

*THE IMPACT OF FUNCTIONAL ANALYSIS METHODOLOGY ON
TREATMENT CHOICE FOR SELF-INJURIOUS AND
AGGRESSIVE BEHAVIOR*

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Self-injurious behavior (SIB) and aggression have been the concern of researchers because of the serious impact these behaviors have on individuals' lives. Despite the plethora of research on the treatment of SIB and aggressive behavior, the reported findings have been inconsistent regarding the effectiveness of reinforcement-based versus punishment-based procedures. We conducted a literature review to determine whether a trend could be detected in researchers' selection of reinforcement-based procedures versus punishment-based procedures, particularly since the introduction of functional analysis to behavioral assessment. The data are consistent with predictions made in the past regarding the potential impact of functional analysis methodology. Specifically, the findings indicate that, once maintaining variables for problem behavior are identified, experimenters tend to choose reinforcement-based procedures rather than punishment-based procedures as treatment for both SIB and aggressive behavior. Results indicated an increased interest in studies on the treatment of SIB and aggressive behavior, particularly since 1988.

DESCRIPTORS: retrospective analysis, functional analysis, self-injurious behavior, aggression, functional communication training

Self-injurious and aggressive behavior have been identified as problematic for both the individuals engaging in them as well as for society at large. Self-injurious behavior (SIB) is a serious and chronic disorder that often results in significant physical, social, and educational risks (U.S. National Institutes of Health, 1989). Similarly, aggressive behavior can cause serious problems both for children and for adults who are often placed in institutions, thus marginalized from society (Patterson, 1982; Robins, 1966).

The most effective treatments for both SIB and aggressive behavior have been based on operant conditioning principles (Favell et al., 1982; Johnson & Baumeister, 1978). These treatments typically have been reinforcement-based procedures, punishment-

based procedures, or a combination of both reinforcement and punishment. Research, however, indicates that reinforcement-based procedures, such as differential reinforcement of other or alternative behavior (DRO, DRA), are often not as effective in eliminating problem behavior as punishment-based procedures (U.S. National Institutes of Health, 1989). Punishment-based procedures, such as overcorrection, time-out, response cost, and contingent stimulation, have been found not only to reduce problem behavior but also to frequently eliminate it (Iwata, Dorsey, Slifer, Bauman, and Richman, 1982/1994; White, Nielsen, & Johnson, 1972). It has been suggested that the greater effectiveness of punishment is due to its ability to overcome whatever source of reinforcement is maintaining the problem behavior, as opposed to altering the existing reinforcement contingency (which is the premise of reinforcement-based procedures) (Azrin and Holz, 1966).

Over the last few decades, legal initiatives

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and ethical considerations have restricted the use of punishment procedures in treating persons with serious behavior problems (Repp & Singh, 1990; Underwood, Figueroa, Thyer, & Nzeocha, 1989). Furthermore, behavior analysts who have effectively used punishment-based procedures have argued that the use of punishment-based interventions should be viewed as a temporary choice until more effective procedures can be devised (Axelrod, 1987).

Several researchers have suggested that one way to make reinforcement-based procedures more effective is to first identify the environmental events that maintain the problem behavior and then to alter them directly (Carr, 1977; Iwata *et al.*, 1982/1994; Johnson & Baumeister, 1978). Identifying the maintaining variables of problem behavior will guide the experimenter to use functional reinforcement for desirable behavior, while SIB or aggression is extinguished (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). Research indicates that when the functional characteristics of treatment are matched to those of behavior, reinforcement-based procedures can be highly effective, thereby reducing the need for punishment-based procedures (Neef & Iwata, 1994).

Environmental variables have been considered as contributing factors to the strengthening of SIB as early as 1969 by Lovaas and Simmons, and more recently for aggressive behavior by Carr, Newsom, and Binkoff (1980). Lovaas and Simmons analyzed the effects of SIB in 3 severely retarded and psychotic children by manipulating attention rates delivered by nursing staff. They demonstrated that the rate of SIB dropped gradually over successive trials. The authors also demonstrated that SIB increased as a result of social attention delivered contingent upon that behavior. Carr *et al.* demonstrated that the severely aggressive behavior of 2 retarded children escalated when de-

