A Model for Problem Solving in Discrete Trial Training for Children with Autism

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Abstract

Discrete trial training (DTT) is a well-established intervention for teaching skills to children with autism; however, few published guidelines are available for determining whether a child's rate of learning a particular skill is satisfactory and, if not, what to do. We assert that progress within 8-10 teaching sessions usually is evidence of satisfactory skill acquisition, whereas absence of progress within this time frame indicates a need to consider modifying or stopping instruction of that skill. Absence of progress may involve (a) consistently low rates of correct responding, (b) variable performance across sessions, (c) increases in problem behavior (often in conjunction with low or variable rates of correct responding), or (d) limited generalization of the skill outside intervention. Likely reasons for each of these patterns are described, and decision flowcharts for identifying possible solutions are outlined. When implemented with supervision from a qualified professional, these flowcharts may facilitate systematic problem solving.
Key Words: autism, applied behavior analysis, discrete trial training, early intervention.

Practitioners often recognize or suspect that a child with autism is not making progress in an instructional program for teaching a specific skill. Without effective and timely troubleshooting, they risk compromising their intervention. If, for example, an unnecessary decision is made to stop a program, the child is deprived of a learning opportunity. If, on the other hand, an ineffective program is continued, the practitioner risks frustrating the child and wasting time.

Though treatment manuals present a wide range of instructional programs and standard procedures for implementing them (e.g., Janzen, 1996; Leaf & McEachin, 1999; Lovaas, 2003; Taylor & MacDonough, 1996), little information is available on systematic trouble-shooting strategies that practitioners may use when this concern arises.

In this manuscript, therefore, we propose a set of trouble-shooting strategies for one common teaching format, discrete trial training (DTT), and these trouble-shooting strategies also may be applicable to other instructional methods. DTT is a highly structured teaching format in which each learning trial has five parts (Smith, 2001):

1. *Cue* (technically called a discriminative stimulus or S^D): The teacher presents a brief, clear instruction or question such as "Do this" or "What is it?"
2. *Prompt*: At the same time as the cue, or immediately after it, the teacher assists the child in responding correctly to the cue. For example, the teacher may take the child's hand and guide him or her to perform the response, or the teacher may model the response. As the child progresses, the teacher gradually fades out and ultimately eliminates the prompt (e.g., guiding the student through less and less of the response) so that the child learns to respond to the cue alone.
3. *Response*: The child is allotted an intratrial response time for emitting the behavior cued by the teacher. The duration of this interval is typically 1-3 seconds but may be adjusted based on the child's learning style and the skill being taught. For example, it can be extended to 3-5 seconds for children who tend to respond slowly or for skills that involve carrying out a sequence of actions, and it can be shortened for skills that the child already has mastered.
4. *Consequence*: If the child has given a correct response, the teacher immediately reinforces the response with praise, hugs, small bites of food, access to toys, or other activities that the child enjoys.

If the child has given an incorrect response, the teacher says "no", looks away, removes teaching materials, models or guides the child to perform the correct response, or otherwise signals that the response was incorrect.

5. *Intertrial interval*: After giving the consequence, the teacher pauses briefly (1-5 seconds) before presenting the cue for the next trial.

Discrete trials are implemented as part of an instructional program that focuses on a specific teaching objective such as identifying body parts or tying shoes. The program includes a sequence of steps or phases for meeting the objective (e.g., teaching identification of an individual body part or working on a particular component of shoe tying). In addition, a program includes a clear definition of the target behavior(s) being taught, as well as procedures for administering cues, prompts, and consequences. Baseline data usually are collected to determine the child's level of mastery prior to instruction. A typical teaching session consists of 10 trials (Romanczyk, 1996), with 1-2 sessions per day for each instructional program in the child's current curriculum (Harris & Weiss, 1998; Weiss, 2001). However, the number of trials per session and sessions per day may vary. For example, children who are just beginning DTT or who quickly become frustrated or inattentive may receive fewer trials per session; more advanced children may have 20 trials per session or multiple sessions per day.

To implement the trouble-shooting strategies we propose, service providers must already be proficient in implementing DTT for children with autism. Thus, the strategies may be especially useful to supervisors, team leaders, case managers, and others who are responsible for overseeing a child's DTT program or training new staff. The strategies also may help hone the analytical skills of less experienced individuals such as parents who are new to DTT, paraprofessionals, instructors, or aides. However, these individuals should not attempt to trouble-shoot on their own. They should work together with the rest of the child's educational or therapy team, with consultation from a supervisor, to decide on appropriate strategies that all team members then implement.

Deciding Whether an Instructional Program Is Not Progressing

To determine if a child is not acquiring a skill in a DTT instructional program, the first step is to examine data collected on the child's rate of correct responding. If the child participates in 10-trial sessions of the program once or twice a day, and trial-by-trial data are collected each time, we suggest that the team review the data from the previous 8-10 times that the program was implemented (i.e., the previous 8-10 sessions with data collection, not necessarily the last 8-10 days). If data are collected less frequently, data from only 5-6 sessions may be examined in order to avoid spending too time on an ineffective program. However, the team should consider increasing the rate of data collection for that program to allow for closer monitoring of the child's progress. If sessions are 20 trials in length with trial-by-trial data collection, data may be inspected after 5 sessions (Greer, 2002).

There should be evidence of progress over the sessions that are reviewed (Harris & Weiss, 1998). The clearest evidence would be that the child's percentage of correct responding has increased over the course of those sessions. For example, even if the child is obtaining only 20-30% correct in the last sessions that were reviewed, this is an increasing trend that indicates improvement if the child was performing near 0% correct in previous sessions. Another sign of improvement would be a reduction in the amount of prompting. Because prompted responses are not usually counted as correct, data may show a low percentage of accurate responding, but successfully fading prompts is an indication that the child is beginning to acquire a skill. Other signs of progress may be quicker responses to instruction or fewer off-task behaviors such as gaze avoidance or self-stimulatory behaviors. If the child is displaying any of these signs of progress, it may be appropriate to continue the program in its current form. It is often helpful to visually inspect graphed data to evaluate progress, which refers to reaching a judgment about the reliability or consistency of intervention effects (Kazdin, 1982).

Evidence of improvement over 8-10 sessions that are 10 trials in length is only a rule of thumb for determining whether or not a program is progressing. Some children acquire skills more rapidly than others. Thus, knowing a child's learning history, a team might decide to extend the assessment over additional sessions. Also, progress may vary at different phases of an instructional program. For example, when a program for teaching imitation of nonverbal actions is first introduced, the child's progress in learning to imitate the first couple of actions that are taught may be slow but should accelerate when additional actions are taught. In addition, the rate of progress may vary across programs (e.g., occurring more quickly for visual-spatial skills than communication skills) or at different phases in the curriculum (e.g., increasing as the child advances).

While the number of sessions that are reviewed may be individualized for a child or instructional program, there are limits. At minimum, an instructional program should be continued for 5 10-trial sessions unless the child has an extremely negative reaction (e.g., a large increase in tantrums or aggression). This period of time gives the child an opportunity to work with different instructors on separate days at varying times. At the other extreme, a month may be the maximum amount of time to continue an instructional program without signs of progress. There are very few examples in the research literature of a child mastering a program after such a long interval in which no progress was evident, and there is no reason to expect that simply repeating a program over and over again will suddenly yield a breakthrough (Odom et al., 2003). If progress has not occurred, it is best to consider modifying the program or components of the instructional format, as discussed in later sections of this article.

In sum, data from 8-10 sessions should give an indication of whether or not progress is occurring. However, in some cases data from a one-week period (e.g., 5 sessions) or from a period of up to one month may be reviewed.

