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# *THE REDUCTIVE EFFECTS OF NONCONTINGENT REINFORCEMENT: FIXED-TIME VERSUS VARIABLE-TIME SCHEDULES*

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The effects of fixed-time (FT) and variable-time (VT) schedules on responding were evaluated with 2 adults with mental retardation. Multielement and reversal designs were used to compare the effects of FT and VT schedules in reducing responses previously maintained on variable-ratio reinforcement schedules. The schedules were equally effective in reducing the target behavior.

DESCRIPTORS: contiguity, developmental disabilities, fixed-time schedules, noncontingent reinforcement, variable-time schedules

During the past decade, more than three dozen studies have been published on the use of noncontingent reinforcement (NCR) as treatment for aberrant behavior exhibited by individuals with developmental disabilities. Fixed-time (FT) schedules, in which the reinforcer is delivered after a set period of time has elapsed, are most commonly used (e.g., Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). Van Camp, Lerman, Kelley, Contrucci, and Vorndran (2000) demonstrated that variable-time (VT) schedules were as effective as FT schedules in reducing the socially maintained aberrant behavior of 2 individuals with mental retardation. This study was the first to evaluate both FT and VT schedules with a clinically relevant population. The purpose of the current study was to examine the generality of the Van Camp et al. findings in a systematic replication by (a) establishing an arbitrary target behavior with a known reinforcement history (instead of treating aberrant behavior with a relatively unknown history), and (b) holding schedule values constant over time (instead of thinning the schedule).

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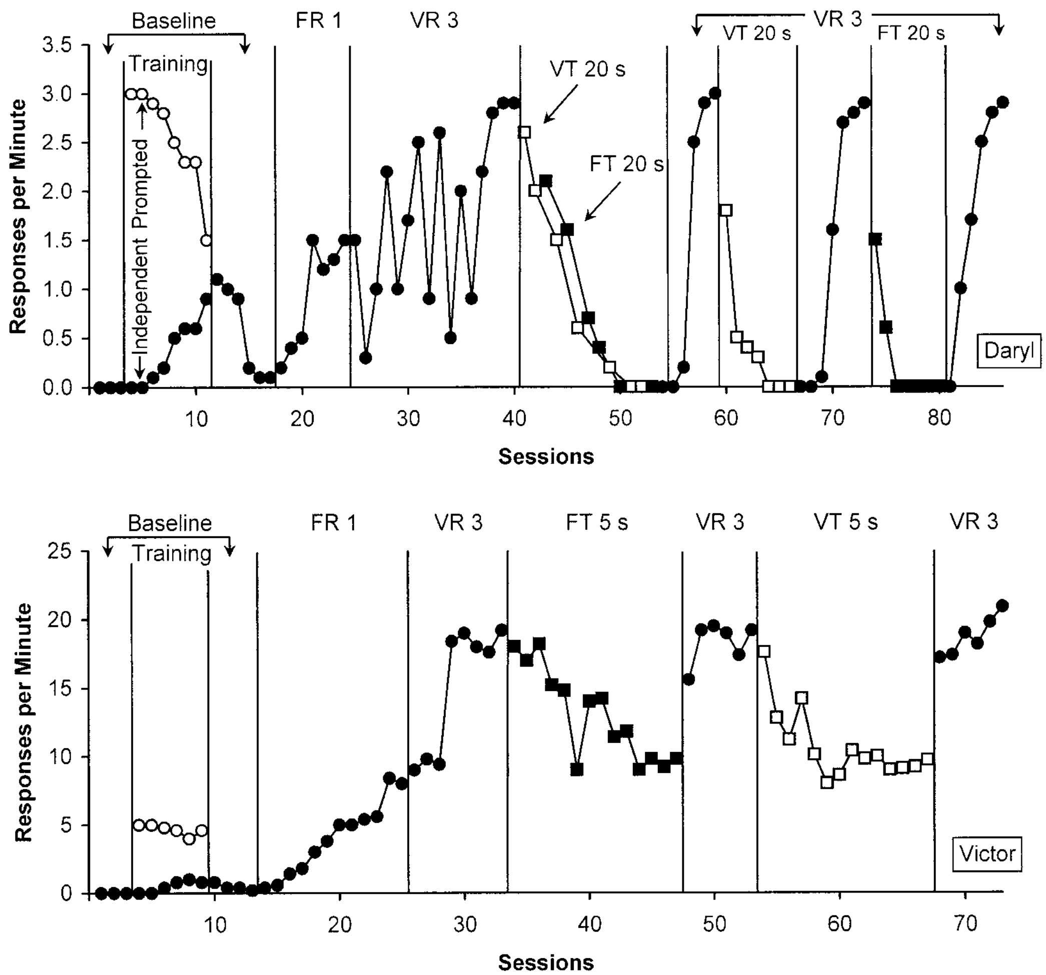
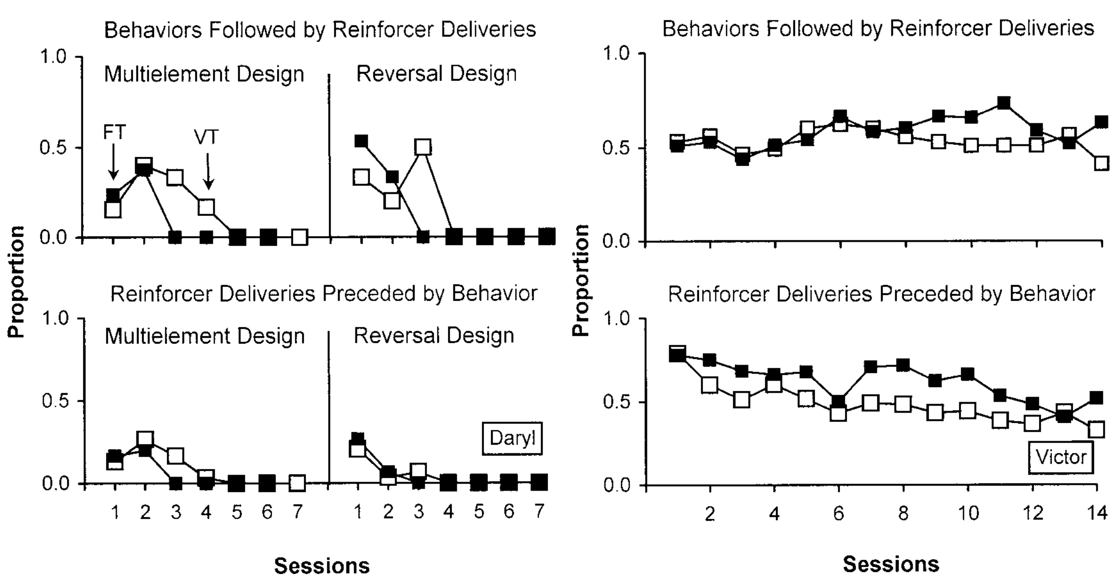
## METHOD

