate its development in other labs.

In our laboratory, subjects are seated in a comfortable easy chair before a personal computer in a small experiment room equipped with an intercom system and two-way mirror for subject observation. CS's consist of abstract visual 4 cm by 5 cm stimuli presented on an IBM Personal Computer with a 19 cm monochrome monitor (green on black). We use skin conductance level (SCL) and skin conductance response (SCR) as measures of conditioning, although not all subjects demonstrate consistent skin conductance and occasionally "low responders" must be removed from the study (see Levis & Smith, 1987). Subjects can be screened for reactivity before they begin the conditioning trials, thereby circumventing the need to remove them post hoc (Levis & Smith, 1987). SCL and SCR measures are recorded on a multi-channel polygraph (Dynograph #R511) using a Beckman 9844 skin conductance coupler. SensorMedics skin conductance electrodes are prepared with a Unibase (Parke Davis) and 0.5% NaCl paste (Lykken & Venables, 1971).

Attempts within our lab to use Conditioned Emotional Responses, measured by response suppression, have not proved fruitful. There are several factors which may account for this, but it is beyond the scope of this paper to discuss them.

Typically mild electric shock, ranging from 1.0-2.0 mA, applied to the outside of the right forearm serves as the US. We use shock because it has proven to be an effective mildly aversive US that is brief, highly controllable and does not produce long lasting harmful effects. We have attempted to use alternative unconditioned stimuli including graphic slides of bodily injury, profanity and increasing task difficulty, but these have not proven as effective. Of these alternative unconditioned stimuli we have demonstrated differential conditioning using increasing task difficulty. This procedure involves a serial addition task in which subjects must add up the total of two successive numbers and respond on a key if the total is an odd number. The CS which proceeds the addition task signals the rate (slow, medium, fast) at which the numbers will follow. Thus far, this technique does not appear to produce robust conditioning effects and the conditioned responses are easily disrupted.

We have chosen a minimal shock level of 1.0 mA because our experience indicates that lower levels typically lead to rapid habituation. There is great variation in how subjects perceive shock. This seems related to a variety of factors such as muscle mass, amount of body fat, skin thickness and psychological variables. Accordingly, subjects choose their own shock levels and are instructed to choose a level that is uncomfortable but not painful. Subjects who find the 1.0 mA level to be too aversive are dismissed from the study. Shock is delivered by a Lafayette (Model #82404) variable amperage shock generator. The shock electrodes were specifically manufactured in our laboratory and consist of two .25 in. nickel plated electrodes fastened .25 in. apart to a 1.5 in. wide x 2 in. long piece of Plexiglass. The Plexiglass is strapped to the subject's right forearm with a velcro strip.

We have had effective results using both delay and trace (200 ms) conditioning procedures. CS presentation intervals are typically 5-10 s, but we

have demonstrated conditioning with CS intervals as long as 40 s. Intertrial intervals can be as short as 30 s, although somewhat longer intervals (60-90 s) allow for more stable responding in highly reactive subjects. However, increasing the intertrial interval can also increase subject boredom which can lead to excessive movement artifact or unexplained SC changes. Depending on the parameters of the specific study, the number of CS+/US and CS- conditioning trials typically varies from 6-12 for each trial type. Although our subjects have often demonstrated anticipatory responding, our most robust and reliable measure of conditioning has been from responses occurring in the 5 s following the termination of the CS when no US is delivered. It may be that more conditioning trials are necessary to reliably demonstrate anticipatory responding. In order to accurately assess potential conditioned responses during the interval following the CS termination, we include at least one probe trial in which the CS+ is presented in the absence of the US.

Given that our subjects are highly verbal and that we use so few conditioning trials, we have sometimes encountered the formation of superstitious behavior and alternative sources of stimulus control. For example, subjects sometimes report attempting to use complicated rules to explain what is happening during the conditioning trials. This problem appears to be exacerbated if random presentation of trials produces an unusual sequence (i.e., several presentations of one stimulus in a row). This can be reduced by placing constraints on the order of the stimulus presentations and/or giving the subjects more explicit instructions before beginning the conditioning (e.g., "You will see two stimuli. One signals that shock is coming. One signals that no shock is coming").