Questions to Consider When a Program Is Not Progressing

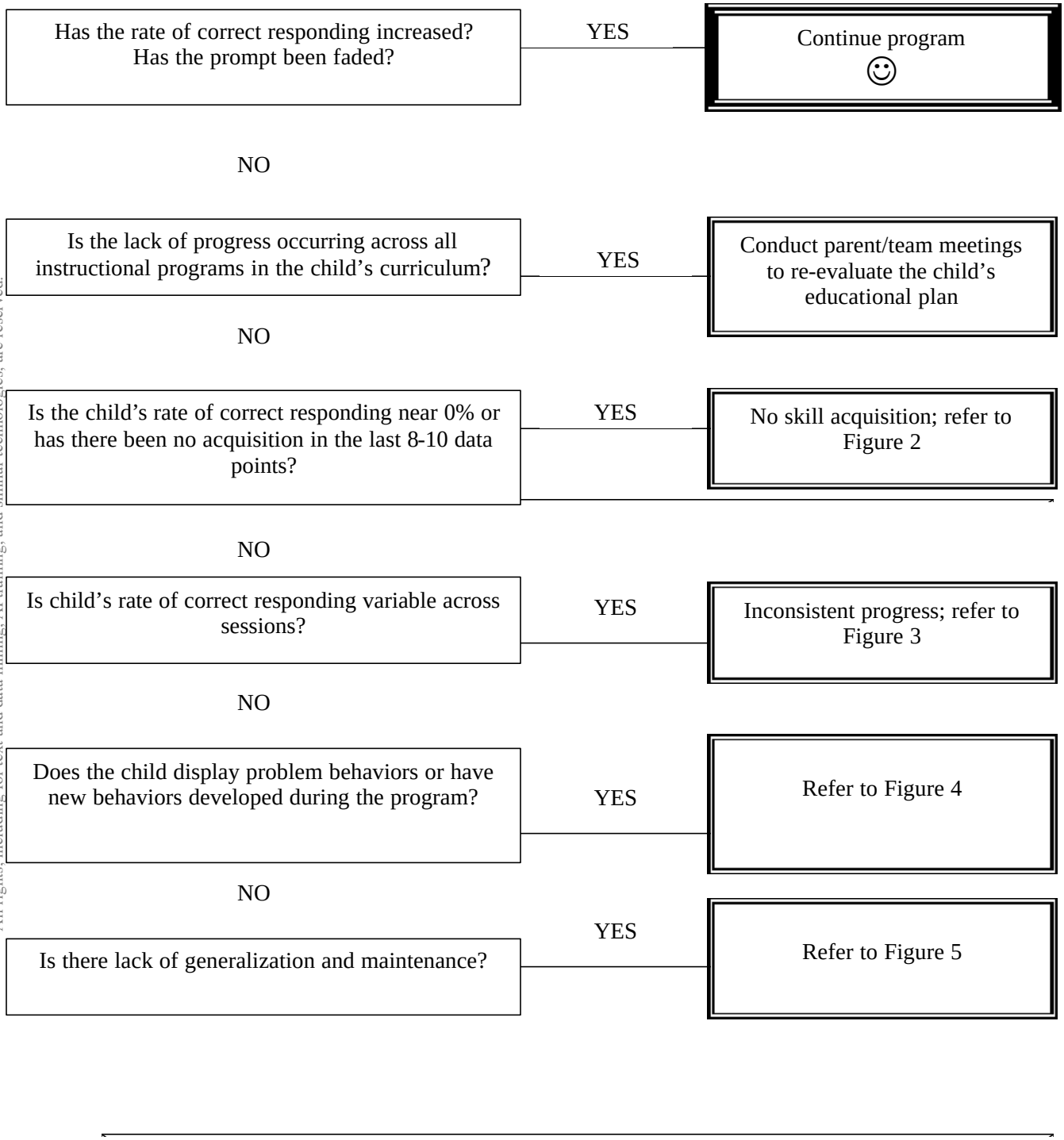

Figure 1. Questions to consider: an organizational schema for troubleshooting common programming problems encountered during early intervention.

