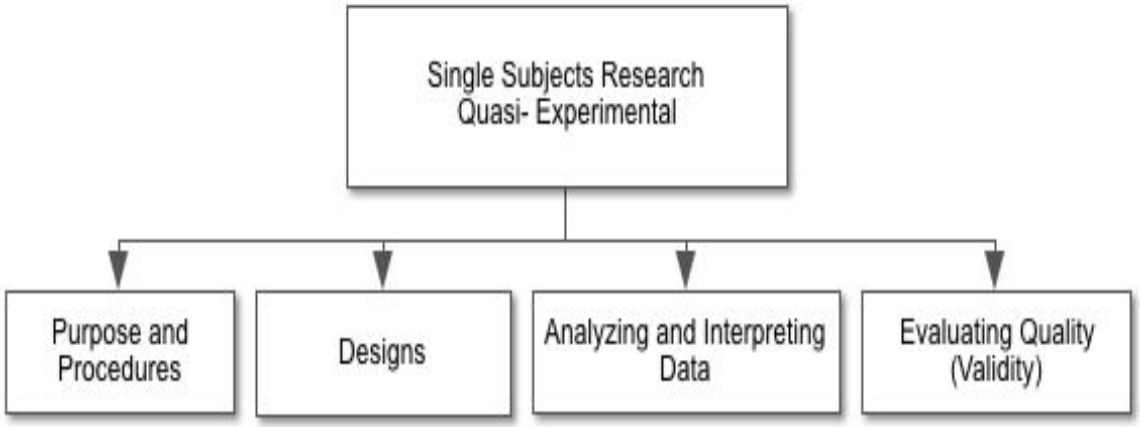
CHAPTER TEN

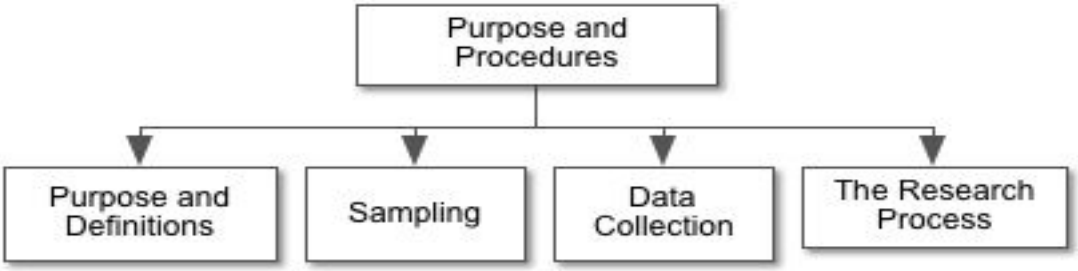
SINGLE-SUBJECTS (QUASI-EXPERIMENTAL) RESEARCH



Chapter Objectives:

- Understand the purpose of single subjects research and why it is quasi-experimental
- Understand sampling, data collection, and research procedures in single subjects research
- Understand single subjects designs
- Understand how data are collected analyzed, and reported in single subjects research
- Understand how single subject studies are evaluated for validity

Purpose and Procedures



Purpose and Definitions

Single-subjects research seeks to test a causal theory by analyzing a behavior and providing a treatment to improve it. In so doing, it identifies "evidence-based practice"' for use in special education, school psychology, and applied behavioral analysis. Single subjects research is practical, cost-effective research that focuses on Individuals and on outcomes that have social importance.

> The field of applied behavior analysis stresses the study of socially important behavior that can be readily observed, and it uses research designs that demonstrate functional control usually at the level of the individual performer. The procedures developed by this field must be replicable, and the extent of the resulting behavior change must have important practical significance for the social community" (Bailey & Burch, 2002, p. 17).

The terms that are used in single subjects research are target behavior, intervention, and baseline. Each is defined below.

- *Target behavior* is the outcome that is measured; it is the dependent variable
- *Intervention* is the specific research-baaed treatment that is expected to produce a positive change in the target behavior; it is the independent variable.
- *Baseline* is the measurement of the dependent variable before the intervention begins and at points when the treatment is withdrawn.

