
FUNCTIONAL ANALYSIS AND TREATMENT OF LOW RATE PROBLEM BEHAVIOR IN INDIVIDUALS WITH DEVELOPMENTAL DISABILITIES

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Extensive research has validated the standard functional analysis as a useful technology for identifying the function of problem behavior in individuals with developmental disabilities. The assessment of low rate problem behavior is one area that has yet to receive a significant amount of research. Some problem behaviors may occur at rates too low to be observed during a standard functional analysis, despite the fact that they may be highly destructive behaviors. The current study evaluated the effectiveness of initiating functional analysis sessions contingent on the occurrence of bursts of problem behavior for producing interpretable functional analysis results. While a standard functional analysis did not produce definitive results with respect to behavioral function, the 'low rate' functional analysis produced interpretable results for all three participants. Two of the three participants were available for the evaluation of treatments based on their functional analysis results. Function-based treatments suppressed rates of problem behavior for both participants. Copyright © 2004 John Wiley & Sons, Ltd.

A central goal in the assessment and treatment of problem behavior is the identification of an operant function. When the function of a behavior that is targeted for reduction is determined, then it is generally clear how extinction can be applied and the functional reinforcer can readily be delivered contingent on appropriate behavior instead of problem behavior. Previous research has demonstrated that functional treatment strategies can yield robust outcomes (Iwata et al., 1994a). Comparative research has demonstrated that function-based treatments are more likely to be effective than arbitrarily selected ones (Carr & Durand, 1985; Iwata et al., 1994a; Repp, Felce, & Barton, 1988).

Some types of problem behavior may not be readily assessable with the standard functional analysis procedure. One example is problem behavior that occurs at low

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rates (i.e. one burst of behavior per day or week). Despite the fact that problem behavior may occur at high intensity, and may represent a serious threat to the safety of an individual's caregivers and/or to him/herself, it may not occur during the functional analysis sessions or may occur too infrequently to produce differentiated results. For example, if a standard functional analysis is conducted and the problem behavior occurs only once, in only one particular test condition (e.g. attention), it is not clear how the results should be interpreted. When evaluating the one session that problem behavior occurred in, the results may appear to be differentiated. However, the fact that it did not occur in any of the other test conditions could either be an artifact of the low rate of the behavior, or the function of the problem behavior may genuinely not be related to the variables manipulated in the other test conditions. It is therefore not possible to make a plausible hypothesis as to the function of problem behavior in such circumstances.

In cases where the standard functional analysis does not produce interpretable results due to low rate problem behavior, an alternative experimental functional analysis procedure may be of use. Only one published study of which the authors are aware has attempted to evaluate such a procedure. Kahng, Apt, and Schonbachler (2001) reported data from a single-subject case study, wherein a standard functional analysis did not yield interpretable results due to the fact that the target behavior did not occur during the analysis. Kahng et al. modified the standard functional analysis procedures by increasing session duration from a typical duration of 10 min to a significantly longer duration of 7 h. Sessions were conducted from 9:00 AM to 3:00 PM, Monday through Friday. This modification resulted in clear, interpretable results, and a treatment based on the results of the analysis effectively suppressed rates of the target behavior.

Two possible limitations of the Kahng et al. (2001) study are worth noting. First, it may not be ethical to expose participants to the duration of deprivation of various forms of social contact (i.e. leisure and attention) that this modification requires. The contingencies utilized in the above study, during the attention condition, essentially amounted to ignoring appropriate behavior, all day, during days in which the attention condition was being implemented. The deprivation that occurs during the standard functional analysis is easy to justify, given the short duration of the sessions (e.g. experimenters only need to ignore participants for 10 or 15 min, after which participants can be exposed to normal social contact again). A second possible consideration is the large number of highly trained staff needed to complete the assessment. Few organizations have two to three staff members that are trained to conduct functional analyses that can be allocated to a single client, seven hours a day, for nine days or more. However, in organizations where this is an option, and in cases where permission from caregivers or legal guardians can be obtained in order to implement prolonged deprivation, the Kahng et al. (2001) procedure is likely to be an

effective assessment alternative when problem behavior occurs at rates too low for the standard functional analysis.

The purpose of this study was to evaluate an alternate modification to the standard functional analysis methodology in the assessment of low rate problem behavior. This study consisted of two experiments. In experiment 1, the 'low rate' modification of the standard functional analysis was compared to the standard procedure. The low rate modification consisted of initiating sessions contingent on the occurrence of problem behavior. The rationale behind this modification was to increase the probability that problem behavior would contact the relevant contingencies, hopefully aiding in the differentiation of assessment results. In experiment 2, treatments based on the functions identified during experiment 1 were evaluated.

