

*THE EFFECTS OF REINFORCEMENT RATE ON
THE SPONTANEOUS SOCIAL INITIATIONS OF
SOCIALY WITHDRAWN PRESCHOOLERS*

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Social skills priming was used to increase the spontaneous social initiations of 2 socially withdrawn preschoolers, 1 of whom had been diagnosed with autism. During priming sessions, the teacher prompted and reinforced social behaviors (e.g., smiling, verbal initiations). We varied the rate of reinforcement during priming sessions and measured the effects of this manipulation on the rate of spontaneous social initiations during the subsequent classroom activity. Spontaneous initiations were more frequent after high rates of reinforcement than after low rates of reinforcement.

DESCRIPTORS: priming, reinforcement rate, social skills

Priming is an intervention strategy that has been used to increase autistic preschoolers' spontaneous initiations to peers in a regular education classroom, with minimal demands on teachers' time (Zanolli, Daggett, & Adams, 1996). *Priming* technically refers to the presentation of a stimulus at one point in time that affects responding at a subsequent point in time (Baer & Wolf, 1970; Catania, 1984). In application, priming also usually includes (a) the same general stimulus conditions as in the activity in which the target response should occur; (b) prompting of low-effort behaviors during priming but not during the subsequent activity (e.g., Baer & Wolf, 1970; O'Brien, Azrin, & Henson, 1969; Zanolli et al., 1996); and (c) high availability of noncontingent (Ayllon & Azrin, 1968; Wilde, Koegel, & Koegel, 1992) or contingent (Zanolli et al., 1996) reinforcers.

High-probability request sequences, which have also been used to increase the spontaneous social initiations of preschool

children (Davis, Brady, Hamilton, McEvoy, & Williams, 1994), have procedural similarities to priming. Like priming, high-probability request sequences involve prompting and reinforcing low-effort, high-probability behaviors prior to the target response. High-probability request sequences are unlike priming in that the low-probability target behavior is then prompted during the activity in which it is expected to occur. Because priming involves only prompting *before* the activity in which the target response is expected, it may be more efficient for teachers who must work with large groups of children. For example, a teacher may prefer to use priming before a group lesson instead of interrupting the lesson to do high-probability request sequences.

One interesting result that is common to discrete-trial procedures, including priming, high-probability request sequences, and discrete-trial teaching, is that rapid trial presentation is more effective than slow presentation (Carnine, 1976; Koegel, Dunlap, & Dyer, 1980; Mace et al., 1988; Zanolli, 1997). In most applications of these procedures, the rate of trial presentation is confounded with the rate of reinforcement because ratio schedules, rather than interval schedules, are most often used with discrete

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trials. Both basic (Nevin, 1992; Nevin, Mandell, & Atak, 1983) and applied (e.g., Mace et al., 1990) research on response persistence suggests that it is the increased reinforcement rate during rapid trial presentation that may be responsible for its positive effects on subsequent behavior. In some studies, reinforcement rate is believed to be the sole controlling variable even when prompt rate is also manipulated (Mace et al., 1988). Alternatively, the trial presentation rate itself, via reduced opportunities for distraction or self-stimulation, has been cited as the probable cause of the rapid-trial effect (Carnine, 1976; Koegel et al., 1977).

The purpose of the present study was to further assess the underlying processes that contribute to the effects of rapid trial presentation by manipulating reinforcement rate during priming while holding the rate of trial presentation constant.

METHOD

PARTICIPANTS AND SETTING

Joel, a 6-year 5-month-old boy who had been diagnosed with autism, was enrolled in both home-based behavior therapy and a preschool program at the time of the study. Joel's skills included expressive labeling of objects, making functional requests, and reading. Although his prompted language and reading skills were quite good, his teachers and parents reported that he did not initiate social interactions or requests for help. This made it difficult for him to participate in small-group activities.

Bill was a 2½-year-old boy with age-appropriate skills. Bill's first language was Chinese, and his parents reported that he appeared to understand both Chinese and English that was spoken at home. However, he seldom spoke in either language. At school, he was rapidly acquiring English labels and request words during direct instruction, but

he still did not initiate requests for help, attention, or social interactions with teachers or peers.

