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Use of Two-Trainer Interactive Modeling as a Potential Means to Engender Social Behavior in Children with Various Disabilities

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Many behavior modification and intervention programs for children are based on procedures developed in operant laboratories using animal subjects, but few use modeling procedures in which one student observes interactions of two proficient trainers. We show how such procedures, which were successfully used to train Grey parrots (*Psittacus erithacus*) to produce and comprehend elements of human language, can be adapted for use with children with autistic spectrum disorders and other disabilities to engender social skills and, in particular, empathetic interactions. Children were evaluated before entering the program and outcomes were recorded to determine improvement levels. No child reached totally normative (physical-age appropriate) levels, but all significantly improved their empathetic social communication skills and use of contextually appropriate behavior. We conclude that a two-trainer modeling system can be a valuable intervention tool for children whose disabilities involve social and communicative skills.

Clinicians and researchers working with children with disabilities, particularly in the field of autism, argue for integration of information and techniques from many disciplines to improve the lives of affected individuals (e.g., Schreibman & Anderson, 2001). In a previous publication (Pepperberg & Sherman, 2000), we described the results of such integration: how an interactive two-trainer modeling system, the Model/Rival (M/R) system, initially developed to train Grey parrots (*Psittacus erithacus*) to use elements of human speech in a referential manner (Pepperberg, 1981), was adapted by Sherman to assist children with (a) autism with limited social/language skills, (b) developmental delay with physical handicaps and lack of language skills, and (c) hyperactivity with impaired cognitive/social skills. No child in the program achieved entirely age-appropriate behavior patterns, but improvements were dramatic. We now describe how these procedures have engendered social skills, particularly empathy, in autistic children and a

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child with language and social dysfunctions.

Note that teaching empathetic behavior was not Sherman's designated goal in adapting the two-trainer modeling procedure used with parrots in the laboratory to the clinical setting with children. Given that research into empathy in animals is a controversial area (e.g., Flack & de Waal, 2000; Kuczaj et al., 2001), that much of the animal data is anecdotal, and that empathic responses by our parrots (phrases such as "What's your problem?", "What's the matter?", "I'm sorry")—although recorded in contextually applicable circumstances—have not been experimentally documented, we did not expect that engendering empathy would be a consequence of the children's training. Our previous studies (Pepperberg & Sherman, 2000) did, however, demonstrate that multiple-trainer techniques shown to be most successful for animals can be adapted usefully for children who require training in lifestyle skills, and the results, although fortuitous, were thus not entirely surprising.

We briefly review previous work with children and animals, describe the procedure used with parrots, discuss the minimal modifications to the parrots' two-trainer system that were made for children, and present three case studies. In each study, the two-trainer system succeeded whereas various single-trainer procedures had failed. These studies are reported descriptively: the setting was a private clinic rather than a clinical research laboratory, and no comparisons were made with children who received other forms of training.

Previous Studies

The use of modeling and observational learning to assist children with disabilities in acquiring appropriate lifestyle skills is not new (reviews in, e.g., Garfinkle & Schwartz, 2002; Ihrig & Wolchik, 1988; Lanquetot, 1989; Pierce & Schreibman, 1997b). Most studies, however, focused on use of a single model (peer-to-child or adult-to-child; Koegel & Rincover, 1974; Strain, Kerr, & Ragland, 1979) and had limited success, except in cases where successive single-trainer models were used (Pierce & Schreibman, 1995, 1997a) or children worked together (e.g., Sherratt, 2002). Interestingly, just like these children with disabilities, Grey parrots often fail to learn referential labels during interactions with a single caretaker (Pepperberg et al., 2000), but achieve significant success in labeling and acquisition of concepts of, for example, category, same-different, relative size, absence, and number via our two-trainer M/R system (review in Pepperberg, 1999). Those human studies that did use some form of two-trainer interactions, or at least groups of interacting children with and without disabilities, also achieved considerable success in training receptive labeling (Charlop, Schreibman, & Tryon, 1983), expressive language (Ihrig & Wolchik, 1988), learning-readiness skills (Lanquetot, 1989), play skills (Garfinkle & Schwartz, 2002; Pierce & Schreibman, 1997b), and in generalizing these accomplishments to natural environmental settings. Nevertheless, few studies involving modeling or any other intervention procedure have focused directly on teaching empathy (note related study by Strain & Schwartz, 2001), a behavioral aspect known to be lacking in autistic children (e.g., Dyck, Ferguson, & Shochet, 2001), and one topic of the present study.

