

## **Contriving Establishing Operations to Teach Mands for Information**

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Many children with autism cannot effectively ask wh- questions to mand for information, even though they may have extensive tact, intraverbal, and receptive language skills. Wh- questions are typically mands because they occur under the control of establishing operations (EOs) and result in specific reinforcement. The current study first investigated a procedure to teach the mand “where?” to children with autism by contriving an EO for the location of a missing item. Following the successful acquisition of this mand, an establishing operation for a specific person was contrived to teach the mand “who?” The results showed that the children acquired these mands when the relevant establishing operations were manipulated as independent variables. The children also demonstrated generalization to untrained items and to the natural environment. These results have implications for methods of language instruction for children who have difficulty acquiring mands for information.

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Typically developing children tend to emit a high rate of questions, especially during the question-asking phase that usually occurs between the ages of 2 and 3 years (Brown, 1968; Brown, Cazden, & Bellugi, 1969). Queries in the form of questions are quite functional for a young language learner. Children can obtain specific information that is important to them, such as the names of items (“What’s that?”) or persons (“Who’s that?”), or the location of missing items (“Where’s Pooh Bear?”) or missing persons (“Where’s Mommy?”). Asking questions also plays a significant role in the rapid expansion of vocabulary that is observed in typically developing children (McNeill, 1970; Slobin, 1971), and is critical for social interaction, conversations, and academic behavior.

A common problem faced by many children with autism is their inability to ask questions (e.g., Charlop & Mil-

stein, 1989; Koegel, 1996). Given the importance of this repertoire to typical language development, it is not surprising to find that there is a substantial amount of research on methods to develop question asking for individuals with language delays. Twardosz and Baer (1973) conducted one of the first studies on the use of behavioral techniques to teach individuals with language delays to ask questions. These researchers showed that the techniques of prompting, fading, chaining, and differential reinforcement were effective for teaching 2 developmentally disabled teenagers to ask “what?” questions. The procedure consisted in first teaching participants to name six letters; then they were presented with a blank card (the letter was written on the opposite side) and echoically prompted to ask “What letter?” Correct responses were reinforced with praise, the answer to the question, and a token. Both participants learned to ask the “what?” question and generalized to color and forms.

Since this early study, several other researchers have expanded the basic procedures to teach children with language delays to ask questions (e.g., Bondy & Erickson, 1976; Charlop &

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Milstein, 1989; Hung, 1977; Knapczyk, 1989; Knapczyk & Livingston, 1974; Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998; Taylor & Harris, 1995; Warren, Baxter, Anderson, Marshall, & Baer, 1981; Wilcox & Leonard, 1978). For example, Taylor and Harris showed that children with autism could not only be taught to ask "What is that?" when shown an unknown object interspersed with known objects, but that this training resulted in the acquisition of new verbal responses, specifically the names of the unknown objects. In addition, these researchers showed that question asking generalized to a less structured teaching arrangement.

The current paper is an attempt to further advance the behavioral research in this area by using the basic teaching procedures of prompts and differential reinforcement to teach children with autism to ask the questions "where?" and "who?" In addition, the paper presents a conceptualization of question asking that is based on Skinner's (1957) analysis of verbal behavior and a research focus that reflects that analysis.

According to Skinner (1957), "A question is a mand which specifies verbal action" (p. 39). As a mand, the response is under the functional control of establishing operations and specific reinforcement (Michael, 1982, 1988, 1993, 2000; Skinner, 1957). Michael (1993) defines an establishing operation (EO) as a motivative variable

that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events and (b) the frequency of occurrence of that part of the organism's repertoire relevant to those events as consequences. The first effect can be called *reinforcer establishing* and the second *evocative*. (p. 192)

The relevant EO for asking a question would be an increase in the value of specific verbal information as a form of conditioned reinforcement. For example, a child may ask "Where's Mommy?" because at that moment the value of verbal information regarding

the location of the child's mother is high (the reinforcer-establishing effect). This increase in value evokes verbal behavior that has a unique history of reinforcement that involves specific verbal action on the part of a listener (the evocative effect). In this example, the relevant consequences involve the listener providing the child with verbal information regarding his mother's location (e.g., "She went to the store").

Most of the existing behavioral research on question asking does not identify the EOs that may be related to the targeted mands for verbal information, nor do they demonstrate any attempt to ensure that the relevant EO is present during training and is the primary source of control for the targeted behavior of asking questions. In other words, do the participants in these studies really want to know the answer to their questions, or are other variables controlling their "correct" responses? In addition, the consequences used in many of the existing studies often consisted of tokens or other tangible reinforcers along with verbal information.

For example, in the Twardosz and Baer (1973) study, the participants learned the verbal response "What letter?" when first prompted in the presence of a blank card and then differentially reinforced with praise, the name of the stimulus on the back of the card, and a token. However, during the preemptive reinforcement condition (used as a reversal condition) in which praise and a token were given before the participant could ask the question, the rate of asking questions drop to near zero. This decrease in behavior seemed to demonstrate that the response was under the functional control of praise, token reinforcement, and the blank card (a nonverbal stimulus). Thus, the response functioned as a tact, not a mand. If the response was under EO control, praise and tokens should not reduce the evocative effect of the EO. For example, if a child really wanted to know where his mother was,

praise and tokens will not likely stop him from asking for information regarding his mother's location. Likewise, if the participants in the Twardosz and Baer study really wanted to know what letter was on the back of the card, they should have continued to mand for that information.