mands were placed on the children but occurred rarely during no-demand situations, suggesting that aggression functioned as an escape response. They also demonstrated that escape-motivated aggression could be controlled by (a) using highly preferred reinforcers to reduce the aversiveness of demand situations, (b) strengthening an alternative nonaggressive response, or (c) using an escape-extinction procedure. Finally, in 1982, Iwata *et al.* (1982/1994) produced the first comprehensive and standardized model for conducting functional analyses. Previous theoretical papers such as that by Carr (1977), and research methods such as those proposed by Bijou, Peterson, and Ault (1968) and by Thomas, Becker, and Armstrong (1968) culminated in the Iwata *et al.* paper (Mace, 1994) which described an operant methodology to assess functional relationships between self-injury and specific environmental events. They observed the SIB of 9 individuals with developmental disabilities during periods of brief, repeated exposure to a series of analogue conditions. The conditions differed along the following dimensions: (a) presence or absence of play materials, (b) high versus low experimenter demands, and (c) absent versus noncontingent versus contingent social attention. Results showed that higher levels of self-injury for 6 of the 9 participants was a function of distinct characteristics of the social or physical environment. The Iwata *et al.* study has not only changed the character of behavioral intervention but also has stimulated a tremendous amount of research (Neef, 1994). Their methodology, originally applied to self-injurious behavior, was quickly used to analyze environment-behavior interactions that maintained problem behaviors such as aggression. For example, Lalli, Casey, and Kates (1997) conducted a functional analysis that showed that the problem behavior of 3 children with developmental disabilities was maintained by tangible positive reinforce-

ment. They then conducted a series of interventions demonstrating the effectiveness of response-independent reinforcement as a treatment package. In another study, Derby, Fisher, and Piazza (1996) analyzed the effects of contingent and response-independent attention on self-injury and self-restraint. They hypothesized that both SIB and self-restraint were maintained by contingent attention based on the results of a functional analysis of SIB. They alternated between providing attention both contingently on either SIB or self-restraint and independently. Results verified the initial hypothesis and suggested that response-independent attention was a potentially effective treatment.

This study examined whether use of functional analysis as a pretreatment assessment procedure has been accompanied by an increased use of reinforcement-based procedures, as has been predicted, and a simultaneous reduction in use of punishment-based procedures, particularly since the introduction of functional analysis approaches to behavioral assessment.

METHOD

Journal Selection

A review of the following journals was conducted: *Analysis and Intervention in Developmental Disabilities*, 1981–1985 (which became *Research in Developmental Disabilities* from 1986–1997); *Behavior Modification*, 1978–1997; *Journal of Applied Behavior Analysis (JABA)*, 1968–1997; *Journal of Autism and Childhood Schizophrenia*, 1971–1978 (which became *Journal of Autism and Developmental Disorders* from 1978–1997); and *Mental Retardation*, 1968–1997. These journals were selected because they publish a large body of research on the treatment of self-injurious and aggressive behavior.

Procedure

We reviewed the abstract and the subject sections for all articles in the five journals

that were examined. If these two sections stated that the target behaviors included SIB, aggression, or both, we identified which treatments were used and whether a functional analysis was conducted. If it was not clear which subject exhibited which target behavior, the article was excluded from the study. This occurred only twice for studies using group designs with a large number of subjects. For *Mental Retardation*, we read each article until we were able to locate the necessary information to make a decision, because the format of this journal does not include a separate subjects section. The target population consisted of individuals with developmental disabilities (including such diagnoses as developmentally delayed, mental retardation, pervasive developmental disorder, autism, and behavior problems usually combined with one of the previous diagnoses). Subjects tended to be predominantly diagnosed as having mental retardation or autism. Fewer subjects were described as having serious problem behaviors without an additional diagnosis.

Target Behaviors

SIB was defined as any behavior emitted by the subject that was described as resulting in or having the immediate potential of resulting in physical harm. All studies examining behaviors identified as SIB were included. Behavior such as hand mouthing may have been recorded as SIB in one study and not in another. When the authors indicated that the intensity and duration were such that chapping around the lips was noted, the hand was bruised, or the skin was broken, the behavior met criterion for SIB. If the authors did not indicate that the behavior occurred at rates that had caused breaking or bruising of the skin or that had the potential of resulting in breaking or bruising of the skin, the behavior did not meet criterion for SIB. Behavior such as forced vomiting, pica, and food or liquid re-

fusal reported alone were not categorized as SIB. If the subject who exhibited any of these behaviors also exhibited SIB or aggression, he or she was included under both categories.

