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The Role of the Reflexive-Conditioned Motivating Operation (CMO-R) During Discrete Trial Instruction of Children With Autism

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Abstract

The principle of motivation has resurfaced as an independent variable in the field of behavior analysis over the past 20 years. The increased interest is the result of refinements of the concept of the motivating operation and its application to the learning needs of persons with developmental disabilities. Notwithstanding the increased emphasis upon modification of motivating operations to reduce problem behavior, there is limited recognition of this important behavioral variable in autism treatment literature. An overview of antecedent-based instructional modifications that lead to a reduction of escape and avoidance behavior of children with autism during instruction is provided. An analysis of these instructional methods as motivating operations is proposed. A conceptually systematic analysis of the influence of instructional methods is offered as a tool for improving the selection and implementation of effective teaching procedures.

Keywords

motivating operations, establishing operations, autism, escape and avoidance behavior, discrete trial instruction

Comprehensive intensive treatment based upon the application of behavior analytic principles has proven to be an effective form of intervention for children with autism (Green, 1996). Researchers have demonstrated the superiority of behavior analytic programs over other approaches to autism treatment or differing levels of intensities of services (Birnbrauer & Leach, 1993; Cohen, Amerine-Dickens, & Smith, 2006; Eikseth, Smith, Jahr, & Eldevik, 2007; Lovaas, 1987; Sallows & Graupner, 2005; Remington et al., 2007; T. Smith, Groen, & Wynne, 2000). These researchers have provided clear evidence that intensive intervention guided by behavior analytic principles can produce substantial benefits for children with a disorder that was once thought to be resistant to all forms of treatment. There are reports of children with autism entering regular education classrooms, achieving substantial cognitive gains, and developing age-appropriate social skills after many years of intensive behavioral intervention (Lovaas, 1987). Recently, evidence has been gathered that suggests school, community, and home applications of intensive behavioral intervention can be equally successful (Eikseth, Smith, Jahr, & Eldevik, 2002; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005). At least five published manuals (Leaf & McEachin, 1999; Lovaas, 1981, 2003; Maurice, Green, & Foxx, 2001; Maurice, Green, & Luce, 1996) for parents and practitioners are available to provide a summary of the effective teaching methods discovered through controlled studies. These manuals provide a user-friendly method of disseminating effective behavior analytic methods for teaching children with autism. The result may be greater acceptance and widespread application of behavior analytic methods with children with autism.

Much of the research and all of the manualized treatment packages emphasize the importance of motivating children to respond to teacher-directed instructional tasks. R. L. Koegel, Carter, and Koegel (1998) and L. K. Koegel, Koegel, Shoshan, and McNerney (1999) suggested that motivation is pivotal to teaching of children with autism because its creation is critical to the development of a wide range of skills. Moreover, given the tendency of these

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children to engage in high rates of escape and avoidance behaviors (R. L. Koegel, Koegel, Frea, & Smith, 1995) within instructional demand settings, methods that increase the motivation to respond may be essential for producing long-term positive outcomes. The ultimate outcome for many children with autism may depend at least partially upon their learning to attend to teacher-directed activities and respond correctly and quickly for reasonable periods of time each day (Drash & Tudor, 1993). This is especially important for children with autism because they frequently fail to learn through exposure to typical social environments (T. Smith, 2001). As an alternative to mere exposure to everyday experiences, the method of discrete trial instruction (Lovaas, 1981, 1987; T. Smith, 2001) has been demonstrated to be one of the most effective instructional tools for teaching important language, social, and cognitive skills to children with autism as a component of a comprehensive program of intervention. The method is modeled after Skinner's (1968) three-term contingency arrangement whereby a stimulus is presented by a teacher, a response occurs, and a consequence follows the response to strengthen or weaken the likelihood that it will occur again under similar conditions.

When discrete trial instruction has been used as a component of a comprehensive program of intensive intervention for children with autism, long-term benefits have been achieved with many children (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; T. Smith, 1999). Notwithstanding the benefits of this method, its proper implementation presents substantial challenges to practitioners. The implementation of discrete trial instruction may conflict with the learning history of children with autism related to escape and avoidance behavior. In other words, the high demand requirements of discrete trial instruction are the same conditions that typically evoke problem behavior in the form of tantrumming, flopping, high rates of stereotypies, aggression, and self-injury. Smith (T. 2001, p. 89) explains: ". . . children with autism may attempt to escape or avoid almost all teaching situations, as well as any requests that adults make of them." Consequently, a thorough conceptual understanding and practical repertoire related to the modification of instructional variables that reduce escape-maintained and avoidance-maintained problem behavior of children with autism appears essential.

This article was generated to provide an overview of the behavioral analysis of motivation during discrete trial instruction and a re-interpretation of the effects of antecedent variables as motivating operations (MO), and, more specifically, the reflexive-conditioned motivating operation (CMO-R). No new methods are presented. Instead, this interpretation is offered to help practitioners and teachers understand why varieties of procedures that have been reported in the literature are effective. Baer, Wolf, and Risley (1968, p. 96) stated that practitioners within a scientific discipline require more than a "collection of tricks" as the source of their procedures. Extension to new areas is accomplished only through the understanding of how procedures work in terms of basic principles. In the case of discrete trial instruction of children with autism, practitioners may benefit from a conceptually systematic analysis of motivation when conducting training, applying the principles to new problems, generally reducing the aversiveness of teaching environments, and decreasing reliance on escape extinction. Moreover, improved selection of appropriate instructional methods may be facilitated.

The Establishing Operation

Michael (1993, p. 192) stated the establishing operation (EO)

> is an environmental event, operation, or stimulus condition that affects an organism by momentarily altering (a) the reinforcing effectiveness of other events and (b) the frequency of occurrence of that part of the organism's repertoire relevant to those events as consequences.

