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DERIVED MANDING IN CHILDREN WITH AUTISM: SYNTHESIZING SKINNER'S VERBAL BEHAVIOR *WITH RELATIONAL FRAME THEORY*

CAROL MURPHY, DERMOT BARNES-HOLMES, AND YVONNE BARNES-HOLMES

NATIONAL UNIVERSITY OF IRELAND, MAYNOOTH, IRELAND

Mand functions for two stimuli (A1 and A2) were trained for 3 children with autism and were then incorporated into two related conditional discriminations (A1-B1/A2 -B2 and B1-C1/B2-C2). Tests were conducted to probe for a derived transfer of mand response functions from A1 and A2 to C1 and C2, respectively. When 1 participant failed to demonstrate derived transfer of mand response functions, transfer training using exemplars was conducted. When participants had demonstrated derived transfer of mand functions, the X1 and X2 tokens that were employed as reinforcers for mand responses were incorporated into two conditional discriminations (X1-Y1/X2-Y2 and Y1-Z1/Y2-Z2). Tests were conducted for derived transfer of reinforcing functions. Finally, tests were conducted to determine if the participants would demonstrate derived manding for the derived reinforcers (present C1 and C2 to mand for Z1 and Z2, respectively). Derived transfer of functions was observed when the sequence of training and testing was reversed (i.e., training and testing reinforcing functions before mand response functions) and when only minimal instructions were provided.

DESCRIPTORS: derived transfer, mands, language, autism spectrum disorder, children

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Based on apparent functional similarities between certain features of human language and derived transfer effects, some researchers have argued that it may be useful to incorporate such effects into the study of human verbal behavior (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000). This position arose out of a recent behavioral account of human language and cognition known as relational frame theory (RFT; Dymond & Barnes, 1997; Hayes, 1991; Hayes, Barnes-Holmes, & Roche, 2001). This theory proposes that a stimulus is rendered verbal if its controlling properties are to some degree based on the derived transfer of functions. An example of such transfer occurs when a behavioral function directly trained for one member of an equivalence class emerges for other members of that class without direct training. This type of derived transfer has been demonstrated with discriminative functions (e.g., Barnes, Browne, Smeets, & Roche, 1995; Barnes & Keenan, 1993); elicited conditioned emotional functions (Dougher, Augustson, Markham, Greenway, & Wulfert, 1994), extinction functions (Dougher et al.), and self-discrimination functions (Dymond & Barnes, 1994), among others (e.g., Barnes-Holmes, Keane, Barnes-Holmes, & Smeets, 2000).

Barnes-Holmes, Barnes-Holmes, and Cullinan (2000) outlined one way in which RFT could be integrated, at a conceptual level, with the more traditional behavioral approach to human language that has arisen out of the work of Skinner (1957). Specifically, Barnes-Holmes et al. argued that each of Skinner's verbal operants (e.g., mands, tacts, autoclitics, intraverbals) could be divided into operants that involve the derived transfer of functions and those that do not. Thus, for instance, a distinc-

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Correspondence should be addressed to Carol Murphy at the Department of Psychology, National University of Ireland Maynooth, Co. Kildare, Ireland (e-mail: murphycarol1@netscape.net).

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tion may be made between explicitly reinforced and derived mands (Skinner referred to the latter as *magical*; see General Discussion). The former occurs, for example, when a child says "milk" as a mand based on a direct history of reinforcement for this utterance (i.e., in the past the utterance has increased the probability of obtaining milk from a caregiver). In contrast, a derived mand might result when the child subsequently learns that "bainne" is the Irish word for milk (the two words participate in an equivalence relation), and "bainne" may then function as a mand in the absence of direct reinforcement. In this case, the mand may be termed a derived mand, in that it has emerged in accordance with an equivalence relation and involves the derived transfer of functions.

The distinction between directly learned and derived responding may help to extend the analysis of human verbal behavior and integrate the burgeoning literature on derived relations with a Skinnerian account of human language (see also Esbenshade & Rosales-Ruiz, 2001; Silverman, Anderson, Marshall, & Baer, 1986; Stoddard & McIlvane, 1986). As an important step towards such integration in both an empirical and applied context, the current research involved developing a procedure to examine directly reinforced and derived mands in 7 children who had been diagnosed with autism.

A mand refers to what is usually termed a request, and mands are controlled, in part, by deprivation, satiation, and aversive stimulation (Skinner, 1957). Motivation may be the satisfaction of a need, or, in the case of aversive stimuli, termination of an event. Establishing a mand repertoire is very important for children with language deficits for many reasons (Sundberg & Michael, 2001), including bringing about conditions that are not already present. Moreover, establishing a repertoire of mands that are not directly trained is also important, because children with autism and associated learning difficulties frequently lack the behavioral flexibility demonstrated in normally developing children (Wahlberg & Jordan, 2001). For example, a child may be able to tact certain items but is unable to mand for the same items, and vice versa (Sundberg & Michael). Such inflexible repertoires may result when learned responses fail to generalize across situations. Developing procedures that successfully demonstrate derived or generalized responding may therefore help behavioral educators to assist children with specific language difficulties characterized by inflexible verbal repertoires.

Understanding the behavioral processes involved in generating a flexible repertoire of mand responses could be important in helping to reduce inappropriate behaviors when an autistic child's initial mand fails to produce reinforcement. For example, if the child has a range of appropriate mand responses within his or her repertoire, alternative appropriate mands may be emitted when an initial mand fails, rather than resorting immediately to inappropriate mands, such as tantrums and other challenging behaviors. One method for establishing such a repertoire could involve explicitly training multiple mand responses for the same reinforcer. Alternatively, according to Barnes-Holmes, Barnes-Holmes, and Cullinan (2000), it might be possible to establish a repertoire of multiple mands via derived transfer through equivalence relations, which would avoid having to train each mand individually. In other words, after establishing a single mand for a particular reinforcer, it may be possible to transfer that function to novel response forms via conditional discrimination training. Subsequently, a child may employ these novel forms as mands without a direct training history for doing so. The three experiments reported here were designed to explore this type of derived transfer of mand functions and related effects.

Experiment 1 was conducted with 3 children with autism. To examine the derived transfer of mand functions, a transitive conditioned establishing operation was arranged (see Michael, 1993). Specifically, this operation involved the absence of tokens from a token board, and a task that required children to mand for X1 and X2 tokens by presenting Stimulus Cards A1 and A2, respectively. Subsequently, conditional discrimination training trials were conducted as follows: A1-B1-C1, A2-B2-C2. Test trials were then conducted for a derived transfer of two distinct mand response functions in accordance with the trained conditional discriminations; that is, tests were conducted to determine if the children would mand for the two X tokens using C1 instead of A1 and C2 instead of A2, in the absence of direct reinforcement for doing so. Next, conditional discrimination training incorporating the two reinforcer tokens was conducted as follows: X1-Y1-Z1, X2-Y2-Z2. Tests were then conducted to probe for derived mands for the derived reinforcer tokens in accordance with the trained conditional discriminations (e.g., would the child present the C1 stimulus card to obtain the Z1 token). Experiment 2 was similar to Experiment 1, except that the sequence of events was reversed (training and testing for the transfer of reinforcer functions occurred prior to training and testing for the transfer of mand response functions). Experiment 3 was also similar to Experiment 1, but the instructions were reduced to a minimum to determine if the derived transfer effects obtained in the previous experiments depended, in some critical way, on the provision of detailed instructions.

GENERAL METHOD

Participants

Seven children with diagnoses of autism, including 1 child with dual diagnoses of autism and attention deficit hyperactivity disorder (ADHD), participated. The study was conducted over a period of roughly 18 months, and the children's ages during this period ranged between 5 years and 9 years. Four children were boys and 3 were girls, and all were students attending the Comprehensive Application of Applied Behavior Analysis to Schooling (CABAS) Project in Kilbarrack, Dublin, Ireland.

Each of the children was categorized as a speaker or early reader within the CABAS system. An individual described as a speaker has learned to imitate word topography and to apply appropriately emitted words with acquired mand, tact, autoclitic, and intraverbal functions. Students with an early reading repertoire have begun to learn to read and write simple words.

