Behav Analysis Practice (2016) 9:257–260
DOI 10.1007/s40617-016-0107-2

BAP BRIEF PRACTICES

Using a Progressive Ratio Schedule of Reinforcement as an Assessment Tool to Inform Treatment

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Published online: 21 January 2016

Abstract A handful of studies have examined the utility of progressive ratio schedules (PRs) of reinforcement in treatment development and treatment efficacy. The current case study explored the utility of PRs as an assessment tool to inform a differential reinforcement treatment package. A PRs assessment was used to identify the breaking point of a functional communicative response before and after treatment. The breaking point was used as the initial reinforcement schedule during treatment. Following treatment, the communicative response increased during a posttest PRs assessment, suggesting the efficacy of the treatment package.

Keywords Behavior analysis · Progressive ratio schedule · Differential reinforcement · Behavioral assessment

A progressive ratio (PR) schedule of reinforcement is defined by an increasing response requirement for reinforcer delivery over successive sessions (DeLeon et al. 1997), or trial-by-trial basis within a single session (Hodos 1961; Roane 2008). For instance, when a child emits a predetermined number of responses (e.g., hand raising five times in a classroom), a reinforcer is delivered (e.g., teacher calls on child). After delivery of the reinforcer, subsequent response requirements can increase a variety of ways, including stepwise (e.g., increasing the number of responses from 5 to 6, then 7, then 8, and so forth), algorithmic (e.g., additively or geometrically), response topography (e.g., specific target response either occurs or stops occurring), session-termination criteria (e.g., specific amount of time elapses between responses, or after a total amount of time elapses within the session), and the amount of reinforces delivered (see also Roane, 2008 for similar overview). Stepwise increases in response requirements have been useful in identifying preference for stimuli used as reinforcers across increased response requirements (Tustin 1994; DeLeon et al. 1997), and reinforcer efficacy across differentiated response requirements (Roane et al. 2001).

Clinical applications of PR schedules of reinforcement can also be effective during treatment development. Identification of schedule effects can be useful for clinicians to determine relative reinforcement schedules for both problem and replacement behaviors. For example, DeLeon et al. (2000) used a PR schedule to directly inform the development of a treatment for aggression (set on a PR schedule of reinforcement ranging from 1 to 20 responses per requirement for reinforcer delivery) and functional communication (set on a fixed ratio 1 reinforcement schedule). When reinforcement schedules were equally probable, both aggression and mands were emitted equally. However, frequency of mands exceeded aggression when the reinforcement schedules were unequal (FR1 to FR20 for mands and aggression, respectively).

While PR schedules have been used to identify relative probability of one response over a second response, to date, minimal research has shown how PRs can be used to inform treatment and the extent to which treatment can

Implications for Practice • Development of progressive ratio (PR) schedule of reinforcement as an assessment tool to determine breaking point
• Systematic assessment used to inform differential reinforcement schedule
• Highlights the clinical utility of using PR schedule assessments to inform treatment in classroom settings
• Demonstrates effectiveness of using PR schedules to increase treatment efficacy

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improve or modify responding on PRs. Therefore, the purpose of the current study was to utilize a stepwise PR schedule of reinforcement to determine the probability of a functional communicative response in order to systematically inform a differential reinforcement treatment package.

Methods

Participants, Setting, and Materials

Dylan was an 8-year-old Caucasian male receiving direct care services from a behavioral health agency in the Midwest. Dylan had an educational diagnoses of emotional disturbance and was referred to the agency for low frequency, high intensity problem behaviors. Behavior analytic sessions were conducted in both a classroom and a small therapy office. Problem behaviors were identified by the agency staff as follows: verbal aggression (i.e., any instance of threatening to physically harm another individual, arguing, and cursing), physical aggression (i.e., any instance of hitting and kicking), property destruction (i.e., any instance of throwing and hitting other people's property), and disruption (i.e., any instance of taking other people's property and crying).

Naturalistic functional analyses (FA), progressive ratio (PRs) assessments, and treatment sessions took place within a small classroom (8 × 10 m) containing 2–3 staff members, between 5–10 students, desks, chairs, and work materials. The preference assessment and functional communication training (FCT) took place within a therapy room (3 × 5 m) containing materials necessary to conduct the sessions. Materials included a desk, chairs, leisure items (including an iPad), paper data sheets, typical agency work tasks, pencils, and a timer.

Response Definition

The primary dependent measure was the frequency of vocal mands. Vocal mands included any verbal statement that requested access to the iPad (e.g., "Can I have the iPad" or "May I please use the iPad"). The secondary dependent measure was the occurrence of problem behavior. Problem behavior data was collected as a dichotomous variable (i.e., yes it occurred, or no it did not).

Procedures

A linear strip design was used to determine the clinical utility and efficacy of a PRs assessment. A preference assessment, functional analysis, and functional communication training were conducted prior to the PRs assessment, to determine functional reinforcers and functionally equivalent responses. Next, Dylan completed the PRs assessment before completing a differential reinforcement treatment package. Following treatment, Dylan completed a post-PRs assessment, to determine the extent to which treatment would increase Dylan's breaking point.

