
The Effect of Varying Teacher Presentation Rates on Responding During Discrete Trial Training for Two Children With Autism

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Abstract

Recent research has emphasized the importance of manipulating antecedent variables to reduce interfering behaviors when teaching persons with autism. Few studies have focused on the effects of the rate of teacher-presented instructional demands as an independent variable. In this study, an alternating treatment design was used to evaluate the effects of varied rates of teacher-presented demands (1 s, 5 s, 10 s) on the occurrence of problem behavior, opportunities to respond, responses emitted, accuracy of responding, and magnitude and rate of reinforcement for two children with autism. Results indicated that fast presentation rate (1 s) resulted in lower rates of problem behavior, higher frequencies of instructional demands, higher frequencies of participant responding, and greater magnitudes and rates of reinforcement. Differential effects on accuracy of responding across conditions were not observed. Implications for manipulating the rate of teacher-presented instructional demands as an antecedent variable to reduce problem behavior are discussed.

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A disproportionate number of children with autism emit high rates of escape and avoidance behaviors during instructional sessions (Koegel, Koegel, Frea, & Smith, 1995). Moreover, Koegel and Covert (1972) found that self-stimulatory behavior in children with autism often interferes with the learning of simple discrimination tasks. When self-stimulatory behavior was reduced, they found that learning occurred at a higher rate. Consequently, the ultimate success of educational programs for many children with autism may be at least partially dependent on teacher manipulation of instructional variables leading to improved learner attention to teacher-directed activities (Drash & Tudor, 1993; Dunlap & Kern, 1996). This may be especially important with children with autism because they frequently fail to learn through incidental exposure to even enriched social environments (T. Smith, 2001).

As an alternative to mere exposure to everyday experiences, the method of discrete trial training (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 (Carr, Newsom, & Binkoff, 1980; McEachin, Smith, & Lovaas, 1993; T. Smith, 1999; T. Smith, Donahoe, & Davis, 2000; Tarbox & Najdowski, 2008). The method includes a three-term contingency arrangement whereby a stimulus is presented by a teacher, a response is evoked, and a consequence follows the response to strengthen or weaken its likelihood of occurring again under similar conditions. When discrete trial training 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 et al., 1993; T. Smith, 1999). Based on the success of this approach, several instructional manuals for parents, teachers, and behavior therapists have been published (Leaf & McEachin, 1999; Lovaas, 1981, 2003; Maurice, Green, & Foxx, 2001; Maurice, Green, & Luce, 1996). All of these manuals provide practitioners with descriptions of the application of behavioral principles (e.g., reinforcement, extinction, stimulus control) to the learning challenges presented by children with autism.

Notwithstanding the benefits of discrete trial training, its proper implementation presents substantial challenges to practitioners. The very method that produces the best outcome typically conflicts with the learning history of children with autism related to escape and avoidance behavior. In other words, the

high demand requirements of discrete trial training are the same conditions that typically evoke problem behavior in the form of tantrums, flopping, off-task behavior, high rates of stereotypies, aggression, and self-injury. T. Smith (2001) explained, "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 teaching repertoire related to the modification of instructional variables that reduce escape, avoidance, and self-stimulatory problem behavior during discrete trial training of children with autism appear essential.

Manipulation of instructional variables related to consequences such as reinforcement and extinction has been extensively studied in the behavior reduction and replacement literature under the rubric of functional assessment and functional communication training (Carr & Durand, 1985; Hanley, Iwata, & McCord, 2003). In recent years, additional emphasis has been placed on the manipulation of antecedent variables to reduce interfering behaviors when teaching persons with autism and developmental disabilities (Carbone, Morgenstern, Zecchin-Tirri, & Kolberg, 2010; Dunlap et al., 1993; Dunlap & Kern, 1996; Dunlap, Kern-Dunlap, Clarke, & Robbins, 1991; McGill, 1999; Michael, 2000; Miltenberger, 1997; Munk & Repp, 1994; R. G. Smith & Iwata, 1997; Wilder & Carr, 1998). Notwithstanding the attention given to antecedent control of behavior, only two empirical studies have focused on the effects of teacher rate of presentation of instructional demands during discrete trial training with children with autism. Both of these studies (Dunlap, Dyer, & Koegel, 1983; Koegel, Dunlap, & Dyer 1980) manipulated the duration of intertrial intervals (ITIs) resulting in either slow- or fast-rate presentation of instructional demands. ITI was defined as the duration of time between the delivery of a consequence (e.g., "Good girl") for one behavior and the presentation of the next instructional stimulus or demand.

Koegel et al. (1980) were the first to investigate the functional relation between ITI duration and correct learner responding in children with autism. The researchers systematically manipulated the duration of ITIs. Long durations ranged from 4 s to 26 s, and short durations were from 1 s to 4 s. Using an alternating treatment design, Koegel et al. demonstrated that shorter duration of ITIs produced a higher rate of correct responses. Incidental recording of self-stimulatory behavior also showed a decrease in these response topographies. Koegel et al. attributed the results to the reduced opportunity for problem behavior during the shorter ITIs. Dunlap et al. (1983) replicated the previous study and then extended the findings by precisely measuring occurrences of self-stimulatory responses emitted by participants with autism. Dunlap et al. found that correct responding and self-stimulatory behavior

were inversely related. That is, self-stimulatory behavior decreased with shorter ITIs whereas correct responding correspondingly increased. Neither of these studies with children with autism, however, measured the effects on any type of problem behavior other than self-stimulatory responses. Dunlap et al. specifically called for future research to include measures of the effects of teacher presentation rates of instructional demands on other topographies and functions of problem behavior frequently emitted by children with autism during intensive teaching sessions.

Other researchers have studied the effects of teacher rate of presentation of instructional demands, or ITI, on the response patterns of populations of participants other than children with autism. The first study of this type was conducted by Carnine (1976) with low-achieving first-grade learners. He found that fast rates of presentation (1 s or less) increased correct responding, decreased off-task behavior, and increased learner response rates on reading tasks when compared with slower presentation rates (5 s). These results were replicated and extended by Tincani, Ernsbarger, Harrison, and Heward (2005) with typically developing prekindergarten children while teaching language skills using a direct instruction program. Tincani et al. (2005) found that 1-s ITIs were superior to 5-s ITIs across all measures including percentage of intervals with off-task behavior, rate of correct responses per minute, and opportunities to respond per minute for all four participants. Darch and Gersten (1985) found similar results with learning-disabled learners during reading activities. Tincani and Crozier (2008) studied the effects of brief teacher wait-times (1 s), as compared with longer wait-times (4 s). It was demonstrated that shorter wait-times produced more correct responding, more response opportunities, and more responses when compared with extended wait-times with children with behavior disorders and learning difficulties. In addition, brief wait-times resulted in lower levels of disruptive behaviors. Lamella and Tincani (2012) replicated the brief versus extended wait-time procedures with children with autism and reported similar findings.