To paraphrase Michael (2004), EOs make someone "want something" and lead to the actions that have produced what is now "wanted." Food deprivation makes you "want" food and therefore leads to actions that have produced food ingestion in the past, such as making a sandwich. A headache makes you "want" pain relief and therefore leads to actions that reduce pain, such as swallowing an aspirin. A significant portion of tantrums and generally disruptive behavior in children with autism during instruction may result from strong motivation for something (EO), such as task removal, a toy, or attention.

The term EO has been considered awkward because it implies only an increase in reinforcing or punishing effectiveness. Therefore, Laraway, Syncerski, Michael, and Poling (2003) recommended replacing the term with MO. Within the remainder of this article, MO will be used rather than EO.

Michael (1993, 2004, 2007) provided descriptions of several unconditioned and conditioned MOs. A full description of each is beyond the scope of this article. Instead, an analysis of problem behavior during discrete trial instruction will be provided, utilizing the relevant concept of the CMO-R. Methods will be suggested that appear to abolish the CMO-R, leading to reductions in problem behavior within the context of demand-related instructional activities with persons with developmental disabilities and autism. Despite the fact that several researchers have demonstrated a reduction in escape-motivated behavior without acknowledging the role of the CMO-R, an increasing number of studies (Iwata, Smith, & Michael, 2000) implicating this important motivational variable seems to suggest a previously unrecognized role. The CMO-R has been implicated directly in several studies as an independent variable that affects the occurrence of problem behavior (Crockett & Hagopian, 2006; DeLeon, Neidert, Anders, & Rodriguez-Catter, 2001; Ebanks & Fisher, 2003; Lalli et al., 1999; McComas, Hoch, Paone, & El-Roy, 2000). The presentation of instructional demands in all these studies implicated the CMO-R as the potential mechanism that accounted for the reported behavioral effects. Michael (1993, p. 203) defined the CMO-R as:

> Any stimulus condition whose presence or absence has been positively correlated with the presence or absence of any form of worsening will function as a CMO in establishing its own termination as effective reinforcement and in evoking any behavior that has been so reinforced.

The CMO-R is an environmental event that ultimately increases the value of conditioned negative reinforcement and therefore evokes any behavior that has led to a reduction in the current aversive condition. In the case of the CMO-R specifically, the conditioned aversive stimulus is the onset of the very stimulus whose offset would function as a form of conditioned reinforcement. For example, when teaching children with autism, the mere delivery of an instructional demand may establish its removal as a reinforcer. Therefore, the offset of the stimulus will act as a reinforcer for any response that removes the instructional demand. In other words, if instructional demands and the setting in which they are presented "signals" or warns of any type of worsening situation (reduced reinforcement, difficult instructional demands, many instructional demands, high rate of errors, etc.), responses that remove the warning signal will be evoked. Within this context, instructional demands act as aversive stimuli and therefore evoke problem behavior that has led to the removal of the demands in the past.

The CMO-R and Teaching Children With Autism

Responding maintained by escape and avoidance of instructional and other types of demands accounts for between 33% and 48% of self-injurious and aggressive behaviors of persons with developmental disabilities (Derby et al., 1992; Iwata et al., 1994). The behavior analytic research literature is replete with interventions for escape-motivated behavior including but not limited to functional communication training (FCT) plus extinction (Hanley, Iwata, & McCord, 2003) and noncontingent escape (J. E. Carr & LeBlanc, 2006). Lovaas (1981, p. 29) suggested "Developmentally disabled children often throw tantrums when demands are placed on them. Their tantrums may interfere seriously with their learning of more appropriate behaviors." Other researchers also have documented the negative role that escape and avoidance behavior plays in the teaching and acquisition of important skills of children with autism. R. L. Koegel et al. (1998, pp. 167–168) claim that:

> It is well documented that children with autism fail to respond to and avoid many types of language and academic interactions . . . failure to respond to everyday environmental stimuli, which appears as a widespread motivation problem, may not only have an impact on a child's communicative and scholastic activities but also can be profoundly detrimental to a child's social development.

Sundberg (1993) suggested that the teaching of language and other skills is often complicated when instructional stimuli act as a CMO-R. This conclusion is particularly problematic because one of the most frequently implemented behavior analytic methods, discrete trial instruction, includes the presentation of frequent teacher-initiated academic demands. T. Smith (2001, p. 86) suggests "As a result, these children are likely to experience frustration in teaching situations. . .. They may react to such frustrations with tantrums and other efforts to escape or avoid future failures." Smith suggests that providers of these services must be equipped with the skills necessary to reduce these problem behaviors during teaching sessions. Some investigators have concluded that the best outcome for children with autism may be related to the teacher's or parent's skill in reducing disruptive behavior and developing learner cooperation during instruction (Lovaas, 2003). Given the fact that there is evidence that instructional and other types of demands delivered to children with autism during teaching sessions (and at other times) might well function as CMO-Rs for some children (R. Smith & Iwata, 1997), a comprehensive understanding of how this independent variable affects learning, and information on how to weaken its control over problem behavior appears essential for teachers and others who guide programs for children with autism.

