SAMPLE STIMULUS CONTROL SHAPING AND RESTRICTED STIMULUS CONTROL IN CAPUCHIN MONKEYS: A METHODOLOGICAL NOTE

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This paper reports use of sample stimulus control shaping procedures to teach arbitrary matching-to-sample to 2 capuchin monkeys (*Cebus apella*). The procedures started with identity matching-to-sample. During shaping, stimulus features of the sample were altered gradually, rendering samples and comparisons increasingly physically dissimilar. The objective was to transform identity matching into arbitrary matching (i.e., matching not based on common physical features of the sample and comparison stimuli). Experiment 1 used a two-comparison procedure. The shaping procedure was ultimately effective, but occasional high error rates at certain program steps inspired a follow-up study. Experiment 2 used the same basic approach, but with a three-comparison matching task. During shaping, the monkey performed accurately until the final steps of the program. Subsequent experimentation tested the hypothesis that the decrease in accuracy was due to restricted stimulus control by sample stimulus features that had not yet been changed in the shaping program. Results were consistent with this hypothesis, thus suggesting a new approach that may transform the sample stimulus control shaping procedure from a sometimes useful laboratory tool to a more general approach to teaching the first instance of arbitrary matching performances to participants who show protracted difficulties in learning such performances.

Key words: matching-to-sample, restricted stimulus control, stimulus control shaping, touching, *Cebus apella*

The first instances of arbitrary matching-to-sample are often very difficult to establish by differential reinforcement procedures in nonhuman primates (cf. Sidman et al., 1982) and in humans with intellectual disabilities (cf. Saunders & Spradlin, 1989, 1990). In smaller scale, the same sort of difficulties have been reported for normally-developing children younger than 4 years old (Augustson & Dougher, 1991; Jordan, Pilgrim, & Galizio, 2001; Pilgrim, Jackson, & Galizio, 2000; Zygmont, Lazar, Dube, & McIlvane, 1992). However, errorless training (i.e., procedures featuring stimulus control shaping protocols [McIlvane & Dube, 1992] such as delayed prompting [see Handen & Zane, 1987], fading [Terrace, 1963], and exclusion [Dixon, 1977]), may facilitate establishing such repertoire.

In stimulus control shaping, after a baseline of simple or conditional discriminative stimulus control training, for example identity matching-to-sample, one implements programmed, typically gradual stimulus changes over a series of shaping trials, for example, in the shape of the sample stimuli so that the task is gradually transformed into an arbitrary matching-to-sample task. Such programs may be used to achieve both intradimensional and extradimensional shifts in stimulus control

This project was supported by a Doctoral Fellowship from CNPq to Ana Leda de Faria Brino, Master Fellowship from CAPES to Ilara dos Reis Nogueira da Cruz, and José Ricardo dos Santos, CNPq Research Productivity Fellowships to Olavo Galvão and Romariz Barros and NIH Grants #HD39816 and HD04147 to William McIlvane. Manuscript preparation was supported in part by Grant # MH90272. Additional support was provided by MCT, Funding announcement 15/2008, with funds from National Council for Scientific and Technologic Development (CNPq, #573972/2008-7) and Research Agency of São Paulo State (FAPESP, #2008/57705-8) in the program of National Institute of Science and Technology on Behavior, Cognition and Education. All aspects of the monkeys' care and research participation were approved and monitored by the Ethics Committee for Animal Research from Federal University of Pará (license # CEPAE-UFPA PS001/2005) in accordance with both local and international standards governing participation of animals in research. Protocols for the experimentation and for the general care of the animals were approved also by IBAMA (Environment Brazilian Institute). We thank Klena Sarges for veterinarian assistance and Adilson Pastana for the excellent home-cage care that our monkeys received.

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doi: 10.1901/jeab.2011.95-387

(e.g., Sidman & Stoddard, 1967), including cross-modality stimulus control transfer (Almeida-Verdu et al., 2008).

The advantage of using well-constructed stimulus control shaping programs is the reduction of error rates, helping to minimize associated emotional reactions (Stoddard & Sidman, 1967) and undesirable instability and/or shifts in discriminative control to stimulus features that are irrelevant from the perspective of the experimenter or teacher (cf. Stoddard & Sidman, 1971).

Interest in the stimulus equivalence potential of nonverbal participants (Hayes, 1991; Horne & Lowe, 1996; Sidman, 1994) has focused attention on the problem of establishing arbitrary matching relations with stimulus sets that can be presumed to be unfamiliar to participants (e.g., Greek letters, abstract nonrepresentative forms, etc.) to control for extra-experimental learning. Establishing such arbitrary-matching baselines can be a time- and labor-intensive process that handicaps both laboratory (e.g., Sidman & Cresson, 1973) and translational research (e.g., in developing augmentative or alternative communication repertoires in so-called ''beginning communicators''—Riechle, Beukelman, & Light, 2002).

