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ORIGINAL PAPER

Effects of Fixed-Time Reinforcement Delivered by Teachers for Reducing Problem Behavior in Special Education Classrooms

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Abstract The effects of fixed-time (FT) reinforcement schedules on the disruptive behavior of 4 students in special education classrooms were studied. Attention provided on FT schedules in the context of a multiple-baseline design across participants substantially decreased all students' challenging behavior. Disruptive behavior was maintained at levels lower than baseline throughout reinforcement thinning and follow-up phases. The results extend existing literature on the use of FT schedules of reinforcement and provide evidence that FT schedules of reinforcement can be practical to implement in special educational classroom settings.

Keywords Fixed time · Non-contingent reinforcement · Disruptive behavior

Introduction

Many children with emotional and developmental disorders exhibit challenging behaviors, which can be maintained by social consequences such as attention (Carr and Durand 1985). Fixed-time (FT) reinforcement is thought to be a desirable intervention to employ in these circumstances. FT schedules involve the delivery of a stimulus identified as a reinforcer for at least some behaviors independently of the behavior being emitted, and this often decreases the rate of targeted challenging behavior. There are numerous reasons why FT schedules may be appropriate for children with problematic behavior maintained by social positive consequences: It is relatively easy to administer, it quickly suppresses undesirable behaviors, and it is not strongly associated with undesirable side effects, such as extinction bursts (see Vollmer et al. 1993). Several parameters of time-schedule implementation have been studied in previous research including variable-time versus FT-scheduled

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reinforcement delivery (Carr et al. 2001; Van Camp et al. 2000), magnitude of reinforcer delivery (Carr et al. 1998), the relative value of FT schedules against other interventions (Vollmer et al. 1993), incorporation of functional versus arbitrary stimuli (Hanley et al. 1997), its mechanisms of action (Kahng, Iwata, Thompson et al. 2000), and reinforcement schedule thinning (Hagopian et al. 1994; Kahng, Iwata, DeLeon et al. 2000).

Several investigators have noted that procedures involving FT schedules may have limitations. For example, Carr et al. (2000) noted two main considerations in this regard. First, adventitious reinforcement can occur when problem behaviors are inadvertently reinforced during a FT schedule of reinforcement. This problem may be overcome, for example, by arranging for a delay in reinforcement (e.g. Britton et al. 2000) in the event of an occurrence of the problem behavior immediately prior to a scheduled delivery of reinforcement. Second, the application of dense schedules (e.g. Hagopian et al. 1994) may be prohibitively time-consuming in an applied setting (see Reilly et al. 2005). However, an initially dense schedule of FT reinforcement may be unavoidable, as a thinner schedule may not be effective during the initial stages of intervention. Over time, dense schedules can be thinned to reduce fortuitous reinforcement of the problem behavior and promote maintenance (e.g. Britton et al. 2000; Hagopian et al. 2004). Under these conditions, consideration needs to be given as to how desired behavior would be maintained during the thinning phase. There has been relatively little research on the maintenance of behavior following FT schedule thinning (see Dozier et al. 2001), which is one focus of the current report. Failure to overcome these difficulties (cf. Britton et al. 2000; Hagopian et al. 2000; Vollmer et al. 1998) can make the interventions difficult to implement, especially in classroom settings (Carr and LeBlanc 2006).

The majority of research on FT schedules has involved individuals in clinical settings (see Boelens 2005), and there have been few studies conducted in educational settings (e.g. Buchanan and Fisher 2002; Jones et al. 2000; O'Callaghan et al. 2006; Rasmussen and O'Neill 2006). Jones et al. (2000) were the first to demonstrate the effects of FT schedules in reducing disruption within an academic setting. In their study, a functional analysis revealed that the disruptive behavior of one child with developmental disabilities was maintained by attention from peers. Peer attention was then delivered on a FT schedule, while disruption continued to produce reinforcement (no extinction). Rasmussen and O'Neill (2006) extended the work of Jones et al. (2000) by demonstrating that FT schedules could be effectively thinned within the classroom. Functional assessments suggested that adult attention maintained the disruption of three typically developing children. Following exposure to an FT schedule with extinction, the reinforcement schedule was thinned in fixed increments to intervals as great as 90 s. Given the practical issues involved in schedule thinning mentioned above, application of FT schedules in classroom settings requires further exploration.