A second problem presents a more serious difficulty in interpreting conditioning and transfer of conditioning effects. We have noted that if a CS- is presented following a presentation of the CS+ in the absence of the US, subjects often demonstrate large SC changes to the CS-. For this reason, the order in which stimuli are presented must be chosen carefully. We are currently exploring the parameters in which these "reversals" occur. We have found that providing subjects with a history involving trials in which the CS+ is presented in the absence of the US prior to the crucial test trials of the experiment reduces the occurrence of such reversals. This can be done by presenting the subject with probe trials, which also serve as measures of conditioning, or by specifically using a partial reinforcement history during the conditioning. It should be noted that although using partial reinforcement reduces the reversal effects, it can also reduce the level of classical conditioning effects, thereby requiring additional conditioning trials.

Given the problems described above, we have recently begun to use fixed presentation orders that include multiple probe trials (partial reinforcement). An example of a typical presentation order is CS-, CS-, CS+, CS-, CS+, CS+/NO US, CS-, CS+, CS-, CS+/NO US, CS+, CS-, CS+, CS-, CS+/NO US, CS-, CS-, CS+, CS+, CS-. This order is designed to reduce alternate sources of stimulus control, reduce the occurrence of reversal effects, and to increase the resistance to extinction in human subjects.

We hope these comments are useful and we welcome any suggestions or reactions.

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CONFERENCE PRESENTATION ABSTRACTS

A Laboratory Study of the Effects of Acute Marijuana Intoxication on Human Motivation

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The acute effects of marijuana smoking were examined using a paradigm where subjects could either work for points or accumulate points in an alternative where no work was required. Subjects experienced two experimental conditions in which points could be earned by pressing buttons on a response panel labelled "A," "B," and "C." In the first condition (Working), a computer screen displayed the letter "A" and the number of responses required to earn a point began at 50 button presses and the response requirement increased progressively by 10% following each point delivery. In the second condition (Working versus Not Working), another alternative was added where the subject began in the Working condition and could opt to terminate this condition (by making 10 responses on button "C") and change to another condition where no work was required, this caused the letter "A" to go off the screen and the letter "B" to appear on the screen and points were presented every 200 s. Point value was manipulated (5, 10, and 20 cents). The effects of smoking placebo or three potencies of marijuana cigarettes on the time spent in the working and not working alternatives were examined. Marijuana smoking produced a reduction in the amount of time spent working for points and an earlier escape to the not working alternative. Marijuana's effects were diminished by increasing the value of the points.

International Cannabis Research Society, L'Esterel, Canada, 1994.

The Effects of Alcohol on Aggression in Human Female Subjects

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The primary purpose of this ongoing study is to characterize the effects of alcohol administration on aggressive responding in females. This study is important because most of the previous research has been conducted with male subjects. The point Subtraction Aggression Paradigm is being used which has two response options available to the subject: (1) point-maintained responding: emitting 100 responses on one button earns the subject 10 cents; and (2) aggressive responding: emitting 10 responses on an alternative button ostensibly substracts 10 cents from another person also working to earn money. Aggressive responses are engendered by a random-time schedule of point loss. Instructions attribute these point losses to button presses by the other fictitious subject (points are subtracted from the subject every 6 s to 120 s following the earning of the first point of a session. Thus far, five subjects have been tested under three doses, 0.25, 0.50, and 1.0 g of alcohol/kg of body weight alcohol and placebos. To control for possible menstrual cycle effects subjects were tested during the mid- to late follicular phase of their cycle. Consistent with previous studies with males, the few females that have completed the study have responded aggressively under this paradigm, and in most cases alcohol increased aggressive responding. For 4 of the 5 subjects the largest increase in aggressive responding was found at the lowest doze of alcohol, 0.25 g/kg.

Association for Behavior Analysis, Atlanta, GA, May, 1994.