### *Participants and Setting*

Daryl was a 27-year-old man who had been diagnosed with severe mental retardation and Sterge-Weber disease. Victor was a 41-year-old man who had been diagnosed with profound mental retardation. Daryl's sessions were conducted in an academic area (3 m by 6 m) containing several tables and chairs at his day-treatment program. Victor's sessions were conducted at a desk in his bedroom at his community-based group home.


Baseline
Training
FR 1
VR 3
VT 20 s
FT 20 s
Independent
Prompted
Responses per Minute
Sessions
Daryl
FT 5 s
VT 5 s
Victor


Behaviors Followed by Reinforcer Deliveries
Multielement Design
Reversal Design
FT
VT
Reinforcer Deliveries Preceded by Behavior
Proportion
Sessions
Daryl
Victor

One experimenter was present during each session. Sessions lasted 10 min and 5 min for Daryl and Victor, respectively, and were conducted one to three times per day, 1 to 6 days per week.

*Response Measurement and Interobserver Agreement*

An arbitrary target behavior was selected for each participant. Daryl's apparatus included a small receptacle and pieces of paper on which his name and two "distracter" names were printed in 18-point type. Daryl's target behavior was defined as making a pencil mark on his name and placing the paper into the receptacle. Victor's apparatus included a small receptacle and large plastic paper clips. Victor's target behavior was defined as picking up a paper clip and dropping it in the receptacle. Response rate was calculated by dividing the frequency of responses by the number of minutes in the session. All sessions were videotaped and scored on a second-by-second basis for occurrence and nonoccurrence of the target behavior using a scoring sheet marked for 300 s and 600 s for Victor and Daryl, respectively. Two independent observers scored at least 31% of the videotaped sessions. The mean point-by-point interobserver agreement scores for occurrences and nonoccurrences of the target behavior were at least 98% for each participant. Independent variable integrity was assessed during each condition (except baseline) and exceeded 92% for each participant (procedures and results are available from the first author upon request).