The purpose of the present study was to build on previous research to assess the effects of FT schedules on problem behaviors in a day-treatment classroom setting. In particular, we sought to replicate the work by Rasmussen and O'Neill (2006) by examining the reductive effects of FT schedules of attention implemented by a

teacher and, subsequently, thinned. Additionally, the current study extended this research by showing implementation by teachers and support assistants in special education classrooms, thinning to leaner schedules for two participants, and conducting follow-up observations for three participants. Although a functional analysis was not conducted to confirm an attention function for problem behavior, a functional assessment interview was used to hypothesize an attention function similar to that of Rasmussen and O'Neill (2006). These techniques were presented to the participants with developmental delays, a population that has so far not been studied using this technique in an educational setting rather than in a clinic.

Method

Participants and Setting

The four children participating in this study were all taught in special educational classrooms located in mainstream schools. Students NJO and NJE (false initials) were both 14 years old, had both been identified as having emotional and/or behavioral disorders by an educational psychologist independent of the current study, and one student (NJE) had been diagnosed with cerebral palsy by a pediatrician. Both of these children had statements of special education needs from their local education authority as having below average intellectual functioning with a low reading ability (their reading ages had been assessed as being equivalent to children between 8 and 9 years of age). The other two children (JR and JS: false initials) were JR, a 7-year-old male, diagnosed with Down syndrome and JS, a 5-year-old male, diagnosed on the autism spectrum by a pediatrician independent of the current study. Both of these children (JR and JS) had been formally assessed by an educational psychologist (independent of this study) and had statements of special educational needs from their local education authority as having below average intellectual functioning.

Students NJO and NJE were taught in a senior school's special needs resource base (SNRB). The SNRB specialized in teaching children identified with emotional and behavioral problems. Within the SNRB, there were typically 11 other children, and between 2 and 3 staff, consisting of the main classroom teacher and formal learning support assistants (LSAs). The other two children were taught in an infant special teaching facility (ISTF; a school for children between 5- and 7 years old), which specialized in teaching children with developmental disorders. Within the ISTF, there were typically 9 other children, and between 3 and 7 staff (averaging 4 staff on a normal day), consisting of the main classroom teacher, formal LSAs, and volunteer LSAs.

Apparatus and Equipment

The functional assessment forms used were originally designed by O'Neill et al. (1997). The partial-interval recording forms that were used were obtained from Tieghi-Benet et al. (2003). The individual actually implementing the intervention,

namely either the class teacher or LSA, was cued using a preset vibrating timer (the Invisible Clock II©), as to when to administer social attention to the particular student under observation. A standard stopwatch found on most mobile phones was used by the researcher and other observer to time the 10-s intervals of the partial-interval recording procedure.

Identification of Participants

Each class teacher was requested to identify two students within their class who they felt exhibited disruptive challenging behavior. Each class teacher was asked to consider whether each student's disruptive behaviors may be maintained by positive social reinforcement in the form of attention. This reinforcer was chosen as it was thought to be relatively common for such children, and this would help to extend the generality of the results. Once two students from each unit had been identified, their parents were provided with a participant information sheet, encouraged to ask any questions that they may have and asked to sign a consent form allowing their child to participate.

Identifying Target Behaviors and Their Consequences

The specific behaviors of the pupils that were to be targeted were identified by functional assessment interviews conducted with the class teacher who knew the child (O'Neill et al. 1997). During the functional assessment interview, respondents were asked a large number of questions, but the main topics were the following: (1) to describe the problem behaviors in terms of their topography, frequency, duration, and intensity, and whether any behaviors were likely to occur together; (2) to define the events that predicted the problem behaviors in terms of the time of day, settings, people, activities, etc.; (3) to identify the consequences of the problem behavior; and (4) to describe the efficacy of the behavior. To assess the reliability of the results of the functional assessment interview, each student who had been identified to participate in the study had a functional assessment questionnaire completed by two adults: the class teacher and the LSA who worked closely with the child. Each adult completed the questionnaire twice, with 1 week between the first and the second completions and both completions prior to intervention. There was a high degree of similarity in the ratings across time for the teachers and support workers, who also showed high degrees of similarity with each other's ratings. The interviews led to the hypothesis that the primary maintaining consequence for all four of the participant's challenging and disruptive behaviors was positive social reinforcement in the form of attention. This was in the form of attention from the adults located within the classroom (either the teacher or formal and volunteer LSAs) and was often in the form of verbal attention or physical contact.

