

MODULE 11

Conducting Single-Case Research

LEARNING OBJECTIVES

- Describe advantages and disadvantages of ABA versus ABAB reversal designs.
- Differentiate multiple-baseline designs (i.e., across participants, across behaviors, and across situations).

Up to this point the quasi-experiments discussed have all involved studying groups of people. In certain types of research researchers use methods that minimize the number of participants in a study. This procedure may sound contrary to the basic principles of design discussed so far. However, in these methods often referred to as **single-case designs**, only one person is measured repeatedly. Frequently the research is replicated on one or two other participants. Thus we sometimes refer to these studies as **small-*n* designs**. Such studies can also be thought of as a variation of the pretest/posttest quasi-experimental design described in Module 10. But in this case pre- and posttest measures are taken on the single participant in the study.

Researchers may choose a single-case design for several reasons. They may want information on only the single participant being studied. They may not be interested in trying to generalize the results to a population, but rather they may only be interested in how the one participant reacts to the manipulation. Single-case research is often used in clinical settings. In clinical studies many researchers believe that it is unethical to use traditional experimental methods in which one group of participants receives the treatment and the other group serves as a control. They believe it is unethical to withhold treatment from one group, particularly when the participants may really need the treatment. In such instances single-case or small-*n* designs are more ethically appealing because they involve providing treatment to all who participate in the study.

Sidman (1960) argues that of the several reasons for conducting single-case studies, each is based on a flaw in designs that use many participants (group designs). One problem with group designs, according to Sidman, is that they do not allow for adequate replication of results whereas single-case designs do. Consequently single-case designs are better at demonstrating a reliable effect of an independent variable.

A second problem is that group designs contribute to error variance in a study. Error variance is the random differences in scores found within the conditions of an experiment. Using many people in a group design increases error variance resulting from individual differences. The increase in error variance may make it difficult to identify a relationship between the variables in the study.

single-case design: A design in which only one participant is used.

small-*n* design: A design in which only a few participants are studied.

TYPES OF

reversal design: case design in which independent variable is introduced and removed one or more times

A third problem that Sidman notes is that when using group designs, we typically look at the mean performance in each group. However, a mean score for a given condition may not accurately represent the performance of all the participants in that condition. Once we have drawn conclusions based on the mean performance within a group, we then attempt to generalize the results to individuals. Psychologists thus draw conclusions about individual behavior based on studying the average performance of a group of people.

Single-case and small-*n* designs address each of these problems. To determine the reliability of the effect, we can either repeatedly manipulate the independent variable with the same participant or perform replications with a few other participants. Further, error variance resulting from individual differences is eliminated because only one participant is used. Finally, rather than looking at group means and conducting the appropriate statistical analyses, we look at only the performance of the single participant in the study to determine the relationship between the independent and dependent variables. Most commonly we graph the performance of the single participant and examine the resulting graph. The effect of the independent variable is determined by how much the participant's behavior changes from one condition to another. Also because the findings are based on an individual's performance, it makes sense to generalize the results to other individuals.

TYPES OF SINGLE-CASE DESIGNS

Single-case designs are of several types. The basic distinction is between a reversal design and a multiple-baseline design. In the reversal design the researcher typically studies a single behavior in a single participant in a single situation, whereas in the multiple-baseline design the researcher may study multiple people, behaviors, or situations.

Reversal Designs

A **reversal design** is a design with only one participant; the independent variable is introduced and removed one or more times. We typically begin the study by taking baseline measures, equivalent to a control condition in a group design. In other words we need to assess how the participant performs before we introduce the independent variable. Once baseline measures are taken, we can introduce the independent variable. At this point we have a simple AB

reversal design: A single-case design in which the independent variable is introduced and removed one or more times.

design, with A representing baseline performance and B the introduction of the independent variable. The problem with this simple pretest/posttest design is that if a change in behavior is observed, we do not know whether it is due to the introduction of the independent variable or to an extraneous variable (a confound) that happened to occur at the same time. In order to improve on this design, typically some type of reversal is introduced.

ABA Reversal Designs

ABA reversal design: A single-case design in which baseline measures are taken, the independent variable is introduced and behavior is measured, and the independent variable is then removed (a return to baseline condition) and measures are taken again.

An **ABA reversal design** involves taking baseline measures (A), introducing the independent variable (B) and measuring behavior again, and then removing the independent variable and taking new measures (A) after returning to the baseline condition. In this manner we can see whether the behavior changes with the introduction of the independent variable and then whether it changes back to baseline performance once the independent variable is removed. This combination of changes gives us a better indication of the effectiveness of the treatment.