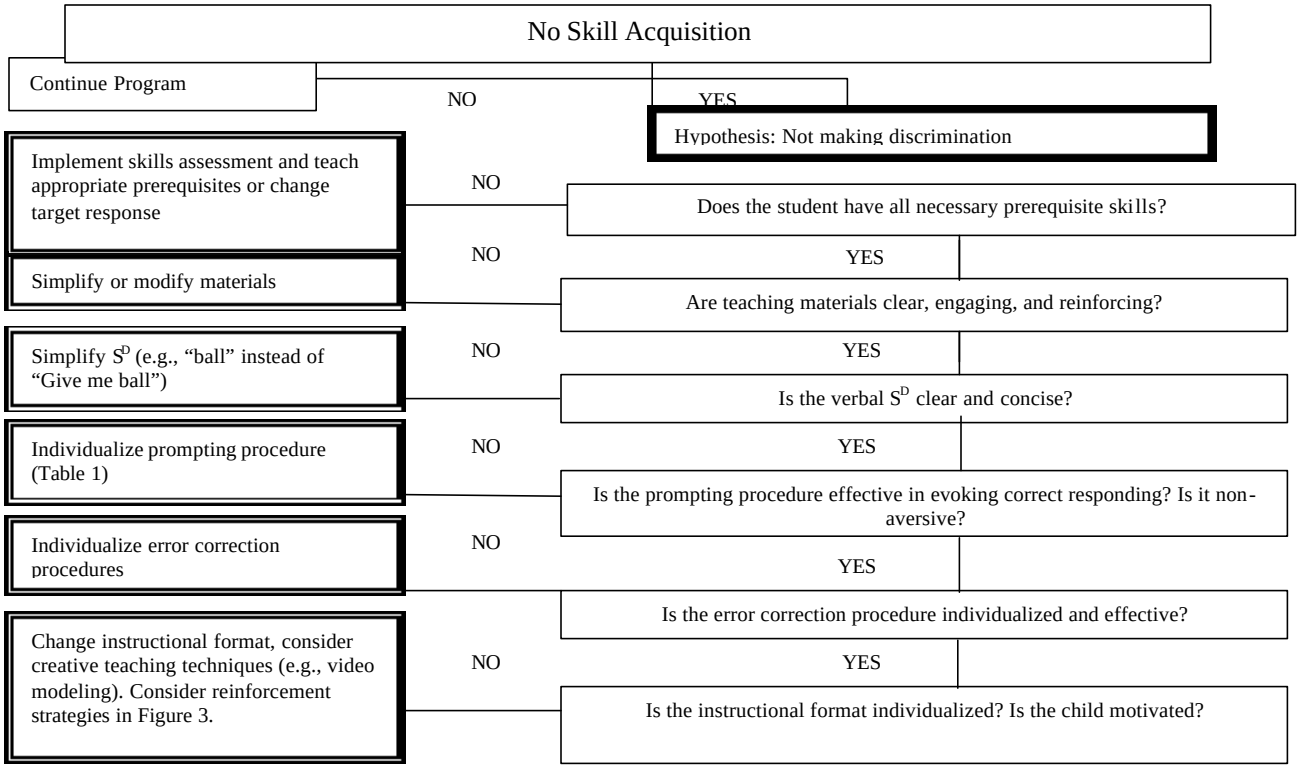

Figure 2. Troubleshooting for no skill acquisition

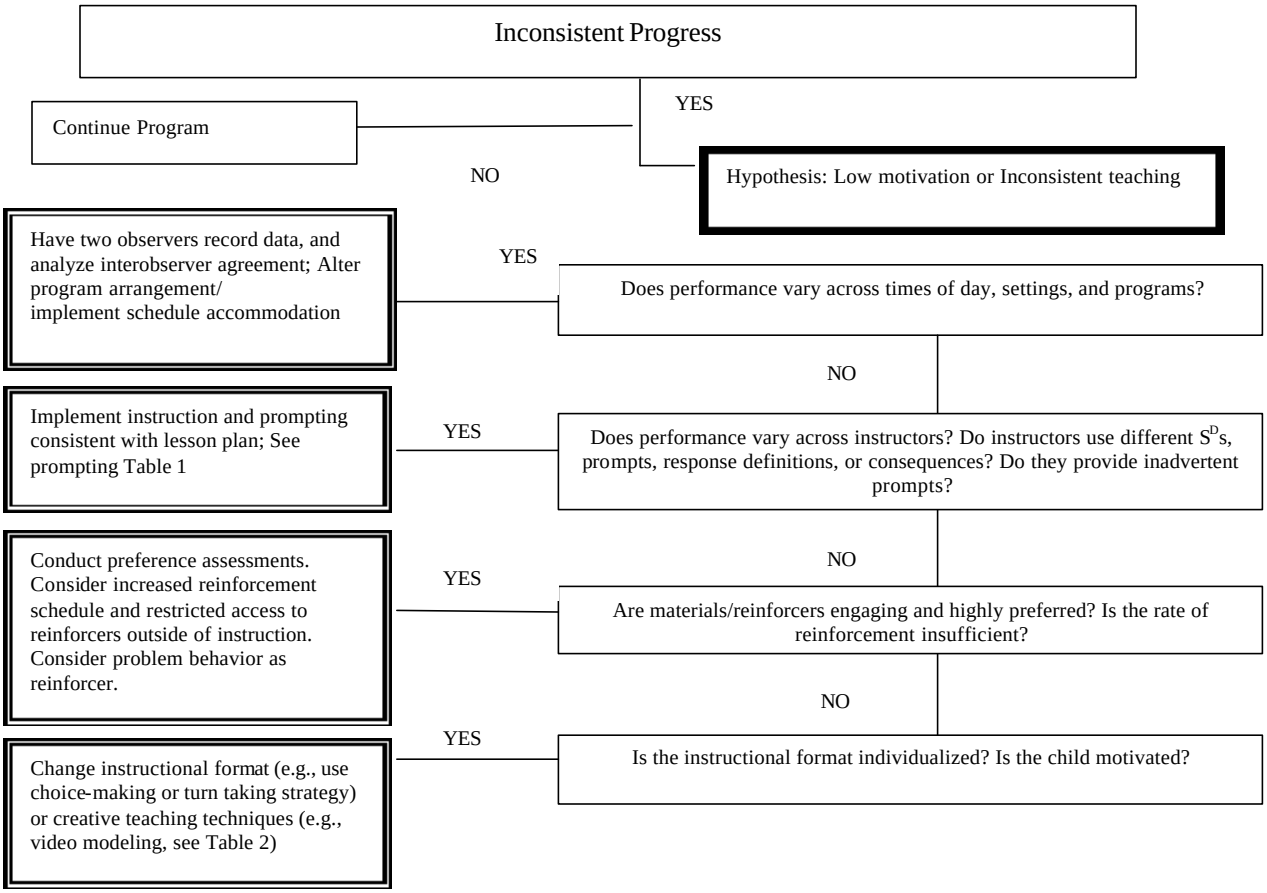

Figure 3. Troubleshooting for inconsistent progress.

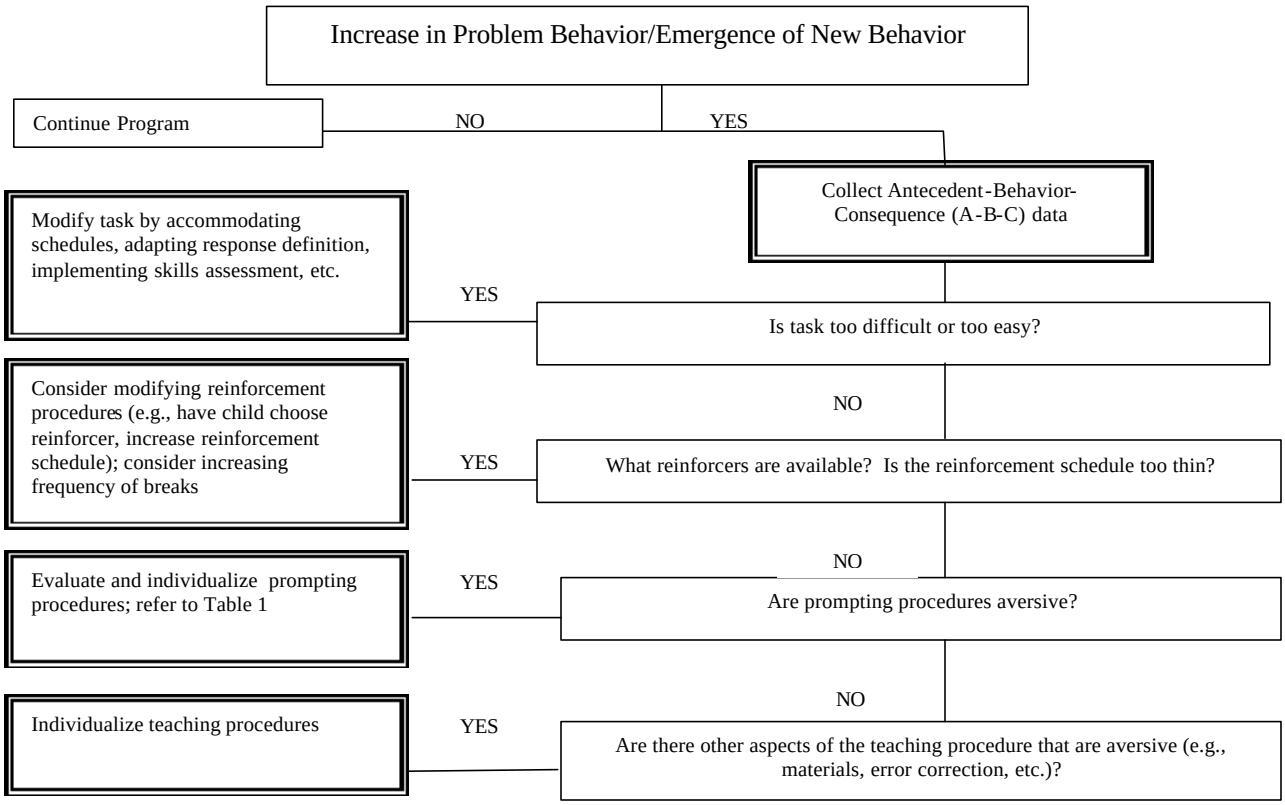

Figure 4. Troubleshooting for increase in problem behavior/emergence of new behavior.