Aggressive behavior was defined as any behavior that resulted in injury towards others or to property (for the purpose of this study, property destruction was included under aggression). Behaviors such as kicking others, pinching, grabbing, hitting, fighting, pulling hair, and damaging property were considered instances of aggressive behavior. Behaviors such as verbal abuse or disruptive behavior not resulting in property destruction were not included.

Functional Analysis Definition

Studies were categorized as having conducted a functional analysis if they conducted an experimental manipulation of antecedent or consequent events that were hypothesized to occasion or maintain problem behavior.

Inclusion Criteria for Articles

Studies were reviewed to assess whether the experimenters had conducted a manipulation of possible maintaining variables or antecedent events. Studies conducting experimental manipulations, similar to the Iwata *et al.* (1982/1994) study, and studies with at least two comparison conditions, as described by Derby *et al.* (1992), were recorded under the category of reinforcement- or punishment-based procedures with a functional analysis. Studies using assessment procedures such as interviews, informal observations, rating scales, or scatter plots, as well as studies that did not conduct an experimental manipulation during assessment, were recorded under the category of reinforcement- or punishment-based procedures without a functional analysis. Studies that conducted an assessment of the problem behavior but did not include a treatment condition were excluded.

Treatment Categories

Studies using a treatment package including differential reinforcement of other or alternative behavior (DRO, DRA), including blocking or extinction, were recorded as reinforcement-based treatments. Also included in the reinforcement-based category were studies using response-independent reinforcement and negative reinforcement. Studies using antecedent interventions, such as physical prompting, escape extinction, stimulus-fading procedures when used with reinforcement, and restraint procedures with noncontingent reinforcement, were recorded as reinforcement-based procedures. Studies using a treatment package including response cost, time-out, overcorrection, punishment, or contingent restraint either alone or in combination with reinforcement-based procedures were recorded as punishment-based treatments.

The following treatment categories were recorded: SIB treated by reinforcement-based procedures with or without a functional analysis; SIB treated by punishment-based procedures with or without a functional analysis; aggression treated by reinforcement-based procedures with or without a functional analysis; aggression treated by punishment-based procedures with or without a functional analysis.

The categories were mutually exclusive. If a study used punishment-based procedures alone or both reinforcement- and punishment-based procedures, it was recorded as a punishment-based procedure. The number of subjects receiving each treatment was also recorded. Numbers of subjects per study were recorded so that reliability for treatment approach could be assessed. For example, if the same subject was being treated for both aggression and SIB, he or she would be counted twice.

Reliability

Interobserver agreement was assessed on articles in all five journals by one of the au-

thors who had not initially reviewed that journal. Each author conducted his or her assessment of interobserver agreement independently. To record agreement, both authors had to classify an article as belonging to the same treatment category or as not belonging in any of the categories. Interobserver agreement was calculated as a percentage by dividing agreements by agreements plus disagreements and multiplying by 100%. When a disagreement was scored, the study was reexamined for appropriate classification. A grand mean of 95.2% was computed, with a range of 94% to 98%.

RESULTS

As shown in Figure 1, a comparison of reinforcement- and punishment-based procedures for SIB and aggressive behavior including all articles (with and without a functional analysis) shows an ascending trend for choosing reinforcement-based procedures for both target behaviors, whereas choice of punishment-based procedures remained relatively stable. Thus, an increased usage of reinforcement-based procedures is observable across the years, beginning in the late 1980s. For purposes of reference, date of publication of the Iwata et al. (1982/1994) study is depicted on the graph.

A comparison of reinforcement- and punishment-based procedures for SIB and aggressive behavior (see Figure 2), including all articles without a functional analysis for both target behaviors, shows no clear trend in the usage of different treatment approaches across years. That is, when a pretreatment functional analysis was not conducted, treatment choice for SIB or aggressive behavior did not differ along the lines of reinforcement- or punishment-based procedures.

