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APPLYING BEHAVIOR ANALYSIS TO CLINICAL PROBLEMS: REVIEW AND ANALYSIS OF HABIT REVERSAL

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This article provides a review and analysis of habit reversal, a multicomponent procedure developed by Azrin and Nunn (1973, 1974) for the treatment of nervous habits, tics, and stuttering. The article starts with a discussion of the behaviors treated with habit reversal, behavioral covariation among habits, and functional analysis and assessment of habits. Research on habit reversal and simplified versions of the procedure is then described. Next the article discusses the limitations of habit reversal and the evidence for its generality. The article concludes with an analysis of the behavioral processes involved in habit reversal and suggestions for future research.

DESCRIPTORS: habit reversal, habit disorders, tics, nervous habits, covariation, functional analysis, awareness training, competing response training, social support

The early 1970s saw the development and evaluation of a number of new behavioral technologies. Azrin and colleagues were responsible for many applications of these behavioral procedures to treat clinical problems such as nervous habits (Azrin & Nunn, 1973), tics (Azrin, Nunn, & Frantz, 1980b), stuttering (Azrin & Nunn, 1974), alcohol abuse (Hunt & Azrin, 1973), enuresis (Azrin & Foxx, 1971), and aggressive and disruptive behaviors (Foxx & Azrin, 1972). Habit reversal, a procedure used to treat nervous habits, tics, and stuttering, was one of the successful treatments developed and evaluated in this era. Like many behavioral interventions at that time, habit reversal was a treatment package consisting of numerous individual treatment components implemented together to achieve maximum reductions in the targeted problem (Azrin & Nunn, 1973, 1977). Because the goal of the early research on habit reversal was to produce immediate and lasting decreases in the occurrence of habit behaviors, analysis of the individual treatment components or elucidation of the behavioral mechanism responsible for the success of the procedure was not a focus of investigation at the time.

More recently, researchers have investigated aspects of this robust treatment package, including simplified versions and variations (Miltenberger, Fuqua, & McKinley, 1985; Rapp, Miltenberger, Long, Elliott, & Lumley, 1998; Wagaman, Miltenberger, & Arndorfer, 1993), limitations (Rapp, Miltenberger, & Long, in press), effectiveness across different populations (Long, Miltenberger, Ellingson, & Ott, 1998), treatment adjuncts (Allen, 1998; Long, Miltenberger, Ellingson, & Ott, 1998; Rapp et al., in press), and mechanisms responsible for its success (Woods, Miltenberger, & Lumley, 1996). The continuing interest in, and research related to, habit reversal speaks to its clinical

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utility. In fact, habit reversal and its variations have been shown to be effective and replicable in over 25 years of research across a spectrum of habits and related behaviors (e.g., Peterson, Campise, & Azrin, 1994; Woods & Miltenberger, 1995, 1996b). In this article, we review and critique the research on habit reversal, starting with a discussion of behaviors typically targeted with these procedures and methods for assessing and analyzing such behaviors. Next we briefly review research on the applications of habit reversal and its variations and conclude with a behavior analysis of the procedure in an attempt to elucidate the mechanisms responsible for its success.

Behaviors Typically Treated with Habit Reversal

As implied in the name, habit reversal is typically used to treat habit behaviors. However, defining habit behaviors is difficult. Researchers have suggested that habits are repetitive or stereotyped behaviors that have negative physical (i.e., tissue damage) or social (i.e., embarrassment, social stigma) effects for the individual (Miltenberger & Woods, in press) and have categorized specific groups of behaviors that have been successfully treated with habit reversal. These groups, all of which are defined topographically, include tic disorders, nervous habits, and stuttering (e.g., Woods & Miltenberger, 1995, 1996b). The fact that the behaviors treated with habit reversal are defined topographically rather than functionally is clearly a limitation of the literature on habit reversal. As E. G. Carr (1993) has pointed out, behavior analysis is not about behavior but about understanding the function of behavior. Unfortunately, little is known about the function of behaviors typically treated with habit reversal. It is our hope that advances in our understanding of these behaviors will ultimately lead to a type of functional classification that is typical of other areas within behavior analysis.

Tic disorders. Tic disorders include motor tics, vocal tics, and Tourette's disorder. Motor tics are rapid, repetitive, jerking movements of muscle groups that are not the result of spasms, chorea, or tremors (Billings, 1978; Finney, Rapoff, Hall, & Christophersen, 1983). Examples of motor tics include facial grimacing, hard or excessive eye blinking, neck jerking or twisting, arm jerking, and shoulder shrugging (Woods, Miltenberger, & Flach, 1996). Vocal tics are defined as "rapid, recurrent, nonrhythmic, stereotyped vocalizations" (*Diagnostic and Statistical Manual of Mental Disorders*, 4th ed., American Psychiatric Association, 1994, p. 104). Examples of vocal tics include grunting, sniffing, coughing or throat clearing not associated with illness, barking noises, and vocalizations of words that serve no obvious communication function. Motor or vocal tics, categorized as transient when they remit within 1 year of onset, occur in approximately 25% of children. Chronic tics, which last more than 1 year, occur in about 1% of the population (Peterson et al., 1994). Tourette's disorder, which includes the occurrence of multiple motor tics and at least one vocal tic, is seen in approximately 0.04% to 0.05% of the population (*DSM-IV,* 1994).

Individuals who exhibit tics often experience a number of physical and social problems. Physically, tics can result in cuts, burns, and bruises (Shimberg, 1995). Tics may also result in negative social consequences. Preliminary research by Woods et al. (1998) showed that college students rated individuals with tics as less socially accepted than individuals who do not exhibit such behaviors. Similar results were found for adults with developmental disabilities (Long, Woods, Miltenberger, Fuqua, & Boudjouk, in press) and eighth graders (Boudjouk, Woods, Miltenberger, & Long, 1998) who exhibited tics.

Although the environmental variables responsible for the development and maintenance of tics have not been studied extensively, it is widely believed that tics are maintained by tension or arousal reduction (Azrin & Nunn, 1973; Bullen & Hemsley, 1983; Evers & Van de Wetering, 1994; Miltenberger & Woods, in press). Originally, Azrin and Nunn (1973) suggested that tics occurred in response to some physical trauma, possibly relieving muscle tension associated with the injury. The tics then continued to occur after the injury had healed. Although this is plausible, not all individuals with tics report prior injury to the muscles involved in the tic. Bullen and Hemsley suggested that tics associated with Tourette's disorder occurred in response to an aversive sensory experience and brought relief from the bodily experience. Evers and Van de Wetering also suggested that tics occur in response to a physiological event such as increased tension or arousal and serve to decrease the aversive physiological event. The accounts of these researchers, along with the subjective reports of individuals with tics, suggest that automatic negative reinforcement, in the form of a reduction in tension or other aversive physiological stimuli, may be a plausible explanation for the occurrence of some tics. However, it is also possible that social reinforcement may be involved in the maintenance of tics in some cases (e.g., J. E. Carr, Taylor, Wallander, & Reiss, 1996; Lahey, McNees, & McNees, 1973; Scotti, Schulman, & Hojnacki, 1994; Wagaman, Miltenberger, & Williams, 1995). Clearly, more research is needed to establish the behavioral mechanism responsible for the development and maintenance of tics.

Nervous habits. Nervous habits include nail biting, hair pulling or twirling, and thumb or finger sucking (hand-to-head habits); lip, mouth, or tongue biting and teeth grinding (oral habits); and other repetitive movements such as scratching and object manipulation. Recent surveys suggest that hand-to-head and oral habits are fairly prevalent (Hansen, Tishelman, Hawkins, & Doepke, 1990; Woods, Miltenberger, & Flach, 1996). In a survey of college students, Woods, Miltenberger, and Flach found that 15% reported hair manipulation; 3% reported hair pulling; 10% reported nail biting; 22% reported chewing on their mouth, lips, or cheeks; 22% reported manipulating objects such as pens, pencils, or jewelry; and 5% reported grinding their teeth. Hansen et al. reported even higher prevalence rates of nervous habits in college students and reported that the students typically engaged in a number of different habits. These results are consistent with other surveys showing that nervous habits occur with regularity in the general population (e.g., Christenson, Pyle, & Mitchell, 1991; Glaros & Rao, 1977; Joubert, 1993).

Individuals who exhibit nervous habits may also experience a number of physical and social problems. Chronic hair pulling can cause hair follicle damage, and thumb sucking can lead to dental problems and the risk of accidental poisoning (Friman & Schmitt, 1989). Likewise, nail biting can cause tissue damage to the fingers and dental problems and can increase the risk of infection (Silber & Haynes, 1992). Two studies have found negative social consequences arising from the occurrence of nervous habits. Friman, McPherson, Warzak, and Evans (1993) and Boudjouk et al. (1998) found that children who suck their thumbs and pull their hair are less socially accepted by their peers than similar children who refrain from such behavior.

As the term *nervous habit* implies, it is assumed that this class of habits is more probable when individuals are nervous or anxious. Unfortunately, there is little experimental support for this proposition. A preliminary investigation by Woods and Miltenberger (1996a) showed that some habit

behaviors (hair and face manipulation) were more prevalent in an anxiety-provoking condition, whereas other habits (object manipulation) were more prevalent in a condition the participants labeled as "boring." According to the *DSM-IV* (1994) definition of trichotillomania, individuals who chronically pull their hair report that the behavior is triggered by increasing tension (anxiety) levels that are subsequently reduced as a consequence of hair pulling. If the self-reports of individual hair pullers are accurate, then hair pulling may be maintained in some cases by automatic negative reinforcement in the form of tension (anxiety) reduction. However, recent research suggests that some cases of hair pulling may be maintained by automatic positive reinforcement in the form of sensory stimulation (Miltenberger, Long, Rapp, Lumley, & Elliott, 1998; Rapp, Miltenberger, Ellingson, Galensky, & Long, 1997). Although it is likely that nervous habits are generally maintained by automatic reinforcement because they are often observed to occur in the absence of any social reinforcement, it has not been established whether tension reduction or sensory stimulation (or some yet-to-be-identified stimulus change) is the most common maintaining variable. Furthermore, it is possible that in some cases nervous habits may be maintained in part by social reinforcement.

