JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1975, 8, 235-246 NUMBER 3 (FALL 1975)

SETTING GENERALITY AND STIMULUS CONTROL IN AUTISTIC CHILDREN[1]

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This study was designed to assess the transfer of treatment gains of autistic children across settings. In the first phase, each of 10 autistic children learned a new behavior in a treatment room and transfer to a novel extra-therapy setting was assessed. Four of the 10 children showed no transfer to the novel setting. Therefore, in the second phase, each child who failed to transfer participated in an analysis of stimulus control in order to determine the variables influencing the deficit in transfer. Each of the four children who did not transfer were selectively responding to an incidental stimulus during the original training in the treatment room. Utilizing a reversal design, each of the four children responded correctly in the extra-therapy setting when the stimulus that was functional during training was identified and introduced into the extra-therapy setting. The extreme selective responding and the resulting bizarre stimulus control found are discussed in relation to the issue of setting generality of treatment gains.

DESCRIPTORS: generalization, autistic children, stimulus control, transfer of control, instructional control, discrimination training, setting events, teacher behavior, accidental contingencies

Research in behavior modification has been primarily concerned with variables that produce behavioral change, and to a lesser extent with variables that predict the generality of those changes. For example, a certain treatment procedure might be shown to be effective in establishing or increasing appropriate behavior. Yet, this behavior may not be performed in extra-therapy settings or with extra-therapy personnel. Recently, however, the issue of the transfer of treatment gains across settings has received increased attention (Baer, Wolf, and Risley, 1968; Birnbrauer, 1968; Birnbrauer, Wolf, Kidder, and Tague, 1965; Kale, Kaye, Whelan, and Hopkins, 1968; Kuypers, Becker, and O'Leary, 1968; Lovaas, Koegel, Simmons, and Stevens-Long, 1973; O'Leary, Becker, Evans, and Saudargas, 1969; Walker and Buckley, 1972). These studies have shown that such transfer does not usually take place without special intervention in the extra-therapy settings. The need for more systematic research is clearly pointed out by Kazdin and Bootzin (1972) who reported that transfer of treatment gains to extra-therapy settings is the exception rather than the rule, and that transfer should be planned rather than depended upon as an inadvertant consequence of the program used.

Most attempts to produce transfer have involved reinforcing the target behavior in more than one environment. However, since a failure to transfer across environments suggests a problem in stimulus control, investigations in

[1]This investigation was supported by Public Health Service Research Grant 11440 from the National Institute of Mental Health and by State of California research grant No. 42-00000-0000832, Title VI-B, of the United States Elementary and Secondary Education Act. The research was conducted in cooperation with William Miners, Director of the Children's Treatment Center of Camarillo State Hospital. The authors are grateful to a number of people for their assistance in various phases of this project. In particular, we wish to acknowledge Dennis Russo for his assistance and comments, and Ivar Lovaas, Crighton Newsom, Janis Costello, and Laura Schreibman for their helpful comments on an earlier version of this manuscript. Reprints may be obtained from either author, Institute for Applied Behavior Science, University of California, Santa Barbara, California 93106.

this area seem appropriate. Autistic children are an excellent population for the study of stimulus variables that may influence transfer across settings because their responding is extremely inconsistent across environments. Further, several studies relate their behavioral inconsistency to deficiencies that the children show when confronted with multiple stimulus inputs (Frith and Hermelin, 1969; Koegel and Rincover, 1974; Koegel and Schreibman, 1974; Koegel and Wilhelm, 1972; Lovaas and Schreibman, 1971; Lovaas, Schreibman, Koegel, and Rehm, 1971; Schreibman, 1975; Schreibman and Lovaas, 1973). Specifically, many of these studies found that when an autistic child was trained to respond to a complex composed of multiple stimuli, only one element of the stimulus complex would acquire control over the child's responding, leaving the other elements essentially nonfunctional. Since any therapy environment is composed of multiple stimuli, it seems plausible that an analysis of stimulus control developed in autistic children during a therapy program might shed at least some light on their inconsistent responding across settiings.

The present experiment consisted of two parts. First, autistic children were taught a behavior in a treatment environment, and transfer to novel extra-therapy setting was assessed. Children who showed no correct responding in the extra-therapy environment then participated in a systematic analysis of the stimulus control acquired by various elements of the therapy environment.

METHOD

Subjects

Ten children aged between 6.5 and 13.5 yr (mean = 10.5 yr) were diagnosed autistic by agencies not associated with this project. None had previously participated in research on generalization. Each child was severely psychotic and lived in an institution at the time of this study. All were either mute or echolalic, displayed no contextual speech, engaged in a great deal of self-stimulatory behavior, and were minimally responsive to instruction. Seven children were found to be untestable on the Stanford-Binet IQ test, with IQ scores estimated to be less than 10. The remaining three achieved IQ scores of 18, 35, and 40. On the Vineland Social Maturity Scale, seven children were placed below the 2-yr level, while the remainder were placed at 3, 5, and 5 yr.