EXPERIMENT 1

Method

Participants and Setting

Three adults with developmental disabilities participated. Linda was a 50-year-old woman, diagnosed with profound mental retardation. Linda's caregivers reported that she engaged in aggression, self-injury (SIB), and property destruction. Historical documentation of Linda's behavior problem described a near life long history of aggression and SIB (exact age of onset was not specified). Jake was a 32-year-old man, diagnosed with severe mental retardation. Jake's caregivers reported that Jake engaged in severe SIB, which sometimes resulted in property destruction (e.g. creating holes in walls via head-banging). Dario was a 25-year-old man, diagnosed with severe mental retardation. Dario's caregivers reported a long standing history of aggression, SIB, property destruction, and stripping. All participants were referred for participation in this study because they exhibited high intensity problem behavior that occurred at low rates. Although Dario and Linda displayed multiple topographies of problem behavior, aggression was targeted for assessment and intervention because their caregivers stressed aggression as a first priority for treatment. Sessions were conducted in therapy rooms that contained tables, chairs, and other materials, appropriate to each condition.

Response Measurement and Interobserver Agreement

The dependent variables were SIB (Jake) and aggression (Dario and Linda). SIB was defined as striking of the participant's head against any surface. Aggression was defined as any hitting, kicking, biting, scratching, head-butting, pinching, throwing objects within 0.3 m of therapists or attempts to do any of these.

During functional analysis sessions, data were collected on the frequency of SIB and aggression, during continuous 10 s intervals, using handheld computers, fitted with Observe[®] data collection software. All functional analysis sessions were 5 min in duration. A second, independent observer collected data during, 61, 35, and 83% of standard functional analysis sessions for Linda, Jake, and Dario, respectively. A second, independent observer collected data during 33, 32, and 33% of low rate functional analysis sessions for Linda, Jake, and Dario, respectively. Agreement for frequency data were calculated by dividing the smaller number of responses by the larger number of responses measured, for each 10 s interval. The fractions obtained were added and the sum was divided by the number of intervals, and the resulting fraction was multiplied by 100 to obtain the mean percentage of agreement. Mean IOA obtained during the standard functional analysis was 97% for Linda ($R = 79\text{--}100\%$), 99% for Jake ($R = 98\text{--}100\%$), and 100% for Dario ($R = 100\text{--}100\%$). Mean IOA obtained during the low rate functional analysis was 88% for Linda ($R = 67\text{--}100\%$), 94% for Jake ($R = 93\text{--}95\%$), and 93% for Dario ($R = 84\text{--}100\%$).

Experimental Sequence and Design

An AB design was used to compare the standard with the low rate functional analysis procedures. A pairwise design was used during the low rate functional analysis in order to ensure that a particular test condition could be alternated rapidly with the control condition, during one burst of problem behavior. A pairwise design was also used during the standard functional analysis so that it could be compared with the low rate analysis. The order of sessions for both analyses was as follows: two attention to one control and two demand to one control.

Standard Functional Analysis

An initial standard functional analysis was conducted, which was similar to the procedures used by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). All conditions were conducted in therapy rooms containing materials appropriate to the condition that was being conducted. All sessions were 5 min in length (Wallace & Iwata, 2000). As is typical in conducting the standard functional analysis, sessions were initiated contingent on the experimenters having time to conduct sessions in their daily schedule. Standard functional analyses were terminated upon meeting one of three mutually exclusive criteria: (i) problem behavior occurred and clearly differentiated results were obtained, (ii) problem behavior occurred and the results were consistently undifferentiated, or (iii) problem behavior did not occur for six consecutive sessions.

During the *attention* test condition, participants were told by the experimenter that the experimenter did not have time to play with them and that the experimenter had work to do. No programmed consequence was provided for any behavior emitted by the participant, except for the target behavior, which resulted in 5–10 s of attention (e.g. ‘don’t hit me, you will hurt me’).

During the *demand* test condition, the experimenter presented academic demands continuously to the participant, using a three-step graduated prompting procedure (i.e. verbal, model, and physical prompts). If the participant complied with the demand on the verbal or gestural prompt, the experimenter delivered 3–5 s of social praise (i.e. ‘good job working’). If the participant displayed the target behavior at any time while a demand was being presented, escape was provided for 30 s. All other behavior was ignored.

During the *control* condition, the participant received 5–10 s of attention from the experimenter, on a fixed time (FT) 30 s schedule. Attention was not delivered within 5 s after the occurrence of problem behavior. In addition, an assortment of toys or leisure items was provided continuously throughout the session.

Low Rate Functional Analysis

All session contingencies were identical to the standard functional analysis. The criterion for initiation of sessions was one occurrence of SIB or screaming (Jake) or aggression (Dario and Linda). Each time sessions were initiated, one cycle consisting of two test conditions followed by one control condition, were conducted, regardless of the participant’s behavior during and between those three sessions. If problem behavior continued to occur after one cycle of three sessions was conducted (thus meeting the criteria for initiation of sessions again), another cycle of three sessions was immediately conducted.

