Chapter 2
Applied Behavior Analysis and Its Application to Autism and Autism Related Disorders

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This chapter will be basic foundations. The theory behind operant conditioning will be the first part of the chapter. Next terms and concepts will be reviewed such as reinforcement, shaping, etc. The presentation of these concepts will include applications to autism. The chapter will conclude with current developments in theory (e.g., functional assessment, positive behavioral supports) and future directions in the application of ABA within the field of autism.

In depth coverage of each of the topics will not be possible given the space limitations of a chapter. Readers are encouraged to independently delve further into the literature, using the cited studies, texts, and chapters referenced in the following pages.

Introduction

Along with the rising prevalence of autism spectrum disorders, there has been a heightened focus on identifying treatments that address the symptoms underlying these disorders in the USA. These symptoms can be grossly categorized into two areas: (1) Behaviors of excess including vocal and motor stereotypies, echoic speech, and rigidity, and (2) behaviors of deficit such as delays in the areas of communication, peer relations, and independent functioning. Many of the behavioral hallmarks of autism have been addressed through strategies based on applied behavior analysis (ABA). This chapter will provide an overview of ABA, including its basic foundations and a discussion of relevant terms and concepts. Several examples from the scientific literature will be described to illustrate how ABA has been used to evaluate and treat the core symptoms associated with autism. At the conclusion of the chapter, we will briefly discuss current developments

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Conceptual Basis and Foundation of Applied Behavior Analysis

Applied behavior analysis (ABA) as a science was established in the early second half of the twentieth century as an approach to the evaluation and selection of change of human behavior based on the operant conditioning principles most famously championed by B. F. Skinner. Operant conditioning can be defined as the process through which the environment and behavior interact to shape the behavioral repertoire of an organism or individual (Skinner, 1953). By 1968, ABA had gained enough of a following in the scientific community that a journal was established (*Journal of Applied Behavior Analysis or JABA*) to publish empirical studies related to the applied behavior analysis of human responding. In the inaugural issue of *JABA*, Baer, Wolf, and Risley (1968) published an article outlining the defining characteristics of ABA. Baer et al. drew a distinction between applied behavior analysis and similar laboratory analysis. Three minimally defining characteristics of ABA were obvious: applied, behavioral, and analytic. Four other defining features were also suggested by Baer et al. Specifically, ABA should be technological, conceptually systematic, effective, and "display some generality" (p. 92).

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In the behavioral context, Baer et al. (1968) established *applied* to mean that the behavior or stimulus addressed was chosen because of its importance to humankind and society, rather than its importance to theory. In addition, the applied nature of the behavior or stimulus of interest should be determined by its context, and should be closely related to the subject being studied. For example, from a laboratory perspective, eating might be a behavior of interest due to its general relationship to metabolism. However, from an applied perspective, eating is a behavior of interest if that behavior is being studied to address individuals who eat too little or too much (Baer et al.). Thus, the range of behavior and stimuli appropriate for applied study can vary widely. Similarly, the range of individuals appropriate for applied study can vary widely.

Behavioral means that the focus should be on what individuals can be brought to do, rather than what they can be brought to say (Baer et al., 1968). Given that behavior is a physical event, its study (or close monitoring) requires precise measurement. Thus, in any ABA program, a method by which the behavior of interest will be measured and that which is reliable and agreed upon by multiple observers must be established. There must be a clear answer to the question regarding whose behavior changed, the observer or the observed. For example, observer drift can result in an apparent change in behavior. However, the change is not due to the behavior of the target individual, but to the measurement behavior of the observer. Calculating interobserver agreement (IOA) is a method by which behavior analysts attempt to demonstrate that the change in behavior is attributable to the individual observed, and not the observers. Several strategies exist to measure IOA. While the exact calculations differ, each strategy requires that multiple, independent observers observe the same situations either simultaneously or via video recordings. For a detailed description of IOA, its benefits, and methods for calculating, the reader is directed to Cooper, Heron, and Heward, Chap. 5.

Analytic refers to the notion that ABA requires a believable demonstration of the events responsible for the behavior. An analysis of behavior has been achieved when an experimenter (scientist, parent, teacher, care provider) can exercise control over the behavior (Baer et al., 1968). Because of this characteristic, demonstrations of ABA are often conducted using some sort of single-subject research design. Baer et al. specifically mentioned two types of designs in their seminal article:reversal and multiple baseline. Reversal designs consist of measuring a behavior in the absence of the variable of interest until steady state responding is achieved. At that point, the variable of interest is applied and its effect on behavior is again measured. If a change is observed, the variable is discontinued or altered (Baer et al.). When the behavior returns to the previous level, the variable is applied again. Multiple baseline designs are used when behavior is likely to be irreversible (e.g., riding a bicycle) or when a reversal is undesirable (Baer et al.). A multiple baseline evaluation consists of establishing two or more baselines and introducing the independent variable in a sequential manner across the baselines (Kennedy, 2005). Both design strategies allow for a demonstration of prediction and control related to the behavior of interest. (For a comprehensive handling of the various designs employed in ABA, the reader is directed to the text on single-case experimental designs by Kennedy).

ABA's emphasis on *technological* means that the "techniques making up a particular behavioral application are completely identified and described" (p. 95). This characteristic is an attempt to ensure that examples of ABA can be reliably replicated by those reading the account (Baer et al., 1968.).

Conceptually systematic highlights ABA's relevance to principle. This characteristic is meant to tie the technological descriptions to basic principles of behavior analysis. For example, Baer et al. (1968) suggested that describing "exactly how a preschool teacher will attend to jungle-gym climbing in a child frightened by heights is good technological description; but further to call it a social reinforcement procedure relates it to basic concepts of behavioral development" (p. 96).

ABA should also be *effective*. That is, the behavioral techniques should produce large enough effects to be of practical value (Baer et al., 1968). In addition, the behavior change resulting from ABA should be durable over time, across a variety of settings, and/or spread to related behavior. That is, the change should have *generality*.

These characteristics help to define ABA as a methodology that can be used to select change, and evaluate human behavior. It is important to note that, in the context of this chapter, ABA does not refer to a specific package designed to address the challenges of autism spectrum disorders. Rather, ABA refers to the conceptual framework upon which multiple approaches are based.

Concepts and Application

A number of treatments have been identified that address the social, communicative, and behavioral deficits and excesses exhibited by many individuals with an autism spectrum diagnosis. In this section, several of the ABA concepts upon which those treatments are derived will be defined and discussed. These concepts, along with treatment examples from the literature, have been separated into consequence-based and antecedent-based approaches. In addition, combined treatments (e.g., one antecedent and one consequence, or two or more of each), as well as a brief description of some packaged approaches, will be reviewed.

Consequence: Punishment and Punishment-Based Procedures

Punishment procedures are those consequence-based procedures that decrease the future likelihood of the target behavior. There are two broad classes of punishment: positive punishment and negative punishment. Both classes of procedures result in the decreased likelihood of future target behavior. The difference comes in the presentation or removal of a stimulus. In a positive punishment program, an aversive stimulus is presented (positive = presented) contingent on the target behavior and results in a decreased likelihood of future responding. In a negative punishment program, a stimulus is removed (negative = removed) contingent on the target behavior, likewise resulting in a decreased likelihood of future responding.