Sampling

Most single-subjects studies are conducted with children who are on the Asperger's / Autism continuum or who have behavioral disorders. Because of the limited target population from which subjects are drawn, the sample is not is not selected through random sampling. In addition, because there is only one subject assigned to each treatment condition it is not possible to use random assignment to the treatment condition. This marks single-subjects research as being quasi-experimental research. While the focus of the research is individuals, there may be as many of nine subjects in a study. While each subject is administered the same treatment (IV), each may have a different targeted behavioral outcome (DV).

Data Collection

Each dependent variable is operationally defined and measured repeatedly over time with a valid observational protocol that achieves and is

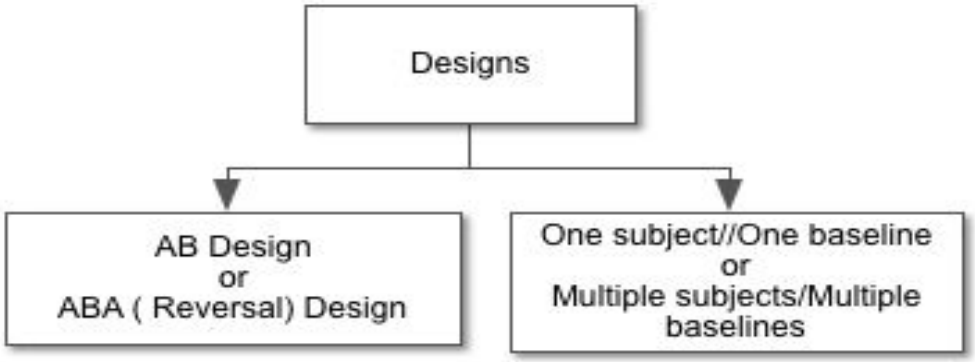
monitored for reliability through inter-observer agreement. Single-subjects research is very similar to quasi-experimental repeated measure designs, the difference being that the treatments and measures are administered to single subjects rather than to a group of subjects. Each subject receives the same intervention; the dependent variable is measured differently for each subject; and results are reported separately for each subject. A distinctive feature of the dependent variable in single-subjects research is that it should have value and importance.

Treatment Procedures

Single-subjects research designs follow a set of procedures as follows:

1. Completion of a research review that identifies a theory-based or empirically validated treatment that serves as the independent variable
2. Identification and operational definition of a target behavior for each subject that serves as the dependent variable
3. Development or selection of a valid and reliable measure (an observational protocol) for collecting data on the DV for each subject.
4. Collection of multiple measurements at baseline
5. Introduction of the treatment to each subject and multiple measurements of the DV after treatment
6. Ongoing monitoring of inter-observer agreement during the experiment
7. Consistent recording and graphing of data on the DV for each observation of each subject.
8. Visual examination of data for each subject

Single-subjects Designs



Designs are identified by the sequence and frequency of measurements in which baseline observations are labeled 'A,' and observations taken after the intervention is introduced are labeled 'B.' In cases where other interventions are added, the intervention is labeled as C, D, etc.

- *AB Design* follows this sequence:

  A: multiple baseline observations of the DV before the intervention is introduced

  B: multiple observations of the DV after the intervention is introduced

- *ABA Design* follows this sequence:

  A: multiple baseline observations of the DV before the intervention is introduced

  B: multiple observations of the DV after the intervention is introduced

  [Withdrawal of the intervention]

A: multiple baseline observations of the DV after the intervention is withdrawn

B: multiple observations of the DV after the intervention is re-introduced

A: observation of the DV at *maintenance*, defined as at least two weeks after the experiment has ended.

Designs are also identified by the number of subjects, no more than three, and the number of baselines involved.

- *One Subject / Single Baseline* design introduces the intervention to one subject at one time.
- *Multiple Subjects / Multiple Baseline* design introduces the intervention to different subjects at different times.

