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Functional Behavioral Assessment: Principles, Procedures, and Future Directions

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Abstract. Through amendments to the Individuals With Disabilities Education Act (IDEA), federal law mandated the use of functional behavioral assessments (FBA) and positive behavioral support plans to address challenging behaviors presented by students in school settings. Although these have long been considered "best practice" in the field of applied behavior analysis, their use by school psychologists has a much briefer history. To assist school psychologists in becoming better acquainted with FBA, we present in this article overviews of the conceptual foundations and underlying principles of FBA and the methods and procedures associated with conducting FBAs in school settings.

Applied behavior analysis has made substantial contributions to the fields of school psychology and education since the initial publication of the *Journal of Applied Behavior Analysis (JABA)* over 30 years ago. The empirical documentation for many of these contributions was chronicled in the edited volume entitled *Behavior Analysis in Education* (Sulzer-Azaroff et al., 1988) and subsequent empirical and conceptual articles published in the *Journal of Behavioral Education, Journal of Positive Behavioral Interventions*, and *Behavior Modification*. These publications offer empirical evidence for the effectiveness of behavior analytic technology in dealing with a host of behavioral excesses and deficits commonly exhibited by students in school settings.

In 1997, the amendments to the Individuals with Disabilities Education Act (IDEA) required by federal law the use of *functional behavioral assessment* and *positive behavioral supports and interventions*. Prior to this legislation, many behavior analysts considered functional behavioral assessment and positive behavioral supports to be "best practices," but federal law did not mandate these procedures (Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; Horner & Carr, 1997; Kern, Childs, Dunlap, Clarke, & Falk, 1994; Sugai, Horner, & Sprague, 1999). Specifically, IDEA states:

> The team must address through a behavioral intervention plan any need for *positive behavioral strategies and supports* [italics added] (614(d)3(B)9i). In response to disciplinary actions by school personnel, the IEP

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> team must within 10 days, meet to develop a *functional behavioral assessment plan* [italics added] to collect information. This information should be used for developing or reviewing and revising an existing behavior intervention plan to address such behaviors (615(k)(1)(B). In addition, *states are required to address the in-service needs of personnel* [italics added] (including professionals and paraprofessionals who provide special education, general education, related services, or early intervention services) *as they relate to developing and implementing positive intervention strategies* [italics added] (653(c)(3)(D)(vi)).

Psychologists adopting an applied behavior analytic perspective have much to offer the educational community in fulfilling the legal mandates of IDEA for conducting functional behavioral assessments and using these assessments in designing and implementing positive behavioral support plans for students with challenging behaviors. The IDEA'97 Amendments do not specify what constitutes a valid functional behavioral assessment nor do they state the essential components of a positive behavioral support plan. It is clear, however, that the drafters of the IDEA Amendments were adopting a behavior analytic perspective to guide best practices in functional assessment and positive behavioral support programming.

The present article presents conceptual and technical underpinnings of functional behavioral assessment (FBA) and discusses how these concepts are related to intervention planning. The process of using FBA and developing positive behavioral supports as required by IDEA'97 is described. Specifically, indirect, descriptive, and experimental FBA strategies are presented and how antecedent variables (e.g., setting events, establishing operations, stimulus events) contribute to a valid FBA is detailed. Directions for future research and practice of FBA-based interventions, issues in making a reliable and accurate determination of behavioral function, and measurement challenges involved with using FBA procedures are also discussed.

Conceptual Foundations of FBA

FBA derives from operant learning theory that is grounded in a philosophy of science known as *functionalism*. Functionalism rejects an understanding of behavior based on topography (form or structure) because behavioral topographies are merely descriptive and, as such, explain nothing about the controlling functions of behavior (Skinner, 1953, 1974). A distinction often is made between behaviorism, experimental analysis of behavior, and applied behavior analysis (Behavior Analysts Certification Board, 1997).

Behaviorism is the philosophy of applied behavior analysis based on a scientific approach to the examination of behavior (including verbal behavior and private events). Behaviorism maintains that all behavior is a function of the interaction between environmental events and behavior rather than being controlled by hypothetical entities (e.g., "mind," "will," and "self"). The *experimental analysis of behavior* is a method (based on the philosophy of behaviorism) for studying behavior and environmental variables of which it is a function and focuses mainly on the study of behavior in controlled environments using automatic recording equipment (e.g., in the laboratory). *Applied behavior analysis,* unlike experimental analysis of behavior, involves studying behavior with significance to participants in naturalistic settings (e.g., school, playground, community). Applied behavior analysis uses the methods of FBA to identify antecedent and consequent events and to use this information in designing interventions to change socially significant behaviors (Wolf, 1978).

Carr (1993) provided an insightful critique of the goals and philosophy of functional assessment, which suggested that behavior analysts are primarily, if not exclusively, concerned with the functions of behavior. In his critique, Carr suggested:

> true behavior analysts have, paradoxically, very little interest in behavior. Thus knowing that a young boy diagnosed as autistic exhibits self-injury is, by itself, not very interesting. What is interesting is why self-injury occurs (i.e., of what variables is it a function) . . . Topography (behavior) does not matter much; function (purpose) does . . . behavior is not the thing of interest to behavior analysts. (p. 48)

Most special education eligibility procedures are based on a structural or categorical

model of assessment in which the primary purpose of assessment is on a descriptive classification rather than functionally based intervention (Reschly & Tilly, 1999). A typical example is illustrated by considering a referral for reading difficulties of a third grade student. A school psychologist adopting a structural approach might administer a test of cognitive ability, a reading test, a visual-motor integration test, and perhaps a human figure drawing test. Based on this battery of tests, the school psychologist may conclude that the reading difficulty is caused by a visual-perceptual processing disorder (a structuralist explanation). A school psychologist adopting a functional assessment model would not likely use any of the above procedures, but rather would assess relationship between environmental events (e.g., rate of instructional presentation, number of opportunities to respond, corrective feedback) and the student's reading performance.