The problem with this design is an ethical one. If the treatment helped to improve the participant's life in some way, it is not ethical to end the experiment by removing the treatment and possibly returning the participant to his or her original state. Thus a further improvement over the ABA design is the ABAB design.

ABAB Reversal Designs

ABAB reversal design: A design in which baseline and independent variable conditions are reversed twice.

The **ABAB reversal design** involves reintroducing the independent variable after the second baseline condition. The experiment thus ends with the treatment, making it ethically more desirable. In addition, it allows us to further assess the effectiveness of the independent variable by introducing it a second time. A study by Hall, Axelrod, Foundopoulos, Shellman, Campbell, and Cranston (1971), which assessed the effectiveness of punishment in reducing the aggressive behavior of a 7-year-old deaf girl, illustrates this design. The participant pinched and bit both herself and anyone else with whom she came in contact. The frequency of these behaviors averaged 72 occurrences per day, preventing normal classroom instruction. As can be seen in Figure 11.1, after a baseline measurement for five days, the experimenters introduced the treatment, in which the teacher pointed at the participant and shouted "No!" after each bite or pinch. The change in the participant's behavior with the introduction of the treatment was dramatic, even on the first day. Even though the participant was deaf, the treatment was still very effective. The number of bites and pinches per day dropped to zero by the end of the first treatment period. The researchers then returned to baseline for a few days to eliminate the possibility of an alternative explanation for the behavior change. As can be seen in the figure, the number of bites and pinches increased during this time. The treatment was then reintroduced on day 26, and once again the number of bites and pinches per day declined dramatically. Thus the ABAB reversal design has the advantage of being more ethical than the ABA design and of offering two baseline measures and two treatment measures to eliminate alternative explanations of

multiple-baseline design: A single-case small-*n* design in which the effect of introducing the independent variable is assessed over multiple participants, behavioral situations.

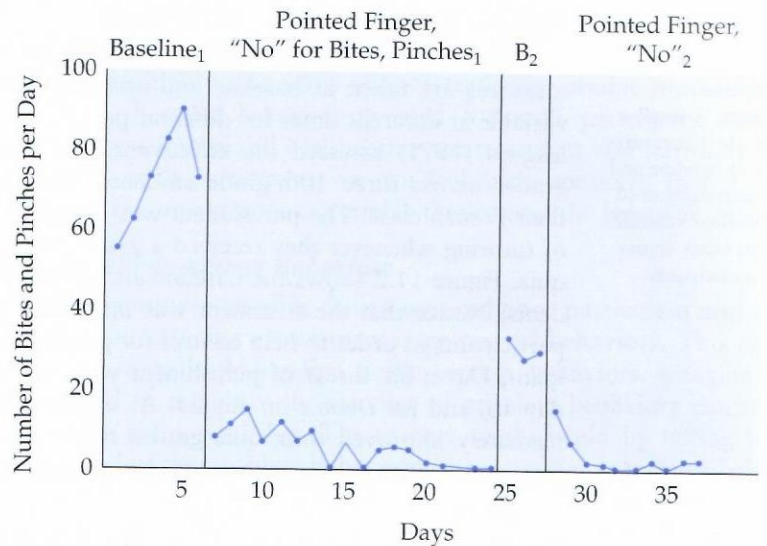


FIGURE 11.1 Number of bites and pinches during the school day

Source: From "The Effective Use of Punishment to Modify Behavior in the Classroom" by R. V. Hall, S. Axelrod, M. Foundopoulos, J. Shellman, R. A. Campbell, & S. S. Cranston, 1971, in K. D. O'Leary & S. O'Leary (Eds.), *Classroom Management: The Successful Use of Behavior Modification*, p. 175. Copyright 1972 by Allyn & Bacon. Reprinted with permission of Pearson Education.

behavior change. This design can be further extended to an ABABA design or an ABABAB design.

Multiple-Baseline Designs

One concern with single-case designs is *carryover effects*, that is, participants "carry" something with them from one condition to another. As a result of participating in one condition, they experience a change that they now carry with them to the second condition. For example, if the treatment in a reversal design permanently changes the participant, then he or she cannot revert to a baseline condition after treatment is introduced. In such cases it is not possible to use a reversal design. In addition, sometimes it is unethical to treat people (improve their condition) and then remove the treatment to assess a baseline condition.

In these situations a multiple-baseline design is recommended. In a **multiple-baseline design** rather than reversing the treatment and baseline conditions numerous times, we assess the effect of introducing the treatment over multiple participants, behaviors, or situations. We control for confounds not by reverting to baseline after each treatment as in a reversal design but by introducing the treatment at different times across different people, behaviors, or situations.

multiple-baseline design: A single-case or small-*n* design in which the effect of introducing the independent variable is assessed over multiple participants, behaviors, or situations.

multiple-baseline design across participants: A small-*n* design in which measures are taken at baseline and after the introduction of the independent variable at different times across multiple participants.