For NJO and NJE, disruptive behavior was identified as the frequency of verbal disruptions. Verbal disruptions were defined as verbally talking out loud to a peer while the teacher was talking without first being asked to contribute either by the teacher, LSA, or class peer. The two children within the ISTF had two separate challenging behaviors: JR displayed oppositional behavior in the form of touching

or taking objects without being asked or withholding objects during a lesson. This disruptive behavior was defined as disrupting a lesson by playing, grabbing, or touching items during a lesson without being asked to do so by the teacher, LSA, or class peer, or refusing to hand back/over an object for more than 7 s on request of the teacher. JS's disruptive behavior was verbal disruption. Verbal disruptions were defined as verbally talking out loud to a peer while the teacher was talking, including repetitive speech of more than two consecutive repeats, without first being asked to so by the teacher, LSA, or class peer.

Measurement

The dependent variable (DV) for all four participants was the percentage of intervals within a session of the individually determined disruptive behavior. A 10-s partial-interval recording procedure was used to collect the data. At the end of each interval, the observer recorded the occurrence, or non-occurrence, of the target disruptive behavior displayed during the 10-s interval.

Experimental Design and Procedures

The study employed a multiple-baseline design across participants, with a thinning phase for each participant and a follow-up phase for three of the four participants. For the two secondary school pupils (NJO and NJE), three to four, 10-min sessions of training were conducted each day that the pupils were in school throughout all the phases. For the two infant school pupils (JR and JS), two to four, 10-min sessions were conducted each day that the pupils were in school throughout all the phases. All sessions throughout all phases and for all four of the children were conducted in their regular classroom settings. The 10-min intervention sessions occurred throughout the day in these settings, with at least 1 h in between each recoding session for any particular pupil. The lessons in which the recordings were taken varied from day to day and from pupil to pupil. However, each of the lessons used as contexts for the intervention was sampled in each phase, and the intervention procedure and timings were not influenced by the lesson in progress. This means that no particular type of lesson, or time of day, could be taken to be solely responsible for the behaviors, in itself, nor for the impact of the various phases on behaviors as each lesson occurred in each phase. Apart from these training sessions, the intervention was not in place during the day. Data were collected throughout all of the sessions by an observer and, on some occasions, by a second observer used to provide interobserver agreement.

Baseline

The baseline data were collected following the functional assessment interviews. During baseline, the special educational classroom environment was not manipulated from that observed during the functional assessment.

Initial FT Phase

During the intervention phases, the two secondary school pupils were observed during independent academic activities which had been set by the class teacher. These activities included Mathematics, English, Science, Religious education, Pastoral studies, and Geography. Due to the ages of the two infant pupils, they were both observed during less formally structured lessons including both individual tasks and group activities. Lessons included number, color, shape, letter activities, reading, computer work, science, and fine or gross motor tasks.

During the initial FT schedule of reinforcement intervention phase, all participants' targeted disruptive behavior was ignored, and either the teacher or LSA (depending on who was administering the FT schedule of reinforcement) provided verbal praise and pats on the arm according to the FT schedule in effect. The participants' initial FT schedules of reinforcement were determined by the mean latency to the first occurrence of problem behavior encountered during the baseline condition (Hagopian et al. 1994). The initial FT schedules were 63 s for NJO, 41 s for NJE, 26 s for JR, and 58 s for JS.

Prior to conducting the initial FT reinforcement schedule, the teachers and LSA practiced delivering FT schedules of attention on another child within the class. Practice sessions were continued until the teacher/LSA felt comfortable with the procedure and ready to continue with the actual participant. The procedure used to administer the FT reinforcement schedule was assisted by the use of a preset vibrating timer (Invisible Clock II©). The FT schedules were always preset by the researcher and were then used to prompt the teacher or LSA as to when they were required to administer social attention to the particular student under observation. A procedure was put into place to prevent the probability of inadvertently reinforcing a co-occurring disruptive behavior with a scheduled delivery of reinforcement. This procedure stipulated that if the student displayed the targeted disruptive behavior immediately prior to the FT schedule of reinforcement, the teacher/LSA would delay the delivery of attention for 10 s (Britton et al. 2000; Rasmussen and O'Neill 2006). No formal data were collected on the number of occasions that this occurred; however, this delay was observed anecdotally by the data collector for NJO and JR on no more than four occasions per child. If the occurrences of problem behavior were exhibited at any other time, they were ignored by the class teacher and LSA.