When a child was brought to the laboratory, a therapist selected a behavior to teach him. After the child learned this behavior, a new adult tested him for transfer to a novel setting. The procedures for selecting target behaviors and assessing transfer are described below.

Selecting Target Behaviors

The behaviors selected for treatment consisted of: nonverbal imitation, where the child would learn to imitate a behavior of the therapist (*e.g.,* raising arm) in response to the verbal stimulus "Do this"; touching a body part in response to the verbal stimulus "Touch your (nose, chin, *etc.*)"; and raising the right or left arm in response to the appropriate verbal stimulus "Right" or "Left". A particular behavior was selected for each child by recording the child's responding during each of these tasks (in the above order) and selecting the first task where responding was consistently incorrect (*i.e.,* no correct responses in the first 20 trials). For example, a child would be seated in the treatment room and told to "Do this", whereupon the therapist might touch his own head. If the child failed to respond correctly, no reinforcer would be given. The therapist's command and appropriate model were repeated until either the child responded correctly on one trial or failed to respond correctly on 20 consecutive trials. If the child consistently responded incorrectly, that behavior was selected for treatment. If the child responded correctly on any trial, reinforcement was provided, but the therapist would not use that task in the experiment.

Training Sessions

Forty-minute training sessions were conducted once per day, two days per week, until the child acquired the appropriate behavior. The child was seated at a table across from the therapist in a 2.5 by 2.5 m treatment room. The therapist started treatment by prompting the child to perform the correct behavior on verbal command. Prompts initially consisted of the teacher taking the child's hand and physically guiding him through the topography of the behavior. For example, if the teacher was training head-touching behavior, he would first say "Touch your head", and then place the child's hand on his head and reward him with a piece of candy. The teacher then gradually began to delay the prompt and reduce its intensity in order to transfer the control of correct responding from the prompt to the verbal stimulus. Food and social praise were given for all correct responses, whether prompted or non-prompted. Incorrect responses were ignored. Training averaged 80 trials per session. When the child responded correctly on 20 consecutive trials without any prompt, he participated in the transfer test.

Transfer Test

Transfer was measured as soon as the child had acquired the new behavior in the treatment room. The therapist took the child outside the treatment room, where a stranger approached the child and led him outside the building. The child was placed facing the stranger, standing on the lawn surrounded by trees. The stranger then presented the same verbal stimulus (and modelling where appropriate) as the original therapist. No reinforcement was given. The transfer test consisted of 10 trials, and the child's responses were recorded as correct or incorrect. For the purposes of this assessment, one or more correct responses indicated that the child showed some measure of transfer to the extra-therapy setting. No correct responses in 10 trials indicated that no transfer occurred. Each session was terminated after a transfer test.

If a child did not transfer (*i.e.,* no correct responses in the extra-therapy setting), a subsequent series of sessions was conducted to assess the control achieved by the various stimuli that were present in the treatment room. In brief, we wanted to see if children who did not transfer would respond correctly in the extra-therapy setting when a stimulus from the treatment setting was introduced outside. Specifically, various stimuli present in the treatment room were systematically introduced outside, and the responses of the children recorded. An attempt was made to identify as many stimulus objects and events as possible that regularly occurred during training. Each stimulus was then presented individually in the extra-therapy environment, until a functional stimulus was identified. The procedures for assessing the control achieved by these stimuli are described below.

Assessment of stimulus control. First, to determine if the original failure to transfer was replicable, each child who did not transfer during the initial assessment (described above), was again taken to the extra-therapy environment and presented with 10 additional transfer test trials. This session was identical to the original transfer test. If the failure to transfer was replicated on these trials, stimulus control in the training setting was assessed.

The assessment of stimulus control began by introducing one stimulus from the treatment environment into the extra-therapy setting (*e.g.,* the original teacher). Ten trials were conducted with this stimulus present (whether or not correct responding occurred), and the child's responses were recorded. No reinforcers were given. If the child did not respond correctly, that stimulus was removed for 10 trials and then a different treatment-room stimulus was introduced. If the child did respond correctly, that stimulus was removed from the extra-therapy environment for 10 trials and then re-introduced for 10 more trials, in a re-

versal design. The assessment of stimulus control was ended when the child was found to be responding to a given stimulus taken from the treatment room.