Zygmont et al. (1992) reported a sample stimulus control shaping procedure that they hoped might provide a general procedural solution to the difficulties of teaching the first instances of arbitrary matching to nonverbal participants. Their participants were children with and without intellectual disabilities. Training commenced with an established identity matching-to-sample baseline (sample–comparison relation B1B1 and B2B2). Then, the sample stimuli (B1 and B2) were gradually transformed into physically dissimilar forms (A1 and A2), thus establishing arbitrary matching relations A1B1 and A2B2. Carr, Wilkinson, Blackman, and McIlvane (2000) systematically replicated Zygmont et al.'s results with children who had severe intellectual disabilities and minimal verbal repertoires.

The research reported here is part of a larger program with the overall goal of reducing errors in acquisition of relational learning tasks in nonverbal humans and nonhumans. In doing so, the program simultaneously advances two agendas—modeling the behavior of humans and nonhumans to inform habilitative procedures for the former (McIlvane et al., 2010) and evaluating the cognitive abilities of the latter. Regarding sample stimulus control shaping procedures specifically, collaborative studies with both nonverbal humans and capuchin monkeys have shown that while sample stimulus control shaping procedures can be a very efficient teaching method (as they were in 2 of 3 participants in Carr et al., 2000, and in 2-year-old children in Boelens, Broek, & Klarenbosch, 2000), they do not yet offer a general procedural solution to the difficulty, often reported in the literature, of establishing arbitrary matching baselines in nonverbal participants.

The purpose of the studies presented here is to report, for the first time in the literature, the use of sample stimulus shaping procedures to establish initial arbitrary conditional relations in capuchin monkeys that had previously exhibited generalized identity matching (Galvão et al., 2005). We also report our efforts to analyze a digression of stimulus control that is possibly recurrent when such stimulus control shaping procedures are carried out (Serna, 2004). These experiments make clear that the sample stimulus shaping procedure is an alternative technique to be used in nonhuman research and suggest directions for future translational work aimed at developing such a procedural solution.

EXPERIMENT 1

This study was a replication of the procedure reported by Zygmont et al. (1992) with *Cebus apella.* The sample stimulus control shaping program was virtually identical.

Method

Participant

Louis (M15), a male capuchin monkey, served. He was 3 years old, had been exposed previously to three-choice, zero-delay visual–visual identity matching-to-sample training, and he had shown strong evidence of generalized identity matching (reported in Galvão et al., 2005). Louis was housed with 3 other capuchins in a group cage (2.5 × 2.5 × 2.5 m) near the laboratory, and he was transported in a carrying cage to participate in sessions. He received regular veterinary care. No deprivation was employed. Louis had free access to water throughout the day, and he received the same daily food ration at 3 p.m., whether or not he participated in a session.

Apparatus

The procedures were conducted in an experimental chamber (0.8 × 0.8 × 0.7 m) made of aluminum, steel, and translucent Plexiglas. It was contained within its own room, attenuating noise and other extraneous environmental stimuli. A computer (PC 486 DX2 66) controlled all operations. One 36-cm VGA color monitor with a touch-sensitive screen (MicroTouch, Inc.) was used for stimulus presentation and response recording. A pellet dispenser (ENV–203 MED Associates) was used for delivering 190-mg banana pellets through a magazine centered below the monitor. A VCR camera was used to videotape sessions through a small window on the back wall of the chamber. The monkey's performance could also be directly observed through a larger window located on the same wall.

Stimuli

There were two sets of two stimuli each (5 × 5 cm)—black shapes on a light gray background (see Figure 1). Stimuli A1, A2, B1, and B2 were Greek letters—the same as those used by Zygmont et al. (1992). Across trials, stimuli were presented in any of nine unsystematically selected positions arranged in a 3 × 3 matrix on a computer screen.

General Procedure

A 0-s delay matching-to-sample procedure was used. Every trial started with a sample, displayed in any one of the nine matrix positions. A touch to this stimulus was required as observing response and was followed by (1) removal of the sample and (2) presentation of comparison stimuli in any two of the nine matrix positions. On every trial, one comparison was defined as the positive stimulus (S+). A touch to it was followed by (1) removal of all comparisons, (2) a red light presented immediately above the magazine opening, (3) a pellet delivery, and (4) a 6-s intertrial interval. The other comparison was defined as the negative stimulus (S−); touching it was followed by removal of the comparison stimuli and the intertrial interval.

Sessions were typically conducted 5 times per week, and the subject's food ration was served regularly 1 hr after the session. Experimental sessions concluded after 72 trials or 25 min, whichever occurred first.