Schedule Thinning Phase

The above procedures were followed during all stages of FT schedule thinning. After between 9 and 18 sessions of the initial FT reinforcement schedule, attempts were made to systematically thin the amount of time from a dense to lean schedule. These schedules were then required for subsequent FT reinforcement for each participant and were increased in fixed increments (Rasmussen and O'Neill 2006). The FT schedule of reinforcement thinning phase for NJO increased the FT schedule from 63 to 252 s over 7 sessions: the FT schedule for sessions 1–3 of the thinning phase = 126 s and for sessions 4–7 the value = 252 s. The schedules increased from 41 to 164 s for NJE over 7 sessions: sessions 1–3 = 141 s; sessions

4–7 = 164 s. For JR, the FT schedule was increased from 26 to 60 s over 24 sessions (although initially the thinning process had to be reversed as performance deteriorated). The FT values on the thinning sessions were the following: sessions 1–3 = 46 s; sessions 4–8 = 36 s; sessions 9–12 = 40 s; sessions 13–15 = 45 s; sessions 16–21 = 50 s; and sessions 22–24 = 60 s. For JS, the FT schedule was thinned from 58 to 90 s over 13 sessions: sessions 1–3 = 68 s; sessions 4–6 = 70 s; sessions 7–10 = 80 s; and sessions 11–13 = 90 s.

Follow-up

During the follow-up phase, baseline conditions were again in force. The teachers were told that the children would be observed again as in the baseline phase, but were not given any instructions about the application of attention on FT schedules, and they did not have access to the timers, etc. That is, the children were observed in a typical classroom setting as in the baseline phase. Data for both secondary school students (NJO and NJE) were collected 14 days after the final thinning session was conducted. Data for one of the infant school students (JS) were collected 3 days after the final thinning session was conduced. Data for a withdrawal phase were unable to be obtained for student JR due to illness, which resulted in an extended absence from school.

Interobserver Agreement

A second observer was used to assess interobserver agreement (IOA) and collected data independently from the primary experimenter. IOA was conducted during at least 20% of the sessions for each participant and during all of the phases including baseline, intervention implementation, thinning, and follow-up. IOA was calculated by dividing the number of agreements from the 10-s intervals by the total number of intervals during the session and multiplying by 100%.

Before beginning IOA data collection, the researcher and IOA observer practiced observing the disruptive behavior of a non-participating student. This student was also educated within the same classroom as the participants involved in the study. The practice sessions continued until the two observers reached an agreement level of at least 85% for at least two consecutive practice sessions.

The mean IOA for NJO was 97.5% (range, 93–100%); mean agreement for NJE was 96% (range, 85–100%); mean agreement for JR was 97% (range, 94–100%); and mean agreement for JS was 95% (range, 90–100%). Cohen's Kappa values were also calculated for these agreements, and these were .84 (range, .78–1.0) for NJO, .89 (range, .75–1.0) for NJE; for JR, these scores were .90 (range, .76–1.0), and for JS, these were .85 (range, .71–1.0).

Results

Figure 1 presents the percentage of 10-s intervals within each 10-min observation session in which disruptive behavior occurred. Overall, the participants exhibited a relatively high and variable rate of the target disruptive behavior during the baseline