It is also possible that nervous habits represent a class of schedule-induced or adjunctive behaviors that occur as a side effect of intermittent schedules of reinforcement, typically time-based schedules such as fixed-time or fixed-interval schedules (e.g., Foster, 1978). Foster suggested that nervous habits may occur to fill the time between the delivery of reinforcers for other behaviors. Lerman, Iwata, Zarcone, and Ringdahl (1994) provided support for this idea by showing that some stereotypic behaviors in individuals with mental retardation were more probable during fixed-time reinforcement schedules and, thus, were characteristic of adjunctive behaviors. Although nervous habits may be schedule induced in some cases, much more experimental evidence is needed to support this proposition. There is also a clear need for future research to address the function of nervous habits. In addition, it would be valuable for researchers to adopt a different label for this class of behaviors that does not imply a function for the behavior.

Stuttering. Stuttering may involve a number of disfluences in the production of speech, including repetitions of word sounds, words, or phrases; prolongation of a word sound; or a hesitation (sometimes called a block) when attempting to speak (Miltenberger & Woods, 1998; Wagaman et al., 1993). These disfluencies disrupt the rhythmic quality of speech and may be accompanied by secondary behaviors that give the indication that the individual is struggling to speak. Secondary behaviors may include reduced eye contact, facial grimacing, distracting vocalizations, and movements of the head, torso, or extremities (Riley, 1972; Van Riper, 1982). About 10% of the population have stuttered at some time in their lives at a level that qualifies for a diagnosis. However, the estimated prevalence in the population is approximately 1% (Bloodstein, 1981). Stuttering is more prevalent in young children and often remits without treatment (Leung & Robson, 1990). Although stuttering does not produce physical damage, it may result in negative social consequences such as teasing and ridicule from peers and discrimination in the college application process (Leung & Robson, 1990).

Although stuttering is commonly believed to be caused by anxiety (Ingham, 1984), research has not supported such a relationship (Ingham & Andrews, 1971). Instead, stuttering has been shown to result from disruption in airflow during speech due to increased tension in the vocal musculature (Brutten & Shoemaker, 1967; Healy, 1991).

Because the tension in the vocal musculature is then decreased following a stutter (Ingham, 1984), stuttering may be at least partly maintained through a process of automatic negative reinforcement (Miltenberger & Woods, 1998). However, as with other habit disorders, social reinforcement may also play a role in the development and maintenance of stuttering if parents or significant others respond to instances of stuttering with attention, assistance, the termination of demands, or other potentially reinforcing social consequences. Researchers should evaluate the controlling variables for stuttering and identify or rule out possible social reinforcement for the behavior.

Covariation among habit behaviors. Research by Hansen et al. (1990) and Woods, Miltenberger, and Flach (1996) suggests that individuals who report the occurrence of a habit behavior are likely to report more than one habit. College students in the survey by Hansen et al. reported exhibiting an average of six different habit behaviors each. Woods, Miltenberger, and Flach found that individuals exhibiting nervous habits were also more likely to exhibit tics. Although these studies are limited by the self-report nature of the data, they suggest the existence of covariation among habit behaviors. Covariation among habits suggests that behaviors with disparate topographies may be part of the same response class (maintained by the same reinforcing consequences) or part of a response chain. Little is known about what factors lead to the preeminence of one habit behavior over other covarying habit behaviors or whether efforts to suppress one habit behavior will result in a decrease in habits that covary with the suppressed behavior.

A number of researchers have investigated the covariation among habit behaviors. Friman and Hove (1987) observed that thumb sucking and hair pulling in 2 young children both decreased when treatment was implemented only for the thumb sucking. Watson and Allen (1993) also showed that successful treatment for thumb sucking was associated with decreased hair pulling in a young child. These findings were consistent with earlier findings by Altman, Grahs, and Friman (1982) and suggest that the two habits were members of the same response class or response chain. In a similar vein, Friman (1990) showed that treatment for thumb sucking in 7 young children not only eliminated their thumb sucking but also eliminated their manipulation of "attachment objects" (i.e., baby blanket), thus suggesting that they were members of the same response class or response chain. Recent research by Long, Miltenberger, and Rapp (1998), however, showed more limited covariation among concurrent habits. Long, Miltenberger, and Rapp treated the thumb sucking of a young girl who also pulled her hair and found that elimination of thumb sucking resulted in a decrease but not elimination of the hair pulling. Subsequent treatment for hair pulling was necessary to also eliminate hair pulling. More research is needed to understand the mechanisms that account for the presence or absence of covariation among concurrent habits in response to treatment and the conditions under which multiple habits function independently of each other.

Functional analysis of habit behaviors. Despite the research suggesting a possible covariation among habit behaviors, little research has focused on assessing the function of habit behaviors. The paucity of functional analysis research may be due to the success of habit reversal and related procedures across a wide variety of habit behaviors without regard to the function of the behavior. Recently, researchers have applied functional analysis procedures to habits in an attempt to identify the controlling variables for the behaviors. Malatesta (1990) analyzed the antecedents to a child's motor tic by manipulating conditions in which the father was ab-

sent versus present. Malatesta found that the tic was more probable when the father was present, but offered no explanation to account for the observed relationship. Woods and Miltenberger (1996a) also manipulated antecedents to determine the relationship between conditions producing "anxiety" and "boredom" and the occurrence of various habits in a college population. In the boring condition (the student was left alone in a barren room), students were more likely to engage in habits involving object manipulation, and, in the condition reported to generate anxiety (the student was told that he or she had to give a talk in front of other students), the students were more likely to engage in hair and face manipulation. These preliminary findings are limited because Woods and Miltenberger manipulated only antecedents and reported no individual-subject data.

A handful of other studies have manipulated consequences in an attempt to identify the function of tics (J. E. Carr, Taylor, Wallander, & Reiss, 1996; Scotti et al., 1994), hair pulling (Miltenberger et al., 1998; Rapp et al., 1997), and thumb sucking (Rapp, Miltenberger, Galensky, Roberts, & Ellingson, 1998). Although there were variations in the experimental conditions among studies, each implemented functional analysis conditions similar to those developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). The researchers all evaluated attention and escape from demands as possible forms of social reinforcement, and alone conditions were used to evaluate the role of automatic reinforcement.

J. E. Carr, Taylor, Wallander, and Reiss (1996) found that a child's vocal tic was most probable in demand and attention conditions, although the tic was elevated across all functional analysis conditions. Similarly, Scotti et al. (1994) found that vocal and motor tics exhibited by an adult with mental retardation were elevated across experimental conditions but were most probable in the demand condition. The results from the demand condition are difficult to interpret in these studies because increases in tics could be due to anxiety elicited by the demands or negative reinforcement in the form of escape from the demands. Future research might look at demand conditions with and without contingent escape to evaluate the role of anxiety versus negative reinforcement. In a recent investigation, Watson and Sterling (1998) asked parents to deliver attention or edible items contingent on their young daughter's vocal tic. These consequences were chosen for analysis based on prior descriptive assessment. Watson and Sterling found that the child's tic was more probable when parental attention was contingent on its occurrence. The results of these three studies suggest that some tics may be at least partly maintained by positive or negative social reinforcement contingencies or may be under multiple control of social and automatic reinforcement contingencies.

Although socially mediated reinforcement may maintain some habit behaviors, the prevailing view is that tics and other habit behaviors are typically maintained by automatic reinforcement contingencies: either negative reinforcement in the form of tension or arousal reduction (Miltenberger & Woods, in press) or positive reinforcement in the form of sensory stimulation (Miltenberger et al., 1998; Rapp et al., 1997). Miltenberger et al. evaluated social disapproval, demand, and alone conditions and found that hair pulling and thumb sucking by a young child and hair pulling and hair manipulation by an adult with mental retardation occurred primarily in alone conditions. Information from the functional analysis and indirect assessment (interview with parents and staff) suggested that the behaviors served a self-stimulatory function for these individuals. Rapp et al. also found that hair

pulling and hair manipulation exhibited by a young woman with mental retardation occurred primarily when she was alone. Rapp et al. then conducted a further analysis to identify the form of sensory stimulation maintaining the behavior. In one condition, the woman wore a rubber glove and did not pull or manipulate her hair. In another condition, free hair was placed near her and she manipulated it but did not pull her own hair. This analysis suggested that the tactile stimulation of the hair between her fingers during hair manipulation was the source of stimulation maintaining the hair pulling. Finally, Rapp, Miltenberger, Galensky, Roberts, and Ellingson (1998) conducted a functional analysis of the thumb sucking of a 6-year-old child by implementing social disapproval, demand, and alone conditions and showed that the behavior occurred almost exclusively in the alone condition. Furthermore, data from the social disapproval condition suggested that social disapproval served as a punisher, which was presumed to be responsible for the absence of the behavior in the presence of the parents and other adults (see also Scotti et al., 1994).