Animal Models and Applications to Children

Conditions that engender referential behavior in animal subjects are those that (a) seem necessary for *exceptional* learning (i.e., learning unlikely during normal development but possible under certain conditions; Pepperberg, 1985, 1997) and (b) often are required for language acquisition by children with specific impairments who lack concomitant social skills (e.g., Rice, 1991). For Grey parrots, acquisition of referential communication (English speech) occurs most readily from two human trainers who demonstrate referentiality and functionality of a label or concept to be learned, socially interact with each other and the bird, exchange roles of questioner and respondent, portray the effects of labeling errors, provide corrective feedback, and adjust the level of training as the subject learns (Pepperberg, 1994; Pepperberg & McLaughlin, 1996; Pepperberg, Gardiner, & Luttrell, 1999; Pepperberg, Naughton, & Banta, 1998; Pepperberg et al., 2000). Related data exist for chimpanzees (*Pan troglodytes*) trained on a computer-mediated symbol system (Savage-Rumbaugh, Rumbaugh, & Boysen, 1980a; Savage-Rumbaugh et al., 1980b). When training lacks some of these elements, subjects fail to learn, or acquire only limited associations rather than full referential use of targeted labels; that is, they cannot transfer label use from training to testing situations (Pepperberg, 1994; Pepperberg et al., 2000; Todt, 1975) or from the training exemplar to other instances of the relevant object or concept (Pepperberg et al., 1998), or they produce but do not comprehend what they have learned (Pepperberg, 1994).

We suggest that the lack of widespread success of single-model intervention procedures for children occurs because several elements of input that exist in M/R training that are critical for exceptional learning are missing in interactions with single trainers. One major element, functionality, is particularly difficult to demonstrate with one trainer. For children, solo training generally proceeds with a trainer presenting an object (e.g., a cookie), uttering an immediate prompt (the targeted vocalization; e.g., "I want cookie"), having the child imitate the prompt, and initiating a time delay between object presentation and prompt that eventually causes the child to produce the prompt before the trainer (Charlop, Schreibman, & Thibodeau, 1985). The phrase "I want cookie" becomes associated with transfer of a specific desired item, but the child does not understand the meaning of or learn how to use individual elements in the phrase—specifically how to label the referent—and generalization to related objects and situations requires additional training (Charlop et al., 1983; Koegel & Rincover, 1974). Similarly, a chimpanzee successfully trained to use symbols to request items from a computer (programmed as a solo trainer) was unable to choose the same items in the presence of those symbols (Savage-Rumbaugh et al., 1980a,b). Solo training also eliminates minor elements of input: Neither role reversal (having a subject be querant as well as respondent) nor effects of errors can be demonstrated. Moreover, use of a single trainer might nullify corrective feedback: Interrupting and correcting a speaker for inappropriate usage could inhibit further practice and hence delay development (Krashen, 1976; Koegel, Dyer, & Bell, 1987; Rice, 1991). Whether caretakers who recast a child's error or expand a child's elementary attempts at communication help or hinder development is unclear (Bohannon et al., 1996; Morgan, Bonamo, & Travis, 1995; Nelson et al., 1995). In contrast, watching a model err and be cor-

rected might encourage practice and accelerate learning (Bandura & Harris, 1966; Leonard, 1973). Finally, for parrots (and children with disabilities, and maybe other animals), the typical form of instruction, that is, “do as I do”, might prevent the subject from separating the targeted behavior pattern or target of the command from the instantiation of the command and thus inhibit building a representation of the required response (Pepperberg, in press). Maybe such subjects must observe a *model* responding to the command “do as I do” to identify behavior patterns to be learned.

Thus, although solo modeling seems to work for children when associative, rather than referential learning is required (e.g., to train a subject to say “I like you” after receiving a hug; Charlop & Walsh, 1986), in situations where context may assist generalization (e.g., use of “Good morning”; Charlop & Trasowech, 1991), or possibly in situations where children must learn oral-facial muscle control for vocal production (Camarata, Nelson, & Camarata, 1994; Connell, 1987), our reading of the literature and our own experiences (Pepperberg & Sherman, 2000; see also Pollard, 2001) indicated some evidence for the superiority of some forms of two-trainer modeling for learning certain other types of tasks. Thus, Sherman continued to adapt the two-trainer system designed for parrots for her work with children.

General Methods

Procedure Used for Grey Parrots

The M/R procedure was adapted from Todt (1975). Basic M/R training involves three-way interactions among two humans and an avian student. M/R training primarily introduces labels and concepts, but also aids in shaping pronunciation. We briefly review the M/R procedure, although the material has been published previously (Pepperberg, 1981, 1994; Pepperberg & Sherman, 2000).

