

Chapter 10 Quasi-Experimental and Single-Case Designs

(Reminder: Don't forget to utilize the concept maps and study questions as you study this and the other chapters.)

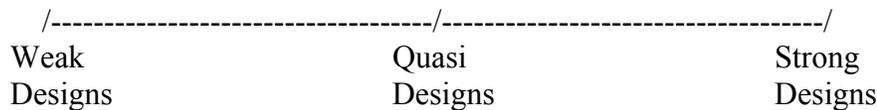
The experimental research designs discussed in this chapter are used when it is impossible to randomly assign participants to comparison groups (quasi-experimental designs) and when a researcher is faced with a situation where only one or two participants can participate in the research study (single case designs).

- Like the designs in the last chapter, quasi-experimental and single-case designs do have manipulation of the independent variable (otherwise they would not be “experimental research” designs).

Quasi-Experimental Research Designs

These are designs that are used when it is not possible to control for all potentially confounding variables; in most cases this is because the participants cannot be randomly assigned to the groups.

- Causal explanations can be made when using quasi-experimental designs but only when you collect data that demonstrate that plausible rival explanations are unlikely, and the evidence will still not be as strong as with one of the strong designs discussed in the last chapter.
- You can view quasi-experiments as falling in the center of a continuum with weak experimental designs on the far left side and strong experimental designs on the far right side. (In other words, quasi designs are not the worst and they are not the best. They are in-between or moderately strong designs.)



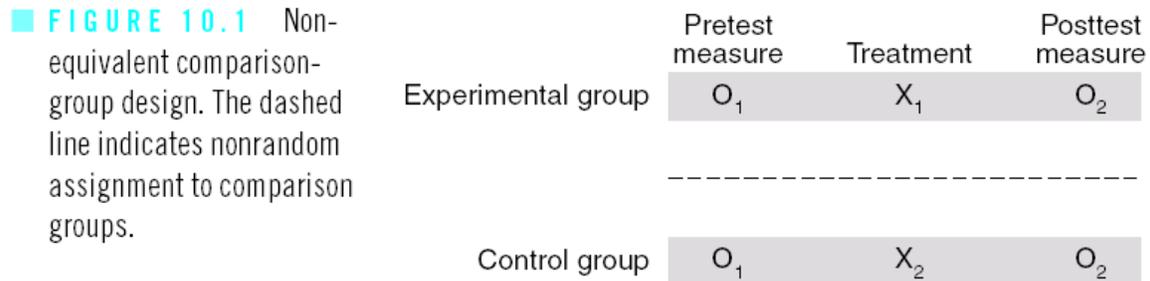
- Three quasi-experimental research designs are presented in the text: the nonequivalent comparison-group design, the interrupted time-series design, and the regression discontinuity design.

Nonequivalent Comparison-Group Design

This is a design that contains a treatment group and a nonequivalent untreated comparison group about of which are administered pretest and posttest measures. The groups are “nonequivalent” because you lack random assignment (although there are some control techniques that can help make the groups similar such as matching and statistical control). Because of the lack of random assignment, there is no assurance that

the groups are highly similar at the outset of the study.

Here is a depiction of the nonequivalent comparison-group design:



- Because there is no random assignment to groups, confounding variables (rather than the independent variable) may explain any difference observed between the experimental and control groups.
- The most common threat to the internal validity of this type of design is differential selection. The problem is that the groups may be different on many variables that are also related to the dependent variable (e.g., age, gender, IQ, reading ability, attitude, etc.).
- Here is a list of all of the primary threats to this design.

■ **TABLE 10.1** Potential Biases That Exist in the Nonequivalent Comparison-Group Design

- *Selection Bias*—Because groups are nonequivalent, there will always be a potential differential selection bias. However, the pretest allows exploration of the possible size and direction of the bias on any variables measured at pretesting.
- *Selection-Maturation*—A selection-maturation bias may exist if one group of participants becomes more experienced, tired, or bored than participants in the other group.
- *Selection-Instrumentation*—A selection-instrumentation bias may exist if the nature of the dependent variable or the way it is measured varies across the nonequivalent groups.
- *Selection-Regression*—A selection-regression bias may exist if the two groups are from different populations such as the experimental treatment group being from a population of individuals with low reading scores and the comparison group being from a population of individuals with high reading scores.
- *Selection-History*—A selection-history bias may exist if an event occurring between the pretest and posttest affects one group more than the other group.