Much work needs to be done to better understand the variables that maintain habits, in that research on the functional analysis of such behaviors is in its infancy. Although it is generally believed that habit behaviors are automatically reinforced (Evers & Van de Wetering, 1994; Woods & Miltenberger, 1995, 1996b), further functional analysis research is needed to substantiate this view, especially in light of the preliminary studies that suggest that social reinforcement contingencies may also play a role in the maintenance of some tics (J. E. Carr, Taylor, Wallander, & Reiss, 1996; Scotti et al., 1994; Watson & Sterling, 1998). Furthermore, functional analyses of habit behaviors may enhance the effectiveness of existing treatments and may lead to the development of other effective treatments that address the function of the behaviors. It will be important for researchers to develop protocols to further analyze behaviors maintained by automatic reinforcement in order to identify the nature of the sensory stimulation that maintains the behavior (e.g., Rapp et al., 1997). Such analyses will be necessary for the development of functional treatments involving sensory extinction (e.g., Rincover, 1978).

Assessment of Behaviors Treated with Habit Reversal

Reliable and valid behavioral assessment using direct observation of the target behavior is one of the hallmarks of applied behavior analysis. The issue of assessment is particularly pertinent to research evaluating treatments for habits because many of these behaviors often occur covertly, possibly because of a history of social punishment for the behaviors (e.g., Miltenberger et al., 1998; Rapp, Miltenberger, Galensky, Roberts, & Ellingson, 1998; Scotti et al., 1994). Although individuals who stutter or exhibit motor and vocal tics typically engage in these behaviors in the presence of the researchers who can then conduct direct observation assessments (e.g., Azrin & Peterson, 1988, 1989; Finney et al., 1983; Wagaman et al., 1993), individuals who bite their nails, suck their thumbs, pull their hair, and engage in similar habits may refrain from these behaviors in the presence of the researchers (e.g., Miltenberger & Fuqua, 1985; Rapp, Miltenberger, Galensky, Roberts, & Ellingson, 1998; Rapp, Miltenberger, Long, Elliott, & Lumley, 1998). Therefore, it is sometimes necessary to utilize assessment procedures other than direct observation or to modify direct observation procedures to capture the occurrence of the behavior. In this section we describe direct observation procedures used to assess habit behaviors and self-monitoring and product

measures as alternatives to direct observation.

Direct observation. In research on habit reversal for motor tics, Finney et al. (1983) and Miltenberger et al. (1985) videotaped participants and later scored the tapes for the occurrence of tics using 10-s or 6-s partial-interval scoring systems. Other researchers have also utilized videotape assessment of tics (Woods, Miltenberger, & Lumley, 1996), hair pulling (Rapp, Miltenberger, Long, Elliott, & Lumley, 1998), thumb sucking (Rapp, Miltenberger, Galensky, Roberts, & Ellingson, 1998), and stuttering (Elliott, Miltenberger, Rapp, Long, & McDonald, 1998) in research evaluating habit reversal. There are a number of benefits of using videotape in assessment. First, the videotape is a permanent record that can be viewed at the researchers' convenience. Second, the researcher can pause the tape during scoring or view the tape numerous times when attempting to score subtle or rapidly occurring habit behaviors. Third, the subject can be videotaped in naturalistic conditions without an experimenter present to decrease reactivity of the observation and to capture behaviors that may occur only when the subject is alone.

Recent work by Miltenberger et al. (1998), Rapp, Miltenberger, Long, Elliott, and Lumley (1998), and Rapp et al. (in press) illustrates a novel application of videotape assessment with individuals with chronic hair pulling. Because the participants did not pull their hair in the presence of others, the researchers placed a videocamera in the participants' homes at a time and place reported to be high risk for hair pulling (e.g., in the evening while watching TV alone). In this way they were able to capture the occurrence of a behavior they could not directly observe under the natural stimulus control of the subject being alone. Furthermore, these researchers utilized a real-time scoring system in which they recorded the occurrence or nonoccurrence of the behavior on a second-by-second basis using the digital timer on the VCR to identify the time of onset and offset of each instance of the behavior. The real-time recording allowed the researchers to report a frequency or duration measure of the behaviors but also produced a record of the exact temporal patterns in the behavior in the observation session (similar to data collection with laptop computers). Information on the temporal patterns among a number of behaviors would be valuable for identifying covariation among habits and for identifying whether treatments are implemented correctly.

Self-monitoring. For those situations in which direct observation or videotape recording of the habit behavior cannot be conducted, self-monitoring or recording by a parent or significant other may be used for data collection in conjunction with periodic reliability assessment from a significant other in the subject's natural environment. In an investigation of treatment for a 3-year-old child's hair pulling, Blum, Barone, and Friman (1993) instructed one of the parents to record the child's hair pulling during high-risk intervals of time. On some occasions, both parents recorded the hair pulling to assess interobserver agreement. In a recent investigation of habit reversal treatment of anger outbursts by a high school tennis player, Allen (1998) asked the student and his parents to record each occurrence of the outbursts during matches. The parents' and student's recordings were then compared for a measure of interobserver agreement.

Product measures. A variety of permanent product measures have been used in research on habit reversal. In the case of hair pulling, researchers have measured the bald areas produced by the behavior (e.g., Tarnowski, Rosen, McGrath, & Drabman, 1987) and have instructed subjects or significant others to collect hair as evidence of pulling (e.g., Altman et al., 1982; Rosenbaum & Ayllon,

1981b). In research on nail biting, researchers have measured nail length as an indication of the occurrence of the behavior (Davidson, Denney, & Elliott, 1980; Vargas & Adesso, 1976). In a recent investigation of habit reversal components for the treatment of chronic mouth biting, Jones, Swearer, and Friman (1997) instructed the participant to dab the inside of his mouth with a white cloth and used the resulting blood spots on the cloth as evidence for the mouth biting.

Although self-monitoring and product measures may need to be used in research in some situations and for some difficult-to-observe response topographies, these methods are clearly less rigorous than direct observation of the behavior as it occurs in natural circumstances. Researchers are encouraged to employ direct observation assessment whenever possible, even with habit behaviors that occur primarily in the absence of others (e.g., Miltenberger et al., 1998; Rapp et al., in press; Rapp, Miltenberger, Long, Elliott, & Lumley, 1998) in order to evaluate treatments in the most reliable fashion.

Review of Habit Reversal and Variations

Researchers have evaluated habit reversal and its variations for a variety of habits and related behaviors. What follows is a description of the treatment package and a brief review of research designed to evaluate variations of the procedure and to identify limitations. For recent reviews of the literature on habit reversal, see Woods and Miltenberger (1995, 1996b) and Miltenberger and Woods (1998, in press).

Habit reversal. The habit reversal package developed by Azrin and Nunn (1973) to treat nervous habits and tics consisted of 10 treatment components organized into four phases: (a) awareness training, (b) competing response training, (c) motivation procedures, and (d) generalization procedures. Five procedures were used to enhance the client's awareness so that the client could discriminate each occurrence of the habit. In response description, the client learned to describe the topography of the behavior. In response detection, the client learned to identify each occurrence of the habit behavior in the session. In the early warning procedure, the therapist helped the client identify when the habit behavior was about to occur. In situation awareness training, the client identified the antecedents that most reliably predicted the occurrence of the habit behavior. In competing response training (noncontingent), the client practiced an incompatible behavior as a way to highlight the muscles involved in the habit behavior.

After awareness training, the therapist conducted competing response training. In this phase of treatment, the client practiced using the competing response (incompatible behavior) for 3 min contingent on the occurrence of the habit or awareness that the habit was about to occur. Successful completion of awareness training was necessary for the detection of each occurrence of the habit and the contingent use of the competing response.

The motivation phase consisted of three procedures. During habit inconvenience review, the client reviewed with the therapist all of the ways in which the habit was inconvenient or embarrassing. In social support training, the therapist instructed the parents or significant others to prompt the client to use the competing response when necessary and to provide praise for the successful use of the procedure. In the public display procedure, the client was encouraged to go into situations in which the habit was likely to occur and to practice the competing response, thereby controlling the habit behavior and generating approval from significant others. In the final phase of treatment, symbolic rehearsal strategies were used in which the client imagined successful control of the habit in situations that had been iden-

tified as being high risk for the behavior in order to promote generalization.

Following the implementation of treatment, usually in one session, the client was instructed to use the competing response (contingent on the habit or the urge to engage in the habit) in all situations outside of the treatment session. Furthermore, parents or significant others were instructed to use social support to promote the successful use of the competing response.

Habit reversal was evaluated initially by Azrin and Nunn (1973) for a variety of nervous habits and tics. Although the early research had methodological limitations, researchers subsequently demonstrated its effectiveness for tics (Azrin et al., 1980b; Finney et al., 1983; Miltenberger et al., 1985), Tourette's disorder (Azrin & Peterson, 1988, 1990), nail biting (Azrin, Nunn, & Frantz, 1980a; Delprato, Aleh, Bambusch, & Barclay, 1977; Nunn & Azrin, 1976), hair pulling (Azrin, Nunn, & Frantz, 1980c; Rosenbaum & Ayllon, 1981b), thumb sucking (Azrin, Nunn, & Frantz-Renshaw, 1980), and oral habits (Azrin, Nunn, & Frantz-Renshaw, 1982). Each of these studies used the treatment package developed by Azrin and Nunn (1973), although some had slight variations (e.g., Azrin & Peterson, 1988, 1990; Finney et al., 1983). Across these studies a consistent finding emerged: Habit reversal is an effective treatment package for the spectrum of behaviors labeled nervous habits and tics. Furthermore, habit reversal is effective for these target behaviors even in the absence of information about the function of the behaviors.