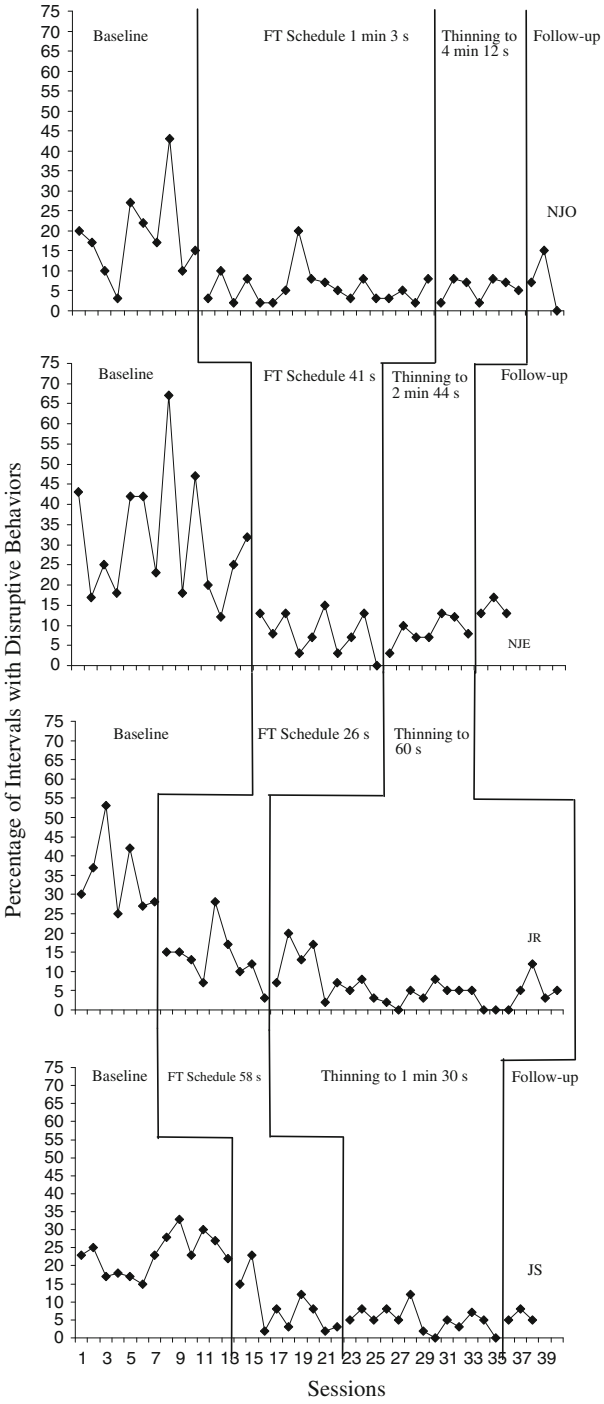

Fig. 1 The percentage of 10-s intervals with occurrences of the targeted behaviors

phase. Implementation of the FT schedules resulted in an immediate decrease of this target behavior for all participants. This decrease relative to baseline was generally maintained throughout the initial intervention (FT training) and throughout the thinning and follow-up phases.

In terms of the individual participants, NJO had a mean level of 25% of intervals with disruptive behavior during baseline, which decreased to a much lower and stable level with a mean of 5% of intervals with disruptive behavior during FT training. This level remained low and stable in the thinning phase (mean = 4%) and showed only a small increase at follow-up, but remained low (mean = 8%) and stable relative to baseline. NJE displayed a very similar pattern of disruptive responding across the phases, albeit at a slightly higher level of disruption than NJO (mean percentage of intervals with disruption: baseline = 35%, FT training = 8%; thinning = 8%; and follow-up = 15%). It might be noted that there was a general increasing trend in the level of disruptive behavior across the final two phases for NJE (thinning and follow-up), but that levels of disruption were much lower than in baseline.

For participant JR, there were initially high but variable levels of disruptive behavior at baseline (mean percentage intervals with disruption = 35%), which decreased in the FT training phase (mean = 15%) and showed a generally decreasing trend across this phase. These levels of disruptive behavior became lower still in the thinning phase (mean, 8%) and appeared stable during this phase.

For participant JS, the level of baseline disruption was relatively high and stable, with a mean 25%. This level decreased across the FT training phase, and there was a mean of 10% of intervals with disruption during this phase. In the thinning phase, the level of disruptions became lower still (mean 5%), and this level was stable across the phase. At follow-up, there had been a slight increase from the thinning phase (mean = 8%), but this was much lower than baseline and appeared stable.

Discussion

This study extends the existing literature on the use of FT schedules of reinforcement by demonstrating their successful implementation in a non-clinical, special educational classroom setting with students of different ages. These students also exhibited generally less extreme though still challenging and disruptive problem behaviors than the majority of participants involved in FT schedule interventions (e.g. Rasmussen and O'Neill 2006; Vollmer et al. 1993). Initial, thinning, and follow-up phases demonstrated that levels of disruptive behavior were maintained lower than at baseline. Therefore, the results provide evidence that the beneficial effects of FT schedules of reinforcement can be effectively maintained after FT schedule thinning in classroom settings.