Another structural or descriptive account of behavior can be found in clinical classification systems for behavior disorders such as the *Diagnostic and Statistical Manual* (4th edition, DSM-IV) (American Psychiatric Association, 1994). The DSM-IV provides a topographical rather than a functional account of behavior. The emphasis in the DSM-IV system is on the "What?" (topography) rather than the "What for?" (function) of behavior (Scotti, Morris, McNeil, & Hawkins, 1996). There is nothing particularly wrong with a structural or descriptive account of behavior except that it provides no information regarding important, identifiable, and controllable environmental events surrounding those behaviors (Gresham, 1999). For example, a diagnosis of Conduct Disorder requires the presence of 3 of 15 symptoms (behaviors) such as bullies others, fights, lying, truancy, and so forth. However, the mere description of these behaviors does not yield the most important information for treatment planning: the function served by each of those behaviors. The remainder of this article describes the most important concepts and techniques involved in conducting valid FBAs for purposes of identifying the functions of behaviors and using this information in the formulation of interventions.

Definitions of FBA

FBA can be defined as a collection of methods for gathering information about antecedents, behaviors, and consequences in order to determine the reason (*function*) of behavior. Once the function of behavior is determined, this information is used to design interventions to reduce problem behaviors and to facilitate positive behaviors (Witt, Daly, & Noell, 2000). FBA is *not* a single test or observation, but rather a multimethod strategy involving observations, interviews, and review of records regarding student behavior, its antecedents, and its consequences. The central goal of FBA is to identify environmental conditions that are associated with the occurrence and nonoccurrence of problem behaviors. In this approach, the function of behavior is represented by a change in an independent variable (environmental conditions) and the effect is represented by a change in a dependent variable (behavior) (Skinner, 1953). It should be noted, however, that there are different kinds of functional relationships. Some functional relationships are correlational, meaning that certain environmental events are associated with the occurrence of certain behaviors. Other functional relationships may be causal in the sense that these environmental events are both necessary and sufficient for the occurrence of a behavior (Johnston & Pennypacker, 1993).

The function of behavior refers to the purpose that behavior serves for the individual. Behavioral functions typically fall into five categories: (a) social attention/communication (positive social reinforcement); (b) access to tangibles or preferred activities (material or activity reinforcement); (c) escape, delay, reduction, or avoidance of aversive tasks or activities (negative reinforcement); (d) escape or avoidance of other individuals (negative social reinforcement); and (e) internal stimulation (automatic or sensory reinforcement) (Carr, 1994).

Behavior analysts often make a distinction between *functional assessment* and *functional analysis*. Functional assessment describes the full range of procedures that can be used to identify the antecedents and consequences associated with the occurrence of

behavior. Functional analysis refers to the experimental manipulation of environmental events in a highly controlled setting to assess the controlling functions these events have on behavior. Horner (1994) suggested that functional analysis is but one approach to functional assessment; however, it is the only approach that uses experimental manipulations to make "causal" rather than descriptive or correlational statements about the operant function of behavior. Treatment matched to the operant function of behavior may follow one of two strategies: (a) weakening the maintaining response-reinforcer relationship for maladaptive behavior (e.g., punishment, extinction) or (b) establishing or strengthening a response-reinforcer relationship for adaptive behavior that replaces the current function of inappropriate or maladaptive behavior (e.g., differential reinforcement) (Mace, 1994). Treatments based on the latter serve as the basis for positive behavioral support programming (Sugai, Horner, & Sprague, 1999).

Principles Underlying FBA

In order to apply FBA principles to students' problem behaviors, a basic understanding of contingencies is required. Contingencies describe a relationship between a behavior (B) and its antecedent (A) and consequent (C) conditions. Although specific antecedent conditions precede and can be associated with a behavior, they do not describe the function of behavior. Rather, from an operant learning perspective, behaviors are maintained by (are a function of) consequences that occur contingent upon those behaviors (Catania, 1998; Skinner, 1953).

Consequent events. In the operant paradigm, there are only two broad functions of behavior: (a) *positive reinforcement* and (b) *negative reinforcement* (Skinner, 1953). When a behavior is positively reinforced, the function of behavior is to bring the behavior into contact with a stimulus. Positive reinforcement can be in the form of social attention, which can include praise, sympathy, reprimands, redirection, consolation, restraint, smiles, frowns, or eye contact (McComas & Mace, 2000). Positive reinforcement can also result in access to tangible or material reinforcers (e.g., toys, food, clothing) or access to preferred activities (e.g., watching television, listening to music, playing video games).

When a behavior is negatively reinforced, the function of behavior is to remove, avoid, delay, or reduce contact with a stimulus. Engaging in behaviors that result in task demands being removed or modified is an example of a behavior resulting in negative reinforcement. McComas and Mace (2000) suggest that task duration, novel tasks, and other sources of aversive stimuli can establish escape or avoidance as a reinforcer for a person's problem behavior.

Yet another source of positive reinforcement for a small number of individuals is known as nonsocial automatic or sensory reinforcement (Iwata, Dorsey, Slifer, Bauman, & Richman, 1994). This typically occurs in cases of self-injurious behavior (SIB) and/or stereotypic behaviors in which the effects of social reinforcement are inconclusive. In these cases, the effects of controlling variables are unclear, therefore leading some researchers to postulate that the behavior may be maintained by self-produced sensory, perceptual, or biological reinforcers (Cataldo & Harris, 1982; Iwata et al., 1994; Kennedy & Souza, 1995).

In sum, a key principle in FBA is that positive reinforcement always involves either the presentation or contact with an event that increases the probability of behavior and negative reinforcement always involves the removal, avoidance, delay, or reduction of an event that increases the probability of behavior. Thus, when conducting functional assessments, school psychologists should identify the positive and/or negative reinforcement contingencies and the specific antecedent conditions under which a target behavior occurs.