Positive Punishment

The contingent presentation of aversive stimuli (i.e., positive punishment) has been largely reduced as effective reinforcer assessment technologies have emerged (e.g., functional analysis of problem behavior). Historic examples of positive punishment programs include the use of electric shocks, water mist, aversive tastes, and physical holds. In cases where positive punishment strategies are currently used, their inclusion in a treatment program typically occurs in combination with other, reinforcement-based procedures (e.g., Ringdahl, Christensen, & Boelter, in press).

Risley (1968) examined the impact of positive punishment procedures to decrease dangerous climbing behaviors displayed by a 6-year-old girl diagnosed with autism and an emotional disturbance. Of note, extinction (ignoring the child's climbing), timeout from social interactions, and attention provided contingent on the absence of climbing had been implemented for an extended amount of time without success prior to the introduction of the aversive punishers. Contingent on climbing, an experimenter shouted "No!," ran to the child, and shocked her on the calf or lower thigh. After several sessions, the shock was replaced at home with a spanking by the mother and then by a time-out in a chair. Immediate reductions in climbing were observed in both settings when these punishment procedures were used. The decrease in climbing was maintained when the shocking device was removed from the home. However, the reductions in the child's behavior in the laboratory were found to only occur in the presence of the stimulus conditions associated with the experiment. That is, the child continued to climb if the experimenter was absent, if the experimenter was present but not in the room where the experiment had been conducted, and when the shock device was absent. Some desired and undesired side effects were noted to occur following the use of the punisher.

Foxx and Azrin (1973) implemented an overcorrection procedure to reduce the self-stimulatory behaviors exhibited by four children, one of whom, Mike, had been diagnosed with autism. Overcorrection is a type of positive punishment that requires the individual to repeat an appropriate form of the target, problem behavior (termed positive practice overcorrection) or repair the damage caused by the problem behavior and bring the environment to a condition better than its original state (termed restitutional overcorrection) contingent on each occurrence of that behavior (Cooper et al., 2007). At the beginning of the experiment, Mike engaged in almost continuous hand-clapping. Contingent on hand-clapping, he was required to complete 5 min of Functional Movement Training. During this training, Mike was taught to move his hands in one of five positions (e.g., hands above his head, hands in his pockets, hands behind his back). Compared to baseline, an immediate decrease to near-zero rates of hand-clapping was observed when the Functional Movement Training overcorrection procedure was implemented. Following several days without hand-clapping, a verbal warning procedure was instituted in which Mike was told to stop engaging in the hand-clapping. Overcorrection was only implemented if Mike did not stop clapping. No hand-clapping was observed during this treatment phase.

Negative Punishment

In contrast to positive punishment, procedures based on negative punishment continue to be used and described in the ABA literature. Two types of negative punishment procedures common in the ABA literature are response cost and timeout from reinforcement. Response cost procedures are negative reinforcement procedures that result in the loss of a specified amount of a reinforcer contingent on each occurrence of the target response (Cooper et al., 2007). Timeout from reinforcement consists of the contingent loss of access to positive reinforcers or the loss of opportunities to earn positive reinforcers for a specified time following a target behavior (Cooper et al.).

Hagopian, Bruzek, Bowman, and Jennett (2007) designed treatments to reduce the destructive behavior exhibited by three individuals diagnosed with autism. Initially, reinforcement-based treatments were implemented to treat problem behavior occasioned by interruption of free-operant behavior. Reinforcement-based treatment only (i.e., differential and noncontingent reinforcement) resulted in sustained decreases for one of the three participants. Time out procedures were implemented for the remaining two participants (hands-down time out for one, exclusionary time out for the other) contingent on problem behavior because the reinforcement-based treatment did not reduce problem behavior to acceptable levels. Problem behavior was further reduced when the time out procedures were implemented. The hands-down time out procedure was subsequently dropped from the treatment package for that participant. However, the exclusionary time out procedure remained a component of treatment for the remaining participant.

Athens, Vollmer, Sloman, and St. Peter Pipkin (2008) also examined the relative effects of a response cost procedure for decreasing inappropriate vocalizations exhibited by a child with autism and Down syndrome. The child's vocalizations consisted of loudly and repetitively using words out of context and loudly and repetitively making unintelligible sounds. Results of a functional analysis indicated that the participant's vocalizations were maintained by automatic reinforcement. Two treatments packages, both including a response cost component, were compared. One treatment consisted of noncontingent attention, a contingent demand, and response cost (brief loss of access to a toy). The other treatment consisted only of response cost and the presentation of a contingent demand. Both packages effectively reduced the child's inappropriate vocalizations. The authors noted that the package without noncontingent attention was easier to implement. In both treatments, response cost was rarely implemented. Although not formally evaluated, it is possible that the presentation of the demand served as a positive punisher that contributed to the decreased use of the response cost procedure.

There are several potential concerns and drawbacks in implementing punishment-based procedures. First, such procedures do not explicitly program for the teaching of appropriate behavior. Second, punishment-based procedures do not program for the delivery of reinforcers. Third, punishment-based procedures can result in stimulus-specific treatment gains, where the desired change in behavior is only exhibited in the presence of the punisher (e.g., Risley, 1968). Other concerns include negative emotional side effects, short-lived effectiveness, potential for abuse (Vollmer, 2002), development of escape and avoidance behavior, and undesirable modeling (Cooper et al., 2007). Given these drawbacks, reinforcement-based treatments are typically implemented as a first step in the treatment of behavior problems. And, when punishment-based procedures are implemented, they are often accompanied by reinforcement-based procedures.

Consequence: Reinforcement and Reinforcement-Based Procedures

Like punishment, reinforcement can be defined by its effect on behavior. Reinforcement refers to the response-dependent presentation (positive reinforcement) or removal (negative reinforcement) of a stimulus resulting in an increased likelihood of responding. With the emergence of assessment technologies designed to reliably identify stimulus preferences and reinforcers instrumental in the maintenance of appropriate and inappropriate behavior, reinforcement programs have become the foundation for programs that address the behavioral deficits and excesses exhibited by individuals with autism. There are many and varied reinforcement-based procedures described in the ABA literature including token economies and differential reinforcement. Within these programs, reinforcers can be delivered immediately following a response, intermittently following fixed or varied numbers of responses, or following specific time parameters (e.g., the first response following 60 s). Alternatively, the reinforcers can be delivered in a delayed fashion with a token, or other icon, used to help bridge the time gap (i.e., a token economy). Finally, single responses can be targeted for increase (e.g., exhibiting a particular communicative response), complex responses can be targeted for increase (e.g., reading), or a series of approximations toward a final response goal (i.e., shaping) or a series of interconnected discrete responses (i.e., chaining) can be targeted. Within the context of autism, clinical issues targeted by reinforcement procedures include appropriate communication, social interactions, and other academic, vocational, and independent living skills. The reader is directed to Ferster and Skinner (1957) for a comprehensive description of various reinforcement schedules.

Reinforcement provides the basis for many strategies and is rarely, if ever, the sole component of treatment. For that reason, examples of positive and/or negative reinforcement as singular approaches to treatment will not be provided. Instead, the application of positive and negative reinforcement will be discussed within the context of other reinforcement-based treatments including token economies and differential reinforcement.

