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APPLICATIONS OF A SEQUENTIAL ALTERNATING TREATMENTS DESIGN

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We propose the use of a combined version of the alternating treatments and multiple baseline designs in situations in which a traditional baseline (no treatment) condition either does not provide an adequate contrast condition or is not feasible or practical due to clinical constraints. We refer to this design as a sequential alternating treatments design because two treatments are initially implemented in a random or counterbalanced fashion and are followed by a sequential change in one or both treatments across settings, subjects, or tasks. The effects of the independent variables are assessed first by analyzing the two series of data points representing the different treatments (relative effects) and then by assessing changes in one or both series, as application of the alternative treatment is introduced sequentially. The sequential application of treatment provides an analysis of control in the same manner as the multiple baseline design; the initial alternating treatments phase provides a contrast condition in much the same manner as a baseline condition. Applications of this design to the assessment of peer training and self-injurious behavior are described.

DESCRIPTORS: within-subject design, clinical evaluation, baseline

In most within-subject designs, a nontreatment or baseline phase precedes the initiation of treatment (Barlow & Hersen, 1984). The baseline phase provides a contrast condition or, as Risley and Wolf (1972) pointed out, a predictor of the target behavior if untreated. In most cases, baseline continues until stability of responding is achieved (Baer, Wolf, & Risley, 1968) so that the results of treatment can be compared directly to baseline. A number of authors (e.g., Barlow & Hersen, 1984; Johnston & Pennypacker, 1981; Kazdin, 1982) have discussed the importance of baseline for evaluating internal validity in within-subject designs.

Occasions When a Traditional Baseline Is Not Feasible or Practical

Some evaluation situations pose feasibility and pragmatic concerns regarding the inclusion of a traditional baseline (no treatment) condition in the experimental design. For example, a pragmatic concern might occur in evaluating the occurrence of social interactions between handicapped and nonhandicapped students in a classroom setting under two different conditions. In one condition, the nonhandicapped peer provides the statement, "Let's play a (specific) game"; in the other condition, the peer says, "Let me show you how to play the game." In this case, the initiating statement made by the peer is the independent variable. Some studies have suggested that social interactions will occur more often for the handicapped child if he or she is asked rather than instructed to play (Haring, Breen, Pitts-Conway, Lee, & Gaylord-Ross, 1987; Sasso, Mitchell, & Struthers, 1986). A comparison of these strategies as a research question poses several pragmatic problems relative to the inclusion of a traditional baseline condition that includes a series of observations of unprompted interactions prior to the initiating-statements condition. If a multiple baseline design across dyads is used for evaluation, the uncontrolled behavior of the peer and the target child always precedes both treatment conditions (play vs. instruct); this order could influence subsequent treatment conditions in unknown directions. In a worst-case scenario, the behavior of the peer or target child might require intervention due

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to inappropriate behavior such as teasing, punishing statements, or the display of socially unacceptable behavior.

The inclusion of baseline also is problematic if the teacher or researcher is interested in evaluating the effects of two types of initiating statements during the *initial* contact between the students. It is not typical for children to be paired or grouped together without instructions regarding their activities. Thus, a great deal of time and effort is sometimes spent developing a baseline condition that seldom occurs in the natural context. Although a return to baseline following treatment (BAB) might be considered to evaluate control, a reversal is possible only if the effects of treatment are not maintained.

Similar concerns can arise in evaluating self-injurious behavior (SIB). For example, assume that a child in a hospital setting engages in SIB only during demanding activities (e.g., self-help skills training and physical therapy). If an activity varies on some known dimension (e.g., passive vs. active participation), it could be viewed as representing more than one treatment (type of demand). In this case, the supposition could be made that it is not demands per se, but distinct types of demands, that produce SIB. Baselines across other activities might be recorded to replicate this finding (e.g., requirements for passive vs. active participation in other activities), but one is still left with a baseline phase that is comprised of two distinct treatments.

Alternating Treatments Design Without Baseline

One solution is to use an alternating treatments design (Barlow & Hayes, 1979) that does not include a baseline phase. The major question addressed by alternating treatments designs is whether one treatment is more effective than another (Barlow & Hersen, 1984; Hains & Baer, 1989). In both examples described above, the two treatment conditions (specific statements or specific demands) may be compared directly to determine whether one treatment resulted in greater effects (higher frequency of social behavior or self-injurious behavior) relative to the other.