A comparison of reinforcement- and punishment-based procedures for SIB and aggressive behavior (see Figure 3), including all articles with a functional analysis, shows a

distinct upward trend for reinforcement-based procedures for both target behaviors. Specifically, an upward trend for SIB was noted since 1988; a similar trend for aggression was noted since 1990. Punishment-based procedures remain at rates considerably lower than reinforcement-based procedures. Thus, when a pretreatment functional analysis was conducted, experimenters tended to choose reinforcement-based treatment procedures.

DISCUSSION

The results of our retrospective data analysis suggest two conclusions. First, there is clear evidence of an increase in interest in the treatment of SIB and aggressive behavior across the years (see Figure 1). This increased interest may be a direct result of the development of an increasingly effective technology for the treatment of serious problem behaviors and an increased need to treat serious problem behaviors as a prerequisite for entry into inclusive community settings. Second, it appears that the use of pretreatment functional analysis increases the likelihood that experimenters will choose reinforcement-based treatments for SIB and aggression, as opposed to punishment-based treatments or reinforcement-based treatments with a punishment component (see Figures 2 and 3). This statement is made with some caution, however, because it is not possible to identify the determinants of practitioner choice based on our review. Furthermore, it is possible that the noted trend reflects the influence of other variables (e.g., editorial practices) that may have acted somewhat independent of the availability of the functional analysis methodology.

A comparison of all studies (see Figure 1) using reinforcement- and punishment-based procedures for SIB and aggressive behavior, with or without a functional analysis, clearly demonstrates that, overall, reinforcement-

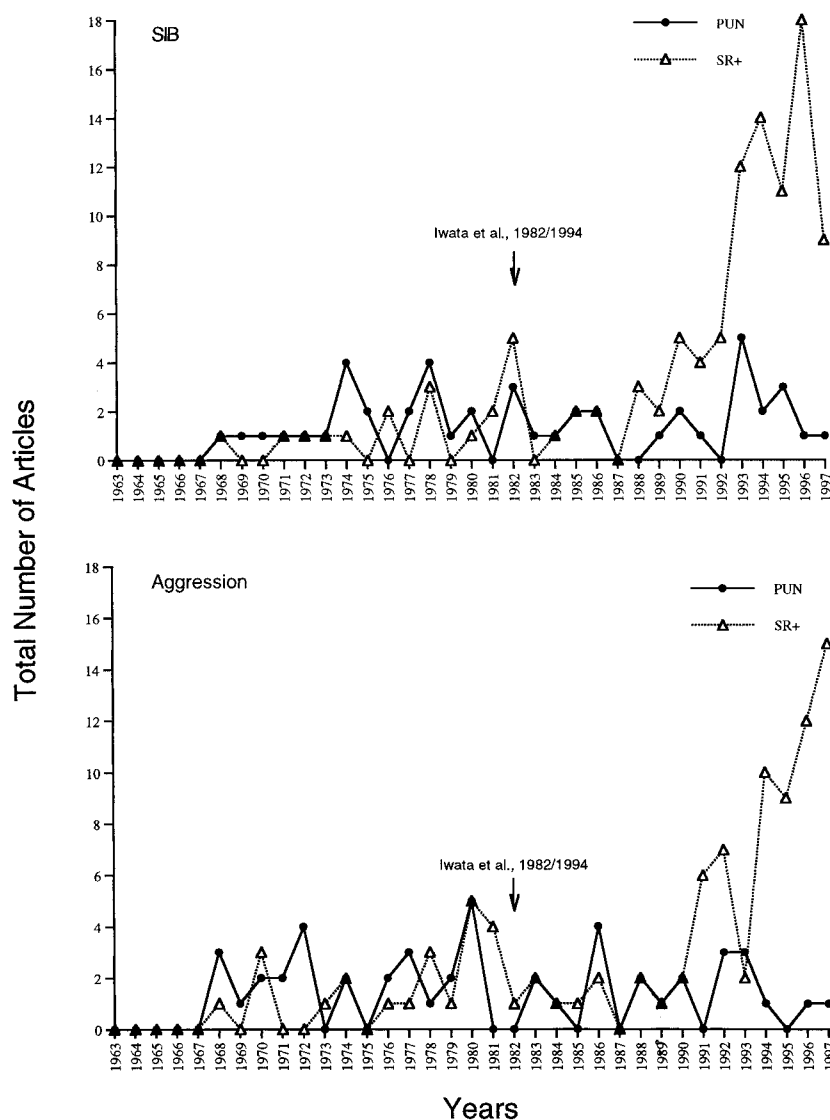


Figure 1. Total number of articles published on treatment of self-injurious and aggressive behavior with reinforcement- and punishment-based procedures.