Token Economy

Token economies refer to the delivery of a conditioned reinforcer that can later be exchanged for another reinforcer. Typical conditioned reinforcers include tokens (hence, the term), points, and stickers. This type of reinforcement system has several advantages, including some resistance to satiation effects, the ability to implement it with relative ease in large-group settings, and, in such settings, the ability to use uniform reinforcers for several individuals (Rusch, Rose, & Greenwood, 1988). Cooper et al. (2007) defined three components of a token economy: (1) A list of target responses, (2) tokens or points to be earned, and (3) a menu of items for which tokens and/or points can be exchanged. In typical application, tokens are usually not of any particular value by themselves. Their reinforcing value comes from the opportunity to exchange them for other, more salient reinforcers (Rusch et al.).

Tarbox, Ghezzi, and Wilson (2006) used a token economy system to increase the eye contact exhibited during discrete trial training of a 5-year-old boy with autism. The study was conducted at a day treatment center for children with developmental disabilities. During baseline, the child was given a verbal prompt to attend to the tutor at the start of each instructional trial. The token reinforcement condition was identical to baseline except that the child received a token (star sticker) contingent on meeting the eye contact requirement. Once the child earned a predetermined number of tokens, he could exchange them for a brief break from instruction. A schedule thinning condition was added in which the number of tokens required to gain access to the reinforcer was increased by a factor of five. In addition, a delay to reinforcement component was added in which the child was required to wait before receiving the backup reinforcer. Compared to baseline sessions, a substantial increase in eye contact was observed when the token economy system was used. This high rate of eye contact was maintained during schedule thinning. Variable rates of eye contact were observed as the delay to the reinforcement was increased.

In addition to targeting sustained attention, token economy systems have also been used to improve the on-task physical activity time of children with autism. Mangus, Henderson, and French (1986) trained a peer tutor to deliver tokens to five children with autism contingent on their meeting a goal for on-task behavior during a physical activity (i.e., walking on a balance beam). The rate of token delivery was individualized for each of the five children based upon their performance during the last 3 days of a baseline phase. After receiving five tokens, the children could exchange the tokens for edible reinforcers selected from a reinforcement menu. On-task physical activity increased for four of the five participants only when the token economy intervention was in place (i.e., lower levels of on-task activity occurred when the token system was removed).

Extinction

Catania (1998) defines operant extinction as, "discontinuing reinforcement of responding" (p. 389). In application, this type of procedure is used as a behavior reduction technique, and requires that the reinforcer maintaining responding is known so that it can be withheld. The procedure is straightforward as it does not require the delivery of reinforcers or punishers. Thus, alternative behavior does not have to be monitored from a procedural standpoint. However, there are other considerations with the procedure that will be discussed later in this section.

While extinction can be an effective behavior-reduction technique, there are a number of considerations to take into account prior to implementation. First, extinction procedures effectively reduce, if not eliminate, individuals' exposure to reinforcing stimuli. Second, extinction procedures do not teach the individual any appropriate methods for recruiting meaningful reinforcers. And, third, extinction procedures can result in an initial increase in target problem behavior (i.e., an extinction burst occurs) and/or can result in variations in response topography, such as the emergence of aggressive behavior (Lerman, Iwata, & Wallace, 1999).

One way to alleviate the drawbacks related to extinction-only procedures is to couple them with some sort of reinforcement-based procedure. This combination of procedures (extinction for problem behavior and reinforcement for some other response) is referred to as differential reinforcement and will be the focus of the following section. Lerman et al. (1999) reported that when extinction was coupled with differential-reinforcement programs, noncontingent reinforcement, or a manipulation of some antecedent variable, the likelihood of extinction bursts (i.e., increases in problem behavior concurrent with the onset of treatment) was reduced as was the emergence of response variations such as aggression.

Differential Reinforcement

Differential reinforcement procedures are consequence-based procedures that include two key components: (1) reinforcement of one response class (i.e., responses maintained by the same reinforcer or reinforcers), and (2) extinction or withholding of reinforcement for a separate response class (Cooper et al., 2007). In application, the response class targeted for reinforcement includes appropriate responses while the response class targeted for extinction includes inappropriate responses (though exceptions can be found). There are a number of differential reinforcement strategies that have been used to address behavioral challenges exhibited by individuals with autism.

Differential Reinforcement of Alternative Behavior

Perhaps the most frequently applied differential reinforcement strategy is differential reinforcement of alternative behavior (DRA). When applied as a behavior reduction strategy, the procedure includes extinction for the target inappropriate or undesired response and contingent delivery of reinforcers following an appropriate response alternative. Reinforcer selection is often based on a pre-treatment assessment designed to identify the function of the inappropriate or undesired response (e.g., an analogue functional analysis; Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). The selected alternative response can vary and might include responses such as compliance (Reed, Ringdahl, Wacker, Barretto, & Andelman, 2005) or communication (Carr & Durand, 1985). The incorporation of appropriate communicative responding into DRA programs is formally known as functional communication training (FCT). FCT has emerged as one of the most frequently applied treatments to reduce severe problem behavior such as aggression and SIB (Tiger, Hanley, & Bruzek, 2008). In FCT program, the reinforcer maintaining problem behavior is identified. Then, an appropriate communicative alternative is identified. Finally, the individual is exposed to the situations that evoke problem behavior. Appropriate responding is prompted and differentially reinforced, with prompt fading. Appropriate communicative responses can vary and include simple gestures such as reaching (Grow, Kelley, Roane, & Shillingsburg, 2008), the use of augmentative communication devices (Ringdahl et al., 2009), manual sign (Shirley, Iwata, Kahng, Mazaleski, & Lerman, 1997), and spoken or vocal responses (Carr & Durand). While appropriate communication is reinforced, FCT also often includes an extinction component for problem behavior.

Not all examples of FCT in the literature have included the extinction component for problem behavior. However, it has been demonstrated that FCT without the extinction component is minimally effective. For example, Hagopian, Fisher, Sullivan, Acquisto, and LeBlanc (1998) reported that FCT without extinction was somewhat effective for 11 ($N=25$) participants. Though decreases were observed for some of the 11 participants, none achieved a 90% reduction in problem behavior (90% reduction being considered a clinically significant outcome). In addition, three of the 11 participants actually exhibited a 50% or greater increase in problem behavior when the extinction component was not in place. The same study reported a 90% or greater reduction in problem behavior for 44% of the participants (11 of 25) when extinction was included. Thus, the existing literature suggests that when FCT is conducted in accordance with the schedule parameters defined by DRA, it is an effective treatment.

