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

Vincent J. Carbone, Barry Morgenstern, Gina Zecchin-Tirri & Laura Kolberg

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 the 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, the autism treatment literature currently reflects limited recognition of this important behavioral variable. This paper provides an overview of antecedent based instructional modifications that lead to a reduction of escape and avoidance behavior of children with autism during instruction. 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). Several comparative studies 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, 2002, 2007; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaas, 1987; Sallows & Graupner, 2005; Remington et al., in press; Smith, Groen, & Wynne, 2000). This research has 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 that school, community, and home applications of intensive behavioral intervention can be equally successful (Eikseth et al., 2002; Howard et al., 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 have provided 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 have emphasized the importance of motivating children to respond to teacher directed instructional tasks. Koegel, Carter, and Koegel (1998) and Koegel, Koegel, Shoshan & McNerney (1999) suggested that motivation is pivotal to the 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 children to engage in high rates of escape and avoidance behaviors (Koegel, Koegel, Frea, & Smith, 1995) within instructional demand settings, methods that increase the motivation to respond may be essential to positive long-term 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 (Smith, 2001). As an alternative to mere exposure to everyday experiences, the method of discrete trial instruction (Lovaas, 1981, 1987; 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 in order 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; 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 sterotypies, aggression, and self-injury. Smith (2001) explains "…..children with autism may attempt to escape or avoid almost all teaching situations, as well as any requests that adults make of them" (p. 89). Consequently, a thorough conceptual understanding and practical repertoire related to the modification of instructional variables that reduce escape and avoidance maintained problem behavior of children with autism appears essential. The purpose of this paper is 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 motivationg operations (MO), and more specifically, the CMO-R. No new methods are presented. Instead, this interpretation is offered to help practitioners and teachers understand why a variety of procedures that have been reported in the literature are effective. Baer, Wolf, and Risley (1968) stated that practitioners within a scientific discipline require more than a "bag of tricks" as the source of their procedures. Extension to new areas is only accomplished 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) 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" (p.192). 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 had been considered awkward since it implies only an increase in reinforcing or punishing effectiveness. Therefore, Laraway, Syncerski, Michael and Poling (2003) recommended replacing the term with motivating operation (MO). Within the remainder of this paper the term MO will be used.

Michael (1993, 2004, 2007) has provided descriptions of several unconditioned and conditioned MOs. A full description of each is beyond the scope of this paper. Our purpose here is to provide an analysis of problem behavior during discrete trial instruction utilizing the relevant concept of the conditioned reflexive motivation operation (CMO-R). And then, to suggest methods 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 studies have demonstrated a reduction in escape motivated behavior without acknowledging the role of the CMO-R the increasing number of studies (Iwata, et al. 2000) implicating this important motivational variable seems to suggest a previously unrecognized role. The CMO-R has been implicated directly as an independent variable that affects the occurrence of problem behavior in several studies in the past few years (Crockett & Hagopian, 2006; DeLeon, Neidert, Anders, & Rodriguez-Catter, 2001; Ebanks & Fischer, 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) 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. (p.203)

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 (i.e., reduced reinforcement, difficult instructional demands, many instructional demands, high rate of errors, etc.), responses which remove the warning signal will be evoked. Within this context, instructional demands act as aversive stimuli and therefore evoke problem behavior that has in the past led to the removal of the demands.

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 non-contingent escape (Carr & Le Blanc, 2006). Lovaas (1981) suggested that children with developmental disabilities and autism frequently engage in problem behavior that interferes with learning. "Developmentally disabled children often throw tantrums when demands are placed on them. Their tantrums may interfere seriously with their learning of more appropriate behaviors" (Lovaas, 1981, p.29). Other researchers have also documented the negative role that escape and avoidance behavior plays in the teaching and acquisition of important skills of children with autism (Koegel et al., 1998). These investigators 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. (Koegel et al., 1998, pp.167-168).

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 since one of the most frequently implemented behavior analytic methods, discrete trial instruction, includes the presentation of frequent teacher initiated academic demands. For example, discrete trial instruction begins with a teacher's instructional demand. Smith (2001) 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". (p.86) 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 skill of the teacher or parent 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 (Smith & Iwata, 1997), for some children 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. Following the laboratory example an applied example will be presented. The figure illustrates how the presentation of a neutral stimulus, through repeated correlation with a worsening set of conditions, becomes a CMO-R. This effect has been demonstrated within the laboratory with animal subjects. 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 the 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 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) 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" (p. 71). Michael's (1982, 1988, 1993, 2000, 2004, 2007) refinements of the concept of the CMO has greatly added 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, 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.