The study was conducted during regular activities in the preschool classrooms. Bill was enrolled in a university-based preschool serving 18 children (both typical and disabled), ages 2 to 5 years. Joel was enrolled in another preschool in the same center with 16 children, ages 4 to 6 years.

The recipient of social initiations was a teacher, because implementing the reinforcement schedules was too complex for peers. All 3 teachers (referred to as Teachers A, B, and C in the results) were undergraduate or graduate student teachers who were part of the regular classroom staff.

MEASURES

Teachers' behaviors were prompting (teacher asked, told, or showed the participant how to do or say an initiation behavior), delivering a tangible item (a hug, high five, or sticker), and approval ("way to go," "good job," "nice talking," "Hi!" "that's good"). Participants' behaviors were scored as initiations only if (a) the participant performed the behavior while looking directly at the teacher's face and (b) there was no teacher behavior within the preceding 5 s. Participants' behaviors were smiling, saying "look," saying the teacher's name, other verbalizing (any English words said while looking at the teacher's face or at an object held by the teacher; this excluded nonword vocalizations, non-English words, and simply requesting the tangible consequence), and touching the teacher. All initiations, including those emitted during baseline and those that were never prompted during priming, were scored. Three negative behaviors (aggression to teacher, self-biting, and crying) were originally defined in the code but never occurred.

All behaviors were recorded on data sheets that had session time in minutes and sec-

onds written down the side and columns corresponding to each behavior category across the top. When a behavior occurred, the observer looked at the stopwatch, then made a check on the data sheet next to the time of occurrence and in the column corresponding to the behavior. In this way, the time of occurrence, frequency, and sequence of behavior were recorded.

INTEROBSERVER AGREEMENT

Observers were undergraduate and graduate students who were not aware of the specific hypotheses of the study. Observers were paired with different partners, which is usually recommended to prevent observer drift (i.e., the progressive disparity between pairs of observers who are in agreement within the pair because of prolonged scoring with only one partner; Foster & Cone, 1980). An agreement was scored if an observer marked the same behavior within 3 s of the other observer. In addition, two different behaviors scored within the same 3 s by both observers had to be in the same order to qualify as an agreement. All other marks on the data sheet were counted as disagreements. Interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Interobserver agreement was checked for 39% of Bill's sessions and 38% of Joel's sessions. Overall agreement was above 80% for each behavior (range, 81% to 100%). Overall agreement for all behaviors combined was 95% for Bill and 94% for Joel; daily agreement ranged from 78% to 100%.

DESIGN

The independent variable was the rate of reinforcement during priming sessions. The dependent variable was the rate of spontaneous initiations to the teacher during the activity sessions. The design was a multiple baseline across participants, with an embed-

ded multielement design (comparing high- vs. low-reinforcement priming) and a reversal. A baseline consisting of activity sessions was followed by a brief phase of priming training, which was followed by a multielement comparison between high- and low-reinforcement priming. The order of conditions during this phase was scheduled using a random number table. The multielement comparison was followed by another baseline. This was followed by a phase of high-reinforcement priming across teachers, in which the procedures for high-reinforcement priming were implemented by 2 teachers (Teachers B and C) other than the teacher in the first priming phase (Teacher A) for Bill and by 1 other teacher (Teacher B) for Joel.

PROCEDURE

Stimulus Preference

Preference was assessed once at the beginning of the study by presenting a variety of items on a table and asking the child to choose one. This procedure was repeated five times. The three items that were chosen most often were used as reinforcers in the study. The possible reinforcers were selected by nominations made by both parents and teachers from a list of items that were available in the classroom. They included three different kinds of stickers, pom poms, balloons filled with sand, crackers, candy, and a card picturing physical affection (hug, high five). The preferred items selected by Bill were three different kinds of stickers. The preferred items selected by Joel were physical affection (a card showing a hug or high five that, when selected, produced the depicted behavior from an adult), crackers, and candy. However, the only tangible reinforcer used for Joel was physical affection, because his parents expressed reservations about using food in the classroom.

