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USING MULTIPLE-EXEMPLAR TRAINING TO TEACH A GENERALIZED REPERTOIRE OF SHARING TO CHILDREN WITH AUTISM

DENISE MARZULLO-KERTH, SHARON A. REEVE, AND KENNETH F. REEVE

CALDWELL COLLEGE

AND

DAWN B. TOWNSEND

INSTITUTE FOR EDUCATIONAL ACHIEVEMENT

The current study examined the utility of multiple-exemplar training to teach children with autism to share. Stimuli from 3 of 4 categories were trained using a treatment package of video modeling, prompting, and reinforcement. Offers to share increased for all 3 children following the introduction of treatment, with evidence of skill maintenance. In addition, within-stimulus-category generalization of sharing was evident for all participants, although only 1 participant demonstrated across-category generalization of sharing. Offers to share occurred in a novel setting, with familiar and novel stimuli, and in the presence of novel adults and peers for all participants during posttreatment probes.

Key words: autism, generalization, multiple-exemplar training, social behavior, sharing, video modeling

Prosocial behavior refers to a broad class of responses that includes smiling, cooperating, taking turns, making friends, expressing empathy, helping others, and sharing (Barton & Ascione, 1979; Bryant & Budd, 1984; Chandler, Lubeck, & Fowler, 1992; Cooke & Apolloni, 1976; Reeve, Reeve, Townsend, & Poulson, 2007; Rogers-Warren & Baer, 1976; Warren, Rogers-Warren, & Baer, 1976). Bryant and Budd (1984) suggested that sharing may be an especially important social behavior for young children because it increases opportunities for positive social interactions with peers and is an integral component of interactive play.

Several studies illustrate successful procedures for teaching children of typical development how to share with their peers. Warren et al. (1976) for example, used modeling and reinforcement to increase offers to share and corresponding acceptances of share offers in two groups of preschool children with reported generalization to a new setting. Barton and Ascione (1979) examined the generalization and durability of sharing by teaching preschool children to share verbally (e.g., ''here you go''), physically (e.g., handing a toy), or both. Physical sharing increased for all children during training, but it generalized and maintained only for children who were taught to share verbally. Verbal sharing increased during training only for children who were taught to share verbally or both verbally and physically; however, verbal sharing did not generalize across settings. Bryant and Budd (1984) extended this training package to six preschoolers with disabilities, focusing on teaching

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Correspondence concerning this article should be addressed to Sharon A. Reeve, Department of Applied Behavior Analysis, Caldwell College, 120 Bloomfield Avenue, Caldwell, New Jersey 07006 (e-mail: sreeve@caldwell.edu).

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specific components of sharing responses: offers, requests, and acceptances. All three components of sharing increased after implementation of instructions, modeling, and behavior rehearsals.

Compared to children of typical development, children with autism often display especially marked impairments in sharing (Baron-Cohen, Leslie, & Frith, 1985; Eisenberg & Fabes, 1998; Rheingold & Hay, 1980; Rutter, 1978; Volkmar, Carter, Sparrow, & Cicchetti, 1993; Wing, 1988). Despite these deficits, few studies have examined methods to teach children with autism to share. Sawyer, Luiselli, Ricciardi, and Gower (2005) increased verbal and physical sharing in one child with autism through the use of priming before play sessions, along with in-session prompts and reinforcement; however, they did not assess skill generalization. Recently, DeQuinzio, Townsend, and Poulson (2008) used a forward chaining procedure to teach children with autism to approach a peer and emit a show-give-play sharing response chain with multiple toy exemplars. Sharing of toys increased for all participants and generalized to nontrained toys, novel locations, and different peers. However, DeQuinzio et al. conducted training and testing with only one class of materials (toys), so it is not clear whether sharing could be successfully taught using other classes of materials or whether sharing would generalize to untrained classes of materials.

Because the utility of a behavior-change procedure is increased when responding generalizes across persons, settings, and materials (Stokes & Baer, 1977; Stokes & Osnes, 1989), it is important to implement procedures that promote generalization. One strategy to accomplish this involves the teaching of multiple exemplars. Multiple-exemplar training has been used to teach numerous skills to individuals with moderate to severe disabilities, including appropriate vending machine use (Sprague & Horner, 1984) and setting and clearing tables (Horner, Eberhard, & Sheehan, 1986). For children with autism, multiple-exemplar training has been used to teach helping behavior (Reeve et al., 2007), empathy (Schrandt, Townsend, & Poulson, 2009), and appropriate affect (Gena, Krantz, McClannahan, & Poulson, 1996), among others.

Stimuli that adequately reflect the diversity of the stimulus characteristics likely to be present under generalization conditions are used during multiple-exemplar training. The identification of these stimuli by the teacher is known as a general case analysis (Engelmann & Carnine, 1982; Horner, Sprague, & Wilcox, 1982; Sprague & Horner, 1984). When responding comes under the control of the stimulus features present in the exemplars used during training, the presentation of novel stimuli that share these features should also occasion the same response.

The purpose of the present study was to extend the findings of DeQuinzio et al. (2008) by establishing a generalized repertoire of sharing in four children with autism. A multiple-exemplar teaching procedure similar to that of Reeve et al. (2007) was used. Specifically, children were taught to share items from multiple classes of materials (art materials, snack foods, toys, and gym materials), and generalization was assessed both within classes of materials and across nontaught classes of materials. In addition, teaching was conducted in different settings to promote generalization across locations, and discrimination of nonsharing situations was targeted and assessed. Finally, we assessed whether sharing was under appropriate stimulus control by sampling situations and stimuli for when sharing was appropriate and situations in which it was not. Also similar to Reeve et al., a combination of video modeling and prompting was used for error correction. Video modeling provided a means to standardize the presentation of the models and has been shown to promote acquisition and generalization of skills for children with autism (Krantz, MacDuff, Wadstrom, & McClanna-

han, 1991; LeBlanc et al., 2003; Nikopoulos & Keenan, 2004; Taylor, Levin, & Jasper, 1999).