Azrin and Nunn (1974) modified habit reversal for the treatment of stuttering and referred to the treatment package as the regulated breathing approach. The 12 individual treatment components were organized into the same four phases as habit reversal: awareness training, competing response training, motivation procedures, and generalization procedures. The major distinction between habit reversal applied to habits and tics and the procedure for stuttering was the nature of the competing response and the addition of relaxation training as a component of treatment for stuttering. The competing response (regulated breathing) involved deep relaxed breathing with a slight exhale prior to the initiation of speech. The client practiced the deep relaxed breathing while speaking for shorter durations at first (e.g., one or a few words). The client then increased the duration of speech as he or she was successful in controlling the stuttering. Contingent on the occurrence of a stutter, the client stopped speaking, took a deep breath, exhaled slightly, and continued speaking. As they did with habit reversal, Azrin and Nunn (1974) demonstrated the effectiveness of the regulated breathing approach for stuttering in an investigation with a number of methodological limitations. However, the procedure has been subsequently evaluated by researchers and shown to be effective for the treatment of stuttering in children and adults (Azrin, Nunn, & Frantz, 1979; Cote & Ladouceur, 1982; Ladouceur, Boudreau, & Theberge, 1981; Ladouceur & Martineau, 1982; Ladouceur & Saint-Laurent, 1986; Saint-Laurent & Ladouceur, 1987; Waterloo & Gotestam, 1988).

Variations of habit reversal. Because habit reversal is a treatment package consisting of numerous components, it was not known which components were necessary for the effectiveness of the package. As a result, researchers subsequently evaluated a number of variations of habit reversal for the treatment of tics, nervous habits, and stuttering in an attempt to simplify the procedure, increase efficiency, and identify the essential treatment components (e.g., Elliott et al., 1998; Miltenberger et al., 1985; Wagaman et al., 1993; Woods, Miltenberger, & Lumley, 1996). Most researchers evaluated some

combination of awareness training, competing response training, and social support.

Miltenberger et al. (1985) investigated a simplified habit-reversal treatment consisting of awareness training and competing response training. The results of this study suggested that awareness training and competing response training were the sufficient components for habit reversal to be effective in the treatment of motor tics. Other researchers have also found that the combination of awareness and competing response training is effective in the treatment of tics and nervous habits (e.g., Azrin & Peterson, 1989; Miltenberger & Fuqua, 1985; Ollendick, 1981).

In an attempt to further simplify the procedures, Woods, Miltenberger, and Lumley (1996) sequentially implemented a number of treatment components common to habit reversal. Results showed that awareness training eliminated the motor tic for 1 child, awareness training and self-monitoring eliminated the tic for a 2nd child, and awareness training, competing response training, and social support was necessary for significant reductions in tics for the remaining 2 children. To help explain the decrease caused by awareness training, the experimenters asked the child what he had done to stop the behavior. The child reported that he had tightened his own neck muscles (used his own competing response) when he started to exhibit his neck-jerking tic. In explaining the reduction produced by the addition of self-monitoring to awareness training, the authors suggested that the act of self-monitoring was actually functioning as a dissimilar competing response. Because other researchers have shown that awareness training or awareness training plus self-monitoring can be effective in the treatment of tics or other habits (Billings, 1978; Ollendick, 1981; Wright & Miltenberger, 1987), further research is necessary to establish the mechanism that is responsible for the effectiveness of these procedures.

The effectiveness of dissimilar competing responses was investigated by Sharenow, Fuqua, and Miltenberger (1989), who found that awareness training and the contingent use of dissimilar competing responses (behaviors that are not incompatible with the target behavior) were effective in treating 3 adults with motor tics. Woods, Miltenberger, and Lumley (1996) also concluded that awareness training and the contingent use of a competing response (similar or dissimilar) were important components for the effectiveness of habit reversal. However, because true component analysis research has not been conducted, we cannot make unambiguous statements about the *necessary* components of habit reversal. Several researchers have suggested that social support is important, especially with children, and have included social support procedures with awareness and competing response training (e.g., Rapp, Miltenberger, Long, Elliott, & Lumley, 1998; Woods, Miltenberger, & Lumley, 1996). Further research is needed to establish the necessary components of habit reversal and to evaluate the mechanism that is responsible for the effectiveness of these components.

The use of habit reversal in the treatment of stuttering was also simplified to include three components (awareness training, competing response training, and social support). Wagaman et al. (1993) implemented the procedures with 8 children who stuttered and showed clinically significant improvement in speech fluency for all children through posttreatment and 1-year follow-up. Wagaman, Miltenberger, and Woods (1995) later collected 3.5-year follow-up data on 7 of the 8 children and found that stuttering was still below baseline levels for all participants, with 5 of the children also below the clinically significant level of 3% words stuttered. These data suggest that the simplified

procedures of awareness training, competing response training, and social support produce results that can be maintained over an extended period of time. Research by Elliott et al. (1998) and Miltenberger, Wagaman, and Arndorfer (1996) further supports the effectiveness of these three components for the treatment of stuttering in children and adults.

From studies seeking to simplify the procedures, it seems clear that the important components of habit reversal involve awareness training and competing response training. Although often used as part of simplified procedures, the necessity of the social support component is not yet well researched. From a pragmatic perspective, it makes sense to include social support procedures with awareness and competing response training. The purpose of awareness and competing response training is to impart the skills necessary to identify each occurrence of the habit and respond with an incompatible behavior, and the purpose of social support is to provide the motivation to continue using the competing response procedure as instructed.

Limits of habit reversal. Although researchers have shown habit reversal and its simplified versions to be effective with children and adults, no systematic effort has been made to establish the limits of habit reversal. It is not yet clear from the literature whether the procedure is effective with young children or individuals with disabilities, or for target behaviors other than tics, nervous habits, and stuttering. It is also not clear whether the effectiveness of habit reversal varies depending on the functions of the behaviors treated. Only recently have researchers begun to evaluate the procedure with younger children and individuals with disabilities.

In two investigations, Long, Miltenberger, Ellingson, and Ott (1998) and Rapp et al. (in press) evaluated the components of awareness training, competing response training, and social support with individuals with mental retardation. Long, Miltenberger, Ellingson, and Ott showed that these components were ineffective or only partially effective in the treatment of fingernail biting and other oral-digital habits exhibited by 4 adults with mild to moderate mental retardation. All participants successfully used the competing response contingent on nail biting during the treatment session, but then failed to use the procedure during assessment sessions in the absence of the therapist. Additional contingencies involving prompts, differential reinforcement, and response cost, implemented when the participant was observed surreptitiously while alone, subsequently decreased the oral-digital habits to near-zero levels for all participants. Rapp et al. similarly demonstrated that these components were ineffective in the treatment of chronic hair pulling and hair manipulation exhibited by an adult with moderate mental retardation. Again the participant successfully used the competing response in the presence of the therapist but not in the absence of the therapist. Following the failure of simplified habit reversal, the client wore a device that emitted a tone when her hand approached her head to pull hair. While wearing this "awareness enhancement device," the participant was more likely to engage in the competing response when alone and subsequently stopped pulling her hair.

Two investigations showed that awareness training, competing response training, and social support were ineffective in the treatment of hair pulling and thumb sucking by a 6-year-old child (Long, Miltenberger, & Rapp, 1998) and thumb sucking by a 5-year-old child (Rapp, Miltenberger, Galensky, Roberts, & Ellingson, 1998). In both studies, the children learned the competing response and used it when the therapist was present, but failed to use the procedure during assessments when they were alone. Long,

Miltenberger, and Rapp subsequently demonstrated the effectiveness of differential reinforcement and response cost for the treatment of hair pulling and thumb sucking. Rapp, Miltenberger, Galensky, Roberts, and Ellingson showed that prompts to use the competing response, delivered when the child was observed surreptitiously while alone, resulted in a substantial decrease in thumb sucking. Interestingly, these researchers found that simplified habit reversal was effective for this participant's twin brother because he used the competing response in the absence of the therapist.

In two other studies, awareness training, competing response training (regulated breathing), and social support procedures were ineffective in the treatment of stuttering. Woods, Fuqua, and Waltz (1997) implemented treatment for a 6-year-old with developmental disabilities but found that the decreases in stuttering were not clinically significant. Elliott et al. (1998) found that simplified habit reversal was ineffective for a 7-year-old stutterer because of problems with treatment compliance (although treatment was effective for 4 other children).

These preliminary investigations into the limits of habit reversal suggest that the procedures are more likely to be ineffective with individuals with mental retardation or with young children, probably because the procedures are not applied with adequate treatment integrity by these individuals. Much more research is needed to establish the limits of habit reversal and the reasons for its ineffectiveness with specific individuals or with specific populations. It is not clear whether the ineffectiveness of the procedure is due to motivational problems, skill deficits, or stimulus control problems in individuals at earlier levels of development. We hypothesize that motivational problems and stimulus control problems often account for the failure of habit reversal. Young children or individuals with disabilities may not experience the negative social consequences for the occurrence of the habit that may be experienced by older children and adults (e.g., Boudjouk et al., 1998; Friman et al., 1993; Long et al., in press; Woods et al., 1998). As a result, a decrease in the behavior would not be as reinforcing as it might be for older individuals whose use of the competing response would be negatively reinforced through escape or avoidance of the aversive social consequence of engaging in the habit. The problem with stimulus control arises because many habits occur when the individual is alone. The individual learns to detect the occurrence of the habit and use the competing response in the presence of the therapist, but is then expected to use it in all other situations when alone. Without therapist contingencies or adequate social support contingencies, the individual fails to use the competing response outside the treatment session.

Generality of habit reversal to other target behavior. Very little work has been done to establish the generality of habit reversal to other types of target behaviors. In two investigations, habit reversal was used to treat facial pain in individuals with temporomandibular disorder (Gramling, Neblett, Grayson, & Townsend, 1996; Peterson, Dixon, Talcott, & Kelleher, 1993) and, in another investigation, it was used to treat scratching associated with neurodermatitis (Rosenbaum & Ayllon, 1981a).