Sample Stimulus Control Shaping Procedure

Step 1: Training two-comparison 0-delay identity matching with B1 and B2. This step was a necessary pretraining to verify a high-accuracy identity-matching baseline from which to launch the sample stimulus control shaping procedure. Sixty trials were required in each session, 30 of each trial type (B1B1 or B2B2). Mastery criterion was set at accuracy ≥ 90% correct for each of the two trial types in three consecutive sessions.

Step 2: Initiating sample stimulus control shaping. During the first four sessions of Step 2, 20 shaping trials with each sample were randomly interspersed within 40 baseline trials identical to those presented in Step 1. In the next two sessions, the same number of shaping trials was, also randomly, interspersed within a 32-trial identity-matching baseline. Note that the stimulus changes were small and intended to exploit probable ''feature class'' membership (i.e., relations involving stimuli that are physically similar rather than identical; cf. McIlvane, Dube, Green, & Serna, 1993). To indicate the probable feature class membership, stimuli involved in shaping trials are indicated alphanumerically as B1a:B1,B2 and B2a:B2,B1.

Steps 3 through 9: Continuing shaping. During these sessions, sample stimuli on shaping trials were progressively altered in form, becoming physically less similar to the corresponding comparison stimuli. Figure 1 shows the programmed stimulus changes. As the program progressed, 40 trials for the current step were randomly interspersed among 32 trials from the previous step.

At Step 9 (Final Performance), Louis was required to match comparison B1 to sample A1 and comparison B2 to sample A2 (the targeted AB arbitrary matching performance). Progression from one step to the next was typically programmed after the subject met a 90% session accuracy criterion. If accuracy on any given step deteriorated substantially at any point, reaching under 70% correct responses in two consecutive sessions, Louis was returned