Recording and reliability. To assess whether the recording of the child's responses was reliable during training and transfer sessions, reliability measures were obtained for the child's correct, prompted, and incorrect responses in both settings. The stranger and a naive observer watched the training sessions through a one-way mirror. The therapist and both observers recorded the child's response on every trial. Each response was recorded as correct, prompted, or incorrect on a precoded data sheet. Reliability between observers was measured by the number of agreements divided by the number of agreements plus disagreements per session. During transfer test trials in the outside setting, the original therapist and the naive observer recorded the child's responses. These observers could not be seen by the child. Reliability between observers was measured in the same way as during treatment. Reliability measures were obtained for all of the test sessions in this experiment. The average reliability for recording the child's responses was 99.6% (range: 98% to 100%).

RESULTS

Transfer Test

The results of the transfer test are presented in Table 1. Six of the 10 children showed some transfer to the extra-therapy setting, ranging from 30% correct responding (Debbie) to 80% correct responding (Kurt). It is interesting to note that each of these six children responded correctly on the first trial presented in the extra-therapy setting. The other four children, however, did not respond correctly on any of the transfer test trials. The six children who transferred could not be distinguished from the four children who did not transfer on the basis of the task, the number of trials to criterion during training in the treatment room, or the number of reinforcers presented in the treatment room.

Assessment of Stimulus Control

Figures 1 to 4 present the results of introducing treatment-room stimuli into the outside setting for the four children who did not show any transfer. The number of correct responses in a block of 10 trials is presented on the ordinate. Sessions are presented on the abscissa. A description of the stimuli used and the responding of each child is given below. The original transfer test is presented at the beginning of each figure.

John. Before introducing treatment-room stimuli into the transfer setting, John's responding was again measured in the extra-therapy environment. The second "Transfer Test" in Figure 1 shows that there was again no transfer. That is, there were no correct responses in 10 trials.

The first treatment-room stimulus introduced outside was the original therapist. The therapist replaced the stranger outside and conducted 10

Table 1

Description of task, trials to criterion during training, and performance on the transfer test for each child.

Child	*Task*	*Trials to Criterion*	*Generalization test*
Gerard	"Do this" (model raises arm)	213	50%
Joey	"Do this" (model touches head)	292	No transfer
Kurt	"Right", "Left"	351	80%
John	"Touch your chin"	176	No transfer
Tommy	"Touch your shoulder"	200	No transfer
Debbie	"Touch your head"	100	30%
Robert	"Do this" (model crosses arms)	124	70%
Taylor	"Do this" (model touches nose)	61	60%
Cliff	"Touch your nose"	33	No transfer
Maria	"Clap your hands"	230	70%