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A Comparison of Computer- and Teacher-Delivered Instruction with Individuals with Mental Retardation

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Stimulus control shaping procedures are potentially powerful tools for teaching discriminations to individuals with developmental disabilities. Soon, microcomputers may make such procedures available in the special-education classroom. Before investing in new technology, however, it seems reasonable to determine whether the new methods offer a true improvement over those in current practice. This experiment compared two methods for teaching

visual discriminations: stimulus fading presented by a computer, and a teacher's instructions presented according to a standard prompting hierarchy. Twenty-two individuals with mental retardation were divided into two groups matched for mental-age equivalent scores. All subjects received training on 16 two-choice visual discrimination problems. One group was trained with a computer-delivered stimulus fading procedure, and the other group was trained by a teacher who sat next to the subject and delivered verbal instructions and visual or physical prompts. The results were: (a) on trials where prompts were given, the teacher's prompts were more effective than the computer's in controlling selections; (b) transfer of control from prompts to training stimuli was superior with the fading procedure; and (c) subjects learned more discriminations with the fading procedure. These results indicate that computer-delivered programmed instruction may have advantages over typical one-to-one teaching methods for some individuals with mental retardation. Further, results like these suggest that the continued development of practical and appropriate software to complement the teacher's efforts in special-education settings is likely to increase overall instructional effectiveness.

27th Annual Gatlinburg Conference on Research and Theory in Mental Retardation, Gatlinburg, TN, March, 1994.

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Extinction-induced Variability and Resurgence in Humans

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College students produced 4-key sequences on a computer keyboard. A colored stimulus on the monitor screen corresponded to colors of the designated "correct" keys for the first four sequences. Each sequence involved different keys and was reinforced by point deliveries on different fixed-ratio schedules of reinforcement. Each sequence remained correct for 20 reinforcers. The final component was a 10-minute extinction period. For half of the subjects, the color of the on-screen stimulus was the same as in the previous (reinforced) condition; for the other half, the on-screen stimulus was a novel color. Data from the extinction phase showed that subjects who had the same color stimulus perseverated in the key sequence formerly reinforced under that stimulus condition, with no resurgence to exact earlier key sequences and no novel key sequences. They did blend some older sequences together, but most of these blends included elements from the final reinforced sequence. Subjects who experienced the novel stimulus in extinction emitted more instances of pure resurgence, a few novel sequences, and a larger proportion of blends of older patterns. The largest proportion of the resurgence consisted of the very first key sequence reinforced originally. The occurrence of blends shows that fragmentary or partial resurgence is common in extinction.

Association for Behavior Analysis, Atlanta, GA, May, 1994.

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Stimulus Control of Stimulus Selection

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A question yet to be fully addressed in behavior analysis concerns the mechanism whereby some stimuli come to control the selection of other stimuli where there is a consistent relation between them. The current conception of conditional discrimination control, wherein the probability of a selection response to one stimulus (the comparison) is heightened by the presence of another (the sample), seems limited because it treats all stimuli as if they were arbitrarily paired. As a result, this approach cannot account for generalization based on relations (such as identity). This paper discusses an alternate notion: one that treats the selection response as an autoclitic report of the occurrence of joint control between two other verbal relations--one describing the sample, and one describing the comparison. Such a notion appreciates consistent relations between stimuli, and as the data illustrate, accounts for a wide variety of generalized performances based on consistent relations.

The Experimental Analysis of Behaviour Group, London, April, 1994.

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A Stimulus-Class Analysis of Stimulus Control Shaping Procedures: Preliminary Studies

Richard W. Serna
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This poster presents data from recently initiated research that examines basic processes in stimulus control transfer via a stimulus-class analysis. A major hypothesis of such an analysis is that a series of stimuli will maintain control across a program of gradual stimulus change only if the subject discriminates the stimuli from adjacent steps of the program as members of the same feature class. Stimuli in a feature class are discriminated on the basis of similar, though not identical, features. Preliminary studies examined ways in which subjects' perception of feature-class characteristics of graded series of stimuli can be assessed in the context of a blank-comparison matching-to-sample (MTS) task. Blank-comparison MTS can be viewed as a "yes/no" procedure that asks the subject whether the sample and displayed comparison stimuli are related. If they are related, the subject makes a "yes" response by selecting the displayed stimulus; if not, he/she makes a "no" response by selecting a blank (blacked out) display. Requirements of a feature-class assessment are that subjects (a) maintain reliable similar-feature MTS performance, where sample-comparison relations are based on similarity, (b) maintain similar-feature MTS performance in the context of the blank-comparison procedure, and (c) respond consistently to novel stimulus probes that are interspersed into a blank-comparison baseline. Results from studies with persons with severe mental retardation show that the assessment is feasible. These results lay the groundwork for more sophisticated procedures to assess and utilize feature-class membership to determine optimal programming in stimulus control shaping.