Experimental Setting

A desk and two chairs were used in all experimental phases, with each participant seated on one side facing the investigator, who was seated on the opposite side. For all test phases, a third chair was placed to one side of the investigator's chair (out of direct eye contact with the child), and the investigator moved to this chair while a second investigator, who was unaware of the previously trained performances, sat in the first investigator's chair. The second investigator conducted all tests, and the first investigator functioned as a second data recorder. Because the investigator who conducted the test phases was unaware of the previously trained performances, subtle cuing of the test performances was highly unlikely.

Sessions were usually conducted two or three times per week. Participants required varying numbers of sessions, and each session was interspersed with frequent 2- to 5-min breaks during which participants could engage in activities of their choice. Sessions normally lasted 1 to 2 hr, and there was usually a break of at least 1 day between sessions. If children showed any sign of distress or boredom, sessions were terminated and resumed at a later date.

Materials

Experiments 1 and 2. Each alphanumeric label (see Figure 1) refers to a specific arbitrary symbol or nonsense syllable that was clearly printed in black ink on the relevant stimulus. The six stimuli that were used for mand

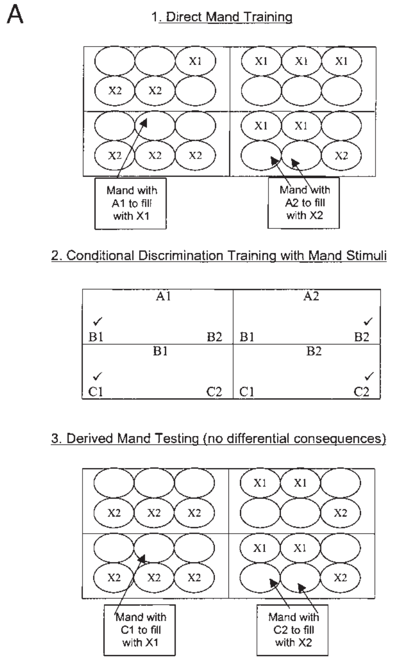

Figure 1A. Schematic representation of the training and testing tasks across each phase of Experiment 1.

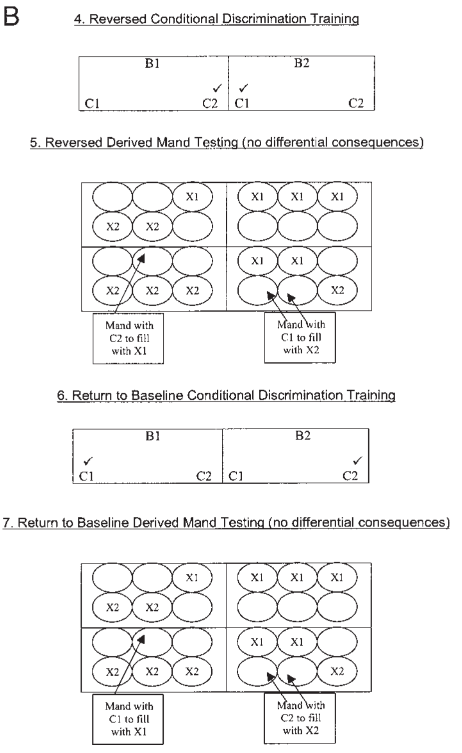

Figure 1B. Schematic representation of the training and testing tasks across each phase of Experiment 1.

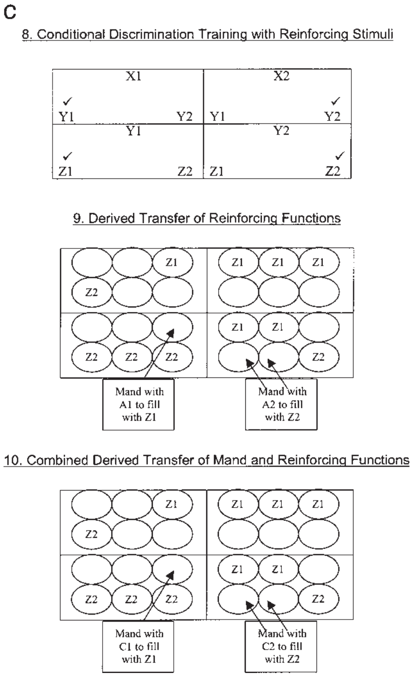

Figure 1C. Schematic representation of the training and testing tasks across each phase of Experiment 1.

training and testing and conditional discriminations consisted of six nonsense syllables (A1, A2, B1, B2, C1, and C2) that were printed on six cards (10 cm by 6 cm). Two cardboard boxes (12 cm by 6 cm by 6 cm) were used for the mand training and testing. A1 was printed on the lid of one box and A2 was printed on the lid of the other box. Six different abstract symbols (X1, Y1, Z1, X2, Y2, and Z2), printed on 8-cm cardboard disks, were used to train and test for derived transfer of reinforcer functions. A rectangular white felt mat (30 cm by 20 cm) with two rows of three empty circles (visual prompts) was used for the mand training and testing. Three extra sets of nonsense syllables were used with Participant 3 to provide exemplar training in the derived transfer of mand functions (Set 2: D1, D2, E1, E2, F1, and F2; Set 3: J1, J2, K1, K2, L1, and L2; Set 4: M1, M2, N1, N2, O1, and O2). Another set of nonsense syllables and abstract symbols were employed in Experiment 3; the alpahnumerics employed in Experiment 1 will be used to designate these stimuli, but it is important to note that the stimuli had not been seen before by any of the participants.

Interrater Agreement

For each experiment, correct responses were scored with a plus and incorrect responses were scored with a minus. Interrater agreement was calculated by dividing the total number of agreements by the number of agreements plus disagreements and multiplying by 100%. Agreement was calculated for all tests and was 100% across participants.

EXPERIMENT 1

Procedure

Direct mand training. The experimental task required each participant to mand on three successive occasions for either an X1 token or an X2 token to obtain the correct types of tokens to complete the token mat. Participants were trained to present the A1 stimulus card to the investigator to mand for an X1 token and to present the A2 stimulus card to mand for an X2 token. The token mat was complete when a row of three X1 tokens and a row of three X2 tokens were present. An equal number of trials commenced with three X1 or three X2 tokens absent, or with two X1 tokens and one X2 token absent or vice versa (see Figure 1A). For example, a mat with three X1 tokens present and three X2 tokens absent required that the student mand with A2 and only A2 on three successive occasions.

A direct mand response was scored as correct if the participant presented A1 (the mand for X1) when X1 was absent from the mat and presented A2 (the mand for X2) when X2 was absent from the mat. A direct mand trial was scored as correct when the trial consisted of three successive correct mand responses and no incorrect responses. Thus, only one incorrect mand response of the three required responses was sufficient to score the entire trial as incorrect.

At the beginning of direct mand training trials, the mat was placed on the desk in front of the participant with three tokens located within three of the six circles on the mat (empty circles on the mat served as visual prompts for absent tokens; see Figure 1A). The stimulus cards, A1 and A2, were then placed on the desk in front of the mat (the left–right positions of these cards were counterbalanced across trials). Two boxes were placed on the desk at the back of the mat along the far edge from the participant. One box had the A1 stimulus on the lid and one had the A2 stimulus on the lid. On each direct mand trial, the investigator placed an X1 token in the A1 box and an X2 token in the A2 box in full view of the participant. On the first trial of direct mand training the investigator presented the following instruction:

> Let's see if you can fill the token-mat. Look, there are three tokens missing [pointing to empty circles]. If you give me this card [pointing to the A1 stimulus card], I will give you one of these [X1] tokens from the box and you can place it on the mat. If you give me this card [pointing to the A2 stimulus card], I will give you one of these [X2] tokens from the box and you can place it on the mat. Look at the mat and see which tokens you need, and then give me a card.