In a series of three experiments, Charlop, Kurtz, and Casey (1990) used a DRA procedure to increase task responding and decrease problem behaviors for children diagnosed with autism. In all of the experiments, the children's stereotyped speech, delayed echolalia, and perseverative behavior were evaluated as potential reinforcers for desired behaviors. In Experiment 1, several sessions were conducted in which four children with autism were required to complete work tasks. In some of the sessions, a preferred food was used as a consequence following accurate responding. In other sessions, the child was able to engage in a stereotypy for accurate responding. In other sessions, the children were allowed to choose either an edible or to engage in the stereotypy contingent on accurate responding. The work tasks that were selected and the stereotypic behavior that served as potential reinforcers varied across the four children. In all sessions, a correction trial was conducted if the child did not produce an accurate response. All children exhibited the highest percentage of correct responding during the condition in which their stereotypy was made available as a contingency. In Experiment 2, similar procedures were used with three children with autism to evaluate the potential effectiveness of delayed echolalia as a reinforcer for correct task performance. A higher percentage of correct responding was observed when delayed echolalia was provided as a consequence than when food was delivered as a consequence. In Experiment 3, a comparison was made for three children with autism between the use of perseverative behavior with specific objects, food, and with stereotypies as potential reinforcers for correct task performance. The highest percentage of correct responding occurred during sessions in which perseverative behavior was available as a consequence. Of note, negative side effects in the form of increases in stereotyped, perseverative, or echolalic behaviors were not observed at the work setting or in the children's homes.

Ringdahl et al. (2002) compared the relative effectiveness of DRA procedures with and without instructional fading for decreasing the destructive, aggressive, and self-injurious behaviors of an 8-year-old girl diagnosed with autism and mental retardation. Results of a functional analysis indicated that the child's disruptive behaviors were maintained by negative reinforcement in the form of escape from instructional demands. DRA without instructional fading consisted of providing the participant with an instruction approximately every other minute. Compliance (i.e., independent completion of the instruction in the absence of disruptive behaviors) resulted in a brief break. Disruptive behaviors during instruction resulted in presentation of another instruction and restoration of the environment. In DRA with instructional fading, no instructions were delivered for three consecutive work sessions. The rate of instruction was then gradually increased (i.e., one instruction delivered every 15 min, followed by adding one instruction every 15 min following each 45-min session with no disruptive behaviors). Initially, high rates of disruptive behavior were observed during the DRA without instructional fading condition. However, the rate of disruptive behaviors decreased across sessions. In the DRA with instructional fading condition, disruptive behaviors occurred at low rates from the outset. The rate of instruction was equivalent in the DRA with and without instructional fading conditions by the end of treatment.

Brithwaite and Richdale (2000) used FCT to target the aggressive and self-injurious behaviors displayed by a 7-year-old boy with autism and an intellectual disability. The evaluation and treatment occurred as part of the child's discrete trial training program at his school. Results of a behavioral interview and an A–B–C observation suggested that the child's disruptive behaviors were maintained by access to preferred items and by escape from difficult tasks. During a training phase, the child was taught a phrase to vocally request a preferred object (e.g., "I want (slinky) please") during tangible sessions and help with a task (e.g., "I need help please") during work sessions. FCT treatment consisted of providing the child with access to the reinforcer (either the toy or help) contingent on an appropriate communicative request. The disruptive behavior was placed on extinction. Substantial reductions in the disruptive behaviors occurred in both the tangible and escape conditions. Specifically, a 99% reduction in disruptive behaviors occurred between baseline and treatment involving FCT for tangible items, and a 90% reduction in disruptive behaviors occurred between baseline and treatment in the FCT escape condition. Corresponding increases in use of the taught phrase were also observed. The inclusion of a delay to reinforcement component did not lead to an increase in disruptive behaviors in either the tangible or escape conditions.

DRA programs can also incorporate negative reinforcement. For example, Reed et al. (2005) used combined fixed-time (i.e., response independent) and contingent schedules of negative reinforcement to treat the destructive behavior exhibited by an 8-year-old boy diagnosed with autism, moderate mental retardation, a seizure disorder, and significant communication deficits. Results of a functional analysis demonstrated that this participant's destructive behavior was maintained by negative reinforcement. During the first treatment phase, a differential negative reinforcement of compliance procedure was implemented in which the child could take a break as soon as he had completed a work task. Compared to baseline, low rates of destruction and high rates of work completion were observed during the differential negative reinforcement treatment. Next, lean and dense schedules of fixed-time escape were added to the differential negative reinforcement treatment. Lower levels of destruction and higher levels of compliance were observed when the fixed-time escape lean schedule was used. This finding suggests that combining a differential negative reinforcement of compliance treatment with a lean schedule for escape can be effective in treating problem behavior maintained by negative reinforcement.

Differential Reinforcement of Incompatible Behavior

Differential reinforcement of incompatible behavior (DRI) can also be considered a type of DRA. However, in this procedure, the alternative response is specified as one incompatible with the target inappropriate response. For example, hands in pockets might be the incompatible response reinforced in the DRI-based treatment of stereotypic hand flapping. By contrast, exhibiting the appropriate vocal response "help" is not physically incompatible with pinching the teacher.

A DRI procedure was used by Smith (1987) to decrease the pica behavior (i.e., ingestion of paper clips, paper, bottle caps, and other nonfood items) of a man diagnosed with autism and profound mental retardation. The study was conducted in a department store where the participant worked. During the baseline phase of the study, the number of incidents of pica was tabulated and attempts at ingestion of metal items were blocked. The DRI treatment consisted of identifying behavior incompatible with pica. Incompatible responses included the participant keeping his hands on his work, staying in his work area, and keeping his mouth clear. Each of these responses was reinforced approximately every 15 min through access to a preferred food, drink, or a preferred activity. Praise was also provided on a 10-min schedule contingent on the participant having a clear mouth, keeping his hands on his work, and remaining in his assigned work location. The experimenter provided verbal redirection if the participant reached for a nonedible item, or the experimenter removed that item before the participant could reach it. An ABAB design was used to evaluate the effectiveness of the treatment. Relative to baseline rates, a substantial reduction in the total number of pica incidents was observed when the DRI treatment was in place. Specifically, mean rates of pica each day was 21 during baseline, 7 during the DRI treatment, 12 during a reversal to baseline, and 5 when the DRI was re-implemented. At a 1-year follow-up, the mean number of instances of pica per day was 0.5.

Differential Reinforcement of Low Rates

Differential reinforcement of low rates of behavior (DRL) is a reductive procedure that has its effect by providing a schedule of reinforcement that is leaner (i.e., reinforcement rate is lower) than what was operating in the pre-treatment environment. The behavior targeted for reduction results in reinforcement following a specified time period that includes the absence of the behavior. The length of that time period is systematically increased to achieve lower rates of the target response. DRL is also referred to as differential reinforcement of diminishing rates, or DRD). One difference with this procedure relative to other DR procedures is that it is not intended to eliminate the target response. Rather, it is intended to reduce the frequency with which the response is exhibited.

Handen, Apolito, and Seltzer (1984) described the use of a DRL procedure to reduce the repetitive verbalizations of an adolescent male diagnosed with autism and mental retardation. The study was conducted in the community residence where the participant resided. The participant had a several year history of repeating statements or asking the same questions hundreds of times each day. During baseline, the investigators tape recorded the participants' verbal responses over a 7-day period and then tabulated the frequency of repetitive verbalizations (i.e., saying any word, phrase, or sentence more than once). No consequences were provided for verbalizations. During the DRL treatment, a 3×5 inch index card was used during each session. The card contained the number of boxes that corresponded to the allowed number of verbalizations within that session. A check was placed through a box each time a verbalization occurred. If the participant met the DRL criterion goal at the end of the session (i.e., having at least one empty box on the card), he received a token. The token could be exchanged immediately following a session for an item from a reinforcement menu or saved. Over the course of the experiment, the criterion level for verbalizations was systematically decreased from a rate of 4.4 to 0.3 repetitions per minute. Relative to baseline, the DRL procedure resulted in a substantial reduction in the participant's rate of verbalizations.