Recently, Allen (1998) showed that a variation of habit reversal was successful in reducing anger outbursts during athletic performance. Allen used awareness training, competing response training involving diaphragmatic breathing contingent on early signs of an outburst, and parent-implemented contingencies with a teenager who played competitive tennis. Allen showed that these procedures were effective in controlling outbursts during practices and competitive matches. Furthermore, the results suggested

that the procedures were effective only as long as the participant and his parents continued to implement them consistently.

In another investigation of the effectiveness of habit reversal for a novel target behavior, Wagaman, Williams, and Camilleri (1998) used awareness and competing response training to treat rumination (regurgitating and reswallowing food following meals) exhibited by a 6-year-old child. Wagaman et al. taught the girl a diaphragmatic breathing procedure to be implemented immediately following meals and contingent on an incident of rumination. Although the authors relied on participant self-monitoring for data on rumination, they gathered reliability data by having the child's mother smell the child's breath for the presence or absence of rumination after meals. Wagaman et al. demonstrated that the procedures eliminated rumination for this girl.

Although habit reversal has typically been used to treat tics, nervous habits, and stuttering, these studies suggests that habit reversal may have greater generality than previously believed. From a logical perspective, the three major components of habit reversal would be valuable for a variety of self-management problems or other clinical problems. Awareness training teaches the individual to discriminate each occurrence of the problem behavior as it happens. Competing response training teaches the individual to replace the problem behavior immediately with an acceptable alternative behavior. Alternatively, some have argued that the competing response serves as an activity punisher similar to overcorrection (e.g., Miltenberger & Fuqua, 1981; Sharenow et al., 1989). Social support procedures then teach significant others to apply supporting contingencies to prompt the individual to use the competing response and to reinforce the individual's successful use of the procedure. It could be plausibly argued that these three treatment components already form the basis of many existing clinical treatments such as cognitive therapies (e.g., Freeman, Pretzer, Fleming, & Simon, 1990), marital therapies (e.g., Jacobson & Margolin, 1979), anger management training (e.g., Feindler, 1987), treatments for obesity and other appetitive disorders (e.g., Stuart & Davis, 1972), and child management therapies (e.g., Forehand & McMahon, 1981). For example, in cognitive therapy the individual is first taught to identify each instance of distorted thinking (awareness training). The individual then learns to challenge the distorted thinking and replace it with more logical or rational patterns of thinking (competing response training). Finally, the therapist delivers the supporting contingencies for the client's successful use of the procedures (social support). Likewise for child management training, the therapist first teaches the parents to detect each instance of their inappropriate interaction with the child that contributes to the child's problem behavior (awareness training). Next the parents learn alternative ways to interact with their child to decrease the likelihood of the child's problem behavior (competing response training). Finally, the therapist provides supporting contingencies and instructs the parents to support each other's efforts (social support). Although a detailed discussion of the relevance of these three components to the variety of existing clinical treatments is beyond the scope of this article, we believe that these three treatment components may have wide generality for a variety of target behaviors.

Analysis of Habit Reversal

In addition to developing and validating effective behavior-change techniques, another goal of applied behavior analysis is to identify and understand the behavioral processes underlying such techniques (Baer, Wolf, & Risley, 1968) in order to learn about fundamental principles of behavior that underlie effective intervention tech-

niques and to establish a link between these applied techniques and a larger body of basic research. By understanding the basic principles on which applied techniques operate, we are presumably in a better position to improve the efficacy and efficiency of intervention techniques. As mentioned earlier, further research is needed to identify the essential components of habit reversal and to elucidate the behavioral mechanisms responsible for its efficacy. In this section, we offer a few tentative observations about the behavioral processes that may be operating in habit reversal and suggest potentially fruitful avenues of research.

First, is it possible that the impressive behavior-change results attributed to habit reversal are simply a result of nonspecific behavior-change processes often referred to as placebo effects? Many of the participants in habit reversal research know that the goal of the intervention and of the researcher is to reduce a particular target behavior. Furthermore, many of the participants may find the rationale underlying habit reversal to be persuasive and may expect habit reversal to be effective in eliminating or reducing their target behaviors. Knowledge of treatment and therapist goals and expectation of treatment efficacy are often identified as essential elements to placebo effects (Kirsch, 1990). The contribution of placebo effects is typically evaluated by comparing the effects of a potentially active intervention to a known inactive treatment under double-blind conditions (Kazdin, 1992). Unfortunately, most research in applied behavior analysis does not incorporate experimental controls to test for and rule out placebo effects. Research on habit reversal is no exception.

In much applied behavior analysis research, concerns about placebo effects are not especially relevant. For example, many research participants may have limited verbal skills, thus making oral communication less effective in conveying treatment expectancies than for participants with higher verbal skills. In other situations, the researcher controls response opportunities and consequences and uses objective measures to evaluate outcome, thus reducing the role of the participant in the administration and evaluation of intervention techniques and presumably reducing, but not eliminating, the influence of placebo effects. For research participants with higher levels of verbal skills who become more actively involved in the self-administration of interventions and the evaluation of treatment outcomes, efforts to evaluate the contributions of nonspecific factors to treatment outcome become more crucial.

Fortunately, the inclusion of baseline measures, characterized by repeated measures and some degree of stability prior to the intervention, does much to rule out the effects of knowledge of treatment and therapist goals on the ultimate outcome. Presumably, research participants would know what the treatment goal was during baseline, and any effect of this knowledge would show up during baseline measures. Nonetheless, the absence of procedures to detect the influence of treatment outcome expectancy (the verbalization, perhaps covert, that the treatment will produce a certain behavioral effect) on the research outcomes for habit reversal is troubling. Only a few studies have compared habit reversal to interventions that are credible but are suspected of being inactive interventions (analogous to a placebo control). Frankel and Merbaum (1982) reported that the addition of therapist contact to the use of a patient treatment manual for habit reversal produced only a modest and insignificant increase in the efficacy of habit reversal. This suggests that therapist contact (a potential contributor to nonspecific treatment effects) had only a minor influence on treatment outcome. Miltenberger and Fuqua (1985) reported that noncontingent practice of a competing response did not produce be-

havioral reductions of the same magnitude as response-contingent practice of the competing response. Finally, De la Horne and Wilkinson (1980) reported that habit reversal produced more sustained reductions in nail biting than did interventions focusing on instructions in nail care. These studies provide modest assurance that the relatively consistent reports of large and immediate decrements in habit behaviors are attributable to habit reversal rather than to nonspecific treatment effects. Research is needed to further assess the contribution of nonspecific factors such as placebo effects and treatment credibility to the documented benefits of habit reversal.

Competing response practice (following awareness training) is the treatment component that is most consistently identified as necessary for the production of the behavioral effects of habit reversal (e.g., Woods & Miltenberger, 1995, 1996b). There are at least two behavioral processes that could underlie the effectiveness of competing response practice: self-administered punishment and differential reinforcement of alternative behavior (DRA). Three procedural aspects of competing response practice are compatible with an analysis based on self-administered punishment. First, practicing a competing responses for 3 min involves some degree of response effort. Although the magnitude of effort involved in practicing most competing responses (e.g, clenching fists, tensing a muscle group) is not extreme, there is evidence that response effort can function as a punisher when required in a response-contingent fashion (e.g., Friman & Poling, 1995; Miltenberger & Fuqua, 1981). Second, engaging in many of the competing responses reported in the habit reversal literature involves some disruption of ongoing activities. If one assumes that the ongoing activities are being maintained through some form of positive or negative reinforcement, then any disruption of those activities to engage in a less reinforcing activity would constitute a time-out from reinforcement. Finally, some of the competing responses may be detectable by observers and thus could be a source of embarrassment or social punishment.

Research testing punishment processes that might be involved in habit reversal is sparse. Miltenberger and Fuqua (1985) reported evidence that contingent practice of competing responses is more effective than noncontingent practice of competing responses, an observation that is congruent with widely accepted models of the necessary conditions for aversive stimuli to act as punishers (e.g., Azrin & Holz, 1966). In addition, Sharenow et al. (1989) reported that both similar and dissimilar competing responses produce response suppression when performed in a response-contingent manner, an observation that is compatible with a punishment by response effort analysis.

A simple punishment analysis has several limitations. For example, explaining why a person would self-administer a punitive stimulus, even in the form of engaging in a competing response, requires some explanation. Why would the punishment contingency suppress the target behavior, rather than the act of self-administering the punishment contingency? It is worth noting that insuring adherence to the competing response procedure often requires the programming of social prompts and reinforcement contingencies. Second, when punishment is effective in suppressing a behavior, it is generally presumed to be effective only as long as the punishment contingency is in effect (Azrin & Holz, 1966). If the controlling variables for the suppressed behavior remain constant, then presumably the behavior will reemerge when the punishment contingencies have been removed. In the case of habit reversal, several studies have reported impressive maintenance of treatment effects (e.g., Azrin & Peterson, 1989; Finney et al.,

1983; Wagaman et al., 1993; Wagaman, Miltenberger, & Woods, 1995) that appear to be inconsistent with a simple punishment analysis. There are several plausible explanations for these impressive maintenance results: (a) Participants continued to engage in the competing response practice long after the initial training; (b) the contingencies responsible for the original target behavior had changed so that punishment contingencies could be terminated without the reemergence of the target behavior; or (c) the original maintaining contingencies remained unchanged but some other, perhaps more acceptable, behavior had emerged to serve the same function as the target behavior. Unfortunately, research to test these plausible explanations has not been conducted. With few exceptions, data on the degree to which people continue to self-monitor and apply the competing response are not available (e.g., J. E. Carr & Bailey, 1996; J. E. Carr, Bailey, Carr, & Coggin, 1996; Woods, Miltenberger, & Lumley, 1996). As mentioned earlier, functional analysis research to identify the controlling variables for nervous habits, tics, and stuttering is in its infancy, and, as a result, efforts to analyze maintenance effects in terms of changes in the reinforcement contingencies have yet to be conducted. Further research is needed to test the punishment model and to explain why the results of habit reversal are maintained over protracted periods of time. Should habit reversal prove to be an instance of self-administered punishment, then well-established guidelines for increasing the efficacy of punishment (e.g., punishment schedule, magnitude and duration of punishment, preventing unauthorized escape) become relevant to programming habit reversal.