The results of two studies conducted by Valcante, Roberson, Reid, and Wolking (1989) and C. H. Skinner, Smith, and McLean (1994) found no difference between fast and slow teacher presentation rates on student performance. The results of both studies were attributed to the initially low rates of self-stimulatory behavior emitted by the participants. Tincani et al. (2005) suggested that learners with higher rates of problem behavior during instructional sessions may derive greater benefit from faster paced instruction. Irrespective of these findings, Valcante et al. (1989) pointed out that fast-paced instruction provided nearly twice the number of learning trials per session

when compared with the slower paced instruction. The authors concluded that because the additional number of trials occurred without reducing rates of correct responding, the results of the study suggested greater efficiency of faster rates of teacher presentation of instructional demands.

R. G. Smith, Iwata, Goh, and Shore (1995) reported a higher rate of self-injurious, escape-motivated behavior for individuals with developmental disabilities during faster paced presentation of instructional demands. When 30 demands were delivered within 15-min sessions, there were higher rates of self-injurious behavior when compared with 15-min sessions where only 15 demands were presented. R. G. Smith et al. (1995) warned, however, that these results may be difficult to interpret because faster paced presentation sessions always included a greater number of demands. Consequently, the effects of pace was confounded by the increased number of demands, therefore rendering interpretation difficult.

Given the dearth of research regarding the effects of rate of teacher presentation of instruction demands with children with autism, this study was designed to

1. replicate the results of previous studies regarding the effects of altering the pace of instructional demands on the occurrences of problem behavior and correct responding during instructional sessions with children with autism;
2. examine the effects of teacher rate of presentation of instructional demands with children with autism who exhibited several topographies of problem behavior during discrete trial instruction. Descriptive analysis suggested that these responses served varying functions;
3. extend the research with children with autism to include measures of opportunities to respond, frequency of responding, and magnitude and rate of reinforcement as a function of faster versus slower rates of teacher presentation of demands;
4. provide a fine-grain analysis of the effects of teacher-paced instruction with children with autism by measuring three rates of presentation commonly recommended in instructional programs for children with autism; and
5. extend the research on the rate of teacher-presented instructional demands to the occurrence of socially mediated behavior to determine whether negatively reinforced escape-maintained behavior was sensitive to manipulations of the pace of instruction.

Method

Participants

Two children diagnosed with autism participated in this study. Both children were rendered the diagnosis of autism by their pediatrician at about 2.5 years of age. The children were selected from a group of children served by the first author of this study. They were selected because discrete trial instruction was a necessary component of their treatment, and they demonstrated substantial rates of problem behavior during their instruction. The families of both children accepted the invitation to participate. The participants resided in the North of Wales, United Kingdom, with their parents. Both participants received a combination of school- and home-based intervention using applied behavior analysis with emphasis on teaching communication skills using B. F. Skinner's (1957) analysis of verbal behavior as a conceptual guide. Both children's programs included one-on-one intensive teaching in the form of discrete trial training interspersed with learning opportunities in more naturalized environments within the home setting. A similar program was implemented for both children in the school setting for part of the instructional day.

David was a 7-year-old male with a diagnosis of autism. All of his instruction was provided in Welsh by instructors who had received training in the application of behavioral principles to the instructional needs of children with autism. David had a weak communication repertoire that included requesting items but only when they were present in his immediate environment. His vocal responses were articulate, and therefore, most persons in his environment effectively responded to his communication efforts. He followed instructions in routine situations and responded to requests to fill in words to commonly presented phrases. David's labeling, or tact, repertoire was weak but developing. He demonstrated relatively strong textual behavior (e.g., reading words). David emitted high rates of self-stimulatory behavior that frequently interfered with his acquisition of skills during discrete trial instructional sessions. In addition, he frequently "bolted" (i.e., ran away) from the instructional environment or manded for other activities that were incompatible with the delivery of instructional demands.

The second participant in the study, Sarah, was an 8-year-old female with a diagnosis of pervasive developmental disorder. Sarah had an overall weak communication and basic learner skill repertoire. She did not produce any intelligible vocalizations, and therefore, she was a candidate for alternative methods of communication. Despite strong efforts to teach her manual sign language, she acquired only a few functional responses over a substantial period of time of instruction. However, her unique tendency to respond to

textual stimuli provided an opportunity to teach her to communicate with text and then to translate that repertoire to the use of a Lightwriter®. The Lightwriter® is an electronic device that allows the user to operate a keyboard to spell words that are then produced as a synthetic voice output by pressing a key as the final step in the process. At the time of the study, Sarah was transitioning from using a book of textual stimuli to learning to type and communicate with the Lightwriter®. She spontaneously requested many preferred items and activities using the Lightwriter®. In addition, Sarah had developed over a 100 word-labeling repertoires, and she responded effectively to most of the verbal behavior of others. Notwithstanding her developing verbal repertoire, Sarah exhibited high rates of disruptive behavior in the form of shouting, whining, hitting, pinching, and kicking. These responses occurred frequently during high-demand situations such as during discrete trial training.

Setting

All of the experimental sessions were carried out in the home of each participant as this was where most of the intensive teaching sessions occurred. The instructional setting for each child was in the family living room where a television was available to display videos as a form of reinforcement. Each child was seated at an instructional table, and the instructor sat opposite David and at the side of Sarah. The instructors were behavior therapists employed by the local school district and received training and supervision from the first author of this study. Task materials were laid out on the floor next to the instructor. A video camera was also set up on a tripod next to the instructional table for purposes of recording each session.

