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An individualized method for establishing and thinning multiple schedules of reinforcement following functional communication training[☆]

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ABSTRACT

Using multiple schedules of reinforcement following functional communication training (FCT) can produce discriminated mands while maintaining low rates of problem behavior (Fisher et al., 1998; Hanley et al., 2001). A review of this literature (Saini et al., 2016) noted the absence of a method for systematically determining the duration of reinforcement (S^D) and extinction (S^Δ) components in such multiple-schedule arrangements. The same review also suggested that introducing a momentary differential-reinforcement contingency could aid in producing discriminated mands by eliminating the possibility of adventitious reinforcement. The current investigation attempted to evaluate these two recommendations by altering the durations of S^D and S^Δ components of a multiple schedule based on participants' response patterns during treatment. Specifically, we (a) yoked the duration of the initial S^Δ component to the rate of mands during FCT and (b) introduced a delay to the S^D following instances of problem behavior. All five participants exhibited discriminated mands. In addition, mands maintained for all five participants, and problem behavior remained low for four participants when the schedule of reinforcement was systematically thinned.

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1. Introduction

Functional communication training (FCT; Carr & Durand, 1985) is one of the most well-validated interventions for challenging behavior exhibited by individuals with developmental disabilities (Tiger, Hanley, & Bruzek, 2008). A substantial number of studies have evaluated the efficacy of FCT, with most showing that it produces significant reductions in problem behavior (National Autism Center, 2009). Furthermore, FCT has high social validity (Wacker et al., 2011) and has been implemented in a wide range of settings, including inpatient clinics (e.g., Asmus et al., 2004), outpatient clinics (e.g., Kurtz et al., 2003), homes (e.g., Wacker et al., 1998), and via telehealth (Wacker et al., 2013).

Functional communication training is a form of differential reinforcement that typically includes two components: (a) establishing a communicative response in the form of a mand for the reinforcer shown to maintain problem behavior in a prior

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functional analysis (FA), and (b) placing problem behavior on extinction. Although attempts have been made at implementing FCT without extinction, studies have generally found that it is a necessary component (Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquistio, & Leblanc, 1998). When these two elements are combined, the strength of the contingency between mands and the functional reinforcer during the initial stages of FCT typically approaches 1.0. That is, the reinforcer is delivered on a fixed-ratio (FR) 1 schedule for mands and is never delivered for other behaviors, including problem behavior.

Establishing the strongest possible contingency between mands and the functional reinforcer has the advantage of maximizing the probability of the mand that serves as the appropriate alternative to problem behavior. However, maintaining an FR-1 schedule of reinforcement for mands is often impractical in the natural environment because very few reinforcers can or should be continuously available for both pragmatic and social-validity reasons (Betz, Fisher, Roane, Mintz, & Owen, 2013; Fisher et al., 1993; Hagopian et al., 1998; Hanley, Iwata, & Thompson, 2001). For example, high rates of reinforcer consumption can interfere with other important daily activities or routines or may be unhealthy, as in the case of edible reinforcers. Also, there are inevitably situations in which it is not feasible to reinforce mands. For example, mands to watch a preferred television program generally cannot be reinforced during an outing to a store. Thus, once initial implementation of FCT has successfully reduced problem behavior, these dense schedules of reinforcement may be viewed as the next barrier to socially valid treatments for problem behavior.

For typically developing individuals, mands are often under the control of discriminative stimuli in the natural environment. Thus, they occur primarily when reinforcement is feasible or likely. In the example above, most children are unlikely to emit mands for a preferred television program during a trip to the store because the stimuli in that environment have been paired with extinction of such mands. Unfortunately, such a history of differential reinforcement in the presence of naturally occurring stimuli may not have been established when FCT is first introduced. As a result, failure to reinforce mands immediately after FCT is likely to result in the return of problem behavior, or *resurgence* (Volkert, Lerman, Call, & Troscclair-Lasserre, 2009). To remedy this problem, researchers developed a method for establishing a history of differential reinforcement of mands in the presence or absence of specific contextual stimuli using a multiple schedule of reinforcement (Fisher, Kuhn, & Thompson, 1998; Fuhrman, Fisher, & Greer, 2016; Hanley et al., 2001).

When used as an adjunct to FCT, multiple schedules involve alternating periods of reinforcement and extinction for mands that were previously trained; thus, mands are reinforced during the reinforcement component but not during the extinction component, whereas problem behavior remains on extinction throughout. Each component is also paired with distinct arbitrary (Hanley et al., 2001) or naturalistic (Kuhn, Chirighin, & Zelenka, 2010) stimuli that signal the availability (i.e., S^D) or unavailability (i.e., S^A) of reinforcement. Typically, the extinction component is set to a brief period (e.g., 15 s) and is gradually increased toward a terminal criterion (e.g., 4 min). Using this type of arrangement, Hanley et al. achieved up to a 4-min period of extinction for problem behavior in the presence of an S^A , while maintaining a 60-s reinforcement component for mands in the presence of an S^D . This method is one of the most common strategies for thinning the schedule of reinforcement as part of a treatment package for severe problem behavior.

There are significant clinical and practical advantages to using multiple-schedule arrangements following FCT to bring mands under the control of discriminative stimuli. Such arrangements can maintain the same strong contingency between mands and the functional reinforcer that is present during the early stages of FCT, while simultaneously bringing responding under the control of discriminative stimuli that are managed by caregivers. However, few studies have examined the procedures for establishing a multiple schedule following FCT or for increasing the duration of the S^A component to a terminal goal. Typically, the duration of the extinction component of the multiple schedule is brief when compared to the reinforcement component and is often determined *a priori*. If problem behavior remains below a pre-determined criterion, the duration of the extinction component then increases in the following session. However, in their review of multiple-schedule-based schedule thinning following FCT, Saini, Miller, and Fisher (2016) identified 31 studies and noted that none of the authors described how they selected the lengths of the initial schedule components.

One approach might be to select the duration of each component of the multiple schedule based on that individual's prior behavior. For example, component duration could be based on the frequency of mands or problem behavior during FCT. Such a strategy would account for momentary fluctuations in motivating operations that increase or decrease the value of the functional reinforcer, and therefore, the likelihood that the individual will engage in problem behavior or mands. For example, high rates of mands suggest the presence of an establishing operation (EO; Michael, 1982) for the reinforcer. Thus, presenting the S^A and placing mands on extinction might increase the likelihood that the individual's behavior contacts the contingency (i.e., extinction) associated with the S^A . However, there is also a risk that extended exposure to extinction due to an excessively long S^A component may also evoke problem behavior (i.e., resurgence; Volkert et al., 2009).

In contrast, mands that occur at a low rate suggest a weaker EO, or one that reaches sufficient strength to evoke behavior only infrequently. Arbitrarily selecting brief S^D and S^A components in this situation could result in problem behavior and mands contacting the contingencies in these components less consistently. For example, if the duration of the S^A component is too brief, it may elapse before there is sufficient deprivation of the functional reinforcer. As a result, lower rates of mands may occur in the presence of the S^A due to the absence of an EO rather than because they are under the control of the discriminative stimulus. Similarly, an entire reinforcement interval may elapse without a mand occurring if the S^D component is too brief. Conversely, if an S^A component is too long, the mands that have replaced problem behavior may be extinguished and result in resurgence of problem behavior.

Another factor that may limit the strength of the contingencies established using a multiple-schedule procedure following FCT is that the use of S^D and S^A components of fixed and arbitrary durations may degrade the extinction contingency for

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