Multiple Baselines across Participants

A **multiple-baseline design across participants** is a small-*n* design in which measures are taken at baseline and after the introduction of the independent variable at different times for different people. As an example, Hall and his colleagues (1971) assessed the effectiveness of threatened punishment for low grades across three 10th-grade students. The three students were all failing their French class. The punishment was being kept after school for a half-hour of tutoring whenever they received a grade lower than C on their daily French quiz. Figure 11.2 shows the baseline and treatment results across the three students. Notice that the treatment was introduced at staggered times across the participants in order to help control for possible confounds. For the first participant, Dave, the threat of punishment was introduced on day 11, for Roy on day 16, and for Debbie on day 21. As shown in the graph, all participants immediately improved their quiz grades once the treatment was introduced. In fact, none of the three participants ever actually received extra tutoring because

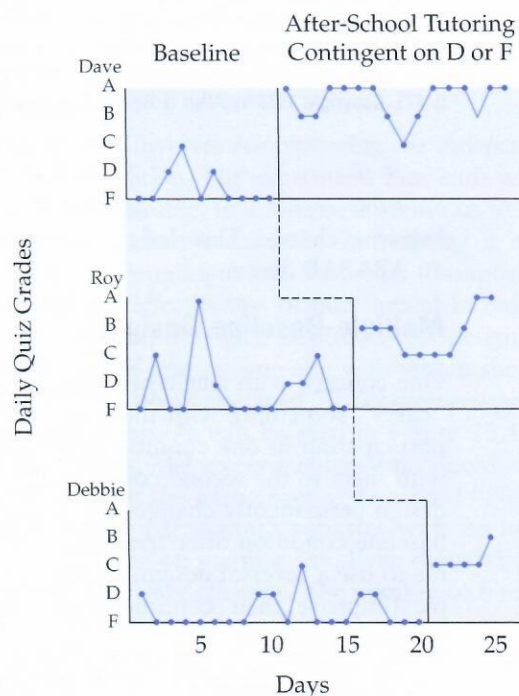


FIGURE 11.2 Quiz grades for three high school French students

Source: From "The Effective Use of Punishment to Modify Behavior in the Classroom" by R. V. Hall, S. Axelrod, M. Foundopoulos, J. Shellman, R. A. Campbell, & S. S. Cranston, 1971, in K. D. O'Leary & S. O'Leary (Eds.), *Classroom Management: The Successful Use of Behavior Modification*, p. 177. Copyright 1972 by Allyn & Bacon. Reprinted with permission of Pearson Education.

multiple-baseline design across behaviors: A small-*n* design in which measures are taken at baseline and after the introduction of the independent variable at different times across multiple behaviors.

multiple-baseline design across situations: A small-*n* design in which measures are taken at baseline and after the introduction of the independent variable at different times across multiple situations.

a small- n design in which the introduction of the independent variable. For example, Hall and his colleagues (1971) assessed the effectiveness of a treatment of withheld punishment for low achieving students who were all failing in their classroom. The treatment was introduced after school for a half-hour each day on their daily French homework. Results across the three students were staggered across the three conditions. For the first participant, the treatment was introduced on day 11, for Roy on day 15, and for the second participant on day 19. In all cases, the treatment was introduced because the students were failing extra tutoring because

tutoring
D or F



25

high students

"classroom" by R. V. Hall, 1971, in K. D. O'Leary & Modification, on Education.

multiple-baseline design across behaviors: A single-case design in which measures are taken at baseline and after the introduction of the independent variable at different times across multiple behaviors.

multiple-baseline design across situations: A single-case design in which measures are taken at baseline and after the introduction of the independent variable at different times across multiple situations.

their grades improved immediately after the threat of punishment was introduced. By altering when the treatment is introduced to each participant, we minimize the possibility that some other extraneous variable produced the results. That is, because behavior changed for each participant right after the treatment was introduced and because the treatment was introduced at different times to each participant, we can feel fairly confident that it was the treatment and not an extraneous variable that caused the behavior change.