Dependent Variables and Response Definitions

The dependent variables were defined and measured in this experiment as shown below:

Frequency of problem behavior per session. An occurrence of problem behavior was recorded when any of the following behaviors occurred:

- Repetitive vocal behavior was defined as saying the same sound over and over.
- Repetitive motor movements were defined as repeatedly moving hands up and down.
- Bolting from the table was defined as the learner suddenly leaving his or her chair and walking or running from the instructional setting.

- Inappropriate mands were defined as any requests that interfered with instructional demands. These mands did not take the form of functional communication for escape from instruction but instead were interfering responses that took the form of mands for irrelevant items.
- Aggression was defined as hand hitting, pinches, and kicks to any part of the body of the instructor.
- Self-injurious behavior was defined as pulling at one's eyelids with thumb and index fingers.

The intervention for these problem behaviors was to block them from occurring, and any blocked behavior was also recorded as an occurrence of problem behavior.

Frequency of teacher-presented instructional demands. The frequency of teacher-presented instructional demands was defined as the total number of instructions delivered during a 10-min instructional session. This included the number of instructions that were repeated during error correction procedures and also the number of instructions to which the learner failed to respond.

Frequency of participant responses. The frequency of participant responses was defined as the number of responses emitted by the learner per 10-min instructional session.

Magnitude or duration of reinforcement. The activities and items that were delivered as reinforcers had been identified previously as stimuli that, when delivered after behavior, increased responding. Magnitude or duration of reinforcement was defined as the cumulative number of minutes the learner viewed a preferred video segment during each 10-min session. While viewing the video, the learners were also provided access to books, pictures, cars, and some edibles.

Rate of reinforcement. Rate of reinforcement was defined as the number of times that a reinforcer was delivered during each 10-min session.

Percentage of correct responses. The percentage of correct responses was recorded as the number of correct responses to the initial presentation of an instructional demand divided by the total number of demands, multiplied by 100 per 10-min session.

Measurement Procedures

Each of the dependent variables was measured following each experimental session by viewing a video recording of the session. The first author acted as the primary observer by viewing a digital recording of each session played on a computer. A data recording sheet was developed specifically to measure

frequency of problem behavior, frequency of instructional opportunities, frequency of responses per session, magnitude of video presentation as a form of reinforcement, and percentage of correct and incorrect responses. For all three frequency measures, a tally mark was recorded to indicate the occurrence of any of the dependent measures. At the end of the session, the tallies were totaled. In the case of problem behavior, a tally was recorded for the occurrence of any of the topographies of problem behaviors as defined above. The percentage of correct responses was measured by recording the number of correct responses per session and dividing by the number of opportunities to respond. The magnitude or duration of reinforcement was measured by recording the length of time each video reinforcer was presented. The duration for each of these opportunities was summed to produce a total duration of reinforcement per session in minutes. The rate of reinforcement was derived by counting the number of times that the reinforcer was delivered per session.

Experimental Design and Conditions

In this study, a nonbaseline type of alternating treatments design (Barlow & Hayes, 1979) was used to assess the effects of the three different treatment conditions: fast, medium, and slow teacher presentation rates, on the dependent variables described above. The rate of presentation of teacher instructional demands was defined as the time between the completion of a learner response to an instructional demand and the presentation of the next instructional demand (Carnine, 1976; R. G. Smith et al., 1995). Teacher presentation rates were varied across conditions such that demands were presented at a rate of 1 s, 5 s, or 10 s. For example, the teacher may display a picture of an object and ask, "What is it?" The presentation of the next demand would be 1 s, 5 s, or 10 s after the learner's response according to which of the three experimental conditions was in place. In the fast-rate condition, instructional demands were presented 1 s after the participant responded to the previous demand. In the medium-rate condition, instructional demands were presented 5 s after the last response, and in the slow-rate condition, demands were presented 10 s after the last response. One session of each condition (i.e., 1 s, 5 s, 10 s) was conducted every other day. The order of the experimental conditions was determined randomly in a counterbalanced fashion to prevent sequence effects.

Each experimental session was 10 min in duration. Throughout each session, the instructor presented instructional demands at the appropriate instructional level for the learner based on an academic assessment. Instructional demands were presented at a ratio of approximately four previously mastered

skills for every one acquisition target. A variety of instructional tasks were mixed during the session to include tacting objects and pictures (labeling), listener responding to commands and selecting pictures of objects, motor imitation, intraverbal responses (e.g., answering “wh” questions), and word-picture matching. All of the sessions were conducted at an instructional table as described above. The instructor carefully presented these demands consistent with the rate of presentation condition (i.e., 1 s, 5 s, or 10 s) in force during that session. However, instructional techniques including error correction, prompting procedures, types of skills presented, schedule of reinforcement, interspersal of mastered and target skills, and mixing of skill domains were held constant for each participant across all three experimental conditions.

All problem behavior was blocked but did not alter the presentation rate. Attempts to move away from the instructional table were also blocked to prevent interruption of the instructional sessions. All of these responses were recorded as instances of problem behavior and were reflected in the data sets presented below.

Both participants had a history that demonstrated that brief opportunities to view preferred age-appropriate videos acted as a form of reinforcement. Therefore, following the appropriate number of responses, based on their predetermined variable ratio schedule of reinforcement, each participant received an opportunity to view about 1 min of a preferred video. The variable ratio schedules of reinforcement were held constant across all three experimental conditions to control for rate and magnitude of reinforcement measures. In other words, if duration of each reinforcer and schedule of reinforcement were not controlled, these two variables could account for treatment effects as opposed to the independent variables of rate of teacher presentation. A potential threat to internal validity was removed by carefully controlling these variables.

Descriptive Analysis of Function of Problem Behaviors

A nonexperimental descriptive analysis of the problem behaviors was not conducted prior to the experiment. Instead, a descriptive analysis was conducted during the implementation of experimental conditions. The descriptive analysis took the form of recording sequence analysis data allowing for the tentative identification of the function of behavior by noting the correlation between a problem behavior and its putative evocative or antecedent stimulus. Based on the sequence analysis data collected, it appeared the major functions of the topographical response forms of problem behavior emitted by participants were socially mediated negative reinforcement in the

form of escape from instructional demands or automatic reinforcement. In other words, an occurrence of problem behavior such as hitting following an instructional demand was suspected to be functionally related to a history of negative reinforcement (escape) and therefore tentatively identified as a member of the class of socially mediated responses. In contrast, problem behaviors such as repetitive nonfunctional vocalizations that were not correlated with identifiable changes in the social environment were tentatively identified as members of the class of automatically reinforced responses.