To facilitate an understanding of CMO-R, an example from the laboratory setting is offered. Figure 1 illustrates the development of the CMO-R and the development of the escape and avoidance behavior it evokes in a laboratory environment. The operant experimental preparation that has yielded high rates of escape and avoidance behavior is referred to as the discriminated avoidance paradigm (Hoffman, 1966). In a laboratory example, rats subjected to painful shock that was preceded by and positively correlated with the sound of a neutral tone learned to terminate the tone and avoid the shock

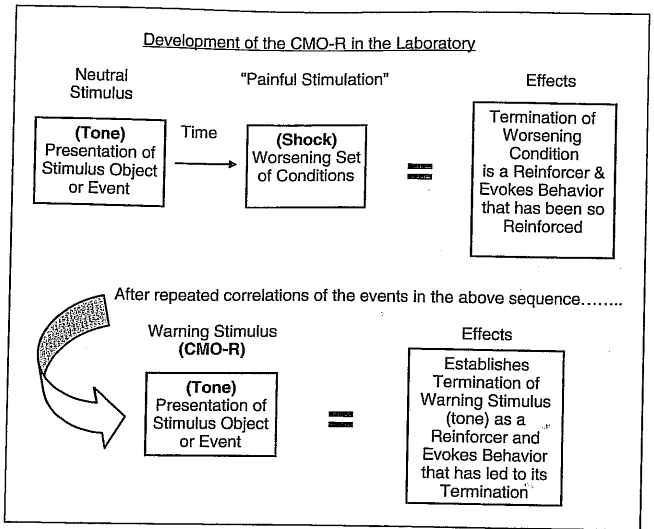

Figure 1. Illustrative diagram of the development of the reflexive-conditioned motivating operation (CMO-R) in the laboratory.

by pressing a metal bar. In this experiment, after repeated exposures to the tone–shock pairings, the mere presentation of the tone established its removal as a reinforcer and evoked behavior that in the past had resulted in its termination, such as bar pressing. Notice how the tone presentation met the two-part definition of the MO in terms of value-altering and behavior-altering effects. Also note the termination of the tone acted as a conditioned reinforcer for the bar pressing.

Within the behavioral literature, the onset of a stimulus like the tone has been identified as a discriminative stimulus (S^D) for the behavior of bar pressing. Michael's (1982, 2007) reinterpretation of the difference between discriminative stimuli and MOs leads to the conclusion that the tone onset acts as a CMO-R. In addition, the reinforcer for the bar press has typically been identified as avoidance of the shock, not the termination of the tone. Michael (2004, p. 71) suggested from a molecular perspective this does not seem reasonable since, "Something not happening does not easily qualify as the kind of event that can function as an immediate response consequence." Michael's (1982, 1988, 1993, 2000, 2004, 2007) refinements of the concept of the CMO has added greatly to our understanding of this behavioral variable. Failure to properly identify these events in terms of their functional relations to behavior may lead to imprecise and ineffective control of behavior in the laboratory, and worse, to poorly designed and implemented treatment programs for children with autism in classrooms and other settings.

Now consider the same arrangement as it relates to the instruction of children with autism within a discrete trial instruction format. Figure 2 illustrates the same arrangement of behavior analytic variables described in the laboratory example provided in Figure 1.

In general, it is recommended that many children with autism receive as much as 25 to 40 hrs per week of intensive behavioral intervention (Green, 1996; Leaf & McEachin, 1999; National Research Council, 2001). An important component of the intensive treatment model is the use of discrete trial instruction. Within this approach, behavioral tasks are divided into component activities. While the instructor is sitting at a child-sized table, he or she usually presents an instructional demand, waits for or prompts the correct response, provides a consequence for the child's response, and then pauses for a few seconds before presenting the next instructional demand (Anderson, Taras, & O'Malley-Cannon, 1996). The daily activities may alternate between structured and unstructured, with opportunities for incidental teaching (Leaf & McEachin, 1999). Many programs combine discrete trial instruction sessions with natural environment teaching (Sundberg & Partington, 1998). Whatever format is chosen, all behavioral treatment programs for children with autism emphasize active learner responding to high rates of teacher-presented instructional demands with the degree of learner cooperation affecting the benefit achieved.

As Figure 2 suggests, the presence of the teacher, display of the materials, and requests to move to the instructional environment all may have been correlated with later stages of the instructional setting when the "worsening set of conditions" became increasingly potent. All of the instructional activities listed in the worsening conditions column in Figure 2 have been identified in the behavioral literature as potentially aversive conditions that may occur during the instruction of children with autism (Langthorne, McGill, & O'Reilly, 2007; McGill, 1999; R. Smith & Iwata, 1997; Wilder & Carr, 1998). In this way, the activities at the beginning of the session serve as a warning signal of movement toward the later stages of the instructional session and therefore establish removal of any and all signs of instruction as a reinforcer and evoke problem behavior, such as aggression, self-injury, and tantrumming that have historically produced task removal (Michael, 2000). In this case, the teacher, the materials, the teacher's voice, and the actual demands all may begin to function as a CMO-R because of their correlation with instructional activities that represent a worsening set of conditions.

The worsening set of conditions in the instructional example is only metaphorically referred to as "painful stimulation." Conditions or stimuli that warn of a decrease in the rate of reinforcement, decrease in the amount of reinforcement, less immediate reinforcement, greater response requirement, greater response effort, and so forth are all worsening conditions that can act as reinforcers for behavior that terminates them (Michael, 2004). Failure to recognize the contribution of the CMO-R to the development of escape and avoidance behavior during the instruction of children