In some cases, the use of an alternating treatments design without a baseline phase is adequate to evaluate functional control: Treatment A is superior to Treatment B across sessions. For example, in the study reported by Steege, Wacker, Berg, Cigrand, and Cooper (1989), the use of an alternating treatments design was sufficient to demonstrate changes in self-injurious behavior across functional analysis conditions without preceding the treatment conditions with a baseline phase. The alternating treatments design, as a comparison design, is adequate for evaluating the relative effects of two or more treatments in the absence of a baseline condition (Barlow & Hersen, 1984).

Alternating Treatments Design With Baseline

In other cases, a baseline condition is necessary to evaluate the effects of treatment, especially if similar effects occurred for both treatments. For example, Wacker, Berg, Wiggins, Muldoon, and Cavanaugh (1985) used a combination multiple baseline (across subjects) with alternating treatments design to evaluate potential reinforcers. In this investigation, two or more microswitch-activated toys were evaluated as potential reinforcers for profoundly handicapped children within an alternating treatments design. Performance during baseline demonstrated that presence of the microswitches, when not connected to the toys, did not increase responding (i.e., pressing the switch). Instead, responding increased only when the microswitches activated specific toys. Of equal importance, the inclusion of some toys resulted in decreased responding relative to baseline, indicating that these toys functioned as punishers to the children. Thus, the presence of baseline provided information needed for evaluating the reinforcing effects of each toy.

A baseline condition is also useful for evaluating carryover effects. For example, Shapiro, Kazdin, and McGonigle (1982) used a baseline condition to evaluate carryover effects directly by changing the presentation of their treatments. The investigators compared response cost, token reinforcement, and a baseline condition by conducting four alternating treatment evaluations, with each dyad of treatment and baseline repeated twice. The tokens produced similar results when compared to either baseline or response cost, demonstrating minimal, if any, carryover effects. In both of the above investigations, a baseline condition, conducted either prior to treatment or counterbalanced with treatment, functioned as a contrast condition against which the results of treatment could be compared.

In the above two examples, the use of a traditional baseline condition permitted more precise evaluation of the effects of the treatment conditions by providing a contrast condition. The contrast condition, in the first example, provided more information on the absolute effects of treatment and, in the second example, provided more information on interaction effects. It is probably for this reason—the provision of additional information—that alternating treatments designs are seldom conducted without a baseline condition, even though a baseline condition is not a technical requirement (Barlow & Hersen, 1984).

Sequential Alternating Treatments Design

A paradox confronts applied researchers: In some applied situations, a naturalistic baseline is difficult to implement, yet the inclusion of a baseline or contrast condition is frequently necessary for more precise evaluations of experimental control. In these situations, improved evaluation of control might be possible by first extending the alternating treatments conditions across subjects, settings, or tasks in a staggered fashion, identical to the multiple baseline design. The alternating treatments condition then could be followed by the sequential application of one or both treatments to evaluate changes in behavior associated with each treatment. An example of this approach is provided in Figure 1. In this simulated investigation (based on a study by McMahon, Wacker, Sasso, & Melloy, 1988), the investigators assigned 2 nonhandicapped peers each to play with 3 moderately mentally retarded boys. One peer was told to approach his assigned partner and say, "Let's play ———; it's a favorite game of mine" (Play statement). The second peer was told to say, "Let me show you how to play ———" (Instruct statement). The same game was used for both peers; only the instructions changed.

In this investigation, the first condition of the design was an alternating treatments phase, with the statements made by a peer serving as the independent variable. The dependent variable was the percentage of social interactions occurring per 10-min session. The initial condition of the design was then extended sequentially across target children to form a sequential alternating treatments design. The results demonstrated good stability of responding, suggesting that social interactions were facilitated more by the play statement than by the instruct statement.

To replicate these results, one of the initiating statements (counterbalanced across children) was changed to the alternative statement; in other words, both peers asked the target child to play or both provided instruction. This was followed by a second change condition, in which both peers provided the opposite statement. The results show that (a) the statement delivered by the peer controlled responding across target children, (b) the results were reversible, and (c) changes in behavior occurred with changes in statement and not as a function of exposure to a particular peer. Extending the initial alternating treatments condition permitted evaluation of the effects of time, exposure to a given peer, practice, and other potential sources of external confounding. By changing the statement delivered by 1 peer and then by the 2nd peer, replication of control over behavior by the independent variable was evaluated.