David emitted a total of 428 episodes of problem behavior across 20 experimental sessions. Thirty-two episodes of problem behavior were suspected to be maintained by socially mediated negative reinforcement, and 396 episodes were suspected to be maintained by automatic reinforcement. Sarah emitted a total of 396 episodes of problem behavior across 30 experimental sessions. For Sarah, 358 episodes of problem behavior were suspected to be maintained by socially mediated negative reinforcement, and 38 episodes were suspected to be maintained by automatic reinforcement.

Interobserver Agreement

Interobserver agreement was assessed on all measures of the dependent variables. Interobserver agreement was calculated for 35% of the sessions by comparing the frequency recorded by each independent observer and dividing the smaller number by the larger number and multiplying by 100. The average interobserver agreement was 92% for problem behavior, 96% for teacher-presented instructional demands, 91% for participant responses, 99% for magnitude of reinforcement, 91% for the rate of reinforcement, and 92% for the percentage of correct responses.

Procedural Fidelity

Procedural fidelity was assessed to determine the extent to which the rate of presentation was implemented according to the requirements of the experimental design. This dimension of the treatment was measured because it was the most susceptible to instructor drift. To assess procedural fidelity, videotape recordings of each treatment session were viewed by the first author to determine the instructor's compliance with the 1-s, 5-s, and 10-s presentation rates. The data were obtained for a randomly selected sample of 25% of the treatment sessions. The observer recorded the duration in seconds between the participant's response and the presentation of the instructional demand. These data were analyzed by calculating the percentage of trials observed that fell

within a reasonable range (see below for specific ranges) around the designated duration for that condition for both participants. In the fast-rate, or 1-s, condition, 99% of the durations were 2 s or less. In the medium-rate, or 5-s, condition, 98% of the durations were within the range of 3 s to 7 s. Finally, in the slow rate, or 10 s, condition, 95% of the durations fell within the range of 8 s to 12 s. These data indicated that the independent variables related to rate of instruction were applied consistently across both participants in this study.

Results

As shown in Figure 1, both participants emitted lower rates of problem behavior during the fast-rate (1 s) teacher-presentation condition. In this condition, David emitted an average of 7 problem behaviors per session, and Sarah emitted an average of 2 problem behaviors per session. In the medium-rate (5 s) teacher presentation condition, David emitted an average of 23 problem behaviors per session, and Sarah emitted an average 11 problem behaviors per session. In the slow-rate (10 s) teacher presentation condition, David emitted an average of 41 problem behaviors per session, and Sarah emitted an average of 27 problem behaviors per session.

Figure 2 displays the frequencies of problem behavior by suspected function per session in the fast, medium, and slow teacher presentation conditions. David emitted higher rates of problem behavior tentatively identified as a member of the class of automatically reinforced responses than socially mediated. In the class of automatically reinforced responses, David emitted an average of 6 problem behaviors per session in the fast (1 s) teacher presentation rate, an average of 21 problem behaviors in the medium (5 s) teacher presentation rate, and an average of about 39 problem behaviors in the slow (10 s) teacher presentation rate. In contrast, in the class of socially mediated responses, David emitted an average of less than 1 problem behavior per session in the fast (1 s) teacher presentation condition, an average of less than 2 problem behaviors in the medium (5 s) teacher presentation condition, and an average of 3 problem behaviors in the slow (10 s) teacher presentation condition.

Sarah emitted higher rates of problem behavior tentatively identified as a member of the class of socially mediated responses. Within the class of automatically reinforced responses, Sarah emitted an average of less than 1 problem behavior per session in the fast (1 s) teacher presentation condition, an average of less than 2 problem behavior in the medium (5 s) teacher presentation condition, and an average of 2 problem behaviors in the slow (10 s) teacher presentation condition. In contrast, in the class of socially mediated responses, Sarah emitted an average of 1 problem behavior per session in the

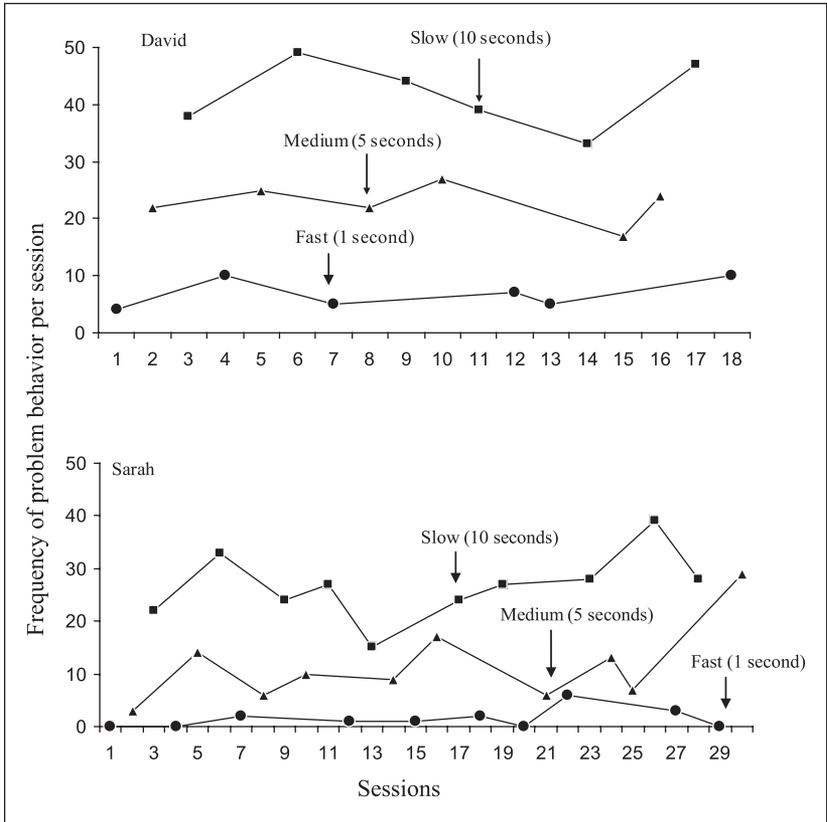


Figure 1. Frequency of problem behavior per session during fast, medium, and slow teacher presentation rates for David and Sarah

fast (1 s) teacher presentation condition, an average of 9 problem behaviors in the medium (5 s) teacher presentation condition, and an average of 24 problem behaviors in the slow (10 s) teacher presentation condition.