METHOD

Participants

Four children with a diagnosis of autism participated. They attended a private school for individuals with autism and had received their diagnoses through independent agencies prior to school enrollment. Direct observation and parent or teacher reports conducted prior to the start of the study indicated that none of the participants engaged in sharing in the classroom or at home. Steven was 8 years 1 month old, Isaac was 7 years 10 months old, Bobby was 8 years 1 month old, and Aiden was 7 years 6 months old. Each participant had previous experience learning skills with discrete-trial instruction and using token-based motivational systems. According to reports by their teachers, each participant also demonstrated the prerequisite verbal skills needed to make the target vocal responses used in the present study (e.g., "Want to try it?" "You try it"), displayed correct imitation of various verbal and motor responses using both in vivo and video models, and followed simple directions to engage in specified activities.

Setting and Materials

Experimental sessions were conducted in a school office that was not used for the participants' daily education. The office contained a desk and three chairs, bookshelf, filing cabinet, computer, printer, and telephone. Additional materials included all relevant stimulus materials (i.e., toys, gym equipment, art materials, and snacks), a portable DVD player, small audio voice recorders, a token board, a video camera with tripod, and data sheets. Approximately every 2 weeks, experimental sessions were conducted in the school's kitchen to promote generalization. The kitchen contained two round tables with five chairs at each, stove, sink, refrigerator, dishwasher, and vending machine. Pre- and posttreatment sessions were conducted in the usual daily classroom to assess generalization of sharing.

Materials and target responses for the study were selected based on data collected with first- through third-grade general and special education students during a cumulative 2 hr of observations in public elementary schools conducted during free play, snack time, outdoor recess, and gym. Materials used included modeling clay, crayons, stamps, jump rope, balls, puppets, pretend food, blocks, small plastic animals, books, cars, and snacks. The majority of the observed sharing statements were requests or directions to share another student's materials (e.g., "want one?," "here you go," "wanna play?," "your turn," and "here"). The classroom teachers were also asked what types of materials the participants were likely to use during free time and group time, when offering to share would be appropriate.

The four stimulus categories were art materials, snack foods, toys, and gym materials. Stimulus categories and items assigned to each participant are listed in Table 1. In each of these four categories, five different materials served as multiple exemplars of the same stimulus category. For example, art materials included crayons, dot paint, markers, colored pencils, and glitter pens. Snack foods for Steven, Bobby, and Aiden included pretzels, cookies, chips, candy, and marshmallows. Specific snack foods were different for Isaac because he displayed disruptive behavior in response to the removal of the original snacks (which were highly preferred) during the initial treatment session. To reduce disruption, snack foods for Isaac included carrots, celery, apples, and raisins. During pre- and postintervention generalization probes, however, snack stimuli for Isaac were the same as those used for the other three participants. Toys included Lego blocks, cars, magnets, Play-Doh, and Peg-Board. Gym materials included a Velcro mitt and ball, basketball, scooter, Hippity-Hop, and Velcro

Table 1
Assignment of Stimuli and Verbal Responses Across Participants

	Steven	Isaac	Bobby	Aiden
Teaching	Art: crayons dot paint markers Snack: pretzels cookies chips Toys: Lego blocks cars magnets	Snack: celery apples raisins Toys: cars magnets Play-Doh Gym: basketball scooter Velcro mitt and ball	Toys: magnets Play-Doh Lego blocks Gym: scooter Hippity-Hop Velcro mitt and all Art: markers colored pencils crayons	Gym: Hippity-Hop Velcro mitt and ball magnetic darts Art: crayons colored pencils dot paint Snack: candy pretzels cookies
Within-category probe	Art: colored pencils Snack: candy Toys: Play-Doh	Snack: carrots Toys: Lego blocks Gym: Hippity-Hop	Art: dot paint Gym: basketball Toys: cars	Art: markers Snack: chips Gym: scooter
Across-category probe	Gym: scooter	Art: crayons	Snack: chips	Toys: cars
Verbal responses	"Would you like to try this?" "Do you want to try?" "Here, you try it." "Try this."	"Try this." "Do you want to try?" "Here, you try it."	"Why don't you try?" "Try this." "Do you want to try?"	"Here, you try it." "Would you like to try this?" "Do you want to try?"
Pre- and posttreatment generalization trials[a]	Snack: marshmallows (G) candy (P) cookies (T) Art: glitter pens (G) colored pencils (P) markers (T) Gym: scooter (P) basketball (G) Velcro darts (G) Toys: Peg-Board (G) Play-Doh (P) Lego blocks (T)	Snack: marshmallows (G) candy (P) pretzels (T) Art: crayons (P) glitter pens (G) markers (G) Gym: Velcro darts (G) Hippity-Hop (P) Velcro mitt and ball (T) Toys: Peg-Board (G) Lego blocks (P) cars (T)	Snack: chips (P) marshmallows (G) pretzels (G) Art: glitter pens (G) dot paint (P) crayons (T) Gym: Velcro darts (G) basketball (P) Hippity-Hop (T) Toys: Peg-Board (G) cars (P) Play-Doh (T)	Snack: marshmallows (G) chips (P) candy (T) Art: glitter pens (G) markers (P) dot paint (T) Gym: Velcro darts (G) magnetic darts (P) Hippity-Hop (T) Toys: cars (P) Peg-Board (G) magnets (G)

[a] Includes stimuli used only during pre- and posttreatment generalization trials (G), probe trials during experimental sessions (P), and teaching sessions (T).

darts. One exemplar in each category was randomly selected for use in pre- and posttreatment generalization probes only (i.e., glitter pens, marshmallows, peg board, and Velcro darts). In addition, materials that served as discriminative stimuli for nonsharing responses were present, including papers to put in a backpack, an academic worksheet, books on the floor that needed to be placed on a table, a dirty tabletop and a towel, and an article of clothing. It should be noted that although the materials used for sharing and nonsharing trials were all selected based on observations of peers in natural settings, no assessment was made regarding the participants' relative preferences for any of the materials.