When a participant presented an appropriate card, the investigator gave him or her the relevant token. The participant was then required to place the token in the appropriate circle on the mat (for the first two or three trials of direct mand training, the investigator physically prompted the child to do this, but such prompting was subsequently unnecessary). When the child placed the token in an available space on the mat, the investigator provided verbal praise (e.g., "well done," "very good," "that's right"). Edible items that had been previously established as reinforcers were presented to the child after approximately every third correct mand.

When a participant made an incorrect response (manded with a stimulus card for a specific token when three such tokens were already present on the mat), the investigator held up the surplus token and said, "That gets you one of these [e.g., X1], but you need one of these [e.g., X2]," and pointed to the relevant empty circle in the relevant row on the mat while delivering the surplus token to the child. Typically, the child placed the surplus token to one side. However, if he or she attempted to place the token on an empty circle on the mat, the investigator repeated "You need one of these [e.g., X1] tokens," while moving the surplus token to one side. No praise or edible reinforcement was delivered following an incorrect mand, and the entire trial was scored as incorrect. The investigator then initiated a new training trial and stated, "Let's begin again."

Participants proceeded to conditional discrimination training with mand stimuli following completion of the mastery criterion for direct mand training of one block of six correct mand trials (i.e., 18 consecutively correct individual mand responses).

Conditional discrimination training with mand stimuli. When a participant successfully completed mand training, he or she was trained in two conditional discriminations using a matching-to-sample (MTS) procedure (see Figure 1A). At the commencement of each block of 10 trials, the investigator placed the B1 and B2 comparison stimulus cards on the desk in front of the participant, with B1 on the left and B2 on the right. The investigator then held up the A1 sample stimulus card and said, "Look at this card, and when I place this card above the other two cards [placing the sample stimulus A1 on the desk above the comparison stimuli B1 and B2] you should point to this card [pointing to B1]." If the child pointed to B1, the investigator immediately provided verbal praise (e.g., "well done," "that's the right one"). If the child pointed to B2, the investigator gently took the child's hand and guided it physically to the B1 stimulus, saying, "This is the one you should point to." Following a 3-s intertrial interval, the investigator moved the A1 stimulus to one side, held up the A2 sample stimulus, and said, "Look at this card, and when I place this card above the other two cards [placing the sample stimulus A2 on the desk above the comparison stimuli B1 and B2] you should point to this card [pointing to the comparison stimulus B2]." If the child pointed to B2, the investigator immediately provided verbal praise. If the child pointed to B1, the investigator gently took the child's hand and guided it physically to the B2 stimulus, saying, "This is the one you should point to." When the child had completed initial trials, the investigator simply asked, "Which one should you point to?" whenever the sample and comparisons were placed on the table; this instruction was used for all subsequent trials.

The investigator conducted five A1-B1 and five A2-B2 MTS trials incorporating block-trial procedures (see Smeets, Barnes-Holmes, & Cullinan, 2000; Smeets & Striefel, 1994). This involved maintaining fixed left–right positions for the comparison stimuli (B1 to the left and B2 to the right) across the first six trials of a 10-trial block, with three trials conducted with the A1 sample stimulus and then three trials with the A2 sample stimulus. These trials were then followed by four trials with the samples alternating quasirandomly and the left–right positions of the comparison stimuli also mixed quasirandomly. A training mastery criterion was set at 10 consecutively correct responses across one such block of 10 trials.

When a participant had completed training for the first conditional discrimination (A1-B1 and A2-B2), training commenced for the second (B1-C1 and B2-C2). The procedure applied was similar to that described for training the first conditional discrimination, except that B1 and B2 were the sample stimuli and C1 and C2 were the comparison stimuli.

Test for a derived transfer of baseline mand response functions. When participants completed training for both conditional discriminations, they were exposed to a test to determine if C1 would function as a mand for X1 tokens and C2 as a mand for X2 tokens (see Figure 1A).

The procedure for the test was similar to that described for direct mand training trials, except for the following details. The first investigator moved to a seat beside the desk and the second investigator moved into the first investigator's seat. The first investigator removed the token boxes from the desk and placed them out of the view of the participant. The C1 and C2 stimulus cards were placed on the desk, instead of the A1 and A2 stimulus cards that were used when training direct mands. The first investigator then said to the child, "Let's see if you know which card will get the right token each time. I won't tell you if you are right until the end, and then we'll finish working together today. This time give the card to [the second investigator]." There was no differential reinforcement provided for responses during test trials. The second investigator simply accepted the cards and delivered tokens without comment. The preset criterion for a successful test was presenting the appropriate cards across a total of six test trials (i.e., 18 correct individual responses).

Reverse derived mands. When a participant had successfully completed the training and test procedures for derived mands, reversal training was introduced (Figure 1B). During this procedure, participants were exposed to retraining with respect to the B1-C1 and B2-C2 conditional discriminations. That is, reinforcement was provided for selecting C1 in the presence of B2 and selecting C2 in the presence of B1 (B1-C2 and B2-C1). Participants were not retrained in the A1-B1 and A2-B2 conditional discriminations, which remained unchanged. When a child successfully completed reversed conditional discrimination training, he or she was subsequently exposed to a test for a derived transfer of mand functions in accordance with the newly trained reversed conditional discriminations. The test was conducted in a manner similar to the previous test for derived mands, except that this time the correct response was to present C2 to mand for X1 tokens and C1 to mand for X2 tokens. This phase was completed when a child manded correctly across six consecutive trials.

Retraining baseline conditional discriminations and a test for a return of baseline mand response functions. If a participant demonstrated a successful reversal of the derived transfer of mand functions, he or she was exposed to a second reversal procedure (Figure 1B). This involved retraining the original baseline conditional discriminations (i.e., B1-C1 and B2-C2), after which the participant was exposed to another test for derived mands. This time the correct response was to again present C1 to mand for X1 tokens and C2 to mand for X2 tokens. Training and testing were conducted in a manner similar to original training and testing phases. When a child manded correctly across six consecutive trials, it was concluded that derived transfer of mand functions in accordance with the retrained baseline conditional discriminations had occurred.

Procedures for Participant 3 deviated from those described above, but for ease of communication these differences will be outlined in the Results section.

Conditional discrimination training with reinforcing stimuli. Trials were conducted in a manner similar to conditional discrimination training with mand stimuli, except that the MTS procedure incorporated the token stimuli (Figure 1C). In effect, the X1 and X2 tokens were used as samples and two novel tokens (disks with different abstract symbols) were used as comparison stimuli (X1-Y1 and X2-Y2). In addition, a second conditional discrimination was trained in which the two Y stimuli functioned as samples and two further novel tokens functioned as comparisons (Y1-Z1 and Y2-Z2).

Tests for a derived transfer of mand and reinforcing functions. Tests were conducted in a manner similar to tests for a derived transfer of mand functions, except that one row of three Z1 tokens and one row of three Z2 tokens were