Results

Figure 1 depicts the results of experiment 1 for Linda, Jake, and Dario, in the top, middle, and bottom panels, respectively. In the attention/control phase of Linda’s standard functional analysis, Linda displayed low and variable rates of aggression in the attention condition ($M = 0.13$ rpm, responses per minute; $R = 0–0.6$ rpm). Linda displayed little aggression during the control condition of this phase ($M = 0.3$ rpm, $R = 0–1.2$ rpm). No pattern of differentiation between the attention and control conditions was apparent. In the demand/control phase of Linda’s standard functional analysis, Linda again displayed low and variable rates of aggression ($M = 1.0$ rpm, $R = 0–4$ rpm). Aggression did not occur in the control condition of this phase.

In the attention/control phase of Linda’s low rate functional analysis, Linda displayed high and variable rates of aggression in the attention condition

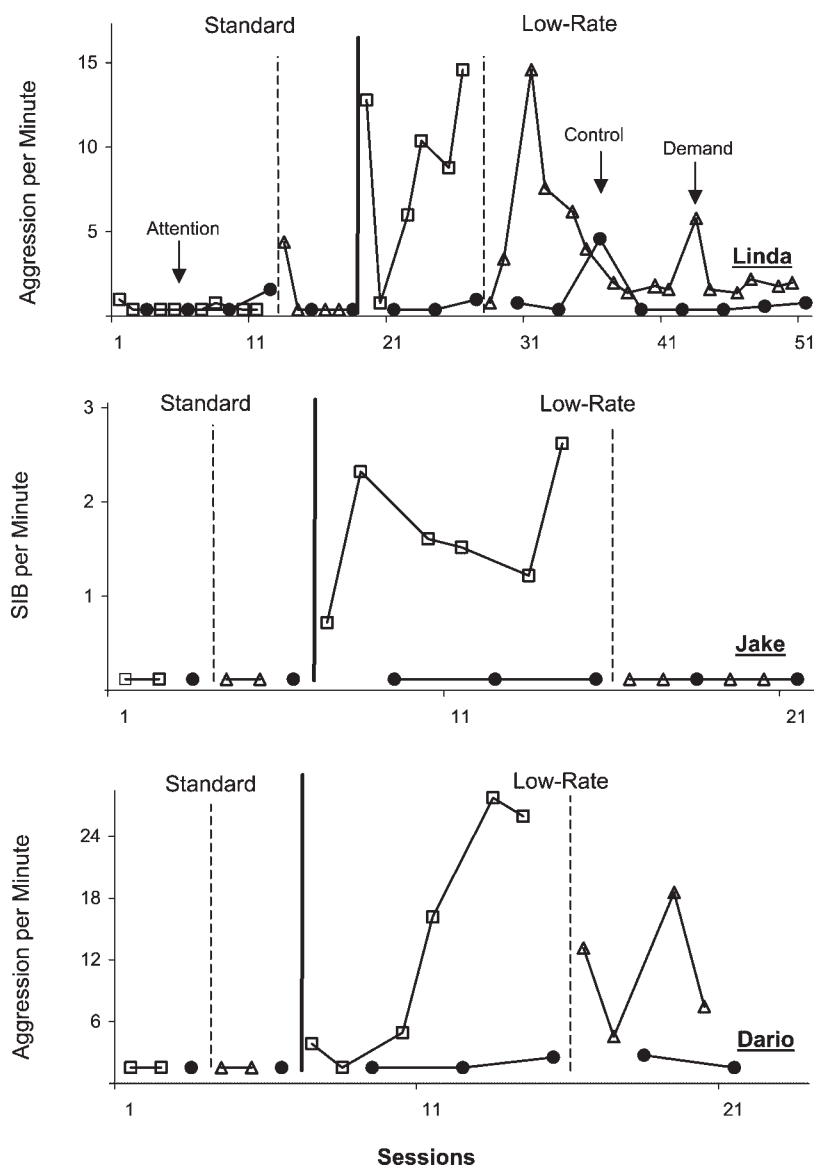


Figure 1. Problem behavior per minute for Linda (top panel), Jake (middle panel), and Dario (bottom panel), during the standard and low rate functional analyses. Bold phase-change lines demark the transition from standard to low rate functional analyses. Dashed lines demark transitions between various test-control phases, as indicated by the legend (middle panel), which occurred within each analysis.

($M = 8.5$ rpm, $R = 0.4\text{--}14.2$ rpm). Linda displayed low rates of aggression in the control condition during this phase ($M = 1.33$ rpm, $R = 0.4\text{--}2.0$ rpm). Rates of responding in the attention and control conditions were differentiated, with consistently higher rates in the attention condition, suggesting a possible attention function for Linda's aggression. In the initial sessions of the demand/control phase of Linda's low rate functional analysis, Linda engaged in high and variable rates of aggression. In the last six demand sessions (the last three cycles of this condition), Linda's aggression stabilized ($M = 2.1$ rpm, $R = 1.0\text{--}5.4$ rpm). Linda initially displayed high and variable rates of aggression during the control condition of this phase. During the last three control sessions (the last three cycles of sessions), Linda's aggression decreased and stabilized ($M = 0.2$ rpm, $R = 0\text{--}0.4$ rpm). Rates of aggression were differentiated, with rates in the demand condition consistently higher, during the latter half of the demand/control phase of Linda's low rate functional analysis, suggesting a possible negative reinforcement function for Linda's aggression. Overall, the standard functional analysis produced uninterpretable data, while the results of the low rate modification suggested dual functions for Linda's aggression: positive reinforcement in the form of access to attention and negative reinforcement in the form of escape from task demands.