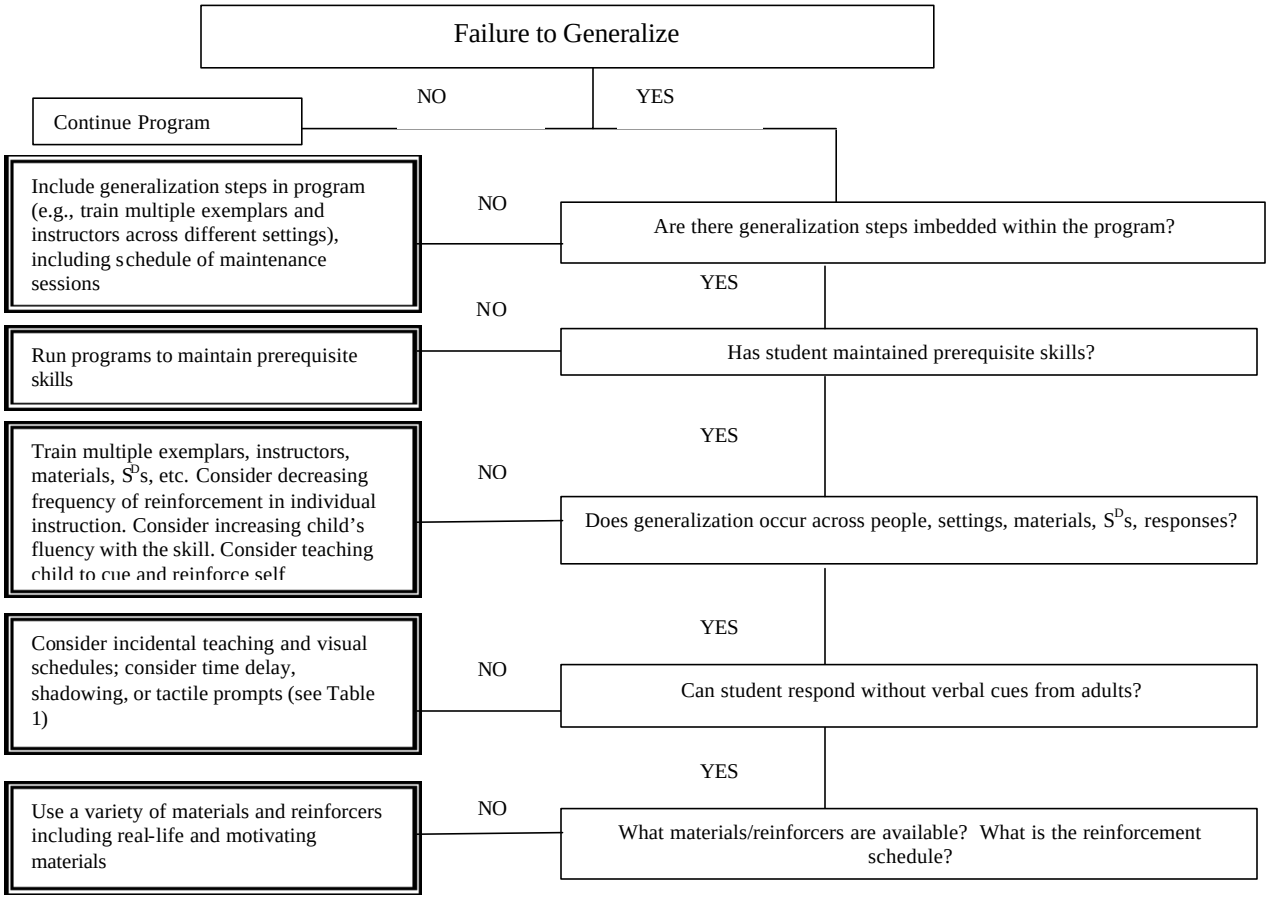

Figure 5. Troubleshooting for lack of generalization

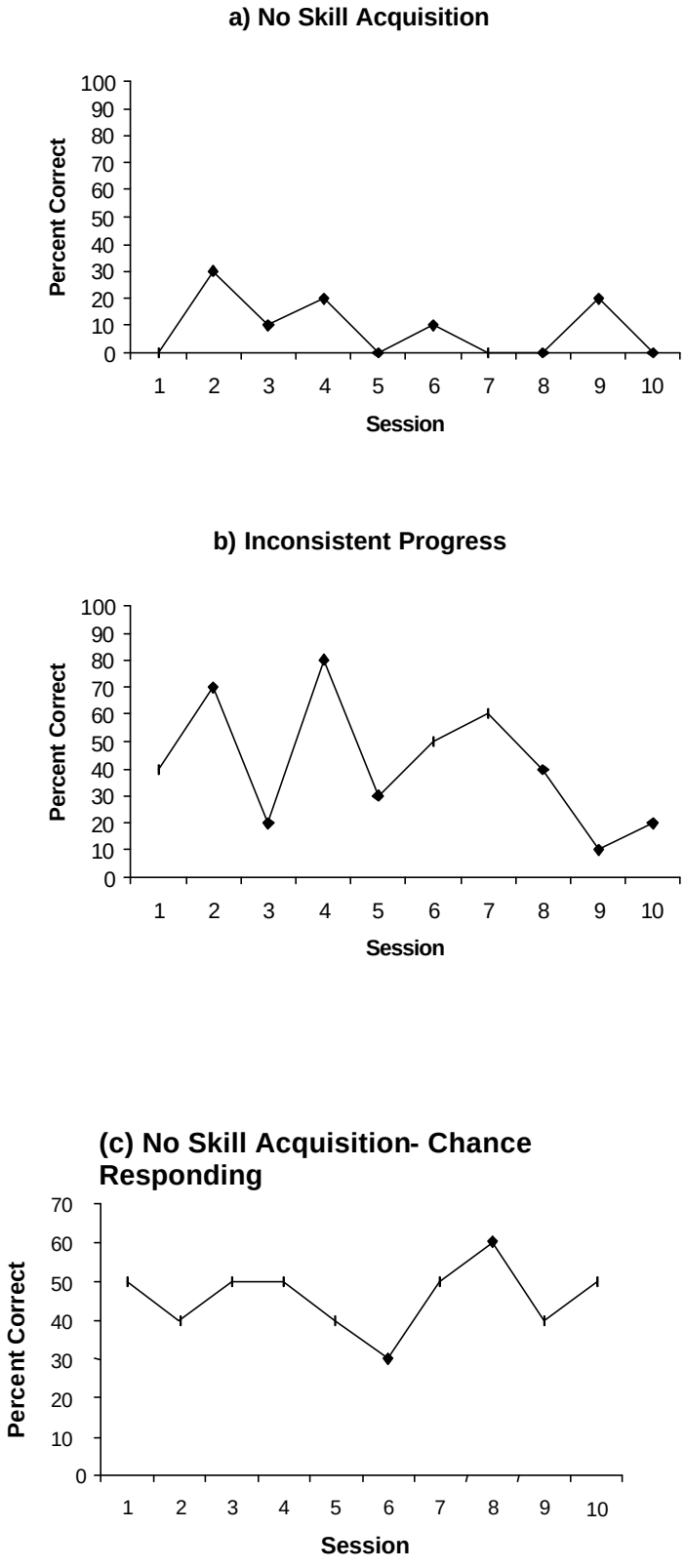

Figure 6. Examples of no skill acquisition (top panel), inconsistent progress (middle panel), and no skill acquisition or chance responding (bottom panel).

Analyzing an Instructional Program That Is Not Progressing

Figure 1 outlines questions to consider when a program is not progressing. The top of the figure indicates that, if the data show any progress in 8-10 sessions, the program should be continued, but, if the data show no progress, there are a series of questions that the team may ask in order to pinpoint the problem. The first consideration is whether the lack of progress is unique to a specific program or program step, or whether it is observed across the student's whole curriculum. If the latter, the team should conduct a general review of the appropriateness of the child's education plan and quality of implementation. Romanczyk (1996) offers a useful model for conducting this review and evaluation. If the trouble mainly affects one program, the next question is whether or not it is important for the child to continue that program. For example, a team may have introduced a program simply because it comes next in a curriculum; however, if the child is not progressing, it is appropriate to re-evaluate the developmental, academic, or functional appropriateness of the program for the child at that time. For example, there is usually no urgent need for the child to master skills such as language concepts (e.g., opposite pairs such as big/little, prepositions, and pronouns) and academics (e.g., reading and mathematics). Other skills, however, may have immediate relevance for the child's functional independence (e.g., requesting desired items, toileting). Additional skills such as imitation and matching may serve as a critical foundation for later instruction. Thus, if a child is not progressing with programs for these skills, extensive efforts at trouble-shooting may be warranted. A further issue to consider is whether the child made progress in the initial steps of a program and then stopped making progress in later steps, or whether the child has had difficulty with the program from the beginning. The former situation may justify greater efforts to continue the program than the latter. Close collaboration between the team and family, with the involvement of a behavioral consultant, is necessary to determine whether to put a program on hold, discontinue a step or condition, or trouble-shoot ways to continue it. An important part of this collaboration is to have periodic parent/team meetings to review the scope and sequence of the child's educational plan and develop priorities for individual programs to implement within that plan.

Figure 1 shows that the next question is whether the program is being run frequently, consistently, and with accurate data collection. In most research on Early Intensive Behavioral Intervention (EIBI) for children with autism, each instructional program is implemented with a child at least 3-4 times per week (Harris & Weiss, 1998). If it is being run less often, the team should increase the frequency and then re-evaluate the child's progress after another 8-10 sessions. It is also important that all team members use the same instructional materials, S^D, prompting methods, and procedures for reinforcing correct responses and correcting errors. Demonstrating an instructional program or reviewing videotaped sessions in a team meeting as well as having the supervisor or another team member observe instruction are ways to ensure consistency. Regarding data collection, some teams may collect data only once or twice a week or may simply estimate the child's performance following a session. However, when there are concerns about a child's progress in a program, it is necessary to enter data immediately after each learning trial in all sessions to ensure the validity of the data.

If the program is being implemented consistently with accurate data collection, yet the child is not making progress, Figure 1 identifies four scenarios that one may see in the data. Figures 2-5, discussed later in the manuscript, discuss problem-solving steps in each scenario:

1. No skill acquisition

a. The child's percentage of correct responding is near 0%. For example, as shown in Figure 6a, a child may have had an instructional program for teaching imitation of nonverbal actions for three weeks, without any clear increase in correct responding (0% in the first session, then 20%, 10%, 30%, 20%, etc.).

b. The child's percentage of correct responding is near chance. For example, if two objects are placed on the table, and the child is asked to select one, a child who is guessing randomly would average 50% correct, as shown in Figure 6c. This situation may arise when the child is not differentiating between objects or S^D's. For example, it may occur when one object is requested repeatedly across trials, but the position of the two objects varies. It also may be observed when the child has mastered selecting one object when it is repeatedly

requested, then mastered the second object when it was repeatedly requested, and now has to select one of the objects when requests for the objects are randomly alternated.