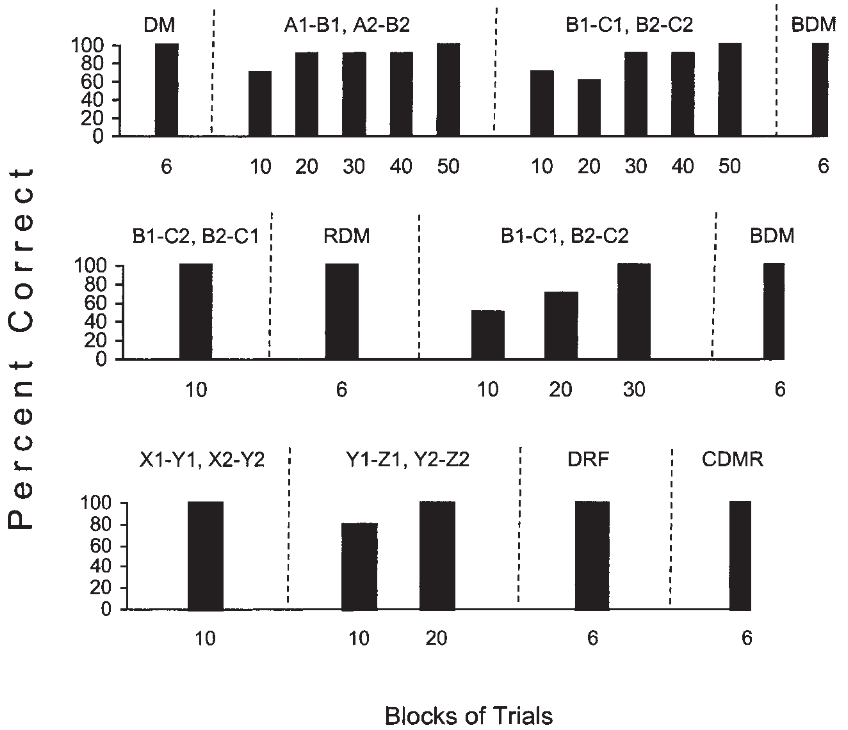

Figure 2. Results for Participant 1. DM = direct mand training. A1 − B1, A2 − B2 + B1-C1, B2 − C2 = conditional discrimination training with mand stimuli. BDM = baseline derived mands. RDM = reverse derived mands. X1 − Y1, X2 − Y2 + Y1 − Z1, Y2 − Z2 = conditional discrimination training with reinforcing stimuli. DRF = derived reinforcer functions. CDMR = combined derived mands and reinforcers.

required to complete the mat (Figure 1C). Two tests were conducted. The first tested for a derived transfer of reinforcer functions using the directly trained mand responses; that is, would the child present A1 and A2 to mand for Z1 and Z2, respectively? The second tested for a derived transfer of reinforcer functions using the derived mand responses; that is, would the child present C1 and C2 to mand for Z1 and Z2, respectively?

Results

The data for individual participants are presented in Figures 2, 3, and 4. The results for Participant 1 (Figure 2) will be described in detail, and summary descriptions will be provided for the remaining participants. Participant 1 required one block of six direct mand training trials in which he was required to present A1 to obtain an X1 token and A2 to obtain an X2 token. Subsequently, he required 10 blocks of 10 conditional discrimination training trials before being exposed to the test for a derived transfer of mand functions (presenting C1 to obtain X1 and C2 to obtain X2). Having demonstrated derived transfer of mand functions, he was then exposed to the conditional discrimination training in which the B-C relations were reversed, followed by reexposure to the test for derived mand functions, which he completed successfully (i.e., he now presented C1 to obtain X2 and C2 to obtain X1). Participant 1 was then retrained in the original B-C baseline conditional discrimination and was exposed for a second time to the test for derived mand functions, which he again completed successfully (i.e., presenting C1 for X1 and C2 for X2). At this point he was exposed to conditional discrimination training involving the X stimuli, which he completed in

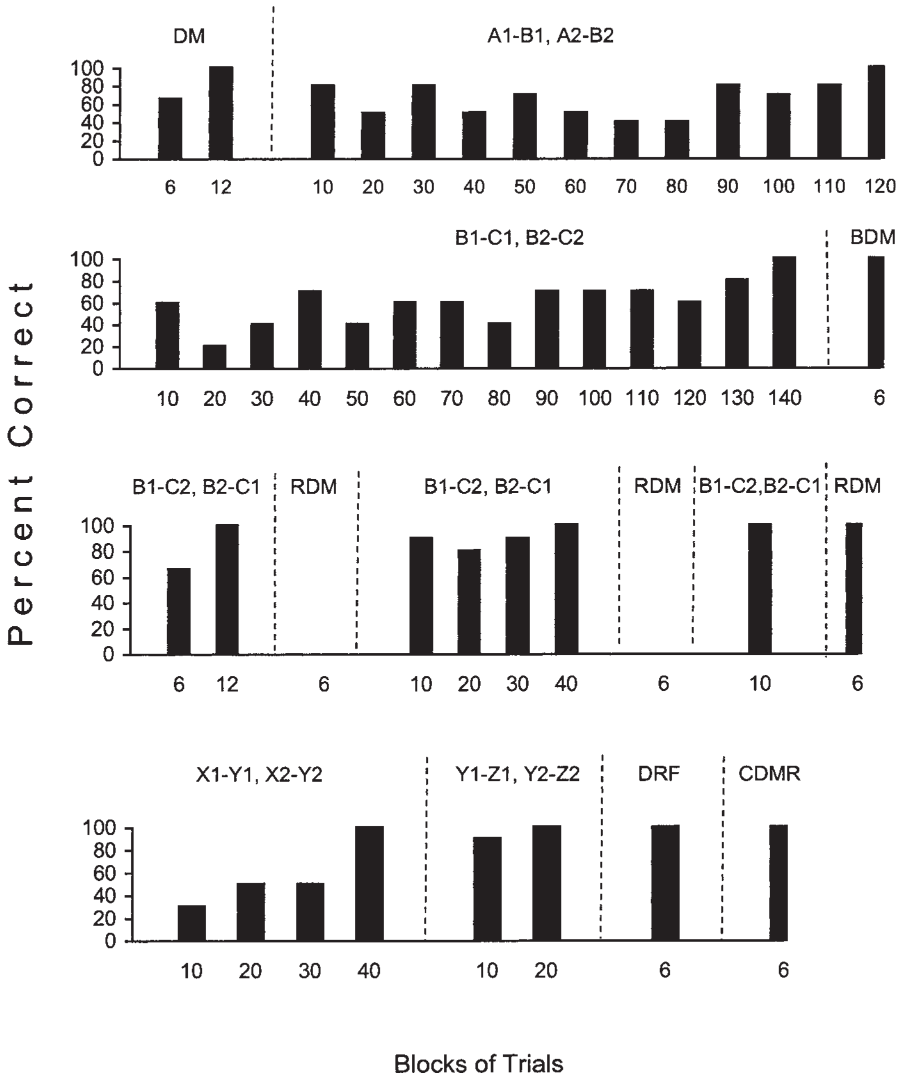

Figure 3. Results for Participant 2. See Figure 2 for details.

three blocks of 10 trials. He was then exposed to a test for a derived transfer of reinforcing functions, followed by the test for derived transfer of both reinforcing and mand functions, both of which he passed.

Participant 2 (Figure 3) successfully demonstrated a derived transfer of mand functions, a derived transfer of reversed mand functions, derived reinforcer functions, and a combined derived transfer of mand and reinforcer functions.

Participant 3 (Figure 4) had been identified by CABAS as having behavioral and attention problems; thus, the mastery criterion for conditional discrimination training trials was lowered to 8 of 10 correct responses during conditional discrimination training prior to the test for derived mands (including the repeated experimental procedures described subsequently).

Having failed to demonstrate derived transfer on the initial test, Participant 3 was exposed to