The alternative to the punishment model is the DRA model in which the competing response is postulated to be an incompatible behavior that supplants the target behavior. In theory, the competing response would take priority over the target behavior because of socially mediated contingencies (e.g., prompts, praise) to ensure that the competing response occurs as prescribed or because the competing response serves the same function (i.e., produces the same reinforcing consequences) as the target behavior. Observations that social support is often needed to insure adherence with the competing response practice and thus produce maximal benefits are compatible with this model (as well as with the punishment model). Research participants are instructed to engage in the competing response contingent upon the occurrence of the target response and when they became aware that the habit was about to occur. If the frequency of habit behaviors declines substantially (as consistently reported in the research literature), then the opportunity to engage in the competing response would also decline if the competing response was applied solely as a response-contingent consequence. If the competing response functioned primarily as a functionally equivalent displacement behavior, then we would expect to see the competing response occur under conditions and with a frequency similar to that of the habit that it is displacing. Unfortunately, with few exceptions (e.g., J. E. Carr & Bailey, 1996; J. E. Carr, Bailey, Carr, & Coggin, 1996; Woods, Miltenberger, & Lumley, 1996), little is known about the degree to which people adhere to the response-contingent application of the competing response procedure. Furthermore, little is known about the extent to which people apply the competing response in a preemptive fashion and the social acceptability of displacing habit behaviors with competing responses that might occur at levels similar to the original habit. Interestingly, this is one place where habit reversal diverges from some of the other examples of clinical behavior-management procedures in that displacing one behavior (e.g., distorted thinking) with an alternative behavior (e.g.,

more logical thinking) is an acceptable long-term solution, whereas adopting competing responses as a permanent displacement for some habit behaviors may be less acceptable as a long-term goal. If future research establishes the validity of the DRA analysis, it would have important implications for the selection of competing responses. More specifically, we would expect that competing responses that produced consequences similar to those produced by the habit behaviors would prove more effective than competing responses that were unrelated to the controlling variables for the habit behaviors. Furthermore, we would expect that competing responses involving minimal response effort would be more effective than those involving more response effort.

Finally, several researchers have reported that awareness training alone is sometimes sufficient to reduce habit behaviors (Woods, Miltenberger, & Lumley, 1996; Wright & Miltenberger, 1987). In a few instances, anecdotal reports suggested that the participants were engaging in self-selected response-contingent competing responses, thus precluding the analysis of awareness training as a stand-alone procedure. Further research is needed to identify the conditions under which awareness training is sufficient to produce meaningful reductions in habit behaviors. For now, it appears to function in a manner analogous to an establishing operation. For those with low levels of awareness of each instance of their habit behavior, awareness training could establish the occurrence of the habit as an aversive event and evoke alternative behaviors in the situations that exerted stimulus control over the habit. Execution of the alternative behaviors would be negatively reinforced by termination or avoidance of the habit behavior. Furthermore, self-awareness appears to be a necessary condition for the correct implementation of response-contingent competing response practice. It is likely that this establishing operation function of awareness occurs in conjunction with the punishment or DRA function of the competing response and helps to motivate the use of the competing response.

It is also possible that awareness training helps to generate rule-governed behavior such that the individual prompts himself or herself to use the competing response contingent on the occurrence of the habit or awareness that the habit is about to occur. Although an explanation of awareness training based on rule-governed behavior has appeal, especially given the failure of awareness and competing response training with individuals with limited verbal abilities, there is no research to support such an explanation. We believe further analysis of rule-governed behavior would be a valuable area of research.

Conclusions and Suggestions for Future Research

Since the development of habit reversal in 1973, researchers have consistently demonstrated its effectiveness for the treatment of a variety of habits, tics, and stuttering. Furthermore, researchers have demonstrated the effectiveness of simplified versions consisting of awareness training and the contingent application of a competing response, sometimes in conjunction with social support procedures. Habit reversal appears to be effective even in the absence of information about the function of the behaviors treated. One important avenue for future research is the functional analysis of habits and tics to better understand the controlling variables that maintain these behaviors. Information on the function of habit behaviors would contribute to our understanding of the principles that underlie the effectiveness of habit reversal and may contribute to the effectiveness of treatment, especially in difficult cases.

Although there are few reports of treat-

ment failures with habit reversal, recent research suggests that it may not be effective for young children or individuals with developmental disabilities (Long, Miltenberger, Ellingson, & Ott, 1998; Long, Miltenberger, & Rapp, 1998; Rapp et al., in press), most likely because of problems with treatment compliance by these individuals. Future research should further evaluate the variables that contribute to treatment failures. Researchers should also investigate adjunct or alternative treatments when habit reversal fails, especially for habit behaviors exhibited by young children and individuals with disabilities (e.g., Long, Miltenberger, Ellingson, & Ott, 1998; Long, Miltenberger, & Rapp, 1998; Rapp et al., in press).

Although little research has evaluated the generality of habit reversal for target behaviors other than habits, tics, and stuttering, recent research suggests that it may be effective for other clinical problems (e.g., Allen, 1998; Wagaman et al., 1998). Researchers should continue to investigate the components of habit reversal for the treatment of other target behaviors. We believe that awareness training, competing response training, and social support may have broad generality for a variety of clinical problems.

Given our limited understanding of the mechanism responsible for the success of the major components (awareness and competing response training) of habit reversal, future research should attempt to elucidate the principles that underlie the success of the procedures. The most plausible explanations are that awareness training involves establishing operation effects or rule-governed behavior and that competing response training involves self-imposed punishment by the application of aversive activities or differential reinforcement of alternative behavior to replace the habit behavior. Better understanding of the principles involved in the success of habit reversal has direct implications for enhancing the effectiveness of treatment. For example, if the punishment explanation is found to be preeminent, then instructions to use competing responses that are more effortful, aversive, or longer in duration may be advised to enhance the effectiveness of punishment. On the other hand, if the DRA explanation is supported, then it would be advised to use a competing response that is functionally equivalent to the habit, less effortful, and brief to increase the probability of this concurrent operant relative to the probability of the habit behavior.

Another direction for future research is to identify the minimal level of adherence with the procedures needed to produce treatment success (e.g., J. E. Carr, Bailey, Carr, & Coggin, 1996). Furthermore, researchers should investigate methods for promoting adherence to the procedures, because adherence problems appear to underlie treatment failures. Allen (1998) used parent-implemented response cost contingencies to promote adherence to habit reversal implemented by an adolescent. Rapp et al. (in press) utilized an awareness enhancement device that sounded a tone whenever the participant's hand moved in close proximity to her head to pull hair. This device prompted the participant to use a competing response and resulted in a decrease in hair pulling following the failure of the habit reversal components. These and other methods for promoting adherence to habit reversal should be evaluated in future research.

One final area for future research and practice is the dissemination of this effective technology so that it is used by professionals who are most likely to have contact with individuals seeking treatment for habits, tics, and stuttering. Researchers should investigate the best way to train and promote the appropriate application of habit reversal across disciplines for which the procedures might be relevant (e.g., psychologists, dentists, speech pathologists, pediatricians, and psychiatrists). Effective use of habit reversal

across disciplines is important for a variety of reasons. First, individuals in need of treatment might not have access to a behavior analyst. Second, most problems are addressed by a primary care physician, so it is important for these professionals to be well versed in habit reversal. Finally, wider dissemination of these procedures might result in a decrease in the use of medications that are often prescribed for specific habit disorders such as tics, Tourette disorder, and trichotillomania. If psychiatrists and primary care physicians were trained in habit reversal, they might implement these procedures instead of, or prior to, prescribing medications.

REFERENCES

Allen, K. D. (1998). The use of an enhanced simplified habit-reversal procedure to reduce disruptive outbursts during athletic performance. *Journal of Applied Behavior Analysis, 31,* 489–492.

Altman, K., Grahs, C., & Friman, P. (1982). Treatment of unobserved trichotillomania by attention-reflection and punishment of an apparent covariant. *Journal of Behavior Therapy and Experimental Psychiatry, 13,* 337–340.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Azrin, N. H., & Foxx, R. (1971). A rapid method of toilet training the institutionalized retarded. *Journal of Applied Behavior Analysis, 2,* 323–334.

Azrin, N. H., & Holz, W. C. (1966). Punishment. In W. K. Honig (Ed.), *Operant behavior: Areas of research and application* (pp. 380–487). New York: Appleton-Century-Crofts.

Azrin, N. H., & Nunn, R. G. (1973). Habit reversal: A method of eliminating nervous habits and tics. *Behaviour Research and Therapy, 11,* 619–628.

Azrin, N. H., & Nunn, R. G. (1974). A rapid method of eliminating stuttering by a regulated breathing approach. *Behaviour Research and Therapy, 12,* 279–286.

Azrin, N. H., & Nunn, R. G. (1977). *Habit control in a day.* New York: Simon & Schuster.

Azrin, N. H., Nunn, R. G., & Frantz, S. E. (1979). Comparison of regulated breathing versus abbreviated desensitization on reported stuttering episodes. *Journal of Speech and Hearing Disorders, 44,* 331–339.