Multiple Baselines across Behaviors

An alternative multiple-baseline design uses only one participant and assesses the effects of introducing a treatment over several behaviors. This design is referred to as a **multiple-baseline design across behaviors**. Imagine that a teacher wanted to minimize the number of problem behaviors emitted by a student during the school day. The teacher might begin by taking baseline measures on all of the problem behaviors (for example, aggressive behaviors, talking out of turn, and temper tantrums). The treatment might be introduced first for only aggressive behaviors. Several days after introducing that treatment, the teacher might introduce the treatment for talking out of turn and then several days later the treatment for temper tantrums. By introducing the treatments for different behaviors at different times, we can eliminate potential confounds. In other words, if all of the treatments were introduced at the same time and behavior changed, we would not know whether the change was due to the treatments or to extraneous variables that also changed at the same time. If we see a systematic improvement across behaviors when the treatment is introduced at different times, we can feel fairly certain that the treatment brought about the change.

Multiple Baselines across Situations

A third way to use the multiple-baseline design is to assess the introduction of treatment across different situations: a **multiple-baseline design across situations**. For instance, Hall and his colleagues (1971) assessed the effectiveness of punishment on a young boy's crying, whining, and complaining behavior during school. The child emitted these behaviors only during reading and math classes each day. Hall devised a system in which the child was given five slips of colored paper bearing his name at the beginning of reading and arithmetic periods each day. One slip of paper was taken away each time he cried, whined, or complained. As can be seen in Figure 11.3, baseline performance was established for the number of cries, whines, and complaints in each class. Then the treatment was introduced on day 6 in the reading class and on day 11 in the math class. In both situations, the number of cries, whines, and complaints declined. Introducing the treatment at different times in the two classes minimizes the possibility that a confounding variable is responsible for the behavior change. Hall then reversed the treatment and went back to baseline. Reversal was possible in this situation because the treatment did not have any carryover effects and because reversing the treatment had no ethical ramifications. The treatment was then reintroduced on day 21 in both classes. Thus, this design is really a multiple-baseline reversal design across situations.

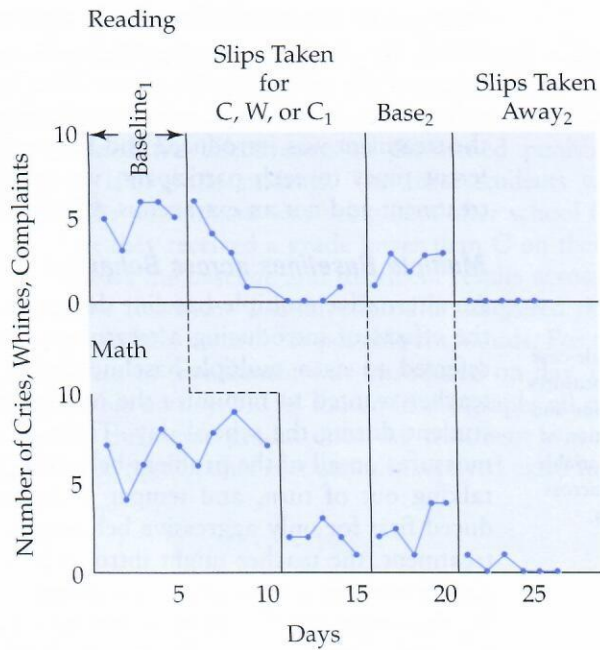


FIGURE 11.3 Frequency of cries (C), whines (W), and complaints (C₁) during reading and math classes

Source: From "The Effective Use of Punishment to Modify Behavior in the Classroom" by R. V. Hall, S. Axelrod, M. Foundopoulos, J. Shellman, R. A. Campbell, & S. S. Cranston, 1971, in K. D. O'Leary & S. O'Leary (Eds.), *Classroom Management: The Successful Use of Behavior Modification*, p. 180. Copyright 1972 by Allyn & Bacon. Reprinted with permission of Pearson Education.

CRITICAL THINKING CHECK 11

SUMMARY

REVIEW OF

single-case design
small-n design
reversal design
ABA reversal design
ABAB reversal design

MODULE EXERCISES

(Answers to odd-numbered exercises are in Appendix A.)

1. Give three examples of single-case designs.
2. Explain with an example the advantages of a reversal design.

CRITICAL THINKING

11.1

1. Single-case research is a type of research in which the researcher studies a single individual or a single group of individuals. It is similar to a quasi-experiment in that it involves taking data on a single group of individuals.

IN REVIEW Single-Case Designs	
Reversal Designs	Multiple-baseline Designs
<p>ABA design: measures taken at baseline, after introduction of independent variable at baseline again</p> <p>ABAB design: measures taken at baseline, after introduction of independent variable at baseline again, and after introduction of independent variable again</p>	<p>Across participants: measures taken at baseline and after introduction of independent variable at different times across multiple participants</p> <p>Across behaviors: measures taken at baseline and after introduction of independent variable at different times across multiple behaviors</p> <p>Across situations: measures taken at baseline and after introduction of independent variable at different times across multiple situations</p>