Video Models

The video models used to teach sharing depicted two peers sharing an activity shown from a third-person viewpoint (i.e., scene perspective). Specifically, a 7-year-old boy was first shown either sitting at a table or standing, engaged in an activity. A second 7-year-old boy then came on camera, approached the first boy, and stood within 0.6 m of him. Following the

Table 2
Video Model Types Across Participants

	Video model	
	Verbal response	Stimulus sets
Steven	"Would you like to try this?"	cookies, cars
	"Do you want to try?"	markers, crayons
	"Try this."	magnets, chips
Isaac	"Try this."	magnets, chips
	"Do you want to try?"	Velcro mitt and ball, pretzel
	"Here, you try it."	ball, Play-Doh
Bobby	"Why don't you try?"	colored pencils, Velcro mitt and ball
	"Try this."	Play-Doh, scooter
	"Do you want to try?"	magnets, markers
Aiden	"Here, you try it."	football, colored pencils
	"Would you like to try this?"	cookies, cars
	"Do you want to try?"	pretzels, Velcro mitt and ball

approach of the second boy, the first boy held out his item and emitted a verbal offer to share. Six video models were used for each participant, and each video model was approximately 8 to 10 s in duration. Stimuli featured in each video model corresponded to stimuli used during training trials for that particular participant. Similarly, verbal offers to share emitted by the peer in the video model were verbal responses assigned to that particular participant during treatment. Table 2 provides a list of the stimuli and responses featured in the video models for each participant. For example, one of Steven's video models depicted a peer coloring with crayons who asked, "Do you want to try?" in response to the approach of the second peer.

Response Measurement

Trained observers scored participant responses on a trial-by-trial basis using pencils and paper data sheets. A correct offer to share was scored only if both the motor and verbal component occurred. A correct motor response consisted of the participant holding out an item to the experimenter within 5 s of her approach to within 0.6 m of the participant. A correct verbal response consisted of a request for the experimenter to engage in an activity with the presented item (e.g., "Do you want to try?"; "Here, you try it") or an approximation of the response (e.g., "Do you want it?"; "try"). A correct nonsharing response was scored if the child responded on a nonsharing trial by completing the task without offering to share, either physically or verbally. Table 2 depicts the randomized assignment of verbal responses taught to participants.

A teacher with master's level training in behavior analysis served as a second observer and scored sharing and nonsharing either in vivo or via videotapes of a session. For each trial, the scoring of the two observers was compared, and only an exact match was considered an agreement. Percentage agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Interobserver agreement data were collected on the dependent variable during 54% of Steven's sessions, 44% of Isaac's sessions, 47% of Bobby's sessions, and 40% of Aiden's sessions. The mean percentage of agreement across all trial types (training, probe, and nonsharing trials) and across all participants was 99% (session range, 97% to 100%). A trained observer also collected data on the accuracy of the experimenter's presentation of discriminative stimuli, reinforcement, trial types, and video model error correction. These procedural integrity data were collected during 95% of all baseline, treatment, maintenance, and pre- and posttreatment sessions. The mean percentage

accuracy on procedural components was 99% (session range, 98% to 100%). In addition, a second observer scored procedural integrity for 46% of Steven's sessions, 34% of Isaac's sessions, 36% of Bobby's sessions, and 34% of Aiden's sessions. The mean percentage of agreement on the accurate presentation of procedural components was 99% (session range, 98% to 100%).

Design and Assignment of Categories

A concurrent multiple-probe design across participants was used. Three of the four possible stimulus categories were assigned to the training condition for each participant; the fourth category was used to assess across-category generalization of sharing responses (see Table 1). Each category contained five possible stimulus exemplars: Three were directly targeted as stimulus exemplars (partially counterbalanced across participants), a fourth exemplar was used to assess within-category generalization of sharing during training sessions, and the fifth exemplar was used to further assess within- and across-category generalization during the pre- and postintervention generalization probes. For example, Steven's teaching trials included crayons, dot paint, and markers (art materials category); pretzels, cookies, and chips (snack foods category); and Lego blocks, cars, and magnets (toy category). Probe trials for Steven included a scooter (gym materials category) to assess across-category generalization, colored pencils to assess within-category generalization for art materials, candy to assess within-category generalization for snack foods, and Play-Doh to assess within-category generalization for toys.

Procedure

Each baseline and treatment session consisted of 18 trials. Of these, nine were teaching trials (three exemplars from each of the three training categories). Four additional trials were generalization probes with the fourth exemplar from each of the three training categories and one exemplar from the fourth stimulus category. To promote response generalization, three of the five experimenter-defined verbal offers to share were randomly assigned to each participant and were rotated across trials. At the start of each trial, the experimenter approached and stood within 0.6 m of the participant while he was engaged in a specific activity. The purpose of presenting these discriminative stimuli was to set the occasion for the participant to offer to share the item or items with which he was engaged. Finally, five nonsharing discrimination trials were interspersed among the nine teaching and four probe trials. To reduce potential order or sequence effects, the order of the trials was randomized, with the exception that all sessions began and ended with a training trial.