There is both conceptual and empirical evidence to suggest that verbal behavior acquired under discriminative stimulus control will not automatically transfer to control by an EO (e.g., Hall & Sundberg, 1987; Lamarre & Holland, 1985; Michael, 1982; Skinner, 1957). Hence, in teaching a child to ask questions, it is important to make sure that the primary source of control is an EO and not a discriminative stimulus, and that the relevant consequence consists of verbal information and not praise, tokens, or other tangible reinforcers. Otherwise, this type of training may produce what on the surface seems to be a correct response; however, the response is evoked for the wrong reasons. That is, the response is correct in form but wrong in function. This type of error has been identified as a common problem in the development of advanced language skills for children with autism (Sundberg & Michael, 2001).

The study by Williams, Donley, and Keller (2000) used a procedure that involved the manipulation of EOs and verbal information as a consequence to teach 2 children with autism to ask questions. These authors placed a desired item in a box, then used echoic prompts and differential reinforcement to establish the response "What's that?" Correct responses produced the name of the item but not the delivery of the item, praise, or any other tangible reinforcer. Following the acquisition of this mand for information, the response "Can I see it?" was established, with the reinforcer consisting of a visual presentation of the object (a mand, but not a mand for information), followed by training the mand "Can I have it?" (also a mand, but not a mand for information). Thus, the participants

acquired three questions that all appeared to be under the functional control of EOs, one of which was a mand for information (i.e., "What's that?").

The purpose of the current study was to determine if the mands "where?" and "who?" could be taught to children with autism by contriving EOs (Hall & Sundberg, 1987; Sundberg, 1993) and providing only specific verbal information as a consequence. In typical speakers the mand "where?" is emitted when there is an increase in the value of information regarding the location of a desired item that is lost or is not in its usual location. For example, if a person is late for work and cannot find his car keys, there is an increase in the value of information that may evoke a mand such as "Honey, where are my keys?" The consequences for this verbal behavior consist in receiving specific information regarding the location of the keys and ultimately the keys. It is important to note that there are at least two EOs involved in this mand for information; we do not look for our keys until we need them (EO 1), and we do not mand for information unless we cannot find them (EO 2).

The mand "who?" is emitted by typical speakers when there is an EO at strength for information regarding a particular person. In the example above, a second mand may occur if the information provided creates another EO such as "One of the children has the keys." At this point, the mand "Do you know who has them?" may provide the information necessary to obtain the desired keys. This chain of behavior now involves at least three EOs and two mands for information. (There may be additional EOs, such as the termination of aversive stimuli or those related to the speaker's employment.)

Two experiments were conducted to examine the EO and its relation to asking questions. In the first experiment, a desired or undesired item was placed in a container and given to a child to remove and play with if he chose to do so. Then, the same container was given

to the child, but it was empty. An echoic or imitative prompt was given (and later faded) for the mand "Where —?" A correct response was followed by information regarding the location of the item. The second experiment involved contriving a new EO following the successful emission of "where?" by telling the child that the item was given to a teacher, thereby increasing the value of information regarding the specific teacher's name. An echoic or imitative prompt was given (and later faded) for the mand "Who has it?" A correct response was followed by information regarding the name of teacher who held the item.

## EXPERIMENT 1

### METHOD

#### *Participants and Setting*

Kevin was a 5-year-old boy with a diagnosis of autism. He used a combination of spoken words and sign language to communicate. He could easily mand for a wide variety of reinforcers, tact over 300 items, and emit several hundred intraverbal responses. His receptive repertoire was substantially stronger than his ability to emit mands, tacts, and intraverbals. However, he was unable to emit the word or sign "where?" to request for information regarding the location of a desired item, even when it was clear that an EO for information regarding location was at strength, as indicated by his collateral behavior of searching for missing items.

Billy was a 6-year-old boy with a diagnosis of autism. He could vocally tact several hundred items and easily mand for items that functioned as reinforcement. His receptive and intraverbal skills were also quite strong, but he too was unable to emit the mand "where?"

The study was conducted at the participants' school, a private school serving children with autism. Typically, one session for each participant was conducted each school day at a table in

a partitioned area (1.7 m by 2 m) in their regular classroom. The other children, teachers, and aides were present in the classroom during the study. Sessions lasted 10 to 20 min for each participant. The materials consisted of a box, bag, and can, along with a variety of common objects and known reinforcers for each participant.

#### *Dependent and Independent Variables*

The dependent variable consisted of the percentage of correct mands "where?" for the 10 training trials for each session (five trials per session for each missing object). The independent variables consisted of (a) the manipulation of an EO, (b) an echoic or imitative prompt and the fading of that prompt, and (c) verbal information regarding the location of an item.

#### *Experimental Design*

A within-subject design with between-subject replication was used to isolate the relevant independent variables. The within-subject comparisons were achieved with a multiple baseline and a multielement design (Ulman & Sulzer-Azaroff, 1975). The multiple baseline compared performance across behaviors for each subject, and the multielement design compared two different levels of establishing operations within each condition. The between-subject comparisons were achieved with a multiple baseline across subjects.