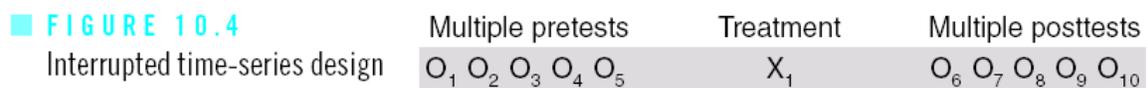
- It is a good idea to collect data that can be used to demonstrate that key confounding variables are not the cause of the obtained results. Hence, you will need to think about potential rival explanations during the planning phase of your research study so that you can collect the necessary data to control for these factors.

- You can eliminate the influence of many confounding variables by using the various control techniques, especially statistical control (where you measure the confounding variables at the pretest and control for them using statistical procedures after the study has been completed) and matching (where you select people to be in the groups so that the members in the different groups are similar on the matching variables).
- Only when you can rule out the effects of confounding variables can you confidently attribute the observed group difference at the posttest to the independent variable.

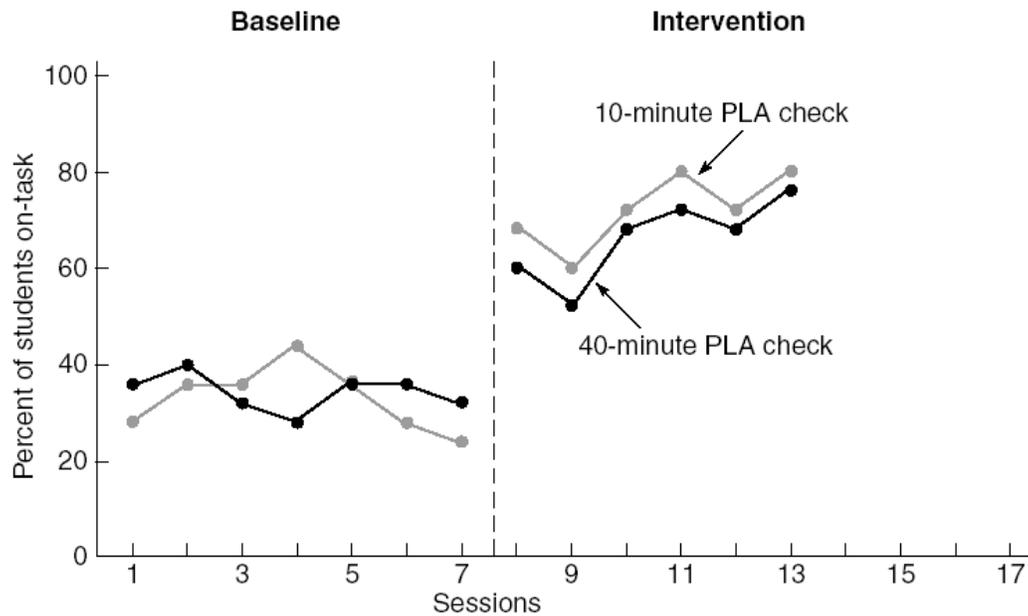
Interrupted Time-Series Design

This is a design in which a treatment condition is accessed by comparing the pattern of pretest responses with the pattern of posttest responses obtained from a single group of participants. In other words, the participants are pretested a number of times and then posttested a number of times after or during exposure to the treatment condition.

Here is a depiction of the interrupted time-series design:



- The pretesting phase is called the baseline which refers to the observation of a behavior prior to the presentation of any treatment designed to alter the behavior of interest.
- A treatment effect is demonstrated only if the pattern of posttreatment responses differs from the pattern of pretreatment responses. That is, the treatment effect is demonstrated by a discontinuity in the pattern of pretreatment and posttreatment responses.
- For example, an effect is demonstrated when there is a change in the level and/or slope of the posttreatment responses as compared to the pretreatment responses.
- Here is an example where both the level and slope changed during the intervention:



■ **FIGURE 10.5** Percentage of students who are on-task at 10 minutes and 40 minutes into the class period. The figure presented here depicts the results of one of five classrooms investigated by Mayer et al. Only one classroom is presented here to illustrate a time-series design, whereas Mayer et al. used five classrooms and a multiple-baseline design. PLA refers to planned activity.

Adapted from G. R. Mayer, L. K. Mitchell, T. Clementi, E. Clement-Robertson, & R. Myatt (1993). "A dropout prevention program for at-risk high school students: Emphasizing consulting to promote positive classroom climates," *Education and Treatment of Children*, 16, 135–146. Reprinted by permission.