Baseline. The participant was seated at a desk. The experimenter presented stimulus materials for that trial (e.g., crayons and a blank coloring page) with a verbal direction to engage in the target activity (e.g., ''color the picture''). Within 5 s of presenting the materials, the experimenter approached the participant and stood within 0.6 m of him. If the participant emitted a correct verbal and motor offer to share, the experimenter responded ''sure'' or ''thanks,'' took the offered item, and manipulated the item appropriately. No prompts or models were provided, and no tokens were delivered for sharing. The experimenter delivered tokens on a variable-ratio (VR) 2 schedule for following the direction to engage in the task and attending to the experimenter. The experimenter did not respond if the participant emitted only a correct motor response or a correct verbal response. If the participant did not emit a correct response within 5 s of the presentation of the discriminative stimuli, the experimenter removed the materials and walked away. After a 5-s intertrial interval, the experimenter presented the participant with the next activity and a new trial began. At the conclusion of a session, participants could trade in their tokens for previously selected activities or materials (e.g., access to a

video game, preferred snacks or toys) that were not used during the sessions.

Treatment. The steps of the procedure are depicted in Figure 1. As in baseline, the experimenter presented the participant with stimulus materials, gave the direction to engage in the target activity, waited 5 s, approached the participant, and stood within 0.6 m of him. Following a correct sharing response during training trials, the experimenter accepted the offered item; confirmed the offer to share by saying ''yes,'' ''sure,'' or ''thank you''; manipulated the offered item appropriately; and then delivered a token. After appropriately manipulating the item and returning it to the participant, the experimenter walked away and gave the direction to clean up. Materials were removed from the table and the trial ended. A new trial began following a 5-s intertrial interval.

If the participant did not respond within 5 s of presentation of the discriminative stimuli, responded incorrectly, or emitted only one component of the sharing response (e.g., motor response or vocal response alone), the experimenter removed the materials and implemented an error-correction procedure similar to that described by Reeve et al. (2007). First, the experimenter presented a video model of a scenario in which appropriate sharing was depicted. Video models were used only when a participant failed to emit appropriate sharing behavior during training trials. For ease of implementation and to promote generalization of sharing, the video models did not necessarily show the same activity in which the participant was engaged during that trial. For example, a video model depicting a peer eating cookies and asking ''Would you like to try this?'' could be presented to Steven during a trial in which he was playing with cars and the target response was ''Would you like to try this?''

None of the participants required prompting to watch the video. When the video model ended, the experimenter presented the materials for that trial a second time and approached and stood within 0.6 m of the participant. If the participant offered to share within 5 s, the experimenter accepted the offered item; responded with ''yes,'' ''sure,'' or ''thank you''; manipulated the item appropriately; and delivered a token to the participant's token board. If the participant did not offer to share within 5 s of the second opportunity to do so, the experimenter provided a physical prompt by using hand-over-hand guidance to assist the child in handing the items with which he was engaged to the experimenter. Simultaneously, the experimenter activated a voice recorder that emitted a recording of the target vocal response. If the participant emitted only one component of the response (e.g., physical or vocal), the experimenter delivered the corresponding prompt for the absent component. For example, if the child handed an item to the experimenter but did not emit a target vocal response, the experimenter provided only an audio prompt by activating the voice recorder. If the child emitted a target vocal response but did not physically offer to share, the experimenter provided only a physical prompt with hand-over-hand guidance. The physical and auditory prompts were repeated until the participant emitted the correct response independently.

As noted previously, generalization probe trials and nonsharing trials were interspersed with training trials. During probe trials, the procedure was identical to that during baseline. During nonsharing trials, the experimenter presented the nonsharing stimuli to the participants and emitted an instruction appropriate for those stimuli (e.g., ''Can you please put the books on the shelf?''; ''Can you please wipe the table?''; ''Put the papers in your backpack''). When the participant completed the nonsharing task (e.g., placed papers in a backpack), the experimenter delivered a token and the trial ended. If a child emitted a sharing response (e.g., ''Want to try?'') during a nonsharing trial, the experimenter paused for 5 s and then