M/R training uses social interaction to demonstrate the targeted vocal behavior. Sessions begin with a bird observing two humans handling an object in which the bird has shown interest. One human trains the second human (the model/rival; i.e., presents and asks questions about the item; “What’s here?” “What toy?”). The trainer rewards correct identifications by physically transferring this item (which thereby becomes an *intrinsic* reward), thus demonstrating *referential* and *functional* use of labels, respectively, by providing a 1:1 correspondence between label and object, and modeling label use as a means to obtain the object (Pepperberg, 1981, 1990, 1991). Training occurs with multiple exemplars of the items to avoid stimulus overselectivity problems. The second human not only is a model for the bird’s responses and its rival for the trainer’s attention, but also enables trainers to demonstrate the aversive consequences that ensue when an error is made: Trainers respond to errors made by the M/R with scolding, and temporarily hide the object. A model/rival is told to speak more clearly or try again when responses are garbled or incorrect, thereby allowing a bird to observe “corrective feedback” (Goldstein, 1984; Vanayan, Robertson, & Biederman, 1985). Unlike the format of many other modeling procedures, here model/rival and trainer reverse roles to show how the communicative process is used by either party to request information or effect environmental change. After humans model the interaction two or three times, the bird is asked to label the object. Initially, any utterance the bird makes that is novel or has any relationship to the target label (i.e., /i/ for “key”) is rewarded; labels for other objects or sounds used for other purposes are not. Humans then resume modeling. In subsequent sessions, the bird is required to approximate the targeted utterance more closely and is rewarded for successive approximations to a correct response; thus, training is adjusted to its level. Note that if humans do not reverse roles with each other during training, birds exhibit two behavior patterns inconsistent with interactive, referential communication: They do not transfer responses to anyone other than the human who posed questions during training and do not learn both parts of the interaction (Todt, 1975). Thus inclusion of role exchange appears to promote greater generalization of behavior.

Adaptations for Children

The basic procedures were the same for the children as the birds, except a few children were rewarded with interaction with an adult or a peer rather than with physical objects (e.g., a toy). Such interactions ranged from social amenities or interactions, to interactive play. Children could also request to enter the main clinic area, ask for specific therapy equipment or a physical game. These rewards were still intrinsic (i.e., had a 1:1 correlation with the request) because the children were being taught specifically to ask for such interactions and items. As noted for the parrots, use of multiple exemplars for the reward may overcome stimulus overselectivity problems encountered by many children with autism.

The Private Clinic Setting

The private clinical setting of the current study has some significant differences from that of a clinical research laboratory, and we clarify these differences so results of M/R intervention can be assessed in context. As in the research setting, each child entering the private clinic is evaluated to determine his/her strengths, level of functioning, and deficits; however, based on this evaluation, the private clinic designs an individualized therapy program with a number of specific goals, often in a variety of areas. These measurable objectives and the focus of the therapy program are altered, sometimes on a rapid basis, as the child progresses or has difficulty with a particular step. The private clinic thus differs from a typical clinical laboratory setting in that children are not given sets of identical or unalterable pre-designed tasks nor are they placed in groupings according to diagnosis, age, or other categories that facilitate controlled data collection for the purpose of comparative testing. Moreover, as a child progresses in private therapy, input from the child's family, school, and community is used to adapt the treatment plan and goals. Data on progress collected from these sources are inherently less rigorous than what can be collected in a controlled clinical research setting, but are crucial for assessing the child's evolving needs.

Evaluation Procedures for Children

The two-trainer system was employed to either extinguish negative behavior patterns and/or increase cognitive-language skills, social skills, and use of body language, facial expressions and gestures. Each child presented different disabilities, and thus the individual goals differed. Progress in meeting these goals was evaluated via interviews, observations, and interactions: Criteria were whether a negative behavior was indeed extinguished and/or a positive behavior was acquired, the extent to which any acquired behavior was performed consistently, and the extent to which it generalized outside of the training situation. Parents and school and community professionals were asked to report changes that showed any shift towards the demonstrated targeted behavior patterns. In addition, for intersession comparisons, Sherman kept detailed notes on her observations of, and interactions with, the child during sessions. The nature of Sherman's caseload did not enable her to collect the kind of objective data that would be possible in large-scale clinical trials (e.g., in 20 tests, a participant presented with situation X responded with action Y versus Z).

