

*FIXED-TIME SCHEDULE EFFECTS IN COMBINATION WITH
RESPONSE-DEPENDENT SCHEDULES*

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We evaluated the effects of fixed-interval (FI), fixed-time (FT), and conjoint (combined) FI FT reinforcement schedules on the responding of 3 adults who had been diagnosed with schizophrenia. Responding on vocational tasks decreased for 2 of 3 participants under FT alone relative to FI alone. Responding under FI FT resulted in response persistence for 2 of 3 participants. Results have implications for the maintenance of desirable behavior, as well as for situations in which FT treatment has been implemented for problem behavior and problem behavior is nevertheless reinforced by caregivers.

Key words: conjoint schedules, noncontingent reinforcement, time-based schedules, schizophrenia, vocational skills

Fixed-time (FT) schedules involve the delivery of a stimulus independent of behavior after a set period of time has elapsed (Catania, 1998). Applied studies on FT reinforcement schedules have focused primarily on the treatment of problem behavior (e.g., Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). However, research findings also have suggested some conditions under which FT schedules might support response maintenance (e.g., Dozier et al., 2001; Ringdahl, Vollmer, Borrero, & Connell, 2001). Although time-based schedules have been a topic of considerable study, their effects on performance when combined with other schedules have received relatively little empirical attention. In the natural environment, it is unlikely that any simple schedule occurs in isolation. Rather, schedules that operate in the natural environ-

ment are likely to be a blend of simple and complex schedules (Nevin, 1998).

In one of the first studies of combined response-dependent and response-independent schedules, Lattal and Bryan (1976) exposed the key pecking of three pigeons to a fixed-interval (FI) reinforcement schedule, in which the first response that occurred after a specified period of time had elapsed produced a reinforcer. Next, the previously evaluated FI schedule was accompanied by an FT schedule that was denser than the FI schedule. The behavior of some subjects decreased when both FI FT schedules were in place, whereas the behavior of others increased relative to when the FI schedule was implemented alone. Both outcomes are relevant to at least two clinical scenarios. First, the response increases observed by Lattal and Bryan suggest that combining FI and FT schedules might be a useful clinical strategy to maintain appropriate behavior. Alternatively, the response decreases suggest that treatments involving FT schedules, designed to decrease behavior, might remain effective even if behavior is intermittently reinforced. Given the relevance of conjoint FI FT outcomes and the inconsistent outcomes reported by Lattal and Bryan, the present study was designed to further evaluate them with a clinically relevant human population.

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METHOD

Participants, Setting, and Materials

Three adults with schizophrenia participated. Judy, Javier, and Samuel were all over 30 years of age at the time of this study. Sessions were conducted in a classroom at a local socialization center for adults with various mental illnesses (Judy and Javier) or the participant's apartment building (Samuel).

A table with supplies needed to engage in the target response (e.g., forms, three-hole paper punch) and a chair were provided for each participant. The experimenter had 14 tokens and a clear bin in which tokens were placed. Token color varied depending on the condition to enhance discrimination. Each token was exchanged for a nickel postsession that was credited to an account at the socialization center (with which participants could buy various snacks).

Response Measurement and Interobserver Agreement

The dependent variable, *task completion*, was defined as picking up one form, placing the top side of the form in the hole punch, punching two distinct holes in the form, and placing the form in the box (a response was scored when the participant was no longer touching the form at the end of the sequence). Observers collected frequency data on task completion and token delivery within 10-s observation intervals using pencils and data-collection sheets. The number of forms prepared by the participant also was counted and recorded at the end of each session. Interobserver agreement was assessed by having a second observer simultaneously but independently score task completion and token delivery during at least 25% of sessions for each participant. Agreement between observers was assessed for each 10-s interval. The smaller frequency in each interval was divided by the larger frequency, and a mean of these values was calculated for the entire session before being converted to a percentage. Mean agreement was

94% for Judy (range, 64% to 100%), 94% for Javier (range, 64% to 100%), and 95% for Samuel (range, 81% to 100%).