The 27th Annual Gatlinburg Conference, Gatlinburg, TN, March, 1994.

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Time-out Postponement in Humans with no Reduction in Overall Time-out Frequency

Brendan F. Tompkins* and
Timothy D. Hackenberg
The University of Florida

In traditional free-operant avoidance procedures, two variables are confounded: (1) overall shock frequency reduction, and (2) postponement of individual shocks. Hineline (1970) devised a procedure that separated the effects of these two variables. He found that, with overall shock frequency held constant, shock-postponement maintained avoidance behavior in rats. The present experiment was a systematic replication of Hineline's experiment. Instead of rats, three adult college students from the University of Florida participated as subjects. Instead of shock, the aversive events consisted of brief interruptions of a continuously running video signal. As in Hineline's study, responding affected the temporal position of aversive events within a trial, but had no effect on their overall frequency or duration. Under these conditions, responding that postponed timeouts was maintained in all three subjects. Responding occurred at a level which postponed nearly all of the timeouts in every session. When responses no longer affected the temporal positioning of the timeouts, responding quickly dropped to low levels in all of the subjects. Upon reinstating the timeout-postponement contingencies, postponement responding recovered. The current procedure allows two variables that can maintain responding in avoidance procedures to be dissociated. With molar variables, such as overall timeout-frequency reduction, held constant, more molecular variables were sufficient to maintain responding.

Reference

Hineline, P. N. (1970). Negative reinforcement without shock-frequency reduction. *Journal of the Experimental Analysis of Behavior*, 14, 259-268.

Association for Behavior Analysis, Atlanta, GA, May, 1994.

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Sample Number and Accuracy of Delayed Matching to Sample

Dean C. Williams, Mark D. Johnston, and Kathryn J. Saunders
University of Kansas
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We compared performance on delayed, two-choice, identity matching to sample across 0, 4, 8, & 16 s delays in 6 subjects with mild mental retardation. Samples were always single stimuli. All subjects were exposed to a form of the task involving only two different stimuli as samples across trials. Subjects were also exposed to one or more of the following variations: (1) trial-unique sessions with new sample and comparison stimuli presented on every trial, or (2) sessions with either 6 or 12 different stimuli serving as samples and comparisons. Accuracy was high on simultaneous and 0 s delayed matching regardless of the number of samples per session. At longer delays, 3 subjects showed substantial differences as a function of sample number. Accuracy was highest on the trial-unique and 12-sample sessions and decreased with stimulus number. Least accurate performance was obtained on 2 sample sessions at the greatest delays. Thus, the delayed matching task is more difficult when fewer rather than more stimuli are included in a session. This effect is likely due to the recency with which an S- has served as an S+ (proactive interference) with smaller stimulus sets. These observations enhance the value of delayed matching for assessing drug effects in people across different levels of intellectual functioning. They indicate a variable, in addition to delay value, that can affect task difficulty and the potential sensitivity of the measures. In addition, they have implications for teaching procedures that use the match-to-sample format.

Association for Behavior Analysis, Atlanta GA, May, 1994.

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*RECENT PUBLICATIONS OF EAHB SIG MEMBERS**

Mandell, C., & Sheen, V. (in press). Equivalence class formation as a function of the pronounceability of the sample stimulus. *Behavioural Processes.*

Schaal, D. W., & Hackenberg, T. D. (in press). Toward a functional analysis of drug treatments for behavior problems in people with developmental disabilities. *American Journal on Mental Retardation.*

Smeets, P. M., & Striefel, S. (1994). Matching to complex stimuli under non-reinforced conditions: Errorless transfer from identity to arbitrary matching tasks. *The Quarterly Journal of Experimental Psychology*, **47B**, 39-62.