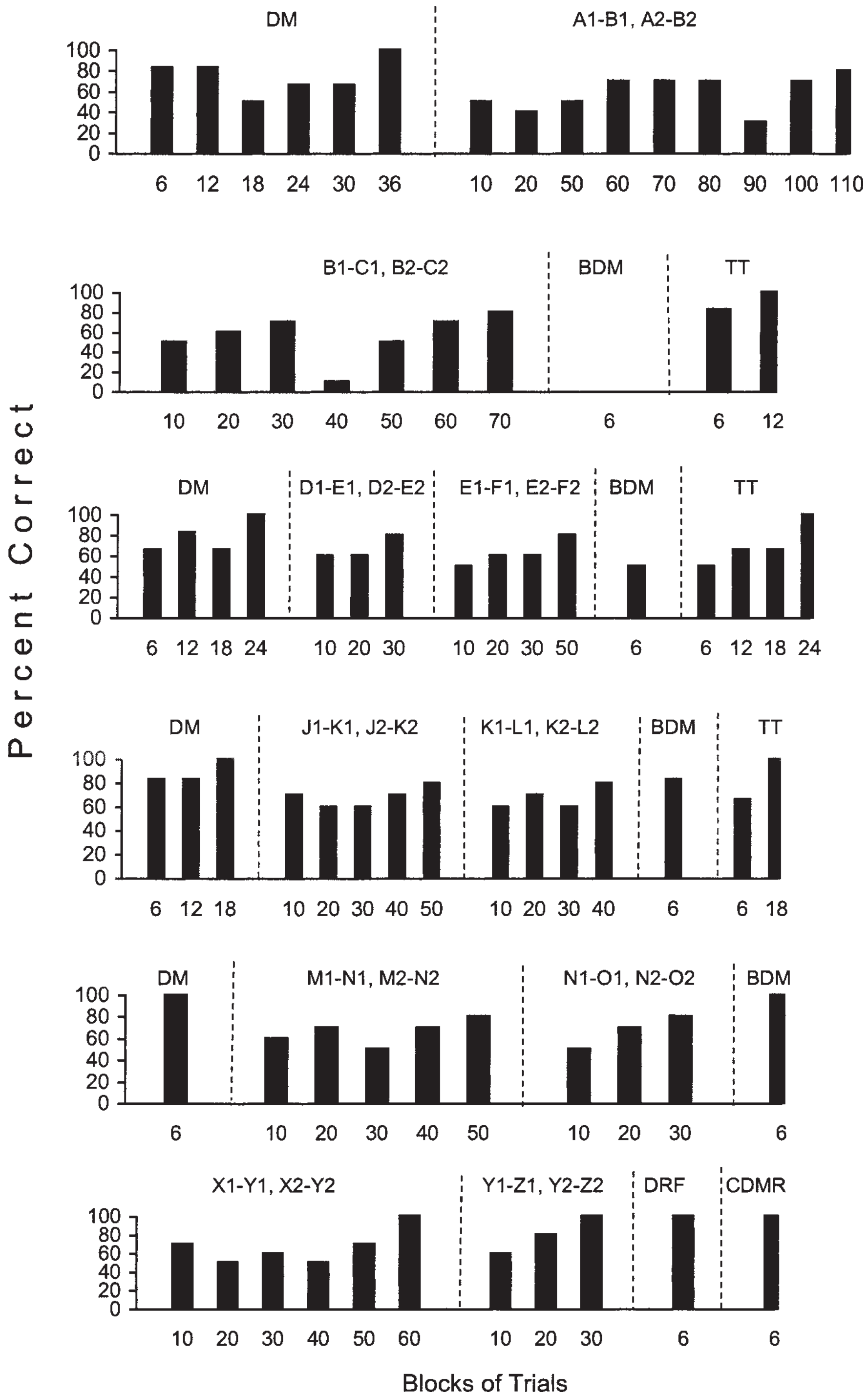

Figure 4. Results for Participant 3. See Figure 2 for details. TT = transfer training.

an exemplar procedure involving explicit transfer training. This involved a procedure similar to the previous direct mand training trials, except that the investigator trained the child to mand with the C1 card instead of the A1 card and to mand with the C2 card instead of the A2 card. Participant 3 achieved the mastery criterion for transfer training trials on the second block of trials.

This participant was then exposed for a second time to mand training, conditional discrimination training, and a test for a derived transfer of mand response functions, but with a novel set of stimuli (labeled D-E-F, see Materials). Having successfully completed the training phases with the new stimulus set, Participant 3 scored 50% (three of six) during test trials, compared with 0% correct responses during the previous test. He was then exposed to a second exemplar procedure using the D and F stimuli; the investigator trained the child to mand with F1 instead of D1 and to mand with F2 instead of D2.

Having successfully completed the transfer training with the D and F stimuli, the participant was exposed for a third time to the mand and conditional discrimination training and transfer testing, but with another novel stimulus set (labeled J-K-L). The participant again failed to demonstrate the predicted derived transfer of mand functions from J1 to L1 and from J2 to L2; however, he demonstrated near-criterion performance of five of six correct test trials. He was then exposed to a third exemplar procedure that involved direct training to mand with the L1 and L2 stimuli instead of the J1 and J2 stimuli, respectively.

Following this training, the participant was exposed for a fourth time to the mand and conditional discrimination training and transfer testing with another novel set of stimuli (labeled M-N-O). On the subsequent transfer test, Participant 3 demonstrated the predicted derived transfer of mand functions in accordance with the trained conditional discriminations (from M1 to O1 and from M2 to O2). Participant 3, like Participants 1 and 2, then demonstrated derived transfer of reinforcer functions and combined derived transfer of mand and reinforcer functions.

EXPERIMENT 2

Experiment 2 was conducted with 3 participants who had not participated in Experiment 1. The aim of the study was to determine if the procedural sequence adopted in Experiment 1 exerted any significant influence on the participants' performances.

Procedure

The procedures in Experiment 2 were similar to those employed in Experiment 1, except that the sequence of experimental events was reversed; the test for derived reinforcers was conducted first, followed by the test for derived mand response functions, followed by the test for combined derived mand and reinforcer functions.

Results

The data for Participants 4, 5, and 6 (Figures 5, 6, and 7, respectively) show that each participant demonstrated derived transfer of reinforcer functions, derived mands, and derived combined mands and reinforcers in accordance with the trained conditional discriminations. Thus, reversal of the experimental procedure did not appear to impinge in any significant way on the derived transfer of mand response and reinforcer functions demonstrated in Experiment 1. Parenthetically, Participant 4 twice failed the test for combined derived mands and reinforcers, but these failures occurred only in the presence of a particular second investigator; when a different second investigator was present the participant passed the combined test twice with no errors. The reason for this difference remains unclear, but it is important to note that both second investigators were blind to the trained performances; thus, subtle cuing during the test was unlikely.

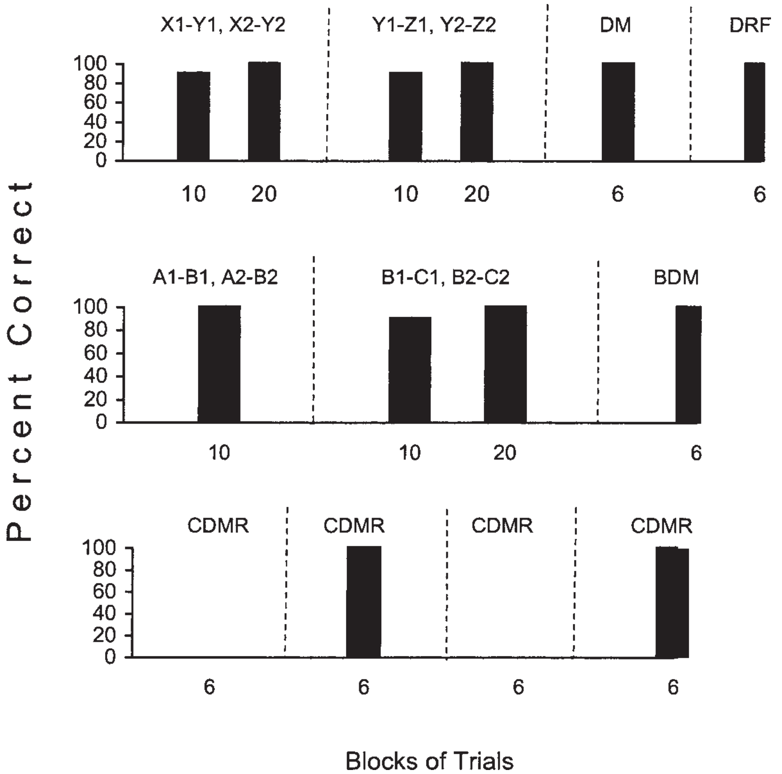

Figure 5. Results for Participant 4. See Figure 2 for details.

EXPERIMENT 3

A potential criticism of Experiments 1 and 2 is that detailed and elaborate instructions were used during training and testing procedures, and thus the role of instructions in generating derived manding remains unclear. Experiment 3, therefore, closely replicated the procedures used in Experiment 1; however, only minimal instructions were provided.

Procedure

Four children participated in Experiment 3; 3 had participated in the previous experiments (Participants 1, 3, and 5), and 1 was experimentally naive (Participant 7). Novel stimuli were used in Experiment 3 (stimulus cards, tokens, and boxes). Procedures were identical to those used during Experiment 1, except that the contents of instructions were altered as follows.