based procedures are selected more often than punishment-based procedures, beginning in 1988 for SIB and in 1991 for aggression. Furthermore, a comparison of reinforcement- and punishment-based procedures *without* a functional analysis (see Figure 2) for self-injurious and aggressive behavior clearly shows that treatment approach tends to be indiscriminated. In other words, when a pretreatment functional analysis has not been conducted, the likelihood

of an experimenter choosing a procedure with a punishment component is about equal to the likelihood of choosing a reinforcement-based procedure. A comparison, however, of reinforcement- and punishment-based procedures for self-injurious and aggressive behavior when a pretreatment functional analysis has been conducted (see Figure 3) clearly shows that treatment tends to be highly discriminated in favor of reinforcement-based procedures. In other words,

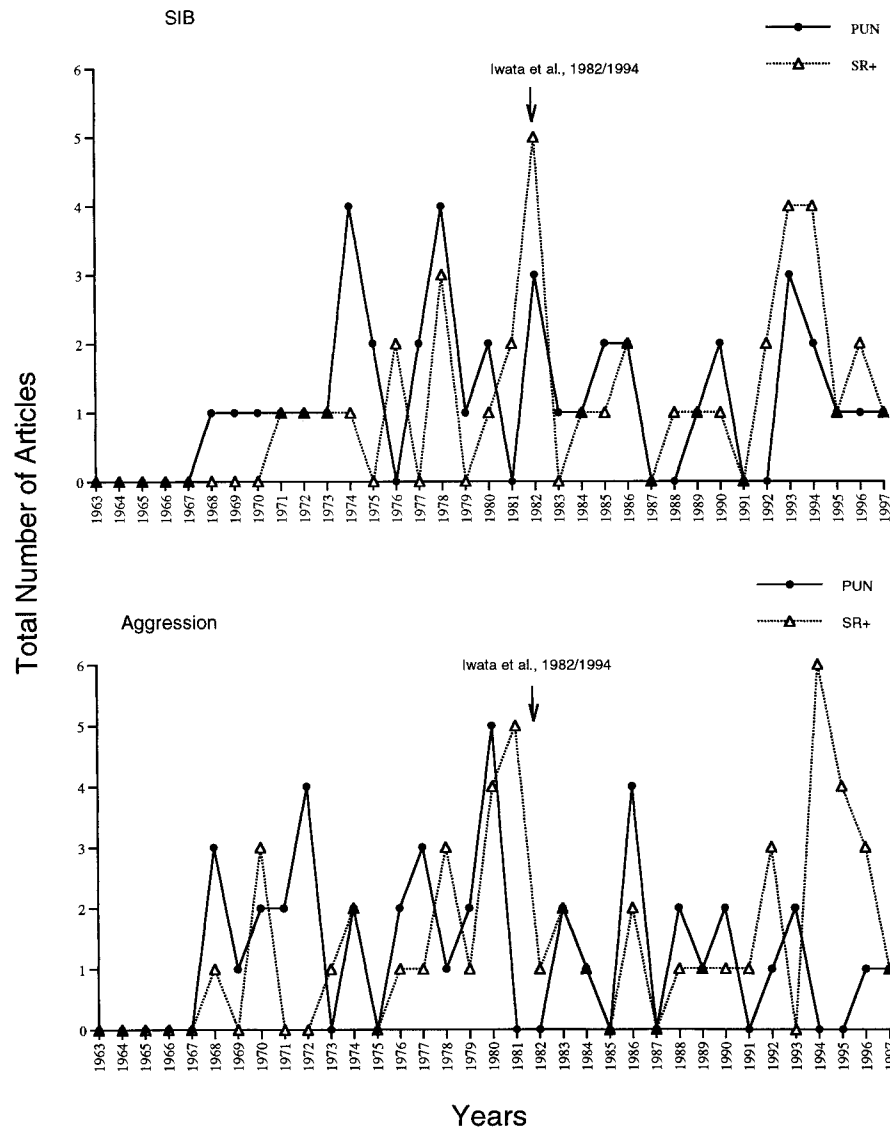


Figure 2. Number of articles published on treatment of self-injurious and aggressive behavior using reinforcement- and punishment-based procedures without a functional analysis.