Subjects

Children in the study were either private clients of Sherman or were referred to Sherman by local school districts. Subjects were chosen for participation based on high social affect, presence of some form of communicative disability, and existence of anticipatory skills. In each case, parents were highly motivated to participate in the study. Choice of subject was independent of any IQ-like measure or level of expressive or receptive language skills. Three of these cases are described below.

Child A: A High-Functioning Autistic Child

Background

A was a high functioning 4-year-old male whose diagnostic criteria identified him as being within the autism spectrum. Expressive language was minimal (fragmented), as was eye contact and social skills. He could, for example, use “hi”, but if asked, “how are you?”, the question word—“how”—evoked an immediate rote response of “4” (his age). A thus was not able to process or understand words in the rest of the sentence. He was unable to answer questions but could request various items with two-word phrases (e.g., utter “want this” while pointing to the item). In general, A could not use or understand language involved in typical daily social interactions; he could not recall information heard on a daily basis because question words still confused him despite the one-on-one speech therapy he had been receiving prior to beginning work with Sherman. Sherman provided individual private therapy two times per week, one hour per session, and A concurrently continued to receive individual speech therapy two times per week, one hour per session, by another therapist, before Sherman’s sessions. The goal for child A was to develop and understand appropriate interactive speech patterns including eye contact.

Specific Intervention Techniques

Training comprised three distinct levels: (a) use of two adults to model target interactions for the child, (b) use of a peer-adult pair (i.e., a child who is A’s peer) to model interactions for the child, (c) encouragement of the child to demonstrate skills acquired in the modeling situation in the absence of a model. Initial training occurred in an isolated setting separate from the primary clinic area. Sherman followed the procedure described above, except that no physical objects were used as rewards. Models demonstrated appropriate communication that engendered positive social interaction, initially with adults (Sherman and either another therapist in the clinic or A’s mother); rewards were positive reactions from these adults, and most importantly, permission to ask to enter the clinic area that had equipment and various activities favored by the child. Training emphasized the concordance of appropriate speech and eye contact. As in the basic procedure, the child’s errors were modeled and corrected, such that a trainer who used “4” in response to “How are you?” was told she was wrong and to try again. Roles of model and trainer were frequently reversed. Initially, each modeling session lasted 10 to 12 minutes, then such interactions were interspersed among other activities in the therapy sessions.

Once appropriate interactions were established with adults and generalized to adults other than those involved in the modeling procedure, the scenario was moved from an isolated setting in the clinic to an integrated setting, in both the clinic and home. A peer-adult pair was used in the procedure and the reward was now interaction with the peer. The final aspect of training was to integrate the child-peer interaction into the general setting.

Results and Discussion

After approximately six therapy sessions, one hour per session, or three weeks of all levels of training, A could communicate with appropriate responses and made eye contact in all settings spontaneously. After the first session, which involved six modeled demonstrations, the child was able to respond to “How are you?” with “I am fine, how are you?” The two-trainer procedure was taught to his mother at the end of the initial treatment session. That evening, A’s mother planned to demonstrate the two-trainer technique to her husband; however, A independently

approached his father, who was returning home from work, and stated, "How are you?" His father said, "Fine, how are you?", to which A responded, "I am fine." Thus A initiated the targeted social greeting and responded to his father correctly (specifically, without any echolalic additional "how are you") before his mother was present or saw her husband. Subsequent training sessions reinforced eye contact, demonstrated how to process, understand, and respond to an entire "question" sentence (e.g., "How many more times do you want to swing? 1, 2, 3 more times?", "How are you?", "How old are you?"), how to use appropriate greetings including how to approach other children who were not part of the training scenario, and finally how to interact using both questions and answers appropriately in a variety of settings.

During the course of therapy, A acquired or improved other skills. He noted peers or adults who were absent from the clinic and spontaneously questioned them about their health upon their return, which could involve as long as a three week hiatus. Communication generalized to peers in other settings, such as preschool. A significant incident indicating progress occurred when A was leaving speech therapy a week after having completed six two-trainer sessions with Sherman, and thought he was going to her clinic for therapy, but remembered that she had cancelled their session because of family illness. He spontaneously said, "I hope they are OK; she (Sherman) can fix it." His mother stated that this phrase was said with great concern in his voice; she believed that the phrase and his tone demonstrated awareness of others and empathy. Although this interpretation could be considered subjective, A had nevertheless extended the trained, targeted intervention to a novel situation: He initiated a comment involving concern for others and ended with a statement demonstrating that he recognized competence in others. Autistic children do not generally demonstrate the ability to show or feel empathy for others (Dyck et al., 2001).