- Many confounding variables are ruled out in the interrupted time-series design because they are present in both the pretreatment and posttreatment responses (i.e., the pretreatment and posttreatment responses will not differ on most confounding variables).
- However, the main potentially confounding variable that cannot be ruled out is a history effect. The history threat is a plausible rival explanation if some event other than the treatment co-occurs with the onset of the treatment.

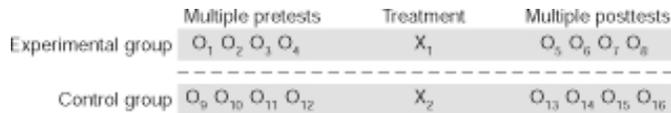
Bonus material (not required)

Although not discussed in the text, there is an extension of the interrupted time-series design. It is called the *multiple time-series design*—it is the basic interrupted time-series design with a comparable control group added to it. I mention this design because I do want you to remember that YOU can put together different designs simply by using different combinations of pretests, posttests, different types of groups, varying the number of pretests and posttests, using a control group or not, including more than one outcome variable, and so forth.

- Both the experimental and control groups are repeatedly pretested in the multiple time-series design. Then the experimental group receives the treatment and the

control group receives some standard treatment or no treatment, and, finally, both groups are repeatedly posttested.

- Here is a picture of the multiple time-series design:

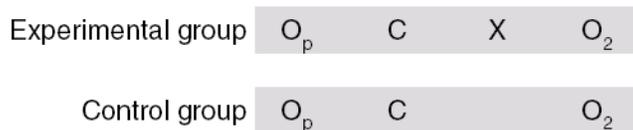


- Including a control group provides control for the history effect, but only if the different groups are truly comparable and any history effect influences both groups to the same degree (i.e., as long as you don't have a selection-history effect). The various additive and interactive effects remain as potential threats to this design.

Regression Discontinuity Design

This is a design that is used to assess the effect of a treatment condition by looking for a discontinuity in regression lines between individuals who score lower and higher than some predetermined cutoff score on an assignment variable.

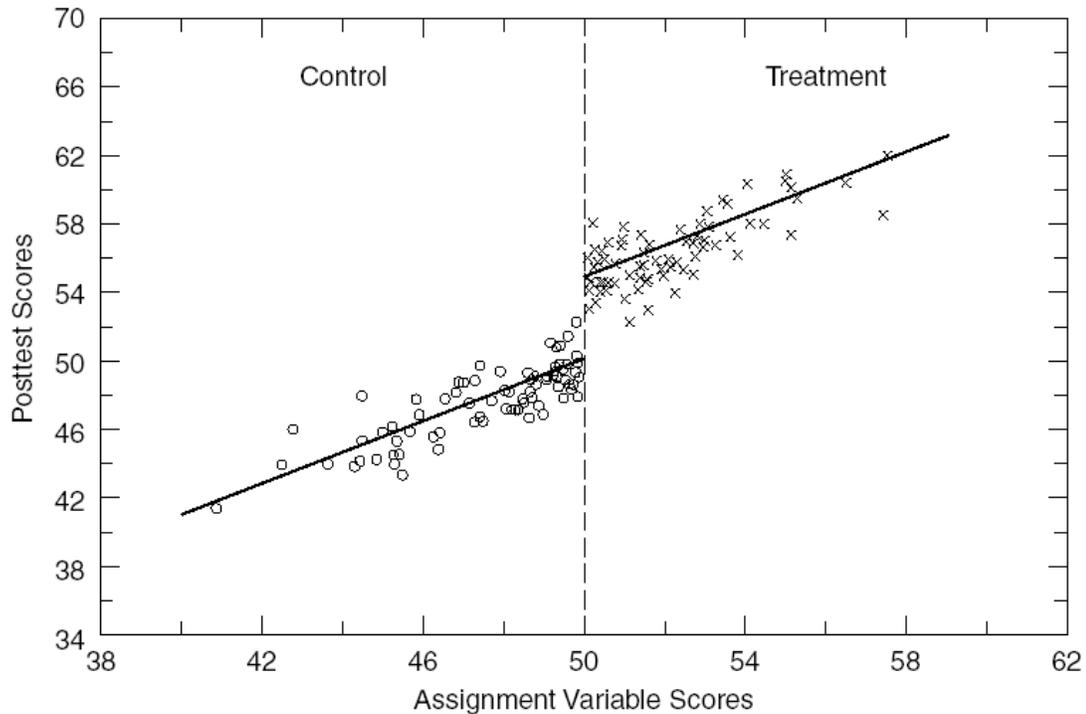
- Here is the depiction of the design:



■ **FIGURE 10.7** Structure of the regression-discontinuity design in which O_p is the preassignment measure, C indicates the preassignment measure cutoff score used to assign participants to conditions in which participants with scores above the cutoff are assigned to the treatment condition and participants with scores below the cutoff are assigned to the control condition, X refers to a treatment condition, and O₂ refers to the posttest measure or the outcome or dependent variable

- For example you might use a standardized test as your assignment variable, set the cutoff at 50, and administer the treatment to those falling at 50 or higher and use those with scores lower than 50 as your control group.
- This is actually quite a strong design, and methodologists have, for a number of years, been trying to get researcher to use this design more frequently.
- One uses statistical techniques to control for differences on the assignment variable and then checks to see whether the groups significantly differ.

Here is an example where a difference or “discontinuity” is easily seen:



■ **FIGURE 10.9** Regression discontinuity experiment with an effective treatment

From W. R. Shadish, T. D. Cook, and D. T. Campbell, *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. Copyright © 2002 by Houghton Mifflin Company. Reprinted by permission.

- If you cannot assign the participants to the treatment condition based on their assignment variable scores, you will not be able to use this design. On the other hand, if you can do this, then this is an excellent design.

Single-Case Experimental Designs

These are designs where the researcher attempts to demonstrate an experimental treatment effect using single participants, one at a time.

- We discuss several single-case designs: A-B-A design, A-B-A-B design, multiple-baseline design, and the changing-criterion design.

A-B-A and A-B-A-B Designs

The A-B-A design is a design in which the participant is repeatedly pretested (the first A phase or baseline condition), then the experimental treatment condition is administered and the participant is repeatedly posttested (the B phase or treatment phase). Following the posttesting stage, the pretreatment conditions are reinstated and the participant is again repeatedly tested on the dependent variable (the second A phase or the return to baseline condition).

- Here is a depiction of the A-B-A design:



■ **FIGURE 10.10** A-B-A time-series design

- The effect of the experimental treatment is demonstrated if the pattern of the pre- and posttreatment responses (the first A phase and the B phase) differ and the pattern of responses reverts back to the original pretreatment level when the pretreatment conditions are reinstated (the second A or return to baseline phase).
- Including the second A phase controls for the potential rival hypothesis of history that is a problem in a basic time series design (i.e., in an A-B design).
- Basically, you are looking for the "fingerprint" of a stable baseline (during the first A phase), then a clear jump or change in level or slope (during the B phase), and then a clear reversal or return to the stable baseline (during the second A phase).
- For example, if you hope for low values on your dependent measure (e.g., talking out behavior), you would hope to see a high-low-high pattern.
- Conversely, if you hope for high values on your dependent measure (e.g., attending to what the teacher says), you would hope to see a low-high-low pattern.
- One limitation of the A-B-A design is that it ends with baseline condition or the withdrawal of the treatment condition so the participant does not receive the benefit of the treatment condition at the end of the experiment.
- This limitation can be overcome by including a fourth phase which adds a second administration of the treatment condition so the design becomes an A-B-A-B design.
- A limitation of both the A-B-A and the A-B-A-B designs is that they are dependent on the pattern of responses reverting to baseline conditions when the experimental treatment condition is withdrawn. This may not occur if the experimental treatment is so powerful that its effect continues even when the treatment is withdrawn.
- If a reversal to baseline conditions does not occur another design (such as the multiple-baseline design) must be used to demonstrate the effectiveness of the treatment condition.

Multiple-Baseline Design

This is a design that investigates two or more people, behaviors, or settings to identify the effect of an experimental treatment. The key is that the treatment condition is successively administered to the different people, behaviors, or settings.

- Here is a depiction of the design:

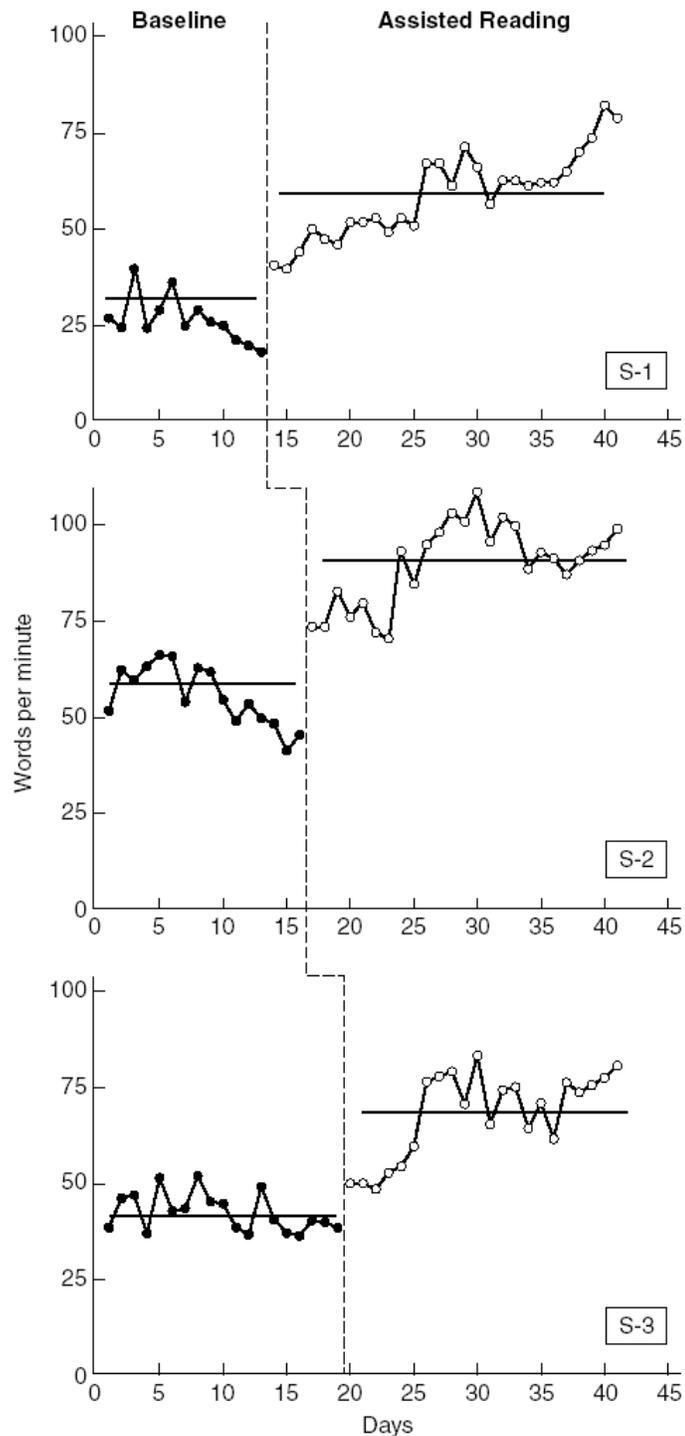
■ FIGURE 10.13 Multiple-baseline design

		<i>Phase 1</i>	<i>Phase 2</i>	<i>Phase 3</i>	<i>Phase 4</i>	<i>Phase 5</i>
Different people, different behaviors, or different settings	A	Baseline	Treatment	Treatment	Treatment	Treatment
	B	Baseline	Baseline	Treatment	Treatment	Treatment
	C	Baseline	Baseline	Baseline	Treatment	Treatment
	D	Baseline	Baseline	Baseline	Baseline	Treatment

- The multiple-baseline design requires that baseline behavior is collected on the several people, behaviors, or settings and then the experimental treatment is successively administered to the people, behaviors, or settings.
- The experimental treatment effect is demonstrated if a change in response occurs when the treatment is administered to each person, behavior, or setting (i.e., when the fingerprint you are looking for is observed).
- Here is an example where a treatment fingerprint is easily seen:

FIGURE 10.14 The correct reading rates during baseline and assisted reading for each participant. Solid horizontal lines indicate condition means. The assisted reading treatment is staggered, first being provided to participant 1, second to participant 2, and third to participant 3. Notice the change in behavior in all three cases after the introduction of the treatment condition.

From L. M. Gilbert, R. L. Williams, & T. F. McLaughlin (1996). "Use of assisted reading to increase reading rates and decrease error rates of students with learning disabilities," *Journal of Applied Behavior Analysis*, 29, 255–257. Reprinted by permission.