Below, are a visual representation, discussion, and example of two designs: AB/One-Subject and ABAB/Multiple-Subjects

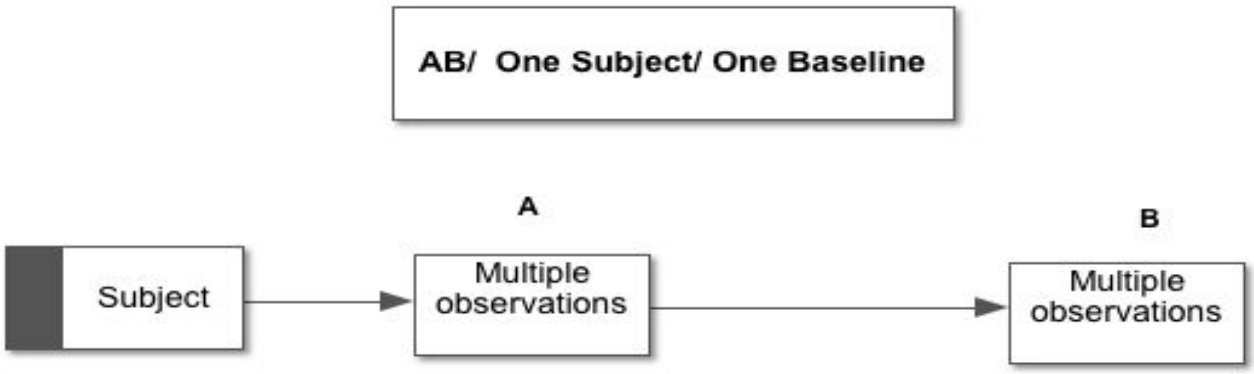


Figure 10. AB / One-subject / one baseline

Example

In the Foxx and Meindi (2007) study, “The Long-term Successful Treatment of Aggressive/Disruptive Behaviors of a Preadolescent with Autism,” the focus of this investigation was Johnny, a thirteen, year-old boy with autism who had exhibited aggressive and destructive behaviors that had not responded to previous treatments. Multiple staff members conducted the first observations (A) of Johnny in his self-contained classroom at a school for children with special needs. This initial observation, which established the baseline, occurred over the course of one school day that was divided into five-minute segments.

After that, a detailed intervention (B) was developed that consisted of “a token economy system, differential reinforcement of other behaviors (DRO), response cost, over-correction, and physical restraint. A number of classroom rules such as ‘No loud talking’ were also created” (p. 88-89). The researchers obtained parental permission for the treatments, which continued for eight months. The intervention phase “was characterized with response costs for negative behaviors and reinforcement of positive behaviors” (p. 90) and consisted of rewarding Johnny with five tokens for each five-minute segment in which he exhibited no negative behaviors. Negative behaviors resulted in having the tokens taken away.

The standard display of data in these studies is a graph of the frequency of incidents during all three phases, baseline, intervention, and post-intervention as represented below.

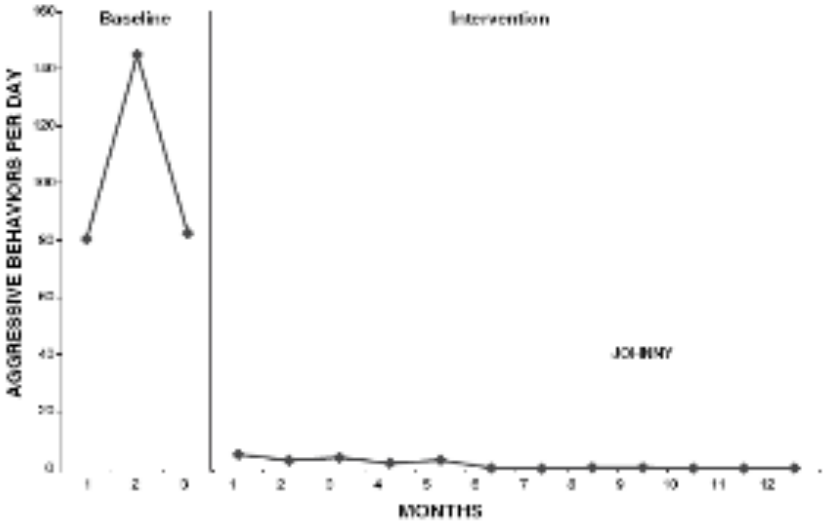


Figure 1. The mean daily number of aggressive/destructive behaviors during baseline, and treatment of Johnny, a 13-year-old-boy with autism.