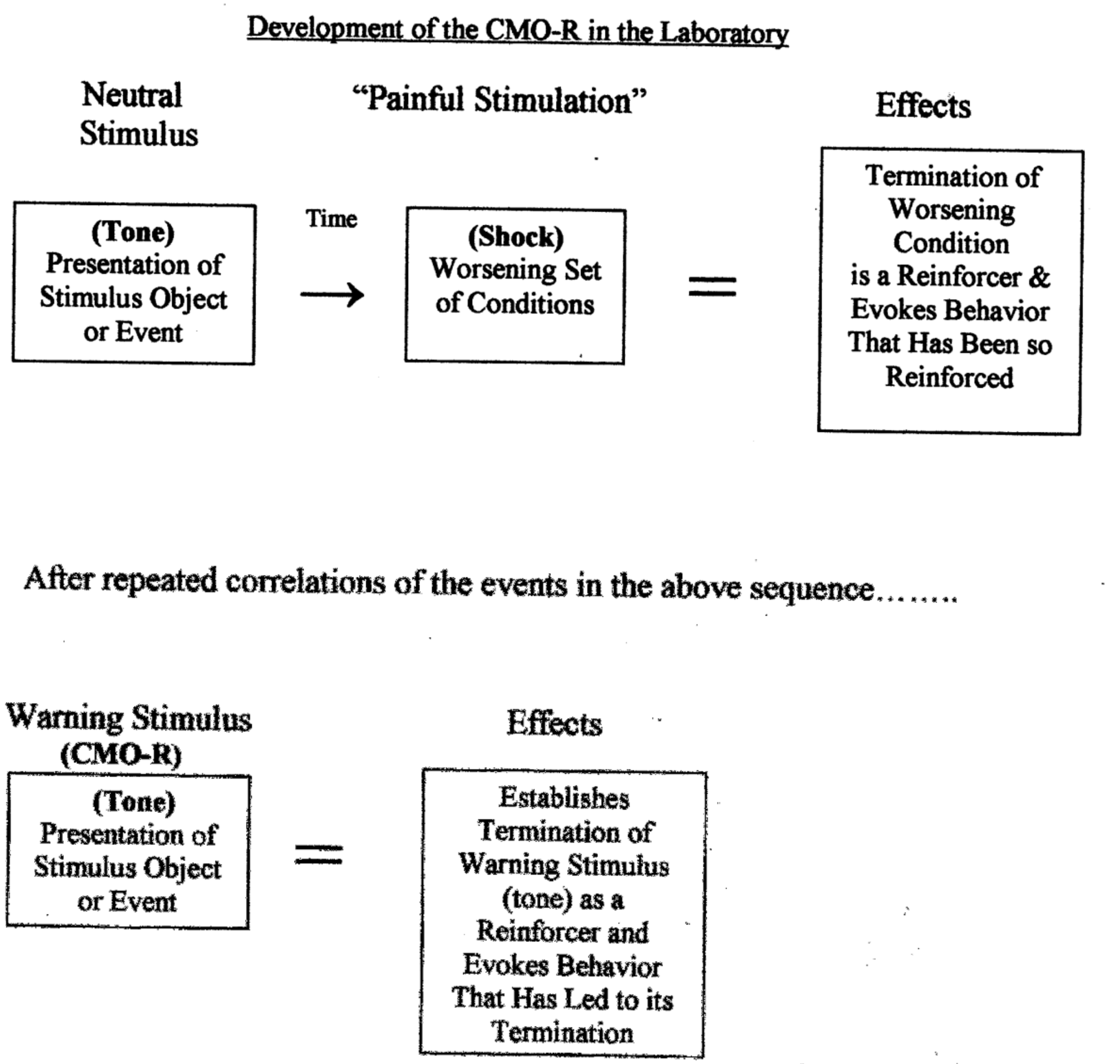

Figure 1. Illustrative diagram of the development of the reflexive conditioned motivating operation (CMO-R) in the laboratory.