Differential Reinforcement of Other Behavior

Differential reinforcement of other behavior (DRO) can be distinguished from other DR-based procedures in that it does not specify a response following which reinforcers should be delivered. Instead, DRO entails providing the programmed reinforcer following intervals during which no occurrences of the target response were exhibited. DRO programs can incorporate either positive reinforcers (e.g., attention, points, and/or preferred activities) or negative reinforcers (e.g., breaks from non preferred activities). In typical application, the reinforcer provided is determined by the function of the target problem behavior or is one that has been demonstrated as more valuable than the reinforcer(s) maintaining the target problem behavior. Differential reinforcement of the omission of behavior and differential reinforcement of zero rates of behavior are other terms used interchangeably with DRO.

Shabani and Fisher (2006) implemented a DRO and schedule thinning procedure to decrease a fear of needles displayed by an adolescent male with autism, mental retardation, and Type 2 diabetes. The evaluation was conducted in an outpatient clinic. During baseline trials, the participant was given a verbal and physical prompt to place his left hand and arm between an outline of his hand and arm that was drawn on posterboard and attached to the top of the table. The therapist then slowly moved a lancet toward the participant's index finger for a blood draw. Baseline trials were terminated when the participant pulled his arm away or if a draw was successfully completed. During the stimulus fading and DRO treatment, the lancet was positioned a set distance from the participant's hand for 10 s. The initial distance was selected based upon observation that the participant did not exhibit signs of distress of hand withdrawal. If the participant kept his hand and arm between the outline for the entire 10-s interval, he immediately received access to a food item that had been previously identified through a preference assessment. If the participant moved his arm more than 3 cm from the outline in any direction, the trial was terminated and the experimenter turned away for 10 s. The distance between the lancet and the patient's hand was systematically reduced whenever a criterion goal of 100% successful trials for two or three consecutive sessions (i.e., 61, 46, 31, 15, 8, 5, and 1 cm) was obtained. Following distance fading, blood draws were attempted. During the baseline trials, the participant withdrew his hand every time a blood draw was attempted. The DRO and fading intervention was successful in systematically increasing the patient's acceptance of closer proximity between his hand and arm and the lancet. At the completion of fading, blood draws were completed with no refusal behaviors in the clinic room as well and in the nurse's station.

Newman, Tuntigian, Ryan, and Reinecke (1997) used a DRO procedure to decrease the disruptive behaviors of three children who had been diagnosed with autism. The evaluation was conducted in a school setting for two of the participants and at home for the third participant. Disruptive behaviors consisted of out-of-seat behavior for two participants and inappropriate nail-flicking (i.e., repetitive contact between fingertips and the nails of another finger) for other participant. A baseline assessment was conducted in which the participants each received ten noncontingent tokens during 10-min sessions. The tokens were traded for food or a break. During the DRO intervention, the children were given a token at the end of each time interval contingent on not engaging in the targeted behavior. As in baseline, the tokens could be traded in after 10-min. The participant's behavior was compared under prompted and unprompted conditions. In the prompted DRO condition, the participants were provided with verbal prompts to take a token at the end of a time interval if problem behavior did not occur. In the unprompted DRO condition, the participants were not reminded to take a token. Out-of-seat behavior occurred nearly 100% of the time during baseline for both participants who exhibited this behavior. When the DRO procedure was implemented, out-of-seat behavior reduced to below 10% by the end of treatment. Similar results were obtained with nail-flicking. Of note, these reductions in problem behavior occurred during both the prompted and unprompted DRO conditions, suggesting that the children were able to manage their behavior.

Similar to DRA, DRO schedules can incorporate negative reinforcement. For instance, Buckley and Newchok (2006) used a negative reinforcement procedure to decrease the screaming and ear covering behaviors of a 7-year-old boy who had been diagnosed with a pervasive developmental disorder. These behaviors were evoked by his hearing different genres of music. Treatment consisted of the examiner playing music and telling the child that the music would be turned off if he could sit quietly with his hands down until a timer beeped. The timer was reset if the target problem behaviors occurred while the music was playing. The interval of time that the music was played was increased contingent on low rates of disruptive behavior in two consecutive sessions. The mean percentage of disruptive behavior dropped from 52% during baseline to 5% during the negative reinforcement treatment.

Thinning Differential Reinforcement Schedules

DR programs are not without their limitations. One such limitation is that the individual can access reinforcers on a frequent basis, resulting in labor-intensive programs when reinforcement delivery requires the presence of a care giver. In addition, if the individual spends much of the time acquiring and consuming reinforcers, other goals and activities might suffer. For example, if an individual is taught as part of a DRA/FCT program that every request for break result in a cessation of academic instruction, they could conceivably entirely escape/avoid their school work, thus hindering academic progress. To alleviate this concern, many DR programs will focus on reducing the availability of the reinforcer by increasing the response requirement needed to obtain the reinforcer or implementing a delay to reinforcement.

Roane, Fisher, Sgro, Falcomata, and Pabico (2004) described a schedule thinning procedure for two children with autism who were evaluated for aggressive behavior. Results of a functional analysis indicated that the children's aggressive behavior was maintained by positive reinforcement. For both participants, treatment consisted of access to 20 s of positive reinforcement contingent on appropriate responding. A substantial decrease in aggression was observed for both children in treatment relative to baseline. At the onset of treatment, the participants had continuous access to response cards that gained them access to positive reinforcement. To increase the treatment's feasibility for caregivers, a reinforcement thinning procedure was evaluated in which access to the response cards was restricted for a fixed amount of time. For both of the children, low levels of aggressive behavior were maintained when schedule thinning in the form of card restriction was implemented. The authors noted that, by limiting access to alternative responding, caregivers may be able to reduce their direct involvement in treatment.

Hagopian, Contrucci Kuhn, Long, and Rush (2005) evaluated the effects of schedule thinning following the implementation of FCT for three children diagnosed with an autism spectrum disorder who displayed aggressive, self-injurious, and disruptive behaviors. Treatment consisted of functional communication training targeting the functional analysis condition in which the highest rate of problem behavior was observed. A reduction in the target problem behavior occurred for all participants. A schedule thinning procedure was then implemented. Schedule thinning consisted of instructing the children that they needed to wait after manding for delivery of the reinforcer (either access to attention or to a preferred tangible items). The length of the delay between manding and reinforcer delivery was progressively increased until a terminal schedule goal was obtained (4 min). The criterion for increasing the delay was two consecutive sessions with a rate of problem behavior at or below 0.2

responses per min. If problem behavior occurred at a rate of greater than 0.2 responses per min across two consecutive sessions, the delay was reduced to the previous response schedule where the terminal goal had been achieved. For all three participants, the treatment goal of at least 4 min was achieved.