Child B: A Child with Nonverbal Learning Disabilities

Background

Child B was a 10-year-old female with nonverbal learning disability and an above-average IQ who attended an advanced private day school. She could not process peers' actions, gestures, facial expressions or nonverbal communication, or assess the impact of her behavior on peers. She could not control her impulses, especially in environments with high stimulation, movement, and that lacked structure; she was therefore unable to enter into or exit appropriately from social group settings or activities with peers. Such behavior led to exclusion from peer-initiated activities.

Her alienation was made worse by her inappropriate speech patterns, which consisted of monologues produced without relevance to the social situation. She would approach peers or adults already engaged in conversation and begin talking without social greetings, and without monitoring the environment or the situation to determine when to engage their attention. Thus, for example, someone could be talking on the phone and she would launch into a monologue without processing that this person was on the phone. In response to being excluded, her inappropriate comments to peers and intrusive behaviors increased. Confrontation

by peers or adults resulted in her engaging in denial, crying, or blaming others. Individual counseling in the past had been unsuccessful and her self-esteem was negatively impacted by the problems. B's low self-esteem was evident from her frequent self-degrading comments, her crying and queries as to why children were rejecting her, and her questioning "What is wrong with me?" She stated that she did not feel she "belonged" to the group at school despite her "best efforts" to make friends. She described repeated social rejections and constant criticisms she received from adults and peers—actions that arose not only because of her continual social blunders but also because of her inability to realize that she had committed blunders—and how bad these negative interactions caused her to feel. The goal of therapy therefore was for B to develop a self-awareness of the consequences of her actions, establish adaptive and flexible behavior patterns, self-control, interpret peers' nonverbal communications and engage in appropriate social activities, thus improving her self-esteem.

Specific Intervention Techniques

The same three levels were used as with child A. The basic procedure followed that described above except that no physical rewards were used. Training occurred in six steps, mostly in the clinic setting, but the child practiced the trained skills during recess at school, at home with peers, and during extra-curricular activities.

The first three training steps occurred in the clinic. Initially, models demonstrated appropriate visual scanning to show how to visually process the environment and events occurring in the environment, then demonstrated use of appropriate social greetings. Next, conversational turn-taking was modeled. The third skill, learning how to interpret behavior so as to anticipate others' actions, was addressed via an interactive game in the main clinic area. Models demonstrated appropriate turn-taking in a modified game of stickball, demonstrating skills needed for cooperative passing of the ball and interpretation of the partner's and opponents' nonverbal communication to anticipate their next moves. Errors were modeled that demonstrated the consequences when targeted abilities were lacking, that is, what happened when someone engaged in impulsive responses, denial, blaming, missing body or facial gesture cues or otherwise acted inappropriately (e.g., when B started crying and wanted to stop play because she was inflexible—could not adapt to change in the structure of the game); in such circumstances, the opponents received the game point.

After the first three weeks of stickball sessions (20 minutes per session), the fourth step began in which the child was given homework assignments to watch and report on nonverbal communication of peers in games, social settings, during movement in crowded areas (e.g., the school playground or the stables where she took horseback riding lessons with other peers), and in the classroom; these assignments were to be completed daily for two consecutive weeks. All levels of training continued during this time.

After child B demonstrated competence on steps one through four, the next session, step five, involved a game, "guess what I am saying". The goal was to interpret a partner's different facial expressions and body gestures. After the initial five sessions (one per week, 15 minutes per session), the child was given a "homework" assignment to approach her social peer groups and watch the facial expressions, body gestures, and "read" the nonverbal communication for group acceptance to join, be a passive or an active listener, or leave the group when cued by peers. Step six, another homework assignment, required B to invite a peer to her home or a community activity (e.g., skating) every weekend to practice social skills and "reading" of nonverbal communication. B reported on all aspects of her "homework" assignments for three consecutive weeks; training sessions continued during this time. In addition, her parents relayed daily reports of B's actions to Sherman; the latter identified any new or ongoing problems (e.g., being "bossy", making rude comments to peers without realizing either that she had done so or the negative impact of such actions on her peers) that were addressed in subsequent therapy sessions using the two-trainer modeling technique.