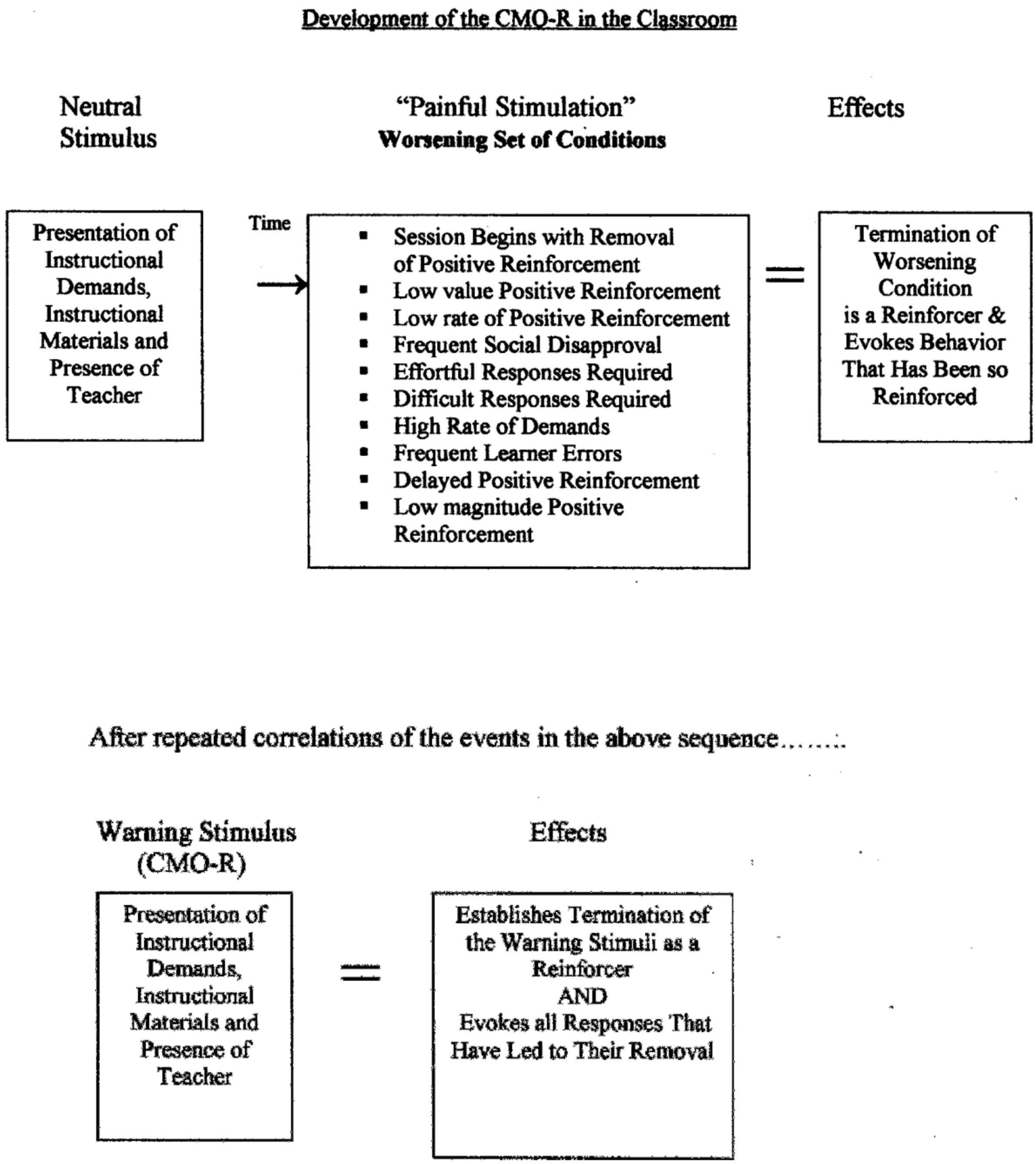

Figure 2. Illustrative diagram of the development of the reflexive conditioned motivating operation (CMO-R) in the classroom.

It is generally recommended that many children with autism receive as much as 25 to 40 hours per week of intensive behavioral intervention (Leaf & McEachin, 1999; Lord & McGee, 2001; Green, 1996). 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 be alternately 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 may all 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 (McGill, 1999; Smith & Iwata, 1997; Wilder & Carr, 1998). In this way, the activities at the beginning of the session serve as a warning signal that movement towards the later stages of the instructional session is progressing and therefore establishes removal of any and all signs of instruction as a reinforcer and evokes problem behavior, such as aggression, self-injury, tantrumming, etc. that have historically produced task removal (Michael, 2000). In this case, the teacher, the materials, the teacher's voice, and the actual demands may all begin to function as a CMO-R due to 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, etc. 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 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 which include the fact that they are both antecedent variables, they are learned, and they both evoke and abate behavior. S^D control is frequently identified 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" (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 have typically 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 more effective practice. Since instructional demands do not "signal" the availability of reinforcement for problem behavior but instead make negative reinforcement in the form of task removal valuable as reinforcement 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). Michael (2000) has 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" (p. 402).

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 all 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) has provided specific labels for each MO as a way of acknowledging the different histories that have led to their control over behavior. Moreover, he has identified the 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 not.

In the case of the CMO-R, it is the only MO which 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, e.g. surrogate, transitive. Consequently, failure to differentiate the CMO-R from other MOs or other behavioral variables in clinical practice would "surely result in theoretical and practical ineffectiveness" (Michael, 2000).

Re-Interpreting Existing Treatments from a CMO-R Perspective

Iwata et al. (2000) suggested that research has recently demonstrated the value of modifying MOs to increase or decrease problem behavior. The authors of all three major reviews of the topic (McGill, 1999; Smith & Iwata, 1997; Wilder & Carr, 1998) devoted sections of their papers 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 sections of these papers on modification of antecedent motivation variables to reduce problem behavior maintained by negative reinforcement analyzed their effects in terms of the CMO-R. They all cited studies in which investigators have implemented procedures to reduce the value of task removal as reinforcers. As pointed out by Smith and Iwata (1997), however, few of the earlier studies have 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" (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 to occur 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 only be a practical solution if the aversive nature of the demands as CMO-Rs could not be reduced. 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's analysis identifies a very important independent variable or class of motivational variables to be considered during discrete trial instruction of children with autism which heretofore have been largely overlooked.

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 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, 1999, p.406). McGill (1999) 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" (p. 406). Moreover, he states that FCT without extinction, punishment, and/or use of antecedent modifications is generally ineffective in reducing behavior maintained by negative reinforcement. This contention is supported empirically by Fisher, Piazza, Cataldo, Harrell, Jefferson & Conner, R. 1993; and Hagopian, Fisher., Sullivan., Acquisto & LeBlanc, 1998. Finally, McGill (1999) 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 in research studies, often under the heading of curricular revisions (Dunlap, Foster-Johnson, Clarke, Kern, & Childs, 1995; Dunlap & Kern, 1993, 1996**;** Dunlap et al., 1993; Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; Kern, Childs, Dunlap, Clarke, & Falk, 1994; Kern & Dunlap, 1998) or antecedent interventions (Miltenberger, 2006). Many of these studies have tested the effectiveness of treatment packages. Typically, variables related to choice of task, task variation, pace of instruction, interspersion of high-probability tasks, partial versus whole-task instruction, task difficulty, reducing learner errors, and so on have been included in the treatment packages to reduce escape-motivated problem behavior (Munk & Repp, 1994). Although these reports have provided useful descriptions of behavior change methods they have 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

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; Lalli et al., 1999; Parrish, Cataldo, Kolko, Neef, & Egel, 1986; Piazza, Fisher, Hanley, Remick, Contrucci, & Aitken 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 non-contingently 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 were 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 studies 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, her 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 increased the value of task removal and evoked the participant's choice behavior of a break.