Shaping and Chaining

While differential reinforcement procedures are usually used to reduce some target inappropriate response(s), other reinforcement-based procedures have been developed to establish responses or repertoires. Two such procedures used with individuals with autism include shaping and chaining. Shaping is the process of differentially reinforcing successive approximations toward a desired response (Cooper et al., 2007). Shaping can be considered a differential reinforcement procedure during which the target response is slightly altered as the individual exhibits responses that are more and more similar to the desired terminal response. Behavioral chains are collections of discrete responses that are performed in rapid and accurate sequences (Rusch et al. 1988). Reinforcement-based acquisition programs sometimes focus on systematically and sequentially reinforcing each of the responses in a chain to establish a particular skill. This process is described as chaining, with two types of chaining (forward and backward) being most often described in the literature. In forward chaining, the responses in a behavioral chain are taught and reinforced in their naturally occurring order (Cooper et al.). Reinforcement might initially be delivered following the completion of Step 1. During the next phase of forward chaining, reinforcement would be delivered following Steps 1 and 2, and so on until all responses are exhibited in the correct order. Backward chaining consists of the teacher or therapist completing all but the last response in a behavior chain, and providing the reinforcer contingent on the individual completing the final response. In the next phase of backward chaining, the reinforcer would be delivered after the individual had completed the next-to-last and final response, and so on until all responses are exhibited in the correct order.

Ricciardi, Luiselli, and Camare (2006) used a shaping procedure to treat specific phobia exhibited by a child with autism. In their study, an 8-year-old boy with autism was differentially provided with reinforcement (access to preferred items) for closer and closer approaches to phobic stimuli. Initially, the child was allowed ongoing access to the preferred items, regardless of proximity to phobic stimuli. Preferred items were then only allowed if the participant successfully approached and stayed within 5 m of the phobic stimuli, then 4, 3, 2 m, and finally 1 m. The use of this shaping procedure successfully resulted in the participant approaching phobic stimuli.

Jerome, Frantino, and Sturmey (2007) used a chaining procedure to help adults with autism acquire internet skills. A 13-step task analysis was generated to develop the skills necessary to access a specific internet site. Initially, the teacher completed the initial 12 steps of the task analysis. An errorless prompting procedure was used to teach step 13 and reinforcement (access to a internet activity along with an edible) was provided contingent on the participants' completing step 13 of the task analysis. Once that behavior was exhibited at criterion, the prompting procedure was applied to the 12th step and reinforcement was delivered after completing steps 12 and 13. Once that combination was exhibited at criterion, the prompting procedure was applied to the 11th step, and reinforcement was delivered following completion of steps 11–13. This process continued until the participants were able to independently exhibit all 13 steps. Both participants were able to acquire all 13 steps, one participant in a single 40-min training session, the other across five 40-min training sessions.

Antecedent Approaches to Treatment

ABA programs have traditionally focused on the response-reinforcement relationship. However, as programs have evolved over the years, the focus has shifted from consequence-based approaches to approaches that focus on manipulating the antecedents relevant to target behavior. In this chapter, we will provide a description of four foci of antecedent-based treatments described in the ABA literature.

Establishing Operations

Establishing operations are those events that alter the reinforcing efficacy, or value, of the reinforcers maintaining a response (Michael, 1982). Establishing operations can be further differentiated by their specific effect on the value of the reinforcer. *Motivating operations (MOs)* are operations that increase the value of the reinforcer. The most basic example of this operation includes deprivation. *Abolishing operations (AOs)* are operations that decrease the value of the reinforcer. The most basic example of this operation includes satiation (Laraway, Snycerski, Michael, & Poling, 2003). MOs result in increased response rates maintained by the reinforcer, whereas AOs result in decreased response rates maintained by the reinforcer.

EOs manipulation has been applied to the treatment of behavior problems exhibited by individuals with autism and other disabilities. Two approaches have been taken in this respect: (1) Providing the reinforcer on a fixed-time, or noncontingent basis (e.g., Reed et al., 2005), and (2) pre-session exposure to the functional reinforcer (i.e., the reinforcer known or hypothesized to maintain the target response).

Taylor et al. (2005) manipulated EOs to increase the frequency of social initiations directed toward peers by three children with autism. The study was conducted in each student's classroom. Prior to intervention, none of the children were observed to initiate requests for preferred items with peers. Preferred snacks for both the participants and peers were identified through free operant preference assessments and were restricted during the school day to increase their desirability. During the MO absent condition, the snack items were presented on separate plates placed in front of the participant and the peer, and the teacher instructed the children to, "have a snack." During the MO present condition, only the peer had access to the snack food. If the participant made an appropriate mand toward the peer for the snack item, the peer handed the participant a small portion of the snack. For all three participants, elevated rates of manding for snacks were observed only in the MO present condition. Participants successfully manded for novel food items or toys when observed during follow-up observations. These results indicated that requesting can be increased through the direct manipulation of establishing operations in the form of the availability of preferred snack items.

Gutierrez et al. (2007) manipulated establishing operations as part of a procedure for teaching children to mand for preferred items in a school setting. Three of the four children included in the study had been diagnosed with autism. The fourth participant displayed behavioral characteristics consistent with an autism spectrum disorder. Each of the participants rarely requested items either vocally or nonvocally and had minimal exposure to picture cards prior to the study. During the initial phases of the study, the participants were taught to exchange picture cards in order to gain brief access to preferred items, activities, and edibles. In the EO manipulation condition, two cards which had been used for training were placed in front of the participant, and the participant had free access to one of the items that he or she had previously manded for in the study. Access to the other preferred item was restricted (e.g., if the child had previously used a picture card to mand for a toy or an edible, during the EO phase he was given access to the edible but not the toy or vice versa). Three of the participants consistently manded for a preferred item when the EO for that item was present and did not typically mand when the EO was absent. These findings suggest that the manipulation of EO's during picture exchange training can help determine whether children are able to accurately discriminate between manding (handing someone a card) and a desired response (gaining access to an outcome that is symbolically represented by that card).

Stimulus Control

Stimulus control is an outcome that emerges after repeated pairings between specific stimuli and consistent consequences. According to Sulzer-Azaroff and Mayer (1991), stimulus control is demonstrated when a particular behavior is predictably occasioned by specific antecedent stimuli. Stimulus control can be systematically achieved only by reinforcing specific responses in the presence of a unique stimulus. Or, stimulus control can emerge naturally as individuals' behavior is exposed to different contexts and their respective reinforcement schedules. For example, a child might learn that requesting bathroom breaks is always reinforced (i.e., the child is allowed to leave the classroom) when Teacher A is asked. However, Teacher B never allows the child to leave following such requests. In this scenario, requests will maintain in the presence of Teacher A and eventually decrease in the presence of Teacher B. Stimulus control can also emerge when punishment is the consistent consequence. For example, if one parent always respond to a problem with an aversive consequence (e.g., spanking), but another parent does not provide any consistent consequence, problem behavior would likely decrease in the presence of the first parent only, because that parent's presence and punishment have been paired.