Direct mand training. Instructions given to students during Experiment 3 were as follows: "Look at the mat and see what tokens you need, and then let's see if you can give me the right card to get the tokens you need."

Conditional discrimination training with mand and reinforcer stimuli. Instructions given to students during Experiment 2 were as follows: "Look at all three cards and point to one of these two [investigator points to the sample and then the two comparison stimuli]."

Results

The results for Experiment 3 are presented in Figures 8, 9, 10, and 11. Participants 1, 3, and 5 demonstrated derived mands, derived reinforcers, and derived combined mand and reinforcer functions. However, participants often required more conditional discrimination training trials in Experiment 3 than in Experiment 1, indicating that detailed instruc-

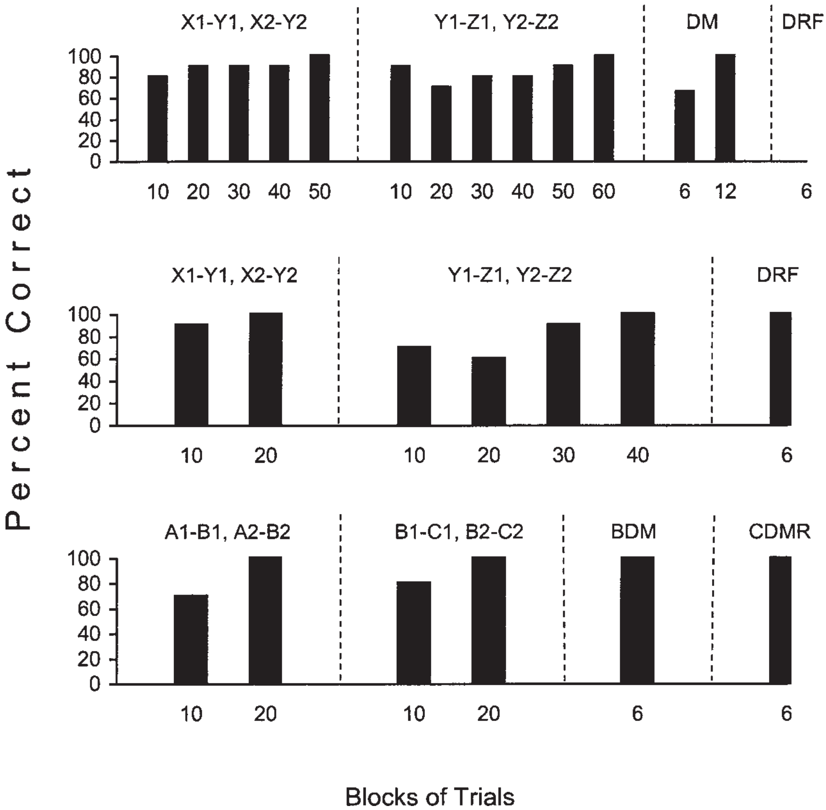

Figure 6. Results for Participant 5. See Figure 2 for details.

tions facilitated their performance. It is noteworthy, however, that Participant 7, who did not participate in Experiment 1, completed Experiment 3 with fewer training and test trials than any other participant.

GENERAL DISCUSSION

The outcomes of this study indicate that, for children with autism, it is possible to establish derived mand and reinforcer functions following appropriate conditional discrimination training. When detailed instructions were provided (Experiments 1 and 2), 6 participants demonstrated derived mands, derived reinforcers, and combined derived mand and reinforcer functions based on sets of interrelated conditional discriminations. The effects of exemplar training were examined when Participant 3 failed to show a derived a transfer of mand response functions. Specifically, this participant required three exemplars of explicit transfer training prior to demonstrating a derived transfer of mand functions. In an ABA reversal procedure, 1 participant demonstrated derived transfer of mand functions across two reversals, and another participant demonstrated a derived transfer of mand functions across a single reversal. In a replicated procedure (Experiment 3) with minimal instructions, 3 participants who had completed Experiment 1 and 1 experimentally naive participant demonstrated derived mands, derived reinforcers, and combined derived mands and reinforcers.

Participant 3 was the only child who initially failed to demonstrate derived transfer of mand response functions; thus, he was exposed to exemplar training (Experiment 1). Participant 3 also had ADHD, and throughout the early experimental procedures he frequently engaged

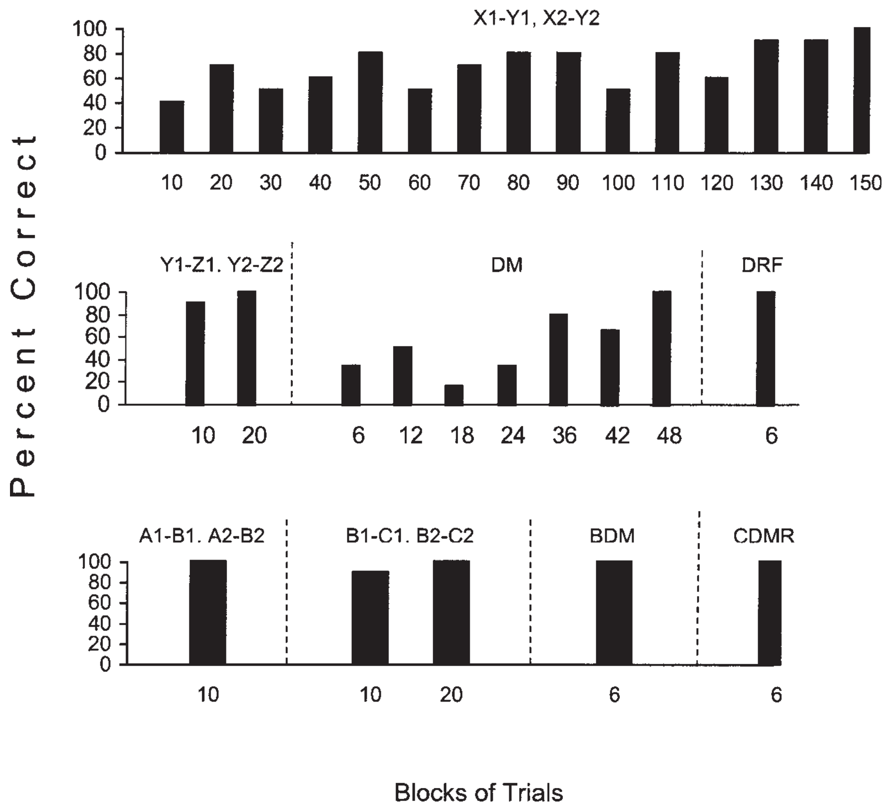

Figure 7. Results for Participant 6. See Figure 2 for details.

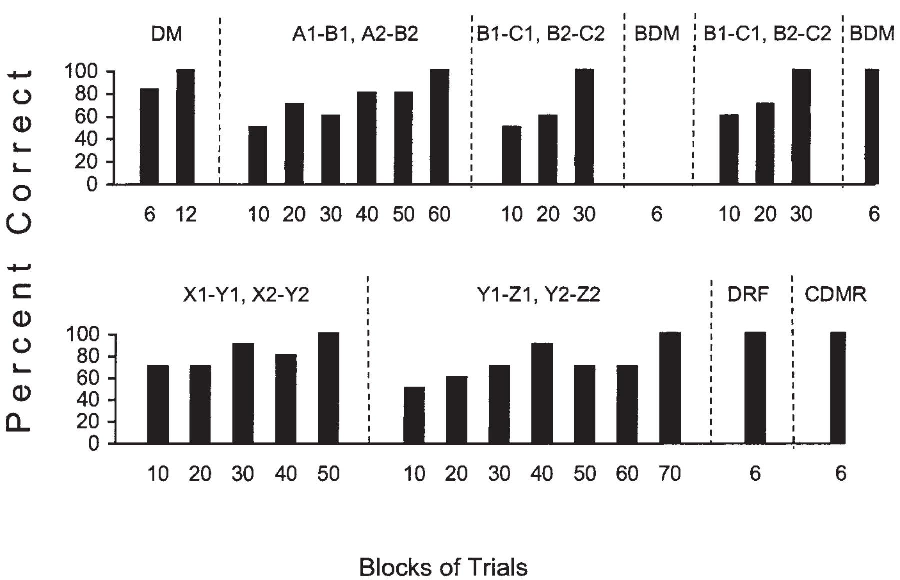

Figure 8. Results for Participant 1, Experiment 3. See Figure 2 for details.