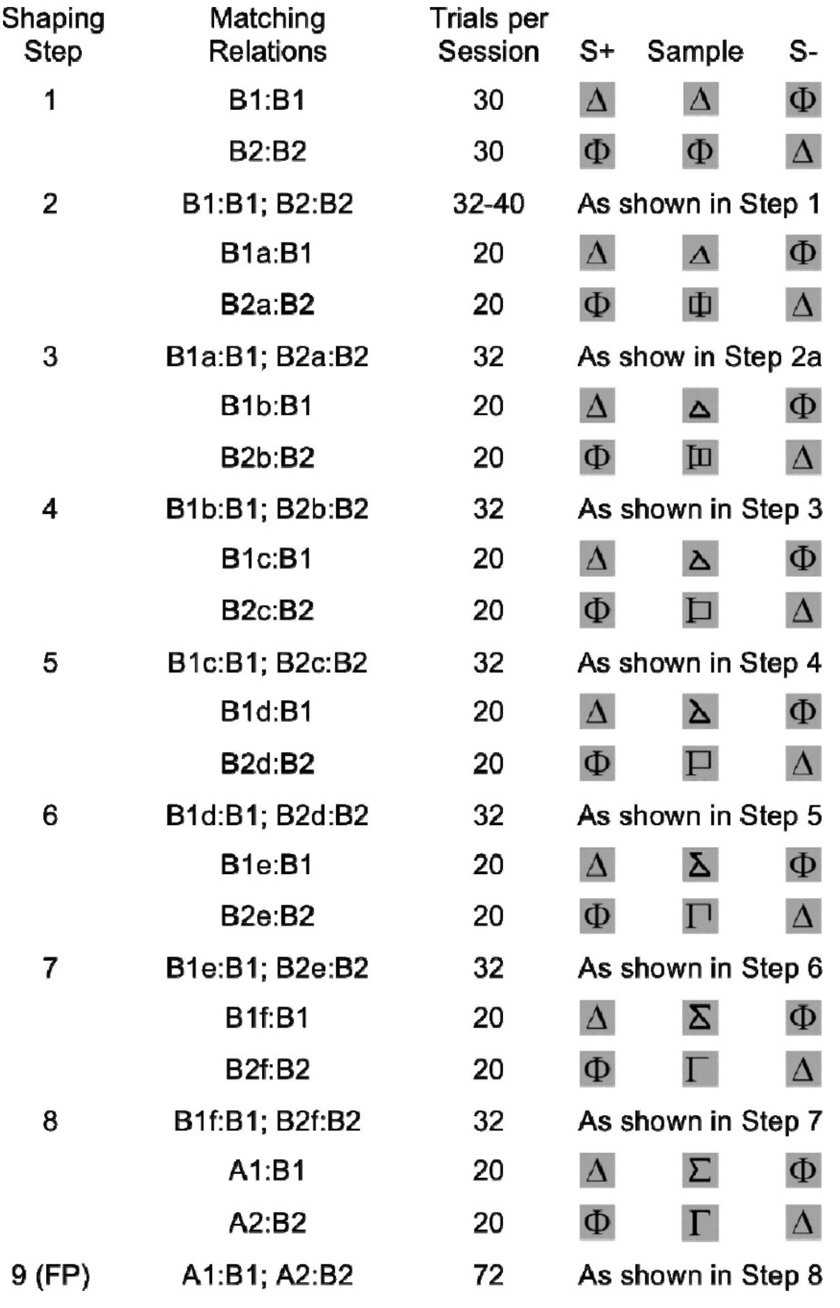

Fig. 1. Sample stimulus control shaping program used with Louis and derived from procedures of Zygmont et al. (1992). See the text for an explanation of the coding system used to label each of the program steps.

to the previous shaping step for one or more review sessions before proceeding.

Results and Discussion

Figure 2 shows accuracy scores during each of the steps of the sample stimulus control shaping procedure. At the majority of steps, Louis met the accuracy criterion in two to three sessions. However, the transitions from Step 3 to Step 4 and from Step 7 to Step 8 were problem areas, requiring more training sessions (10 and 11 sessions in Steps 4 and 8,

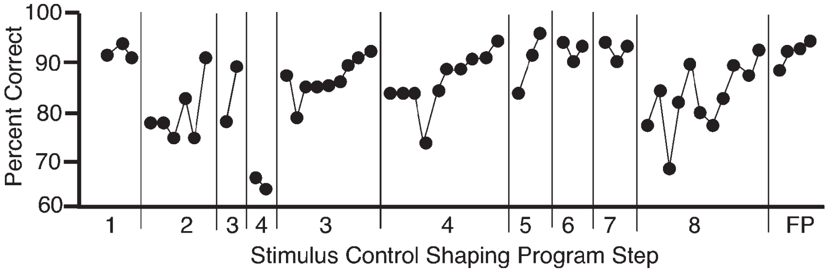

Fig. 2. Step-by-step program results from the shaping program used with Louis. (FP = final performance.)

respectively) until criterion or even a return to the anterior step (from step 4 to 3). These data are similar to those that have been obtained in research with humans with developmental limitations (e.g., McIlvane & Cataldo, 1996) and were not entirely unexpected. The procedure had been adapted directly from Zygmont et al. (1992), and the shaping series was not optimized (as in Sidman & Stoddard, 1967). Nevertheless, the method did prove feasible and effectively taught the targeted arbitrary matching. Thus, the data encouraged further studies aimed at refining the methodology and improving understanding of the variables that determine whether or not step-to-step transfer proves rapid and efficient.

EXPERIMENT 2

Subsequent research with both nonverbal humans and monkeys has shown us that while sample stimulus control shaping procedures can be effective, protracted shaping may be required, and error rates are not always kept low (two outcomes illustrated in Experiment 1). When protracted shaping is required, the method proves costly in terms of time and effort. Still, compared with a trial-and-error procedure, sample stimulus control shaping procedure seems to be more effective to create arbitrary conditional discrimination repertoires because it is a condition with higher probabilities of reinforcement. Boelens et al. (2000) and Jordan et al. (2001) showed that 2–3-year-old children exposed to sample stimulus control shaping were able to learn arbitrary relations, a repertoire that could not be taught to children of the same age (Augustson & Dougher, 1991) or 3–6-year-old children (Pilgrim et al., 2000) using a trial and error procedure. Interestingly, the children's performance in the final training phase of Augustson and Dougher's experiment was similar to Louis' performance in problem areas in Experiment 1 of this study. Findings such as these suggest that the advantages of using stimulus shaping procedures outweigh its costs.

Research has been underway with both humans and monkeys to render the method more efficient and effective, aimed specifically at preventing breakdowns such as those that occurred at Steps 4 and 8 with Louis. Historically, the analysis of such breakdowns has been that the step occasioning the breakdown was ''too big'' to allow the learner to progress. There are two problems with this account. First, the logic is circular in that one infers adequate step size from success and inadequate step size from failure. Second, the account implies that merely making the program steps ever smaller is the solution to all breakdowns. It is not (e.g., Serna, 2004).

Refining program steps does prove helpful in many cases, however, perhaps especially early in the shaping series. That acknowledged, our laboratories have accumulated a number of cases with both humans and monkeys in which sample stimulus control shaping proceeds apparently successfully through virtually all programmed stimulus changes. However, at the final step of the program—wherein step differences seem very small—performance breaks down, sometimes even to chance levels. With humans (e.g., one in the study by Carr et al,. 2000), we have seen performances disrupted by changes of only a few pixels (out of hundreds) in a computer-generated form. In such cases, it is hard to conclude merely that the final program step was ''too big.''