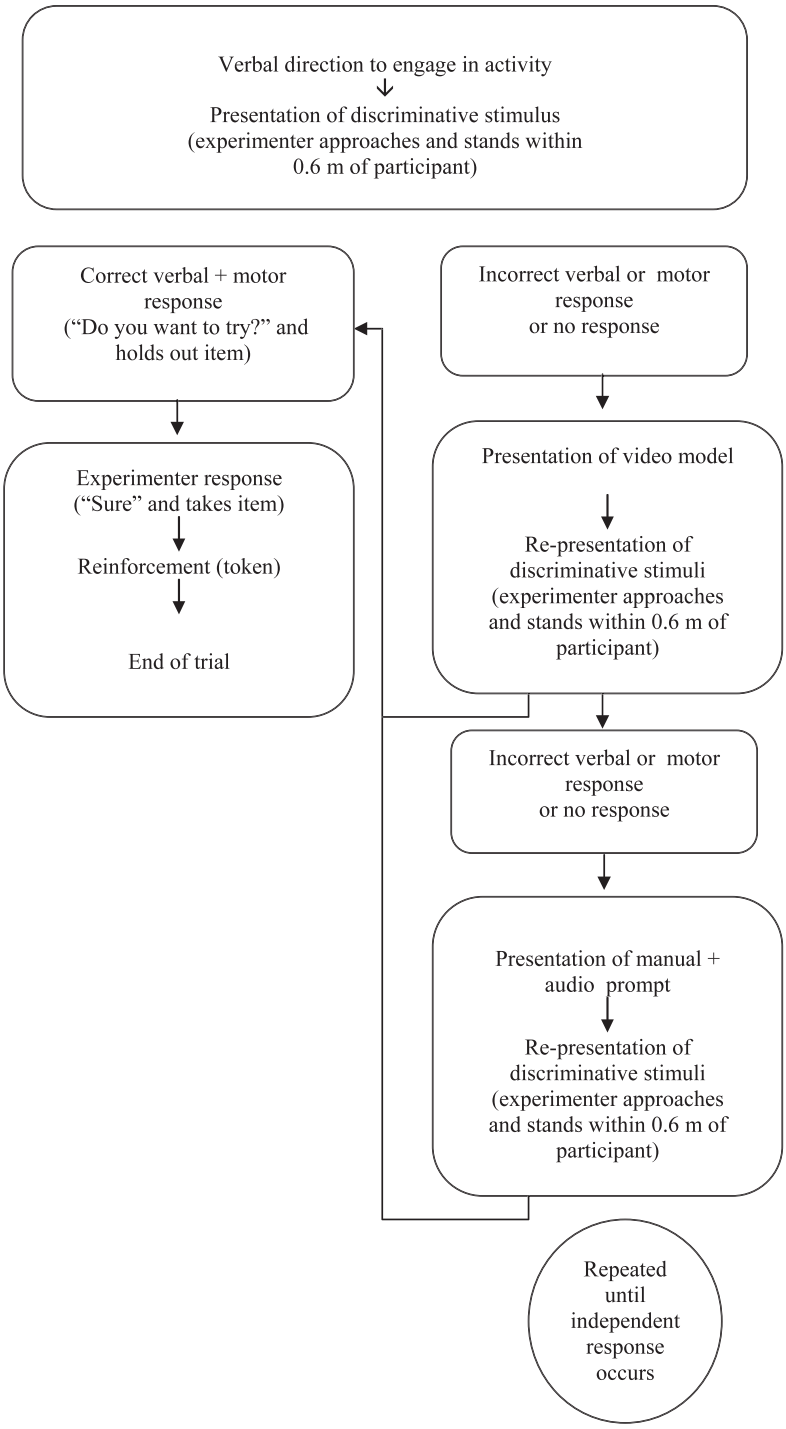

Figure 1. Instructional procedure for sharing trials during treatment.

presented the same nonsharing trial a second time while verbally instructing the child to complete the task. This continued until the child completed the task and did not emit a sharing response. These nonsharing trials were included to ensure that the participants attended to the relevant discriminative stimuli that set the occasion to offer to share and to prevent overgeneralization of the target response to nonsharing stimuli.

One participant (Isaac) engaged in disruptive behavior during the general prompting procedure during training trials. To facilitate skill acquisition and reduce the occurrence of disruption, additional prompts were used during treatment. A gestural prompt was added to the discriminative stimuli in each trial, and a behavior-specific praise statement was delivered for offers to share. During teaching trials, after presenting the stimulus materials and giving Isaac a verbal direction to engage in the activity, the experimenter approached Isaac, stood within 0.6 m, and extended an open palm toward him. Following errors, the video model and auditory or manual prompts were delivered as in the treatment procedure. In addition, when Isaac shared correctly, the experimenter emitted a behavior-specific praise statement (e.g., "Great! You handed it to me and said, 'try this.'"). The experimenter no longer delivered behavior-specific praise when Isaac met the mastery criterion and no longer delivered the gestural prompt after the schedule of reinforcement was thinned.

The mastery criterion was offering to share independently on at least 89% (eight of nine) of the teaching trials for four consecutive sessions. The fixed-ratio (FR) 1 schedule of token delivery for correct responding was thinned to VR 2 when the participant met the mastery criterion. After criterion-level responding occurred during teaching trials for two consecutive sessions at VR 2, the schedule was thinned to VR 5. After two consecutive sessions of criterion-level responding on the VR 5 schedule, the posttreatment generalization probe trials were conducted. The schedule of reinforcement for Aiden was not systematically thinned due to his completion of participation at the end of the school year.

Pre- and posttreatment generalization probes. The experimenter conducted probes assessing generalization of sharing to novel settings, novel people, and novel stimuli during two sessions prior to baseline and two sessions after the training criterion was met. The 12 trials in each session consisted of three trials of teaching stimuli, four trials of probe stimuli that served as within- and across-category generalization probes during training sessions, three trials of the fifth stimuli from each of the three training categories that were not presented during training, and two trials of additional stimuli from the fourth, nontraining category. With the exception of the scooter, Hippity-Hop, dot paint, and magnets, stimuli used in the pre- and posttreatment generalization probes were never presented in experimental sessions. Table 1 depicts stimulus types used in pre- and posttreatment generalization probe trials for each participant. During these probe sessions, a novel instructor presented the stimulus materials and gave the direction to engage in the target activity. In addition, 5 s after the presentation of the materials, a peer was directed to "see what [participant's name] is doing" and to approach the participant and stand within 0.6 m of him. The peer, who was approximately the same age as the participant, was another child with autism. This trial format was unique because it was a peer who approached the participant rather than the person who initially presented the materials. The participant did not receive tokens for correct responses or on-task behavior, nor did he receive prompts or video models following incorrect responses. No additional prompts were provided if the participant emitted a correct offer to share, and the peer accepted the item. If the participant emitted a correct response and the

peer did not take the item, the instructor directed the peer to accept the item and to manipulate it appropriately (e.g., ''You can eat the chip,'' or ''Take the crayon and color with Steven.''). The materials were removed and the trial ended if the participant did not emit a correct response within 5 s of the presentation of the discriminative stimuli.