*Item selection and baseline.* Two groups of items were chosen. One group consisted of items that had a history of functioning as a form of reinforcement for each participant (e.g., toy giraffe, rubber frog, viewmaster), and the other group consisted of items that had no history of functioning as reinforcement (e.g., cup, pen, raisin). The participants could tact and receptively discriminate all items as well as mand for the desired items. Six items were selected for Kevin (three known reinforcers and three neutral items), and four items were selected for Billy

(two known reinforcers and two neutral items).

A baseline was conducted for each participant. The baseline consisted of placing one of the items in a container that the participant could tact and receptively discriminate (either a box, bag, or can), and giving the container to the participant along with the verbal prompt "Get your —." The participant looked into the container, took the item out, and either played with the item (which he did with all the desired items) or handed it to the experimenter, placed it back in the container, or set it on the table (which he did for all the undesired items). Following this brief contact with the item, the container and the item were removed and the participant was given a book or a different toy. Then he was again presented with one of the containers and the verbal prompt, but this time the container was empty. The participant's verbal behavior after looking in the empty container was recorded. This procedure was repeated for all items and was conducted for three sessions.

*Pretraining.* The participants had been selected because they emitted the prerequisite skills for this advanced form of manding. These skills consisted of strong tact and receptive repertoires along with manding for tangible reinforcers and emerging intraverbal repertoires. However, both participants required some pretraining. Both participants were taught to get a variety of desired reinforcers out of each container placed a short distance away. For example, the experimenter would say "Get your frog, it's in the bag," while pointing to the bag. Then the pointing prompt was faded. This training took one session for each participant.

*Intervention.* Two items were selected for intervention for each participant. One item from the desired list (the one that appeared to be the strongest form of reinforcement) and one from the undesired list were chosen for each participant. The other items were occasionally tested under baseline conditions. The session began just like base-

line with the presentation of each item in one of the containers (free-access trials) and the verbal prompt "Get your —." Then following brief contact with the item and a brief distraction, the participant was presented with an empty container and told "Get your —." During the distraction activity, the item was placed in one of the other two containers positioned about 2 m away from each side of the participant. If the participant manded "Where —?" he was told which of the other two containers held the item (e.g., "The frog is in the bag") and was allowed approximately 30 s to play with the item after he retrieved it from the container. If he did not play with the item, he was presented with the next trial. If the participant did not mand, manded incorrectly, or emitted an approximation, he was prompted with "Say [or sign] where —." An echoic or imitative response was immediately followed by the verbal information regarding the location of the item. Echoic and imitative prompts were gradually faded each trial by using partial prompts and a delay procedure. There were 10 training trials each session; five on each item, with the items alternated each trial. After two trials on each item, another free-access trial was given for both items.

#### *Response Definition and Reliability*

The experimenter recorded the occurrences of the vocal and signed responses and scored them as correct, an approximation, or incorrect. A correct response was scored if the participant emitted the whole word "where?" and the name of the item or the complete sign "where?" and the name of the item. An approximation was scored if the participant emitted part of the word or sign "where?" or said or signed "Where?" but failed to identify the item. An incorrect response was scored if the participant failed to emit any response within 10 s, said or signed only the name of the missing item, or emit-

ted any verbal responses other than the targeted responses.

A second observer independently recorded the participants' responses during 18% of the sessions (there were 15 sessions for Kevin and 18 sessions for Billy). Reliability data were taken for the baseline and training sessions. A point-by-point reliability method of dividing the total number of agreements by the agreements plus disagreements and multiplying by 100% was used. The mean percentage agreement score for baseline was 100%, and the mean percentage agreement score for the training sessions was 95% (range, 80% to 100%).

### RESULTS AND DISCUSSION

The results are presented in Figures 1 and 2. During baseline neither participant was able to emit the mand "where?" when an EO for information regarding the location of a desired item appeared to be present ( $M = 0\%$ ). It seemed that an EO was present because upon looking in the empty box both participants immediately began looking around for the missing item (e.g., by looking under the container, on the floor, quizzically at the experimenter and the other materials). Following intervention on the first set of items, both participants were able to successfully mand for information regarding the location of the items. Kevin met the criterion of two consecutive sessions at 100% in only five training sessions ( $M = 68.5\%$  for the whole condition), whereas Billy required eight training sessions ( $M = 41\%$  for the whole condition).

One aspect of the study was to determine if there would be a difference between the acquisition of the mand with items that were judged by the experimenters to have different reinforcing value (e.g., a plastic giraffe vs. a pen for Kevin, and a rubber frog vs. a cup for Billy). This difference did occur as expected for Kevin but not for Billy. Kevin showed faster acquisition on the highly preferred giraffe (Figure

1), but Billy showed faster acquisition on what was speculated to be the less preferred item, the cup (Figure 2). However, it turned out that Billy enjoyed putting the cup to his mouth, sucking it tight, and then blowing it into the air (a form of self-stimulation). He became less interested in the frog (i.e., the EO for the frog was weak, as evidenced by his failure to play with it when he located it). Thus, it appeared that there was some relation between the value of the missing item and its evocative role for the mand "where?"