Antecedent events. As mentioned earlier, the central tenet of operant learning theory is that behavior occurs or does not occur as a function of its consequences. As such, FBA seeks to identify reinforcement and punishment contingencies rather than antecedent events for which influence on behavior is viewed as both secondary to and derived from consequences (Smith & Iwata, 1997). Antecedent events, however, can have a substantial influence on behavior. Antecedent events can be classified as discriminative stimuli, establishing operations, or

setting events. Each of these antecedent events will be discussed briefly in the following paragraphs.

A *discriminative stimulus* or S^D is an antecedent event that is associated with or otherwise signals that a response will be reinforced. Skinner (1953) argued that almost all operant behavior is under stimulus control and, if this were not the case, all behavior would be equally likely on all occasions resulting in chaos. Thus, behavior that is reinforced in the presence of a given stimulus and not other stimuli is said to be under *stimulus control*. For example, the recess bell at school is a S^D for the class to go outside and play (presumably a reinforcing event). Operant intervention procedures relying on differential reinforcement are based on the principle of stimulus control (e.g., differential reinforcement of other behavior or DRO and differential reinforcement of incompatible behavior or DRI).

Another antecedent event, which has an influence on behavior, is an *establishing operation* or EO. An EO is defined as a variable that temporarily alters the effectiveness of a reinforcer for behavior (Michael, 2000). EOs do two things: (a) they increase the momentary salience of a stimulus as a reinforcer, and (b) they increase the probability of behaviors that are associated with contacting that stimulus (Smith & Iwata, 1997). For example, not drinking fluids and exercising heavily for a period of time are EOs for increasing the effectiveness of water as a reinforcer for drinking behavior and other behaviors associated with obtaining water.

EOs do not derive their functional properties through the process of differential reinforcement (i.e., stimulus control), but rather their presence or absence mediates the effectiveness of stimuli as reinforcers to increase (establishing operation) or decrease (abolishing operation) the frequency of behavior (Smith & Iwata, 1997). One example of using EOs to decrease rates of behavior can be found in the literature on self-injurious behavior (SIB) (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). These authors conducted a functional analysis showing that SIB of three participants was maintained by contingent social attention (i.e., each instance of SIB was reinforced by the participant being told to stop engaging in SIB). The intervention consisted of a schedule of noncontingent reinforcement (NCR) in which attention initially was provided in 100% of 10-second intervals, which was subsequently faded to a fixed interval, 5-minute schedule. The NCR dramatically reduced rates of SIB because it temporarily eliminated the effectiveness of attention as a reinforcer (satiation) and termination of the contingency between SIB and the delivery of social attention (extinction).

Another example of the use of EOs can be found in a study by Ray and Watson (in press). These authors found that for one child, out-of-seat behavior occurred in only 32.5% of the intervals and that both escape and access to tangible reinforcers maintained that behavior. However, on days in which the child slept less than 5 hours the previous night, out-of-seat behavior increased to 57.5% of the intervals and only access to tangibles maintained that behavior. In this case, sleep deprivation served as an EO for increasing the effectiveness of tangible reinforcers and decreasing the effectiveness of escape for out-of-seat behavior (an abolishing operation).

Vollmer and colleagues showed that methelphenidate administered to children with attention deficit/hyperactivity disorder (ADHD) functioned as an EO to alter the effectiveness of commonly used classroom reinforcers such as peer social attention and avoidance of task demands (Vollmer et al., 1993). Knowledge of EOs such as those depicted in the above studies can substantially impact the effectiveness of a given intervention because of the different functions of the behavior in the presence or absence of an EO.

Setting events are antecedent events that are removed in time and place from the occurrence of behavior, but are functionally related to that behavior (Bijou & Baer, 1961; Kantor, 1970; Wahler & Fox, 1981). Given a particular setting event, a particular behavior is more likely to occur than if the setting event is absent. For example, getting into a fight on the bus on the way to school can serve as a setting event for noncompliance to teacher instructions later in the school day. Setting events, unlike

discriminative stimuli, are removed in time and place from behavior (i.e., behavior is not under the stimulus control of the setting event). Setting events, unlike EOs, do not necessarily alter the momentary effectiveness of a reinforcer. It should be noted, however, that some behavior analysts consider setting events as being an example of one type of EO (see Smith & Iwata, 1997 for a comprehensive discussion). A much more comprehensive treatment of the entire area of antecedent control can be found in the edited volume by Luiselli and Cameron (1998).

FBA Methods and Procedures

FBA methods can be categorized as (a) *indirect* using interviews, historical/archival records, checklists, and rating scales; (b) *direct* or *descriptive* utilizing systematic behavioral observations in naturalistic settings; and (c) *experimental* employing standardized experimental protocols that systematically manipulate and isolate contingencies controlling problem behaviors using single case experimental designs (Horner, 1994; O'Neill, Horner, Albin, Storey, & Sprague, 1997; Witt et al., 2000). Specific methods within each of these three categories will be described in the following sections.

Indirect FBA Methods

Indirect FBA methods involve the assessment of behavior that is removed in *time* and *place* from the actual occurrence of that behavior (Cone, 1978; Gresham & Noell, 1999). Functional assessment interviews, historical/archival records, and behavior rating scales/checklists are the most commonly used indirect FBA methods and will be described below.

Functional assessment interviews. A functional assessment interview (FAI) has four primary goals: (a) to identify and operationally define the target behavior, (b) to identify the antecedent events associated with the target behavior, (c) to obtain preliminary information concerning the *hypothesized or probable* function served by the target behavior, and (d) to identify appropriate replacement behaviors that will serve the same function served by the target behavior.