Experiment 2 evaluated a hypothesis that has emerged over time from the human studies: One unintended side-effect of the sample stimulus control shaping might be de facto shaping of unintended restricted stimulus control by stimulus features that remain unchanged during the program. To illustrate and clarify, if samples and comparisons used in shaping procedures retain their identity relations at the level of specific features—even seemingly minuscule ones—then these unchanged features are available to serve as the basis for matching-to-sample. Such ''hidden'' identity relations are irrelevant stimulus control topographies (McIlvane & Dube, 2003). If irrelevant control topographies predominate, then ever-finer changes in other stimulus features may be merely shaping along irrelevant stimulus dimensions and the program will fail (e.g. Touchette, 1969). Experiment 2 took this perspective in searching for possible determinants of late-program breakdowns in sample stimulus control shaping. Experiment 2 was part of a larger effort to develop arbitrary matching relations that could be used to assess the potential of *Cebus apella* to exhibit relational properties of stimulus equivalence.

Method

Participant

The participant was Guga (M09), a 7-year-old male *Cebus apella*. He had served also in earlier studies, exhibiting three-comparison identity matching-to-sample and generalized identity matching (Galvão et al., 2005). Guga lived with 3 other capuchins in an open-air cage close to the laboratory. An attached auxiliary cage (0.5 × 0.5 × 0.5 m) served as an access point to a transportation cage used to bring him to the laboratory for sessions.

Apparatus

Sessions were carried out in a test chamber (0.80 × 0.80 × 0.70 m) mounted in an aluminum superstructure contained within a larger cubicle (2.5 × 1.9 × 2.9 m). The floor, ceiling, and left wall of the chamber were made of steel screen with circular holes. The right and front walls were metal plate. A hinged door (0.35 × 0.20 m) on the left wall was used to access the interior of the chamber. A rectangular opening (0.26 × 0.20 m) in the front wall permitted the monkey to touch the touch-sensitive screen of a 33-cm color monitor that was used to display stimuli. Centered 24 cm below the opening was a receptacle for delivering 190-mg pellets via a tube connected to a Med Associates automatic pellet dispenser. All stimulus presentation and response recording was automatically managed by a microcomputer (AMD K6 150). A camera attached to the upper-right corner of the test chamber permitted video recording of sessions.

General Procedure

Sessions were conducted Monday through Friday. No food deprivation was used. Daily food ration was served at about 3 p.m., and the sessions were regularly conducted early in the morning. A 0-delay, three-comparison procedure was used throughout. Stimuli were black-and-white forms within a square white background (2.43 × 2.43 cm). Every matching-to-sample trial began with presentation of a sample in any of nine positions of a 3 × 3 matrix on a computer screen. When Guga touched it, the sample was replaced by three comparison stimuli in positions that varied unsystematically across trials. If Guga touched a stimulus defined as S+ (i.e., a match to the sample), a pellet was delivered immediately and a 6-s intertrial interval commenced. If he touched an S−, the intertrial interval commenced and no pellet was delivered. Sessions ended after a predetermined number of trials were completed or after 25 min, whichever came sooner.

Stimulus Control Shaping

Figure 3 shows a subset of trials from the shaping program which was similar to the program used with Louis except that (1) a greater number of shaping steps were programmed and (2) the shaping methodology used a somewhat different approach. Initially, Guga's baseline was identity matching with stimuli from Set D (D1D1, D2D2, and D3D3). During shaping, samples were transformed via replacement of horizontal bands of the Set D stimuli with ''geographically'' corresponding bands derived from Set C stimuli. Whenever a stimulus change was made, it applied to all members of the set. The shaping procedure sought to replace gradually and completely the bands of Set D sample stimulus components with bands of Set C components such that Guga would come ultimately to show accurate CD arbitrary matching.