identifying the variables that maintain the problem behavior increases the likelihood that treatment will be based on the alteration of reinforcement contingencies. Thus, the results of this study verify predictions made in the past regarding the impact of conducting a functional analysis on treatment choice for self-injurious and aggressive behavior. Specifically, the expectation that the identification of the maintaining vari-

ables for problem behavior would allow the design of reinforcement-based treatment options that would effectively address problem behaviors without the need for punishment-based procedures has been met (Axelrod, 1987; Neef & Iwata, 1994). Although the data in this study do not indicate that the absolute number of published articles using punishment-based procedures is decreasing, it is clear that the proportion of published

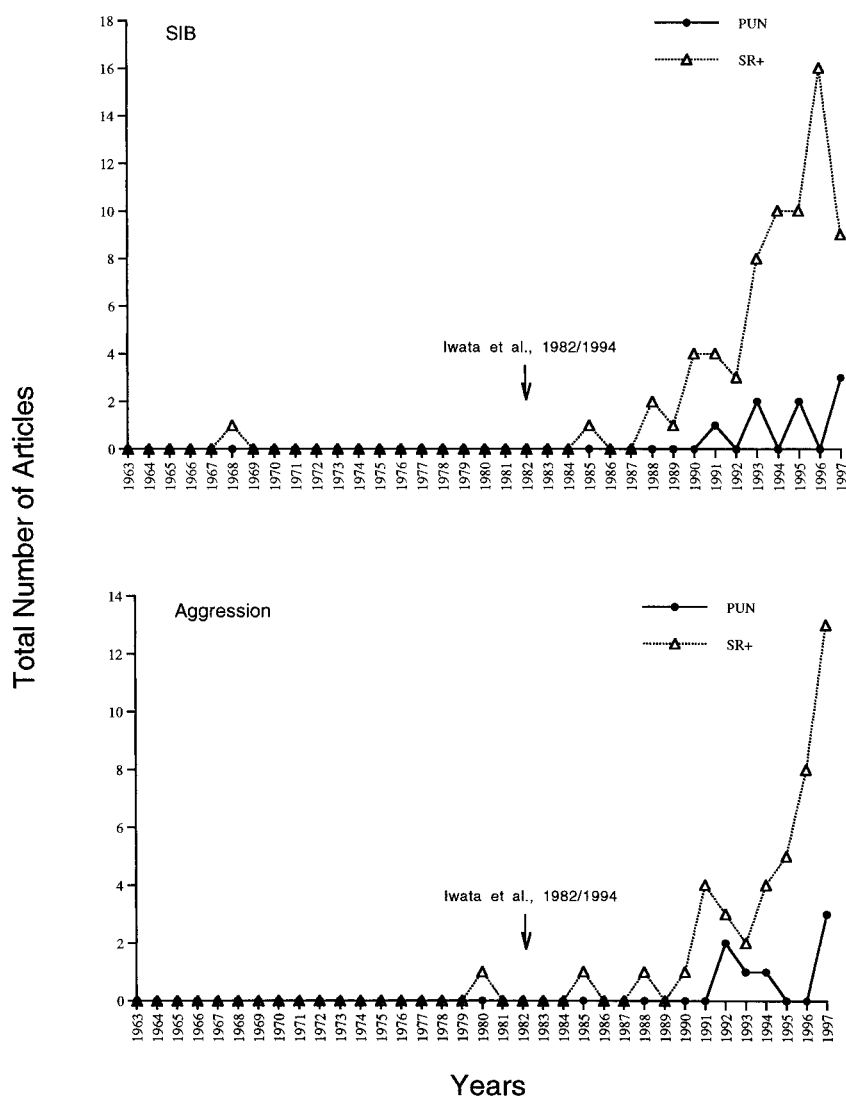


Figure 3. Number of articles published on treatment of self-injurious and aggressive behavior using reinforcement- and punishment-based procedures with a functional analysis.

articles using punishment-based procedures has substantially declined.