Maintenance. Maintenance sessions were conducted 1, 2, and 5 weeks after the posttreatment generalization probes for Steven, and 1, 2, and 3 weeks after the posttreatment generalization probes for Isaac and Bobby. Maintenance sessions were not conducted for Aiden because the school year ended and he was no longer available to participate. Procedures were identical to those in baseline except that the experimenter did not deliver tokens for on-task behavior.

RESULTS

Figure 2 shows the percentage of teaching, probe, and nonsharing trials in which each participant independently offered to share, across consecutive sessions. Probe data are collapsed across both within-category and across-category generalization trials. During baseline, none of the participants offered to share during any trial, with the exception of Aiden, who handed a nonpreferred food item to the experimenter on two occasions and said ''here.'' Following the successive introduction of treatment across participants, systematic increases in offering to share occurred during both teaching and probe trials. The percentage of trials in which Steven offered to share during teaching trials systematically increased from 0% during baseline to 100% during treatment. During probe trials, the percentage of trials in which he offered to share increased from 0% during baseline to 75% during treatment. Isaac's offers to share during teaching trials changed in a similar manner, increasing from 0% during baseline to 100% during treatment. His offers to share during probe trials increased from 0% during baseline to 75% during treatment. Bobby demonstrated an increase in offers to share on teaching trials from 0% during baseline to 100% during treatment and from 0% during baseline to 50% during treatment for probe trials. Aiden also demonstrated an increase in offers to share on teaching trials from a mean of 2% during baseline to 89% during treatment, and from 0% during baseline to 75% during treatment for probe trials.

Higher percentages of correct responses occurred during within-category probe trials (Steven, $M = 80\%$; Isaac, $M = 67\%$; Bobby, $M = 63\%$; Aiden, $M = 60\%$) than during across-category probe trials (data not shown). Specifically, Steven offered to share during across-category generalization probe trials during only one treatment session ($M = 9\%$). Bobby never demonstrated across-category generalization during treatment, and Aiden demonstrated generalization during two treatment sessions ($M = 13\%$). Isaac was the only participant who demonstrated across-category generalization on several occasions ($M = 56\%$).

Throughout experimental sessions, all participants displayed some degree of vocal response generalization beyond the three scripted target phrases they were taught. Steven made nine unscripted vocal offers to share, Isaac made seven, Bobby made two, and Aiden made seven. Examples of nontaught offers to share included ''Would you like to draw?''; ''Would you like to build?''; ''ride the scooter''; ''try, please.''

None of the participants offered to share during any trial presented during the two pretreatment generalization probe sessions (Figure 2). After each participant met the mastery criterion, however, the percentage of trials in which each participant offered to share in the presence of both familiar and novel stimuli, in a novel setting, and with novel adults and peers increased compared to the pretreatment generalization probes. Steven offered to share with a peer on 100% of the trials presented for both