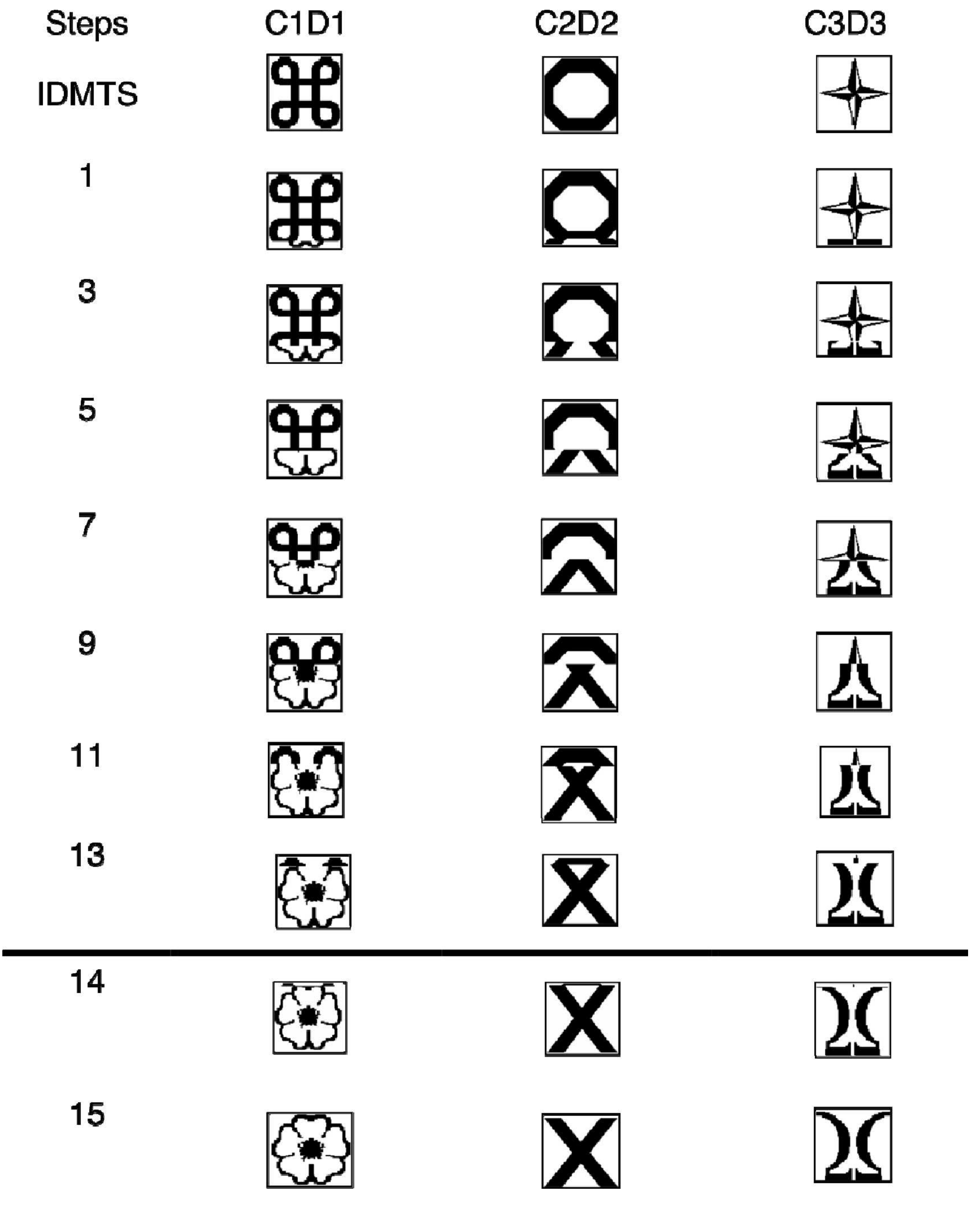

Fig. 3. Illustrative steps of the sample stimulus control shaping procedure used with Guga. The horizontal black line shows the point at which the program broke down after Step 13.

Stimulus Control Analysis Probe Procedures

These were implemented after precipitous drops in accuracy in the late stages of the shaping procedure (shown by the horizontal bar in Figure 3). Probes were carried out over three sessions. In each, test trials presented a different portion of the sample stimuli C2 and C3 from Step 13 (the omission of C1 is

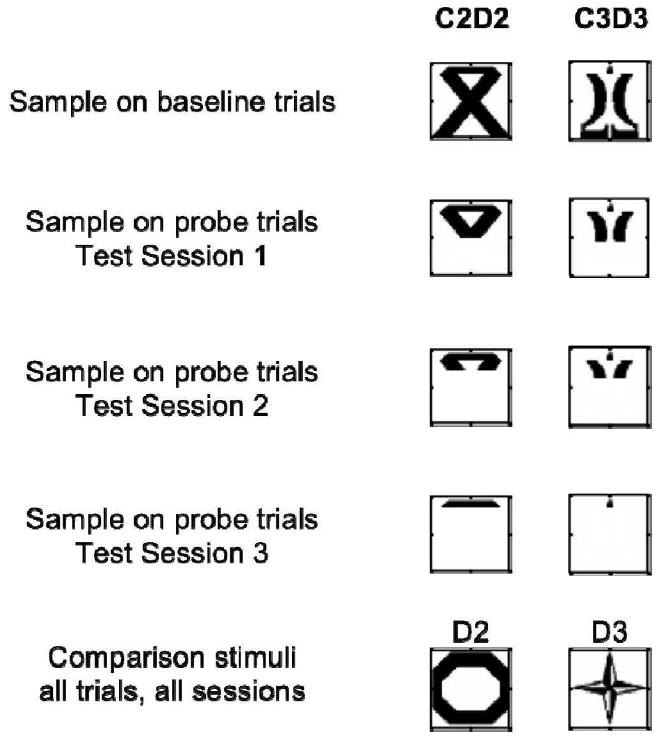

Fig. 4. C2 and C3 stimuli displayed on baseline and probe trials in Experiment 2.

explained with the Results). Via this method, we sought to assess the degree to which sample stimulus features that were unchanged (or virtually so) during shaping would retain stimulus control of accurate matching to the comparison stimuli.