The results of Jake's functional analyses are depicted in the middle panel of Figure 1. Jake displayed no SIB during the standard functional analysis. This pattern of results precluded an indication of behavioral function for Jake's SIB. During the attention/control phase of Jake's low rate functional analysis, moderate and variable rates of SIB were observed in the attention condition ($M = 1.55$ rpm, $R = 0.6\text{--}2.5$ rpm). SIB did not occur during the control condition in this phase. Rates of SIB in the attention condition were higher than those in the control condition, as well as being consistently differentiated from those in the control condition, suggesting an attention function for Jake's SIB. Jake's SIB did not occur during the demand/control phase of his low rate functional analysis. Overall, the standard functional analysis did not produce interpretable results, while the low rate modification produced results that suggested that Jake's SIB was maintained by positive reinforcement in the form of access to attention.

The bottom panel of Figure 1 depicts the results of the standard and low rate functional analyses for Dario. Dario's aggression did not occur during the standard functional analysis, precluding an indication of behavioral function. During the attention condition of the attention/control phase of the low rate functional analysis, Dario initially engaged in low rates of aggression, followed by a consistently increasing trend ($M = 11.82$ rpm, $R = 0\text{--}26.2$ rpm). Dario engaged in consistently low rates of aggression during the control condition of this phase. During the demand condition of the demand/control phase of Dario's low rate functional analysis, high and variable rates of aggression were observed ($M = 9.38$ rpm, $R = 3\text{--}17$ rpm). Dario displayed consistently low rates of aggression in the control condition of this phase. Overall, the results of the standard

functional analysis precluded an interpretation of the function of Dario's aggression, while the results of the low rate modification suggested that Dario's aggression was maintained by positive reinforcement in the form of access to attention and negative reinforcement in the form of escape from task demands.

Discussion

In general, the results of experiment 1 suggest that the low rate modification to the standard functional analysis may provide an effective alternative in cases where problem behavior is not observed at sufficient rates to suggest a function in the standard procedure. If the low rate technology proves to be accurate and reliable through additional replication, then dissemination of the technology may make function-based treatments available to a wider range of individuals for whom function-based treatments have not been available previously.

A limitation of experiment 1 is short session duration (5 min) and the short overall durations of the standard functional analyses for Dario and Jake. Although previous research (Wallace & Iwata, 2000) suggests that 5 min is a sufficient duration for functional analysis sessions, it is possible that implementing longer sessions would have produced interpretable results in the standard functional analyses for these participants. Despite the fact that problem behavior never occurred during six consecutive sessions for Dario and Jake during their standard functional analyses, it is also possible that problem behavior would have occurred if additional sessions had been conducted, increasing the possibility of attaining interpretable results in these analyses.

Although the results of experiment 1 suggest that the low rate functional analysis may successfully identify the function of problem behavior that occurs at low rates, the results should be considered tentative, as this is the first study evaluating this procedure (i.e. initiating functional analysis sessions contingent on problem behavior). Future research should replicate the current methodology across other populations and in other settings. Moreover, given that the purpose of any functional assessment is to prescribe function-based treatment, it should be considered necessary to further test the utility of any assessment procedure by evaluating treatments that are derived from its results.

EXPERIMENT 2

Method

Experiment 2 consisted of the evaluation of function-based treatments that were designed based on the results obtained in experiment 1. Noncontingent reinforcement

(NCR) was implemented as treatment for the attention function for both participants. Functional communication training (FCT) was implemented as a treatment for the escape functions for both participants. In order to attempt to produce maximum reductions in problem behavior in the shortest time possible, and because all participants in experiment 2 attended day treatment programs, treatment was implemented all day, every day that the participants attended their programs. Because all treatments were implemented in the participant's natural work areas of their day treatment programs, and treatment was conducted all day, all appropriate behaviors and requests on the part of the participants resulted in access to praise or the item requested across all conditions (i.e. baseline and treatment). It was not deemed clinically justified to ignore all non-targeted appropriate behavior all day, as would be necessary in order to conduct an analogue treatment evaluation.

Sessions were either 1 h (Linda) or 2 h (Dario). Sessions in experiment 2 consisted of experimenters implementing treatment (as was done the rest of the day) and collecting behavior data, at times during which sufficient experimenters were available. Thus, sessions were not different from other periods during the participants' days, with the exception that experimenters interacted with them and collected data on their behavior, rather than the participants' regular caregivers doing so. Reversal designs were used to evaluate each treatment.

Participants and Setting

Linda and Dario participated. Unfortunately, Jake's state case manager was not willing to allow him to be exposed to baseline conditions in order to empirically evaluate a treatment for his SIB. Alternatively, his caregivers requested a treatment protocol based on our functional analyses, without the benefit of empirical evaluation. They were provided with a protocol that described an FT schedule of attention delivery and planned ignoring of SIB and were informed that implementation of this protocol might decrease the future probability of his SIB.