School psychologists conducting functional assessments often work out of a consultation framework in which they garner information about students' behavior from third parties such as teachers, parents, and, in some cases, students themselves (see Bergan & Kratochwill, 1990). During the initial stages of functional assessment, it is important for interviewers to obtain information that is as precise as possible from these third parties to assist in functional assessment. It should be noted that an FAI provides only one person's perspective or perception of a problem, which yields only partial information regarding behavioral function.

Witt et al. (2000) recommend that the following questions should be asked in the initial FAI:

- What is your major concern? Rank the problems you see from most important to least.
- How does this student compare in academics in general and in specific areas compared to other students in the class?
- What do you think is causing the problem?
- What is the reaction of the student's parents to the problem?
- Is there a time during the day when the problem is worse?
- Is there a time during the day when the problem does not occur or is better?
- How many times a week does the student miss school or arrive late?

Witt et al. (2000) as well as O'Neill et al. (1997) and Edwards (in press) provide more extensive FAI forms that can be used to obtain information from teachers, parents, and students. These sources provide step-by-step guidelines for conducting FAIs with the Witt et al. (2000) text offering the most comprehensive, up-to-date treatment of this topic for school psychologists and special educators as it relates to IDEA'97.

Historical/archival records. School records often contain a great deal of useful information for FBA. A first step in conducting FBA should be a systematic review of these school records. A useful aid in reviewing school records is the *School Archival Records Search* (SARS) (Walker, Block-Pedego, Todis, &

Severson, 1991). The SARS is a systematic recording and quantification of existing school records. The SARS provides information on archival variables usually contained in school records: demographics, special education status (referral, certification, placement), school transience and attendance, achievement test scores, retentions, disciplinary contacts, Title I services, and negative narrative comments. In addition to these variables, information can also be found in school records regarding the number of suspensions, previous accommodations or interventions, and records of parent conferences.

School record searches are an efficient use of time and can eliminate unnecessary redundancies in the FBA process. School records are one of the most valuable FBA methods for severe, low frequency behaviors, which are not amenable to direct observation such as physical assaults, carrying weapons to school, or destruction of school property (Witt et al., 2000). Additionally, along with FAIs, school records may provide one of the only ways to obtain information on students who have been suspended from school.

Behavior rating scales/checklists. Behavior rating scales and checklists can be used as an adjunct to other FBA methods serving as a brief initial method of identifying target behaviors for more in-depth direct functional assessment and intervention. Clearly, behavior rating scales do not provide information on the antecedents and consequences of target behaviors. Commonly used behavior rating scales include the *Teacher Rating Form, Child Behavior Checklist, Teacher Rating Form, Youth Self-Report* (Achenbach, 1991) and the *Social Skills Rating System* (Gresham & Elliott, 1990). Rating scales can also be adapted to include specification of antecedents and contexts as well as ratings of possible functions served by behavior.

A useful checklist for identifying problem behaviors is the *Critical Events Index* (CEI) (Walker & Severson, 1992). The CEI is a 33-item teacher checklist of behavioral pinpoints having high saliency and intensity, but low frequencies (e.g., steals, fights, physically assaults others). Recent studies have shown that the CEI was highly accurate in identifying students at risk for behavior disorders (Gresham, Lane, MacMillan, & Bocian, 1999). The behaviors on the CEI might be termed "behavioral earthquakes" because of their high intensity; however, they are not amenable to FBA because they occur at low frequencies. With these types of behaviors, teacher reports (via interviews and checklists) and perhaps school records may be the only sources of FBA information.

Readers are cautioned not to rely exclusively on indirect methods such as behavior rating scales or checklists to identify target behaviors or to determine behavioral function. It may be tempting to rely on these rating scales because of their brevity and efficiency; however, they are inadequate for conducting a comprehensive FBA (Gresham & Noell, 1999; Witt et al., 2000).

Direct Descriptive Functional Assessment

Direct observation of antecedents, behaviors, and consequences is the hallmark of FBA. Direct observation should be used to confirm the information obtained from the indirect assessment procedures described earlier. A useful method of conducting a descriptive direct observation is an Antecedent-Behavior-Consequence analysis using an A-B-C recording form. In using this procedure, the student's behavior is observed in the classroom, playground, or other relevant setting. The behavior is observed and the events occurring immediately prior to and following the behavior are recorded.

The A-B-C procedure can lead to a determination of the plausible function of behavior. For example, during independent seatwork for reading (antecedent condition), a school psychologist may observe a student leaving his seat, talking with other students, throwing materials at others, putting his head on the desk, and/or scribbling graffiti on the desk. Clearly, these behaviors have a different topography (form), but their description and recording does not explain the most important thing we want to know: What function(s) are these behaviors serving?

For each of these behaviors, the student's teacher may react with a verbal reprimand, repeated instructions to begin work, offering help

to get started with the assignment, or ignoring these behaviors. Furthermore, the student's peers may react by ignoring these behaviors, laughing at these behaviors, throwing materials back at the student, and so forth. By observing and recording the sequence of events that surround target behaviors, the school psychologist can form hypotheses regarding antecedent and consequent events that may be prompting and maintaining the student's problem behaviors.

Direct observation methods. FBA stresses the importance of assessing *objective features* of behavior such as frequency, temporality (duration, latency, and interresponse time), intensity, and permanent products (Gresham, 1985; Gresham & Noell, 1999). By focusing on objective dimensions of behavior, one does not rely on subjective and nebulous factors, which have little practical explanatory value. The objective dimensions of behavior are assessed using observation-based recording methods. A number of recording methods are designed to assess the four dimensions of behavior (frequency, temporality, intensity, and permanent products). Much more detailed treatments of the following direct observation procedures can be found in other sources (Kazdin, 1984; Shapiro & Kratochwill, 2000; Sulzer-Azaroff & Mayer, 1986).