Anglesea, Hoch, and Taylor (2008) used a stimulus control procedure as part of a treatment to decrease the rapid eating of three teenagers with autism. The total number of seconds of eating time to consume the target food was compared during sessions when a vibrating pager provided the teenagers with prompts to take a bite versus the total number of seconds of eating time when the pager was inactivated. All attempts to take bites before the pager vibrated were blocked. Training sessions were conducted to teach the participants to consume food only when the pager vibrated. When the vibrating pager was used, the participant's eating rate for the target foods decreased and was comparable to the length of time that it took a typical adult to consume the same foods. A reduction in the total number of seconds of eating time for the target foods was not observed when the pager was inactive. All participants ate one bite of food immediately following vibration of the pager on 100% of occasions during probe sessions, suggesting that the pager vibration exerted stimulus control over bite taking.

Transfer of stimulus control is a treatment strategy that can be followed when differentially high levels of problem behavior are correlated with specific stimuli. Ray, Skinner, and Watson (1999) treated problem behavior exhibited by a child with autism using a stimulus control procedure. Prior to treatment, compliance with demands was differentially higher when the participant's parent delivered the instruction compared to when the teacher delivered instruction. The teacher was then paired with the parent during instructional situations. Initially, instructional sessions were composed of 75% (3 of 4) parent-delivered instructions and 25% (1 of 4) teacher-delivered instructions. Compliance was high with both adults. Over time, the teacher-delivered instructions increased as parent-delivered instructions decreased. Compliance continued at high levels. By the end of treatment, the parent-delivered instructions were entirely eliminated and compliance continued to be exhibited at high levels. These results suggested that stimulus control over compliance was successfully transferred from the parent to the teacher.

Prompt Procedures

Prompts have been defined by Cooper et al. (2007) as antecedent stimuli that occasion specific responses and are supplemental to a behavioral treatment. There are at least two broad categories of prompts: response prompts and physical prompts. Response prompts such as physical guidance target behavior. Stimulus prompts target the conditions that exist prior to the occurrence of a target behavior. Stimulus prompts are often used as a means to occasion behavior. Once responding is more frequent and reliable in the presence of naturally occurring stimuli, these auxiliary stimuli can be removed.

DeQuinzio, Townsend, Sturmey, and Poulson (2007) used prompting as part of a treatment plan for teaching three young children with autism to imitate facial models. Prior to treatment, all of the children did not accurately imitate varying facial expressions (e.g., they cried when others smiled at them or laughed when others cried). *Smile*, *frown*, *surprise*, and *anger* were the facial expressions targeted for imitation in this study. During baseline, the experimenter modeled one of the facial expressions. During imitation training, a combination of prompting, modeling, differential reinforcement, and error correction procedures was utilized. Specific to this section of the chapter, prompting consisted of a least-to-most hierarchy in which the experimenter started by providing a verbal statement ("do this") if the participant had not imitated a facial model within 5 s of its presentation. If the participant still did not imitate the facial model, the experimenter provided another verbal statement and also modeled two facial motor movements that were topographically related to the target response. If the child still did not imitate the motor movements, the experimenter then manually prompted the correct response (e.g., used two fingers to turn the corners of the participant's mouth up). If the child did not imitate the motor movement following this manual prompt, the experimenter next combined the manual prompt with a verbal statement (e.g., "that's smiling"). All children consistently displayed high rates of imitation of some of the facial models in training relative to baseline.

Prompts have also been used to increase the social initiations of children with autism. Taylor and Levin (1998) used a tactile prompting device (vibrating pager) to teach a student with autism to initiate verbal interactions toward an adult during play activities.

Social initiations were defined as a verbal statement that occurred in the absence of verbal models, when it was related to the context of the activity, was directed towards another person, and that was a complete sentence. Three conditions were compared: a no-prompt condition in which the tactile device was not placed in the child's pocket and verbal models were not provided, a verbal prompt condition in which an adult therapist modeled a social initiation every minute, and a tactile prompt condition in which the pager was placed in the child's pocket and was preset to vibrate every minute. Teaching sessions were conducted in which the child's hand was placed on top of the pager when it vibrated and a verbal initiation was modeled by an adult therapist. A most-to-least hierarchy was used to fade the prompts until the child was able to independently make verbal initiations each time the pager vibrated. During follow-up probes, the child sat at a table with two typically developing children and participated in cooperative learning activities. Neither the participant nor the peers were provided with instructions or consequences for initiating verbal interactions or responding to each other. Frequency of initiations was compared across conditions in which the pager was in the child's pocket and programmed to vibrate every 60 s, when the pager was not activated, and when the pager was not in the child's pocket. Across three different play activities with an adult therapist, the child displayed a substantially higher frequency of verbal initiations with the tactile prompt compared to the no-prompt or verbal prompt conditions. Likewise, the child initiated verbal interactions more frequently with peers when the tactile prompt was activated than when the prompt was not activated or was unavailable. These findings suggest that the pager served as an effective tactile prompt for increasing the child's verbal initiations with adults and peers. Shabani et al. (2002) extended these findings by incorporating a prompt fading program to remove or reduce the reliance on prompts.

Choice

Providing a choice within behavioral treatment programs has been demonstrated to be an effective strategy for reducing problem behavior (e.g., Dibley & Lim, 1999). Within the context of behavioral treatment, choice can be considered an antecedent variable because it is in operation before the target response occurs and not in response to a behavior. Within a concurrent-operants arrangement, Thompson, Fisher, and Contrucci (1998) evaluated the relative preference for choice making of a 4-year-old boy diagnosed with pervasive developmental disorder. The child had been referred for the evaluation of destructive behavior and, prior to conducting the experiment, had been noted to exhibit problem behaviors when he was not able to make choices. During the initial portion of the assessment, a paired-choice preference assessment was conducted and a most preferred item (cola) was identified. During the concurrent-operants assessment, the child could touch one of three switches. Each switch resulted in a different outcome. The "no-choice" switch resulted in the examiner pouring the child cola into a cup. The "choice" switch resulted in the examiner pouring the identical amount of cola into a cup, but the child was allowed to choose how the cola was delivered (i.e., which cup the cola was poured into, whether a straw was provided, etc). A "control" switch produced no programmed consequence. Findings from the study were that the child consistently pressed the "choice" switch at higher rates than the "no-choice" switch, even when the "choice" option resulted in a substantially lower rate of reinforcement. This result indicates that choice in how the reinforcer was delivered was a potent variable for this child.

Combining Antecedent and Consequence-Based Components

In practice, the treatments described so far throughout this chapter are often combined to form larger treatment packages. Antecedent and consequence-based interventions are oftentimes combined as part of a comprehensive treatment program. For example, the referenced Reed et al. (2005) study included a differential reinforcement component (i.e., breaks contingent on compliance) and a noncontingent reinforcement component (i.e., fixed time delivery of breaks). The noncontingent reinforcement component can be conceptualized as an antecedent approach that would affect the MO for escape-related behavior. Thus, motivation to engage in problem behavior, previously demonstrated to be maintained by escape, should have been reduced because the participants had access to this reinforcer on a fixed-time basis.