During the initial intervention phase, the FT schedule immediately decreased disruptive behavior for three out of the four participants, which was generally maintained during the thinning and follow-up phases. Research has indicated that dense FT schedules may be necessary at the outset of a treatment program and that with systematic thinning, the subsequent effectiveness of a lean schedule can be

enhanced (Carr and LeBlanc 2006; Hagopian et al. 1994). The present study effectively replicates these findings by thinning all participants' dense schedules to leaner values. It should be noted that the schedule values used in the present work were longer than those previously employed, and this may have implications for the feasibility of implementing this intervention.

A number of limitations concerning the clinical and educational applications of the current procedure should be noted. First, problem behavior was placed on extinction during intervention but not during baseline, and the effects of the FT manipulation alone cannot be assessed. Second, we attempted to conduct a follow-up assessment, but this occurred not long after the termination of initial training, and further assessments after that may have revealed a different pattern of results. Third, the current study focused only on behaviors hypothesized to be attention-maintained, and further work would be necessary to see whether such NCR procedures are effective for behaviors maintained by other reinforcers. In this context, it is important to note that descriptive analyses of challenging behavior such as the functional assessment interview employed in the current research can produce false positives for the attention function (Hall 2005; Lerman and Iwata 1993; Thompson and Iwata 2007). Although the effect of the attention-based intervention used here does support the hypothesis that the challenging behaviors were, at least in part, maintained by attention, the lack of additional information regarding the specific assessment procedures used combined with the possibility that other functions may have also been present complicate the interpretation of the current findings. Nevertheless, the lack of direct functional behavior assessment results should be remedied in further research and used in addition to teacher-completed interviews (Asmus et al. 2002; Gresham et al. 2001). Finally, the current study did not employ measures of treatment fidelity (i.e. how accurately the teacher implemented the procedures) or social validity (e.g. did the teacher believe the intervention is appropriate). These measures are important (see Lang et al. 2010), and future research on this topic should consider adding such measures as, without this measure, there is need for extreme caution in attributing the intervention effects to the specific procedures that the teachers were instructed to implement, as it cannot be known with certainty that the procedures were implemented as intended.

Despite these limitations, the current study is consistent with previous research (e.g. O'Callaghan et al. 2006; Rasmussen and O'Neill 2006; Wilder and Carr 1998), in demonstrating that FT schedules of reinforcement can be effectively conducted within educational settings. Interventions using FT schedules are advantageous in that they directly address the contingency maintaining problem behavior while allowing for delivery of reinforcing stimuli. Due to the fact that extinction is not used alone, FT schedules may produce relatively fewer side effects than other extinction-based interventions.

The results are particularly interesting in light of the fact that the intervention itself was implemented by class teachers and thinned to values ranging from 60 s to 4 min 12 s. While implementation of the procedure required some procedural or behavioral knowledge on the part of the teacher in order to conduct the intervention effectively (conduct of a functional assessment, use of thinning procedures, etc.), it was apparent that the intervention was successful in most cases, and this suggests that such procedures could be applied readily in such contexts.

In terms of the practical applications of these findings, the results demonstrate that FT reinforcement schedules can be used as an effective treatment procedure for disruptive behavior maintained by socially mediated positive reinforcement. The results are particularly interesting in light of the fact that FT reinforcement schedules have been shown to be effective when used to decrease more than one disruptive target behavior. This highlights that FT reinforcement schedules are potentially valid for use within special educational classroom settings where the ratio of teachers to LSAs would lend support for managing the intervention. This study specifically demonstrated that FT schedules of reinforcement can be effective for participants with emotional and/or behavioral deficits and individuals with developmental disorders, such as autism and Down syndrome.

There are some potential disadvantages of FT schedules that should be noted, and these include the possibility of adventitious reinforcement, which can be eliminated by using a delay of reinforcement technique as in the current study. Also, the initial resources needed to implement the dense FT schedules, until it has been successfully thinned to an acceptable level, may be problematic in some applied settings. It should also be noted that antecedent interventions should be used only as an interim solution and are ultimately designed to gain immediate control over the problem behavior (Cooper et al. 2007). This is because changing the establishing operation for the problem behavior does not permanently alter the conditions motivating the behavior or promote alternative desirable behaviors (Miltenberger 2005). Future research should attempt to isolate the specific behavioral mechanisms responsible for the effects of FT schedules. Also, further research is warranted on the effects of FT schedules in a wider range of applied settings: for example, in mainstream classrooms using a wider range of participants, both with and without developmental or learning disabilities.

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