Figure 4 shows probe trial types from each probe session. Each such session presented 46 baseline and 8 probe trials. Baseline trials presented relation C1D1 at the final performance (Step 15) and C2D2 and C3D3 at Step 13 (Figure 4, Row 1), the latter being the step before the breakdown. Test trials presented components of C2 and C3 as samples. In Test Session 1, tests displayed the upper halves of C2 and C3 as samples (Row 2). In Test Session 2, tests displayed a smaller portion of the uppermost parts of C2 and C3 (Row 3). In Test Session 3, tests displayed very small portions of the uppermost parts of the C2 and C3 at Step 13 – the only remaining stimulus components that were identical with those comparisons D2 and D3 respectively (Row 4). On all three tests, the comparisons were always from Set D (Row 5).

Results and Discussion

During the shaping program, Guga virtually always selected comparison D1 when the sample was C1. Accuracy was similarly high on trials on which C2 or C3 was the sample until Step 14 of the program. At this point, accuracy dropped to near-chance levels on the two trial types—a program breakdown similar to that seen at Step 4 in the program used with Louis.

During probe sessions, selections on baseline trials were virtually errorless (one error in 138 trials presented in three sessions). Figure 5 shows results on the probe trials of Tests 1–3. The number of probe trials in each test session was eight, four each of the two possible types (C2D2 and C3D3). All of the scores were well above the chance level (represented by the dashed horizontal line in Figure 5) for a three-comparison task.

The high score on Test 1, seven correct of eight responses (87.5%), showed that presenting only a portion of the C2 and C3 samples did not disrupt accuracy appreciably. The above-chance results of Test 2, six correct of

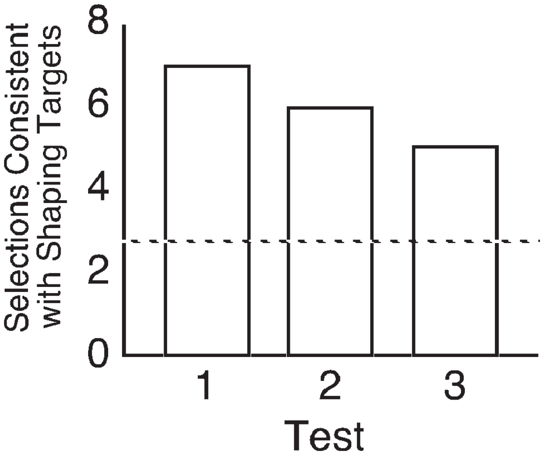

Fig. 5. Results of probe tests conducted in Experiment 2. Histograms show the number of trials (out of 8) on which Guga selected the comparison stimulus corresponding to the sample on each type of probe trial. The horizontal line shows the level of performance that would be expected by chance.

eight responses (75%), suggest retained control by only a restricted subset of stimulus features common to the sample and comparison stimuli. Which feature(s) actually controlled behavior was not revealed by the test, but one might speculate that the thick top line of sample C2 and/or the diminishing top central feature of sample C3 was/were important, the presence versus absence of which rendered selections of D2 or D3 more or less probable. The results of Test 3, five correct of eight responses (62.5%), were more equivocal, perhaps because all but a miniscule portion of the original controlling features were now absent.

The breakdown in accuracy at Step 14, the probe data, and visual comparison of Steps 13 and 14 together suggest that little or no control had developed by the new (nonidentical) C2 and C3 stimulus features that were coming to predominate as shaping proceeded. Had such new control developed, one could have anticipated high accuracy when new features were combined with the original ones. That did not happen; these combinations failed to support accurate matching at Step 14. Our conclusion is speculative, of course, because we did not conduct probe tests with the new features. Doing so might have obliterated the program control entirely and undercut our objective of teaching CD matching and ultimately conducting symmetry tests with Guga, which was accomplished subsequent to the probing.