Event-based recording is designed to measure the frequency of behavior and is best used with behaviors that are discrete in nature (i.e., they have an obvious beginning and end). Behaviors such as number of correct oral responses to teacher questions, number of times a child hits others, or the number of positive comments to others would be conducive to event recording. Frequency of behavior is often converted to a rate measure by dividing the observed frequency of behavior by the time (in minutes) observed. For example, a behavior having an observed frequency of 10 during a 20-minute observation period would have a rate of .5 responses per minute. Rate measures are useful when observations take place on multiple occasions for differing observation periods thereby making the data comparable for interpretive purposes.

A variation of event-based recording that is useful for teachers is known as a Planned Activity Check (PLACHECK) (Sulzer-Azaroff & Mayer, 1986). In using PLACHECK, the teacher defines a behavior such as working quietly. At periodic intervals, the teacher looks and simply counts the number of students engaged in the behavior. For example, if 20 out of 30 students are engaged in the behavior at 10:30 a.m., 67% of the class would be working quietly. If the teacher used PLACHECK at 11:00 a.m. and found that only 10 of 30 children were engaging in the behavior, then only 33% of the class would be working quietly. It should be noted that PLACHECK is not technically measuring the number of times a behavior occurs, but rather the number or proportion of students engaging in a particular behavior.

Another variation of event recording that coordinates the occurrence of behavior with specific times of the day is known as the scatter plot method (Touchette, MacDonald, & Langer, 1985). This method records occurrence of a behavior on a time grid and the resulting information is used to specify the times of the day the target behavior is most and least likely to occur. This grid is especially useful in identifying activities, task demands, and consequences occurring throughout the school day that are associated with problem behavior. For example, higher rates of disruptive behavior may occur between 9:00 and 9:30 on Monday-Friday than at any other times of the day. In this particular classroom, language arts requiring a great deal of handwriting occurs between 9:00 and 9:30. One reasonable hypothesis is that the student is engaging in disruptive behavior to avoid or escape the handwriting demands in language arts.

Witt et al. (2000) admonish that interpretations from scatter plot data may be misleading or inaccurate. In the above example, there may be alternative variables that account for the disruptive behavior between 9:00 and 9:30. As such, any hypothesis regarding the presumed function of the target behavior should be tested using brief direct observations in the classroom rather than relying solely on scatter plot data.

Interval-based recording measures record behavior as occurring or not occurring

during specified time intervals. A time unit such as 1 minute might be divided into six, 10-second intervals. A behavior would be observed as occurring or not occurring during each of the six, 10-second intervals. A behavior such as off-task, for example, might be recorded for 5 minutes across 30, 10-second intervals. If the student were off-task 15 of the 30 intervals, the student's rate of off-task behavior would be 50%.

Interval-based recording methods are best used for behaviors that are continuous and do not have a clearly defined or observable beginning and end. Interval-based recording can take three forms: (a) partial interval recording in which a target behavior is recorded if it occurs at *any time* during the interval, (b) whole interval recording in which the target behavior is recorded if it occurs for the entire interval, and (c) point (momentary) time sampling in which the target behavior is recorded if it occurs at the *end* of the interval (Witt, Elliott, Daly, Gresham, & Kramer, 1998).

Time-based recording methods refer to the measurement of the temporal aspects of behavior such as duration, latency, and interresponse times. In time-based recording, the temporal aspects of behavior, *not* its frequency, are measured. *Duration* refers to how long a behavior lasts and can be measured in seconds, minutes, or hours. Walker and Severson (1992) recommended a simple method for conducting duration recording in which the observer starts a stopwatch when the behavior is occurring and stops it when the behavior is not occurring. The total elapsed time on the watch in minutes is divided by the total minutes observed and the result is multiplied by 100 to calculate percent duration of the behavior. For example, if the elapsed duration of the watch were 5 minutes for a 15-minute observation period, the duration would be 33%. For more than one behavior, the observer can use two stopwatches and follow the same procedures.

Latency refers to the amount of time elapsed between an environmental event and the initiation or completion of a specific behavior. Thus, duration recording measures the elapsed time when a behavior is occurring whereas latency recording measures the elapsed time when behavior is not occurring. Latency recording is appropriate for many types of behaviors found in classrooms that involve instructions, directions, or commands (e.g., sit down, clean up your desk, begin work).

Interresponse times (IRTs) refer to the amount of time elapsed between instances of the same behavior. IRTs may be useful in determining specific antecedent events or times of the day in which behavioral episodes are most and least likely. For example, if the average IRT for temper outbursts is 3 minutes between 9:00 and 11:00 a.m. and the average IRT is one hour between 12:00 and 3:00 p.m., then the observer may investigate what activities and task demands are occurring between 9:00 and 11:00 compared to those occurring between 12:00 and 3:00.

Permanent product recording methods refer to the measurement of actual physical by-products or traces of behavior. Written work, vandalized school property, messy restrooms, cigarette butts, and the like are amenable to permanent product recording. Permanent product recording represents an easier means of measurement than other recording procedures and products can be collected and stored for future reference. Permanent products of academic work such as worksheets completed, short stories written, and written spelling tests provide a particularly easy and efficient form of data collection. It should be noted that permanent products are traces or results of behavior rather than behaviors themselves and the ownership of those behavioral by-products sometimes may not be easy to determine (e.g., vandalism, graffiti, littering).

Summarizing functional assessment data. When enough data have been collected for an FBA, the information must be summarized in a fashion to be useful in making intervention decisions. This summary has three steps: (a) formulation behavioral hypotheses, (b) constructing a competing behaviors pathway model, and (c) comprehensive intervention planning based on behavioral hypotheses and competing behaviors pathway (Sprague, Sugai, & Walker, 1998).

Behavioral hypothesis statements are testable conjectural statements about the pre-

sumed function of behavior (Repp & Karsh, 1994). Behavioral hypotheses have three criteria: (a) they must be based on information from earlier assessments (records, interviews, observations); (b) they must specify variables that are testable, measurable, and can be manipulated by teachers or others in classroom or other settings; and (c) consultees and consultants must agree that hypotheses represent reasonable syntheses from accumulated assessment information (Kern & Dunlap, 1999; Sprague et al., 1998).