Activity Sessions

Activity sessions lasted 5 min; one session was conducted per day over a 6-week period. Bill's activity was working with fine-motor materials (crayons, blocks, magnets, etc.) with 1 teacher and 1 to 3 peers present. Joel's activity was working on handwriting and spelling at a worktable, with 2 teachers and 6 peers present. No prompts for initiations were given during activity sessions. Spontaneous initiations to the teacher received reinforcement (approval and a sticker for Bill; high five or hug for Joel) on a variable-interval (VI) 30-s schedule. Intervals for the VI schedule were randomly generated by a computer program ($M = 30$ s; range, 5 s to 55 s). The teacher set up the schedule before the session by writing the times during which reinforcement would be available on a check sheet that she used during the session. All spontaneous verbal initiations in English, including behaviors that had not been prompted during the priming sessions, received reinforcement according to the VI 30-s schedule.

Priming Sessions

The specific initiation behaviors that were prompted during the priming sessions were selected by the boys' teachers. For Bill, two behaviors were prompted during the priming sessions: say "look" and say the teacher's name. These behaviors were prompted three times each (in randomized order) during the priming session, for a total of six trials. For Joel, the prompted behaviors were to say "look," to smile at the teacher, and to say the teacher's name; these behaviors were prompted twice each for a total of six trials per priming session.

For each trial of the prompting procedure, the teacher gave a verbal instruction and modeled the behavior to the participant. For example, to prompt smiling, the teacher said, "Joel, smile at me," while smiling at

the participant. If Joel did not respond within 3 s, the teacher repeated the prompt once. If he still did not respond, the teacher worked with the priming activity materials until it was time to deliver the next scheduled prompt. If Joel responded correctly, the teacher either delivered preferred reinforcers or worked with the activity materials until it was time for the next prompt, depending on the VI schedule for that condition. The teacher delivered reinforcement by expressing approval and giving Bill a sticker or giving Joel a high five or hug. All reinforcers required a very brief time to deliver; therefore, their duration was not timed.

Priming (CRF). Initiations were prompted every 15 s, and all correct responses received reinforcement. This condition was implemented because both children emitted no initiations during baseline. We wanted to be sure that priming would result in some unprompted initiations before comparing the effects of high and low reinforcement rate.

The session timer was started when the teacher and the child sat down at the activity. When the child remained seated and had been manipulating the activity materials for 5 consecutive seconds, the teacher began prompting. The purpose of waiting until the child was engaged with the activity was to avoid disrupting the prompting schedule because of the child's changing positions or reaching for new materials. The actual amount of time that elapsed before the first prompt was delivered was 8 s to 15 s. Each priming training session lasted 90 s to 108 s and was immediately followed by an activity session.

High-reinforcement-rate priming. During each session, initiations were prompted every 15 s. Correct responses received preferred reinforcers on a VI 15-s schedule ($M = 15$ s; range, 5 s to 25 s).

The timer for the VI schedule was started when the child sat down in the activity area, before the first prompt was delivered. The

timer was started before the first prompt so that the rate of reinforcement would be synchronized with the time the child spent in the priming stimulus context; the association of reinforcement rate and stimulus context has been shown to be a powerful variable in previous studies on behavioral momentum (e.g., Mace et al., 1990). The first prompt was actually delivered 5 s to 18 s after the session timer began. Each high-reinforcement-rate priming session lasted 90 s to 110 s, depending upon when the first prompt was delivered.

A VI schedule was chosen over a variable-ratio schedule so that a constant rate of reinforcers could be delivered in each session, independent of slight variations in the timing of prompts or the speed of the child's response. A total of five or six reinforcers were scheduled for each rapid priming session. When an interval on the VI schedule elapsed, the child received a consequence for the next correct response, independent of the exact time the prompt was delivered. There was no limited hold procedure, but unused reinforcers were not carried over from one session to the next. Each priming session was immediately followed by an activity session in which spontaneous initiations received reinforcers on a VI 30-s schedule.

Low-reinforcement-rate priming. Everything in the low-reinforcement-rate condition was the same as in the high-reinforcement-rate condition, except that correct responses received reinforcement on a VI 45-s schedule ($M = 45$ s; range, 8 s to 82 s). The actual time elapsed before the first prompt was delivered ranged from 5 s to 21 s, and the sessions lasted 95 s to 112 s. Two reinforcers were scheduled in each session, with the exception of one session in which the 82-s interval occurred, one session in which one reinforcer was scheduled, and one session in which three reinforcers were scheduled. Each session was immediately fol-

lowed by an activity session in which spontaneous initiations received reinforcement on a VI 30-s schedule.