In the above example, evaluation of experimental control by the independent variable was established through two distinct design modifications: (a) sequential modification of the treatment condition and (b) two change (or replication) conditions, each demonstrating that behavior was controlled by the peers' verbal statements. Although both design modifications are desirable for experimental control, pragmatic considerations (e.g., maintenance) may limit the use of the replication conditions (in the same way that standard reversal designs may not be possible). When replication or reversal conditions are not possible, the sequential

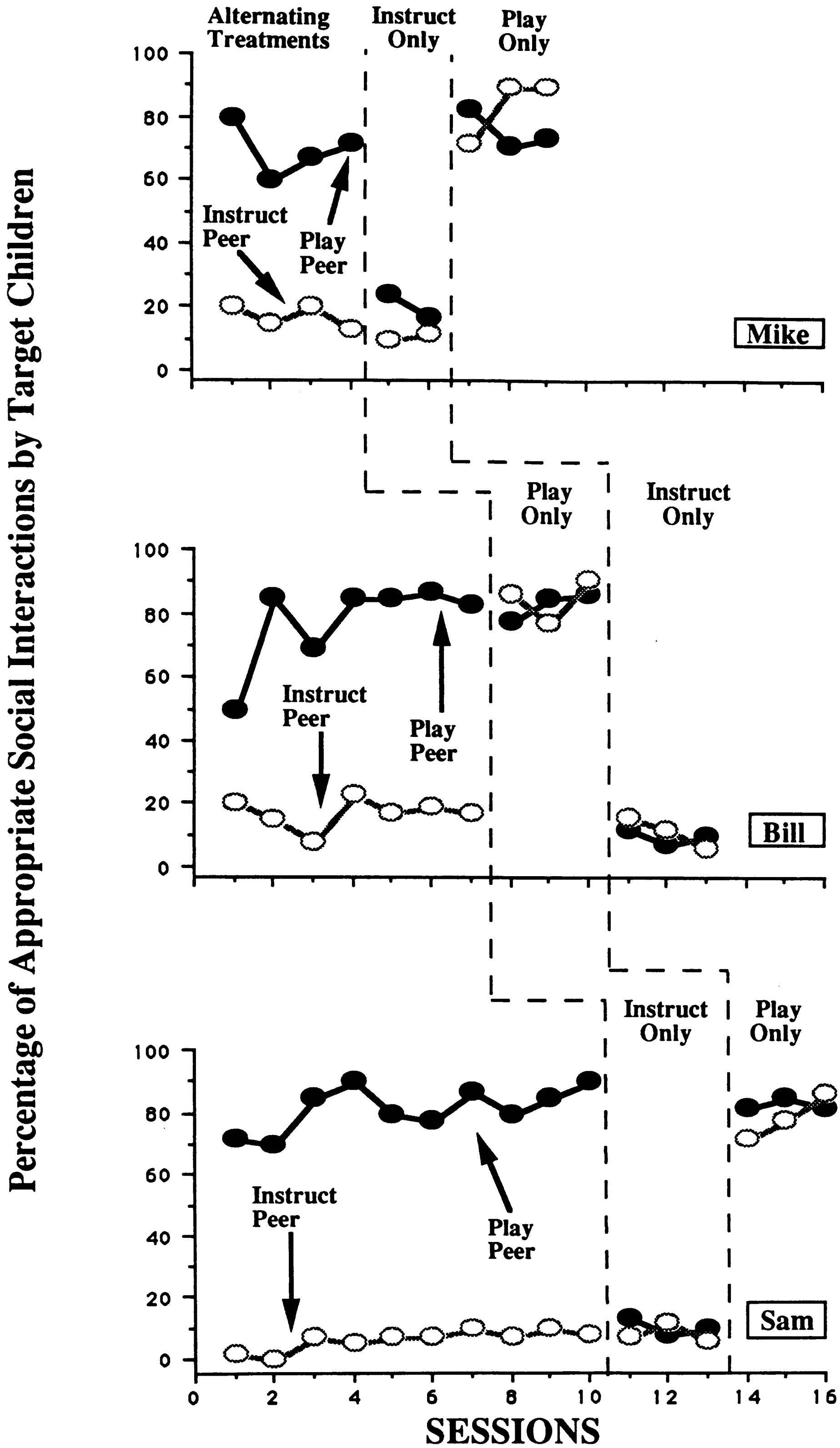

Figure 1. Example of a sequential alternating treatments design across subjects with peer training.

application of one of the treatments can still provide increased information regarding experimental control.