Design and Conditions

A reversal design was used. Prior to the first session, the experimenter modeled the response and told the participant, "Here is a task you can do. You can do as much as you want, as little as you want, or none at all." Prior to subsequent sessions, the experimenter presented the instruction without the model. During baseline, the participant was permitted to work on the task, but no tokens were delivered (or present). Baseline was included to determine whether responding would occur in the absence of programmed reinforcers. Prior to each subsequent condition, the participant was informed that tokens could be exchanged after the session for one nickel each. Each session lasted 20 min or until all 14 tokens had been delivered, whichever came first. This criterion was included to control the number of reinforcers delivered across sessions. During FI 60-s sessions, the experimenter placed a black token into the clear bin contingent on the first target response that occurred after a 60-s interval. During the FT 60-s sessions, the experimenter placed a red token into the bin every 60 s, regardless of whether the participant engaged in the target response. During the conjoint FI FT sessions, a blue token was placed in the bin for the first target response that occurred after a 60-s interval and every 60 s regardless of whether or not the participant completed a response. The extinction condition (for Judy only) was identical to the baseline condition.

RESULTS AND DISCUSSION

Figure 1 depicts response rates for all participants. Responding during baseline was elevated initially but eventually reached low or zero rates for all participants. The presence of task materials may have initially evoked responding in baseline due a prior reinforcement