Figures 1 and 2 also show performance on a second, and for Kevin, a third set of items. Following training on the first set of items, Kevin successfully manded for the location of two new and desirable items without training (horse and dog), but he failed to consistently mand for the location of two other less desirable items (raisin and Lego®). Billy did not emit the targeted mand on the second set without direct training. However, with this set he performed slightly better on the more desired item and never reached criterion on the less desired item. In addition, Billy's parents reported that he began to spontaneously emit the mand "where?" at home, but only when the EO for a particular item was strong. Kevin did not demonstrate any spontaneous responding, but he was successful on several probe trials involving other reinforcers following his last formal training session.

Eventually, both participants were able to mand "where?" for both items, even though they were of unequal reinforcing value. A similar effect was noted by Hall and Sundberg (1987), who pointed out that the evocative effect of the EO appeared to be most salient at the time of acquisition of a new mand. This effect is perhaps due to other variables such as discriminative stimuli and conditioned reinforcers acquiring control during the experimental conditions. For example, after several sessions both participants appeared to enjoy getting up from the table and looking in the containers. It had be-

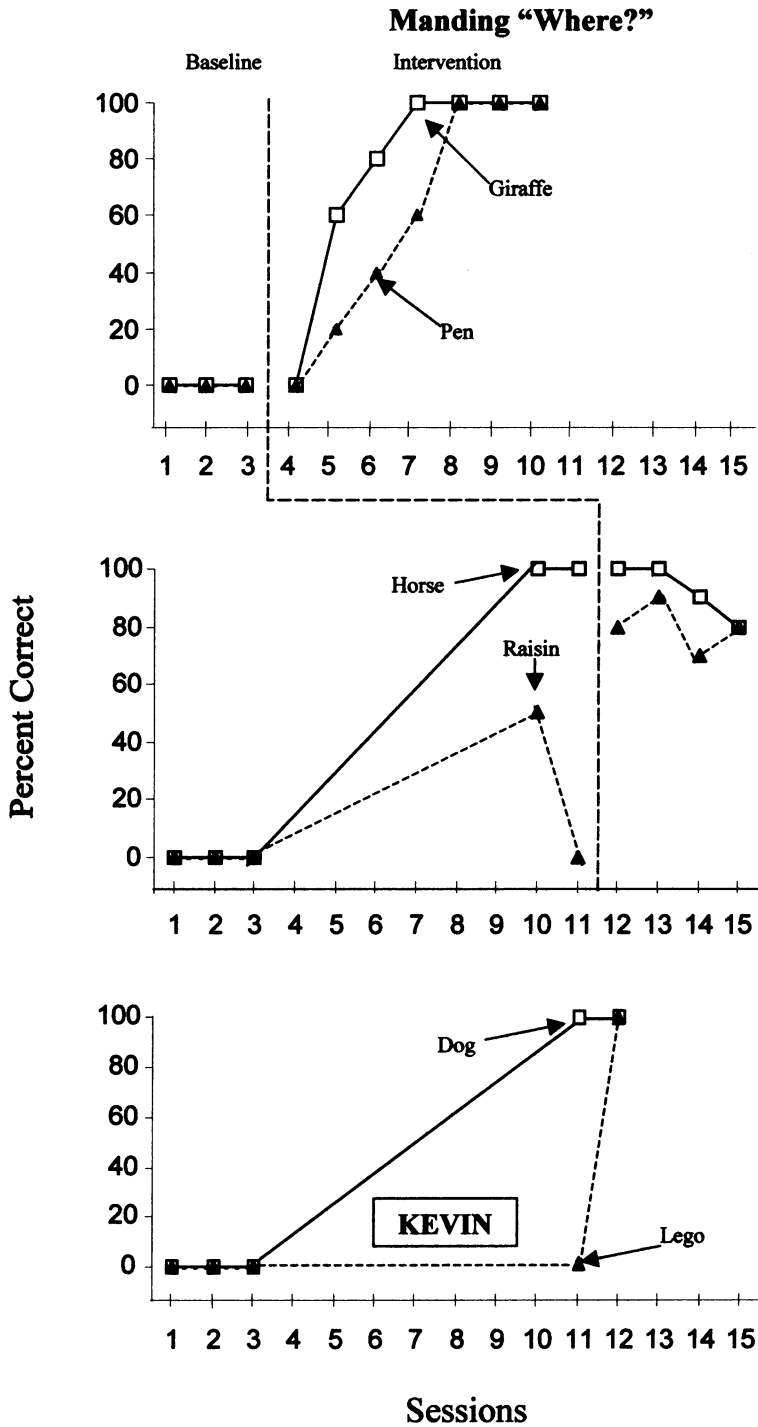


Fig. 1. Percentage of correctly manding "where?" by Kevin across three sets of items. The open squares represent items that were assessed as strong forms of reinforcement, and the closed triangles represent items that were assessed as nonreinforcing items.