2. Inconsistent performance

a. The child's performance is highly variable across sessions. For example, in an instructional program for matching identical objects to each other, the last five data points may be 40%, 70%, 20%, 80%, and 30% (Figure 6b). The criterion for mastery of the program is 80% across two consecutive sessions.

b. The child often responds correctly but does not reach the criterion for mastery. For example, a child may have an instructional program for identifying body parts in which she often performs above chance level but has not met mastery criterion across two consecutive sessions (e.g., 70%, 80%, 60%, 80%, 60%).

c. The child was approaching the criterion for mastery, but his percentage of correct responding has begun to decrease (e.g., 60%, 80%, 70%, 40%, 30%).

3. Failure to generalize

For example, a child successfully labels pictures of household objects such as a refrigerator, towel, or bed with the pictures that are used at school. However, her mother reports that she does not label these items at home, even when verbally prompted.

Once the problem is identified, the team may form a hypothesis about why it is occurring and ask further questions to identify solutions, as discussed below. This process involves examining the components of the discrete trial (e.g., the S^D, prompts, and consequences). In some instances, more than one problem may be identified. For example, a child may show both an absence of skill acquisition and an increase in problem behaviors during the program. Solutions for each problem may then need to be considered. However, teams should make only one or two changes at a time so that they can assess the impact of each change. If the change does not produce an increased rate of skill acquisition, it may be necessary to repeat the problem-solving process, incorporating data on the child's performance after the most recent change.

No Skill Acquisition

When there is little or no skill acquisition, the most likely explanations are found through analyses of the antecedent components of the discrete trial: discriminative stimuli, prompts, or instructional materials. For example, the child may not be differentiating between the discriminative stimuli used in the program, or the prompts may be ineffective in setting the occasion for the behavior. Consequent events (i.e., error correction and reinforcement procedures) also may be a factor and should be considered as well.

Figure 2 shows that the first step is to verify that the child has the necessary prerequisite skills. If not, the team may have to postpone a program until these skills are a solid part of his repertoire. For example, if the program requires the child to give a verbal response (e.g., saying a word or phrase), the child must be able to articulate the word intelligibly. If the program involves imitating an oral-motor movement such as smacking his or her lips, the child should already be proficient at imitating gross motor movements such as clapping hands and tapping legs. If the program involves teaching an abstract language concept (e.g., an opposite pair such as big/little), research on typical language development (Fenson et al., 1993) suggests that the child should have mastered at least 50 words for names of objects (ball, doll, cookie, etc.). Referring to a published EIBI curriculum (e.g., Janzen, 1996; Leaf & McEachin, 1999; Lovaas, 2003; Taylor & MacDonough, 1996) or consulting with a supervisor may be necessary to determine whether the child has prerequisite skills.

Figure 2 indicates that, if the child has the prerequisite skills, the next questions focus on antecedents (instructional materials, S^D, and prompt). When materials such as objects or pictures are being used, teams may consider whether to substitute new ones. For example, a line drawing or picture with a plain background may be easier for a child to identify than a picture with a busy background. In a program for teaching a child to differentiate between *big* and *little*, it may be best to start by presenting a big and little version of the same object (e.g., a big car and a much smaller car), rather than two different objects. The S^D may also be simplified.

For example, instead of saying, “Give me car”, the instructor may simply say “Car.” Instead of saying, “Put the block on top of the table” the instructor may say only, “On top.” Also, it may be appropriate to change prompting procedures. For example, physical prompts (i.e., providing hand-over-hand guidance) may be aversive to some children (MacDuff, Krantz, & McClannahan, 2001). Table 1 lists other prompts that can be considered such as modeling the correct response, using positional cues (placing the correct object or picture closer to the child than the other items), and gesturing. Also of note is that research has found that within-stimulus prompts (prompts that are incorporated into the materials or S^D) are more readily faded than extra-stimulus prompts (prompts that are separate from the materials or S^D) (Schreibman, 1975). For example, when teaching a child to select a picture for a preferred item instead of pictures for non-preferred items, the picture for the preferred item may be in color while the other pictures are in black and white (Frost & Bondy, 1994). As another example, when teaching a child to differentiate between the letters *b* and *d*, the loops on each letter can be exaggerated.

Table 1

Prompting Procedures

Type of Prompt*	**Definition**	**Example**	**Advantages/ Disadvantages**
Gestural	Using a visual gesture, such as a point, to indicate the correct response	In a program for identifying objects, pointing to the correct object while giving the S^D, “Give me [object]”	Easy to implement and fade out
Verbal	Providing part or all of a response audibly	Immediately after asking “What is it?” while holding up a cookie, saying the word or providing the first sound (“c”)	Easy to implement but can be the most difficult to fade
Modeling	Showing the correct response, or part of a response	While giving the S^D “Clap hands”, the instructor performs the action	Easy to implement and fade out but requires that student has well-developed imitation skills
Positional	Modifying the placement of materials	In a program for matching words to corresponding pictures, placing the correct picture closer than other pictures to the student	Easy to implement and fade out
Physical	Placing one’s hand on the child’s hand, wrist, elbow, etc., to guide the student to complete a response or perform a task	When teaching a child follow the instruction “Stand up”, placing hands on the back of child’s shoulders and lightly nudging the shoulders; when shadowing the child during a group activity, sitting behind the child and providing hand-over-hand guidance as needed to complete tasks	Often useful for motor activities and for activities in which it is advantageous for the child to complete tasks without orienting to instructor (e.g., self-help activities or group lessons). May be aversive to some

			children
Pictorial	Pictures used to represent objects, actions, and tasks	When teaching a long response chain such as making microwave popcorn, using a picture to represent each individual step	Helpful for children who have good visual skills. Useful for cueing child to perform activities without relying on verbal prompts from adults
Textual	A written cue such as a checklist, label, written instruction or script	Placing a written instruction next to a picture depicting a game for a child to read when asking a caregiver or peer to play the game	Useful for cueing child to perform activities without relying on verbal prompts from adults. Requires the child to have reading skills.
Time Delay	Providing a prompt after a designated period of time following the instruction (S^D); the time can be increased as child progresses	When starting to teach a new expressive label, saying the word immediately after presenting the S^D, "What is it?" As the child progresses, the time between the S^D and prompt (saying the word) is gradually increased	Beneficial in promoting initiation of communication without verbal cues from adults. However, student may simply wait for prompt unless S^D is already effective
Tactile	A devise such as a vibrating pager ("Gentle Reminder") that is activated remotely at designated time intervals to cue the child to engage in a specific behavior	When a classroom teacher asks a question during Circle Time, pager is activated to prompt the child to raise his or her hand	Useful for encouraging child to respond without an adult nearby
Within Stimulus	Using the physical properties of a target response as a relevant stimulus to help increase the likelihood of a correct response	When teaching a child to identify the word blue, teaching the color "blue" having the word surrounded by a blue border, and gradually decreasing the size of the border as the child progresses	Within stimulus prompts are often the easiest of all prompts to fade out. However, it may be time-consuming to prepare materials.

**Note: A combination of prompts may be used*

Prompt Hierarchy

- Most-to-Least Prompting: starting with a very salient prompt and gradually using less salient prompts as the child progresses; usually used for teaching new skills. Examples:
    - Graduated guidance: progressively reducing physical guidance (e.g., when teaching a writing task, starting by placing one's hand on the child's hand, then fading by placing the hand on the wrist, then on the arm, the shoulder, etc.)

  - Progressive Time Delay: systematically increasing the length of time between the S^D and prompt as the child acquires a skill (e.g., starting with a 0 second delay, then increasing to 2 seconds, 5 seconds, etc.)
  - Combination procedures such as starting with a full physical prompt (hand-over-hand guidance), then using a lesser physical prompt, then using modeling or gestures, and then using no prompts
- Least-to-Most Prompting: Initially using no prompt but providing increasingly greater levels of prompting until the child successfully completes the response, usually used for skills that the child has previously mastered.
  - Physical prompts: providing manual guidance as needed
  - Time delay-verbal-modeling: waiting expectantly, then, if no response, giving a verbal prompt (e.g., asking, "What do you want?"), then, if still no response, demonstrating the response (e.g., say, "I want puzzle")

If the child's difficulties persist despite modifications of the antecedent stimuli, consideration should be given to changing the target response. For example, if a child is not requesting desired items using spoken language, the child may be successful with using alternative communication strategies such as the Picture Exchange Communication System (PECS; Frost & Bondy, 1994). It is unclear whether acquiring skills through augmentative communication will help the child learn spoken language (Yoder & Layton, 1988); however, it will not impede learning (Charlop-Christy, Carpenter, Le, LeBlanc, & Kelley, 2002), and it may in itself be a very useful communication strategy. As another example, if a child is not acquiring a receptive language skill (e.g., selecting an object when requested to do so), he might be successful when it is first taught expressively (e.g., presenting an object and asking the child to state the name of the object; Wynn & Smith, 2003).