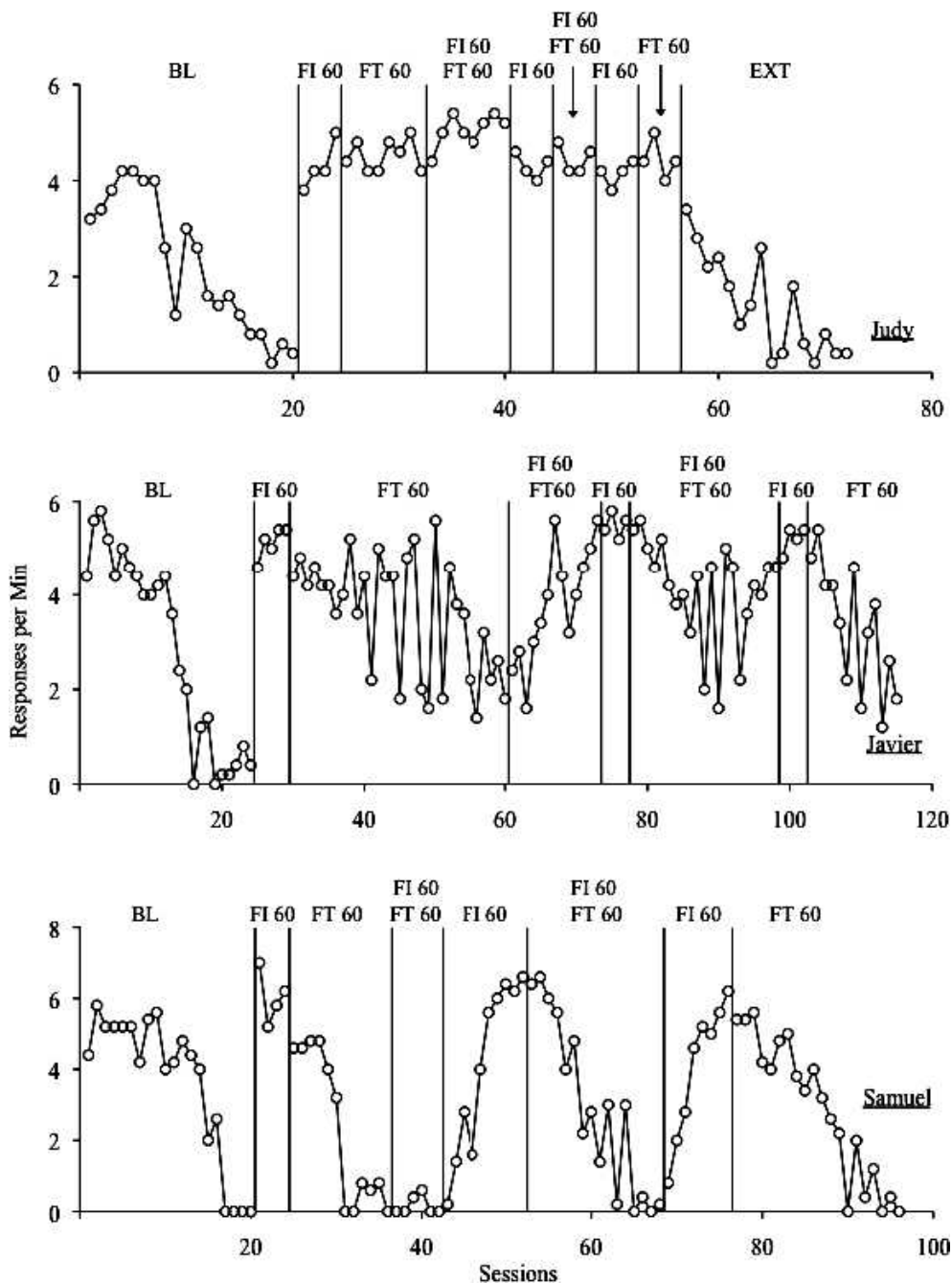


Figure 1. Responses per minute of vocational task completion for Judy (top), Javier (middle), and Samuel (bottom) across conditions.

history for working in the environment. Responding of all participants increased and remained stable under the FI 60-s schedule. Judy continued to respond throughout all

conditions (FI alone, FT alone, and FI FT combined). To rule out the possibility that task completion itself had become automatically reinforcing, her responding was exposed to

extinction. It subsequently decreased to low levels. For Javier, responding in the FT condition decreased by about half the rate observed during the FI 60-s condition, recovered under the first exposure to the FI FT condition, and persisted during the replication of the FI condition. His response rate during the second exposure to the FI FT condition was variable in that responding gradually decreased but eventually increased to levels slightly lower than those obtained in the prior FI condition. Responding persisted in the subsequent FI condition and showed an overall decreasing trend in the final FT condition. For Samuel, responding during the FT 60-s condition was reduced to near zero and was unaffected by the introduction of the FI FT condition. This effect was generally replicated in the subsequent exposures to these conditions, and responding was highest under the FI 60-s condition.

Performance during the conjoint FI FT condition may have some implications for the programming of reinforcers in applied settings. Reinforcers may be purposely arranged contingent on adaptive behavior at some times, arranged independent of behavior at other times, or involve a combination of both (e.g., Dozier *et al.*, 2001). Results for Judy and Javier suggest that the combination of FI and FT schedules would maintain desirable behavior. In practice, this suggests that periodic errors of commission (i.e., the provision of reinforcers when the target behavior has not occurred) may not negatively disrupt behavior. Further, if some proportion of reinforcers can be provided independent of behavior to maintain performance, this approach may reduce the level of monitoring required in practice and may be more acceptable to practitioners and caregivers. However, the FI and FT schedules were temporally similar, so this implication remains a matter for future research. On the other hand, results for Samuel suggest a clinically acceptable outcome of combining FI and FT stimulus presentation, but only if the response is some form of problem behavior. What is effective

with respect to behavioral outcome is dependent on clinical objectives.

Additional research is needed to determine the predictor variables for response maintenance or suppression under such conjoint arrangements so that they can be appropriately matched to clinical objectives. One such predictor variable may be performance during the FT alone condition following exposure to contingent reinforcement. For example, Judy's responding persisted during the FT alone condition, and she also continued to respond during the FI FT condition (i.e., persistent responding during FT alone might predict persistent responding during FI FT). On the other hand, Samuel's behavior was often suppressed during FT alone, as was his behavior during FI FT (i.e., response suppression during FT alone might predict response suppression during FI FT).

Because session duration during the FI FT condition was driven in part by response rate, it is possible that completion of the work requirement was also negatively reinforced. That is, consistent levels of responding produced reinforcers according to the FI schedule, thereby producing shorter work sessions than in the FI sessions and the FT sessions. However, session duration was not tracked; thus, we can only speculate about this possibility.

The current study has some additional limitations. First, the brevity of some of the conditions makes it difficult to determine what might have happened given more extended exposure to the contingencies. Second, all reinforcement schedules were fixed schedules, which likely do not represent schedules that operate in the natural environment. Fixed schedules were selected to remain consistent with a programmatic line of research from which this study was based, although the 60-s value was arbitrarily selected. Third, the schedule values may not be implemented with ease in an employment or educational setting; however, thinner schedule values could be assessed in future studies. Fourth, the mecha-

nisms responsible for persistence and suppression were not determined. A thorough analysis of the moment-to-moment changes in responding may reveal why Samuel's responding was suppressed during the FI FT condition. At this point we can only speculate that decreases in Samuel's response rate brought more responding into contact with the FT component of the conjoint FI FT arrangement. Finally, only one FT value was studied.

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