Sessions were conducted in the respective work areas for each participant, located in a day treatment program for adults with developmental disabilities.

Response Measurement and IOA

Frequency data were collected on aggression and appropriate mands across the day, during continuous 15 min intervals. The definition of aggression was identical to that in experiment 1. Appropriate mands were defined as exhibiting the manual sign for a break (Dario) or vocally stating 'Go away' (Linda). A second, independent observer collected data during 34% of sessions of the treatment evaluation for the possible attention function of Linda's aggression and 39% of demand sessions. A

second, independent observer collected data during 38% of Dario's attention sessions and 38% of demand sessions. Calculations of IOA were identical to that in experiment 1, with the exception that the intervals were 15 min, rather than 10 s. Mean IOA obtained for Linda was 93% for her attention sessions and 94% for her demand sessions. Mean IOA obtained for Dario was 94% for his attention sessions and 90% for his demand sessions.

Attention Baseline

Attention baseline sessions were conducted using the same programmed contingencies as those described in the functional analysis attention condition.

Noncontingent Attention

Noncontingent attention sessions were conducted by providing 3–5 seconds of attention on an FT 1 min schedule. Delivery of attention was delayed 5 s contingent on aggression.

Escape Baseline

Baseline conditions were conducted using the same instructional procedure (i.e. continuous instruction using a three-step prompting procedure) and the same programmed contingencies as those described in the escape condition of the functional analysis.

Functional Communication Training

The experimenter presented academic demands continuously to the participant, using a three-step graduated prompting procedure. If the participant complied with the demand on the verbal or gestural prompt, the experimenter delivered 3–5 s of social praise (i.e. 'good job working'). If the participant signed break (Dario) or said 'Go away' (Linda), the participant received a 30 s break from the demands. Mand topographies were selected from topographies that the participant's caregivers had observed them displaying, but did not display frequently (i.e. no more than a few times a week). Physical prompting was used to train Dario's mand. A full-physical prompt was immediately used while a demand was issued, thus resulting in Dario displaying the appropriate mand and escaping from the demand within 1 s of the verbal prompt (i.e. the first prompt of the demand) being implemented. Linda was trained to emit her mand by embedding a prompt within the verbal and model prompts of each demand. For example, an experimenter would say to Linda, 'Linda,

touch the soda card or say *go away*'. Because the topography of the mand was vocal, it was not possible to use physical prompting.

Results

The top panel of Figure 2 depicts the results of the evaluation of the treatment for the possible attention function of Linda's aggression. During baseline, Linda displayed low to moderate rates of aggression, with a consistent increasing trend ($M = 3.38$ rpm, $R = 1.04$ – 9.26). Linda displayed aggression in only one session of the subsequent NCR phase, with a rate of 0.03 rpm. During the return to baseline phase, Linda displayed low to moderate rates of aggression ($M = 1.52$ rpm, $R = 0.21$ – 5.76 rpm). During Linda's final treatment phase, aggression occurred during two sessions, with rates of 0.09 and 0.08, respectively.

The second panel from the top of Figure 2 depicts the results of the analysis of treatment efficacy for Linda's escape maintained aggression. During the baseline phase, Linda engaged in moderate and consistent rates of aggression ($M = 2.3$ rpm, $R = 2.08$ – 2.48 rpm). During the first FCT phase, Linda displayed low rates of aggression ($M = 0.26$ rpm, $R = 0$ – 0.63 rpm). Rates of aggression during the return to baseline phase were initially low, followed by a return to levels similar to those observed during the first baseline phase ($M = 1.98$ rpm, $R = 0.42$ – 2.85 rpm). During the final FCT phase, Linda's aggression decreased to near zero levels, with the exception of the second to last session ($M = 0.9$ rpm, $R = 0$ – 4.83 rpm).

The third panel from the top of Figure 2 depicts the results of the treatment evaluation for the possible attention function of Dario's aggression. During baseline, Dario displayed high rates of aggression ($M = 2.5$ rpm, $R = 2.2$ – 3.2 rpm). Dario did not engage in aggression during the first NCR phase. During the return to baseline phase, Dario displayed aggression at a rate greater than that in the first baseline phase ($M = 5.5$ rpm, $R = 3.98$ – 7.01 rpm). During the final NCR phase, Dario displayed aggression during only one session, at a rate of 0.03 responses per minute.

The bottom panel of Figure 2 displays the results of the evaluation of a treatment for the possible escape function of Dario's aggression. During the initial baseline phase, Dario engaged in aggression at moderate to high rates ($m = 6.35$ rpm, $R = 3.03$ – 9.66 rpm). Aggression did not occur during the first FCT phase. During the return to baseline phase, Dario displayed aggression at moderate rates ($m = 4.18$ rpm, $R = 4.06$ – 4.3 rpm). During the final FCT phase, Dario consistently engaged in near-zero rates of aggression ($m = 0.01$ rpm, $R = 0$ – 0.03 rpm).