ABA-Based Comprehensive Approaches to Autism Treatment: Intervention Programs that Utilize Applied Behavior Analysis Procedures

Over the past four decades, several wide-ranging interventions and treatment programs have been developed to address the difficulties in social interactions, communication, and restricted and repetitive behaviors that are commonly displayed by individuals with an autism spectrum diagnosis. In this section, a brief overview of three widely utilized programs that utilize applied behavior analysis procedures will be provided. References will be provided for each of these programs so that the reader can obtain additional information if desired.

UCLA Young Autism Project

The UCLA Young Autism Project (YAP) is an intensive home-based intervention program for young children with autism developed by Ivaar Lovaas and colleagues (http://www.lovaas.com/). This intervention is sometimes referred to as discrete trial teaching. In the original YAP study, children in the intensive-treatment group received as much as 40 h of intervention weekly for at least 2 years (Lovaas, 1987). The focus of therapy was on increasing language, attending, imitation, social behavior, play, and self-care skills, and decreasing disruptive behaviors. Intensive teaching was provided through a discrete trial format. Please reference Lovaas (1981) and Maurice, Green, & Luce (1996) for specific information on discrete trial teaching procedures and curriculum. Children in the minimal-treatment group received similar services but for only 10 h a week, and a third control group of children received an eclectic mix of interventions. Compared to their baseline performance, children in the intensive-treatment group gained an average of 37 IQ points over the course of the treatment, representing an average difference of 31 points higher in comparison to the control group. In addition, 47% of the children in the intensive group successfully completed first grade in a regular education setting. A follow-up study was conducted with those children who successfully completed first grade without support. At the age of 13, eight of these nine students were continuing to succeed in regular education settings without support. This group continued to perform significantly higher than the control group on measures of intelligence and adaptive abilities (McEachin, Smith, & Lovaas, 1993). Based upon the results of these studies and others, the UCLA YAP model has been described as one of the most empirically validated interventions (Simpson, 2005). Subsequent to the seminal article by Lovaas, the methodology based on the YAP program has been widely utilized in home and school settings. See Reichow and Wolery (2009) for a listing of articles that have utilized this methodology. Of note, some concerns have been raised about the methodological procedures that were employed by Lovaas (Gresham & MacMillan, 1998). In an analysis of early intensive behavioral intervention programs based on the YAP methodology, Reichow and Wolery noted that the YAP model has produced strong effects for many children. However, not all children responded positively to this intervention, suggesting that additional research is needed to identify modifications in procedures or alternative intervention procedures that would benefit this subgroup.

Pivotal Response Training

Pivotal response training (PRT) is a model that combines applied behavior analytic procedures and developmental approaches to provide opportunities for children with autism spectrum disorders to learn within natural environmental settings (http://psy3.ucsd.edu/~autism/prttraining.html). PRT was developed by Drs. Robert and Lynn Koegel at the University of California Santa Barbara. The model focuses on pivotal areas, defined as those areas that, when targeted, result in meaningful collateral changes in other areas of functioning and responding (Koegel & Koegel, 2006). Pivotal areas that have been identified are: (1) Motivation, (2) Responsivity to multiple cues, (3) Self-management, (4) Self-initiations, and (5) Empathy. Motivational strategies that are applied in PRT include: following the child's lead, using preferred items and activities, teaching within natural contexts, providing clear instructions, providing choices, reinforcement of attempts, varying and interspersing tasks, and using naturally occurring reinforcers (Dunlap, Iovanne, & Kincaid 2008). Instead of a focus on teaching discrete skills through repeated trials, PRT targets developmental skills within natural environments. An emphasis is placed on family involvement in the design and delivery of the intervention, data collection and monitoring, and implementation of interventions in both home and school settings. To date, research on PRT has demonstrated that this model can result in improvements in areas such as language acquisition, play skills and social interactions, and decreases in challenging behaviors. In addition, several studies using PRT have demonstrated generalization of skills and high levels of parent acceptability.

Treatment and Education of Autistic and related Communication-Handicapped Children

The treatment and education of autistic and related communication-handicapped children (TEACCH) program contains several components focused on modifying the environment to meet the individualized needs of individuals with autism (http://www.teacch.com/). This intervention is often referred to as structured teaching (Simpson, 2005). TEACCH was developed by Eric Schopler and colleagues at the University of North Carolina in the early 1970s. Over the past three decades, TEACCH programming has been used in classrooms and in community settings across the world. The four main components of the TEACCH program are: (1) Physical organization and structure, (2) Daily schedules, (3) Work systems, and (4) Task structure. Examples of these four components that are commonly used in classroom, community, and home settings include: establishing clear visual and physical boundaries in rooms to minimize visual and auditory distractions, developing physically separate work and leisure areas in classrooms, the use of schedules (e.g., object, picture, icon, or written word schedules) to increase independence, individualized work systems to increase an individual's understanding of what and how much work needs to be done, and incorporating visual structure within tasks. Please see Mesibov and Howley (2003) and Mesibov, Shea, and Schopler (2004) for details on TEACCH procedures. Through the use of visual and external organization procedures, TEACCH attempts to increase an individual's understanding of situations and expectations, thereby decreasing anxiety and frustration related to comprehension and communication difficulties. Because of TEACCH's focus on environmental manipulations aimed to improve learning and limit frustration, the program can be viewed as containing a series of antecedent-based strategies. Although TEACCH is widely used and has been described as a Promising Practice, fewer evaluative studies have been published in peer-reviewed journals relative to studies of early intensive behavioral intervention programs (Simpson) to date.

Future Directions and Summary

A number of areas are ripe for future research and application involving the use of ABA methodology with individuals with autism spectrum disorders. Within the area of early identification, recent research has suggested that autism can be reliably identified in many children as young as 12–18 months of age. Given the demonstrable positive effects of early intervention, it will be important to determine if ABA procedures can be tailored to working with toddlers recently diagnosed or strongly suspected of having an autism spectrum disorder.

Individualizing treatment based upon our knowledge of autism is another area of future focus. As more has been learned about the heterogeneous presentation of autism spectrum disorders, clinicians can increasingly focus on isolating key components that are most likely to lead to successful outcomes for different subgroups. It might be the case, for example, that different cognitive and communicative patterns may preclude or predispose individuals on the spectrum to treatment strategies that rely more heavily on antecedent-based interventions. Research can also increasingly focus on issues related to clinical outcomes. For instance, with respect to generalization and maintenance of skills, what represents the best mode of delivery for treatment: discrete trial training or training in naturally occurring situations?

Finally, outside of the clinical and research realm, the rapid increase in the number of individuals diagnosed with autism will most likely mean that the policies put in place to assist such individuals will require close review. At the time that this chapter was written, eight states have passed legislation requiring private insurance companies to cover autism services, including ABA (www.autismvotes.org). Given the high costs that can be associated with ABA services, these state initiatives may play a key role in determining the accessibility of ABA for children and families impacted by autism.

In the preceding pages, we have attempted to provide an overview of ABA concepts as well as studies that illustrate how these concepts have been used to address the social, communicative, and behavioral concerns exhibited by many individuals diagnosed with autism spectrum disorders. While each of these concepts can be investigated in more depth (and, the reader is invited to do so), what should be apparent is the long-standing empirical nature of evaluation and treatments based upon ABA methodology. It is important to note that, although it did not emerge as an approach specific to autism, ABA has yielded substantial contributions specific to this population.

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