Behavioral Treatment of Stereotypic Movement Disorders

by NANCY J. KEUTHER, PhD, and RICHARD L. O'SULLIVAN, MD

Many compelling arguments exist for the use of behavioral interventions in the treatment of stereotypic movement disorders (SMDs). Foremost among these is the fact that behavioral interventions can be highly effective and pose minimal risk to the patient when utilized appropriately. Additionally, while pharmacotherapy has been documented to have benefit in decreasing these behaviors, medications can have untoward side effects and are not always effective. In fact, a handful of earlier studies suggested superior efficacy for behavioral interventions over pharmacotherapy with this population.1,2 This may no longer be the case, however, with the advent of newer medications and increased knowledge of medication use. Finally, behavioral treatment is often necessary for the development of alternative behavior, as it does not always emerge spontaneously when medications have reduced the identified problem.

OVERVIEW OF BEHAVIORAL INTERVENTIONS

An extensive array of self-injurious behaviors (SIBs) and other stereotypies have been treated in the behavioral literature with a wide range of interventions.2-6 Identified target behaviors have included body rocking, head banging, eye gouging, face slapping, hand flapping, arm waving, hand mouthing, object spinning, air swallowing, and repetitive vocalizations. Among the behavioral techniques investigated are overcorrection, time out, faradic shock, extinction techniques (including visual screening plus attention and escape extinction), movement suppression, response cost, verbal reprimands, contingent water mist, ammonia inhalation, food satiation, self-monitoring, functional communication training, response chaining, and DRO, DRA, and DRI techniques (differential reinforcement of other, alternative, and incompatible behaviors). These techniques have been studied in isolation as well as when used together in multimodal treatment packages. In this article we will provide descriptions and examples of several of these learning-based approaches to highlight their application and clinical utility.

Historically, many professionals and the lay public have mistakenly equated behavioral approaches with the use of aversive techniques. Considerable controversy has arisen over the ethics of punishment procedures. The opponents argue that their use can rarely be justified7-9 whereas proponents claim that their effectiveness supports their use.10 Some critics have expressed concern that these techniques may negatively impact social relatedness. Of interest, however, no difference in social behavior was reported in two treatment studies of SIB and stereotypy11,12 when the mildly aversive technique of visual screening (in which the patient's face is covered with a soft bib on occurrence of the problem behavior) was compared with the non-aversive approach of gentle teaching.7

In general, the use of aversive techniques as the primary treatment intervention is discouraged unless 1) the problem behavior is physically harmful or potentially lethal, or 2) reinforcement approaches (such as rewarding
an alternative, adaptive behavior) have been unsuccessful. For the most part, it is universally-accepted that punishment techniques alone are insufficient and should always be coupled with reinforcement approaches to teach or increase alternative behavior. Treatment interventions combining accelerative techniques (such as reinforcement approaches, which increase the frequency of a behavior) and decelerative techniques (such as punishment approaches, which decrease the frequency of a behavior) are believed to be the most effective. To clinically illustrate this point, treatment of a child who flaps his hands to get attention would likely be the most successful if a reinforcement procedure (such as praise or tokens) were given for verbal requests for social contact coupled with a punishment procedure (such as attention extinction or facial screening) to decrease the hand flapping.

A METHODOLOGIC REVIEW OF THE EXISTING LITERATURE

A review of the literature reveals numerous issues that complicate efforts to draw general conclusions about the efficacy of behavioral techniques for SMDs. Among these impediments are the predominance of single-subject case studies and case series, methodologically-flawed study designs, the use of different outcome variables and data recording methods across studies, and the absence of interobserver reliability ratings in some reports. Another common obstacle is the use of treatment packages instead of isolated behavioral techniques. Finally, the failure to complete “functional analyses of target behaviors” and systematic assessments of punishers and reinforcers has often resulted in the inappropriate selection of treatment interventions.

The behavioral literature for SMDs is largely comprised of case studies and case series because group treatment designs are generally less feasible. The major reason for this lack of feasibility is that different functional processes may underlie the same problematic SMD in different individuals. As a result, the treatment intervention needs to be tailored to the individual patient to optimize treatment efficacy. For example, face slapping may serve as an attention-getting behavior in one individual, provide desired sensory stimulation in another patient, and operate to decrease environmental demands in yet another case. Each case warrants a different behavioral intervention that is “matched” to the hypothesized functional process underlying the problem behavior. If a single treatment intervention in a group treatment format were applied across all three cases, the reported efficacy would likely be artificially lowered by failure to match the treatment with the outcome of the functional analysis.