By shortening the teacher presentation rate, both participants were presented with a higher frequency of demands (see Figure 3). In the fast-rate (1 s) condition, instructors presented an average of 77 demands to David and an average of 47 demands to Sarah. In the medium-rate (5 s) condition, instructors presented an average of 47 demands to David and an average of 39 demands to Sarah. In the slow-rate (10 s) condition, instructors presented an average of 31 demands to David and an average of 28 demands to Sarah.

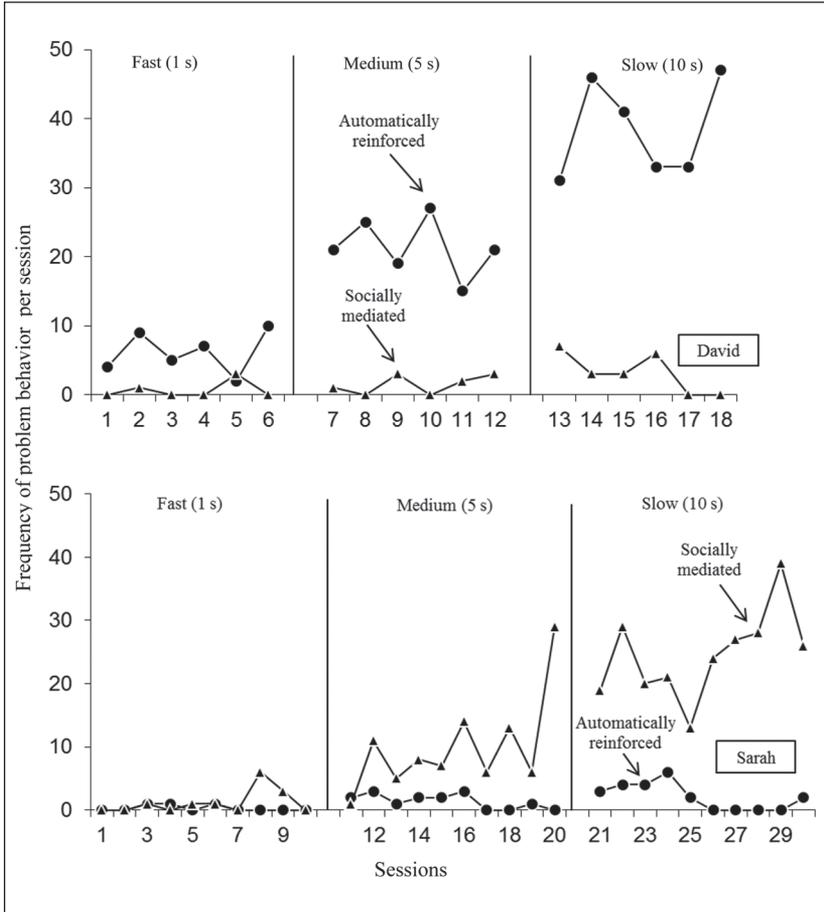


Figure 2. Frequency of problem behavior per session by suspected function during fast, medium, and slow teacher presentation rates for David and Sarah

Similarly, in the fast-rate (1 s) condition, both learners emitted a higher frequency of responses (see Figure 4). In the fast-rate (1 s) condition, David emitted an average of 57 responses, and Sarah emitted an average of 42 responses. In the medium-rate (5 s) condition, David emitted an average of 32 responses, and Sarah emitted an average of 35 responses. In the slow-rate (10 s) condition, David emitted an average 20 responses, and Sarah emitted an average of 26 responses.

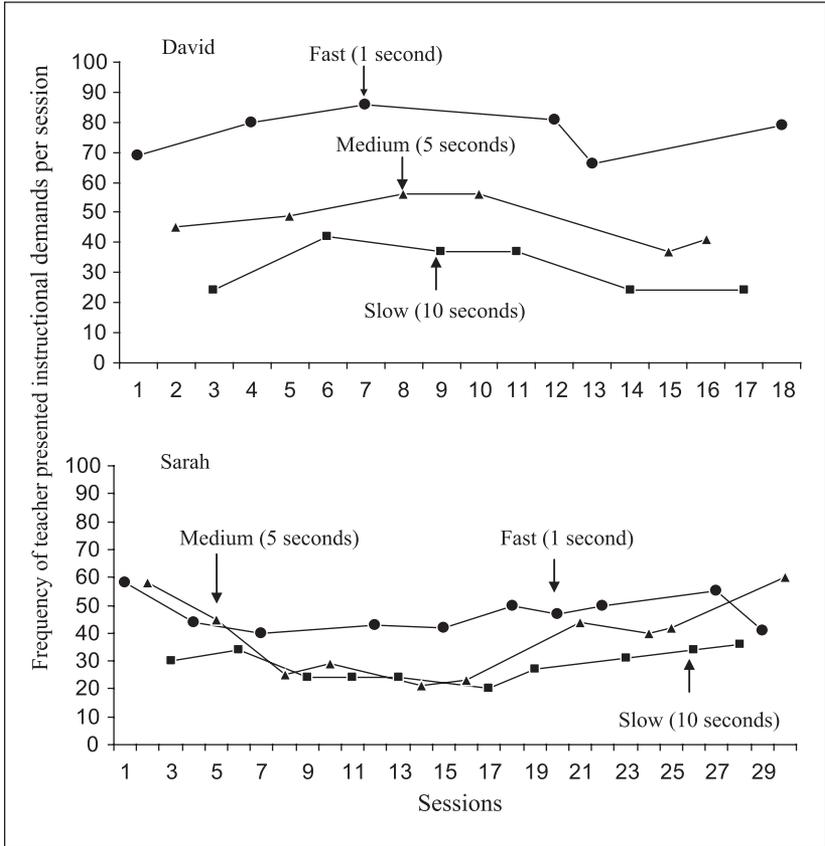


Figure 3. Frequency of teacher presented instructional demands per session during fast, medium, and slow teacher presentation rates for David and Sarah

As displayed in Figure 5, both participants contacted a greater magnitude of reinforcement in the fast-rate (1 s) teacher presentation condition. In this condition, David contacted an average 3 min and 35 s of reinforcement, and Sarah contacted an average 2 min and 25 s of reinforcement. In the medium-rate (5 s) condition, David contacted an average 2 min and 25 s of reinforcement, and Sarah contacted on average 1 min and 40 s of reinforcement. In the slow-rate (10 s) condition, David contacted an average 1 min and 24 s of reinforcement, and Sarah contacted an average 1 min and 15 s of reinforcement.