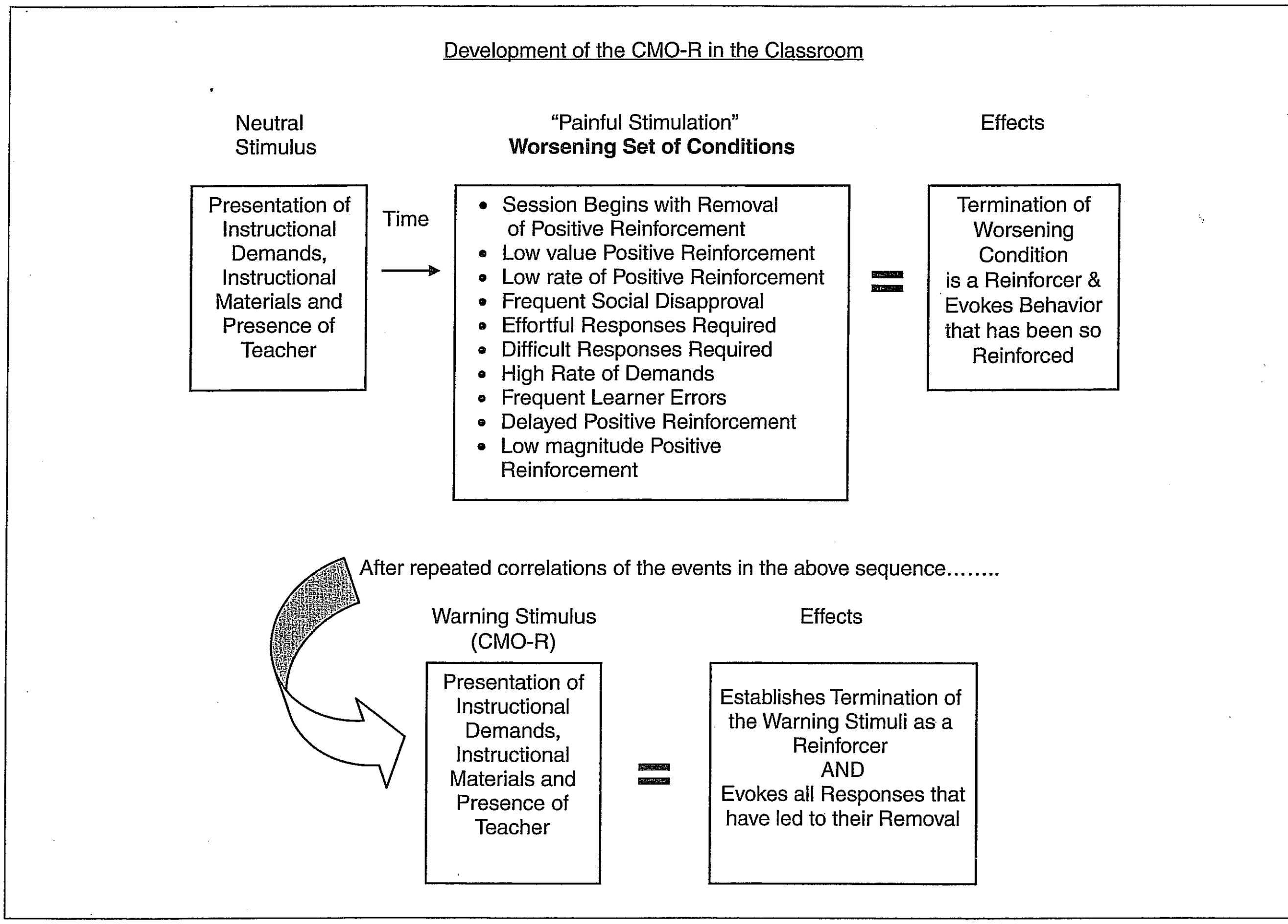

Figure 2. Illustrative diagram of the development of the reflexive-conditioned motivating operation (CMO-R) in the classroom.

with autism may reduce the likelihood that the instructional methods necessary to weaken its effects will be implemented.

Differentiating S^Ds from MOs

An issue central to this topic is the difference between the S^D and the MO. The fact is these two antecedent stimuli share several structural and functional characteristics including the fact that both are antecedent variables, are learned, and evoke and abate behavior. S^D control is identified frequently as the source of behavior change that is more properly ascribed to the effects of CMO-R. "Whereas the discriminative stimulus derives control over responding through a special historical relationship with behavioral consequences, Skinner's account of other antecedents suggests a different source of influence between some antecedent stimuli and behavior" (R. Smith & Iwata, 1997, p. 346). In this quote, Smith and Iwata are referring to the MO as the "different source of influence." Notwithstanding this distinction, behavior analysts typically have been trained to classify all antecedent evocative stimuli as discriminative stimuli (Schlinger, 1993). This set of circumstances ". . . leaves a gap in our understanding of operant functional relations" (Michael, 1993, p. 191). Moreover, Michael (1996) suggests that being able to talk about these different variables is essential to being able to analyze them effectively during instructional sessions. Therefore, when analyzing the evocative effects of demands on problem behavior with children with autism, reliance on the concept of the MO may lead to practice that is more effective.

Because instructional demands do not "signal" the availability of reinforcement for problem behavior but instead make negative reinforcement in the form of task removal valuable, they are best identified as an MO. This is the critical property that differentiates an S^D from a CMO-R. "In short, EOs change how much people want something; S^Ds change their chances of getting it" (McGill, 1999, p. 395).

Differentiating the CMO-R From Other MOs

Different MOs acquire their control over behavior through different mechanisms and histories. Unconditioned MOs have unique histories related to the species phylogeny. Conditioned MOs have unique histories related to an individual's ontogeny. In other words, the histories that have led to the development of the many unconditioned and conditioned MOs are remarkably different. Moreover, the mechanisms that account for their effects are all different. Consequently, practitioner efforts to abolish the effects and abate behavior related to any of the unconditioned or conditioned MOs would require substantially different environmental manipulations specific to each type of motivating operation. As a result, Michael (1993, 2007) provided specific labels for each MO as a way of acknowledging the different histories that have led to their control over behavior. Moreover, he identified different forms of unpairing that can be used to decrease behavior evoked by conditioned MOs. Practitioners who are aware of these differences will certainly be more effective in controlling behavior than those who are unaware.

The CMO-R is the only MO that is engendered with evocative control over behavior through a history of correlation with a worsening setting of conditions. As a result of this unique history, the mere presentation of this type of stimulus event immediately establishes its removal as a form of reinforcement. Methods to reduce the effects of the CMO-R are procedurally distinct from unconditioned as well as other conditioned MOs (i.e., surrogate, transitive). Michael (2000, p. 402) highlighted the importance of this distinction by claiming ". . . to say that thinking of two evocative variables with such different histories and implications for prediction and control as though they were the same would surely result in theoretical and practical ineffectiveness."