Some of the existing studies lack rigorous methodologic designs (e.g., withdrawal, alternating treatments, or multiple baseline). This precludes firm conclusions regarding the efficacy of the treatment intervention. In the case of AB designs, where the treatment phase (B) follows the baseline (or assessment) period (A), it is impossible to unequivocally conclude that observed changes in the target behavior can be attributed to the treatment itself rather than to other alternative sources of behavioral fluctuation over time (e.g., changes in caregivers or the social milieu). Furthermore, not all studies have established stable baselines for the target behavior prior to the introduction of treatment. In these cases, it is also impossible to conclude that observed changes in the target behavior are causally related to the planned intervention rather than to other sources of behavioral variability. For example, if an individual was exhibiting less body rocking over time immediately prior to treatment initiation, it would be impossible to attribute further reductions in the behavior after treatment to the intervention, given the declining trend in the behavior prior to the start of treatment.

The use of different dependent variables and data-recording methods across studies precludes the application of meta-analytic techniques often used successfully to assess treatment outcomes in specific populations, such as patients with obsessive compulsive disorder. In general, selection of outcome variables follows from the hypothesized intent of the treatment intervention. Thus, when punishment techniques are utilized to decrease an unwanted behavior, the dependent variable most commonly measured is the problem behavior itself. In contrast, when reinforcement techniques are implemented to teach or increase an alternative response, the dependent variable is usually the new replacement behavior. As a result, outcome variables can either be the frequency and duration of target behaviors or alternative responses. In cases where the frequency of specific interventional occurrence is high, time sampling methods may alternatively be used in which observations occur during a scheduled percentage of time intervals. Finally, interobserver reliability ratings are not always performed on the dependent variable, thus challenging the accuracy of reported data. In the absence of consistent ratings across raters, one cannot effectively argue that reported changes in behavior reflect actual change.

Prior to recognition of the importance of functional analyses of problem behaviors, researchers made erroneous, a priori assumptions regarding the impact of specific interventions on target behaviors. As a result, treatment efficacy was likely limited since inappropriate interventions were implemented. For example, time out and “planned ignoring” were frequently viewed as punishment techniques given the withdrawal of social attention. However, this cannot be automatically concluded since, alternatively, these interventions could operate to remove the individual from aversive tasks (e.g,
challenging academic lessons or job demands). If the latter is true, these interventions could negatively reinforce the target behavior (increase the probability of the problem behavior by removal of the aversive stimulus of task demands). Another example would be when a verbal reprimand is anticipated to punish a target behavior but, conversely, it reinforces the problem behavior through the mechanism of social attention.

Furthermore, stimuli can not be expected to universally operate as reinforcers or punishers when consequating behavior. It is only through systematic analyses that one can identify the reinforcing and punishing qualities of various stimuli for different individuals under varying environmental contexts. It is once again not surprising that conflicting treatment outcomes exist throughout the literature, given that investigators have previously made widespread assumptions regarding how specific stimuli would function when following target behaviors.

Finally, treatment packages are commonplace and prevent conclusions about which individual treatment components are critical to behavior change. It is often in systematic dismantling procedures that the relative contributions of each intervention within an effective treatment package can be identified. However, given that SIBs may be severe or life-threatening, it is often not ethical to withhold any treatment that may reduce or eliminate the identified problem for the purposes of sequential examination of each individual intervention.

**FUNCTIONAL ANALYSES OF TARGET BEHAVIOR**

One of the basic tenets of the behavioral treatment of SMDs is that behaviors with similar topography may serve very different functions. Furthermore, while different processes may underlie the same behavior in two individuals, multiple processes may be implicated in a single SMD in one individual. In addition, the functional process for an SMD may change in the same individual as a function of time and context. In other words, the same behavior may serve different purposes for different individuals, or multiple functions for the same individual. A single target behavior may serve different purposes for the same individual in different contexts or over time.

As an example, head banging may occur in the context of rigorous task demands (eg, using utensils rather than fingers at meal time) and function to allow the individual to escape the aversive task (ie, using utensils). The identical behavior of head banging in non-demanding environments may also operate in the same or different individuals to elicit social attention. In contrast, head banging may also occur for the vestibular or tactile stimulation that results from it. Thus, a comprehensive assessment of the outcome of the behavior in the context in which it occurs is critical to the design of an effective treatment intervention. Of note, the emphasis in behavioral analysis is on identification of those processes involved in the maintenance of the behavior rather than its etiology.