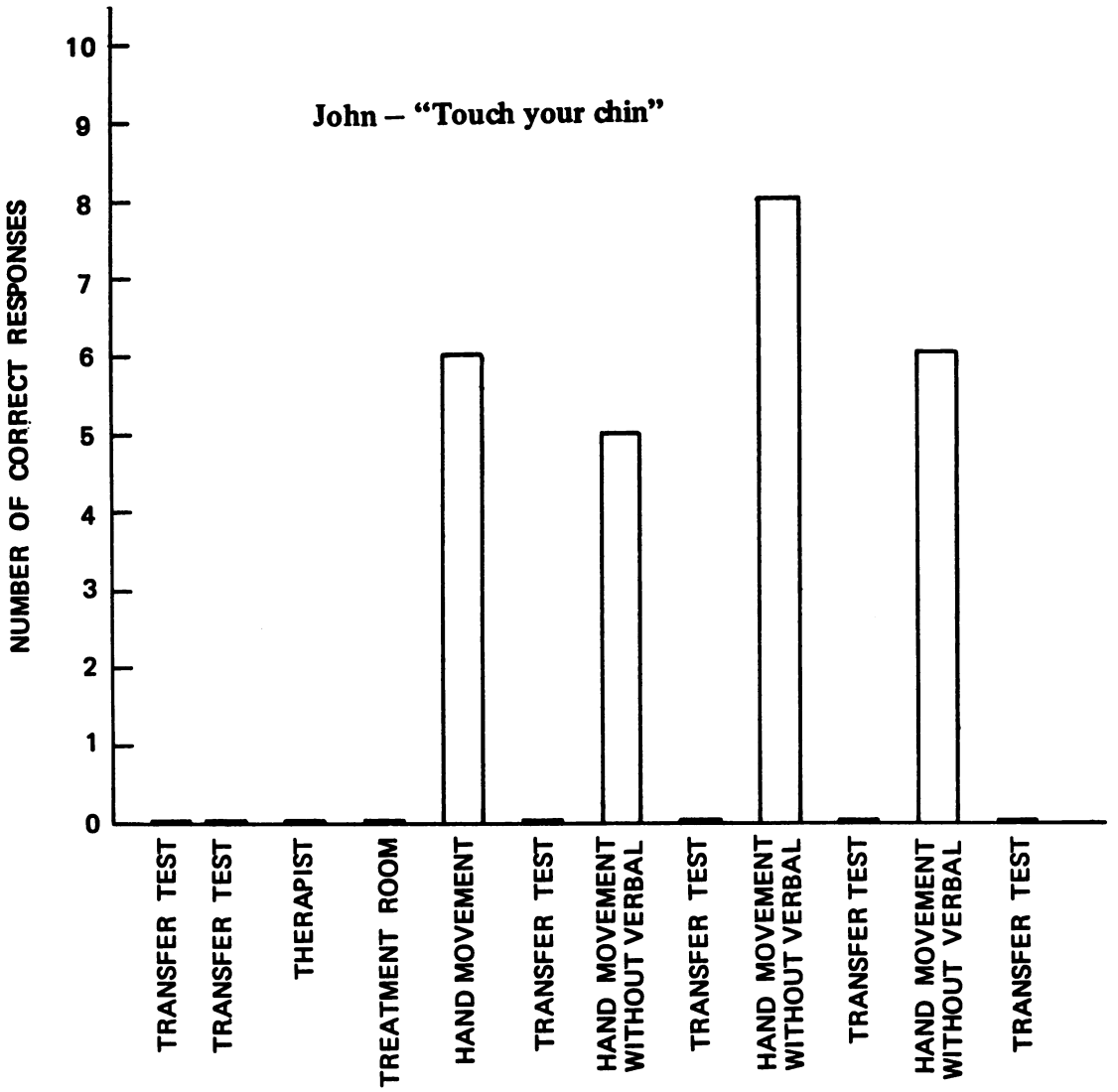

Fig. 1. John. The number of correct responses per block of 10 trials during transfer tests and when treatment-room stimuli were introduced into the transfer (extra-therapy) setting.

trials. The condition "Therapist" in Figure 1 shows the results of the 10 trials. John did not respond correctly on any trial. That is, he showed no transfer to the original therapist when that therapist was introduced outside.

To assess whether it was necessary for John to be in the treatment room for correct responding to occur, the next manipulation was to take John back into the treatment room. John was placed standing, facing the stranger in the middle of the treatment room. The condition "Treatment Room" shows John's responding on these trials. Again, no correct responses were observed; *i.e.*, he showed no transfer to the treatment room when the stranger was presenting the trials.

The next stimulus introduced outside was an incidental behavior performed by the first therapist in the treatment room, which was not performed by the stranger outside. While observing training sessions we noted that in the treatment room, the therapist showed John a piece of candy before the start of each trial. Specifically, the therapist started a trial as fol-

lows. First, the therapist had his own hand in his lap, holding a piece of candy. Next, he raised his hand (and candy) until it was directly in front of John's mouth. Finally, he said "Touch your chin". We became aware of this sequence of behaviors when we noticed that John often responded at the same time or before the therapist said "Touch your chin". Possibly, John was responding to the hand movement of the therapist, rather than the verbal stimulus. To test this possibility, the hand movement was introduced outside and John's responses were recorded. The stranger started a trial outside by raising his hand (without candy) from his side until it was directly in front of John's mouth. Then the stranger said "Touch your chin", and recorded John's response. No rewards were present, so we could rule out possible responding to the sight of candy. John's responding is shown in the condition "Hand Movement". For the first time John responded correctly in the outside setting, six times in 10 trials. At this time, the hand movement was removed from the outside setting in order to assess whether correct responding would cease when the hand movement was removed. The third "Transfer Test" in the graph shows that, again, no correct responses occurred. The next manipulation was to present the hand movement without the verbal stimulus. In this way we hoped to find out if John was selectively responding to the hand movement alone. Therefore, the stranger raised his hand at the beginning of each trial, but did not say "Touch your chin". The condition "Hand Movement without Verbal" shows the results of these trials. John responded correctly five times in 10 trials. Additional conditions are presented in the graph that replicate the effect of the therapist's hand movements on John's responding.

In short, the results show that John was selectively responding to a hand movement of the therapist. When John learned to touch his chin in the original training sessions, he was responding to the arm-raise of the therapist, rather than to the verbal stimulus "Touch your chin".

Joey. Joey was first retested in the extra-therapy setting to see if the previous lack of correct responding during the original transfer tests was replicable. The results of these trials are shown in the second "Transfer Test" in Figure 2. There were no correct responses in 20 trials.