Williams, D. C., & Saunders, K. J. (in press). Methodological issues in the study of drug effects on cognitive skills in mental retardation. In N. W. Bray (Ed.), *International review of research in mental retardation.* New York: Academic Press.

*Excludes *JEAB*, *JABA*, and *The Behavioral Analyst.*

New EAHB SIG Chairs

We are happy to announce the new Chairs of the SIG and editors of the *EAHB Bulletin*: Dean Williams of The University of Kansas and Tom Critchfield of Auburn University. Tom and Dean will be serving for the next 2 years. Their editorship of the *Bulletin* will begin with the next issue (Fall 1994).

SUBMIT ABSTRACTS, ARTICLES, CHAPTERS, AND BOOKS PUBLISHED, AND GRANTS RECEIVED FOR THE NEXT ISSUE

To keep current with member activities we would like to publish abstracts from conference presentations, articles published or in press, and grants received in every issue. Please send abstracts from ABA, Behavioral Pharmacology, and other Spring conferences. Abstracts (including those published as part of "Grants Received") should be no more than 200 words; those longer than 250 words will be returned to you for editing. Send to Dean Williams by October 1, 1994.

GRANTS AWARDED TO EAHB SIG MEMBERS

Grant Title: Species Differences in Choice and Self-Control
Principal Investigator: T. D. Hackenberg
Affiliation: University of Florida
Agency: National Institute of Mental Health
Dates: 04/01/94 - 03/31/97
Amount: $271,931

Several converging lines of evidence point to notable human-nonhuman differences in choices with contrasting short-term and longer-term outcomes. This balancing of immediate against temporally remote consequences is implicit in many issues concerning human health and welfare (e.g., preventive medicine, drug abuse, pollution); it is also a key relationship in cost/benefit interpretations of human and nonhuman behavior, such as optimality theory in behavioral ecology and maximization theory in microeconomics. In the proposed research, two related lines of experimentation will be pursued concurrently. One line of work, conducted with pigeons, squirrel monkeys, and humans, seeks to minimize procedural differences, particularly differences in motivational/economic context, of which human-nonhuman discrepancies reported in the literature may be partly a function. A second line of research, conducted with humans only, will focus on relations between verbal and nonverbal functioning, and the participation of such functioning in human-nonhuman differences. Together, this work will help clarify human-nonhuman differences in choice and self-control, and the degree to which principles discovered in the nonhuman laboratory are applicable to fairly complex human behavior. In identifying variables of which adaptive choice is a function, this research may also provide a starting point for developing effective self-management techniques in humans.

Grant Title: Stimulus Control Transfer in Mental Retardation
Principal Investigator: Richard W. Serna
Agency: NIH, HUD-3
Dates: July 1, 1994 to June 30, 1999
Amount: $349,361

This NIH - FIRST award is a 5-year, process-oriented study of stimulus control transfer in individuals with severe to moderate intellectual disabilities. The research will contribute to a general theoretical account of such transfer, and also to the development of a more effective and efficient teaching technology for this population. The project derived from recent studies that sought reliable methods for teaching arbitrary conditional relations (i.e., those not based on common physical features). Those studies made obvious certain questions about basic processes involved in stimulus control transfer. For example, in programs that teach by graduated stimulus change (e.g., fading and shaping), what kinds of relations among the stimuli in the series result in successful transfer? What accounts for failure to transfer during these procedures? Answers to these questions will contribute not only to a theoretical account of stimulus control transfer, but to the prediction of optimal arrangements of training conditions. Regrettably, relevant research during the past two decades has not much clarified the basic processes involved. As a consequence, stimulus control shaping continues to be regarded as more empirically derived art than theoretically integrated science. This project has two main goals. First, I plan to conduct a theoretically guided analysis of basic processes involved in stimulus control shaping. In particular, I will analyze interactions among feature classes (stimulus classes defined by physical features) in the course of stimulus control transfer. Second, I plan to apply what I learn from this analysis to improve discrimination training methodology.

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