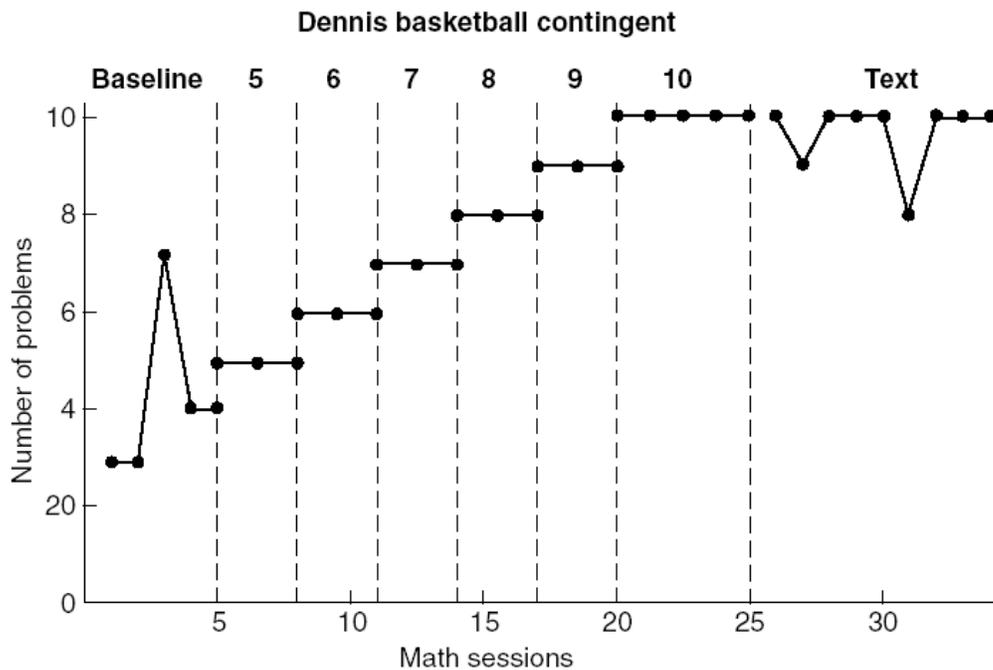


- Rival hypotheses are unlikely to account for the changes in the behavior if the behavior change only occurs after the treatment effect is administered to each successive person, behavior, or setting.
- This design avoids the problem of failure to revert to baseline that can exist with the A-B-A and A-B-A-B designs.

Changing-Criterion Design

This is a single-case design that is used when a behavior needs to be shaped over time or when it is necessary to gradually change a behavior through successive treatment periods to reach a desired criterion.

- This design involves collecting baseline data on the target behavior and then administering the experimental treatment condition across a series of intervention phases where each intervention phase uses a different criterion of successful performance until the desired criterion is reached.
- The criterion used in each successive intervention phase should be large enough to detect a change in behavior but small enough so that it can be achieved.
- Here is an example this design.



■ **FIGURE 10.16** Number of math problems solved in a changing-criterion design

Adapted from R. V. Hall, & R. G. Fox (1997). *Changing-criterion designs: An alternative applied behavior analysis procedure*. *New Developments in Behavioral Research: Theory, Method, and Application*. In honor of Sidney W. Bijou, edited by C. C. Etzel, G. M. LeBlanc, and D. M. Baer, 1977. Hillsdale, NJ: Lawrence Erlbaum Associates. Copyright © 1977 by Lawrence Erlbaum Associates. Reprinted by permission of the publisher and the authors.

Methodological Considerations in Using Single-Case Designs

The following table presents some major methodological issues you must consider when using single-case designs.

■ **TABLE 10.3** Methodological Issues in Single-Case Studies

1. **Baseline**—The behavior of the participant before the administration of the experimental treatment condition. Baseline serves as the standard for assessing change induced by the experimental treatment condition, and to serve as this standard, it must be stable. A stable baseline is characterized by (a) an absence of trend or baseline data that does not increase or decrease over time and (b) little variability, which is defined by Sidman (1960) as only a 5 percent variability.
 2. **Changing One Variable at a Time**—In single-case studies, only one variable can be changed from one phase of the experiment to the next. This is necessary to be able to isolate the effect produced by that variable.
 3. **Length of Phases**—Agreement does not exist with regard to the length of phases. Some researchers state that the various phases should be of equal length, and others state that each phase should be continued until some degree of stability has been achieved.
 4. **Assessment of Treatment Effect**—There are two approaches to assessing the effect of an experimental treatment:
 - a. **Visual inspection**—Looking at the data generated in the various phases is sufficient to identify a treatment effect if the baseline and intervention data do not overlap (there is a change in the level of the baseline and intervention phases) or if the trend of the data in the baseline phase is different from that which exists in the intervention phase.
 - b. **Statistical analysis**—A statistical analysis such as a time series analysis is necessary if there is a great deal of variability in the data. In general, the statistical analysis is not needed if there is little variability in the data and the baseline data is very stable. When these two conditions do not exist, a statistical analysis should be used.
-