Both NCR and FCT were effective in decreasing Linda and Dario's problem behavior maintained by both positive reinforcement in the form of attention and negative reinforcement in the form of escape from demands. These data are in and of

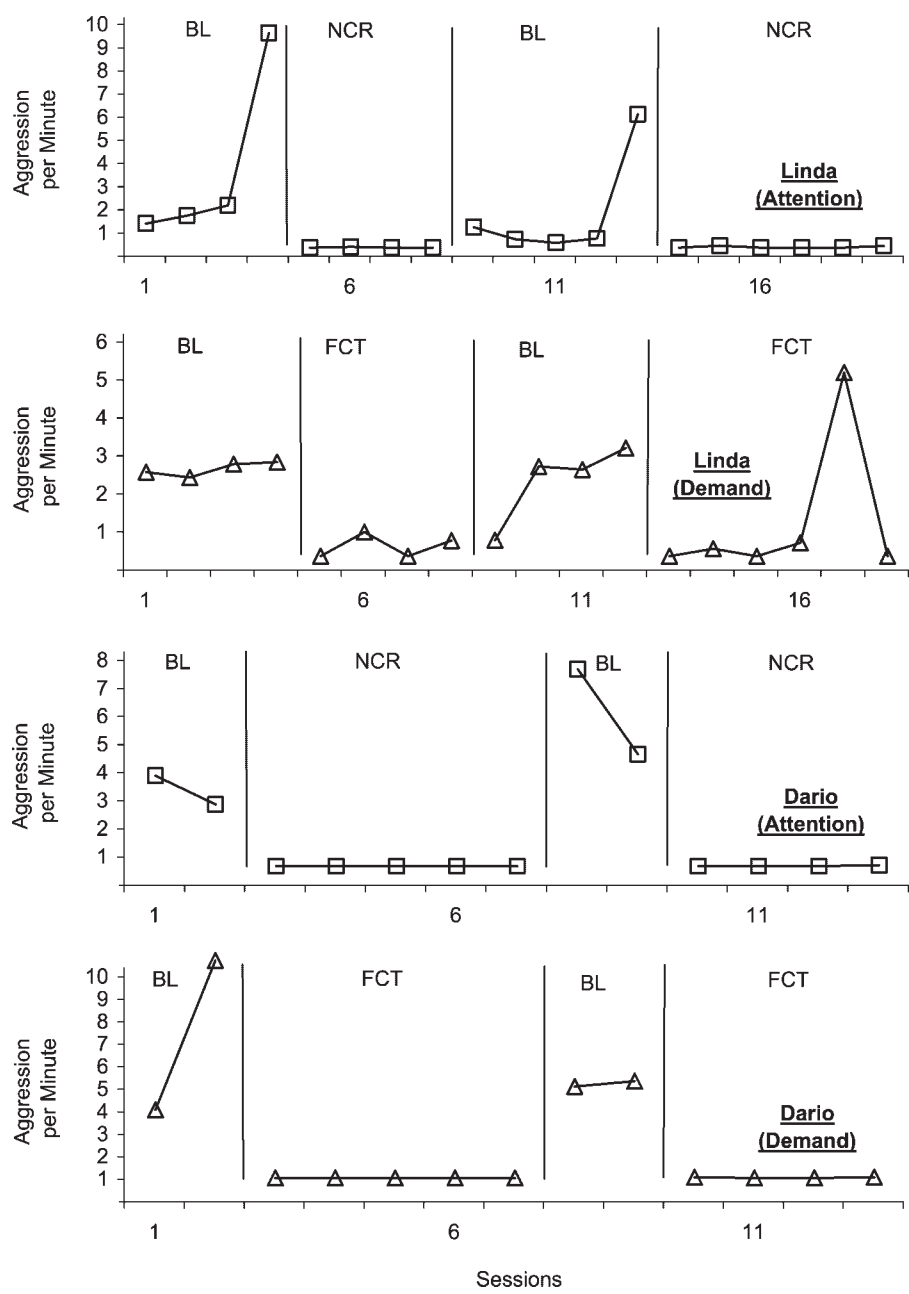


Figure 2. Problem behavior per minute during treatment analyses, for both escape and attention functions, for Linda (top two panels) and Dario (bottom two panels).

themselves interesting in that the treatments were evaluated in the participants' current vocational placement rather than in an analog or clinical setting. Moreover, these results demonstrate the viability of these to interventions in natural settings.

GENERAL DISCUSSION

Previous research has demonstrated the utility of functional analysis methodology as an assessment tool for problem behavior (Iwata et al., 1994b). However, little research has been reported on the experimental assessment of behaviors that occur at rates too low to produce interpretable functional analysis results. The results of this study suggest that low rate problem behavior can be readily assessed using the standard functional analysis methodology, with the simple modification of initiating sessions contingent on the occurrence of the target behavior. Although the results of this study should be considered tentative, it appears as though the low rate modification to the standard methodology could significantly contribute to clinicians' ability to create function-based treatments for low rate behavior. This possibility is further substantiated by the success of the treatment evaluations for Linda and Dario in experiment 2. The success of these evaluations lends support to the validity of the low rate functional analysis outcomes. One way that the results of the low rate functional analysis might have been further validated would have been to compare treatments based on them (e.g. the treatments used in experiment 2) to other treatments that were not based on the results of the low rate analysis. Future researchers should consider such a strategy.

