

SINGLE SUBJECT RESEARCH

What Are Single-Subject/System Designs?

- Single-subject designs involve in-depth quantitative study of the response of an individual or a group of individuals to an intervention or the withdrawal of that intervention (Szymanski, 1993).
- Basically, single-subject designs, focus on a single individual in a research sample (Alberto & Troutman, 1990), are the extension of the quasi-experimental studies – time-series designs (Wang, 1995) or a variation of the time-series/within-subjects design (Dooley, 1990).
- The interrupted-time-series design represents the logical extension of the general observation-treatment-observation design (Elmes, Kantowitz, & Roediger, 1992).

Definition of Related Terms (Alberto & Troutman, 1990)Variables

- Dependent Variable (DV): The behavior targeted for change
- Independent Variable (IV): The treatment or procedure that the experimenter controls – the treatment or procedure being used to change behavior
 - Typically, in single-subject studies, the categories of the IV reflect the phases of the treatment or lack of treatment. For example,
 - Baseline, Treatment, No Treatment
 - Baseline, Treatment A, Return to Baseline, Treatment B, Return to Baseline
 - Baseline, Treatment A, Treatment A+B, Treatment A+B+C, Fade

Components of Single-Subject DesignsBaseline Measures

- Baseline data are measures of the level of behavior (the DV) as it occurs naturally, before intervention.
- Baseline data serve two functions:
 - descriptive function
 - predictive function
- Baseline should be stable and baseline trends should be taken into account before intervention. *A trend in the data* refers to an indication of a distinctive direction in the performance of the behavior. *A trend* is defined as three successive data points in the same direction. A baseline may show no trend, an increasing trend, or a decreasing trend. (The researcher should initiate intervention on an ascending baseline only if the objective is to decrease the behavior. In contrast, the researcher should initiate intervention on a descending baseline only if the objective is to increase the behavior.)

Intervention Measures

- A series of repeated measures of the subject's performance under a treatment or intervention condition.
- The IV (treatment or intervention) is introduced and its effects on the DV (the subject's performance) are monitored. **Trends in treatment data** indicate the effectiveness of the treatment and provide the researcher with guidance in determining the need for changes in intervention procedures.

Others

- Phase: A distinct stage/period of a target behavior (e.g., baseline phase, treatment/intervention phase, withdrawal phase).
- Withdrawal: Termination of the administration of an intervention or treatment.
- Probe: A thorough examination or investigation to the DV (i.e., the target behavior that you want to improve).

Purpose of Single-Subject/System Designs

- Use it to monitor and evaluate participants' responses to the interventions with which they address participants' target problems. The strategy is to intensively study one participant system at a time (Grinnell, 1993).

Characteristics of Single-Subject/System Designs

According to Kratochwill and Williams (1988), single-case experimental designs have following five characteristics:

1. The researcher repeatedly assesses the DV across various phases of the experiment. Data collected prior to, during, and following the intervention allow measurement of changes on the DV.
2. The researcher should have ability to measure variability on single or multiple dependent measures across time.
3. The researcher usually specifies in great detail the nature of the IV/DV, and the characteristics of the setting, therapist, and participant. Most of these variables are held constant during intervention phases so that functional relationships can be established between the IV and DV.
4. This kind of design can rule out major threats to internal validity through replication of the experimental effects.
5. When applying this kind of design, the researcher has some degree of flexibility to change the nature of the design as data are evaluated across time, or to combine design elements to better rule out various threats to internal validity.

Requirements for Single-Subject/System Designs

1. Operational definition of the target behavior must be clearly stated and measurable (Alberto & Troutman, 1990).

2. Outcome measures used to evaluate accomplishment of the objectives must be capable of producing quantitative data that are both valid and reliable.
3. Data must be displayed appropriately. The data obtained from studies conducted following single-system designs are almost always presented in a simple graphic format (Grinnell, 1993).

Two Major Types of Single-Subject/System Designs

Depending on the level of sophistication of the research design and the validity and reliability of the data collected under it, studies of participant systems based on single-subject/single-system designs can be used to answer two different types of questions (Grinnell, 1993):

1. Evaluative question: Did the participant system improve during the course of the intervention?
2. Experimental question: Did the participant system improve because of intervention?

According to Grinnell (1993), the above two types of questions form the basis for categorizing the designs into two major types. However, the following examples are mainly summarized from two books: (a) Alberto & Troutman (1990), and (b) Grinnell (1993).