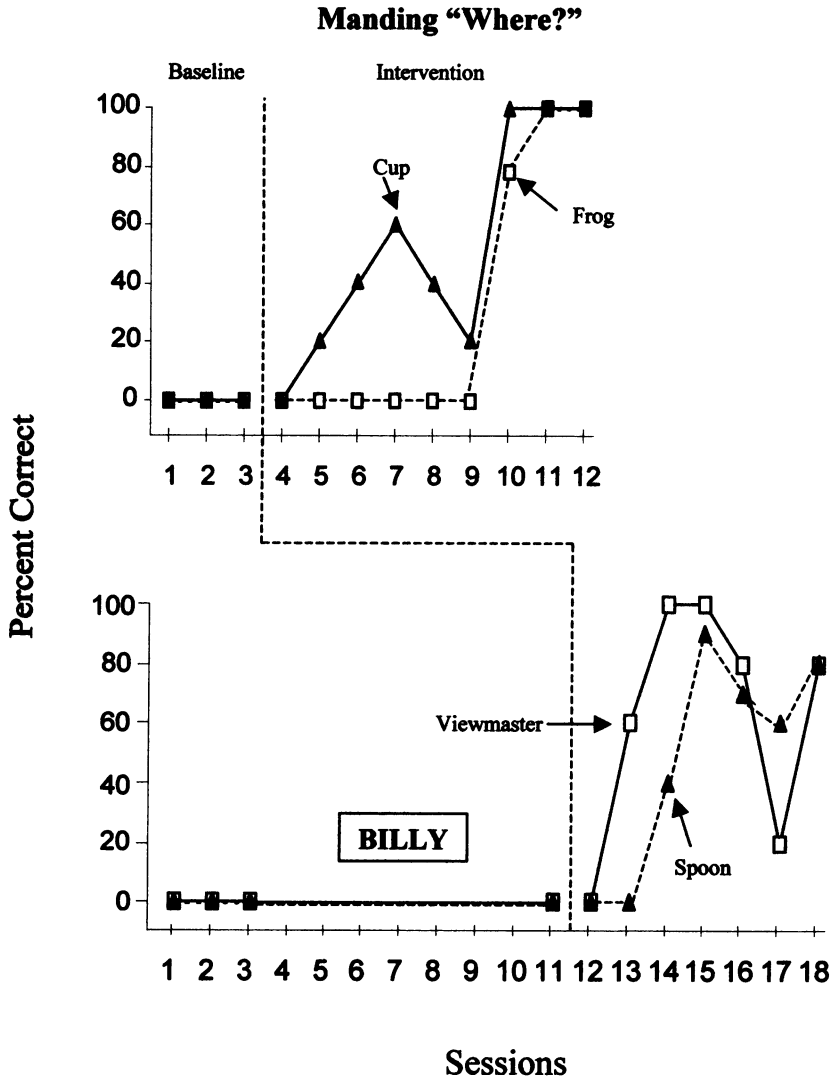


Fig. 2. Percentage of correctly manding "where?" by Billy across two sets of items. The open squares represent items that were assessed as strong forms of reinforcement, and the closed triangles represent items that were assessed as nonreinforcing items.

come a type of game for them. This effect suggests the untrained emergence of new sources of control and is in need of further research.

However, there were times when it appeared that the EO for a particular item was weak for Billy (see the bottom panel of Figure 2), and his performance dropped substantially. Often during the free-access trial Billy looked into the container but did not take out the item. After a free-access trial with this effect, he usually did not

mand "where?" on the next trial. Following Session 18, a new desired item (a ball) was placed in the box for a free-access trial. He took the ball out and played with it. Then a missing-item trial was presented and Billy immediately manded "Where ball?" This effect seemed to demonstrate the importance of the EO for the missing item as an independent variable, and the transitory and momentary effects of the EO as described by Michael (1982, 1988). This effect represents an-



other topic in need of further research, especially given the points made above about other types of control that seemed to emerge during the study.

The results of Experiment 1 show that children with autism can learn to mand for information regarding location when EOs are used as independent variables, along with the procedures of prompting, fading, and differential reinforcement involving verbal information. A second experiment was conducted to determine if the mand "who?" could be added to this verbal chain. As previously stated, "who?" is emitted by speakers when there is an EO at strength for information regarding a particular person. This experiment attempted to contrive this type of EO and use it as an independent variable for teaching the mand "who?"

## EXPERIMENT 2

### METHOD

#### *Participants and Setting*

Kevin was the same child who participated in Experiment 1. However, he was approximately 1 year older and had successfully been emitting the mand "where?" in the natural environment, but not the mand "who?" This participant now used speech as his main form of verbal behavior, but he occasionally accompanied speech with sign language if he was not understood by listeners.

Joey was an 8-year-old boy with a diagnosis of autism. He could vocally tact several hundred items and easily mand for items that functioned as reinforcement. His receptive and intra-verbal skills were also quite strong. He could successfully emit the mand "where?" under the relevant EOs, but could not appropriately emit the mand "who?"

The setting and containers were the same as Experiment 1. However, different items and reinforcers were used, along with a variety of teachers who held the common objects and known reinforcers for each participant.

*Dependent variable.* Correct and incorrect mands "where?" and "who?" were recorded. In addition, for the last two sessions, the latency between the final word in the verbal stimulus "I gave it to a teacher" and the mand to the correct teacher for the item was recorded.

