

BRIEF REPORT

CONDITIONAL DISCRIMINATION AND STIMULUS EQUIVALENCE IN YOUNG CHILDREN FOLLOWING THREE DIFFERENT BASELINE TRAINING PROCEDURES

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It is widely recognized that subjects with developmental disabilities often encounter difficulties in learning arbitrary conditional discriminations (e.g., Eikeseth & Smith, 1992; McIlvane, Dube, Kledaras, Ienacco & Stoddard, 1990; Saunders & Spradlin, 1989, 1990, 1993). However, similar difficulties have been reported for young, normally-developing children (e.g., Augustson & Dougher, 1991; Pilgrim, Jackson & Galizio, 2000; Schilmoeller, Schilmoeller, Etzel & LeBlanc, 1979; Zygmont, Lazar, Dube & McIlvane, 1992). For example, in the Pilgrim et al. study, normally developing children (ages 3-6) failed to master an arbitrary match-to-sample (MTS) task under conditions of differential reinforcement, but acquisition was observed when specific instructions or sample-naming procedures were used. Unfortunately, the use of explicitly verbal procedures may be problematic when the experimental question involves emergent relations because of the theoretical controversy over the role of verbal processes in such relations (see for example, Horne & Lowe, 1996, and commentaries). In an attempt to develop a training procedure that required no verbal interaction with subjects, Pilgrim et al. also explored the effects of pretraining a conditional discrimination with thematically related stimuli (e.g., given a picture of a flower as a sample stimulus, choosing a picture of a vase, and not a cake was reinforced). This thematic MTS pretraining was effective in facilitating acquisition of an arbitrary conditional discrimination problem for most children.

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Although thematic MTS training contributed to acquisition in the absence of explicitly verbal interactions, Pilgrim et al. noted that the effectiveness of thematic training depended on children's pre-experimental histories with the thematic stimuli, and that these were likely to have involved verbal processes. In contrast, wholly non-verbal training procedures have been developed in other laboratories for teaching arbitrary MTS to children. For example, in sample stimulus-control shaping procedures (Etzel, Milla, & Nicholas, 1996; Zygmont et al., 1992) the sample stimuli in identity-matching relations are gradually changed until they are physically different from the reinforced comparison choice, thus establishing arbitrary relations. In sum, several different techniques are now available to facilitate the acquisition of arbitrary MTS in children. Little is known however about how these techniques compare in terms of speed of acquisition and number of errors, or with respect to the emergence of equivalence relations. The present study provides for preliminary consideration of specific instructions, thematic pretraining, and stimulus-control shaping with respect to these dimensions.

METHOD

Subjects and Apparatus

Nineteen children (ages 2 to 4) were studied in a quiet area in their preschool. A Macintosh computer was used for stimulus presentation and data recording using software designed by Dube (1991). Responses were made by touching an Edmark touchscreen or by moving and clicking a mouse.

Procedure

Each trial began with the presentation of a black and white stimulus in the center of the screen. A response to the sample stimulus produced three comparison stimuli displayed 7.5 cm from the sample, each in one of the four quadrants of the monitor. A response to the

comparison designated as correct produced a fanfare and animated stars while errors resulted in a buzzer. A 1.5 s intertrial interval separated the comparison choice from the presentation of the next trial's sample. Sessions consisted of 24 or 36 trials (depending on the training phase) and lasted approximately 15 min. Edible reinforcers (fruit, candy) were provided at the end of each session. Mastery criterion for each training phase was set at 90% correct for 2 consecutive sessions. For each training phase, sample stimuli appeared equally often, and the position of comparison stimuli varied unsystematically.

All children were initially pretrained with an identity matching task involving familiar and then abstract figures used only during pretraining. After meeting criterion, subjects were unsystematically assigned to one of three training conditions (with the three exceptions noted below) designed to facilitate acquisition of an arbitrary conditional discrimination with abstract stimuli (A1 B1, A2 B2, A3 B3). For children assigned to the Instruction Condition, the experimenter presented cards depicting A1, A2, B1 and B2 and told the child how to make correct responses: "When this object (A1 or A2) comes up in the middle of the screen, I want you to find this one (B1 or B2, respectively)." Children then began training in which A1 or A2 was presented as the sample, and B1 and B2 were the comparisons. The instructions were repeated prior to each of the first five trials of each session, and again following errors. After achieving the mastery criterion, subjects were exposed to the full AB baseline (as above but with B3 presented as a third comparison on all trials and A3 presented as a sample on 1/3 of the trials) without instructions.