Single-System Evaluative Designs

1. The B Design
 - In the B design, systematic assessment of the outcome measure(s) and implementation of the intervention begin simultaneously. Repeated measurements are taken while the treatment continues, and at the end of the treatment period the data are depicted on a simple graph. Visual inspection of this graph permits one to make inferences as to whether or not the participant's target problem has improved over the treatment period.
 - The B design indicates whether the level of the participant's target problem is changing in the desired direction.
2. The AB Design
 - The AB design requires a valid and reliable outcome measure that is amenable to repeated assessment. However, this design calls for assessing the participant system's target problem several times before the intervention begins.
 - There are two phases:
 - o In the baseline period (A Phase) fluctuations in the participant system's target problem are monitored but no attempt is made to effect any changes in the problem – only measuring the target problem.
 - o Interventions are carried out in the B Phase, which follows the baseline period.
3. The Changing Criterion Design
 - This design is used to evaluate a gradual and systematic increase or decrease in the client's performance level by changing the criterion for reinforcement in a stepwise fashion.

- This design, much like the AB design, also includes two phases. The intervention phase is divided into subphases. Each subphase requires a closer approximation of the terminal behavior than the previous one. The participant's performance thus moves gradually from the baseline level to the terminal objective.

Single-System Experimental Designs

- Such designs attempt to control for alternative hypotheses by demonstrating that there is more than one coincidence in which treatment began and then the participant system improved or in which treatment is discontinued and the participant deteriorated.
 - The purpose of doing studies based on this kind of design is to determine whether the researcher can appropriately draw the inference that the independent variable (IV) (i.e., the intervention) is the plausible cause of change in the dependent variable (DV) (i.e., the participant system's outcome).
 - This involves the concept of the internal validity of the design – the extent to which it can demonstrate that any changes in the DV would result from the IV and from no other plausible factors.
 - A variety of single-system designs can be used to answer the experimental question in practice and research: Did the participant system improve because of intervention?
1. The ABAB Design/The Withdrawal Design/The Reversal Design
 - This design involves the sequential application and withdrawal of an intervention to verify the intervention's effects on a target behavior. By repeatedly comparing baseline data to data collected after application of the intervention strategy, the researcher can determine whether a functional relationship exists between the DV and the IV.
 - A study using this design is conducted by first employing the evaluative AB design described above (a baseline period followed by an intervention phase) and then temporarily halting treatment for a second baseline period before the intervention is resumed. (In effect, the ABAB design represents two AB designs in succession.)
 - Such designs are only appropriate when the intervention employed has readily removable or temporary effects. Removing treatment interventions in this manner is ethically acceptable only if the participant will not be put at risk.
 2. The BAB Design
 - Sometimes it is not feasible to use a baseline period (A Phase) for ethical reasons; the participant's target problem may be too severe or dangerous to postpone an intervention. There may also be pragmatic reasons to avoid using a baseline period; a program to be evaluated may already be operating. In such cases, the BAB design is appropriate.
 - The BAB design records outcome measures repeatedly over time while an existing program in operation or treatment is being applied in the first B Phase (B₁). Then the existing program or treatment is temporarily removed, and records are kept of the outcome measures. In the B₂ Phase, the program or treatment is reinstated and the effects are again observed.

3. The BCBC Design (the Multiple-Component Design)
 - Used to compare the relative effectiveness of two different treatment interventions.
4. Multiple Baseline Designs
 - Outcomes across individuals
 - o Measures the effects of an intervention as it is applied to two or more participants with the same target problem.
 - Outcomes across settings
 - o Used to evaluate the effectiveness of a treatment intervention applied to a single client/student system's target problem in different environmental settings.
 - Outcomes across behaviors
 - o Used to evaluate the effectiveness of a similar treatment program when applied to various problems experienced by the same participant.

The Potential for Use of Single-Subject/System Designs

- Single-system designs provide a valuable means of evaluating both agency-based programs and the services provided to clients/students by counselors or educators.
- They can be used in the evaluation of virtually all types of practice models; for example, in working with families, students with special needs or challenges, small groups, communities, and organizations (Grinnell, 1993).
- A variety of single subject designs can be used to conduct research involving a low incidence population (Szymanski, 1993).

Activity for Single-Subject Designs

Consider the article by Holm, Santangelo, Fromuth, Brown, & Walter (2000).

1. What was the research design?
2. What was the research problem?
3. What were the variables (include operational definition, function, and scale of measurement)?
4. What were the results of the study?
5. What did the authors conclude based on these results?