As a result of this treatment protocol, Johnny's negative behaviors, graphed at the baseline were reduced to near zero at intervention points, and this result was maintained for over a year.

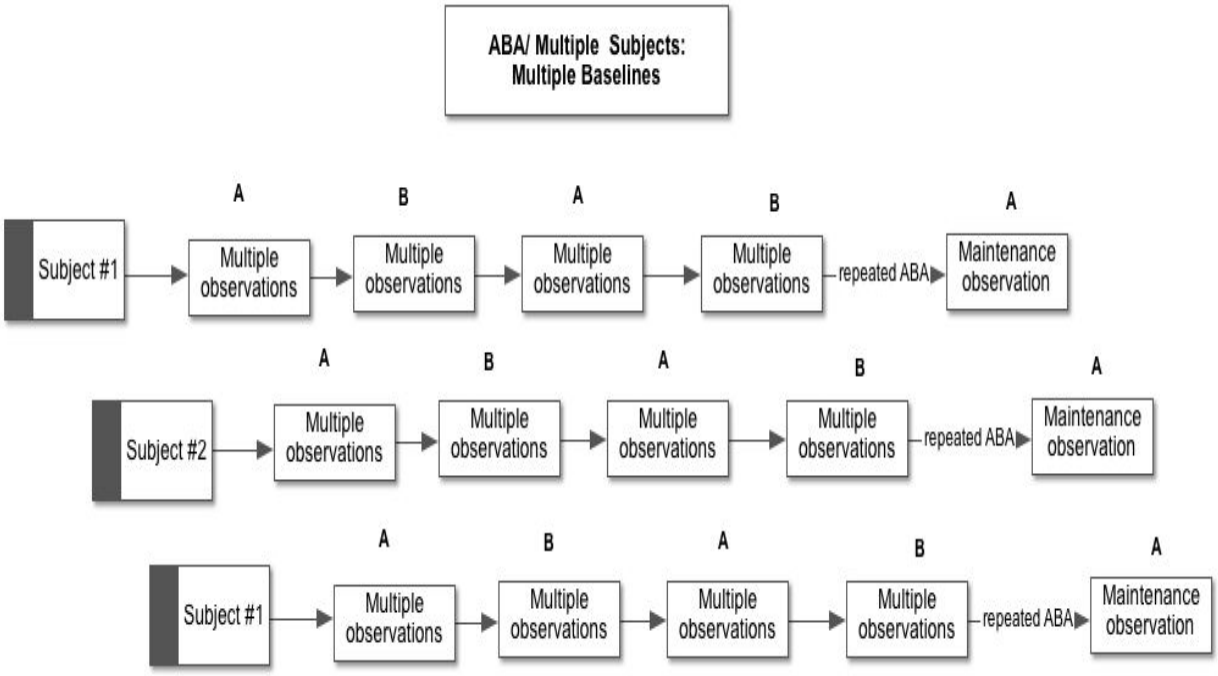


Figure 11. ABA/ Multiple Subject /Multiple Baselines

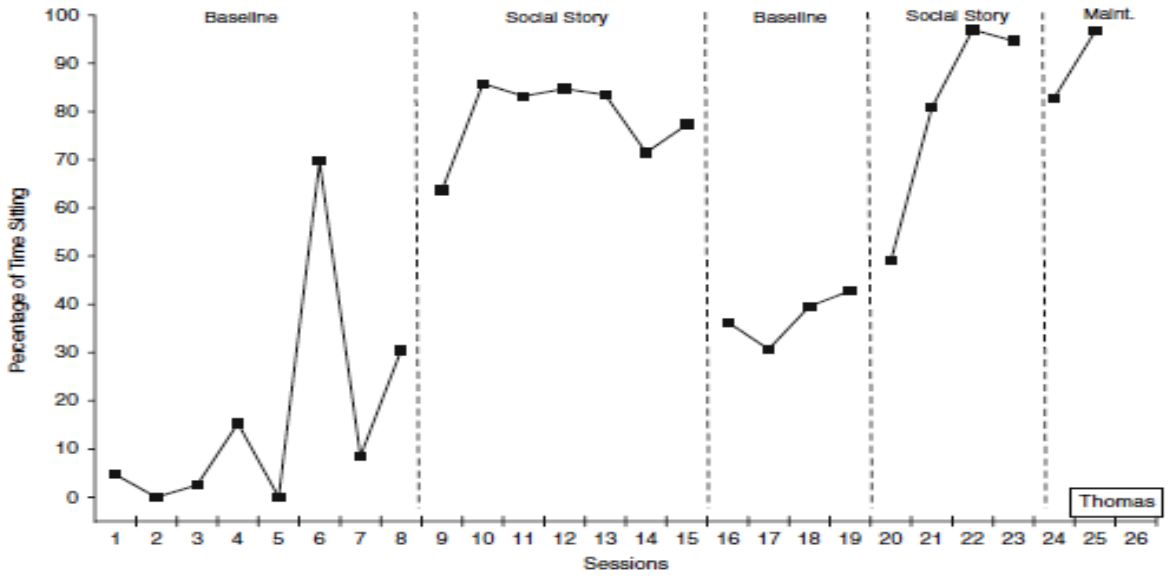
Example

Crozier and Tincani (2006) studied three subjects who experienced the same intervention and tested the hypothesis that *social stories* would improve their target behaviors. Social stories are short stories that are specifically written about an