As demonstrated by Kennedy (1994) and then again in a recent study by Call et al. (2004), the addition of a positive reinforcer delivered during instruction reduced the escape-motivated non-compliant behavior of some participants. Call et al. (2004) 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" (p.155). These authors and others have 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, etc. 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 Carr and Carlson (1993) and Kemp and Carr (1995) demonstrated that demand related problem behavior could be reduced by embedding reinforcing activities during community activities and in employment settings, respectively. Carr, Newsom, and Binkoff (1980) found that activities such as storytelling during demand situations 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 non-compliance in students with severe disabilities.

Errorless Instruction

Several studies have demonstrated that when students make frequent errors during instructional sessions, levels of problem behavior are high (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. By 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, Hoch, Paone, & El-Roy, 2000). Research studies have shown that escape-motivated problem behavior can be virtually eliminated by removing demands (Carr & Durand, 1985; 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 studies have shown that it is possible to alter the demands and then re-introduce them 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; Pace, Iwata, Cowdery, Andree, & McIntyre, 1993; Zarcone, Iwata, Smith, Mazaleski, & Lerman, 1994; Zarcone, Iwata, Vollmer, Jagtiani, Smith, & Mazaleski, 1993). For example, Pace et al. (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 they 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 were probably 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 in some cases 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- 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 on consecutive trials) may increase problematic behavior during instructional sessions for persons with autism (Dunlap, 1984; Dunlap & Dunlap, 1987; Dunlap, Dyer, & Koegel, 1980; McComas et al., 2000; Winterling, Dunlap, & O'Neill, 1987). For example, Winterling et al. (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. In addition, they demonstrated that increased skill acquisition occurred with the task variation approach in a second study with an adult with autism. These results were 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

Studies have evaluated the effects of pace of instruction on acquisition and problematic behavior in different types of learners (Carnine, 1976; Dunlap, Dyer, & Koegel, 1983; Koegel, Dunlap, & Dyer, 1980; Tincani, Ernsbarger, Harrison, & Heward, 2005). For example, Koegel et al. (1980) and Dunlap, et al. (1983), both demonstrated that short inter-trial 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 behaviors 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. A recent study by 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 behaviors 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 as well.

In contrast, a few studies seem to suggest that a faster pace of instruction is related to increases in escape-motivated problem behavior (Smith, Iwata, Goh, & Shore, 1995; Zarcone et al., 1994; Zarcone et al., 1993). In these studies, when the pace of the instruction was increased, the number of tasks the individuals were required to complete was also increased. For example, in Smith et al. (1995) the two conditions were a high-rate condition in which 30 trials were presented during the 15-minute session and a low-rate condition in which 10 trials were presented during the 15-minute session. The low-rate condition always produced lower rates of self-injurious behaviors. Since 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 is also increased. Second, if a child does not engage in escape-motivated problem behavior or engages in quick responding, they are 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 studies have demonstrated that variables beyond the control of the instructor may establish CMO-R during planned instructional sessions. Several studies have demonstrated that 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 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 and when the additional CMO-R of having a planned activity was cancelled or delayed. 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 30-40 minutes 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. This study demonstrates the importance of behavior analysts understanding the concept of the CMO-R to reducing problem behavior.

Choice Making

Choice making may function as an abolishing operation and reduce the value of escape from tasks (Dyer, Dunlap, & Winterling, 1990; McComas et al., 2000; Vaughn & Horner, 1997). For example, Dyer et al. (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 studies have demonstrated that problem behavior can be reduced when easy tasks are interspersed with difficult tasks (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). Two studies found similar effects 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 errors, and higher rates of social disapproval. By interspersing easy tasks with more difficult tasks the value of the CMO-R is reduced. It is recommended 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 easier 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. One study demonstrated this effect by introducing new tasks each time self-injurious behavior (SIB) reached low levels (Smith et al., 1995). Following introduction of the novel task, SIB increased leading to the identification of the novel tasks as MOs. Simple exposure to the task may reduce the value of this CMO-R over several sessions for some individuals. 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. 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 abolishing the reinforcing value of escape from tasks (Smith et al., 1995).

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 discrete trial instruction. With knowledge of the concept of the CMO-R, behavior analysts 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.

References

Anderson, S. P., Taras, M., & O' Malley-Cannon, B. (1996). Teaching new skills to young children with autism. In C. Maurice, G. Green, & S. C. Luce (Eds.), *Behavioral intervention for young children with autism* (pp. 181-194). Austin, TX: PRO-ED.

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

Bijou, S. W., & Baer, D. M. (1965). *Child development II: Universal stage of infancy.* New York: Appleton-Century-Crofts.

Birnbrauer, J. S., & Leach, D. J. (1993). The Murdoch Early Intervention Program after 2 years. *Behaviour Change, 10,* 63-74.

Call, N. A., Wacker, D. P., Ringdahl, J. E., Cooper-Brown, L. J., & Boeltric, E. W. (2004). An assessment of antecedent events influencing noncompliance in an outpatient clinic. *Journal of Applied Behavior Analysis, 37,* 145-158.

Cameron, M. J., Ainsleigh, S. A., & Bird, F. L. (1992). The acquisition of stimulus control of compliance and participation during an ADL routine. *Behavioral Residential Treatment, 7,* 327-340.

Carnine, D. W. (1976). Effects of two teacher presentation rates on off-task behavior, answering correctly and participation. *Journal of Applied Behavior Analysis, 9,* 199-206.