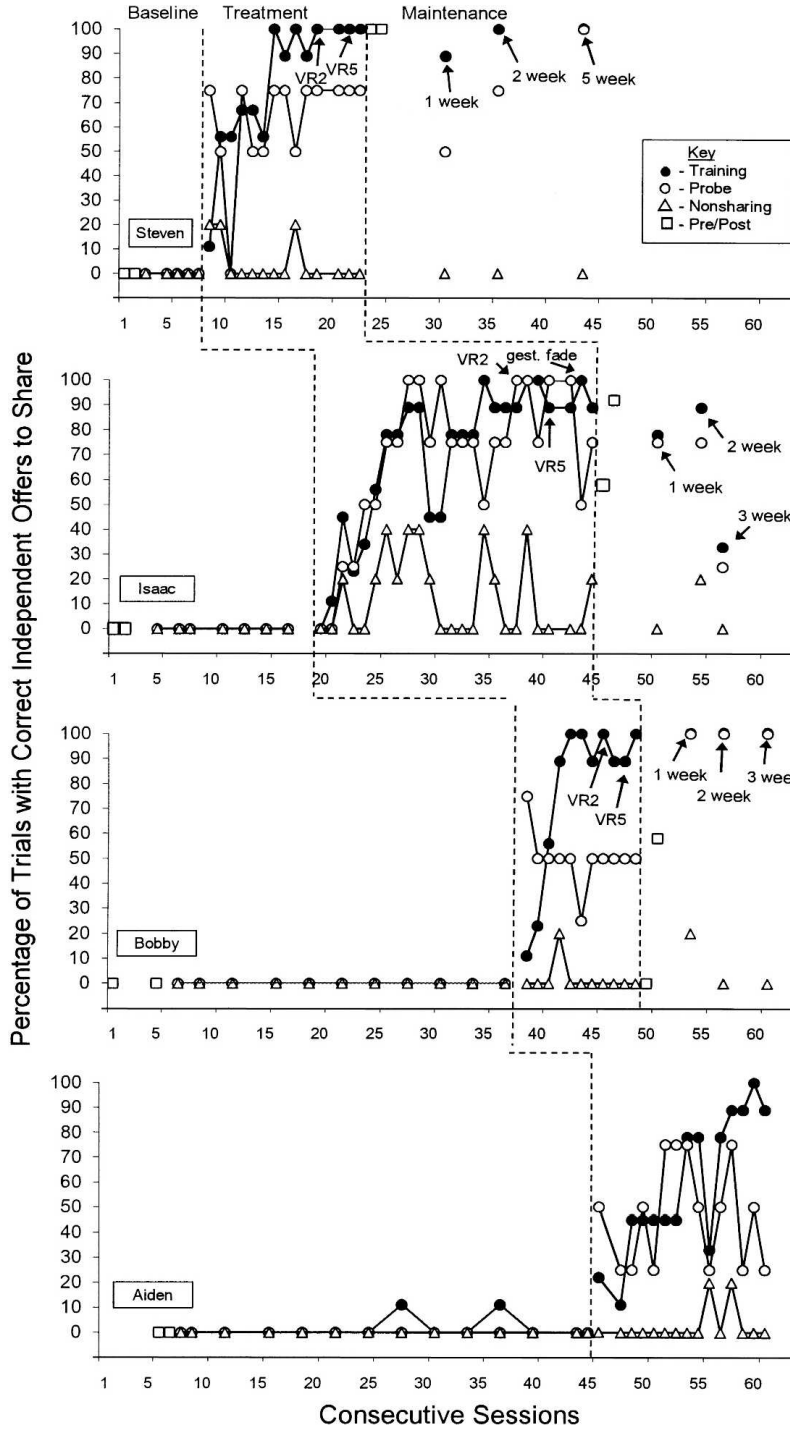

Figure 2. Percentage of trials with correct independent offers to share across consecutive sessions.

posttreatment sessions. During the first posttreatment probe, Isaac's offers to share with a peer increased to 58% of trials and to 92% of trials during the second probe. Bobby did not offer to share during his first posttreatment generalization sessions, and offers to share were moderately high (58%) during the second posttreatment session. He did, however, physically offer to share (holding out an item to his peer) on 75% of trials during the first posttreatment session and 92% of trials during the second session. His data demonstrate an increase in physical sharing with his peers from physically offering to share during 0% of all pretreatment trials. Posttreatment generalization sessions were not conducted with Aiden due to time limits. Across the trials that assessed generalization, Isaac and Bobby had higher percentages of correct responses on within- and across-category probe trials that featured familiar stimuli that were not associated with teaching than they did on within- and across-category trials that featured novel stimuli. Steven maintained criterion levels of responding during maintenance probes when no tokens were delivered. Isaac's offers to share during maintenance were just below the criterion at 78% (seven of nine) of trials. Bobby offered to share during 100% of maintenance trials.

During baseline, none of the participants offered to share during nonsharing trials (i.e., trials with task stimuli rather than sharing stimuli). As the treatment was introduced, offers to share during nonsharing trials increased somewhat for all participants: up to 20% for Steven, Bobby, and Aiden, and up to 40% for Isaac. Steven's, Bobby's, and Aiden's offers to share during nonsharing trials then decreased to 0% and remained at 0% during the last five treatment sessions. During maintenance probe sessions, Steven did not offer to share nonsharing stimuli, and Isaac and Bobby did not offer to share nonsharing stimuli during two of the three maintenance probes.

DISCUSSION

Four children with autism learned to offer to share in the presence of appropriate discriminative stimuli during teaching trials. In addition, all participants demonstrated stimulus generalization by offering to share during probe trials using materials from the same category of stimuli used during teaching and, for one participant, from categories that were not used during teaching. Pre- and posttreatment generalization probes indicated that offers to share increased for three participants in a novel setting, with a novel instructor and peer, and in the presence of novel and familiar stimuli following treatment. Sharing occurred infrequently when it was not contextually appropriate (i.e., nonsharing trials). In addition, Steven, Isaac, and Bobby maintained the skill of offering to share during maintenance sessions following the termination of treatment. Finally, all participants demonstrated some response generalization by emitting unscripted vocal offers to share. Thus, the current study demonstrated the establishment of a generalized repertoire of offering to share in these four children with multiple categories of stimulus materials.

The present study extends the findings of DeQuinzio et al. (2008) in a number of ways. First, sharing was taught across multiple stimulus categories, which likely produced robust within-category generalization of sharing (but a lesser degree of across-category generalization). In addition, teaching multiple exemplars of vocal responses appropriate for sharing also likely produced the vocal response generalization of sharing. By including trials in which it was not appropriate to share, we demonstrated that sharing had come under the control of relevant stimulus characteristics and that sharing infrequently or rarely overgeneralized to nonsharing scenarios. Finally, maintenance of sharing was observed after reinforcement was thinned at specified criterion levels of responding.

During teaching trials in which no response or an incorrect response occurred, the presentation of the video model correction procedure preceded a correct response during the subsequent presentation of the in vivo discriminative stimuli during only 31% of trials across participants (data not shown). The second part of the error-correction procedure (additional auditory or manual prompts) was used with the video model for the other 69% of training trials in which no response or an incorrect response occurred. These data suggest that the combination of a video model with audio and manual prompts may have been more effective in producing the target response than was the video model alone. A future study might compare the effects of these error-correction procedures under controlled conditions.