Another possible strategy is to modify the error correction procedure. In some educational settings, instructors are trained to respond to errors with verbal statements such as saying "no" or "try again." The aim of this procedure is to help the student distinguish between consequences given for a correct response and an incorrect response. In other settings, instructors may use nonverbal feedback such as physical guidance or modeling (Holmes, 1998), sometimes requiring the student to give the correct response before going on to the next learning trial (Greer & McDonough, 1999). This procedure is designed to draw attention to the correct response. Another procedure, which is sometimes colloquially called "errorless learning," involves providing guidance before the student completes an incorrect response (Holmes, 1998), then delaying the start of the next learning trial, and giving no other feedback at all. Research on the relative efficacy of these procedures is limited but suggests that no one procedure is always best. For example, some children with autism appear to do better with statements such as "no" or "try again" while others do better with modeling or guidance (Smith, Mruzek, Wheat, & Hughes, 2005). Thus, when a child is not acquiring a skill, it may be helpful to change the error correction procedure (e.g., using modeling instead of saying "no" or vice versa). Familiarity with the student's learning style may assist in determining which error correction strategy will be effective.

An additional strategy is to increase reinforcement. A variety of approaches for doing so are available and they summarized in the next section and in Figure 3.

If the child continues to show poor acquisition, another possibility is to switch from DTT to another instructional format (see Figure 2). For example, video modeling is a well established procedure through which a child learns a new skill by imitating another person who performs the skill on videotape. Studies indicate that video modeling can be effective in teaching a variety of skills such as conversation, pretend play, use of schedules to guide activities, activities of daily living (e.g., bathing), and community skills (e.g., purchasing) (see Corbett, & Abdullah, 2005). This technique has also been shown to generalize well (Charlop & Milstein, 1989; LeBlanc et al., 2003). Table 2- gives guidelines for developing a video model and using it to teach children with autism.

Table 2

Guidelines for Video Modeling

Creating a Video

1. Actors wear neutral clothing and stand against a neutral background
2. Actors face the camera, rather than each other. This may look awkward for some activities such as conversations, but it facilitates learning by allowing the child to see every element of the target social skill including gestures, facial expressions, and general affect.
3. Actors slow down and exaggerate words, actions, gestures and facial expressions in order to facilitate accurate modeling.
4. Actors use materials that interest the child (e.g., favorite toys or puzzles for a video of turn-taking, colored soap or bubbles for hand-washing, costumes of favorite characters for role-play)
5. Scripts are kept short.

Sample Script 1:

A: Let's talk about your family.
B: I have a sister.

A: What's your sister's name?
B: Mariellen. Do you have a sister?

A: Yes, I have a sister.
B: What's her name?

Sample Script 2:

A: Let's talk about Game Boy.
B: I like Game Boy.

A: What's your favorite game?
B: My favorite is Kirby.

A: What does Kirby do?
B: Kirby runs to the castle.

Implementing a Video Modeling Program

1. When introducing a new video, have the child view it three consecutive times. Prompt and reinforce for "good sitting", "good looking", etc., as needed.
2. After presenting the video, say, "Now you do it, like on TV" (or similar statement)
3. Reinforce for approximations and correct imitations.
4. If necessary, have the child watch the video again and present an opportunity for imitation after each subsequent viewing.

If necessary, prompt by saying, "Say, ___[sentence from the video]" or "Do [action from the video]" or by presenting a textual cue (e.g., words or picture symbols for what the child is to say or do).

Variations of modeling procedures also exist and may be useful. For example, modeling can be done *in vivo* (having a skill demonstrated by a peer or adult who is physically present). Also, rather than demonstrating a skill, a script can be presented in writing, in pictures, or verbally from an audiotape or Language Master (EIKI International, Inc.). A Language Master is a machine that reads words recorded on magnetic cards (McClannahan & Krantz, 1999) that can be used to cue completion of tasks, such as in an activity schedule, or teach conversational skills, for example.

Incidental teaching is another example of an alternate teaching strategy that has substantial research support (Delprato, 2001). It is used to encourage skills such as communication by setting up situations in the natural environment that encourage the child to initiate communication and then respond in ways that require additional language from that person (Hart & Risley, 1982). For example, an instructor might arrange toys in sight but out of reach of a child. When the child reaches for a toy, an opportunity arises to teach requesting or to require increasingly complex requests or elaborate on other learned skills (e.g., attributes). To prompt the child, the instructor may just wait expectantly (a procedure called time delay) or ask a question (e.g., "What do you want?"). If the child correctly makes the request, he or she receives the desired toy. Also, an instructor may hide a favorite object from a child, so that the child must ask, "What is it?" or "Where is it?" to gain access to the object. A person or action figure can be hidden so that the child is encouraged to ask, "Who is it?" Koegel and Koegel (1995) and Fenske, Krantz, and McClannahan (2001) describe incidental teaching procedures for children with autism in greater detail. They emphasize that although incidental teaching may initially focus on encouraging a child to request objects or activities, it can be used to teach a variety of other language skills such as seeking help, using syntax such as prepositions, and asking for missing items that are needed to complete a task or activity.

For skills that involve completing a chain of behaviors, such as a self-help task or a sequence of play activities, activity schedules that are presented in a series of photographs, picture cues, or words are another well-established intervention (MacDuff, Krantz, & McClannahan, 1993; McClannahan & Krantz, 1999). These visual cues are sometimes arranged in a vertical or horizontal line or in a flip book with one activity per page. The child is usually given a general instruction (e.g., "See what's next"), and physical guidance is used as needed to prompt the child to refer to the schedule and carry out activities. McClannahan and Krantz (1999) provide an excellent discussion of procedures for using schedules.

The preceding discussion demonstrates that, when a child is showing no skill acquisition, there are many possible ways to modify the antecedents, target behavior, reinforcement, and error correction procedures, and there are often instructional formats other than discrete trial training that merit consideration.

Inconsistent Progress

As shown in Figure 3, when variable (up-and-down) performance occurs it is likely that teaching procedures are inconsistent or that the child has low motivation during instructional sessions. Inconsistent teaching may take a variety of forms. For example, differences in performance may be observed across settings, indicating that components of the environment may interfere with efficient learning. Distractors in the room may be responsible, or the student may be uncomfortable in unfamiliar surroundings. To remedy this problem, the same setting should be used for all teaching sessions, especially when working on a new or difficult skill. Later, after the child has mastered the skill, teaching sessions can be carried out in different settings to promote generalization. Temporal factors may also contribute to inconsistent progress. A student may be more successful during the morning hours, relative to afternoon or evening hours. In this case, new or especially difficult programs should be administered early in the day. Graphing data on a scatterplot can help identify patterns of responding and isolate behavior that may be highly correlated with a time of day, setting, absence or presence of certain people, reinforcement contingencies, etc. (Touchette, MacDonald, & Langer, 1985).

Variation in performance also may be caused by inconsistencies across instructors; analysis of instructor uniformity should take place whenever an instructional program is not progressing. Having two different observers record data and analyze interobserver agreement (IOA) may be especially important (Figure 3). IOA data may reveal that instructors have different criteria for what constitutes a correct response. For example, one instructor may accept a response in which the child initially gives an incorrect answer but quickly changes to the correct answer, whereas other instructors may count this response as incorrect. One instructor may consider a verbal approximation of a word or phrase to be acceptable, while others may require accurate pronunciation. An instructor might also be giving subtle, inadvertent prompts such as glancing or moving slightly in the direction of the correct response, changing facial expression when the child begins to make an incorrect response, or presenting S^Ds in a predictable order (Lovaas, 1977; Charlop-Christy & Kelso, 1997). Alternately, effective use of reinforcement by certain instructors may contribute to enhanced performance in their teaching sessions. In this case, communication between instructors can facilitate the consistent implementation of effective teaching strategies.