Carr, E. G., & Carlson, J. I. (1993). Reduction of severe behavior problems in the community using a multicomponent treatment approach. *Journal of Applied Behavior Analysis, 26*, 157-172.

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication instruction. *Journal of Applied Behavior Analysis, 18,* 111-126.

Carr, J. E., & LeBlanc, L. A. (2006). Noncontingent reinforcement as antecedent behavior support. In J. K. Luiselli (Ed.), Antecedent assessment & intervention: Supporting children & adults with developmental disabilities in community settings (pp. 147-164). Baltimore, MD: Brookes.

Carr, E. G., Newsome, C. D., & Binkoff, J. A. (1980). Escape as a factor in the aggressive behavior of two retarded children. *Journal of Applied Behavior Analysis, 13*, 101-117.

Carr, E. G., Schreibman, L., & Lovaas, O. I. (1975). Control of Echolalic speech in psychotic children. *Journal of Abnormal Child Psychology, 3,* 331-351.

Cohen, H., Amerine-Dickens, M., & Smith, T. (2006). Early intensive behavioral treatment: Replication of the UCLA model in a community setting. *Journal of Developmental and Behavioral Pediatrics, 27*, S145–S155.

Crockett, J. L., & Hagopian, L. P. (2006). Prompting procedures as establishing operations for escape-maintained behavior. *Behavioral Interventions, 21,* 65-71.

DeLeon, I. G., Neidert, P. L., Anders, B. M., & Rodriguez-Catter, V. (2001). Choice between positive and negative reinforcement during treatment for escape-maintained behavior. *Journal of Applied Behavior Analysis, 34,* 521-525.

Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northup, J., Cigrand, K., et al. (1992). Brief functional assessment techniques to evaluate aberrant behavior in an outpatient setting: A summary of 79 cases. *Journal of Applied Behavior Analysis, 25,* 713-721.

Drash, P. W., & Tudor, R. M. (1993). A functional analysis of verbal delay in preschool children: Implications for prevention and total recovery. *The Analysis of Verbal Behavior, 11*, 19-29.

Ducharme, J. M., & Worling, D. E. (1994). Behavioral momentum and stimulus fading in the acquisition and maintenance of child compliance in the home. *Journal of Applied Behavior Analysis, 27,* 639-647.

Dunlap, G. (1984). The influence of task variation and maintenance tasks in the learning and affect of autistic children. *Journal of Experimental Child Psychology, 37,* 41-64.

Dunlap, L. K., & Dunlap, G. (1987). Using task variation to motivate handicapped students. *Teaching Exceptional Children, 19,* 16-19.

Dunlap, G., Dyer, K., & Koegel, R. L. (1980). Motivating autistic children through stimulus variation. *Journal of Applied Behavior Analysis, 13,* 619-627.

Dunlap, G., Dyer, K., & Koegel, R. L. (1983). Autistic self-stimulation and intertrial interval. *Journal of Mental Deficiency, 88,* 194-202.

Dunlap, G., Foster-Johnson, L., Clarke, S., Kern, L., & Childs, K. E. (1995). Modifying activities to produce functional outcomes: Effects on the disruptive behaviors of students with disabilities. *Journal of the Association for Persons with Severe Handicaps, 20,* 248-258.

Dunlap, G., & Kern, L. (1993). Assessment and intervention for children within the instructional curriculum. In J. Reichle & D. P. Wacker (Eds.), *Communication and language intervention series: Vol. 3. Communicative alternatives to challenging behavior: Integrating functional assessment and intervention strategies* (pp. 177-203). Baltimore: Paul H. Brooks Publishing Co.

Dunlap, G., & Kern, L. (1996). Modifying instructional activities to promote desirable behavior: A conceptual and practical framework. *School Psychology Quarterly, 11,* 297-312.

Dunlap, G., Kern-Dunlap, L., Clarke, S., & Robbins, F. R. (1991). Functional assessment, curricular revisions and severe behavior problems. *Journal of Applied Behavior Analysis, 24,* 387-397.

Dunlap, G., Kern, L., dePerczel, M., Clarke, S., Wilson, D., Childs, K. E., et al. (1993). Functional analysis of classroom variables for students with emotional and behavioral challenges. *Behavioral Disorders, 18*, 275-291.

Durand, V. M. (1990). *Severe behavior problems: A functional communication instruction approach.* New York: Guilford.

Dyer, K., Christian, W. P., & Luce, S. C. (1982). The role of response delay in improving the discrimination performance of autistic children. *Journal of Applied Behavior Analysis, 15,* 231 – 240.

Dyer, K., Dunlap, G., & Winterling, V. (1990). Effects of choice making on the serious problem behaviors of students with severe handicaps. *Journal of Applied Behavior Analysis, 23,* 515-524.

Ebanks, M. E., & Fisher, W. W. (2003). Altering the timing of academic prompts to treat destructive behavior maintained by escape. *Journal of Applied Behavior Analysis, 36,* 355-359.

Eikseth, S., Smith, T., Jahr, E., & Eldevik, S. (2002). Intensive behavioral treatment at school for four to seven year old children with autism: A one-year follow-up. *Behavior Modification, 26,* 49-68.

Eikseth, S., Smith, T., Jahr, E., & Eldevik, S. (2007). Outcomes for children with autism who began intensive behavioral treatmet between ages 4 and 7. *Behavior Modification, 31,* 264-278.