*Procedure*

Before the study began, a list of preferred foods and beverages was generated from caregiver report for each participant. A brief multiple-stimulus preference assessment (Carr, Nicolson, & Higbee, 2000) was conducted before each session to select a preferred food or beverage item to be delivered during all sessions except baseline. Sessions began with an instruction (i.e., "do this") and a model of the appropriate response.

*Baseline (extinction).* No consequences were provided for responding.

*Training.* A least-to-most prompting hierarchy (i.e., vocal, gestural, physical) was used to teach the target behaviors. When responses began to occur independently, the prompts were informally faded. Praise was delivered contingent on responding (prompted or independent).

*Fixed-ratio (FR) 1 reinforcement.* The experimenter delivered the preferred food or beverage item contingent on each response.

*Variable-ratio (VR) 3 reinforcement.* The experimenter delivered the preferred food or beverage item contingent on an average of three responses (range, two to four responses). This condition served as the reinforcement baseline against which FT and VT effects were compared.

*FT.* The experimenter delivered the preferred food or beverage item on an FT schedule, and no programmed consequences were provided for responding. Daryl's FT schedule value was 33% of the interreinforcement interval during the initial VR 3 phase. Victor's FT schedule value was 50% of the interreinforcement interval during the initial VR 3 phase.

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Figure 1. Number of responses per minute during reinforcement (FR, VR) and time-based schedule (FT, VT) conditions for Daryl (top panel) and Victor (middle panel). Proportion of target behaviors followed by reinforcer delivery within 5 s, and proportion of reinforcer deliveries preceded by target behaviors within 5 s for Daryl (bottom left panels) and Victor (bottom right panels).

*VT*. The experimenter delivered the preferred food or beverage item on a VT schedule, and no programmed consequences were provided for responding. Daryl's VT schedule value was 33% of the interreinforcement interval during the initial VR 3 phase, with a range of 10 s to 30 s. Victor's VT schedule value was 50% of the interreinforcement interval during the initial VR 3 phase, with a range of 1 s to 10 s.

*Experimental Design*

A reversal design was used to evaluate the effects of FT and VT schedules, with the order of schedules counterbalanced across participants. An additional multielement analysis was conducted with Daryl.

## RESULTS AND DISCUSSION

As shown in Figure 1, the initial phases demonstrated that (a) neither participant performed the target behavior in the absence of programmed reinforcement, (b) training was effective in establishing the response, and (c) the FR 1 and VR 3 schedules maintained responding. Daryl was initially exposed to FT and VT schedules in a multielement design. Both schedules resulted in gradual reductions in responding to zero levels. Because of the potential for multiple-treatment interference, Daryl was exposed to an additional evaluation using a reversal design. Both schedules again resulted in similar trends to zero. Response patterns for Victor also were nearly identical under the FT and VT schedules. Responding decreased to about 50% of the previous VR 3 level and then remained stable.

Figure 1 also shows the results of a contiguity analysis of FT and VT session data for both participants. The analysis, which is similar to that employed by Van Camp et al. (2000), revealed few reliable differences between FT and VT schedules. However, it did indicate a high degree of contiguity between Victor's target behaviors and the programmed reinforcer deliveries, suggesting adventitious reinforcement as a likely mechanism for response maintenance under both FT and VT schedules. This finding is not surprising, given the relatively dense schedules (i.e., 5 s) and high response rates. Nevertheless, the results are interesting because it appears that FT and VT schedules were equally likely to result in adventitious reinforcement.

These findings should be evaluated in light of at least three limitations. First, a relatively narrow range of VT schedule values was evaluated. In other words, the FT and VT schedules may not have differed enough to produce differential effects. Second, the schedule values were relatively dense (i.e., 5 s and 20 s), and these findings may not extend to thinner schedules. Finally, sequence or interaction effects may have influenced the outcome.

In conclusion, the current study systematically replicated the findings of Van Camp et al. (2000) by demonstrating similar reductive effects of FT and VT schedules using the same experimental designs (i.e., reversal, multielement). The consistent findings are especially noteworthy given the various procedural differences between the two studies, including the reinforcement history, FT and VT schedule values, VT schedule ranges, target behaviors, reinforcers, and session lengths. In addition, the FT and VT schedules remained unchanged in the current study, whereas Van Camp et al. employed a schedule-thinning procedure. These results, which suggest a certain robustness of NCR, are important for at least two reasons. First, because it is probably easier for caregivers to deliver reinforcers at regularly scheduled times, FT schedules can be used instead of VT schedules. Second, NCR should remain effective even if the integrity of an FT schedule degrades into something resembling a VT schedule.

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