Preference Assessment A multiple stimulus without replacement (MSWO) preference assessment (DeLeon and Iwata 1996) was conducted to identify preferred tangible items. Seven tangible items were identified from informal interviews of both Dylan and Dylan's teacher. This assessment was conducted until a clear distinction of preferred items emerged.

Functional Analysis Researchers identified environmental conditions that maintained Dylan's problem behavior. First, Dylan's teacher completed a Questions about Behavioral Functional (QABF) scale. The results of the QABF indicated that Dylan's problem behavior may have been maintained by access to tangibles, though there was a lack of distinct differentiation between the attention and tangible scores. The outcomes identified by the QABF were used to inform a naturalistic functional analysis (FA), which was conducted in Dylan's classroom. Three conditions were assessed during the FA (enriched environment, access to attention, and access to tangible items) across 5 min sessions. During the enriched environment condition, Dylan was provided access to a preferred item, non-contingent attention was provided approximately every 30 s, and no demands were placed. During the attention condition, Dylan was provided access to a preferred item with no demands placed, and 30-s access to social attention was provided upon engagement of problem behavior. During the access to tangible condition, Dylan was provided non-contingent attention approximately every 30 s with no demands placed and access to the preferred tangible item was contingent upon problem behavior.

Functional Communication Training (FCT) Once the function of Dylan's problem behavior was identified, the researchers trained Dylan to engage in appropriate manding using functional communication training (FCT). During FCT, the researcher first modeled the appropriate response to Dylan (e.g., "Can I have the iPad?"), before starting the training trials. Mastery criterion was set at 100 % accuracy for three consecutive trials, and Dylan met mastery criterion within the first session.

Progressive Ratio Reinforcement Schedule (PRs) Assessment Following FCT, Dylan completed the PRs assessment in the classroom to determine the breaking point of Dylan's functional communicative responses. During the

PR assessments, problem behavior was placed on extinction, while vocal mands (i.e., "Can I have the iPad?") were placed on a step-wise PR1 schedule of reinforcement. The sequence was comprised of an arithmetic progression incrementing by 1 after each reinforcer presentation. The PRs assessment began by providing reinforcement for every response emitted by Dylan (FR1), with subsequent increased response requirements (FR2, FR3, FR4, etc.). Following engagement in vocal mands, Dylan was provided 30-s access to the iPad, before the subsequent response requirement increased to FR2. Termination criterion was defined as engaging in problem behavior or no engagement in mands after 60 s elapsed following reinforcer consumption. The breaking point was identified as the last PR response requirement completed prior to terminating the session. Dylan completed this assessment before and after treatment, to examine the extent to which responding would match the end ratio requirement during treatment. The structure of the second PRs assessment was identical to the first.

Treatment A differential reinforcement of alternative responses (DRA) was examined using a changing criterion design. The reinforcement schedule for the alternative response (i.e., mands) was a fixed ratio (FR) schedule, where the first ratio of treatment was determined by the last response requirement achieved during the PR assessment. Once Dylan was successful at engaging in the alternative response (i.e., vocal mand for the iPad) without engaging in aggression for three to six sessions, the response requirement for access to reinforcement was systematically increased by 25 % (and rounded to the nearest whole number) for each phase (i.e., the response requirement of FR 14 increased by 25 %, or four responses, which resulted in the next response requirement of FR 18). To demonstrate experimental control, the response requirement per phase was either increased or decreased by 25 %, or the phase length was varied between three and six. Treatment was terminated when Dylan engaged in problem behavior.

Interobserver Agreement

A second observer independently observed and recorded data for the frequency vocal mands and aggression across phases. Observers were considered reliable after reaching a minimum of 80 % reliability as compared to the senior researcher prior to collecting interobserver agreement (IOA). Researchers evaluated trial-by-trial IOA during the FA as well as the treatment sessions. Trial-by-trial IOA was assessed by comparing the observers' data during each trial. Agreement was defined as the same number of instances of the alternative response or problem behavior during each trial. IOA was calculated by dividing the number of trials with agreements by the number of trials with agreements plus disagreements and multiplying by 100. IOA was calculated for 44.44 % of the progressive ratio assessment sessions, with an average IOA of 100 %. IOA was calculated for 36.67 % of treatment sessions, with an average IOA of 100 %.