Azrin, N. H., Nunn, R. G., & Frantz, S. E. (1980a). Habit reversal versus negative practice treatment of nail biting. *Behaviour Research and Therapy, 18,* 281–285.

Azrin, N. H., Nunn, R. G., & Frantz, S. E. (1980b). Habit reversal versus negative practice treatment of nervous tics. *Behavior Therapy, 11,* 169–178.

Azrin, N. H., Nunn, R. G., & Frantz, S. E. (1980c). Treatment of hair pulling (trichotillomania): A comparative study of habit reversal and negative practice training. *Journal of Behavior Therapy and Experimental Psychiatry, 11,* 13–20.

Azrin, N. H., Nunn, R. G., & Frantz-Renshaw, S. E. (1980). Habit reversal treatment of thumb sucking. *Behaviour Research and Therapy, 18,* 395–399.

Azrin, N. H., Nunn, R. G., & Frantz-Renshaw, S. E. (1982). Habit reversal versus negative practice treatment of self-destructive oral habits (biting, chewing, or licking of the lips, cheeks, tongue, or palate). *Journal of Behavior Therapy and Experimental Psychiatry, 13,* 49–54.

Azrin, N. H., & Peterson, A. L. (1988). Habit reversal for the treatment of Tourette syndrome. *Behaviour Research and Therapy, 26,* 347–351.

Azrin, N. H., & Peterson, A. L. (1989). Reduction of an eye tic by controlled blinking. *Behavior Therapy, 20,* 467–473.

Azrin, N. H., & Peterson, A. L. (1990). Treatment of Tourette syndrome by habit reversal: A waiting list control group comparison. *Behavior Therapy, 21,* 305–318.

Baer, D., Wolf, M. M., & Risley, T. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1,* 91–97.

Billings, A. (1978). Self-monitoring in the treatment of tics: A single-subject analysis. *Journal of Behavior Therapy and Experimental Psychiatry, 9,* 339–342.

Bloodstein, O. (1981). *A handbook on stuttering.* Chicago: The National Easter Seal Society.

Blum, N. J., Barone, V. J., & Friman, P. C. (1993). A simplified behavioral treatment for trichotillomania: Report of two cases. *Pediatrics, 93,* 993–995.

Boudjouk, P. J., Woods, D. W., Miltenberger, R. G., & Long, E. S. (1998). *Social perceptions of habit disorders among adolescents.* Manuscript submitted for publication.

Brutten, E. J., & Shoemaker, D. J. (1967). *The modification of stuttering.* Englewood Cliffs, NJ: Prentice Hall.

Bullen, J. G., & Hemsley, D. R. (1983). Sensory experience as a trigger in Gilles de la Tourette's syndrome. *Journal of Behavior Therapy and Experimental Psychiatry, 14,* 197–201.

Carr, E. G. (1993). Behavior analysis is not ultimately about behavior. *The Behavior Analyst, 16,* 47–49.

Carr, J. E., & Bailey, J. S. (1996). A brief behavior therapy protocol for Tourette syndrome. *Journal*

of Behavior Therapy and Experimental Psychiatry, 27, 33–40.

Carr, J. E., Bailey, J. S., Carr, C. A., & Coggin, A. M. (1996). The role of independent variable integrity in the behavioral management of Tourette syndrome. *Behavioral Interventions, 11,* 35–45.

Carr, J. E., Taylor, C. C., Wallander, R. J., & Reiss, M. L. (1996). A functional-analytic approach to the diagnosis of a transient tic disorder. *Journal of Behavior Therapy and Experimental Psychiatry, 27,* 291–297.

Christenson, G. A., Pyle, R. L., & Mitchell, J. E. (1991). Estimated lifetime prevalence of trichotillomania in college students. *Journal of Clinical Psychiatry, 52,* 415–417.

Cote, C., & Ladouceur, R. (1982). Effects of social aids and the regulated breathing method in the treatment of stuttering. *Journal of Consulting and Clinical Psychology, 50,* 450.

Davidson, A. M., Denney, D. R., & Elliott, C. H. (1980). Suppression and substitution in the treatment of nail biting. *Behaviour Research and Therapy, 18,* 1–9.

De la Horne, D. J., & Wilkinson, J. (1980). Habit reversal treatment for fingernail biting. *Behaviour Research and Therapy, 18,* 287–291.

Delprato, D. J., Aleh, E., Bambusch, J., & Barclay, L. A. (1977). Treatment of fingernail biting by habit reversal. *Journal of Behavior Therapy and Experimental Psychiatry, 8,* 319.

Elliott, A. J., Miltenberger, R. G., Rapp, J. T., Long, E. S., & McDonald, R. (1998). *Brief application of simplified habit reversal to stuttering in children.* Manuscript submitted for publication.

Evers, R. A. F., & Van de Wetering, B. J. M. (1994). A treatment model for motor tics based on a specific tension-reduction technique. *Journal of Behavior Therapy and Experimental Psychiatry, 25,* 255–260.

Feindler, E. (1987). Clinical issues and recommendations in adolescent anger-control training. *Behavior Modification, 14,* 66–80.

Finney, J. W., Rapoff, M. A., Hall, C. L., & Christophersen, E. R. (1983). Replication and social validation of habit reversal treatment for tics. *Behavior Therapy, 14,* 116–126.

Forehand, R. L., & McMahon, R. J. (1981). *Helping the noncompliant child: A clinician's guide to parent training.* New York: Guilford.

Foster, W. A. (1978). Adjunctive behavior: An underreported phenomenon in applied behavior analysis? *Journal of Applied Behavior Analysis, 11,* 545–546.

Foxx, R. M., & Azrin, N. H. (1972). Restitution: A method of eliminating aggressive-disruptive behavior of retarded and brain-damaged patients. *Behaviour Research and Therapy, 10,* 15–27.

Frankel, M. S., & Merbaum, M. (1982). Effects of therapist contact and a self-control manual on nail biting reduction. *Behavior Therapy, 13,* 125–129.

Freeman, A., Pretzer, J., Fleming, B., & Simon, K. (1990). *Clinical applications of cognitive therapy.* New York: Plenum.

Friman, P. C. (1990). Concurrent habits: What would Linus do with his blanket if his thumb-sucking were treated? *American Journal of Diseases of Children, 144,* 1316–1318.

Friman, P. C., & Hove, G. (1987). Apparent covariation between child habit disorders: Effects of successful treatment for thumb sucking on untargeted chronic hair pulling. *Journal of Applied Behavior Analysis, 20,* 421–425.

Friman, P. C., McPherson, K. M., Warzak, W. J., & Evans, J. (1993). Influence of thumb-sucking on peer social acceptance in first-grade children. *Pediatrics, 91,* 784–786.

Friman, P. C., & Poling, A. (1995). Making life easier with response effort: Basic findings and applied research on response effort. *Journal of Applied Behavior Analysis, 28,* 583–590.

Friman, P. C., & Schmitt, B. D. (1989). Thumb sucking: Pediatrician's guidelines. *Clinical Pediatrics, 28,* 438–440.

Glaros, A., & Rao, S. (1977). Bruxism: A critical review. *Psychological Bulletin, 84,* 767–781.

Gramling, S. E., Neblett, J., Grayson, R., & Townsend, D. (1996). Temporomandibular disorder: Efficacy of an oral habit reversal treatment program. *Journal of Behavior Therapy and Experimental Psychiatry, 27,* 245–255.

Hansen, D. J., Tishelman, A. C., Hawkins, R. P., & Doepke, K. J. (1990). Habits with potential as disorders: Prevalence, severity, and other characteristics among college students. *Behavior Modification, 14,* 66–80.

Healy, E. C. (1991). *Readings on research in stuttering.* White Plains, NY: Longman.

Hunt, G. M., & Azrin, N. H. (1973). A community-reinforcement approach to alcoholism. *Behaviour Research and Therapy, 11,* 91–104.

Ingham, R. J. (1984). *Stuttering and behavior therapy: Current status and experimental foundations.* San Diego: College Hill Press.

Ingham, R. J., & Andrews, G. (1971). The relation between anxiety reduction and treatment. *Journal of Communication Disorders, 4,* 289–301.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27,* 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982)

Jacobson, N. S., & Margolin, G. (1979). *Marital therapy: Strategies based on social learning and behavior exchange principles.* New York: Brunner Mazel.

Jones, K. M., Swearer, S. M., & Friman, P. C. (1997).

Relax and try this instead: Abbreviated habit reversal for maladaptive self-biting. *Journal of Applied Behavior Analysis, 30,* 697–699.

Joubert, C. E. (1993). Incidence of some oral-based habits among college students and their correlations with use of oral stimulants. *Psychological Reports, 72,* 735–738.

Kazdin, A. E. (1992). *Research design in clinical psychology* (2nd ed.). Boston: Allyn & Bacon.

Kirsch, I. (1990). *Changing expectations: A key to effective psychotherapy*. Pacific Grove, CA: Brooks/Cole.

Ladouceur, R., Boudreau, L., & Theberge, S. (1981). Awareness training and regulated breathing method in modification of stuttering. *Perceptual and Motor Skills, 53,* 187–194.

Ladouceur, R., & Martineau, G. (1982). Evaluation of regulated breathing method with and without parental assistance in the treatment of child stutterers. *Journal of Behavior Therapy and Experimental Psychiatry, 13,* 301–306.

Ladouceur, R., & Saint-Laurent, L. (1986). Stuttering: A multidimensional treatment and evaluation package. *Journal of Fluency Disorders, 11,* 93–103.

Lahey, B., McNees, M., & McNees, M. (1973). Control of an obscene "verbal tic" through time-out in an elementary school classroom. *Journal of Applied Behavior Analysis, 6,* 101–104.