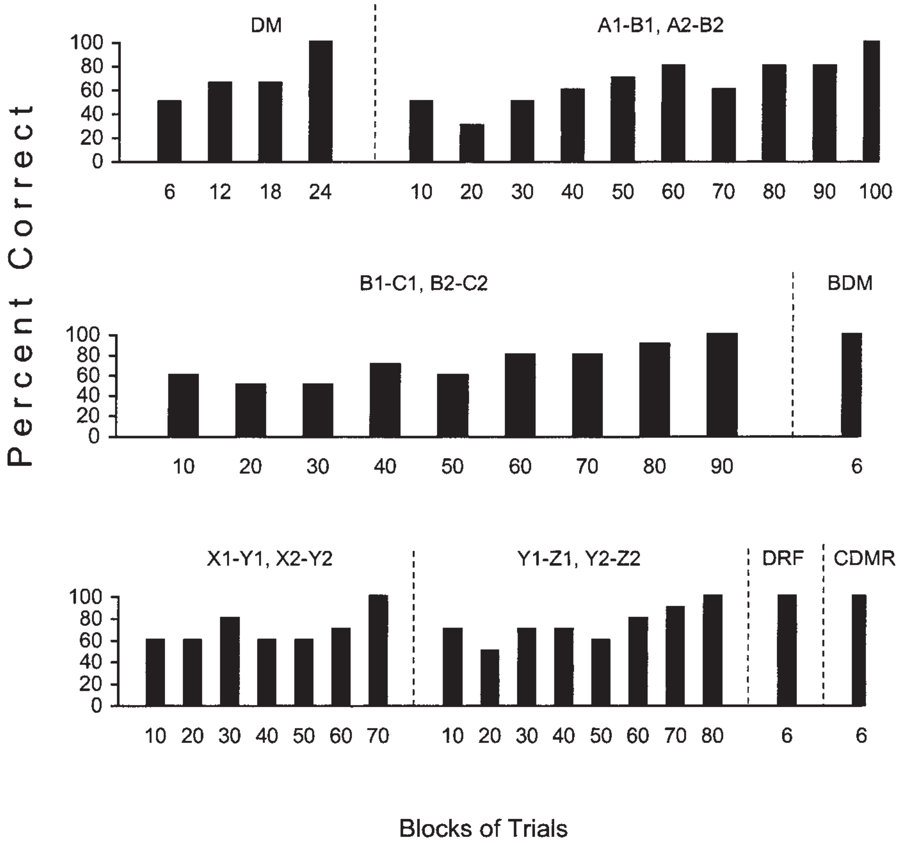

Figure 9. Results for Participant 3, Experiment 3. See Figure 2 for details.

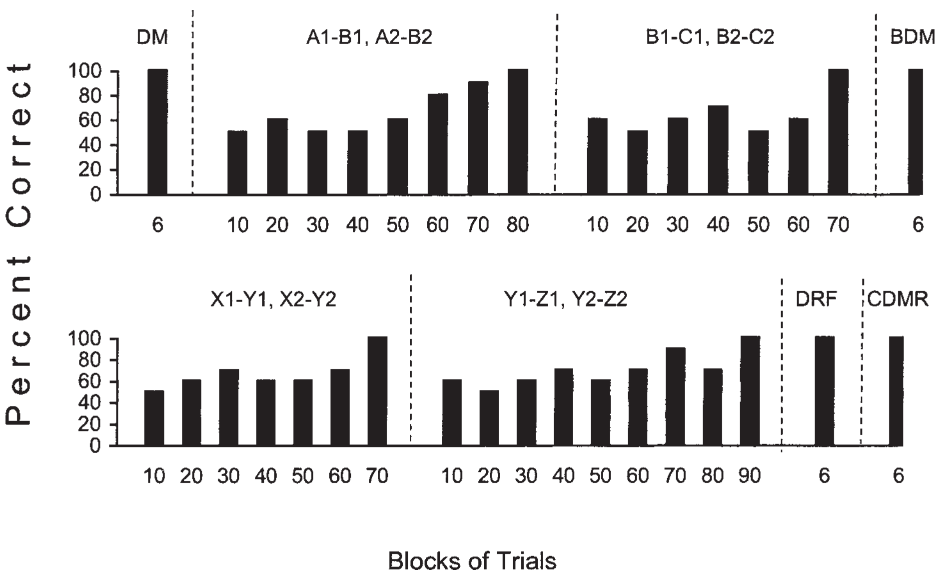

Figure 10. Results for Participant 5, Experiment 3. See Figure 2 for details.

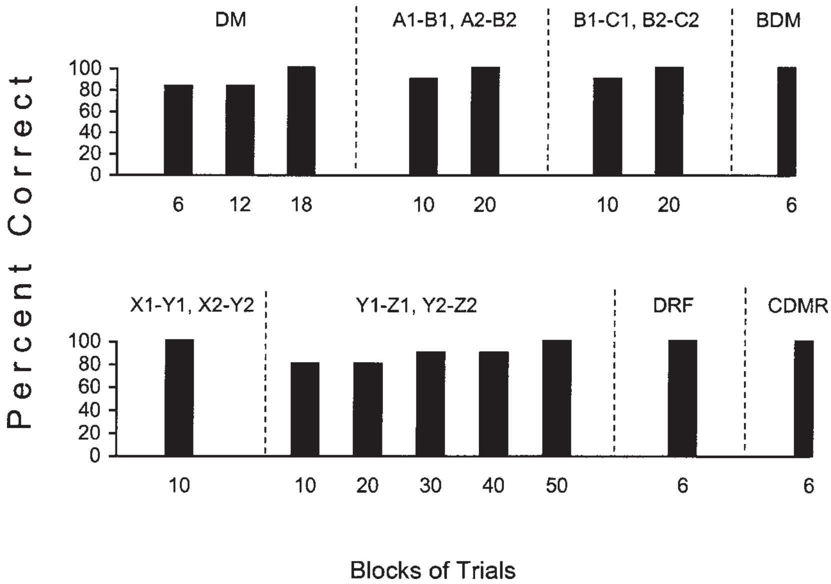

Figure 11. Results for Participant 7. See Figure 2 for details.

in off-task behaviors that may have interfered with the establishment of stimulus control that was required for the derived transfer of mand response functions. Previous research on derived transfer has shown that inability to maintain on-task behavior appears to correlate with test failures (Barnes et al., 1995). Alternatively, the lowered mastery criterion for conditional discriminations may account for the greater difficulty in demonstrating derived transfer. Regardless of the specific reasons behind the initial test failures, Participant 3 ultimately demonstrated derived transfer of mand response functions after the provision of exemplars involving direct transfer training (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000).

It is possible that the instructions presented during Experiments 1 and 2 played a significant role in establishing the baseline mand responses and conditional discriminations, and perhaps provided important contextual cues for the derived transfer performances (Barnes, 1994). However, previous research has shown that derived transfer does not occur in the absence of the appropriate baseline contingencies, even when detailed instructions are used (Barnes et al., 1995). Clearly, a systematic examination of the role of instructions in derived transfer studies with both children and adults is needed. As a first step in this direction, only minimal instructions were provided during mand and conditional discrimination training in Experiment 3 (see also Dymond & Barnes, 1994). Although test performances did not appear to be affected by minimal instructions, some students required more training trials. A plausible interpretation of the effects of the instructions in Experiments 1 and 2, therefore, is that they served to facilitate the effects of the reinforcement contingencies, rather than to function as a substitute for them. In any case, further research is required in this area.