Fisher, W., Piazza, C., Cataldo, M., Harrell, R., Jefferson, G., & Conner, R. (1993). Functional communication training with and without extinction and punishment. *Journal of Applied Behavior Analysis, 26*, 23-36.

Green, G. (1996). Early behavioral intervention for autism: What does research tell us? In C. Maurice, G. Green, & S. C. Luce (Eds.), *Behavioral intervention for young children with autism* (pp. 181-194). Austin, TX: PRO-ED.

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31*, 211-235.

Hanley, G. P., Iwata, B. A., & McCord B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36,* 147-185.

Harchik, A. G., & Putzier, V. A. (1990). The use of high-probability requests to increase compliance with instructions to take medication. *The Journal of the Association for Persons with Severe Handicaps, 15,* 40-43.

Heckaman, K., Alber, S., Hooper, S., & Heward, W. (1998). A comparison of least to most and progressive time delay on the disruptive behavior of students with autism. *Journal of Behavioral Education*, *8*, 171-202.

Hoffman, H. S. (1966). The analysis of discriminated avoidance. In W. K. Honig (Ed.). *Operant behavior: Areas of research and application* (pp. 499-530). New York: Appleton-Century-Crofts.

Horner, R. H., & Day, H. M. (1991). The effects of response efficiency in functionally equivalent competing behaviors. *Journal of Applied Behavior Analysis*, *24*, 719-732.

Horner, R. H., Day, H. M., & Day, J. R. (1997). Using neutralizing routines to reduce problem behaviors. *Journal of Applied Behavior Analysis*, *30*, 601-614.

Horner, R. H., Day, H. M., Sprague, J. R., O'Brien, M., & Heathfield, L. T. (1991). Interspersed requests: A nonaversive procedure for reducing aggression and self-injury during instruction. *Journal of Applied Behavior Analysis*, *24*, 265-278.

Howard, J. S., Sparkman, C. R., Cohen, H. G., Green, G., & Stanislaw, H. (2005). A comparison of intensive behavior analytic and eclectic treatments for young children with autism. *Research in Developmental Disabilities*, *26,* 359-383.

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., et al. (1994). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis, 27,* 215-240.

Iwata, B. A., Smith, R. G., & Michael, J. (2000). Current research on the influence of establishing operations on behavior in applied settings. *Journal of Applied Behavior Analysis, 33*, 401-410.

Keller, F. S., & Schoenfeld, W. N. (1950). *Principles of psychology.* New York: Appleton-Century Crofts.

Kemp, D. C. & Carr, E. G. (1995). Reduction of severe problem behavior in community employment using a hypothesis-driven multicomponent intervention approach. *Journal of the Association for Persons with Severe Handicaps, 20,* 229-247.

Kennedy, C. H. (1994). Manipulating antecedent conditions to alter the stimulus control of problem behavior. *Journal of Applied Behavior Analysis, 27,* 161-170.

Kennedy, C. H., & Itkonen, T., & Lindquist, K. (1995). Comparing interspersed requests and social comments as antecedents for increasing student compliance. *Journal of Applied Behavior Analysis, 28,* 97-98.

Kennedy, C. H., & Meyer, K.A. (1996). Sleep deprivation, allergy symptoms and negatively reinforced problem behavior. *Journal of Applied Behavior Analysis, 29,* 133-135.

Kern, L., Childs, K. E., Dunlap, G., Clarke, S., & Falk, G. D. (1994). Using assessment –based curricular intervention to improve the classroom behavior of a student with emotional and behavioral challenges. *Journal of Applied Behavior Analysis, 27,* 7-19.

Kern, L., & Dunlap, G. (1998). Curricular modification to promote desirable classroom behavior. In J. K. Luiselli & M. J. Cameron (Eds.), *Antecedent control* (pp. 289-308). Baltimore: Paul H. Brooks Publishing.

Koegel, L. K., Koegel, R. L., Shoshan, Y., & McNerney, E. (1999). Pivotal response intervention II: Preliminary long term outcome data. *Journal of the Association for Persons with Severe Handicaps, 24,* 186-198.

Koegel, R. L., Carter, C. M., & Koegel, L. K. (1998). Setting events to improve parent – teacher coordination with autism. In J. K. Luiselli & M. J. Cameron (Eds.), Antecedent control (pp. 167-187). Baltimore: Paul H. Brooks Publishing.

Koegel, R. L., Dunlap, G., & Dyer, K. (1980). Intertrial interval duration and learning in autistic children. *Journal of Applied Behavior Analysis, 13,* 91-99.

Koegel, R. L., Koegel, L. K., Frea, W. D., & Smith, A. E. (1995). Emerging interventions for children with autism: Longitudinal and lifestyle implications. In R.L. Koegel & Koegel (Eds.), *Teaching children with autism: Strategies for initiating positive interactions and improving learning opportunities* (pp. 1-15). Baltimore: Paul H. Brookes Publishing Co.

Lalli, J. S., & Casey, S. (1996). Treatment of multiplied controlled problem behavior. *Journal of Applied Behavior Analysis, 29,* 391-396.

Lalli, J. S., Vollmer, T., Progar, P. R., Wright, C., Borrero, J., Dency, D., et al. (1999). Competition between positive and negative reinforcement in the treatment of escape behavior. *Journal of Applied Behavior Analysis, 32*, 285-296.

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36,* 407-414.

Leaf, R., & McEachin, J. (1999). *A work in progress: Behavior management strategies and a curriculum for intensive behavioral treatment of autism.* New York: DRL Books, L.L.C.