Re-Interpreting Existing Treatments From a CMO-R Perspective

Iwata et al. (2000) suggested researchers have demonstrated the value of modifying MOs to increase or decrease problem behavior. The authors of all three major reviews of the topic (McGill, 1999; R. Smith & Iwata, 1997; Wilder & Carr, 1998) devoted sections of their articles to the modification of MOs as independent variables. They all subdivided this section into the MO modifications that were effective in reducing problem behavior maintained by positive, negative, and automatic reinforcement. The modification of antecedent motivation variables to reduce problem behavior maintained by negative reinforcement was analyzed in terms of the CMO-R. All authors cited studies in which investigators implemented procedures to reduce the value of task removal as reinforcers. As pointed out by R. Smith and Iwata (1997), however, few of the earlier researchers relied on the concept of the MO. Instead, they attributed the results to the structural variables of setting events and contextual variables or improperly to the effects of stimulus control. Recognition of the role of the MO has been obscured by the fact that a conceptually systematic approach that focuses on the functional relations among environmental stimuli and behavior has not been the general practice in the field. "In fact, a criticism of applied behavior analysis is a perceived failure to relate the many procedures generated for changing socially significant behavior to basic behavioral principles" (R. Smith & Iwata, 1997, p. 343).

Michael (2000, 2007) provided a conceptual analysis of the modification of the CMO-R as a guide to practitioners serving persons with autism and developmental disabilities. He adopted the notion of increasing the effectiveness of instruction as a unifying concept under which motivational antecedent variables, previously identified as setting events or contextual variables, could be classified as motivating operations. Within his analysis, Michael rejected the idea of merely removing the CMO-R (e.g., instructional demands) to reduce problem behavior because presentation of frequent instructional demands is a necessary condition for learning within discrete trial instruction methodology. Additionally, he agreed that the function-altering effects of extinction could reduce problem behavior but would leave the CMO-R in place and therefore would be a practical solution only if there could be no reduction in the aversive nature of the demands as CMO-Rs. He concluded that in most cases the CMO-R could be abolished by altering the instructional practices so that "instruction results in less failure, more frequent social and other forms of reinforcement, and other general improvements in the demand situation to the point at which it may not function as a demand but rather as an opportunity" (Michael, 2000, p. 409). Michael identifies a heretofore largely overlooked independent variable (or class of motivational variables) that needs to be considered during discrete trial instruction of children with autism.

McGill (1999) provided additional support for Michael's recommendation related to instructional modification. He stated that merely reducing the problem behavior while leaving the aversive nature of the demand situation unresolved is an unsatisfactory solution. He suggested that not only are practitioners obligated to reduce problem behavior but also to alter the challenging environment encountered by most persons with autism and developmental disabilities. McGill (p. 406) agrees with Durand (1990) that problem behaviors are at least partially the result of poorly arranged environments and that the CMO-R ". . . is a reflection of aberrant environmental characteristics (such as inappropriate demands)." McGill (p. 406) goes on to say that failure to manipulate the CMO-R may raise ethical concerns ". . . because it leaves a counterhabilitative environment in place and may be limited in its effectiveness because the circumstances evoking problem behavior still exist." Moreover, he states that FCT without extinction, punishment, and/or use of antecedent modifications generally is ineffective in reducing behavior maintained by negative reinforcement. This contention is supported empirically by Fisher et al. (1993) and Hagopian, Fisher, Sullivan, Acquisto, and LeBlanc (1998). Finally, McGill concluded that merely teaching a functionally equivalent response may not be sufficient to reduce problem behavior without modification of the value of the reinforcer that has led to the acquisition and maintenance of the response.

Treatments Designed to Abolish the CMO-R

Many effective antecedent modifications to reduce problem behavior have been demonstrated, often under the heading of curricular revisions (G. Dunlap, Foster-Johnson, Clarke, Kern, & Childs, 1995; G. Dunlap & Kern, 1993, 1996; G. Dunlap et al., 1993; G. Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; Kern, Childs, Dunlap, Clarke, & Falk, 1994; Kern & Dunlap, 1998) or antecedent interventions (Miltenberger, 2006). Many of these researchers have tested the effectiveness of treatment packages. Typically, variables related to choice of task, task variation, pace of instruction, interspersal of high-probability tasks, partial-task versus whole-task instruction, task difficulty, reducing learner errors, and so forth, have been included in the treatment packages to reduce escape-motivated problem behavior (Munk & Repp, 1994). Although these reports provided useful descriptions of behavior change methods, they failed to analyze them in terms of basic behavioral principles. Failure to provide a behavioral analysis of the effects of antecedent manipulations leaves the practitioner without the information necessary to analyze complex and novel cases. Notwithstanding this issue, many of the antecedent behavior reduction procedures recommended to reduce escape-motivated behavior can be re-interpreted in terms of modification of the CMO-R. Such an analysis suggests that the antecedent variables identified in the curricular revision literature acted as abolishing operations to the extent that they decrease the value of the reinforcer that is maintaining the problem behavior and therefore abated the responses that they previously controlled. A re-interpretation of the curricular revision research findings will reduce their explanatory mechanisms to a handful of behavioral principles and provide a conceptually systematic approach to the treatment of escape-motivated problem behaviors of children with autism during discrete trial instruction. This type of behavioral analysis may have important practical implications for persons who instruct children with autism.

Many behavior analytic practitioners have made use of the evidenced-based procedures described in the following section. No new procedures are offered. What follows is a discussion of some of the evidenced-based instructional practices that have been demonstrated to reduce problem behavior during instruction along with a re-interpretation of the effects and benefits of these methods in terms of altering the function of CMO-Rs.