Results and Discussion

During the course of therapy, B's parents reported that her inappropriate behaviors had decreased and that peers were now including her in social school settings and activities. Parents and child reported an increase in invitations from some peers to join activities on weekends (e.g., being asked to attend a park party and swimming). Peers from school accepted invitations to B's house or to outside activities but did not invite her to their homes or to their activities. Peers from extra-curricular activities (e.g., children she met at the stables) reciprocated and invited her to their homes, to spend the night, and to go to movies and to other activities. B was enthusiastic with the results and her parents concurred.

Although she has greatly improved, B has not yet fully acquired appropriate behavior patterns. She reported that she was monitoring facial expression and body gestures, but that she still does not understand the subtle cues. She has difficulty "reading peers" personality characteristics, adapting her behavior accordingly, or recognizing the characteristics of a peer that would make a natural friend. Such issues result in occasional impulsive, inappropriate social behaviors, such as talking without monitoring the environment, but B's conscious effort to "read" all aspects of others' behavior has helped her decrease the frequency of these incidents. Her parents report that B is better at anticipating behavioral consequences, thinking about actions and reactions, but that she has not yet developed the ability to "put herself in someone else's shoes". Thus B has not achieved full empathy, but is acquiring use of empathetic behavior patterns.

Child C: Using an Autistic Child as a Peer Model

Background

C was a high functioning 4-year-old male with autism. Expressive language was minimal in that he used fragmented learned phrases such as "no way" as a rote response when he did not understand what was said to him (e.g., to questions such as whether he wanted to play), "chase me" to initiate a game, or engaged in echolalic repetitions. He maintained minimal eye contact with others and had minimal social skills (e.g., could use "hi" with a verbal prompt). He appeared not to be "connected with the world" except with his mother and father for brief periods. He was unable to answer questions or request items. In addition to his therapy with Sherman, C received individual private speech therapy two times per week for one hour per session from another therapist; however, spontaneous speech was not cross-applying to other settings. The goal of the two-trainer procedure was for child C to develop appropriate interactive speech patterns.

Peer Model Background

The peer model, P, used only with C, was also an autistic child, who initially had been nonverbal, had poor eye contact, had non-purposeful repetitive behaviors and minimal speech. Through two-trainer modeling therapy with Sherman, P has progressed to complex imaginary play skills, participates in mainstream extra

curricular activities of her choice without adult intervention, uses and understands joint attention and false-belief, is able to understand humor and sarcasm, figures out how to obtain desired responses from others (i.e., can negotiate), and demonstrates empathy for others. She continues two-trainer interactive therapy to gain higher-level social skills.

Specific Intervention Techniques

Sessions with child C were to follow the progression described for children A and B, that is, not to initiate a peer-adult session until the child had acquired some skills from two adult therapists; however, while C was in the clinic area, P entered to work with the other therapist, was introduced to C, and requested to join the activity. Because C was looking and smiling at her, C appeared strongly motivated to work with P, so training levels were interspersed with one another. Note that peers used as model/rivals are usually children who have no clinical diagnoses—often siblings, other “typical” children—but in this case the interaction between P and C prompted Sherman to use P.

The activity in this session was navigation of a long jersey/lycra/spandex tunnel, filled with large therapy balls that a child had to maneuver around to get through to the end. When Sherman asked P, “What do you want?”, P responded with a poorly articulated two-word sentence, “want in,” reverting to an earlier stage likely out of carelessness, as she is sometimes wont to do. Sherman and the other therapist picked up on this fortuitous behavior, and, using P, modeled correct and incorrect utterances, demonstrating both proper and improper articulation and length, emphasizing which sentence (“I want to go into the tunnel”) was required to gain entrance. All variations were modeled two times with P. Sherman had placed her hand in front of the tunnel to prevent entrance until she was given the correct response. P entered the tunnel after she produced the correct response. Sherman then blocked the tunnel and looked at C, and was about to engage in the modeling procedure when C spontaneously repeated P’s exact response, “I want to go in the tunnel, please” with appropriate eye contact. Note, this sentence was his first complete recorded spontaneous utterance. The few previous adult-adult two-trainer interactions to which C had been exposed had not been as successful as with children such as A and B, but C responded immediately to the adult-peer interaction.

The basic procedure was then implemented as described above, using P as one of the models. Thus, for example, C’s target behaviors were modeled with P and Sherman, both when C gave incorrect responses and to increase language during an activity. Roles of model and trainer were frequently reversed.

For child C, rewards were physical objects (desired therapy equipment) or specific activities, such as interaction with P and the ability to request an activity in which both could participate. Training emphasized acquisition of appropriate speech and social interaction (targets were appropriate use of the word “I”, object labeling, spontaneous speech, and improved eye contact). Training sessions were conducted in an integrated clinic area with P. The final aspect of training was to transfer interactions to adults other than the therapists, to other children, and into general settings.