The first treatment-room stimulus introduced into the outside setting was an incidental behavior of the original therapist. When we observed the therapist working with Joey in the treatment room, we noticed that Joey's hands were held in his lap until a trial was started. Specifically, the therapist started a trial as follows. First, the therapist held Joey's hands in his lap. Then the therapist said "Do this". Finally, the therapist modelled the correct response by touching his own head. We became aware of this sequence of behavior when Joey responded correctly at the same time or before the teacher modelled the response. To test the possibility that Joey might be responding to the teacher letting go of his hands, hand restraint was manipulated outside in the following manner. Since Joey was standing, the stranger held Joey's hands to his legs. Then he started a trial by saying "Do this". Immediately, the stranger touched his own head, simultaneously removing the restraint from Joey's hands. The effect of introducing this stimulus outside is shown in the condition "Restraint" in Figure 2. Joey responded correctly six times in 10 trials. At this point, test trials were presented without the restraint stimulus. These trials were identical to the original transfer trials. Joey's responding on these trials is shown in the following "Transfer Test" condition. There were again no correct responses in 10 trials. In the next condition, we again presented the restraint stimulus to start each trial. However, the teacher did not say "Do this" or model the correct behavior. Specifically, the teacher merely held Joey's hands to his legs, then started a trial by letting go of his hands. The condition "Restraint without verbal or model" shows Joey's

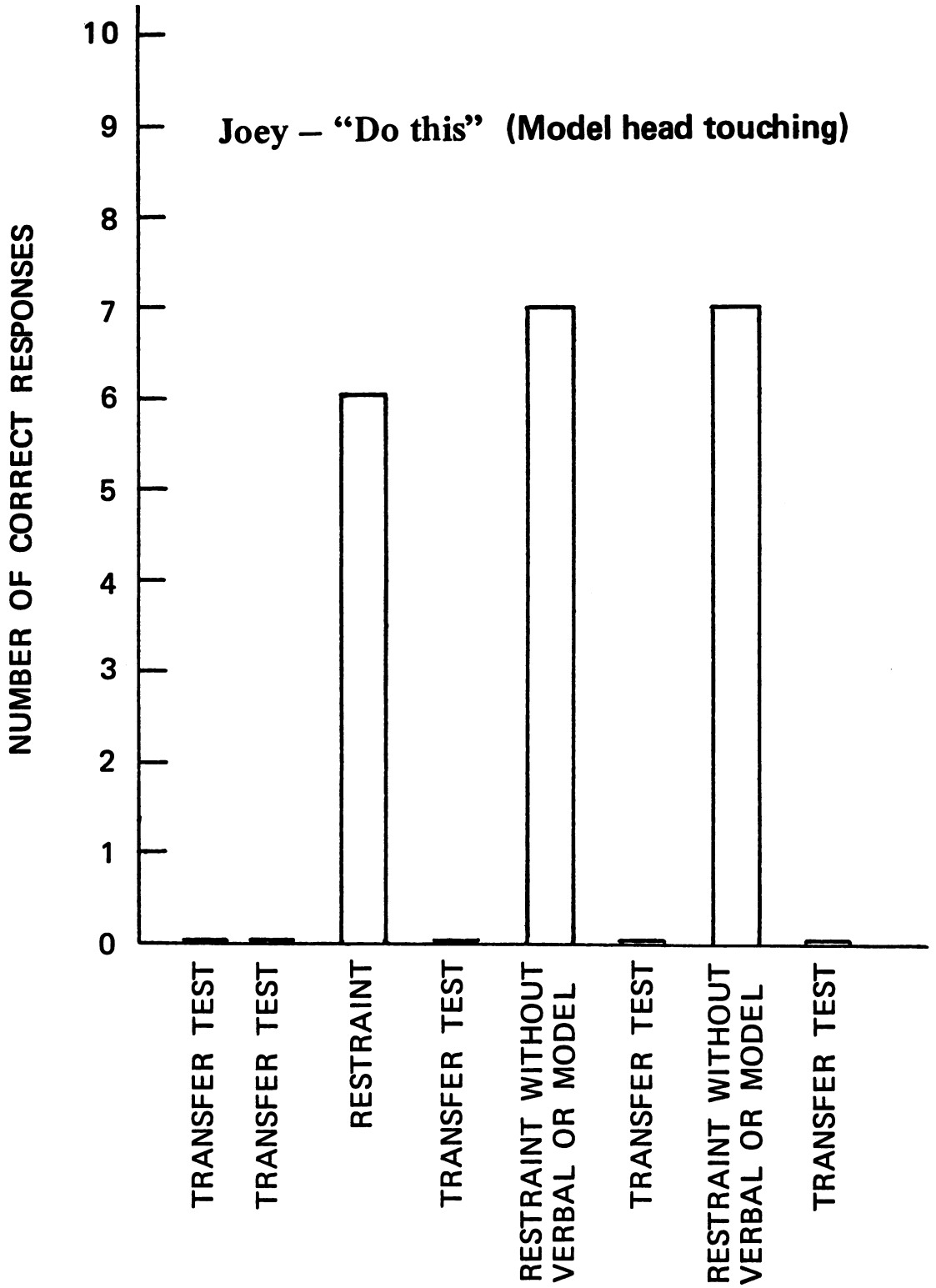

Fig. 2. Joey. The number of correct responses per block of 10 trials during transfer tests and when treatment-room stimuli were introduced into the transfer (extra-therapy) setting.

responding on these trials. He responded correctly on seven of 10 trials. Additional conditions are presented in the graph that effectively replicate the control of the "removal of hand restraint" on Joey's responding.