To facilitate the analysis of the contingencies that maintain self-injurious behaviors, Iwata and colleagues outlined a protocol involving four analogue assessment conditions. This assessment methodology was developed in response to Carr’s analysis of the potential motivations for self-injury. In the analogue demand condition, the patient is instructed to complete a specified task. In the social attention condition, interaction between the investigator and the individual occurs contingent on the occurrence of the problem behavior. In the toy play condition, the patient is placed in an enriched environment where external sources of stimulation are present. In the alone condition, the patient is isolated in a room without social stimulation or toys present. Observed influences of these analogue conditions on the target behavior suggest a role for these contingencies in the maintenance of the target behavior. It is only once these positive (social/sensory) and negative (escape) reinforcement contingencies are identified that optimal treatment interventions can be selected. Thus, a “functional match” can be made between the contingencies hypothesized to maintain the target behavior and appropriate extinction procedures for use in treatment.

Specific outcomes of the functional analysis of behavior can then be mapped to three functional variations of extinction procedures. In these extinction procedures, reinforcers are removed which previously followed a problem behavior and are hypothesized to have maintained it. In attention extinction, social attention is purposefully withdrawn contingent on occurrence of the SMD. The intervention of planned ignoring would be appropriate when analogue assessment identified increases in the SMD following contingent social attention. In sensory extinction, the environment is manipulated to eliminate visual, tactile, or vestibular stimulation that had been demonstrated in the functional analysis to accelerate the SMD. Examples of the latter would include the use of padded helmets, gloves, and vibrators when tactile or vestibular stimulation was involved, or facial screening when visual stimulation was reinforcing the SMD. Finally, escape extinction, the individual is prevented from avoiding the demand situation by exhibition of the SMD.

A recent study by Iwata and coworkers demonstrates the value of functional analysis prior to treatment selection. Reduced head banging in three children occurred only when the specific procedural variation of extinction was employed that terminated the reinforcement previously shown to maintain the behavior.

**IDENTIFICATION OF EMPIRICALLY DERIVED CONSEQUENCES**

The behavior analyst should identify empirically derived consequences (EDC) when the
results of a functional analysis of behavior are unclear or an SMD appears to be maintained by internal mechanisms of reinforcement, EDC is a procedure for the systematic evaluation of the punishing and reinforcing qualities of various stimuli for the individual patient. Because EDC can identify idiosyncratic responses to various stimuli, the professional is better able to identify the most effective and efficient treatment interventions. This is of particular importance in the case of SIBs where potential tissue damage can be avoided. Furthermore, overall treatment resistance can be reduced by the selection of optimal interventions and exposure to aversive stimulation can be limited.

For many SMDs, initial efforts should be directed towards the identification of non-aversive techniques. However, it has been repeatedly demonstrated that reinforcer-based treatments have not always been effective or rapid enough in the cases of potentially lethal SMDs. With SIBs and aggressive behavior, the use of punishment may be warranted to reduce SIBs to acceptable levels. In these cases, the least aversive treatment should be used. Of note, positive side effects to the use of aversive treatment techniques for SMDs have been reported, including improvement in affect and social interaction.

**MANIPULATION OF ANTECEDENT CONDITIONS**

The majority of studies to date have focussed on the underlying behavioral processes and the effect of stimuli following problem behavior. Other research studies, however, have addressed issues of behavioral control by antecedent (or preceding) stimuli.

The technique of fading is one example in which controlling, antecedent stimuli for problem behavior are successively reduced over time. For example, stimulus fading was used in one study with a profoundly retarded man with SIBs who engaged in self-restraint by wrapping his arms in his shirt. In the first step, control of self-restraint was transferred from the individual’s shirt to a towel. Fading techniques were then used to reduce the physical size of the towel to that of a headband while keeping SIBs at a low level. In another study treating SIBs, task instructions were initially eliminated and then gradually reintroduced while the individual was prevented from escaping task demands. Kennedy demonstrated that task demands no longer operate as antecedents for problem behavior when they are gradually reintroduced within the context of high rates of social comments.

Finally, interspersal techniques have also shown promise for the reduction of SMDs. These procedures involve the alternating presentation of previously-mastered tasks with novel acquisition tasks.

**INNOVATIVE CONCEPTS AND NEW DIRECTIONS**

Recent reports have highlighted some new avenues in the behavioral treatment of SMDs. Among the more promising areas are the use of non-contingent reinforcement (NCR), instruction in alternative, adaptive behaviors, the use of self-management techniques, and behavioral momentum.