Results and Discussion

After the initial accidental modeling with the female peer, child C spontaneously asked for items by using “I want” and looking at the object for help on labeling throughout the session. In session two, two days later, child C spontaneously asked for items using target words without intervention. In session three, five days after session two, and session four, two days after session three, child C omitted the word “I”. The peer-adult model was used only one time in each session and C was able to reinstitute the target word “I”. In session six, five days after session four, child C communicated with appropriate responses (e.g., “I want the ball”, “I want unlock”, “I want the tunnel”) with eye contact without intervention. In this session, child C looked at Sherman when P entered the clinic (interpreted as a non-verbal request to leave the activity in progress), and with Sherman’s approval, child C ran over to the peer, said, “hi, P”, spontaneously stating her name. C also

asked, "Want to play?" At this point, P gently placed her hands on child C's face, and said, "Look at me. How are you?" Child C responded with eye contact, a smile, and "hi." Note that this behavior was also an important step for P.

P engaged in another spontaneous interaction in session six that demonstrated her progress and was used to assist C. P had a bandage on her finger and when she requested everyone to look at her injury, Sherman stated, "Ouch, that must hurt." Sherman, the other therapist, and P then looked at each other's various cuts and bruises and commented appropriately (e.g., "Does that hurt?" "Are you OK?"). Two-trainer modeling was used to help P with her articulation. Child C was a passive observer, but was asked if he had any injuries or if he was "OK" and saw the modeled responses. Interestingly, in session eight, only 5 days later, child C looked at Sherman's hand, saw a cut, asked, "Are you OK?" and spontaneously placed a round "happy face" sticker on the cut like a bandage.

In general, eye contact between C and Sherman is now consistent and this eye contact does not overwhelm his sensory system. C is able to anticipate "set up" materials and spontaneously assists with clean up. Directions are given to him across the room and he demonstrates appropriate responses and reactions. He continues to exhibit minimal nonpurposeful, repetitive behavior patterns in the clinic, but echolalic speech now occurs only when he is having receptive language difficulties. The target word, "I", is consistently used in requests without intervention, along with full sentences, such as "I want the blue swing, please." His parents reinforce social greetings and consistent use of the word "I".

C's acquired behavior patterns demonstrate awareness of others, the environment, and some empathy, which is important because autistic children do not generally demonstrate the ability to show or feel empathy for others (see above). Modeling demonstrated the correct way to obtain desired needs and wants, and, by observing the modeled interactions, child C was able to learn to link his own experiences and feelings to others and how to link his desire to participate with P and the activity. Whether C sensed some empathy from P is unclear, but P actively and clearly demonstrated empathy with C (as a result of her training), and C maintained eye contact with her, remained aware of her actions and interactions, and seemed to "stay in contact with the world" while in contact with P, and she responded to him in kind. Possibly C chose P as his model/rival, and play with P as his reward, because of these positive responses. Whether P's autism provided her with additional insight into acting as a model is unclear, but should be the subject of future study.

General Discussion

Sherman's original goal was to extend initial use of a two-trainer modeling system to teach abilities required for functional performance in daily living (e.g., lifestyle-enhancing behavior patterns, increased self-esteem and awareness, and improved communication skills) to children with various disabilities specifically related to sociality and communication. Children in our preliminary study (Pepperberg & Sherman, 2000) demonstrated significant gains in communication and social interaction with peers and adults, leading to an increased positive evaluation of their overall lifestyle skills. For these children, previous interventions using single-trainer systems resulted in minimal or no improvement, or their skills did not gen-

eralize to other settings. We discussed in detail (Pepperberg & Sherman, 2000) the differences between the two-trainer model system and other interventions, including inclusive school programs. Sherman therefore extended the program to include several additional subjects, some of whom (A, B, C, and to some extent P) are discussed here. These children not only attained many of the stated goals of improving their communicative and social skills, but also began to exhibit empathetic behavior.