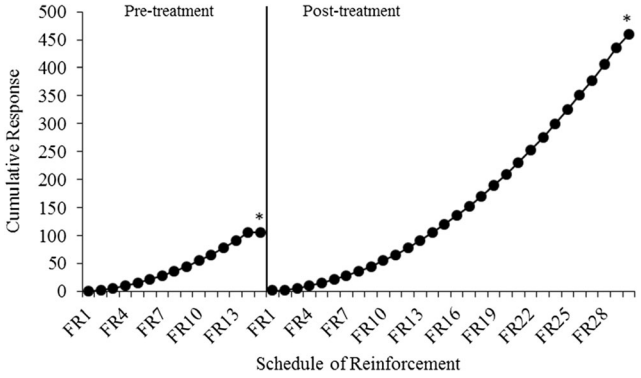

Fig. 1 Cumulative vocal mands during the PRs assessment before and after treatment. * = breaking point

Results and Discussion

Outcomes derived from the preference assessment suggested iPad was a highly preferred item and was used during the tangible condition of the FA. During the naturalistic FA, Dylan engaged in higher rates of verbal and physical aggression to access tangibles (i.e., an iPad), suggesting Dylan's problem behavior was maintained by access to the tangible item (i.e., an iPad).

Figure 1 depicts cumulative mands during both progressive ratio assessments. During baseline, Dylan engaged in mands throughout each successive PRs requirements without engaging in aggression, until the PR schedule increased to 14. During the FR 15 schedule, Dylan engaged in aggression (i.e., verbal statements about engaging in physical aggression if he did not get the iPad), and the assessment was therefore terminated. Following treatment, Dylan's engagement in mands increased to FR 29 before he engaged in aggression. During the FR 30 schedule, Dylan engaged in 25 appropriate mands before he engaged in aggression.

Figure 2 depicts the frequency of mands during treatment. The first FR schedule was determined from the breaking point of the PRs assessment (i.e., 14 responses; FR 14). During the first phase, Dylan exceeded the number of required responses during the second trial, which extended the number of sessions to six before he continued to the next phase (FR 18). During FR 18, FR 23, and FR 29, Dylan met criterion during three consecutive sessions. When returning to a previously mastered criterion (FR 18), Dylan exceeded the criterion during the first session, but met criterion for the following three

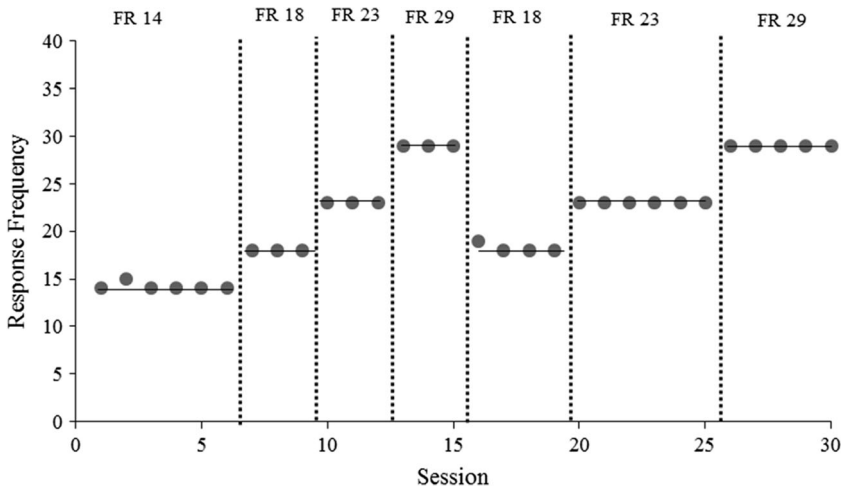

Fig. 2 Frequency of vocal mands during treatment

sessions. During FR 30, Dylan engaged in problem behavior and treatment was terminated.

The results of the current study replicate and extend previous research by demonstrating how breaking points of communicative responses can be used to inform treatment. These results also highlight how breaking points also change following treatment, as indicated by Dylan's increased responding during the post-PRs assessment. Interestingly, the last successful schedule of reinforcement (FR 29) was also the maximum criterion during the treatment sessions. This result supports the efficacy of differential reinforcement treatment packages, in increasing tolerance to progressive reinforcement schedules. Given that the current study analyzed Dylan's behavior in a classroom setting, the current study lends support for the utility of both PRs assessment and differential reinforcement procedures in naturalistic settings.

While the current study provides a translational model for systematically increasing alternative responses in a classroom setting, there are limitations that should be considered. First is the inclusion of a single response topography, rather than two responses (e.g., problem behavior and mands). A single response topography limits the extent to which we can determine the efficacy of the treatment. However, the termination criterion set for both the PR assessment and treatment was defined as engagement in problem behavior, given that Dylan's aberrant behaviors were low in frequency. Similarly, no follow-up data was collected to determine the extent to which Dylan's manding maintained throughout various natural reinforcement schedules in the classroom. Another limitation was the pre-experimental history of the selected mand. The mand was selected to ensure Dylan's success, in addition to discussions with the classroom teacher about best ways for Dylan to communicate. Future research should consider replicating the current study while taking data on both the problem behavior and functional communicative response, to validate the effects of the treatment package across response classes, rather than a single behavior. Future research should also consider evaluating effects of PR assessments with other assessments, including outcomes as well as efficiency to completion.

Compliance with Ethical Standards All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of Interest The authors declare that they have no competing interests.

Informed Consent Participant ascent was obtained from the individual included in the study.

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