Methods to Reduce the Effects of the CMO-R During Discrete Trial Instruction

Programming Competing Reinforcers

Researchers of several studies with persons with disabilities demonstrated that problem behavior evoked by a CMO-R and reinforced through termination of the demand situation can be reduced without controlling the negative reinforcing consequence that has maintained the behavior (Call, Wacker, Ringdahl, Cooper-Brown, & Boeltric, 2004; Lalli & Casey, 1996; Parrish, Cataldo, Kolko, Neef, & Egel, 1986; Piazza et al., 1997; Russo, Cataldo, & Cushing, 1981). In other words, behavior maintained by negative reinforcement can be weakened by programming positive reinforcement for an alternative compliant response or by delivering it noncontingently during high demand situations. This can be accomplished without eliminating the response–reinforcer relation in some cases (Lalli et al., 1999). The effects of positive and negative reinforcement were studied in a series of investigations with participants whose problem behavior had been acquired and maintained through task removal (Lalli & Casey, 1996; Lalli et al., 1999; Piazza et al., 1997). By programming concurrent schedules of reinforcement in which compliance with task demands was positively reinforced (e.g., with food, praise) and problem behavior resulted in task termination, the competing effects of positive and negative reinforcement could be assessed.

These researchers demonstrated that introduction of positive reinforcement for responses that were alternatives to the negatively reinforced problem behavior reduced the problem behavior without modification of the maintaining contingency, and in some cases without the use of extinction for problem behavior. In the Lalli et al. (1999) study, the results were achieved when the programmed schedule of reinforcement actually favored responses that produced task removal (i.e., negative reinforcement). The authors concluded that the presentation of the positive reinforcer abolished the CMO-R or value of task removal as a reinforcer and abated the class of responses that had produced that reinforcer in the past. In a follow-up study by DeLeon et al. (2001), the competing effects of positive and negative reinforcement on problem behavior maintained by task removal were investigated with a chained schedule. A child with autism was provided the opportunity to choose a positive reinforcer (i.e., potato chip) or negative reinforcer (i.e., break) after completing a scheduled number of responses. When the number of demands was relatively low, the participant reliably chose the positive reinforcer. It appeared that the presence of the positive reinforcer decreased the value of task termination as a reinforcer. However, the participant's preference switched to the break when the number of tasks required for reinforcement increased to more than 10. The authors concluded that the switch to the preference for a break when demands were increased indicated the demands had returned to their initial status as a CMO-R and therefore the value of task removal increased and evoked the participant's choice behavior of a break.

As demonstrated by Kennedy (1994) and then again by Call et al. (2004), the addition of a positive reinforcer delivered during instruction reduced the escape-motivated noncompliant behavior of some participants. Call et al. (2004, p. 155) concluded ". . . the addition of an arbitrary positive reinforcer can sometimes be sufficient to reduce problem behavior that is maintained, partially or solely, by negative reinforcement." These authors and others suggested that this effect is the result of lessening the aversive context of the instructional setting by the delivery of a competing positive reinforcer. These results appear consistent with Michael's (2000) analysis of how the function of demands may be altered from an aversive stimulus to an opportunity for the delivery of reinforcement.

Pairing and Embedding the Instructional Environment With Positive Reinforcement

McGill (1999) recommends several methods for weakening the value of the CMO-R to reduce escape-motivated problem behavior during instructional sessions with persons with developmental disabilities and autism. He suggests both consequence and antecedent modifications that may be effective. In any case, presentation of the stimuli that have evoked negatively reinforced problem behavior without presentation of the worsening condition that has typically accompanied them will reduce the value of the CMO-R and abate problem behavior. One method of accomplishing this outcome is to pair and embed the teaching context, personnel, materials, and so forth with an "improving set of conditions" through the delivery of positive reinforcers. In this way, the aversiveness of the teaching environment is reduced and therefore less likely to evoke escape and avoidance responses (Kemp & Carr, 1995).

Embedding reinforcing activities in a context of instructional demands has been shown to reduce behavior evoked by instructional demands. Studies by E. G. Carr and Carlson (1993) and Kemp and Carr (1995) demonstrated that demand-related problem behavior during community activities and in employment settings could be reduced by embedding reinforcing activities. E. G. Carr, Newsome, and Binkoff (1980) found that activities such as storytelling reduced escape-motivated responses and increased compliance with demands. Kennedy, Itkonen, and Lindquist (1995) demonstrated that merely embedding social comments prior to low probability demands decreased noncompliance in students with severe disabilities.

Errorless Instruction

Several researchers have demonstrated that when students make frequent errors during instructional sessions, levels of problem behavior are high (E.G. Carr & Durand, 1985; Ebanks & Fisher, 2003; Heckaman, Alber, Hooper, & Heward, 1998; Weeks & Gaylord-Ross, 1981). Instructional methods that reduce the frequency of errors have been demonstrated to reduce the level of problem behavior. An analysis of these results in terms of motivational variables suggests that errors may function as an MO and increase the reinforcing value of task removal or termination. If the instructor prevents or at least minimizes errors during instruction (i.e., errorless learning), the CMO-R is abolished and students engage in fewer problem behaviors. For example, Heckaman et al. (1998) demonstrated that when instructors used response prompts with a progressive time delay and students made very few errors, levels of disruptive behavior were dramatically reduced. In comparison, when a least-to-most prompting strategy was used the student made many more errors and had higher levels of disruptive behavior.

In a similar manner, Ebanks and Fisher (2003) reduced escape-motivated destructive behavior by providing antecedent prompting to reduce errors and by interspersing easy tasks with the more difficult demands. This intervention resulted in zero levels of destructive behaviors. Weeks and Gaylord-Ross (1981) found that students had higher levels of problem behavior during difficult as opposed to easy tasks. Almost no problem behavior occurred when students were making correct responses. Errorless instruction dramatically reduced problem behavior and increased learning.

These finding suggest the importance of minimizing learner errors through antecedent prompting methods. The reduction in errors probably functioned as an abolishing operation that reduced the effectiveness of escape as a reinforcing consequence and, as a result, reduced escape-motivated problem behavior.