GENERAL DISCUSSION

We report these studies primarily to focus attention on the general methodological issue of how to develop the first instances of arbitrary matching-to-sample in participants without verbal repertoires that can be used in prompting correct performances. Despite much research by us and colleagues who work with such participants (e.g., Saunders & Spradlin, 1989, 1990; Sidman et al., 1982), we do not yet have a reliably rapid, efficient method for teaching initial arbitrary matching baselines to nonhuman primates or to children who are minimally verbal or nonverbal. (Teaching new relations within the context of an established arbitrary matching baseline does not present the same challenges in that efficient, effective teaching methods based on exclusion [McIlvane & Stoddard, 1981] typically suffice in this application.)

Although programming methods such as sample stimulus control shaping (Boelens et al., 2000; Carr et al., 2000; Jordan et al., 2001; Zygmont et al., 1992) and those that require successive discrimination of samples (e.g., Saunders & Spradlin, 1989; Sidman et al., 1982) often do succeed with minimally verbal or nonverbal participants, they may also often require protracted, time- and labor-intensive efforts. The main question, of course, is why there is unaccounted variability across individuals. Here, the stimulus control topography coherence analysis seems to apply (McIlvane & Dube, 2003; McIlvane, Serna, Dube, & Stromer, 2000). Briefly, it emphasizes the need to design contingencies that require stimulus control by features that the experimenter or teacher intends to establish—not assume that participants will attend to those features spontaneously (see Stoddard, 1968, for a particularly instructive illustration of a mismatch between the intended and actual effects of stimulus control procedures).

We think that our two-experiment series has two main points of interest. First, Experiment 1 systematically replicated the results of the study by Zygmont et al. (1992) with *Cebus apella*—to our knowledge the first study to demonstrate arbitrary matching acquisition via sample stimulus control shaping procedure in nonhumans. Second, the results of Experiment 2 point to a variable that may help us to understand why there is variability in outcomes across individuals and tasks in sample stimulus control shaping procedures. Experiment 2 strongly suggests that the program breakdown at Step 14 resulted because Guga continued to attend to the unchanging stimulus features of C2 and C3—despite the fact that the ''new'' features gradually replacing the ''old'' features were novel and becoming progressively more prominent as shaping progressed. Restriction in stimulus control of this type recalls findings in the human clinical literature that have been termed *stimulus overselectivity* or *restricted stimulus control* (e.g. Dube & McIlvane, 1997, 1999; Litrownik, McInnis, Wetzel-Pritchard, & Filipelli, 1978; Lovaas, Koegel & Schreibman, 1979). These investigators studied procedures that exposed children with autism and related neurodevelopmental disabilities to stimuli with multiple stimulus dimensions or components. They discovered that such children attended only to a subset of the dimensions/components, apparently ignoring other seemingly obvious ones.

If, as we suspect, our monkeys' failures during shaping were due to overselective attending to unchanging features, then the way to improve such procedures is *not* to make the steps smaller and more gradual—the standard remedial technique that emerged from research on errorless learning techniques (e.g., Sidman & Stoddard, 1967). Indeed, smaller, more gradual shaping steps might actually exacerbate problems—resulting perhaps in the shaping of even more restricted stimulus control. We think that must be what happens when a seemingly well-constructed shaping series (1) brings the participant to the penultimate program steps with few or no errors (2) only to fail completely at the final performance.

If we are correct in our analysis of stimulus control shaping procedures and processes, then shaping technology might be informed by techniques that have proven useful in remediating overselective attending in the clinical literature. These include intermittent reinforcement schedules during shaping and stimulus sets that explicitly require attending to multiple elements to meet the requirements of the contingencies (Koegel & Schreibman, 1977; Schreibman, Charlop, & Koegel, 1982). One technique that may prove useful in forestalling unwanted restrictions in stimulus control during shaping was pioneered by Serna (2004); he presented shaping stimuli that not only changed in form but also had systematic deletions of varying portions of the stimuli such that attending to only a restricted set of stimulus features would not lead to consistently high accuracy.

Serna's (2004) approach might be extended via use of computer algorithms that systematically vary sample stimulus features during shaping such that no one feature or set of features would be preserved during the process. For example, the progressive replacement of bands that was done with Guga's program could have been done in a different manner. Instead of replacing bands progressively from the bottom to top (as shown in Figure 3), the replacements could have been made at points more broadly distributed across the stimuli and varied algorithmically such that different stimulus features were replaced on different trials. Doing this might encourage the participant to attend to a broader range of features in order to maintain accuracy during the program.

The strategy pioneered by Serna (2004) and extended as discussed here appears to be a novel one in stimulus control shaping procedure design. The objectives of stimulus control shaping at each program step would be defined as (1) developing stimulus control by new stimulus features and (2) discouraging exclusive control by those that had formerly served as the basis for discrimination—perhaps even at early program steps. Would this type of procedure forestall development of ''overselective'' attending to a narrow range of features during shaping? That outcome seems entirely possible.

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Received: December 2, 2010
Final Acceptance: February 16, 2011