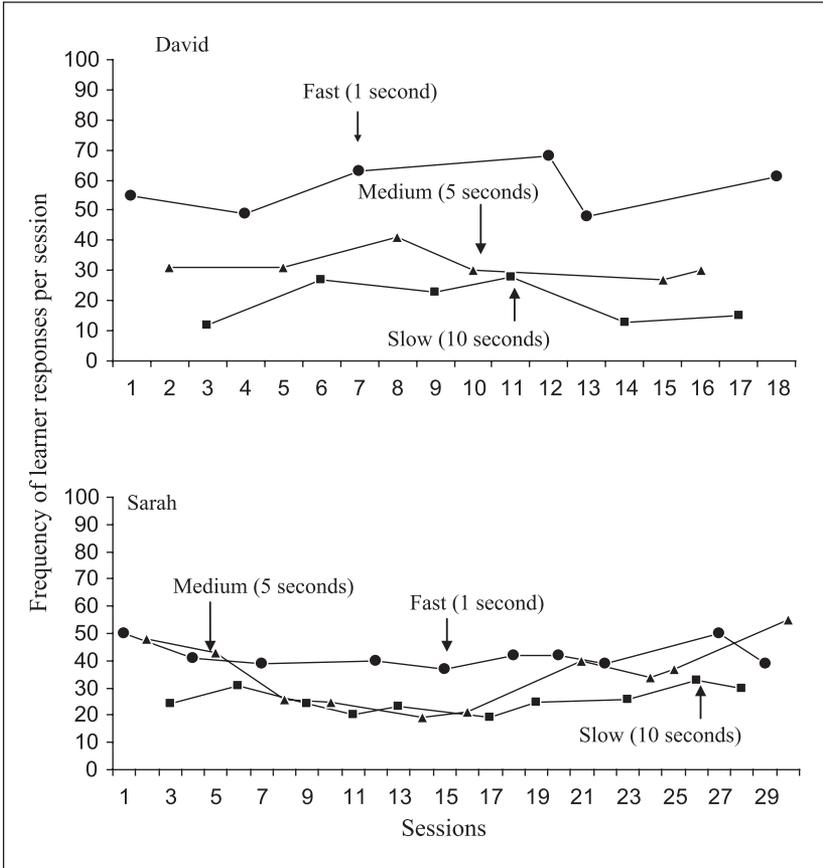


Figure 4. Frequency of learner responses per session during fast, medium, and slow teacher presentation rates for David and Sarah

Figure 6 displays the rate of reinforcement per session across each of the three teacher presentation rate conditions. David contacted reinforcement most frequently in the fast-rate (1 s) condition. He contacted reinforcement an average of four times per session during the fast (1 s) teacher presentation condition, three times per session during the medium-rate (5 s) condition, and two times per session during the slow-rate (10 s) condition. Sarah contacted reinforcement an average of three times per session during the fast-rate (1 s) condition, two times per session during the medium-rate (5 s) condition, and one

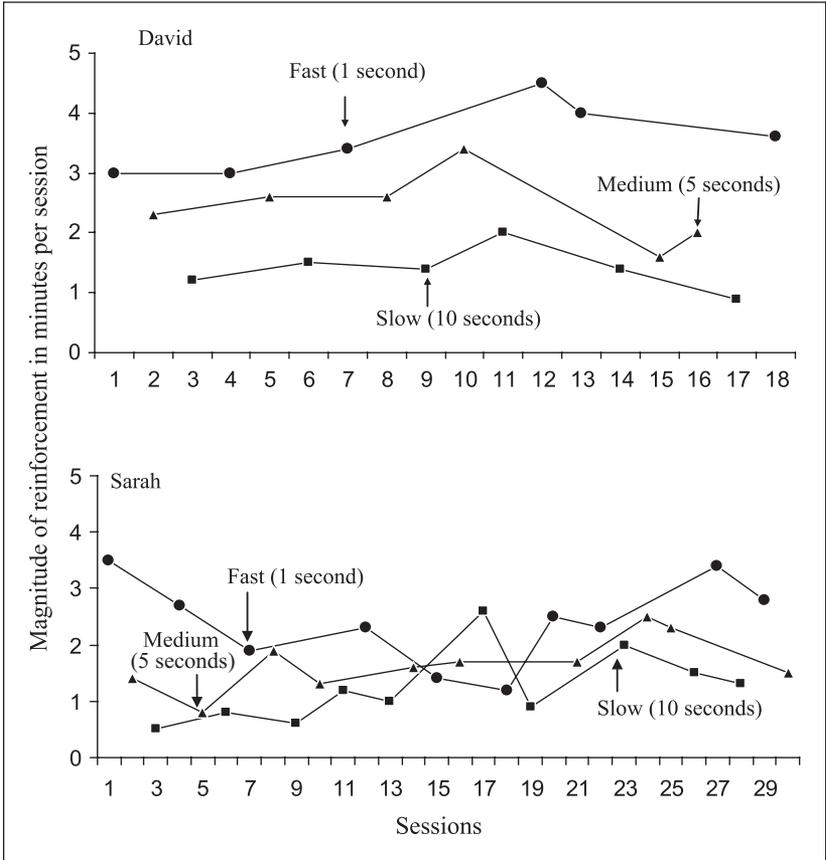


Figure 5. Magnitude of reinforcement in minutes per 10-min session during fast, medium, and slow teacher presentation rates for David and Sarah

time per session during the slow-rate (10 s) teacher presentation condition. Although these averages are slightly different, the rates of reinforcement per session for Sarah were not differentiated across the three teacher presentation rate conditions as indicated by the high number of overlapping data points.