*Independent variable.* The independent variables consisted of (a) the manipulation of an EO, (b) an echoic prompt and the fading of that prompt, and (c) verbal information regarding the name of the person who had the missing items.

#### *Experimental Design and Procedure*

The design was the same as in Experiment 1.

*Item selection and baseline.* Two groups of items were chosen. One group consisted of items that had a history of functioning as reinforcement for the participants (e.g., elephant, whistle, frog), and the other group consisted of items that had no history of functioning as reinforcement (e.g., pants, button, fork). The participants could mand for the desired items and could tact and receptively discriminate all items and the various teachers who held the items during the experiment. Six items were selected for Kevin (three known reinforcers and three neutral items), and six items were selected for Joey (three known reinforcers and three neutral items). Coincidentally, the reinforcing and neutral items turned out to be the same for both participants.

Baseline was conducted for each participant. The baseline consisted in placing one of the items in a container (either a box, bag, or can) and giving the container to the participant along with the verbal prompt "Get your —." The participant looked into the container, took the item out, and either played with the item or gave it to the experimenter, placed it back into the container, or put it on the table (free-access trial). Following brief contact with the item, the container and the item were

removed and the participant was given a book or toy. Then he was presented with the container and verbal prompt again; however, this time the container was empty. Under these circumstances, both participants always manded "Where —?" and the experimenter responded with "I gave it to a teacher." The participants' verbal behavior following this information was recorded. This procedure was repeated five times for all six items and for two sessions for both participants (except Joey received a third baseline session for frog and pants).

*Intervention.* Two items were selected for intervention for each participant. One item was chosen from the desired list, and one was chosen from the undesired list. The other items were occasionally tested under baseline conditions. The intervention was the same as in Experiment 1, except before the participant was given the empty container and told to get the item, it was covertly given to one of three other teachers in the room. Following the successful mand "where?" the experimenter said "I gave it to a teacher." A correct response ("Who has it?") was followed by the name of the teacher who had the item. An incorrect response was followed with the echoic prompt "Say who has it." After a correct echoic response, the name of the person who had the item was given. Echoic prompts were gradually faded each trial by using partial prompts and a delay procedure. There were 10 training trials each session, five on each item, and the two items were alternated each trial. After three trials on each item, a free-access trial was given (the item was in the container). Following intervention on the first set of items for Kevin and the second set of items for Joey, a variety of novel items (both reinforcing and nonreinforcing) were individually placed in the container (free-access trial), and was followed by a single missing-item trial.

*Follow-up.* Six months following the conclusion of the study a follow-up session was conducted with Joey.

### *Response Definitions and Reliability*

The experimenter recorded the occurrences of the verbal responses and scored them as correct, an approximation, or incorrect. A correct response was scored for the mand "where?" if the participant emitted the whole word "where" and the name of the item. A correct response was scored for the mand "who?" if the participant emitted the words "Who has it?" An approximation was scored if the participant emitted part of the word "where" or "who" or said "where?" but failed to identify the item. An incorrect response was scored if the participant failed to emit any response within 10 s, said only the name of the missing item, or emitted any verbal responses other than the targeted responses. In addition, for the last two sessions and for the follow-up session, data were taken on the latency between the final word in the teacher's sentence "I gave it to a teacher" and the participant's mand to that teacher for the item.

A second observer independently recorded the participants' responses during 19% of the sessions (there were 11 sessions for Kevin and 10 sessions for Joey). Reliability data were taken for the baseline and training sessions. A point-by-point reliability method of dividing the total number of agreements by the agreements plus disagreements and multiplying by 100% was used. The mean percentage agreement score for the baselines was 100%, and the mean percentage agreement score for the training sessions was 97.5% (range, 95% to 100%). In addition, one reliability check was made on the latency measure for 1 participant, yielding a score of 93% (range, 69% to 100%).

### RESULTS AND DISCUSSION

The results of Experiment 2 are presented in Figures 3 and 4. During baseline both participants could successfully emit the mand "Where's my —?" but not the mand "Who has it?" After three sessions of intervention (two for frog and pants and one for the novel