In summary, we found that Joey was selectively responding to the teacher letting go of his hands. When Joey learned to touch his head during the original treatment sessions, he was responding to the removal of the restraint on his hands, rather than to the verbal and modelling stimuli of the teacher.

Tommy. The second "Transfer Test" condition in Tommy's graph effectively replicates the lack of correct responding observed on the original transfer test. That is, Tommy showed no correct responding in 20 trials. In the following condition, the original therapist tested Tommy outside. The condition "Therapist" in the graph shows that Tommy did not respond correctly to the original therapist when he was outside. We noted peculiarities in Tommy's responding when we were selecting stimuli to be introduced into the outside setting. In fact, at one point after he had supposedly learned the response, Tommy did not touch his shoulder for the original therapist in the treatment room. One initial prompt trial was required to get Tommy to respond correctly. The teacher prompted him by slightly pushing Tommy's elbow upwards. After one prompted trial, Tommy again began to respond correctly for the next 20 consecutive trials. Therefore, it seemed possible that Tommy may have "hooked" on the initial prompt trial as a stimulus for responding on future trials. To test this hypothesis we introduced the prompted trial in the outside setting.

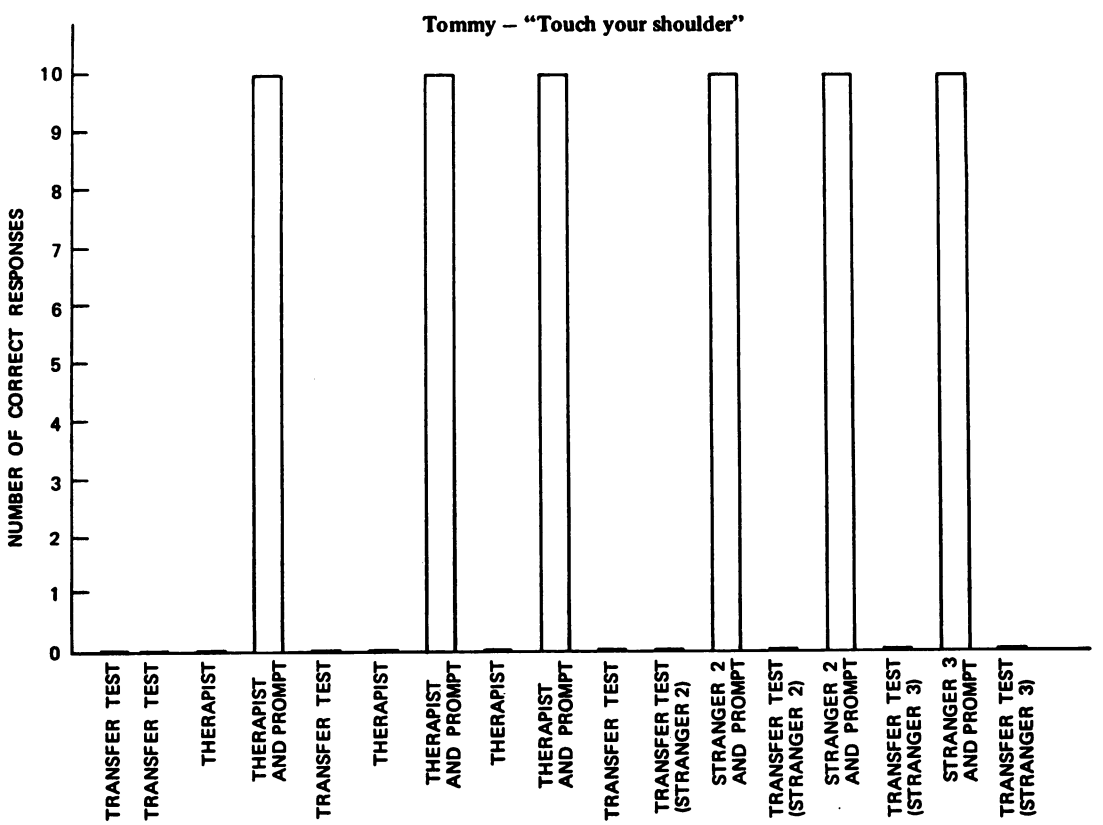

Fig. 3. Tommy. The number of correct responses per block of 10 trials during transfer tests and when treatment-room stimuli were introduced into the transfer (extra-therapy) setting.