Figure 7 displays the percentages of correct responding across each rate of teacher presentation. For both participants, the teacher presentation rates did not result in differential responding in terms of accuracy. David responded most accurately during the medium-rate (5 s) condition, with an average of

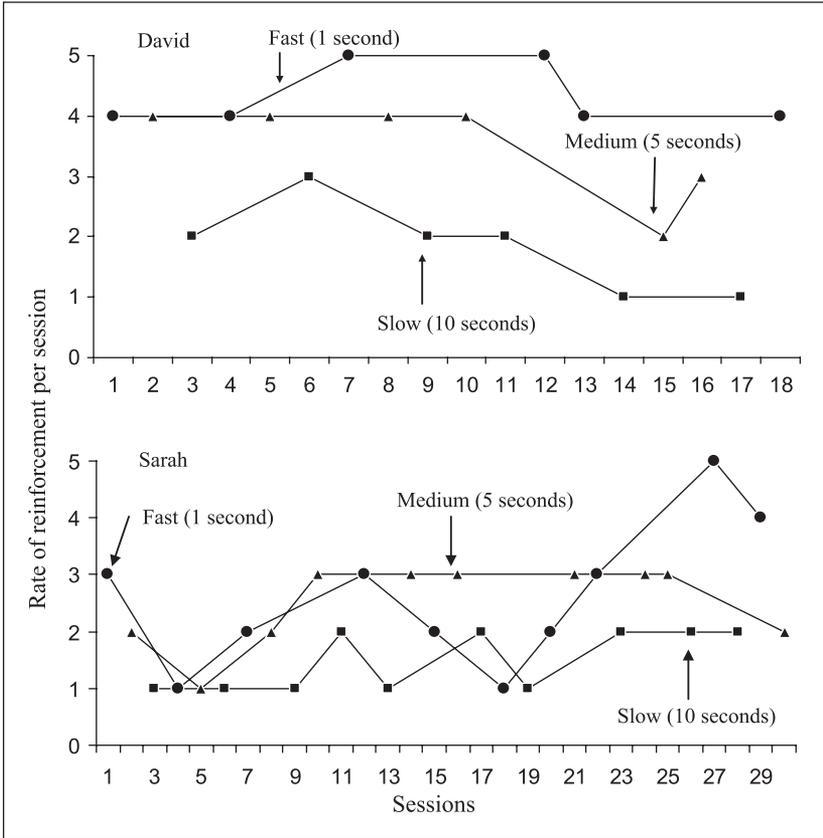


Figure 6. Rate of reinforcement per session during fast, medium, and slow teacher presentation rates for David and Sarah

60% of his responses being correct when compared with an average of 56% during the fast-rate (1 s) teacher presentation condition and an average of 49% during the slow-rate (10 s) condition. Sarah also responded most accurately during the medium-rate (5 s) teacher presentation condition, with an average of 81% of her responses being correct. In the fast-rate (1 s) condition, 77% of her responses were correct, and in the slow-rate (10 s) condition, 80% of her responses were correct.

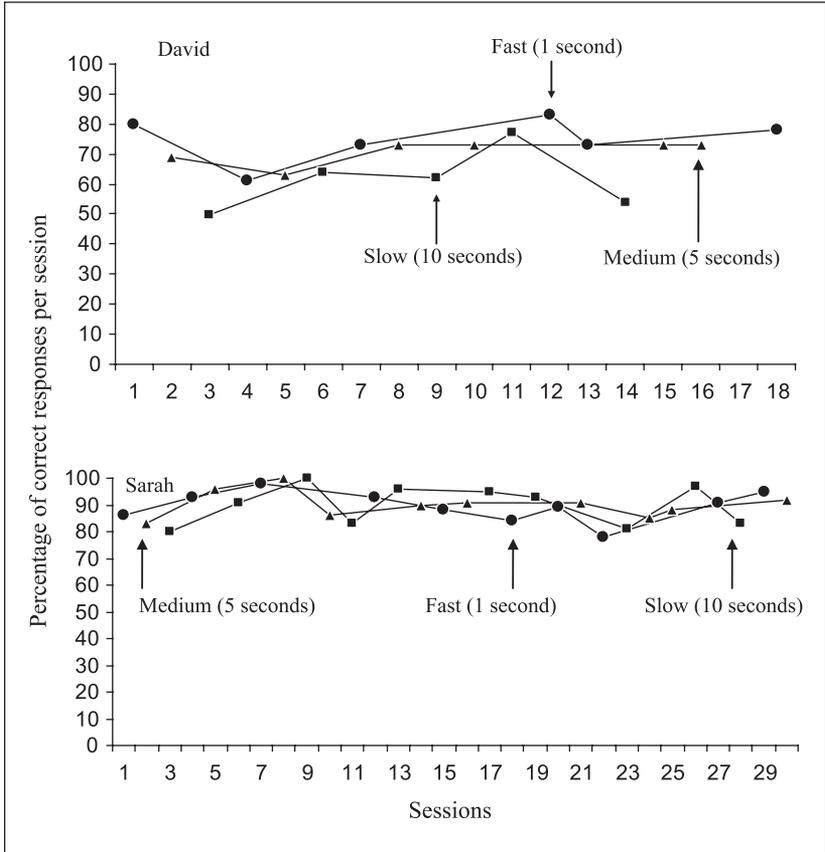


Figure 7. Percentage of correct responses per session during fast, medium, and slow teacher presentation rates for David and Sarah

Discussion

The results of this study demonstrated that fast rates of teacher presented instructional demands produced lower rates of problem behavior, increased number of instructional demands presented, increased number of learner responses emitted, and increased magnitude and rate of reinforcement for both participants in this study. Furthermore, this study extended previous research by demonstrating that rate of teacher-presented instructional demands was functionally related to the occurrence of behavior maintained by socially

mediated negative reinforcement. Previous research had exclusively examined the effect of teacher presentation rate on automatically reinforced or self-stimulatory behavior. The current study adds to the existing body of literature related to pace of instruction by providing evidence that faster teacher presentation rates produced decreases in behavior maintained by socially mediated negative reinforcement in the form of escape.