Children assigned to the Thematic Condition received conditional discrimination training in which the sample and correct comparison stimulus were familiar members of a common category. Figure 1 shows the three thematic sets that were available including animals, body parts, and vehicles (Set 1), faces and trees (Set 2) and fruits and flowers (Set 3). During Thematic training, if, say, a picture of a cat was presented as a sample, then choosing a cow (rather than an airplane or a hand) was reinforced. After mastering one of the Thematic sets, subjects were presented with the arbitrary AB task (A1B1, A2B2, A3B3). If a subject showed no trend toward mastery of one of the Thematic sets within 10 sessions, a different set was introduced.



Figure 1

Finally, children in the Sample Stimulus-Control Shaping (SSCS) condition were initially exposed to identity matching with two stimuli, B1 and B2. Following mastery, sample stimulus B1 was gradually changed in shape through 18 successive steps progressively approximating, and finally becoming, stimulus A1. Training began with Step 1 (Identity matching) and following 5 consecutive correct responses moved to Step 2, and so on. Each new session began one shaping step lower than the highest one mastered on the preceding session. After Step 18 the arbitrary AB task with all six stimuli (A1B1, A2B2, A3B3) was introduced. Figure 2 shows the stimulus variations at each step of the shaping sequence.

After meeting criterion on AB, children in all conditions were trained on a second 3-choice conditional discrimination, AC, with trial and error conditions. When the AC discrimination was mastered, AB and AC trials were randomly mixed. When the mastery criterion was met, reinforcement density was reduced to 75% of the trials, and then to 50%. Probe trials were then interspersed with baseline trials on each subsequent session. Each subsequent session assessed only one equivalence property (i.e., reflexivity, AA, BB, CC; symmetry, BA, CA; or equivalence, BC, CB) with 6 or 9 probe trials per session, and probe testing was conducted for a minimum of 18 sessions in order to observe stable probe performances.