In the next condition, the original therapist presented a prompted trial (described above) immediately *preceding* a block of 10 test trials. The condition "Therapist and Prompt" shows the dramatic change in Tommy's responding. He responded correctly on all 10 test trials. In the next condition, the stranger returned outside. The third "Transfer Test" in the graph shows that again no responses occurred. In the next condition, we retested Tommy with the original therapist without any introductory prompted trial. Less than 5 min had elapsed since Tommy responded correctly on each of 10 trials for that therapist. The results are shown in the second "Therapist" condition. Tommy did not respond correctly on any trial. In the next condition, the original therapist presented another introductory prompted trial. There were again 10 correct responses in 10 trials. After 30 sec had elapsed, the therapist presented another block of 10 trials without the preceding prompted trial. There were no correct responses during these trials, as shown in the final "Therapist" condition. Finally, the introductory prompt stimulus was re-introduced. For the third time, the original therapist presented the prompt stimulus. The third "Therapist and Prompt" condition shows that Tommy again responded correctly on each of the 10 trials following the introductory prompted trial. These results were then replicated with two additional strangers ("Strangers 2 and 3" in the figure). The remaining conditions in the graph demonstrate and replicate that Tommy selectively responded on the basis of the initial prompted trial with each adult, rather than to the verbal command "Touch your shouder".

Cliff. We conducted a second transfer test for Cliff. The results of this test are shown in Figure 4. There were no correct responses in 20 trials.

The first treatment-room stimulus introduced into the transfer setting was the therapist. The condition "Therapist" shows that no correct responses were observed during 10 trials. At this time, Cliff was taken back into the treatment room by the stranger. They were standing in the middle of the room away from the table and chairs. Ten trials were presented and, again, no correct responses were observed.

The table and chairs were the next treatment-room stimulus introduced into the outside setting. They were brought outside and placed on the lawn. Cliff and the stranger stood facing each other across the table. Each was standing in front of a chair. The dramatic change in Cliff's responding is shown in the condition "Table and Chairs". Cliff responded correctly seven times in 10 trials. At this point, the table was removed to see if the presence of the chairs was sufficient for correct responding to occur. The condition "Chairs" shows that no correct responses occurred during 10 trials. Additional trials are presented in the graph, which effectively replicates the control of the table on Cliff's responding. Similar to the three previous children, these data show inappropriate stimulus control. However, Cliff's responding is slightly different, since only the table and chairs *combined with* the verbal stimulus would evoke a correct response. Nevertheless, his results are similar in that they demonstrate bizarre stimulus control, differing considerably from what a typical therapist might expect to occur during treatment.

DISCUSSION

This experiment assessed the transfer of behavior changes in autistic children across settings. Ten children learned new behaviors in the treatment room, and responding in a novel extra-therapy setting was recorded. The treatment gains of six children showed some transfer across settings, while the remaining four children failed to transfer. The latter four children did not perform any correct responses on either the original transfer test or on subsequent replications of the transfer tests.

The four children who failed to transfer participated in an analysis of stimulus control. During the original training, these children were