The manner in which sessions were scheduled in experiment 2 warrants additional discussion. Because the participants for whom treatment was assessed attended sheltered workshops for adults with developmental disabilities and behavior problems, it was deemed clinically appropriate to implement treatment across the day in these settings. In order to maintain a high level of precision in treatment implementation, experimenters implemented treatment during specified periods of the day and behavior data collected during those periods were used for treatment evaluation. That is, sessions did not differ from the participants' daily lives during experiment 2, with the exception that experimenters implemented treatment and collected data, rather than the participants' standard caregivers doing so. Therefore, sessions were initiated non-contingently, as it would not have been possible to initiate sessions contingent upon problem behavior, due to the fact that treatment was already being implemented all day, every day. While this could be considered a limitation (due to the fact that sessions were initiated differently in experiments 1 and 2), the results of experiment 2 serve to lend greater plausibility to experiment 1; they are not intended to be compared directly with experiment 1. That is, in any two different

experiments, where each utilizes separate single-subject designs, experimental control is demonstrated by comparing data from one phase in one experiment with data in another phase of the same experiment, not the other experiment.

It is interesting to note that summarizing data from one continuous hour (in the case of Linda) and two continuous hours (in the case of Dario) resulted in sufficient rates of problem behavior to allow for consistent baselines to be observed. That is, although problem behavior occurred at low rates during the standard functional analysis for Linda, and did not occur at all during the standard functional analyses for Dario and Jake, problem behavior occurred at high rates during the baselines of Dario's and Linda's treatment evaluations, presumably due to the fact that data were averaged over 2 h and 1 h periods, respectively. It is thus reasonable to assume that the standard functional analysis might have produced interpretable results if sessions had been alternated over a one or two hour period and rates of problem behavior were summarized across all sessions of each condition that were conducted in that time. Future researchers could conduct a standard functional analysis, rotating through all relevant conditions all day, and summarize the average daily rate for each condition. Because no single condition would be conducted all day, concerns over long periods of deprivation would be eliminated. It is already probably a common practice for organizations that are responsible for the care of individuals all day (e.g. inpatient units and schools) to conduct standard functional analysis sessions, alternating between conditions, for large portions of the day. It is possible that simply summarizing the data for each condition, on a daily basis, would reveal clear functional relationships that the standard data interpretation does not. Future research is needed to evaluate the strengths and limitations of this possibility.

One potential limitation to the current study is the sequence in which functional analysis conditions were conducted. Three sessions were always conducted in the following order: two sessions of the test condition followed by one session of the control condition. It is possible that the bursts of problem behavior that were occurring when the sequence of sessions was initiated would happen to decrease to near zero rates after 10 min, regardless of the conditions being implemented. Although this is possible, it appears unlikely given the results of Jake's low rate functional analysis. In every case where demand sessions were implemented with Jake, his problem behavior was immediately suppressed. This is consistent with a 'pure' attention function, given that implementing demand conditions nearly always constituted an increase in the amount of attention that Jake was exposed to. If attention-maintained problem behavior is evoked by deprivation from attention, then providing attention, even if in the form of demands, would probably eliminate the establishing operation that established attention as reinforcing, thus suppressing problem behavior. In addition, for all three participants, caregivers anecdotally reported that, although bursts of problem behavior did not occur often, they often

persisted for an hour or more before subsiding. Both of these variables lessen the likelihood that low rates were observed in the control conditions for all participants simply due to the passage of 10 min. Nevertheless, future research should randomize the order of conditions, or perhaps conduct the control condition at the beginning of each sequence of sessions, in order to rule out this possibility.

The pattern of Dario's responding during the assessment of escape as a reinforcer, in his low rate functional analysis, warrants comment. Each time a cycle of sessions was conducted, the first demand session produced higher rates of aggression than the second one, which was conducted immediately after. One possible interpretation of this pattern is that Dario's aggression was not actually maintained by negative reinforcement, and that conducting escape sessions actually diminished whatever establishing operation evoked aggression before sessions were initiated. It is thus possible that continuing to implement demand sessions (rather than implementing a control session) would have resulted in continued decreases in rates of aggression, thereby questioning the negative reinforcement interpretation of Dario's aggression. A second interpretation of this pattern is also apparent. Note that Dario's aggression occurred during the first session of each cycle of sessions at rates much higher than was necessary to produce escape from all demands (i.e. 11.6 and 17 responses per min, whereas demands were only presented at a maximum rate of 2 per min). It is possible that contacting the contingency of 30 s escape from demands during the first session of each cycle produced behavior in the second session of each cycle that more efficiently produced reinforcement (i.e. occurred at rates closer to those necessary to produce maximum reinforcement with minimum effort).