TEACHERS' ADHERENCE

Observations of teachers' behavior were compared to a written outline of the correct procedures for each session. Five aspects of the procedure were scored as either correctly or incorrectly implemented: correct number, order, and timing (within 5 s) of prompts during the priming sessions; giving no prompts for initiations during the activity sessions; and correctly delivering the schedule of reinforcement (reinforcement was delivered contingently when the designated interval was finished). Implementation was above 95% correct in all sessions.

RESULTS

PRIMING SESSIONS

Bill and Joel responded correctly to 80% or more of prompts delivered during priming sessions; Bill's overall percentage correct was 94% (range, 67% to 100%) and Joel's percentage correct was 88% (range, 52% to 100%). Reinforcement rate during priming did not affect correct responses to prompts for either Bill or Joel.

ACTIVITY SESSIONS

Spontaneous Initiation Rate

Neither Bill nor Joel initiated to the teacher during the activity-only (baseline) condition (Figure 1). Priming training increased spontaneous initiations in the subsequent activity sessions ($M = 2.90$ per minute for Bill; $M = 0.96$ per minute for Joel). High-reinforcement priming resulted in higher rates of spontaneous initiations in the activity sessions ($M = 1.80$ per minute for Bill; $M = 1.76$ for Joel) than did low-reinforcement priming ($M = 0.85$ per minute for Bill; $M = 0.30$ for Joel). Bill's mean rate

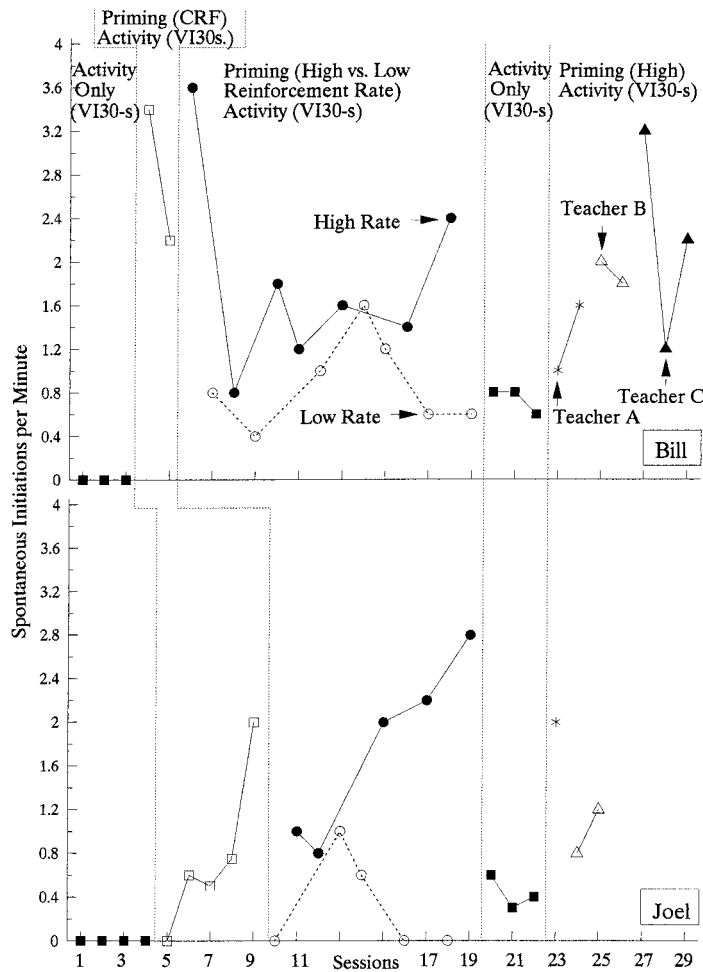


Figure 1. Spontaneous initiations to the teacher during all conditions for Bill (top panel) and Joel (bottom panel). On each day, 1 teacher conducted the priming session, ran the subsequent activity, and received all initiations.

of spontaneous initiations after high-reinforcement priming was more than twice as high as after low-reinforcement priming, and Joel's mean rate after high-reinforcement priming was nearly six times higher than after low-reinforcement priming. Response rates after low-reinforcement priming were stable, and rates after high-reinforcement priming were increasing by the end of the phase for both participants. Bill and Joel continued to initiate to the teacher when priming was discontinued, although at a lower rate. On each day in the final phase, a new teacher used high-reinforcement

priming, conducted the activity, and received initiations. Bill and Joel initiated to each of the teachers at higher rates than during the activity-without-priming phase ($M = 1.89$ per minute for Bill; $M = 1.42$ for Joel).