Despite the arguments in favor of reinforcement-based procedures, there is research suggesting that the source of reinforcement for problem behavior may be unclear, or it may be an automatic response product. When a behavior problem is not maintained by social reinforcement, it may be difficult to treat with reinforcement-based procedures alone (Iwata et al., 1994). In ad-

dition, researchers have argued that in some cases it is necessary to suppress competing problem behavior through punishment before reinforcement of functional alternative behaviors can be effective. Fisher et al. (1993) found that functional communication training (FCT) was most effective in reducing serious problem behaviors and in producing generalized and enduring treatment effects when it was combined with punishment rather than used alone or in

combination with extinction. Hagopian, Fisher, Sullivan, Acquisto, and LeBlanc (1998) recently replicated these findings with a large sample of persons with mental retardation ($N = 21$). They found that the rates of problem behavior were higher during FCT with extinction than during FCT with punishment. These findings indicate that punishment-based procedures, in some cases, may be the most effective way to treat serious behavior problems.

Additional perspectives for the explanation of the development and spread of functional analysis methodology become apparent when one examines the broader context of the evolution of the scientific community of applied behavior analysis over the past three decades (1970s through 1990s). Behavior modification was an early approach that emphasized how powerful reinforcement and punishment contingencies can change behavior regardless of its causes. Applied behavior analysis was an approach that emphasized the analysis of functional relations between behavior and its causes (Mace, 1994). In the years between the late 1970s and early 1980s, a series of position papers advocated more analytic research (Birnbauer, 1979; Michael, 1980; Pierce & Epling, 1980; Ribes, 1977). These authors expressed the concern that applied behavior analysis research had allowed *principles* to be replaced by *procedures, methods, and ideas*. Birnbauer characterized this tendency as "naked empiricism, which leaves the consumer at a loss for deciding how and when to use the procedure" (p. 18).

Similarly, Ribes (1977) argued that "without a theoretical framework and without carrying out the requisite basic research on human and social behavior, applied technology will become a blind pragmatism without long-term goals" (p. 421). Michael (1980) pointed out that, in the process of developing successful treatment procedures, the independent variables (i.e., treatment packag-

es) had become increasingly complex, thereby obscuring which aspect of the independent variable was affecting the outcome.

Functional analysis has provided an assessment methodology that addresses these concerns. Functional analysis methodology reduces the need for reliance on default technologies which has been characteristic, at times, of behavior modification. By conducting a systematic manipulation of environmental variables, pretreatment functional analysis can often pinpoint the current causes of the problem behavior. This permits the design of a treatment that is specifically tailored to treat the problem behavior by withholding its reinforcing consequence while simultaneously teaching a functional behavior that will permit access to that same reinforcer.

Applied behavior analysts continue to ask many questions regarding the utility and efficacy of functional analyses. Vollmer and Smith (1996) summarized the developments and limitations of functional analysis methodology along two dimensions: (a) functional analysis as an assessment method for treatment prescription (clinical application) and (b) functional analysis as a research method. They suggested that what may be a limitation of functional analysis as a clinical application (e.g., time constraints) would not be a limitation for functional analysis as a research method, and vice versa. An example of the latter case is illustrated by an evaluation of escape extinction that may contribute to our understanding of basic behavioral processes but may not translate into a complete clinical intervention. Nevertheless, Vollmer and Smith concluded that clinical and research themes in functional analysis are usually symbiotic.

Continued research in applied behavior analysis in the area of pretreatment assessment has indicated specific suggestions for the improvement and refinement of functional analysis methodologies. It seems that

a useful distinction for future research would be one that identifies two major directions in functional analysis: (a) research attempting to expand or refine functional analysis methodologies (e.g., addressing the issue of naturalistic vs. analogue conditions) and (b) research aiming to analyze trends with respect to functional analysis methodology (e.g., addressing the question of whether pretreatment functional analyses tend to result in the selection of specific types of treatment procedures or treatment packages).

Furthermore, Sytsma and Bonem (1998) propose a number of suggestions that can extend current methods of functional analysis research. They argued that empirical evidence is necessary to demonstrate that interventions based on functional analysis are more effective than arbitrarily derived interventions. They noted that long-term follow-up data showing that treatment gains are generalized and maintained are lacking, and they advocated the need for data on the cost effectiveness of functional analysis methods. Such research may suggest different ways of reevaluating functional analysis methodology to better address efficacy considerations. Providing answers to these types of questions may further contribute to the desirable growth of applied behavior analysis technology and facilitate the evolution of our science.

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