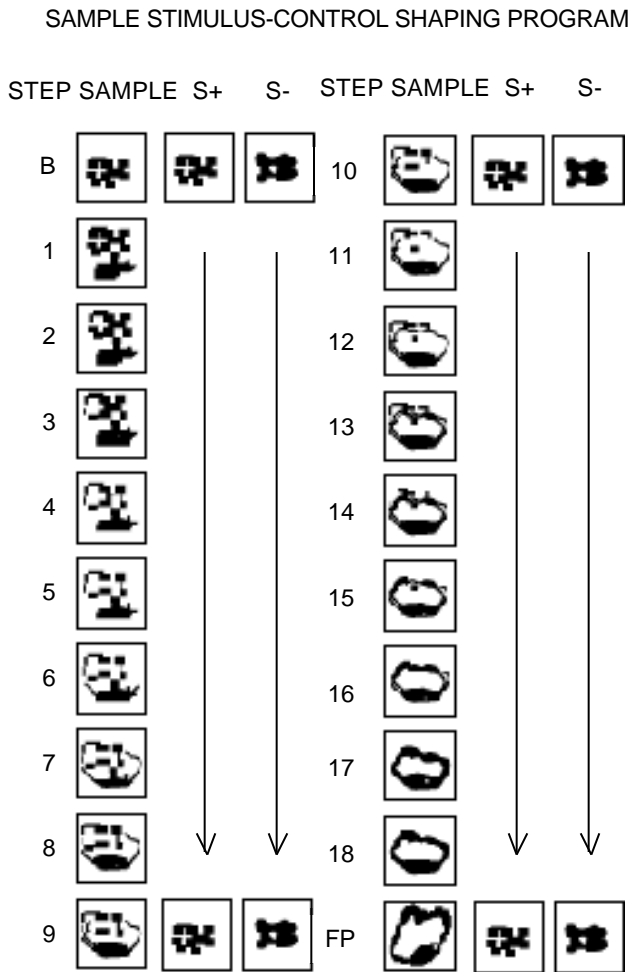


Figure 2

RESULTS

Five children were originally assigned to the Instructions condition (Mean age = 40.5 months), but one subject (TK) failed to acquire the discrimination with instructions and after 14 sessions was re-assigned to the SSCS condition. Twelve children were initially assigned to the Thematic condition (Mean age = 43.5 months), but two of these subjects failed to acquire the AB discrimination and after 14 (Subject CM) or 16 sessions (Subject JD) were re-assigned to the SSCS condition. Five subjects were studied in the SSCS condition (Mean age = 41.0 months) including the three children originally assigned to other conditions.

In order to assess the effectiveness of the three procedures, we determined the total number of sessions completed from the first session following pretraining to mastery of the initial AB conditional discrimination, as well as the

total number of errors made during this period. These data are presented for each subject in Figure 3. The four children who completed Instructions training showed the most rapid acquisition (top panel) and the fewest errors (bottom panel; but note that Subject TK, who failed to meet the training criterion is not included with the other four Instructions children in Figure 3). Acquisition was slower and more variable with SSCS and Thematic training. Two of the Thematic children (ST and AC) showed rapid acquisition (10 sessions or fewer) comparable to those trained with Instructions but several required nearly 40 total sessions (note JA, CW and TR), and two children never met criterion (CM and JD - not included with the other Thematic group children in Figure 3). Subjects in the SCSS conditions required an intermediate number of sessions (15-29), but tended to make fewer errors overall than children receiving Thematic training. (Note that data in Figure 3 from subject TK exclude sessions with instructions, and that data for CM and JD exclude sessions in Thematic training.) These differences were evaluated statistically through Median Tests which confirmed that fewer sessions to criterion were required with Instructions training than with either Thematic subjects ($p < .01$) or SCSS ($p < .05$), but that these latter groups did not differ ($p > .05$). Instructions subjects made significantly fewer errors than Thematic ($p < .05$), but the differences between Instructions and SCSS and between Thematic and SCSS were not significant.

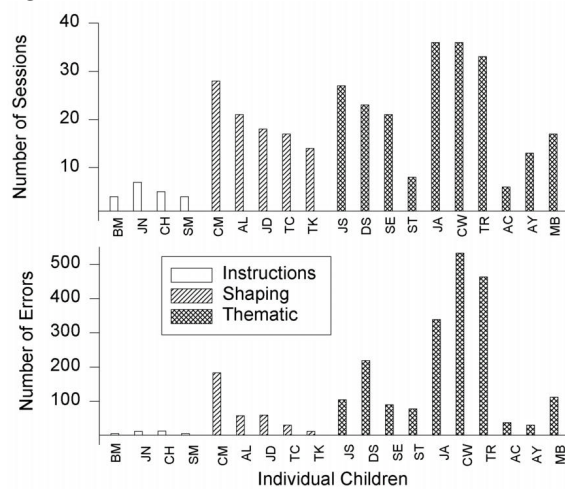


Figure 3

Figure 4 shows number of sessions (top panel) and number of errors (bottom panel) to reach

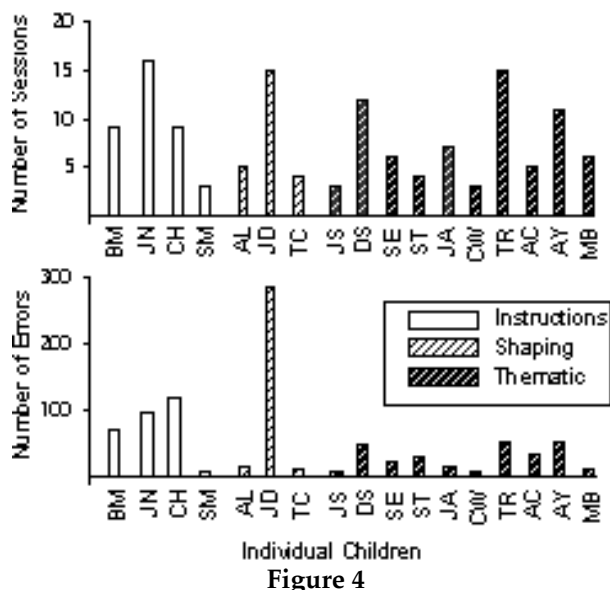


Figure 4

mastery criterion on the second conditional discrimination. Note that two subjects from the SCSS group (TK and CM) were not included in Figure 4 because they left the experiment during this phase. Although considerable variability is evident with both measures, there appears to be little evidence of any differences between training conditions and indeed, Median tests on sessions and errors were non-significant ($p > .05$).