**Manding “Where?” and “Who?”**

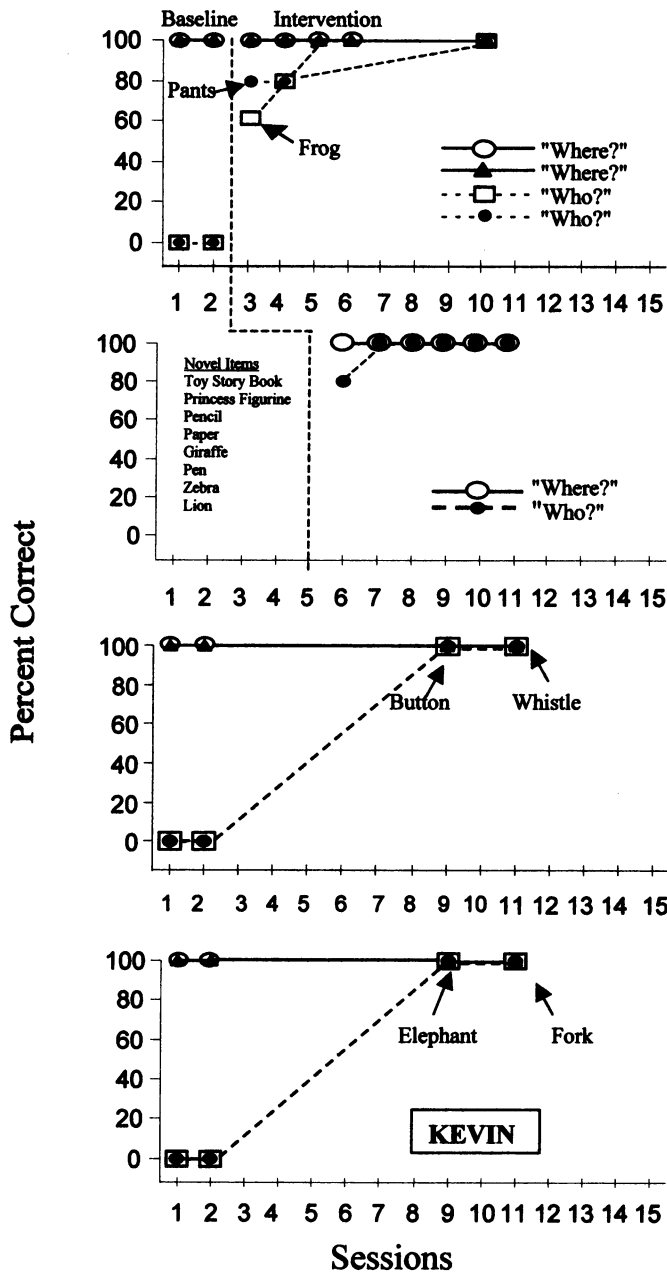


Fig. 3. Percentage of correctly manding “where?” and “who?” by Kevin across four sets of items. The open oval and the closed triangle represent mands for “where?” for the desired and undesired items, respectively. The open square and the closed circle represent mands for “who?” for desired and undesired items, respectively. For the novel items, the open oval represents mands for “where?” and the closed circle represents mands for “who?”

**Manding “Where?” and “Who?”**

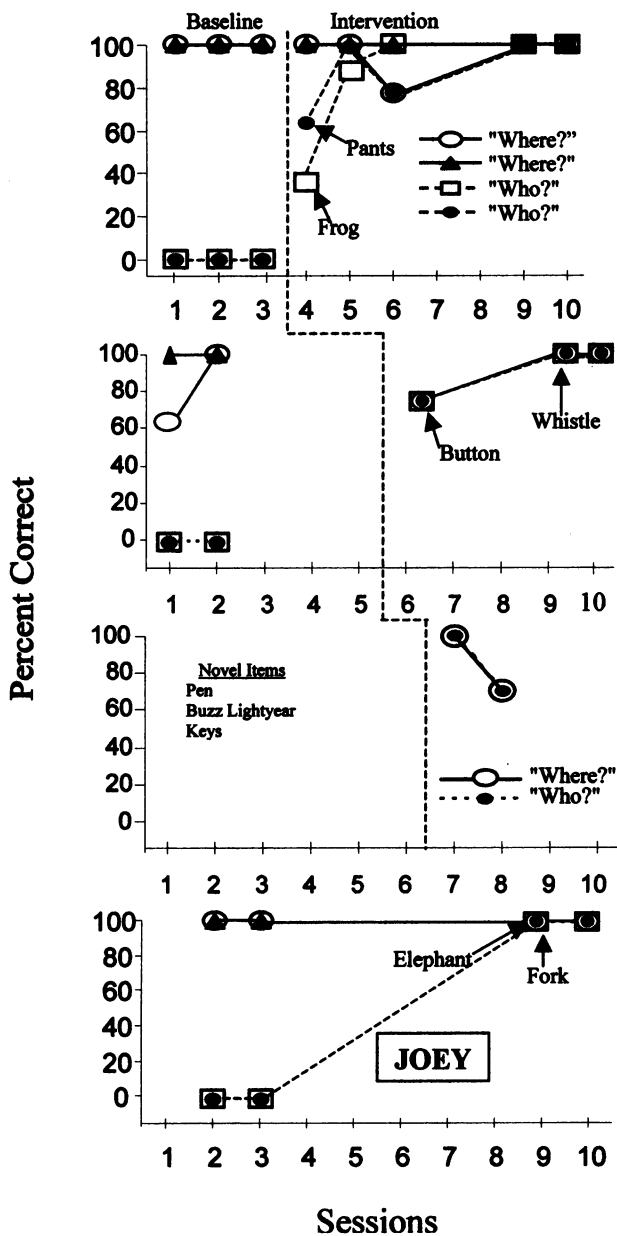


Fig. 4. Percentage of correctly manding “where?” and “who?” by Joey across four sets of items. The open oval and the closed triangle represent mands for “where?” for the desired and undesired items, respectively. The open square and the closed circle represent mands for “who?” for desired and undesired items, respectively. For the novel items, the open oval represents mands for “where?” and the closed circle represents mands for “who?”

items), Kevin was able to successfully mand for information by emitting "Where's my —?" and "Who has it?" for every item presented ( $M = 95.8\%$ ). In addition, Kevin emitted an additional mand for the item itself when he reached the teacher; thus, this chain of behavior involved three separate mands. There was not much difference between the desired and the undesired item in terms of percentage correct. Joey also acquired the mand "Who has it?" with minimal training and reached 100% by the fifth session ( $M = 90.5\%$ ). He too manded for the item when he reached the teacher and showed no difference in terms of percentage correct between the desired and undesired items.