Stimulus Demand Fading

Instructional demands have been implicated as a CMO-R in several studies (DeLeon et al., 2001; Ebanks & Fisher, 2003; Lalli et al., 1999; McComas et al., 2000). Researchers have shown that escape-motivated problem behavior can be virtually eliminated by removing demands (E. G. Carr & Durand, 1985; E. G Carr et al., 1980). However, this approach is impractical for teaching children with autism because failure to present instructional demands virtually eliminates learning opportunities. As a result, several researchers have shown that it is possible to alter the demands along a variety of dimensions, including task difficulty (Cameron, Ainsleigh, & Bird, 1992; Weeks & Gaylord-Ross, 1981), number of low probability requests (Ducharme & Worling, 1994), response effort (Horner & Day, 1991; Richman, Wacker, & Winborn, 2001; Wacker et al., 1990; Weld & Evans, 1990), and number or rate of instructional trials (Kennedy, 1994; Zarcone, Iwata, Smith, Mazaleski, & Lerman, 1994; Zarcone, Iwata, Vollmer et al., 1993). For example, Pace, Iwata, Cowdery, Andree, and McIntyre (1993) used a combination of extinction and fading instructional demands to reduce escape-motivated problem behaviors. Initially the instructor simply sat with the child until she or he completed a session with no problem behavior. Then, the instructor delivered one instructional demand at about the midpoint of the session. Over successive sessions, more demands were faded into the session. The results suggested that the fading procedures accelerated the behavior reduction effects of extinction. These results probably were obtained because the original task demands functioned as a CMO-R that increased the value of escape-motivated problem behavior. Removal of demands weakened the MO and decreased escape-motivated problem behaviors. Their gradual re-introduction did not create enough of a CMO-R to increase escape-motivated problem behaviors.

Modifying the rate, difficulty, and effort of responses during discrete trial instruction appears to reduce escape-motivated and avoidance-motivated problem behaviors. Over time, instructors may be able to fade in the rate, difficulty, and effort of demands until high levels of instructional participation are reached without problem behavior.

Task Variation

Some investigators have found that mass trialing (i.e., constantly presenting the same stimulus over consecutive trials) may increase problematic behavior during instructional sessions for persons with autism (G. Dunlap, 1984; G. Dunlap, Dyer, & Koegel, 1980; L. K. Dunlap & Dunlap, 1987; McComas et al., 2000). For example, Winterling, Dunlap, and O'Neill (1987) demonstrated that task variation dramatically reduced the levels of problem behavior for children and an adult with autism. They compared a condition in which the same task was presented on every trial to a condition in which tasks were varied frequently. The task variation condition produced less problem behavior. They demonstrated that increased skill acquisition occurred with the task variation approach in a second study with an adult with autism. These results were probably obtained because task variation functioned as an abolishing operation that reduced the value of escape from tasks. To use everyday language, doing the same task over and over again is boring. These findings suggest that mixing and varying instructional tasks during discrete trial instruction may function as an abolishing operation and decrease the effectiveness of escape as a reinforcer.

Pace of Instruction

Researchers have evaluated the effects of pace of instruction on acquisition and problematic behavior in different types of learners (Carnine, 1976; Tincani, Ernsbarger, Harrison, & Heward, 2005). For example, R. L. Koegel, Dunlap, and Dyer (1980) and G. Dunlap, Dyer, and Koegel, (1983) demonstrated that short intertrial intervals (ITI) reduced stereotypic behavior in children with autism when compared to long ITIs. In addition, children achieved higher rates of correct responding during the short ITI condition. In general, children exhibited less off-task behavior and acquired more skills during brisk-paced instruction. Pace of instruction probably functions as an abolishing operation, reducing the value of escape and avoidance as reinforcers. Specifically, during the ITI, reinforcement is not available and with longer, as compared to shorter intervals, the child receives a lower rate of reinforcement for instructional sessions of equal duration. Roxburgh and Carbone (2007) investigated this issue directly and found that during instruction of children with autism, shorter ITIs produced a higher rate of reinforcement and therefore less problem behavior. During long ITIs, the learner likely receives automatic reinforcement for stereotypic behavior. In contrast, instructional demands delivered at a brisk pace reduce the rate of reinforcement available through automatic reinforcement and increases the rate of socially mediated positive reinforcement available. Children who do not engage in off-task behavior and are impulsive (i.e., respond too quickly) are unlikely to benefit from fast-paced instruction (Dyer, Christian, & Luce, 1982). However, it appears that these children are less likely to engage in escape-motivated problem behavior in the first place.

In contrast, a few researchers suggest that a faster pace of instruction is related to increases in escape-motivated problem behavior (Zarcone et al., 1994; Zarcone, Iwata, Vollmer et al., 1993). In these studies, when the pace of the instruction was increased, the number of tasks the individuals were required to complete also was increased. For example, in the study by R. Smith, Iwata, Goh, and Shore (1995), the two conditions were a high-rate condition in which 30 trials were presented during the 15-min session and a low-rate condition in which 10 trials were presented during the 15-min session. The low-rate condition always produced lower rates of self-injurious behaviors. Because the number of instructional demands delivered is confounded with pace in this experiment, it is not possible to separate out the effects of pace with the effects of the number of instructional demands. The authors of this study discussed the difficulty of attempting to study pace of instruction without confounding variables of differences in reinforcement amount, rate, and ITIs.

Overall, it has been found that pace of instruction is an important variable that might serve as an abolishing operation that reduces the effectiveness of escape as a reinforcer. But as mentioned above, there are some exceptions to this finding. First, pace of instruction is not likely to be an effective abolishing operation if the number of demands or the duration of the session also is increased. Second, if a child does not engage in escape-motivated problem behavior or engages in quick responding, she or he is less likely to benefit from a fast pace of instruction. For a comprehensive discussion of variables related to pace of instruction see Tincani et al. (2005).