The next step in summarizing FBA information is to construct a competing behaviors pathway model. A competing behaviors pathway model is a graphic description of variables (antecedent and consequent) associated with problem behavior (O'Neill, Horner, Albin, Storey, & Sprague, 1997). Such a model is useful because it: (a) links behavioral intervention procedures to FBA data; (b) matches values, skills, and capacity of the people who will implement the intervention plan; (c) enhances treatment integrity; and (d) increases the logical consistency among different procedures in the comprehensive intervention plan (Sprague et al., 1998).

Figure 1 is an example of a diagram of a competing behaviors pathway model based on the example provided by O'Neill et al. (1997) and described by Sprague et al. (1998). Five components are necessary for diagramming the model: (a) conditions or situations leading to the problem behavior (setting events/establishing operations and immediate stimulus events); (b) specification of the desired behavior; (c) specification of the problem behavior; (d) specification of the alternative behavior; and (e) analysis of the consequences maintaining the desired, problem, and alternative behaviors. An extremely important concept in behavior change is that inappropriate problem behaviors are performed instead of desired or appropriate behaviors because the former behaviors successfully compete with the latter because they are more *reliable* (i.e., they result in the same consequence most of the time) and more *efficient* (i.e., they are easier to perform) (Horner, Dunlap, & Koegel, 1988).

The final step in the process is to select an intervention procedure based on this competing behaviors pathway model. Although a comprehensive treatment of the intervention literature is far beyond the scope of the current article, there are several general considerations. The first consideration in intervention planning is to focus on changing antecedent events that will make the problem behavior less likely. Recall that antecedent events can be setting events, establishing operations, or stimulus (immediate) events. A number of antecedent event changes can be used including: (a) altering schedule of activities, (b) changing size and composition of groups, (c) shortening task length, (d) interspersing easy with difficult tasks, (e) providing precorrections for appropriate behavior, (f) adapting the curriculum or response requirements for the task (oral recitation versus written responses), and (g) providing a break (Sprague et al., 1998).

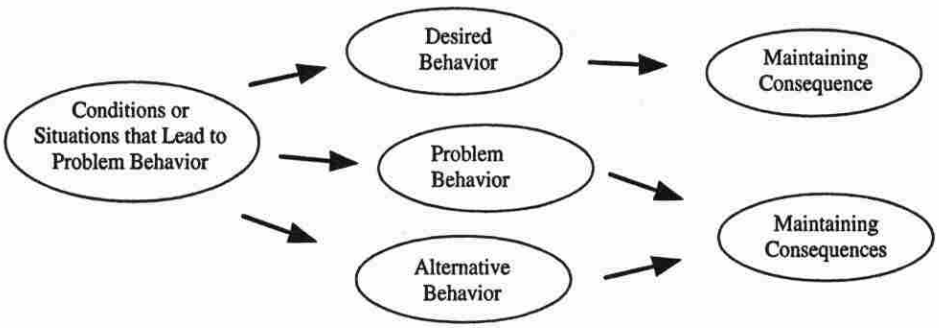
Another set of strategies focus on changing the way in which consequent events are provided to make appropriate competing behaviors more likely. O'Neill et al. (1997) describe two general strategies for altering consequent events: (a) increase the value of the consequence for the desired behavior and (b) decrease the value of the consequence for the inappropriate behavior. This phenomenon is known as the Matching Law, which states that the relative rate of responding for two or more behaviors will match the relative rate of reinforcement for those behaviors (Herrnstein, 1961). For example, if disruptive behavior in the classroom is reinforced, on average, every 2 times it occurs (variable ratio-2 or VR-2 schedule of reinforcement) and math work completion is reinforced, on average, every 10 times it occurs (variable ratio-10 or VR-10 schedule of reinforcement), the Matching Law predicts that disruptive behavior would be *5 times* more frequent than math work completion.

A final set of strategies focuses on directly teaching alternative appropriate behaviors. These strategies are based on a replacement behavior model that is common in social skills as well as academic skills intervention work (Gresham, 1998; Witt et al., 2000). According to this logic, some behaviors are not performed because the student does not have the desired behavior in his or her repertoire (i.e., an acquisition or skill deficit). As such,

problem behaviors occur because the student has no other acceptable or appropriate behavioral alternatives. Intervention strategies in these cases should utilize modeling, coaching, and behavioral rehearsal to teach appropriate behaviors. Once taught, these behaviors can be made to occur more frequently using a combination of antecedent and consequent strategies.

Considerations. When target behaviors and reinforcing events are clear, discrete, and immediate, narrative A-B-C analysis or empirical systematic direct observation procedures may allow for a relatively straightforward determination of the function served by inappropriate behaviors. However, several properties of reinforcement, including delayed reinforcement, intermittent reinforcement, and reinforcement for competing behaviors, can compromise the effectiveness of direct observation in the natural environment. Moreover, low frequencies of target behaviors (e.g., "behavioral earthquakes" mentioned earlier) may limit the clear determination of behavioral function.

Both narrative descriptions and empirical recording procedures are based on a *sequence* of events and, as such, are based on *contiguity* (correlational proximity) rather than *contingencies* ("cause" and effect relationships). For instance, the sequence could be that a student misbehaves and the teacher reprimands the student for this misbehavior. Because the teacher reprimand is the event that immediately follows the behavior (i.e., a contiguous event), this sequence suggests that the



The competing behavior process is organized around functional assessment hypothesis statements and involves the following steps:

- Write the functional assessment hypothesis statement(s);
- Identify what the desired behavior should be, given the problem conditions/situations;
- Identify an alternative, appropriate behavior that the student may use to obtain the same reinforcing outcome produced by the problem behaviors;
- Identify procedures for ensuring that (a) the problem behavior is not rewarded and (b) alternative, appropriate behavior is positively reinforced;
- Identify procedures for ensuring that the most desired behavior results in more positive reinforcement than all other behaviors;
- Make a list of changes that will make performance of competing (appropriate) behaviors more likely than problem behaviors.