Of particular importance related to teaching children with autism is the finding that faster rates of teacher-presented instructional demands produced lower rates of problem behavior for both participants. These findings are consistent with the results reported by a number of previous studies (Carnine, 1976; Dunlap et al., 1983; Koegel et al., 1980; Tincani & Crozier, 2008; Tincani et al., 2005) but oppose the results reported by R. G. Smith et al. (1995) that showed increased rates of problem behavior with faster rates of instructional demands. R. G. Smith et al. suggested that their results may be attributed to an increase in the number of instructional demands presented within the fast-rate condition. However, by directly measuring the number of instructional demands presented as a function of instructional pace, an examination of the relationship between these variables was made possible. As shown in Figures 3 and 4, contrary to the results of R. G. Smith et al., the results of this study indicated that not only were the rates of problem behavior lower in the fast-rate condition, but the number of instructional demands presented and the number of participant responses emitted were also higher. These results suggest that for the participants included in this study, the number of instructional demands did not produce higher rates of problem behavior. The data presented in Figure 3 on the rate of teacher-presented instructional demands allow for a complete account of the relation between pace of instruction and the occurrence of problem behavior. Failure to report on these data would lead to an incomplete analysis given the assertions of R. G. Smith et al. Perhaps the results of the current study are best explained by considering the differences in the magnitude and rate of reinforcement across conditions and the role of conditioned motivating operations.

The reflexive conditioned motivating operation (CMO-R) is an antecedent and evocative variable whose presentation may increase the rate of all behaviors that have been negatively reinforced with the removal of the presenting stimulus due to a history of correlation with a worsening set of conditions (Michael, 2000). Michael (2000) and Carbone et al. (2010) suggested that the escape-motivated behavior of persons with developmental disabilities during discrete trial instruction may occur due to the increase in the value of negative reinforcement established by the presentation of instructional demands. These authors suggested that modifications of teaching procedures may result in abolishing the CMO-R. In light of Michael's analysis, the findings of this

study suggested that rate of instruction may act as an abolishing operation by decreasing the value of negative reinforcement and abating problem behaviors. This abolishing effect may be the by-product of a higher magnitude of reinforcement or rate of reinforcement for responding produced by fast-rate instruction. In this study, both participants' responding received a greater magnitude of reinforcement during the fast-rate condition when compared with the lower rates conditions. In addition, David's responses received a higher rate of reinforcement when compared with the other two presentation rates. For Sarah, the rate of reinforcement was frequently, but not consistently, highest in the fast-rate condition. Conversely, in the R. G. Smith et al.'s (1995) study, only vocal praise and escape from instructional tasks served as consequences for correct responding. Unlike the current study, high rates of instructional demands in the R. G. Smith et al. study were not correlated with an improving set of conditions in the form of increased access to reinforcement. Consequently, the value of negative reinforcement, or escape from instructional demands, was not abolished and may account for the result obtained by R. G. Smith et al. In other words, the manipulation of teacher presentation rate lead to increased access to reinforcement for the participants in this study. Under these conditions, instructional demands no longer functioned as aversive stimuli, evoking problem behavior maintained by negative reinforcement, but instead, due to a correlation with positive reinforcement, functioned as discriminative stimuli.

Interestingly, for Sarah, although the magnitude of reinforcement was reliably higher in the fast pace instructional sessions, the rate of reinforcement was not consistently higher. These results suggest important implications for future research related to best practices for discrete trial instruction. Future studies should investigate the differential effects of various changes to these parameters of reinforcement. For example, the rate of reinforcement may be systematically increased while the magnitude of reinforcement is held constant, and vice versa. The results of such studies would have important implications for the arrangement of instructional trials related to issues of efficiency (e.g., delivering reinforcement less frequently within instructional periods with lower rates but greater magnitudes of reinforcement) and motivating operations (e.g., providing less reinforcement across instructional trials but at high rates to maintain the value of a reinforcer over instructional sessions).

The findings that fast rate of teacher-presented instructional demands increased participants' opportunities to respond are consistent with previous research (Darch & Gersten, 1985; Tincani & Crozier, 2008; Tincani et al., 2005; Valcante et al., 1989) and have important implications for the arrangement of discrete trial instruction for children with autism and other developmental disabilities. As a consequence of a faster pace of presentation of

instructional demands, the number of opportunities invariably increases. However, the presentation of response opportunities does not necessarily produce concomitant increases in learner responding. The occurrence of aberrant behavior, such as those described in this study (e.g., self-injury, aggression), during discrete trial training interferes with instructional trials and precludes the emission of desirable learner responses. Children with autism often require many teaching trials to learn new skills (T. Smith, 2001), but simply presenting more instructional trials may not produce the intended educational outcomes and, as previous research has demonstrated, may lead to increases in maladaptive behavior (R. G. Smith et al. 1995). By manipulating the teacher presentation rates to increase responses emitted by the learner, without concomitant increases in interfering problem behavior, new skills can be taught more efficiently and lead to faster rates of acquisition. In addition, a reduction in problem behavior during teaching sessions where a fast pace of instruction is implemented correlates with an increase in teaching time. Important instructional time is not lost due to the occurrence of problem behavior.

The results of this study failed to replicate the findings that faster presentation rates increase correct responding. (Dunlap et al., 1983; Koegel et al., 1980) Although overall, the data for this measure clearly showed a pattern of improvement with faster rates, the number of data points overlapping among the conditions forces one to conclude that the effects of the treatments were not differentiated as it relates to correct responding. An important distinction between the current study and previous research is that in this study, both previously mastered and new tasks were presented as instructional demands. Conversely, in previous research (Dunlap et al., 1983; Koegel et al., 1980), only new task were presented. Therefore, a relatively higher overall rate of correct responding may be expected in the current study when compared with previous research. It is possible that the already high rates of correct responding rendered the differences produced by varying presentation rates insignificant.

This study is limited by the small number of participants from whom results were obtained. In addition, the function of the problem behavior was not experimentally determined. Future researchers should consider conducting an experimental analysis of the functions of problem behavior to report on the potential differential effect rate of instruction has on varying functions of problem behavior.

Notwithstanding these limitations, this study extends the literature on the importance of rate of instruction with children with autism by reporting dependent variables not reported in previous studies (i.e., number of demands, learner responses, and magnitude and rate of reinforcement). Important

implications regarding the arrangement of discrete trial training can be derived from these results. By directly measuring the rate of teacher instructional presentation rate, the results of this study clarify the relationship between this variable and the occurrence of problem behavior. The results of this study suggest that rather than higher instructional rates leading to increases in problem behavior, if high presentation rates are correlated with high rates or high magnitudes of reinforcement, more instructional opportunities may be provided with fewer occurrences of problem behavior.

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