Lack of motivation, the second part of the hypothesis presented in Figure 3, is a common problem when teaching children with autism. In addition to the kind of erratic performance illustrated in Figure 6b, the child may display other behavioral signs of low motivation such as responding slowly or not at all to S^Ds, glancing only briefly at instructional materials, pushing back or fidgeting in the chair, verbally protesting, or engaging in repetitive behaviors. There are several ways to respond to low motivation, but the most straightforward solution is to examine reinforcement procedures. As shown in Figure 3, an important consideration is to identify preferred reinforcers.

Preference assessments are an example of a widely used tool to encourage the student to choose his own reinforcers (Cannella, O'Reilly, & Lancioni, 2005). While some preference assessment procedures are quite lengthy and may require training from a professional behavior analyst (Fisher et al, 1992), others are more straightforward. A common procedure is to present an array of choices. For children who communicate in either spoken words, gestures such as pointing, or visual systems such as PECS, the instructor can hold up a choice board with pictures or drawings and ask, "What do you want to work for?" It may be necessary to prompt by asking, "Do you want _____?" For less verbal children, the instructor can hold up two or three objects simultaneously, ask, "What do you want to work for?", and determine which object the child reaches for or looks at (Mason, McGee, Farmer-Dougan, & Risley, 1989). Often, these procedures are used to identify a single reinforcer that is repeatedly presented to a child during task sessions. However, it is usually more effective to have the child choose a reinforcer often (e.g., at the beginning of each instructional program) in order to prevent satiation and allow for changes in preference. It is important to have a limit on access to the reinforcer (e.g., setting a timer for access to toys or giving only a small amount of food while keeping the rest away) so that the reinforcer maintains its effectiveness and the child is soon ready to resume instruction.

Another tactic for motivation enhancement is to increase the schedule of reinforcement. A child may be performing well during some tasks when receiving praise or access to a preferred activity after an average of three or four correct responses, but may benefit from reinforcement after every one or two correct responses for new or difficult tasks (Delmolino & Harris, 2004). Instructional programs for teaching new skills should initially have more regular and frequent reinforcement than programs for helping the child maintain previously mastered skills. Similarly a difficult instructional program may require more reinforcement than other programs, even if the student has worked on the program for several weeks. Reinforcement should not automatically be increased to giving one reinforcer for each correct response. Rather, the reinforcement schedule may be increased in increments until there is evidence that the child's performance has improved. In addition to altering the reinforcement schedule, enabling the child to anticipate when reinforcement will be given is helpful. A token economy system, in which the child earns a certain number of pennies or stickers and then exchanges them for reinforcers, may be an effective approach, particularly for children who can count.

Sometimes, none of the choices that are typically offered in preference assessments (e.g., toys, food, or gross motor activities) are effective reinforcers, even when given on a dense schedule. Figure 3 indicates that one possible solution is to restrict access to reinforcers outside of instructional program (Klatt, Sherman, & Sheldon, 2000). For example, while it is inappropriate to prevent a child from having regular meals and snacks, it is reasonable to reserve preferred snacks such as crackers or small bits of candy for instructional programs. This is likely to increase the potency of these foods as reinforcers (McAdam et. al., 2005). Similarly, some highly preferred toys can be used as reinforcers in instructional programs and stored out of sight of the child at other times. Access to preferred foods or toys may be restricted further by limiting their use to new or difficult instructional programs.

Another possibility, shown in Figure 3, is to use short, constrained episodes of problem behaviors (e.g., repetitive or perseverative activities) as reinforcers when other preferred activities or items cannot be identified. In some cases, particularly with young children and others who do not yet have a wide variety of reinforcers, opportunity to engage in problem behaviors is a more effective reinforcer than standard choices (Charlop, Kurtz, & Casey, 1990). This strategy may seem counterintuitive because the usual goal in an early intervention program is to minimize such behaviors. Of course, instructors cannot let a child perform dangerous actions such as self-injurious behavior (SIB), displays of aggression, and pica. Nevertheless, they can consider offering opportunities for repetitive motor activities such as hand-flapping, perseverative behaviors such as lining up toys or gazing at spinning objects, and delayed echolalia (e.g., repeating scripts from favorite movies). They can do so even when they are attempting to reduce such behaviors during other parts of the child's day. Indeed, depriving the child of access to these activities most of the time and then using them as reinforcers for correct responding in instructional programs may be an especially effective combination. Also, as with other reinforcers, it may be helpful to conduct frequent preference assessments, using the procedures described earlier, so that the child can choose the object or activity that he or she will earn. It is very important to stick to a standard method of reinforcer presentation (e.g., setting and enforcing a time limit) so that the student understands that these reinforcers are available only at the instructor's discretion. In addition, efforts should continue to identify other reinforcers and establish new ones (e.g., pairing praise for correct responses with the presentation of opportunities to engage in problem behavior).

In addition to modifying instructional procedures, Figure 3 depicts several other strategies for addressing low motivation. One is choice making, which has been demonstrated to increase task responding and decrease off-task behaviors (Moes, 1998). Having the child choose reinforcers has already been discussed. Children also may be given a choice of which instructional program to do next, or they may be given pictures or words for three or four programs and asked to arrange them in the order they would like to do them. Further, they may choose preferred materials (e.g., markers and paper for a drawing program).

Incorporating preferred materials into programs also may increase motivation (Klatt, Sherman, & Sheldon, 2000). For example if a child has a strong interest in trains, it may be more effective to teach prepositions by asking the child put the train on top of or under another object than to use a neutral object such as a block. It may be more effective to teach the pronouns *he/she* by using preferred action figures than using pictures of unfamiliar people.

Turn taking and task interspersal are two additional strategies that may increase motivation by introducing variety into instructional sessions. As an example of turn-taking, an instructor may ask the child to draw something, then the instructor will draw something him/herself, then ask the child to draw something again, and so on. Or, for children who can speak in sentences, an instructor could make a request of the child, then tell the child that it is his or her turn to make a request of the adult (e.g., "Your turn—ask me, 'What is it?'"), and so on. The child can be introduced to turn-taking during breaks between instructional sessions; when the child becomes familiar with this routine, it can then be included into sessions. Task interspersal involves incorporating previously learned skills into a new instructional program. For example, if a child is

learning a new language concept (e.g., an opposite pair such as *hot/cold*), requests to select a hot or cold object can be mixed with requests to imitate simple actions (e.g., identify body parts; Dunlap, 1984).

The alternate teaching formats described in the preceding section are important options to consider. Incidental teaching programs are specifically designed to capitalize on objects or activities that are of particular interest to the child (Fenske, Krantz, & McClannahan, 2001). With their reliance on visual materials, video modeling and activity schedules also may have appeal. For additional information on approaches for increasing motivation, Delmolino and Harris (2004) provide an excellent reference.

Increase in Problem Behavior

A child may display an increase in problem behaviors such as tantrums or aggression during instructional programs. These behaviors may occur in conjunction with a lack of skill acquisition or inconsistent progress, or they may arise independently. The key to analyzing the behavior and how it relates to instructional programs is to collect behavioral data. First and foremost, an operational definition of the problem behavior must be developed so that the data collection is accurate and reliable. An operational definition is a description of the target behavior that is both observable and measurable. For example, an operational definition of tantrums might be screaming, or making loud verbal protests for three or more seconds. Data are most commonly collected by recording the behavior as it occurs by writing a narrative of the antecedent, behavior, and consequence around each episode or event of the target behavior (A-B-C data). This type of data collection allows for a specific description of the environmental conditions under which the behaviors were emitted, which may be critical to problem solving, such as where and with whom was the program being run (Cooper, Heron, & Heward, 1987). It also gives information on the rate of occurrences of behavior so that change in frequency over time can be monitored.