Only recently have standard tests been developed to evaluate social skills and the ability to “read” nonverbal communication and facial expressions (Baron-Cohen et al., 2001; Heavey et al., 2000; Roeyers et al., 2001; Senju et al., 2002), and the relative accuracy of the various tests is still in question (Roeyers et al., 2001). But, because behavioral gains, even if not rigorously quantified, are obvious to caretakers and others with whom the children interact, programs are being designed to facilitate and develop such skills in children within the autism spectrum and with related social disabilities. The programs may include: stories, workbooks, videos, and role-playing (e.g., Charlop-Christy & Carpenter, 2000; Charlop-Christy, Le, & Freeman, 2000; Sherer et al., 2001). The two-trainer technique can be used in conjunction with the new programs to add the functional performance component while demonstrating to the child the consequences of correct and incorrect responses. Most current individualized behavioral programs, whether designed for use in children’s homes or at their schools, are not demonstrating functionality, role reversal, or consequences of errors—issues we believe are crucial for referential learning. These issues recall a point made earlier in this paper: that the typical form of single-trainer instruction, that is, “do as I do”, might prevent the subject from separating the targeted behavior pattern or target of the command from the instantiation of the command and thus inhibit building a representation of the required response (Pepperberg, in press); quite possibly subjects must observe and identify with a *model* responding to the command “do X” to determine behavior patterns to be learned and connect those patterns with “X”. (Think about a command such as “touch your nose” that a single trainer demonstrates on *her* nose.) Specifically, what Sherman is initially training the children to do via our two-trainer modeling system is to *imitate* the response of the model—to identify with the model, to take the model’s point of view so as to recreate that individual’s actions in oneself—what is known as higher-order or controlled imitation (see reviews in Byrne, 2002; Whiten, 2002), behavior that is also required for success on “theory of mind” problems (Baron-Cohen et al., 2001) and empathic responses, and that is severely lacking in most autistic children (Smith & Bryson, 1994). Williams et al. (2001) have argued that the correlation between autism and lack of imitative behavior may be through a faulty “mirror neuron” (MN) system—MNs being that part of the nervous system that responds to an observed action just as though the action were actively being executed by the observer (review in Arbib & Rizzolatti, 1996). In autistic children, the MN system appears to function properly at the motor cortex level (i.e., the neurons respond appropriately to observed actions, Avikainen, Kulomaeki, & Hari, 1999), but what appears missing is the ability to integrate such activity into a cognitive system to engender overt imitation. Note that autistic behavior and its communicative deficits often appear at the point at which (a) self-awareness, (b) the need to understand self as separate from others, and (c) recognition of others as information sources all become critical for learning

(Tager-Flusberg, 2000)—exactly the same requirements that are needed for controlled imitation. This point also matches the time when, conceivably, some executive process, missing in an autistic's MN system, would normally begin to function fully. Although the actual role of MNs in imitation is unclear, and several different MN systems likely exist (Pepperberg, in press), our modeling system may assist in strengthening or helping to form connections in whatever system does exist for the children in these studies (note Wolf et al., 2001). Such an assumption would be consistent with Gordon and Barker's (1994) argument that what is lacking in autistic children is not a theory of behavior, but a skill. If action planning is indeed the ability to select (even if unconsciously) the appropriate neurons and combine them into patterns of appropriate temporal activation (Arbib & Rizzolatti, 1996), then this skill indeed could be trained through our modeling system.

Although correlations between learning in parrots and children with disabilities might not at first seem obvious, we previously showed how an interactive two-trainer modeling system involving referential rewards, successfully used in Pepperberg's laboratory with Grey Parrots for 25 years, was adapted with considerable success in Sherman's clinic, over the course of a decade, for children with divergent diagnoses (see Pepperberg & Sherman, 2000 for a sample). For the past two additional years, the procedure has shown success on a trial basis in engendering empathy in a small number of children with a far more limited range of diagnoses. As we suggested previously (Pepperberg & Sherman, 2000), extensive studies, with detailed evaluations that can be subjected to rigorous statistical analysis, now should be performed to compare the use of this technique with current standard techniques for engendering empathy. Most published studies do not specifically contrast the use of single- versus two-trainer procedures, nor the relevance of intrinsic versus extrinsic rewards. One Australian study, however, a master's thesis by Pollard (2001) was a rigorous comparison our two-trainer model with standard intervention methods (e.g., Hadwin et al., 1996) for engendering social competence (although not specifically empathy) in several children at different points on the autistic spectrum. Pollard's conclusion was that the M/R two-trainer method, even when additionally adapted to a clinical laboratory setting, enabled all children to make significantly greater gains than other procedures in all areas evaluated (belief [recognizing other's knowledge], reading emotion, and understanding pretense) and to cross-apply the skills in different settings without facilitation. These data along with Sherman's case studies clearly provide support for further clinical investigation on how to use the interactive two-trainer modeling technique in clinical, home, and school settings to examine whether it can engender behavior such as empathy on a widespread basis.

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