An example of this type of sequential alternating treatments design is provided in Figure 2. In this example, an initial assessment demonstrated that the subject, a profoundly mentally retarded child, engaged in self-injurious behavior during demanding activities. Within these activities, however, the behavior of the child was inconsistent, suggesting that different types of demands during the activities were differentially affecting behavior. To better assess whether specific types of demands had differential effects on the occurrence of self-injurious behavior, separate occurrence data were collected for both passive and active demands. The active demands were defined as prompting the child to participate partially in the activity, and the passive demands were defined as occurring when the activities were performed for the child.

During the alternating treatments condition, a greater percentage of self-injurious behavior occurred across all activities when the subject was provided with passive versus active demands (see Figure 2). However, as was the case for the first example, possible confounding effects occurred because the passive and active demands occurred in the context of the same activity. The possibility of this type of confounding effect was reduced by showing the same effects across four activities (standard alternating treatments design), but was virtually eliminated with the sequential application of active demands across the activities. Because the modification of activities occurred in a sequential fashion, the effects of practice and exposure to treatment were evaluated in the same way that these extraneous variables are evaluated within a multiple baseline across tasks design.

Applications and Limitations of the Sequential Alternating Treatments Design

The application of the sequential alternating treatments design is limited to the same situations recommended for the alternating treatments design, as discussed by Barlow and Hersen (1984) and Hains and Baer (1989): Relatively quick effects of treatment are expected with minimal carryover effects from one treatment to the next. In these situations, the greatest utility of the sequential alternating treatments design is probably in clinical or educational situations in which two or more independent variables warrant evaluation and relatively brief periods of time are available for identifying the respective effects of each independent variable. For example, in the evaluation of aberrant behavior discussed earlier, the control of behavior by one treatment over another might first be evaluated through direct comparison across situations and then confirmed through sequential changes in one or both treatments over time.

In other situations, the greatest utility might be when implementation of baseline poses pragmatic problems. For example, the applicability of a traditional baseline may be problematic in situations in which the student is receiving on-the-job training. Instead, the student might initially receive two types of instruction (e.g., picture prompts vs. time delay prompting) across work tasks to determine the relative effects of each instructional approach. Once relative differences have been identified, introduction of the preferred approach across work tasks in a staggered fashion provides the teacher with evidence of functional control in the same manner as the multiple baseline design.

In our previous research, the sequential alternating treatments design would have been useful in our evaluations of self-injurious behavior (Steege et al., 1989), picture prompts in school settings (Wacker, Berg, Berrie, & Swatta, 1985), and social behavior (Sasso & Rude, 1987).

Hains and Baer (1989) provided a thorough evaluation of alternating treatments designs and presented several options for evaluating interaction effects. We agree with Hains and Baer that evaluation of interaction effects can be important and can be best evaluated within the design options they proposed. Those options should be considered when interaction effects are of interest, because the sequential alternating treatments design is not as useful for evaluating interaction effects.

Gast and Wolery (1988) also proposed a modification of the alternating treatments design, which