Lord, C., & McGee, J. P. (2001). *Educating children with autism.* Washington, D.C. National Academy Press.

Lovaas, O. I. (1981). *Teaching developmentally disabled children: The ME book*. Austin, TX: PRO-ED.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology*, *55*, 3-9.

Lovaas, O. I. (2003). *Teaching individuals with developmental delays: Basic intervention techniques*. Austin, TX: PRO-ED.

Mace, F. C., & Belfiore, P. (1990). Behavioral momentum in the treatment of escape-motivated stereotypy. *Journal of Applied Behavior Analysis, 23*, 507-514.

Mace, F. C., Hock, M. L., Lalli, J. S., West, B. J., Belfiore, P., Pinter, E., et al. (1988). Behavioral momentum in the treatment of noncompliance. *Journal of Applied Behavior Analysis, 21,* 123-141.

Maurice, C., Green, G., & Foxx, R. M. (2001). *Making a difference: Behavioral intervention for autism.* Austin, TX: PRO-ED.

Maurice, C., Green, G., & Luce, S. C. (1996). *Behavioral interventions for young children with autism: A manual for parents and professionals*. Austin, TX: PRO-ED.

McComas, J., Hoch, H., Paone, D., & El-Roy, D. (2000). Escape behavior during academic tasks: A preliminary analysis of idiosyncratic establishing operations. *Journal of Applied Behavior Analysis, 33,* 479-493.

McCord, B. E., Iwata, B. A., Galensky, T. L., Ellingson, S. A., & Thomson R. J. (2001). Functional analysis and treatment of problem behavior evoked by noise. *Journal of Applied Behavior Analysis, 34*, 447-462.

McEachin, J. J., Smith, T., & Lovaas, O. I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal on Mental Retardation, 97,* 359-372.

McGill, P. (1999). Establishing operations: Implications for the assessment, treatment and prevention of problem behaviors. *Journal of Applied Behavior Analysis, 32*, 389-418.

Michael, J. (1982). Distinguishing between the discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior, 37,* 149-155.

Michael, J. (1988). Establishing operations and the mand. *The Analysis of Verbal Behavior, 6*, 3-9.

Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16,* 191-206.

Michael, J. (1996). What every student of behavior analysis ought to learn: A system for classifying the multiple effects of behavioral variables. *The Behavior Analyst, 18,* 273-284.

Michael, J. (2000). Implications and refinements of the establishing operation concept. *Journal of Applied Behavior Analysis, 33,* 401-410.

Michael, J. (2004). *Concepts and principles of behavior analysis.* Kalamazoo, MI: Society for the Advancement of Behavior Analysis.

Michael, J. (2007). Motivating Operations. In J. O. Cooper, T. E. Heron, & W. L. Heward (Eds.), *Applied behavior analysis* (pp. 374-391). Upper Saddle River, NJ: Prentice Hall/Merrill

Miltenberger, R. G. (2006). Antecedent interventions for challenging behaviors maintained by escape from instructional activities. In J. K. Luiselli (Ed.), Antecedent assessment & intervention: Supporting children & adults with developmental disabilities in community settings (pp. 101-124). Baltimore, MD: Brookes

Munk, D., & Repp, A. (1994). The relationship between instructional variables and problem behavior: A review. *Exceptional Children, 60,* 390-401.

Neef, N. A., Iwata, B. A., & Page, T. (1980). The effects of interspersal instruction versus high density reinforcement on spelling acquisition and retention. *Journal of Applied Behavior Analysis, 13,* 153-158.

O'Reilly, M. F. (1995). Functional analysis and treatment of escape-maintained aggression correlated with sleep deprivation. *Journal of Applied Behavior Analysis, 21*, 225-226.

O'Reilly, M. F. (1997). Functional analysis of episodic self-injury correlated with recurrent otitis media. *Journal of Applied Behavior Analysis, 30,* 165-167.

O'Reilly, M. F., Lacey, C., & Lancioni, G. E. (2000). Assessment of the influence of background noise on escape-maintained problem behavior and pain behavior in a child with Williams syndrome. *Journal of Applied Behavior Analysis, 33,* 511-514.

Pace, G. M., Iwata, B. A., Cowdery, G .E., Andree, P. J., & McIntyre, T. (1993). Stimulus (instructional) demand fading during extinction of self-injurious escape behavior. *Journal of Applied Behavior Analysis, 26,* 205-2112.

Parrish, J. P., Cataldo, M. F., Kolko, D. J., Neef, N. A., & Egel, A.L. (1986). Experimental analysis of response covariation among compliant and inappropriate behaviors. *Journal of Applied Behavior Analysis, 19,* 241-254.

Piazza, C. C., Fisher, W. W., Hanley, G. P., Remick, M. L., Contrucci, S. A., & Aitken, T. L. (1997). The use of positive and negative reinforcement in the treatment of escape-maintained destructive behavior. *Journal of Applied Behavior Analysis, 30,* 279-298.

Remington, B., Hastings, R. P., Kovshoff, H., degli Espinoza, F., Jahr, E., Brown, et al. (in press). A field effectiveness study of early intensive behavioral intervention: Outcomes for children with autism and their parents after two years. *American Journal on Mental Retardation.*

Richman, D. M., Wacker, D. P. & Winborn, L. (2001). Response efficiency during functional communication instruction: Effects o effort on response allocation. *Journal of Applied Behavior Analysis, 34,* 73-76.