Non-contingent reinforcement refers to the delivery of those reinforcers responsible for maintenance of the SMD on a schedule that is independent of the occurrence of the SMD. For example, Lussier reported reduction to near-zero levels in object-grabbing and object-mouthing behaviors when free access to a chewstick was made available. Vollmer and colleagues demonstrated that a NCR schedule of social attention decreased SIBs as effectively as a planned intervention to differentially reinforce other behavior. Of note, NCR has the practical advantages of decreased reliance on staff for implementation as well as greater control by the patient over access to reinforcers.

Instruction in alternative, socially-acceptable and functional behaviors has been shown to be of benefit in the reduction of SMDs. In an early study, institution of an exercise program with retarded adults was demonstrated to reduce problem behaviors over a several week period with return of the aberrant responses on program discontinuation. In functional communication training (FCT), individuals are instructed in alternative ways to communicate that have the same functional outcome as does the SMD. For example, the individual might be taught to verbalize requests for social contact if a self-injurious behavior functioned to solicit attention from others. The technique of FCT, coupled with other techniques, has been shown to successfully reduce stereotypic behavior maintained by attention, escape, and access to preferred items.

Self-management techniques have also been demonstrated to be successful in the management of SMDs. Stahmer and Schreibman instructed autistic children in the discrimination of appropriate play behavior and then provided reinforcement for the occurrence and correct recording of desired behavior. Results indicated that the children learned to play appropriately in unsupervised settings and their skills generalized to new settings. Similar findings with the use of self-management techniques were earlier reported by Koegel. As with NCR, these techniques place fewer demands on the time and effort of caregivers.

Finally, behavioral momentum refers to the scheduling of high-probability requests prior to task-related demands. The intent of this procedure is to establish a momentum of compliance that will increase cooperation with low-probability task requests. This technique has been shown to increase compliance and decrease escape-maintained stereotypy but may require coupling with escape extinction.
CONCLUSIONS

The behavioral treatment of SMDS is an evolving field that offers considerable promise for the effective treatment of these challenging and refractory problem behaviors. The effective implementation of behavioral treatment technology, however, remains in the domain of the skilled applied behavior analyst who is adequately trained in (1) the functional assessments of behavior and relevant reinforcers and punishers and (2) the appropriate selection and design of treatment interventions.

From a research perspective, investigators must adopt rigorous standards, including the establishment of stable baselines prior to intervention, operational definitions of target behaviors, interobserver reliability ratings, rigorous treatment designs, matching of treatments to the outcome of functional analyses of behavior, and instruction in alternative behavior coupled with declarative techniques. The failure of less restrictive alternative interventions should be documented prior to the use of punitive techniques (unless in the event of severe SIBs). Efforts should be made to program maintenance of behavior change as well as generalization across settings, behaviors, and other change agents. Co-occurring behaviors (eg, interpersonal behavior and academic achievement) should be assessed along with target behaviors.

To date, the bulk of behavioral studies have targeted SMDS in individuals with severe impairments. Given that SMDS can also persist beyond infancy in intellectually-normal individuals, future research should explore techniques for the treatment of these behaviors in less clinically-impaired populations. The technique of habit reversal training, shown to be effective in the treatment of trichotillomania, would likely be successful in the treatment of many SMDs in higher functioning individuals. This multifaceted treatment approach encompasses many techniques, including competing response training, identification of habit-prone situations, awareness training, relaxation training, and self-monitoring. Enhanced reliance on self-management techniques and less emphasis on external control of behavior, should also be possible with higher-functioning individuals who exhibit SMDS.

Future research also needs to examine outcomes with the combined interventions of pharmacotherapy and behavioral treatment. One could maintain that in certain instances, such as the presence of psychosis, compulsive behaviors, severe anxiety or depression, or impulsivity, medication treatment may be necessary before the individual is able to acquire and exhibit new behavior patterns. Future investigations need to address how the use of medications can enhance, or conversely inhibit, learning curves.

The behavioral literature to date has focused on the value of a functional assessment of target behavior prior to selection of treatment intervention. We also emphasize the necessity of a thorough psychiatric assessment at the initial evaluation to identify clinical comorbidities and overall skill levels. By definition, SMDS is a broad, heterogeneous grouping that encompasses repetitive behaviors that share features with tics, compulsions, and other clinical syndromes. It is likely that the combination of a comprehensive and sophisticated clinical assessment, coupled with a functional analysis of behavior, will alone afford the necessary information for optimal selection of treatment interventions.

REFERENCES