Prosocial behavior will be functional for children with developmental disabilities only when the behavior generalizes beyond training conditions across responses, stimuli, locations, and individuals (Reeve et al., 2007; Stokes & Baer, 1977). Behavior analysts can use a general case analysis when designing teaching strategies for generalized prosocial behavior by first identifying the relevant discriminative stimuli that occasion appropriate responses under natural conditions, and then ensuring that these characteristics are present under teaching conditions (Engelmann & Carnine, 1982; Horner et al., 1982; Sprague & Horner, 1984). In the present study, this was accomplished by observing children sharing in their natural settings. Once identified, these putative discriminative stimuli for sharing were grouped into categories for training purposes. Multiple exemplars were presented from each of the stimulus categories assigned to teaching trials to program for generalization across novel stimuli within the same stimulus category (Reeve et al., 2007). It is likely that generalization of sharing occurred across novel stimuli from the same category because the set of training exemplars adequately reflected the diversity of the stimulus characteristics that were present under generalization conditions. As a result, the outcomes of the present study add to the previous research literature that has shown that multiple-exemplar training is effective for teaching numerous generalized skills (Gena et al., 1996; Horner et al., 1986; Reeve et al., 2007; Schrandt et al., 2009; Sprague & Horner, 1984).

Response generalization of verbal offers to share was also assessed in the present study. Three verbal responses were assigned to each participant for training. During treatment, Steven, Isaac, Bobby, and Aiden each learned to emit all three of their target statements. However, the participants emitted a variable number of novel verbal offers to share. Future studies may determine whether additional response exemplar training might produce a greater degree of response generalization and more consistency across participants.

Generalized sharing across categories was not observed for Steven and Bobby, and limited generalization was displayed by Aiden. These outcomes may be attributed to the single presentation of an across-category generalization probe during each treatment session. It is possible that additional opportunities for responding to across-category probe stimuli would have produced somewhat higher percentages of trials in which sharing occurred. Given that Isaac did demonstrate across-category generalization of sharing, it is also possible that the features of the across-category probe stimuli for Isaac (art category, crayons) were more similar to the features of the training stimuli from his training categories than were Steven's (gym category, scooter) and Bobby's (snack category, chips). For example, a group of many crayons was presented to Isaac, similar to the presentation of all stimuli in the toy category (e.g., a group of cars) and many stimuli in the snack category (a plate of raisins). Another possible reason for Isaac's success in sharing during the presentation of across-category probe stimuli may be the additional

prompting and behavior-specific praise used during training. Additional research may show that these more comprehensive prompting procedures and praise statements lead to more robust generalization of sharing.

For Steven, failure to generalize sharing in across-category probe trials during treatment may have occurred because his probe trial involved the scooter, which was the only trial to take place in the hallway immediately outside the office that served as the experimental setting. Thus, his failure to share may have been due to an idiosyncrasy of the hallway. He did demonstrate across-category generalization, however, during both posttreatment generalization sessions by offering to share the scooter (probe item) and the basketball (novel item) with a peer.

For prosocial behavior to be maintained beyond training conditions, natural contingencies of reinforcement must operate on the behavior. For the specific response of offering to share, the naturally occurring reinforcers may be the positive response from, and social exchange with, the sharing recipient. Offering to share may not occur in some children with severe social deficits (e.g., children with autism), because the natural contingency of the response may not function as a reinforcer. Thus, the response of offering to share often requires teaching with programmed arbitrary reinforcement. We successfully shifted from arbitrary reinforcement to natural contingencies by initially using tokens (arbitrary reinforcement) paired with a natural verbal response (the experimenter responding ''thanks'' or ''sure'' while receiving the offered item), then systematically fading token reinforcement across two additional phases after the criterion level of offering to share.

Results indicated that a single presentation of a video model following response errors had limited success in establishing an offer to share. It is possible that the video model was not as effective in the present study compared to that used by Reeve et al. (2007) because the video model did not match the in vivo exemplar for each training trial. Although there is no empirical precedent for presenting a video model that does not match the presented trial, we believed it was an interesting parameter to investigate. A future study might directly examine differences in the effects of matched and nonmatched video models on skill acquisition and generalization. It is also possible that a live model may have been more effective than a video model. Additional studies may compare the effectiveness of live and video models for teaching sharing and other prosocial skills (e.g., Geiger, LeBlanc, Dillon, & Bates, 2010).

The selection of the stimuli used during sharing scenarios in the present study was based on normative observations by the experimenter and reports from the participants' teachers regarding types of items the participants might be expected to share in the classroom. One limitation, however, is that formal preference assessments were not used to evaluate or select the sharing stimuli (Carr, Nicolson, & Higbee, 2000; DeLeon & Iwata, 1996; Fisher et al., 1992). More rapid skill acquisition and more robust generalization and maintenance of sharing may have been obtained if preferences for the stimuli had been determined. For example, sharing a highly preferred item may be aversive, thus requiring additional prompting and more potent contrived reinforcers. In contrast, sharing a less preferred item may require little training or contrived reinforcement. In fact, anecdotal information regarding preferences was used to select Isaac's snack category. Based on his reported history of displaying tantrums when preferred foods were restricted, we selected snack foods that were predicted to be less preferred to reduce the potential for tantrums. Future studies might examine the relation between the preference level of shared stimuli (e.g., highly, moderately, and least preferred) and speed of acquisition and generalization of sharing.

In addition to differences in preference, the likelihood of sharing an item may also be affected by the quantity of stimuli available. For example, when children interact with multiples of the same item, they may be more likely to share that item because others are still in their possession. In contrast, interaction with only one item may make it less likely that the item will be shared, because sharing would involve total removal of the item. Both single items and groups of items were used in the current study, so experimenters may wish to evaluate this parameter under controlled conditions in future studies.

Additional applications of the procedures used in this study to other areas of prosocial behavior may identify more efficient and effective procedures for establishing generalized repertoires of prosocial skills in children with autism. These repertoires would ensure that children with autism have more opportunities to interact effectively with others and to experience greater acceptance by their peers (Bryant & Budd, 1984; Cooke & Apolloni, 1976; Eisenberg & Mussen, 1989).

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