Figure 1. Competing behavior pathway model.

reprimand is positively reinforcing the inappropriate behavior. Although immediate reinforcement tends to be stronger than delayed reinforcement (Catania, 1998), it is not always the case that events occurring immediately following a behavior are actually controlling the behavior. For example, it could be that the misbehavior is not being positively reinforced by the teacher reprimand. Instead, the event actually reinforcing the misbehavior may be peer attention that the student receives during recess or after school (delayed reinforcement).

Another limitation of direct observation in the natural environment is related to *schedules of reinforcement* as opposed to the immediacy of reinforcement. Research has shown that intermittent schedules of reinforcement are very effective in maintaining behavior (Catania, 1998). Even when behaviors are reinforced by events that occur immediately after those behaviors, those reinforcers may not be delivered very often. For example, a school psychologist may observe a student engaging in inappropriate behaviors that are reinforced by intermittent teacher attention. However, because the teacher may ignore the behavior the majority of the time it occurs (a thin variable schedule of reinforcement), the school psychologist observing the student may never see the teacher reinforce the behavior. Thus, the school psychologist may conclude erroneously that teacher attention is not reinforcing the behavior.

Classroom environments are complex situations where students can engage in a variety of competing behaviors. Recent research shows that students' aberrant behaviors are functionally related to reinforcement contingent upon those aberrant behaviors and reinforcement for competing behaviors (O'Neill et al., 1997; Sprague et al., 1998). Although an A-B-C analysis may indicate plausible reinforcing events for inappropriate behaviors, it may also be necessary to collect data on reinforcement procedures (e.g., rates of reinforcement, quality of reinforcement, immediacy of reinforcement) for competing behaviors to accurately determine behavioral function.

Experimental Functional Analysis

An alternative to functional assessment in naturalistic environments such as playgrounds or classrooms involves a more rigorous experimental methodology that allows for stronger statements regarding behavioral function. Iwata and colleagues pioneered this methodology in their longstanding study of self-injurious behavior (Iwata et al., 1994). *Functional analysis* involves exposing an individual to each of the possible maintaining conditions in a tightly controlled experimental design such as a multi-element or reversal design. Typically, an individual is exposed to four possible maintaining contingencies in a controlled analogue situation (social attention, access to tangibles, escape from aversive stimuli, and automatic reinforcement) plus a control condition (e.g., free play). In a typical multi-element design, these five conditions are counterbalanced and rapidly alternated (Sidman, 1960). Rates of the target behavior under each of these conditions are graphed and compared and the condition producing dramatically higher rates of responding is considered to be *functional* in controlling the behavior.

A variation of this methodology is known as *brief functional analysis,* which involves a much smaller number of analogue sessions (e.g., one condition per session) than the extended functional analysis methodology described above (Northup et al., 1991). In brief functional analysis, an initial analogue assessment is conducted for two conditions (e.g., attention and escape). Subsequently, a replication using a reversal design is conducted for the "best" and "worst" conditions to validate behavioral function. For example, a behavior analyst may systematically manipulate the three conditions of escape, access to tangibles, and social attention in a counterbalanced fashion compared to a control condition (e.g., free play). If rates of the target behavior are higher in the social attention condition than the other conditions, social attention is designated as the function served by the target behavior.

Although the methodology developed by Iwata et al. (1994) for studying self-injurious behavior (SIB) has undergone a number of iterations (e.g., brief functional analysis, con-

firmatory functional analysis), the essentials remain basically the same. By controlling the delivery and rate of reinforcement and the influences of extra-experimental variables (e.g., reinforcement for competing behaviors), one can make stronger statements regarding behavioral function and design functionally specific interventions. Despite the methodological rigor of functional analysis, there are limitations regarding the external validity of the findings and the amount of time and expertise required to conduct a valid functional analysis (Gresham, Quinn, & Restori, 1999). These limitations are discussed more fully below.

Future Directions for Research and Practice of FBA in Schools

Clearly, FBA belongs in the armamentarium of school psychologists not only because of the IDEA '97 Amendments, but also because of its potential utility in designing treatments based on the function of behavior. Classroom interventions may be ineffective because treatments often are selected and implemented without an adequate assessment of behavioral function. Traditional *behavior modification* is distinguished from *behavior analytic* interventions in that the former is not based on behavioral function, but rather relies on strong reinforcers and/or punishers that override the conditions maintaining behavior (Mace, 1994). At least four problems can arise when interventions are selected without considering behavioral function: (a) the intervention may strengthen a problem behavior via positive reinforcement, (b) the intervention may strengthen a problem behavior via negative reinforcement, (c) the intervention may be functionally irrelevant to a problem behavior, and (d) the intervention may not provide alternative sources of reinforcement for more desirable behavior (Vollmer & Northup, 1996).

A key question when using FBA is whether intervention matched to the operant function of behavior is more effective than non-FBA interventions. That is, does FBA have treatment validity? Braden and Kratochwill (1997) argued that prescribed interventions without FBA data can be effective under three conditions: (a) assessment costs exceed treatment costs, (b) consequences of delaying treatment are minimal, and (c) no link between behavior function and treatment selection has been demonstrated. A similar logic commonly is used in medicine to treat symptoms of low-risk, high-prevalence disorders such as prescribing antipyretic medication for fevers without expensive lab or blood tests to determine their precise cause. In fact, a recent functional analytic treatment study supports this practice (Lalli et al., 1999). These authors showed that all 5 participants who clearly had escape-motivated problem behavior (e.g., self-injury, disruptive behavior) responded better to a positive reinforcement intervention (edibles) than a negative reinforcement treatment (30-s escape from tasks). Future research should seek to determine the conditions and behaviors for which FBA is and is not required in designing effective behavioral intervention plans.