Roxburgh, C. & Carbone, V. J. (2007). *The effects of varying teacher presentation rate on responding during discrete trial instruction of two children with autism.* Manuscript in preparation.

Russo, D. C., Cataldo, M. F., & Cushing, P. J. (1981).Compliance instruction and behavioral covariation in the treatment of multiple behavior problems. *Journal of Applied Behavior Analysis, 14,* 209-222.

Sailor, W., Guess, D., Rutherford, G., & Baer, D. M. (1968). Control of tantrum behavior by operant techniques during extinction of self-injurious escape behavior. *Journal of Applied Behavior Analysis, 1,* 237-243.

Sallows, G. O. & Graupner, T. D. (2005). Intensive behavioral treatment for children with autism: Four year outcome and predictors. *American Journal on Mental Retardation, 6,* 417- 438.

Schlinger, H. D. (1993). Establishing operations: Another step toward a functional taxonomy of environmental events. *The Behavior Analyst, 16,* 207-209.

Singer, G. H., Singer, J., & Horner, R. H. (1987). Using pretask requests to increase the probability of compliance for students with severe disabilities. *Journal of the Association for Persons with Severe Handicaps, 12,* 287-291.

Skinner, B. F. (1968). *The technology of teaching*. Englewood Cliffs, New Jersey: Prentice Hall.

Smith, T. (1999). Outcome of early intervention for children with autism. *Clinical Psychology: Research and Practice, 6,* 33-49.

Smith, T. (2001). Discrete trial instruction in the treatment of autism. *Focus on Autism and Other Developmental Disabilities, 16,* 86-92.

Smith, T., Groen, A. D., & Wynne. J. W. (2000). Randomized trial of intensive early intervention for children with pervasive developmental disorder. *American Journal on Mental Retardation, 105*, 269-285.

Smith, R., & Iwata, B. (1997). Antecedent influences on behavior disorders. *Journal of Applied Behavior Analysis, 30*, 267-278.

Smith, R. G., & Iwata, B. A., Goh, H. L., & Shore, B. A. (1995). Analysis of establishing operations for self-injury maintained by escape. *Journal of Applied Behavior Analysis, 28,* 515-536.

Sundberg, M. (1993). The application of establishing operation. *The Behavior Analyst, 16*, 215-218.

Sundberg, M. L., & Partington, J. W. (1998). *Teaching language to children with autism or other developmental disabilities.* Pleasant Hills, CA: Behavior Analysts, Inc.

Tincani, M., Ernsbarger, S., Harrison, T. J., & Heward, W. L. (2005). Effects of two instructional paces on pre-k children's participation rate, accuracy, and off task behavior in the language for learning program? *Journal of Direct Instruction, 5,* 97-109.

Vaughn, B. J. & Horner, R. H. (1997). Identifying instructional tasks that occasion problem behaviors and assessing the effects of student versus teacher choice among these tasks. *Journal of Applied Behavior Analysis, 30,* 299-312.

Vollmer, T. R., & Iwata, B. A. (1991). Establishing operations and reinforcement effects. *Journal of Applied Behavior Analysis, 24*, 279-291.

Wacker, D. P., Steege, M. W., Northup, J., Sasso, G., Berg, W., Reimers, T., et al. (1990). A component analysis of functional communication instruction across three topographies of severe behavior problems. *Journal of Applied Behavior Analysis, 23,* 417-429.

Weeks, M., & Gaylord-Ross, R. (1981). Task difficulty and aberrant behavior in severely handicapped students. *Journal of Applied Behavior Analysis, 14*, 449-463.

Weld, E. M., & Evans, I. M., (1990). Effects of part versus whole instructional strategies on skill acquisition and excess behavior. *American Journal of Mental Retardation, 4,* 377-386.

Wilder, D. A., & Carr, J. E. (1998). Recent advances in the modification of establishing operations to reduce aberrant behavior. *Behavioral Interventions, 13,* 43-59.

Winterling, V., Dunlap, G., & O'Neill, R. E. (1987). The influence of task variation on the aberrant behaviors of autistic students. *Education and Treatment of Children, 10*, 105-119.

Zarcone, J. R., Iwata, B. A., Hughes, C. E., & Vollmer, T. R. (1993). Momentum versus extinction effects in the treatment of self-injurious escape behavior. *Journal of Applied Behavior Analysis, 26,* 135-136.

Zarcone, J. R., Iwata, B. A., Smith, R. G., Mazaleski, J. L., & Lerman, D. C. (1994). Reemergence and extinction of self-injurious escape behavior during stimulus (instructional) fading. *Journal of Applied Behavior Analysis, 27,* 307-316.

Zarcone, J. R., Iwata, B. A., Vollmer, T. R., Jagtiani, S., Smith, R. G., & Mazaleski, J. L. (1993). Extinction of self-injurious escape behavior with and without instructional fading. *Journal of Applied Behavior Analysis, 26,* 353-360.

Author Note

Vincent J. Carbone, Carbone Clinic; Barry Morgenstern, Institute of Professional Practice; Gina Zecchin-Tirri, Carbone Clinic; Laura Kolberg, Carbone Clinic.

We would like to thank Jack Michael and Tim Vollmer for their comments on an earlier version of this manuscript.

Correspondence concerning this article should be addressed to:

Vincent J. Carbone
The Carbone Clinic
614 Corporate Way
Suite #1
Valley Cottage
New York, 10989
E-mail:drvjc@aol.com