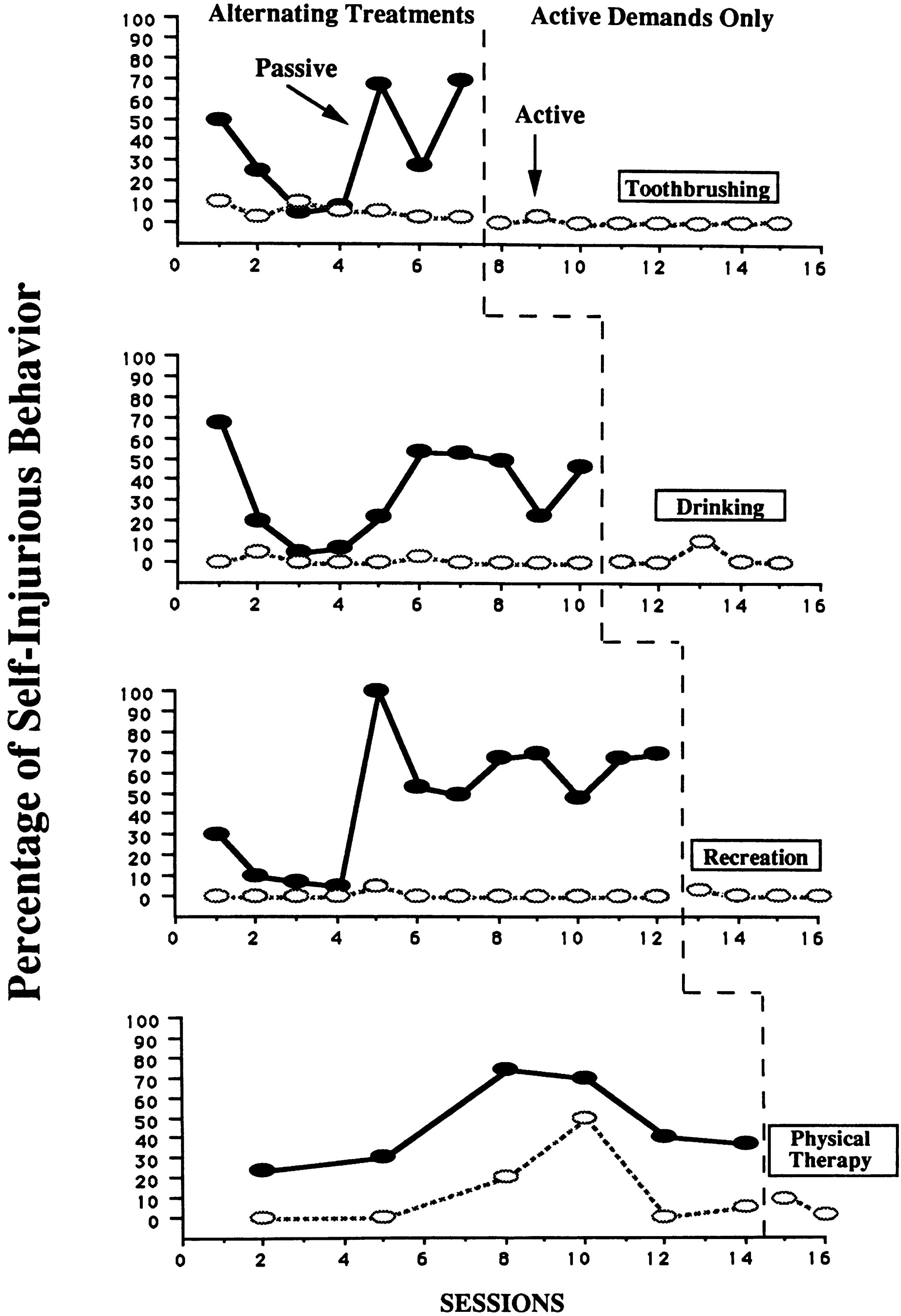

Figure 2. Example of a sequential alternating treatments design across tasks with self-injurious behavior.

they termed the parallel treatments design, for treatments that produce durable results that are not easily reversible. In situations in which two or more treatments will be compared, and both treatments are expected to produce durable results, the use of the parallel treatments design should be considered.

Summary

We suggest that the sequential alternating treatments design be considered in situations in which, for a variety of reasons, conducting a traditional baseline condition may prove to be difficult. These situations may occur most often when two or more independent variables are possible or are in effect during initial observation or assessment. In the sequential alternating treatments design, the alternating treatments condition constitutes a contrast condition within which the relative effects of each variable are evaluated. This condition is then followed by one or more change conditions, in which one treatment is sequentially applied across subjects, tasks, or settings.

The absence of a baseline phase can still be problematic with the sequential alternating treatments design. Without a baseline, for example, it is possible only to compare the relative effects of two treatments and to demonstrate the sequential control established by one or both of those treatments. In many situations, this may be adequate, as with the self-injurious behavior example. In other cases, this may not be adequate, because the central question is concerned with the absolute magnitude of effects, or with interaction effects, in addition to relative effects.

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