Finally, Figure 5 shows performances on reflexivity, symmetry and equivalence probe trials during the final five sessions of probe testing. Eight of the nine subjects who reached this stage performed at criterion level (90% or higher) on each probe type, consistent with the formation of stimulus-equivalence classes. Subject CH, in the Instructions condition, reached criterion for reflexivity and symmetry, but after more than 60 total probe sessions had not met criterion on equivalence trials.

DISCUSSION

All three of the training methods used were effective in promoting the acquisition of an arbitrary conditional discrimination for most children. This is a valuable finding in that most children in the age group studied would not be expected to master this type of problem through trial and error (Augustson & Dougher, 1991; Pilgrim et al., 2000). Although all training procedures were effective, differences between procedures were noted. These differences must be interpreted with caution because of questions regarding the comparability of the groups prior

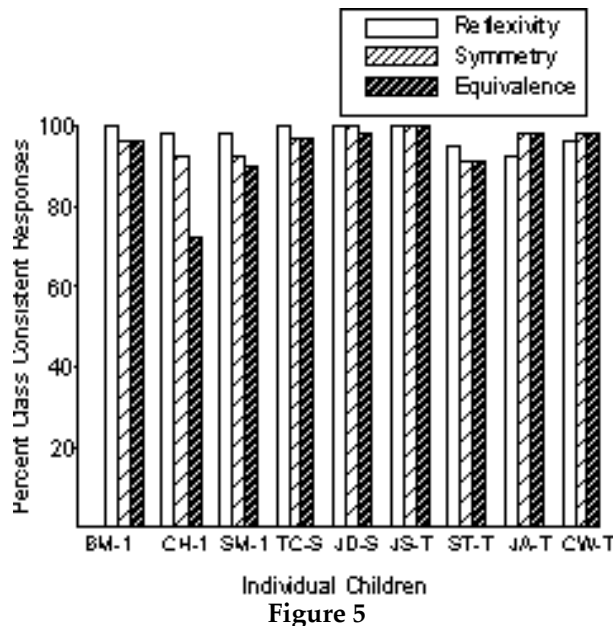


Figure 5

to training. For example, children in the Thematic training condition were, on the average, slightly older than those in the other two groups, and of course, three of the SCSS children were placed in that training condition only after failing in one of the other conditions. Nonetheless, it was interesting to note that instructions resulted in the most rapid acquisition with the fewest errors for the four subjects who completed the Instructions training. That one subject (TK) failed to reach mastery with instructions, however, indicates a limitation of this procedure. Subject TK appeared to have very low-level verbal abilities - most of her verbal interactions with the experimenters were characterized as echolalic in nature. Her failure to benefit from instructions illustrated that their effectiveness is limited to children with adequate verbal skills.

Thematic and SSCS training appeared to be about equally efficient in terms of sessions and errors to mastery of the initial conditional discrimination. The advantage of these techniques was that they did not explicitly require verbal skills on the part of the subject. Thematic training was effective in 10 of the 12 children tested and, given the ease with which it was programmed, has much to commend it. SSCS was effective in all five children tested. This success rate is particularly impressive given that three of these children had failed previously with Instructions (TK) or Thematic (CM & JD) training. One limitation of SSCS is the relative

response cost required to develop the graded stimulus sequences.

It is also worth noting that there were no differences in performance between subjects from the various training conditions with respect to acquisition of a second conditional discrimination. Finally nine of the 10 subjects tested showed emergent probe performances indicative of equivalence-class formation. Equivalence thus emerged whether or not the baseline training involved verbal manipulations. This seems an important finding given the procedural differences that characterize the literature on equivalence performances in young children.

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