Neutralizing Routines

Several researchers have demonstrated that variables beyond the control of the instructor may establish CMO-R during planned instructional sessions. Occurrences such as sleep deprivation (Kennedy & Meyer, 1996; O'Reilly, 1995), otitis media (O'Reilly, 1997), and cancellation of preferred activities (Horner, Day, & Day, 1997) have increased problem behavior during instructional sessions that have followed them. Horner et al. (1997) demonstrated that it may be possible to create an abolishing operation or "neutralizing routine" that reduces the effectiveness of the value of instructional demands as CMO-R following unplanned daily occurrences. In this study, two students engaged in problem behavior contingent on error corrections when the additional CMO-R of having a planned activity cancelled or delayed occurred. The implementation of a neutralizing routine substantially reduced problem behavior. The neutralizing routines used in this study consisted of the students engaging in highly preferred activities 30 to 40 min prior to the instructional session. Students emitted zero levels of problematic behavior during the neutralizing routine condition.

Some individuals will benefit from high periods of dense reinforcement and low demand activities prior to instructional sessions especially after the denial of other reinforcers. These researchers demonstrate the importance of understanding the concept of the CMO-R in reducing problem behavior.

Choice Making

Choice making may function as an abolishing operation and reduce the value of escape from tasks (McComas et al., 2000; Vaughn & Horner, 1997). For example, Dyer, Dunlap, and Winterling (1990) found problem behavior was dramatically reduced when students were offered choices of activities and reinforcers during instructional sessions. The choice condition dramatically reduced problem behavior in all participants. Choice likely functions as an abolishing operation for escape-motivated problem behavior because the child has the opportunity to specify the current motivation. Because the child could stop an activity at any time and choose a new activity, there is limited possibility of creating a CMO-R for escape-maintained problem behavior. Many children will benefit from the opportunity to make choices regarding activities within discrete trial instruction sessions.

Interspersal Instruction

Several researchers have demonstrated that problem behavior can be reduced when easy tasks are interspersed with difficult tasks (E. G. Carr et al., 1980; Harchik & Putzier, 1990; Horner, Day, Sprague, O'Brien, & Healthfield, 1991; Mace & Belfiore, 1990; Mace et al., 1988; Neef, Iwata, & Page, 1980; Singer, Singer, & Horner, 1987). In two studies, similar effects were found when interspersing social comments with instructional demands (Kennedy, 1994; Kennedy et al., 1995). Problem behavior may have been reduced with the use of these procedures because the interspersal of easy tasks functions as an abolishing operation reducing the value of escape as a reinforcer. Difficult tasks probably function as a CMO-R because they are correlated with a worsening set of conditions related to low rates of reinforcement, high rates of error, and higher rates of social disapproval. By interspersing easy tasks with more difficult tasks, the value of the CMO-R is reduced. The recommendation is to combine extinction with interspersal instruction to ensure its effectiveness (Zarcone, Iwata, Hughes, & Vollmer, 1993). It is also important to avoid presenting easy tasks immediately following problem behavior. If this were to occur, problem behavior would likely be strengthened by negative reinforcement (Sailor, Guess, Rutherford, & Baer, 1968). Despite the data suggesting the negative effects of this practice (Sailor et al., 1968), many educators remove difficult tasks contingent upon problem behavior and present alternative maintenance or more easily mastered tasks. In any case, children with autism may benefit from interspersal of easy and target skills during discrete trial instruction.

Task Novelty

The simple presentation of a novel task may serve as CMO-R for some students and increase the value of task removal as a reinforcer. R. Smith et al. (1995) demonstrated this effect by introducing new tasks each time self-injurious behavior (SIB) reached low levels. Following introduction of the novel task, SIB increased, leading to the identification of the novel tasks as MOs. Simple exposure to the task over several sessions may reduce the value of this CMO-R. It is probably important to introduce novel tasks gradually, because introducing high rates of novel stimuli will likely serve as an MO, increasing the effectiveness of escape as a reinforcer. Gradual introduction may be effective in keeping the value of task removal as a reinforcer low. Simple exposure to novel stimuli may benefit some children and reduce escape-motivated problem behavior.

Session Duration

The length of the treatment session may serve as a CMO-R that increases the value of escape. R. Smith et al. (1995) found idiosyncratic differences among participants in how session duration may serve as an MO. The authors clearly considered the passage of time as a behavioral variable. Some participants had little or no problematic behavior early in the session, but high rates later in the session suggested that the passage of time in the demand condition may have functioned as a CMO-R. Other participants engaged in a relatively high rate of problem behavior early in the session, but the rate decreased over the length of the session. This implies that the actual presentation of the demand condition may have served as the MO. The authors make treatment recommendations based on this analysis. Specifically, for learners who engage in problematic behavior late in the session, it may be best to arrange several sessions of short durations. For students who engage in the most problem behavior at the start of the session, it may be advantageous to have relatively long instructional sessions, but fewer per day. These treatment recommendations are directly related to an analysis of the behavior based on session duration functioning as an MO that may either establish or abolish the reinforcing value of escape from tasks.

Conclusions

A thorough understanding of the principle of motivation and an analysis of instructional methods as MOs can provide behavior analysts with a powerful technology for reducing problem behavior during any instruction, including discrete trial instruction. With knowledge of the concept of the CMO-R, practitioners may be better equipped to evaluate, select, and implement instructional methods that reduce escape and avoidance behavior exhibited by a large percentage of children with autism and related disabilities. A conceptually systematic approach to determining the influence of antecedent motivational variables will equip instructional decision makers with a wider range of choices of teaching methods and, maybe more importantly, will provide a natural science approach to analyzing and modifying instructional methods when the performance of learners with autism does not result in expected outcomes.

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