expected behavior for a specific activity. The subjects were three children on the Autism Spectrum who attend the same inclusive preschool program. The three children were all between 3 and 5 years old, and each an identified target behavior. Thomas's social story depicted his target behavior, to sit still for ten minutes during circle time; Daniel's social story described his target behavior, to talk with his peers during snack time; and James's social

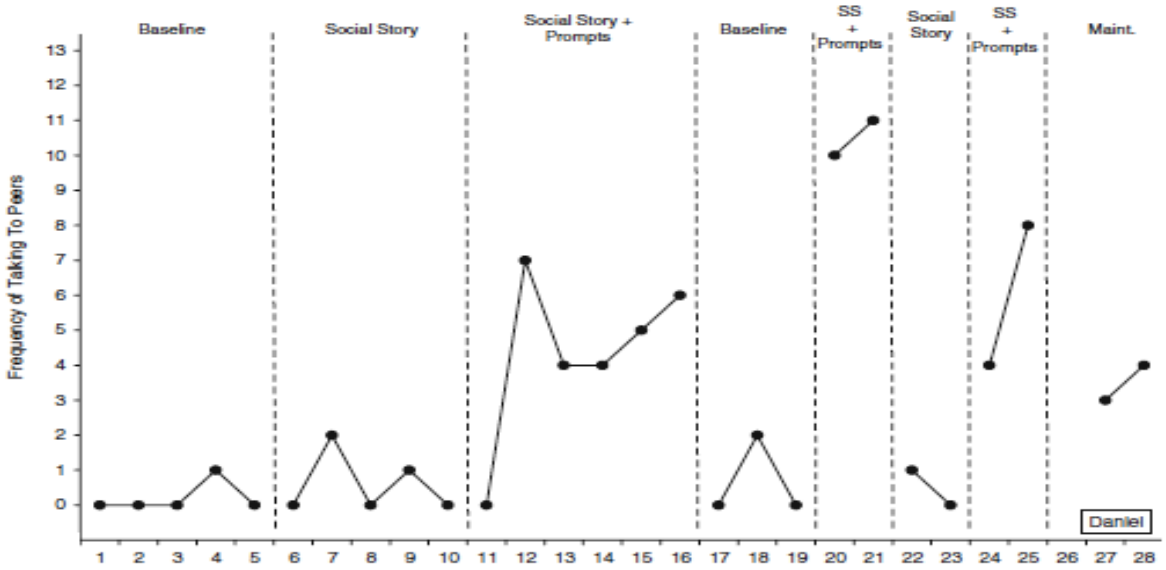
story was written to help him understand how to play appropriately in the block area.