Another issue that should be addressed is the empirical basis for determining behavioral function. Determination of function is usually based on visual inspection of graphed data. A considerable body of research suggests that even highly trained behavior analysts cannot obtain consensus in evaluating single-case data using visual inspection (DeProspero & Cohen, 1979; Knapp, 1983; Matyas & Greenwood, 1990, 1991; Ottenbacher, 1990; Park, Marascuilo, & Gaylord-Ross, 1990). A study by Hagopian et al. (1997) demonstrated that individuals with advanced training in applied behavior analysis could not readily determine behavioral function of graphed data with the mean interrater agreement being only .46. Only when structured criteria were developed and 1 to 2 hours of training were completed did interrater agreement reach acceptable levels.

Based on the above data, is it reasonable to expect that school psychologists can reliably and accurately determine behavioral function and use this information to design interventions? This question becomes particularly acute when FBA is conducted in uncontrolled settings (e.g., classrooms or playgrounds) using descriptive and indirect FBA methods. At this time, there are few empirical studies supporting reliable and accurate practice to determine behavioral function reliably or accurately and, in turn, using

this information in designing appropriate function-based interventions.

Another issue in using FBA in school settings is the need to evaluate the reliability and validity of different FBA methods. This is a complex topic and this article cannot do justice to it in the space provided (see Shriver, Anderson, & Proctor, this issue). However, it should be noted that many professionals in the area of functional assessment argue that traditional concepts of reliability and validity are irrelevant in a functional assessment framework (Cone, 1978; Gresham & Lambros, 1998; Kazdin, 1977; Nelson, Hayes, & Jarrett, 1986). For example, *reliability* in functional assessment refers to agreement among observers viewing the same behavior at the same time regarding its occurrence or nonoccurrence (Baer, 1977; Johnston & Pennypacker, 1993; Suen, 1990). Technically, this is more accurately termed interobserver agreement rather than reliability. "Reliability" in functional assessment uses the principle of equivalent forms in that it reflects the degree to which two observers are behaving as equivalent measuring instruments (Strosahl & Linehan, 1986).

Other measurement issues in FBA deal with the following questions: What is the stability of behavioral function over time, settings, and assessors? How does one deal with multifunctioned behavior? That is, a behavior may serve one function in a particular setting at one point in time and serve another function in another setting at another point in time. What is the agreement among different FBA methods (indirect, descriptive, experimental)? Are some behaviors simply not amenable to FBA? For instance, how does one use FBA to determine behavioral function of internalized, less observable behaviors (e.g., inappropriate thoughts, anxiety, depressed behaviors)? How does one conduct an FBA on behaviors occurring at extremely low frequencies (e.g., fire setting, weapon assault, sexual behavior)? A more detailed discussion of these measurement issues can be found in Fox, Conroy, and Heckaman (1998).

Another unresolved issue in FBA deals with external validity. That is, to what extent can FBA information be generalized across settings, practitioners, and behaviors, and over time? Nelson, Roberts, Mathur, and Rutherford (1999) reviewed 97 studies that used functional assessment procedures over the past 10 years. Of the 458 participants in these studies, 88% (n = 405) were individuals having low-incidence disabilities (e.g., severe and profound mental retardation) with only 12% (n = 53) having high-incidence disabilities (e.g., learning disabilities, mild mental retardation, emotional/behavioral disorders). Approximately 42% of the studies targeted self-injurious behavior, 25% aggressive behavior, and 18% disruptive behavior with the remaining 15% being other behaviors (property destruction, noncompliance, stereotypy). Over 60% of the FBAs were conducted in clinical settings (e.g., hospitals) with only 23% conducted in school settings.

Much of what we know about functional analysis is based on low-incidence disability groups using FBA conducted in clinical settings (Nelson et al., 1999). Gresham, Quinn, and Restori (1999) conducted a brief review of studies published in the *Journal of Applied Behavior Analysis* (1995, 1996, & 1997) and noted that virtually all of this literature used simulated (analogue) assessments rather than assessments conducted in naturalistic settings focused on persons having severe to profound mental retardation and targeted self-injurious behavior. Currently, functional analysis research suffers from threats to external validity in terms of generalizing outcomes to other participants, settings, and researchers.

In an insightful article critiquing the use of functional assessment in schools, Walker and Sprague (1999) suggested that there are two models or approaches to assessment of behavior problems. One model, termed the *longitudinal* or *risk factors exposure model*, grew out of research on the development of antisocial behavior patterns and seeks to identify molar variables operating across multiple settings that put students at risk for long-term pejorative outcomes (e.g., delinquency, school dropout, arrests). The second model, called the *functional assessment model*, seeks to identify microvariables operating in specific situations

that are sensitive to environmental contingencies. Both models are useful, but answer quite different questions.

Walker and Sprague (1999) suggest the following: If one's goal is to understand and manage problem behavior in a specific setting, then functional assessment is a useful procedure. However, if one's goal is to understand the variables that account for risk across multiple settings and predict a student's future, then one needs to know something about the student's genetic-behavioral history (risk factors). This is the goal of longitudinal research and is not of pressing concern to school study teams or IEP committees in schools. Admittedly, the functional assessment model (particularly functional analysis) suffers from several threats to external validity and one should not assume that the same results could be generalized to other populations, methods, settings, and behaviors.

In sum, there are many reasons for adopting a functional assessment model for use with students at-risk for or having disabilities. This article has outlined many of those procedures and the assumptions upon which they are based. It is highly likely that future research will provide data showing the applicability of these procedures across a wide range of behaviors, settings, and students. The key to accomplishing this is a team approach in which no one professional group (e.g., school psychologists) takes ownership of the functional assessment process.

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