A-B-C data may indicate whether the problem behavior is occurring during one particular program or is being exhibited across various contexts, whether the behavior is emitted at higher rates with one instructor than others or at similar rates across instructors, and whether it occurs with the presentation of the S^D, prompt, consequence, or other events. Problem behavior may be a sign that the task is too easy or too difficult and the child may engage in these behaviors in order to avoid or escape the task (Foxx, 2001). For example, when a target is too easy, a child may become bored and act out to terminate the task. To avoid reinforcing the problem behavior, it is important to continue the session until the child complies with a cue from the teacher. After the session ends, however, it may be beneficial to stop running the instructional program and shift the focus to applying the skill to everyday situations outside of instruction. If a task is too difficult, as often occurs when teaching a new target skill or with a child that is just beginning early intervention, problem behavior may enable the child to escape from the task. Again, the teacher should continue the session until the child complies with an instructional cue from the teacher. Subsequently, however, stopping or putting the program on hold, or using the troubleshooting strategies for lack of skill acquisition (Figure 2) should be considered. Before choosing one of these courses of action, the team also should be aware that some children often resist the introduction of new tasks, even when instructional fit and reinforcement have been adequately considered. Under these circumstances, continuing the program and using the strategies discussed below for reducing problem behavior may be the best decision.

Problem behavior also may emerge when there is insufficient reinforcement or opportunity to take breaks. Teams may consider reinforcement strategies and task interspersal, as reviewed in the preceding section and in Figure 3. In addition, they may shorten sessions. For example, they might conduct 5 trials per session instead of 10 or move away from having any standard number of trials, instead ending sessions after an especially good response from the child or after a short number of consecutive correct responses. A common strategy to increase communicative, spontaneous language is teaching the child functional communication skills (e.g., manding for a break) through a process called Functional Communication Training (FCT; Halle, 1987).

Problem behavior may arise because aspects of the instructional program are bothersome to the child. As noted, manual prompts are aversive to some children. Textures of instructional materials may be aversive, and sights or sounds may be frightening. Error correction procedures may provoke displays of frustration (Smith, Mruzek, Wheat, & Hughes, 2005). Overenthusiastic praise or applause may make the child cringe or cover her ears. Thus, the procedures in the instructional program may need to be revised.

In the event that a problem behavior persists after the strategies in Figure 4 are implemented, or if the behavior poses an immediate danger to the child or others, a more extensive functional analysis, with consultation from a professional behavior analyst, is necessary to evaluate the behavior and develop a detailed behavior plan to address it.

Failure to Generalize

The term *generalization* refers to the occurrence of relevant behavior under different, nontraining conditions (i.e., across subjects, settings, people, behaviors, and time). Lack of generalization despite apparent mastery of the skill during instructional sessions is a frequent occurrence. In this situation, as indicated in Figure 5, the first logical question is whether there is any plan in place for generalization. For example, are specific generalization steps built into the program? Although behavior analysts have known for many years that taking a "train and hope" approach to generalization is unrealistic (Stokes & Baer, 1977), this approach remains prevalent.

If there is a plan, the next question in Figure 5 is to consider whether the child demonstrates the skill when the instructional program is re-introduced. If not, it may be necessary to conduct teaching sessions of the program regularly until the child again demonstrates mastery. To prevent the loss of newly established skills, it may be useful to set up a skill maintenance schedule. For example, after mastery of a receptive label program, a practitioner may schedule maintenance sessions 2-3 times per week, then once per week, then bi-weekly, once monthly, etc. Alternatively, teams may set aside a particular day (e.g., "Maintenance Monday") to run through all of a child's maintenance programs. The additional teaching sessions above and beyond mastery are an example of a maintenance strategy called overlearning (Stokes & Osnes, 1989). Another overlearning method is to work on increasing fluency (i.e., rate and accuracy of responding; Binder, 1993). An additional overlearning approach is to introduce instructional programs that progress from foundational to more advanced skills. For example, letter identification is a pre-requisite to sight word recognition, then phonics, reading/writing words, and so on.

If the child demonstrates continued mastery in the instructional program but does not display the skill in other situations, it may be because the child responds only to the particular instructional materials used in the program (i.e., the skilled behavior is "stimulus bound"). It is often observed that children with autism attend to certain stimulus features present during discrimination training that may independently occasion the behavior of interest whereas other features do not, a phenomenon referred to as overselectivity (Lovaas, Koegel, & Schreibman, 1979). A common strategy to address this problem is to use different examples of an item (e.g., different types of toy school buses, pictures of school buses, models of school buses), including stimuli that the child is likely to encounter outside of instruction (e.g., picture of the child's school bus he takes to school). Similarly, a child may respond only to the S^D that was used in the program, in which case instructors may systematically vary the S^D (e.g., asking the child to respond to different greetings such as, "Hi," "Hello," and "How are you today?").

Sometimes, a child may display a skill only in the instructional setting (Rincover & Koegel, 1975). Instructors may then systematically provide instruction in different locations or recruit people in those settings such as peers or teachers to assist in providing instruction. In addition, they may use strategies to ensure that reinforcement is available across settings. For example, they may teach behaviors that are likely to produce reinforcement, such as requesting (e.g., manding for a break), tacting, greeting, or initiating conversations (Koegel & Koegel, 1995). Also, they may work on fluency, enabling the child to emit the response quickly.

For example, if a child takes several seconds to respond to a greeting from a peer, the peer may go on to another activity and not acknowledge the response. However, if the child responds as quickly as other children do, the greeter will probably smile, nod, or otherwise reinforce the response. Instructors also may thin the reinforcement schedule during instructional sessions, so that it more closely resembles the reinforcement available in other settings. Finally, instructors may teach the child to cue and reinforce him or herself. For example, instruction in visual activity schedules may include teaching the child to set up the schedule and obtain a reinforcer after completing the steps (Delmolino & Harris, 2004; McClannahan & Krantz, 1999). Alternatively, instructors can simply display visual prompts in the child's environment and prompt the child to refer to these cues.

Another frequent generalization problem is that, while a child may reliably display a skill whenever an instructor makes a direct request to do so, the child does not initiate use of the skill without a request (Smith, 2001). The incidental teaching strategies that were previously described may be useful in addressing this problem. Some of the prompting strategies that are listed in Table 1 also may be useful. For example, physical guidance, with the instructor staying behind the child and gradually reducing the level of guidance, is commonly used for this purpose. An instructor may use physical guidance as a prompt for responding to a visual schedule, instructions from the classroom teacher, or statements from a peer; the instructor then fades out this prompt gradually so that the child is responding only to the schedule, teacher or peer (Krantz & McClannahan, 1993). Another prompting procedure that is often used to promote initiation is time delay. As previously noted, in this procedure, the instructor simply waits expectantly and does not say anything. The child is thus encouraged to communicate without waiting for a direct request from the instructor to do so.

Another prompting procedure that has been found effective in several studies and is perhaps under-utilized for children with autism is tactile prompting. A tactile prompting device is a pager worn by the student that, when activated, vibrates for a designated time interval. The vibration provides a sensory cue for the student to engage in a target behavior. The first such device to be used in a DTT study was called the Gentle Reminder (Davidson, 1995). Another readily available device is the JTech pager (JTECH Communications Inc., 2004), which can be worn inconspicuously in a student's pocket or under clothing. Tactile prompts have been used to increase social initiations (Taylor & Levin, 1998; Shabani, et al., 2002) and safety skills such as requesting help in the community (Taylor, Hughes, Richard, Hoch, & Coello, 2004). They are not observable by anyone other than the instructor and child; for this reason, they are non-stigmatizing and useful in community settings such as regular education classrooms. Because instructors can administer tactile prompts at a distance, they can reduce their direct monitoring of and assistance to the child. They also can systematically fade the prompt so that the child responds with increasing independence.

In general, strategies for generalization involve planning for continued practice over time, systematically varying instructional procedures and the settings in which instruction takes place, providing opportunities for the child to obtain reinforcement for displaying the skill, and using instructional formats and prompting strategies that encourage initiation from the child rather than reliance on adult cues (Stokes & Baer, 1977; Stokes & Osnes, 1989).

Discussion

Even after thorough problem solving has been conducted, there are, of course, situations in which choosing to discontinue a program or a particular step or condition is a sound decision. If the above questions and suggested strategies for problem solving a particular problem prove to be unsuccessful, the best solution may be to put a program on hold and re-introduce it at a later date, or discontinue the goal and choose another target skill. The lead teacher, program consultant, or case manager, in conjunction with the parent or caregiver, typically best makes this decision with input from other team members. If it involves a severe and persistent problem behavior that is not responsive to the strategies addressing ways to decrease problem behavior (Figure 4), additional assessment and behavior support plans that are developed by a professional behavior analyst may be necessary. Nevertheless, systematic procedures are available that may be used to effectively analyze why a program is not progressing and how to help the child with autism successfully acquire target skills.

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