Lerman, D. C., Iwata, B. A., Zarcone, J. R., & Ringdahl, J. (1994). Assessment of stereotypic and self-injurious behavior as adjunctive responses. *Journal of Applied Behavior Analysis, 27,* 715–728.

Leung, A., & Robson, W. L. (1990). Stuttering. *Clinical Pediatrics, 29,* 498–502.

Long, E. S., Miltenberger, R. G., Ellingson, S., & Ott, S. (1998). *Simplified habit reversal treatment for fingernail biting and related oral-digital habits exhibited by individuals with mental retardation.* Manuscript submitted for publication.

Long, E. S., Miltenberger, R. G., & Rapp, J. T. (1998). *Augmenting simplified habit reversal with response cost procedures in the treatment of thumb sucking and hair pulling.* Manuscript submitted for publication.

Long, E. S., Woods, D. W., Miltenberger, R. G., Fuqua, R. W., & Boudjouk, P. (in press). Evaluating the social effects of habit behaviors exhibited by individuals with developmental disabilities. *Journal of Developmental and Physical Disabilities.*

Malatesta, V. J. (1990). Behavioral case formulation: An experimental assessment study of transient tic disorder. *Journal of Psychopathology and Behavioral Assessment, 12,* 219–232.

Miltenberger, R. G., & Fuqua, R. W. (1981). Overcorrection: Review and critical analysis. *The Behavior Analyst, 4,* 123–141.

Miltenberger, R. G., & Fuqua, R. W. (1985). A comparison of contingent versus non-contingent competing response practice in the treatment of nervous habits. *Journal of Behavior Therapy and Experimental Psychiatry, 16,* 195–200.

Miltenberger, R. G., Fuqua, R. W., & McKinley, T. (1985). Habit reversal with muscle tics: Replication and component analysis. *Behavior Therapy, 16,* 39–50.

Miltenberger, R. G., Long, E. S., Rapp, J. T., Lumley, V. A., & Elliott, A. J. (1998). Evaluating the function of hair pulling. *Behavior Therapy, 29,* 211–219.

Miltenberger, R. G., Wagaman, J. R., & Arndorfer, R. E. (1996). Simplified treatment and long term follow-up for stuttering in adults: A study of two cases. *Journal of Behavior Therapy and Experimental Psychiatry, 27,* 181–188.

Miltenberger, R. G., & Woods, D. W. (1998). Speech disfluencies. In T. S. Watson & F. Gresham (Eds.), *Handbook of child behavior therapy* (pp. 127–142). New York: Plenum.

Miltenberger, R. G., & Woods, D. W. (in press). Assessment and treatment of habit disorders. In J. Austin & J. E. Carr (Eds.), *Handbook of applied behavior analysis*. Reno, NV: Context Press.

Nunn, R. G., & Azrin, N. H. (1976). Eliminating nail biting by the habit reversal procedure. *Behaviour Research and Therapy, 14,* 65–67.

Ollendick, T. (1981). Self-monitoring and self-administered overcorrection: The modification of nervous tics in children. *Behavior Modification, 5,* 75–84.

Peterson, A. L., Campise, R. L., & Azrin, N. H. (1994). Behavioral and pharmacological treatments for tic and habit disorders: A review. *Developmental and Behavioral Pediatrics, 15,* 430–441.

Peterson, A. L., Dixon, D. C., Talcott, G. W., & Kelleher, W. J. (1993). Habit reversal treatment of temporomandibular disorders: A pilot investigation. *Journal of Behavior Therapy and Experimental Psychiatry, 24,* 49–55.

Rapp, J. T., Miltenberger, R. G., Ellingson, S., Galensky, T. L., & Long, E. S. (1997, November). *Functional analysis and treatment of hair pulling maintained by digital-tactile stimulation.* Paper presented at the annual conference of the Midwest Association for Behavior Analysis and Therapy, Fargo, ND.

Rapp, J. T., Miltenberger, R. G., Galensky, T. L., Roberts, J., & Ellingson, S. A. (1998). *Functional analysis and simplified habit reversal treatment of thumb sucking.* Manuscript submitted for publication.

Rapp, J. T., Miltenberger, R. G., & Long, E. S. (in press). Augmenting simplified habit reversal with an awareness enhancement device: Preliminary findings. *Journal of Applied Behavior Analysis.*

Rapp, J. T., Miltenberger, R. G., Long, E. S., Elliott, A. J., & Lumley, V. A. (1998). Simplified habit reversal treatment for chronic hair pulling in three

adolescents: Clinical replication with direct observation. *Journal of Applied Behavior Analysis, 31,* 299–302.

Riley, G. D. (1972). A stuttering severity instrument for children and adults. *Journal of Speech and Hearing Disorders, 37,* 314–322.

Rincover, A. (1978). Sensory extinction: A procedure for eliminating self-stimulatory behavior in psychotic children. *Journal of Abnormal Child Psychology, 6,* 299–301.

Rosenbaum, M. S., & Ayllon, T. (1981a). The behavioral treatment of neurodermatitis through habit reversal. *Behaviour Research and Therapy, 19,* 313–318.

Rosenbaum, M. S., & Ayllon, T. (1981b). The habit-reversal technique in treating trichotillomania. *Behavior Therapy, 12,* 473–481.

Saint-Laurent, L., & Ladouceur, R. (1987). Massed versus distributed application of the regulated breathing method for stutterers and its long term effect. *Behavior Therapy, 18,* 38–50.

Scotti, J. R., Schulman, D. E., & Hojnacki, R. M. (1994). Functional analysis and unsuccessful treatment of Tourette's syndrome in a man with mental retardation. *Behavior Therapy, 25,* 721–738.

Sharenow, E. L., Fuqua, R. W., & Miltenberger, R. G. (1989). The treatment of muscle tics with dissimilar competing response practice. *Journal of Applied Behavior Analysis, 22,* 35–42.

Shimberg, E. F. (1995). *Living with Tourette syndrome*. New York: Simon & Schuster.

Silber, K. P., & Haynes, C. E. (1992). Treating nail biting: A comparative analysis of mild aversion and competing response therapies. *Behaviour Research and Therapy, 30,* 15–22.

Stuart, R. B., & Davis, B. (1972). *Slim chance in a fat world: Behavioral control of obesity*. Champaign, IL: Research Press.

Tarnowski, K. J., Rosen, L. A., McGrath, M. L., & Drabman, R. S. (1987). A modified habit reversal procedure in a recalcitrant case of trichotillomania. *Journal of Behavior Therapy and Experimental Psychiatry, 18,* 157–163.

Van Riper, C. (1982). *The nature of stuttering* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.

Vargas, J. M., & Adesso, V. J. (1976). A comparison of aversion therapies for nail biting behavior. *Behavior Therapy, 7,* 322–329.

Wagaman, J. R., Miltenberger, R. G., & Arndorfer, R. E. (1993). Analysis of a simplified treatment for stuttering in children. *Journal of Applied Behavior Analysis, 26,* 53–61.

Wagaman, J. R., Miltenberger, R. G., & Williams, D. E. (1995). Treatment of a vocal tic by differential reinforcement. *Journal of Behavior Therapy and Experimental Psychiatry, 26,* 35–39.

Wagaman, J. R., Miltenberger, R. G., & Woods, D. W. (1995). Long-term follow-up of a behavioral treatment for stuttering in children. *Journal of Applied Behavior Analysis, 28,* 233–234.

Wagaman, J. R., Williams, D., & Camilleri, T. (1998). *A case study of a behavior intervention for the treatment of rumination.* Manuscript submitted for publication.

Waterloo, K. K., & Gotestam, K. G. (1988). The regulated breathing method for stuttering: An experimental evaluation. *Journal of Behavior Therapy and Experimental Psychiatry, 19,* 11–19.

Watson, T. S., & Allen, K. D. (1993). Elimination of thumb sucking as a treatment for severe trichotillomania. *Journal of the American Academy of Child and Adolescent Psychiatry, 32,* 830–834.

Watson, T. S., & Sterling, H. E. (1998). Brief functional analysis and treatment of a vocal tic. *Journal of Applied Behavior Analysis, 31,* 471–474.

Woods, D. W., Fuqua, R. W., & Waltz, T. (1997). Evaluation and elimination of a vocal avoidance response in a child who stuttered: A case study. *Journal of Fluency Disorders, 22,* 287–297.

Woods, D. W., Long, E. S., Fuqua, R. W., Miltenberger, R. G., Outman, R. C., & Boudjouk, P. J. (1998). *Evaluating the social acceptability of persons with tic disorders.* Manuscript submitted for publication.

Woods, D. W., & Miltenberger, R. G. (1995). Habit reversal: A review of applications and variations. *Journal of Behavior Therapy and Experimental Psychiatry, 26,* 123–131.

Woods, D. W., & Miltenberger, R. G. (1996a). Are persons with nervous habits nervous? A preliminary examination of habit function in a nonreferred population. *Journal of Applied Behavior Analysis, 29,* 259–261.

Woods, D. W., & Miltenberger, R. G. (1996b). A review of habit reversal with childhood habit disorders. *Education and Treatment of Children, 19,* 197–214.

Woods, D. W., Miltenberger, R. G., & Flach, A. D. (1996). Habits, tics, and stuttering: Prevalence and relation to anxiety and somatic awareness. *Behavior Modification, 20,* 216–225.

Woods, D. W., Miltenberger, R. G., & Lumley, V. A. (1996). Sequential application of major habit-reversal components to treat motor tics in children. *Journal of Applied Behavior Analysis, 29,* 483–493.

Wright, K. M., & Miltenberger, R. G. (1987). Awareness training in the treatment of head and facial tics. *Journal of Behavior Therapy and Experimental Psychiatry, 18,* 269–274.

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