The first experiment demonstrated that the value of the missing item was initially an important variable in evoking mands. This difference did not appear in the percentage correct data for Experiment 2, but it was observed that both participants walked faster to the adult when the desired item was missing. Therefore, latency data were taken during the last two sessions for both participants. The mean latency (over 60 trials) for the items thought to be desirable for Kevin was 5.937 s, but it was 8.975 s for the assumed less desirable items. For Joey, the mean latency (over 60 trials) for the items thought to be desirable was 5.04 s and was 5.684 s for the assumed undesirable items. These data show a difference in the reinforcing value of the items. These results are consistent with other research on EOs and specific reinforcement that shows that other measures of response strength, such as latency and choice, can show differences in the evocative effects of an EO that may not appear with correct responses as a dependent variable (Stafford, Sundberg, & Braam, 1988).

#### *Generalization and Follow-Up*

Figures 3 and 4 also show the participants' performance on several novel items. Kevin successfully emitted

the three-component mand for almost all new items presented in the container. Joey's performance varied more, but he was also able to mand for the new items missing from the container. In a natural setting, both participants correctly emitted the three-component mand when their lunch boxes were removed from the usual location and when items were missing from their lunch boxes. An interesting element of this condition was that Kevin became quite upset when his lunch box was missing, and although he correctly emitted the mands, he shouted them in a very angry voice. This condition demonstrated the aversive nature of missing items and suggests the possibility that reflexive conditioned EOs (Michael, 1993) may be involved in some manding for information. The role of this type of EO in manding and mand training is in need of further research.

A single follow-up session was conducted with Kevin 6 months after the end of the formal study. He scored 100% on 21 trials, involving six different items. Two of the items were new items never tested before (caterpillar and crayon). There was no difference in percentage correct for desired versus undesired items, but there were large differences in the response latencies. The mean latency for the desired items was 11.9 s, whereas the mean latency for the undesired items was 22.4 s.

### GENERAL DISCUSSION

The results of these experiments show that children with autism can learn to mand for information when EOs are used as independent variables that make information valuable, and thus function as conditioned reinforcement. It appears that there are two EOs necessary for the mand "where?" and three EOs necessary for the "where?" and "who?" mand chain. First, for "where?" if the reinforcing value of an item is strong (EO 1), then the absence of that item from a known location will

establish information regarding the item's location as a form of reinforcement (EO 2). For example, if a child wants a particular toy (EO 1) and it is not in the usual location (EO 2), he is likely to mand "Where's my —?" to an appropriate listener. The third EO occurs when the information provided after the mand "Where's my —?" establishes additional information as valuable, as in "I gave it to a teacher" (EO 3).

Part of the reason that children with autism may have difficulty in acquiring question-asking behavior is that for many of these children verbal information does not function as a form of conditioned reinforcement. Any procedure that attempts to teach this behavior without a relevant EO that makes information valuable must rely on other more potent reinforcers such as tokens and other tangible items to establish the correct response form. However, once the response form is established, it may actually be under discriminative stimulus control rather than EO control. That is, a speaker may emit a topographically correct question, but the response is a function of the availability of reinforcement rather than an increase in the value of specific verbal reinforcement (Michael, 1982, 1988; Skinner, 1957). In commonsense terms, the child may not really want to know the answer to the question, but is emitting the behavior to obtain some other form of reinforcement (e.g., attention, tokens). Thus, it should not be surprising to find that the targeted repertoire of asking questions for information does not occur in the natural environment, or when it does it may not be for the same reasons that a typically developing child asks questions.

It was interesting to note that in the current study these relatively complex mands were acquired quickly and generalized easily. In both experiments the participants emitted the mand correctly when new items were tested. These rapid effects were similar to those found by Hall and Sundberg (1987) when EOs were used to teach mands

for missing items needed to complete a reinforcing chain of behavior. These data collectively suggest that the EO is an important independent variable for language training, and can be easily incorporated into daily language training for children with language delays (Carroll & Hesse, 1987; Drash, High, & Tutor, 1999; Michael, 1988, 1993; Sundberg, 1993; Sundberg & Michael, 2001; Sundberg & Partington, 1998).

Future research on the EO and complex manding could further improve our ability to develop language skills for children who do not acquire language in the typical manner, especially children with autism. Other mands for information should be examined (e.g., "what?" "when?" "which?" and "why?"). All of these mands involve EOs, although they are different from the EOs that evoke "where?" and "who?" For example, the mand "when?" should be under the functional control of an increase in the value of information regarding a specific time, whereas the mand "which?" should be under the control of information regarding a specific object. Research examining the role of the EO in teaching these mands could be helpful not only for language training but also for advancing behavioral research on the role of the EO as an independent variable in behavior analysis.

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