During the mand training phases of the current study, drawings of the arbitrary shapes associated with the cards were present on the lids of the two token boxes. Consequently, an important part of the direct mand training may have involved learning to match the mand card with the appropriate shape on the lid of the token box. More informally, if a child wanted to receive an X1 token to place on the mat, the response involved matching the A1 card with the A1 that appeared on the lid of the box (the A1 box contained the X1 tokens). During the transfer of mand functions test, however, the lids of the boxes were no longer in view; and thus, the mand functions of the A stimuli had to transfer to the C stimuli in order for the participants to pass the derived transfer of functions test. This shift from a mand response that could be mediated via identity matching (A to A stimuli) during training to a mand response that could not be mediated in this way during testing may explain some of the difficulties that Participant 3 experienced. Subsequent research might investigate this issue, with a view to determining if the provision of a mediating identity-matching response can facilitate trained or derived manding in young children when they fail to demonstrate one or both of these effects.

A related issue concerns the fact that in the current study no attempt was made to test for the formation of equivalence relations that would normally be expected to correlate with the derived transfer of functions (e.g., Barnes & Keenan, 1993; but see de Rose, McIlvane, Dube, Galpin, & Stoddard, 1988; Sidman, Wynne, Maguire, & Barnes, 1989). Equivalence tests were not included in the current study for two reasons. First, it was deemed important to demonstrate a derived transfer of mand functions in the absence of such a test, because it would involve directly pairing or matching the A and C stimuli together (albeit without differential reinforcement). Consequently, any transfer performance that followed an equivalence test could be attributed to A and C stimulus compounding or other direct associative processes (Barnes & Keenan, 1993; Hayes, Kohlenberg, & Hayes, 1991; see Dymond & Rehfeldt, 2001, for a detailed discussion of this issue). Second, for language training to be generative, the need to undertake exhaustive equivalence tests before any transfer is obtained would undermine the utility of the paradigm itself. Nevertheless, future studies might include equivalence tests after a successful transfer test.

The current study adopted a research strategy that aims to synthesize Skinner's (1957) approach to human language with that of RFT (see Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000, for a detailed discussion). The successful generation of derived mand responses and derived reinforcers indicates that attempting such a synthesis may be worthwhile both conceptually and empirically. In fact, the current work may shed some light on the origins of what Skinner called magical mands, which he described as follows:

> There are mands which cannot be accounted for by showing that they have ever had the effect specified or any similar effect upon similar occasions. The speaker appears to create new mands on the analogy of old ones. Having effectively manded bread and butter, he goes on to mand the jam, even though he has never obtained jam before in this way. (p. 48)

Skinner goes on to argue that such mand responses "must, of course, already be part of the [speaker's] verbal repertoire as some other type of verbal operant" (p. 48) and that "This sort of extended operant may be called a magical mand" (p. 48). The current study appears to provide a basic experimental model of the type of behavioral history that may give rise to the extended verbal operant that Skinner referred to as magical mands and suggests that a synthesis between Skinner's work and RFT may help to provide empirical evidence for the generative nature of some of the extended verbal operants identified in *Verbal Behavior*.

It is possible that, for some participants in the current study, teaching the derived mands directly would have been more efficient in that the sometimes lengthy conditional discrimination training could have been replaced by direct mand training. However, the current research was intended as "translational" in that it aimed to bring a basic research preparation into an applied domain—the establishment of complex verbal repertoires in children with autism. The results indicate that derived manding as a behavioral process can be observed and even generated using multiple exemplars with a learning-disabled population. Future studies should of course explore alternative and potentially more efficient means of generating this behavioral process, because there is a clear need to identify the impediments to and facilitators of derived transfer of functions in populations with and without a diagnosis of autism.

REFERENCES

Barnes, D. (1994). Stimulus equivalence and relational frame theory. *The Psychological Record*, *50*, 61–81.

Barnes, D., Browne, M., Smeets, P., & Roche, B. (1995). A transfer of functions and a conditional transfer of functions through equivalence relations in three- to six-year-old children. *The Psychological Record*, *45*, 405–430.

Barnes, D., & Keenan, M. (1993). A transfer of functions through derived arbitrary and nonarbitrary stimulus relations. *Journal of the Experimental Analysis of Behavior*, *59*, 61–81.

Barnes-Holmes, D., Barnes-Homes, Y., & Cullinan, V. (2000). Relational frame theory and Skinner's *Verbal Behavior*: A possible synthesis. *The Behavior Analyst*, *23*, 69–84.

Barnes-Holmes, D., Keane, J., Barnes-Holmes, Y., & Smeets, P. M. (2000). A derived transfer of emotive functions as a means of establishing differential preferences for soft drinks. *The Psychological Record*, *50*, 493–511.

de Rose, J. C., McIlvane, W. J., Dube, W. V., Galpin, V. C., & Stoddard, L. T. (1988). Emergent simple discrimination established by indirect relation to differential consequences. *Journal of the Experimental Analysis of Behavior*, *50*, 1–20.

Dougher, M. J., Augustson, E., Markham, M. R., Greenway, D. E., & Wulfert, E. (1994). The transformation of eliciting functions through stimulus equivalence classes. *Journal of the Experimental Analysis of Behavior*, *62*, 331–351.

Dymond, S., & Barnes, D. (1994). A transfer of self-discrimination response functions through equivalence relations. *Journal of the Experimental Analysis of Behavior*, *62*, 251–267.

Dymond, S., & Barnes, D. (1997). Behavior-analytic approaches to self-awareness. *The Psychological Record*, *47*, 181–200.

Dymond, S., & Rehfeldt, R. (2001). Supplemental measures of derived stimulus relations. *The Experimental Analysis of Human Behavior*, *19*, 8–12.

Esbenshade, P. H., & Rosales-Ruiz, J. (2001). Programming common stimuli to promote generalized question-asking: A case demonstration in a child with autism. *Journal of Positive Behavior Interventions*, *3*, 199–210.

Hayes, S. C. (1991). A relational control theory of stimulus equivalence. In L. J. Hayes & P. N. Chase (Eds.), *Dialogues on verbal behavior: The First International Institute on Verbal Relations*. Reno, NV: Context Press.

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (2001). *Relational frame theory: A post-Skinnerian account of language and cognition*. New York: Plenum.

Hayes, S. C., Kohlenberg, B. S., & Hayes, L. J. (1991). The transfer of specific and general consequential functions through simple and conditional equivalence relations. *Journal of the Experimental Ananlysis of Behavior*, *56*, 119–137.

Michael, J. (1993). Establishing operations. *The Behavior Analyst*, *16*, 191–206.

Sidman, M., Wynne, C. K., Maguire, R. W., & Barnes, T. (1989). Functional and equivalence relations. *Journal of the Experimental Ananlysis of Behavior*, *52*, 261–274.

Silverman, K., Anderson, S. R., Marshall, A. M., & Baer, D. M. (1986). Establishing and generalizing audience control of new language repertoires. *Analysis and Intervention in Developmental Disabilities*, *6*, 21–40.

Skinner, B. F. (1957). *Verbal behavior*. Englewood Cliffs, NJ: Prentice Hall.

Smeets, P. M., Barnes-Holmes, D., & Cullinan, V. (2000). Establishing equivalence classes with match-to-sample format and simultaneous-discrimination format conditional discrimination tasks. *The Psychological Record*, *50*, 721–744.

Smeets, P. M., & Striefel, S. (1994). A revised block-trial procedure for establishing arbitrary matching in children. *Quarterly Journal of Experimental Psychology*, *47B*, 241–261.

Stoddard, L. T., & McIlvane, W. J. (1986). Stimulus control research and developmentally disabled individuals. *Analysis and Intervention in Developmental Disabilities*, *6*, 155–178.

Sundberg, M. L., & Michael, J. (2001). The benefits of Skinner's analysis of verbal behavior for children with autism. *Behavior Modification*, *5*, 698–724.

Wahlberg, T., & Jordan, S. (2001). A case study in the dynamics of autism. In T. Wahlberg, F. Obiakor, & S. Burkhardt (Eds.), *Autism spectrum disorders: Educational and clinical interventions* (pp. 53–65). Oxford, UK: Elsevier.

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