A limitation of Jake's low rate functional analysis is the fact that sessions were initiated contingent on the occurrence of SIB *or* screaming, despite the fact that screaming was not a target behavior. The rationale for this was the fact that Jake's caregivers reported that Jake always emitted SIB immediately following the initiation of screaming. This aspect of the methodology may have limited the assessment in that screaming may not have always preceded SIB, and thus SIB could have failed to occur during the low rate analysis, thus rendering the analysis useless. However, SIB was observed during the analysis and clear differentiation occurred. In addition, previous research has demonstrated the utility of including precursor behavior in the analysis of problem behavior (Smith & Churchill, 2002).

A limitation of Dario's FCT treatment was that physical prompting was never formally eliminated. After nine total sessions of treatment, four of which followed his reversal to baseline, his problem behavior was effectively suppressed and formal data-based evaluation of the treatment was terminated. Dario was anecdotally observed to emit the manual sign for 'break' on a regular basis following the treatment evaluation and his caregivers reported that he did not require further prompting or training of any kind. Although the central purpose of this study was to

evaluate a modification to the standard functional analysis (i.e. not to directly research the effectiveness of treatment procedures), data should have been collected to further confirm that Dario's communication response maintained in the absence of experimenter prompting.

A potential limitation to the low rate methodology is that it requires a team of individuals who are trained to implement functional analysis methodology to be on call at all times of the day, so that functional analysis sessions can be initiated immediately contingent upon the onset of problem behavior. This may represent an impossible requirement in some clinical facilities. In outpatient clinics, for example, therapists may only have one or two hours per week when they are available to conduct assessment sessions. In cases such as these, clinicians do not have adequate time to wait for problem behavior to occur. However, in other settings, such as schools, vocational workshops, and inpatient facilities, trained staff may be available at virtually any time. In addition, initial research demonstrates that training in functional analysis procedures can be provided quickly and efficiently to individuals who have little or no experience with behavior analysis, problem behavior, or functional assessment (Iwata et al., 2000; Moore, et al., 2002). Thus, institution or school staff, such as school counselors (who are often required to be present at their school all day), could be trained to conduct functional analysis sessions. Such staff might then be available to conduct sessions when the problem behavior occurs. Thus, the low rate procedure may be practical in settings where staff are available all day, and sufficient resources exist for training one of them in functional analysis methodology.

A point of interest with respect to the low rate methodology is that, while reinforcers may be identified, specific environmental events that set the occasion for problem behavior at any particular time may not. For example, attention may be identified as the functional reinforcer, but no information may be obtained as to why the problem behavior occurs at one time and not another (as opposed to higher rate problem behaviors that tend to occur more or less all the time). Caregiver anecdotal reports of events that commonly preceded bursts of problem behavior were bowel movement 'accidents' for Dario and 'downtime' for Jake. Linda's caregivers did not report any particular event that commonly preceded bursts of problem behavior.

While it is true that the low rate methodology that was evaluated here does not identify consistent antecedent setting events, it is not clear whether the identification of such variables is critical for successful treatment. Specifically, function-based treatments generally include components that allow frequent access to the functional reinforcer of problem behavior contingent on appropriate behavior, or noncontingently. Presentation of reinforcement before a burst of problem behavior occurs will likely diminish the relevant establishing operation of deprivation or aversive stimulation that establishes the functional reinforcer at any given time. For example,

in the case of an individual whose problem behavior is maintained by access to attention, it is possible that the reason why their problem behavior occurs at low rates is that extended periods (e.g. 5 or 10 h) of deprivation from attention are required to establish attention as a reinforcer for problem behavior. If this were the case, providing attention every half hour would probably suppress future occurrences of problem behavior. Similarly, if an individual's problem behavior were maintained by escape from demands, but only the demands of a particular staff member were aversive, and a treatment reinforced compliance and extinguished problem behavior in all demand contexts, the problem behavior should be successfully reduced, regardless of which staff member worked with the participant (i.e. problem behavior would always be on extinction and compliance would always be reinforced). Regardless of idiosyncratic setting events, frequent access to the functional reinforcer and extinction of problem behavior should decrease the occurrence of problem behavior.

An area of functional assessment that requires future research is the assessment of behavior problems that are apparently too violent to allow therapists to voluntarily expose themselves to the behaviors. For example, one of the individuals who was referred to the experimenters for inclusion in this study displayed problem behavior that consisted of aggression, and occurred only one time per month, on average. However, this individual was over six feet in height, and possessed considerable strength and agility. The topographies of aggression that this individual had emitted in the past included attempting to stab a staff member with a steel fork and attempting to break a staff member's arm. It was not deemed safe to include this individual in the current study, because it did not appear that therapists could conduct the experimental sessions without undue risk of physical injury to themselves. Future research should attempt to develop assessment methodologies for extremely aggressive behavior so that individuals with extreme aggression can benefit from function-based treatments.

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