Variety of Initiations

Both Bill and Joel used a variety of behaviors to initiate, including behaviors that were not prompted during the priming session. Bill's initiation behaviors included saying the teacher's name, saying "look," touching the teacher, and other verbal behaviors

such as the names of letters or objects used in the activity, requests ("I want paper"), and greetings. Joel's initiation behaviors included smiling, saying the teacher's name, touching the teacher, and several verbal behaviors (saying the names of the toys, commenting on the color or motion of the toys in the activity). There was no consistent difference in the variety of initiations between high- and low-reinforcement conditions.

DISCUSSION

Reinforcement rate during priming affected subsequent social initiations to teachers during regular classroom activities: Both Joel and Bill initiated more after a high reinforcement rate than after a low reinforcement rate. This effect was independent of both the prompt rate during priming and the reinforcement rate during the activity, because both of these variables were held constant across the two conditions.

There was some evidence of response generalization, because initiation behaviors that had never been prompted during priming also increased, although reinforcement rate did not have differential effects on this variable. There was little evidence of maintenance, because a high rate of initiations was not maintained when priming was withdrawn. Initiations were reinstated by several different teachers who used priming, indicating that the procedure has some practical utility.

The effects of reinforcement rate during priming sessions on subsequent initiation rates is consistent with the findings of basic and applied research on the importance of prior reinforcement rate for response persistence or behavioral momentum (Mace et al., 1990; Nevin et al., 1983). Our results suggest that the behavioral persistence produced by priming is greatly influenced by prior reinforcement rate. This conclusion does not rule out the potential influence of rapid

prompting (Carnine, 1976; Koegel et al., 1980). Future research that evaluates the effects of rapid and slow prompting while holding reinforcement rate constant will be needed before we can fully understand the effects of rapid trial presentation.

If the effects of priming are primarily due to prior reinforcement rate, then the research on behavioral momentum could be readily applied to priming, as it has been to high-probability request sequences (Mace et al., 1988). This application might help to refine priming so that additional generalization and maintenance of desired behavior could be obtained.

Finally, our study extended the existing applied literature on prompt-driven procedures in two ways. First, reinforcement rate was shown to have an effect without an artifactual correlation with prompt rate, as in previous studies. Second, we established that reinforcement rate influences subsequent unprompted social behavior in a regular preschool setting, a phenomenon that was not investigated in previous comparisons of rapid and slow trial presentation.

The present study represents an initial step in the analysis of priming and other prompt-driven social skills procedures. Further research may identify more effective ways to use these procedures, thereby giving us another tool for enabling withdrawn children to be fully and functionally included in the social lives of their peers.

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STUDY QUESTIONS

1. According to the authors, what is priming and how is it normally used?
2. Why did the authors suggest that priming may be more efficient for teachers to use than high-probability instructional sequences? Can you suggest a situation in which the high-probability sequence would be more efficient?
3. How did the study extend previous research on the effects of trial presentation rate?
4. What were the procedural similarities and differences among the three priming conditions?
5. Describe the experimental design used to evaluate the effects of the priming conditions and the procedure used to maintain equal rates of reinforcement.
6. Summarize the results obtained for both participants with respect to rate of priming, response generalization, and maintenance.
7. Given the differences observed in rates of social initiation during the activity sessions following high- and low-rate reinforcement priming, in what way were the results obtained during the preceding priming sessions unusual?

8. Although the present data suggested that behavioral persistence was influenced by rate of reinforcement, the authors noted that their experiment did not rule out the possibility that rate of prompting also contributed to the overall results. Describe an experiment that would examine the influence of both variables.

Questions prepared by Juliet Burke and SungWoo Kahng, The University of Florida