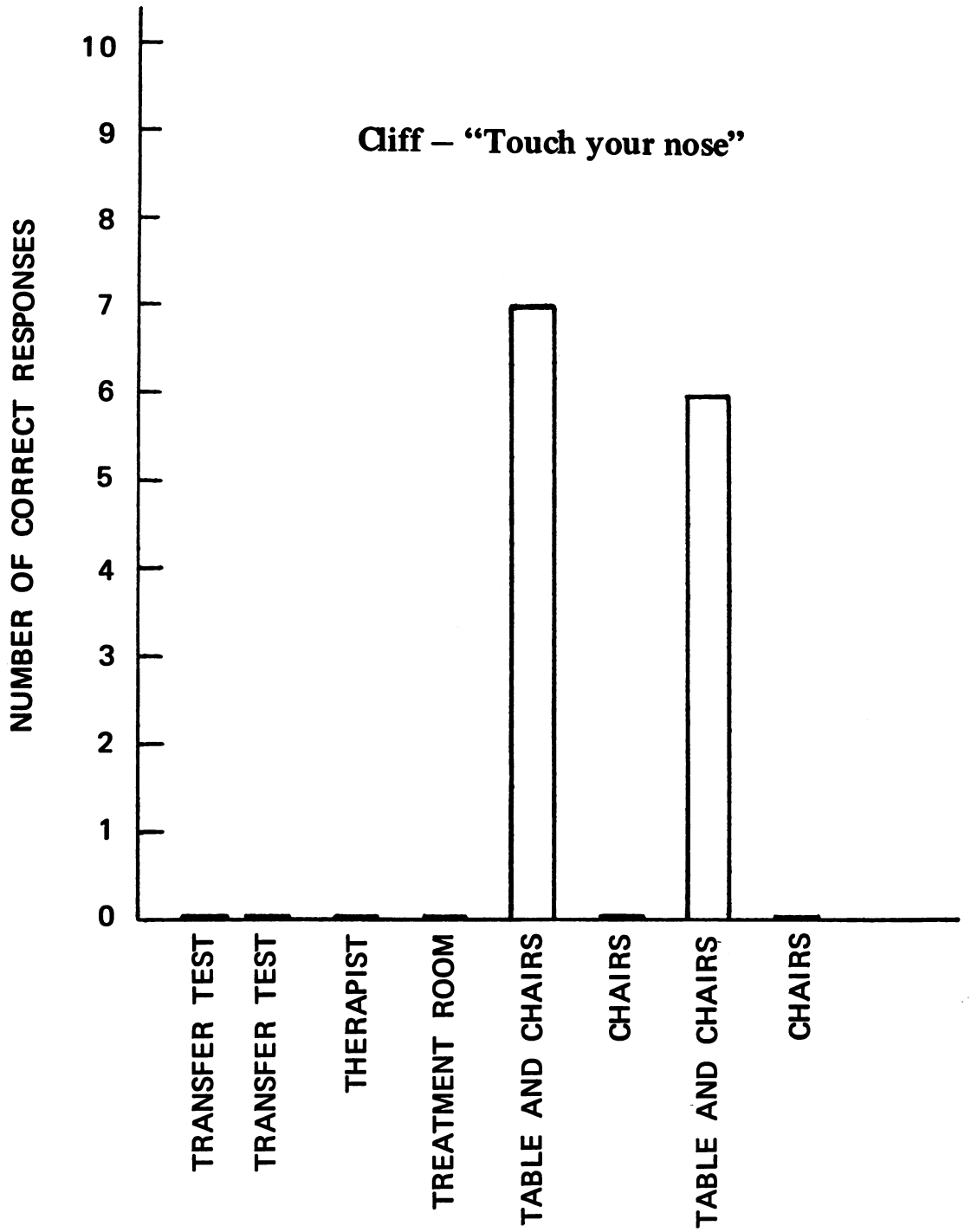

Fig. 4. Cliff. The number of correct responses per block of 10 trials during transfer tests and when treatment-room stimuli were introduced into the transfer (extra-therapy) setting.

selectively responding to an incidental stimulus in the treatment room. When that stimulus was presented in the extra-therapy setting, each child responded correctly. That is, in order to bring about the transfer of treatment gains to extra-therapy setting, it was necessary that

the stimulus that came to control responding in the treatment setting was also present in the extra-therapy setting.

It should be noted that the study was conducted in a laboratory setting approximating clinical conditions, and that only one behavior was used for each child. It is possible that these conditions may to some extent limit the external validity of the findings.

The results show that four children did not transfer because they were not responding to the appropriate cues during training. For example, when the teacher said "Touch your chin" and then the child proceeded to touch his chin, we assumed that the child was responding to what the teacher said. The assessment of stimulus control showed this assumption to be incorrect. This did not, however, seem to be an unreasonable assumption. When teaching other populations of children, teachers generally do not worry about the child responding to an incidental hand movement to the complete exclusion of the teacher's instruction and the rest of the treatment environment. Autistic children may, therefore, be showing extreme overselectivity, which results in very restricted stimulus control. Any therapist working with autistic children must ensure that the child learns a new behavior on the basis of the stimulus by which the *therapist* desires to achieve control. Perhaps procedures that use multiple therapists in multiple settings (*e.g.,* Stokes, Baer, and Jackson, 1974; Wahler, 1971) would help by making it difficult for idiosyncratic and unreliable stimuli to acquire control over appropriate responding.

It is also interesting to look at the amount of correct responding that occurred in the extra-therapy setting during the assessment of stimulus control. The stimuli that produced correct responding in the transfer setting did not produce 100% correct responding. For example, John responded correctly at 60%, 50%, 80%, and 60% to the hand movement. The fact that he did not respond at 100% to this stimulus may indicate that extinction may have been occurring because no reinforcement was being given in the transfer setting. It is also possible that, for John, a generalization gradient may have formed around the hand movements of the original therapist, but not around other stimuli in the therapy environment. An investigation of the generalization gradients of autistic children may prove to be of interest.

Finally, it should be pointed out that a majority of the children in this study did show some transfer to the extra-therapy setting without any special intervention, although the amount of correct responding in the extra-therapy setting varied to a great extent. While we do not know whether or not these six children were also responding selectively, or even if they were responding to the appropriate instruction of the therapist, it is apparent that they had learned to respond to a training-room stimulus that was also functional in the extra-therapy setting. In this case, where children do initially transfer, the question may become one of how to *maintain* treatment gains in extra-therapy settings, rather than how to produce *transfer.* Perhaps the distinction between producing transfer and maintaining correct responding in transfer settings is an important one to make. The problem of transfer may require different treatment procedures than for maintenance. For autistic children, both problems may be relevant. Additional studies addressing these issues are in progress in our laboratory.

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Received 5 November 1974.
(Final acceptance 17 March 1975.)