The researchers wrote stories for each child that described the child by name and portrayed him as demonstrating the desired behavior in a school activity. The original design was an ABAB design, which meant the researcher would observe, intervene and observe, and observe, etc. Thomas and James responded to the original design, but Daniel did not. The researchers added a second intervention for Daniel, making his an ABCABC design. At the end of the experiment, the researchers saw an increase in appropriate behaviors and a decrease in inappropriate behaviors for each subject. The researchers displayed their data for each subject in the following charts(Crozier and Tincani, 2006, pp. 1809-1810)

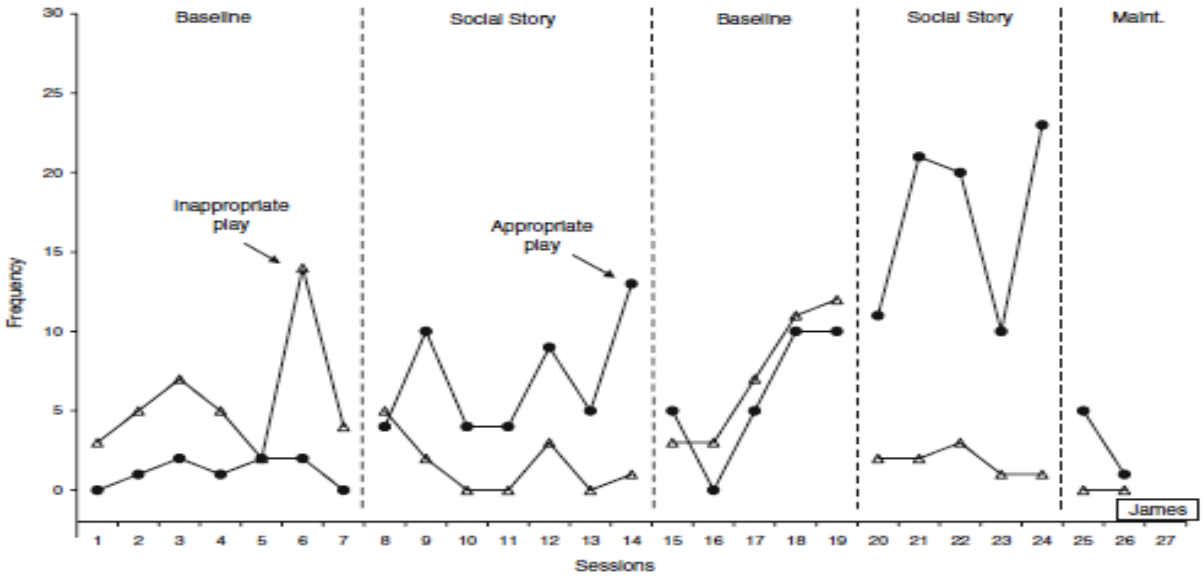
Data Display for Thomas: Percentage of Time Siting During Circle Time



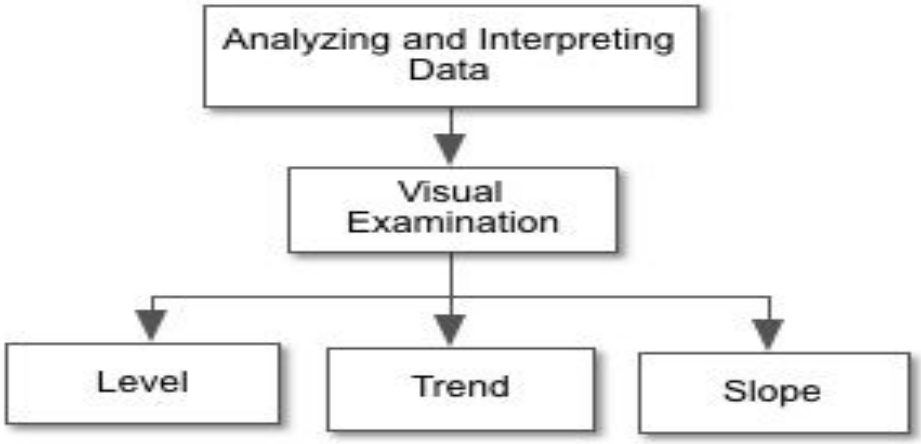
Data Display for Daniel: Frequency of Talking with Peers at Snack



Data Display for James: Frequency of Appropriate Play in Block Area



Analyzing and Interpreting Data



Although there have been recent attempts to apply statistical analysis to single subjects research, most studies rely exclusively on visual examination of

graphed data to make inferences about the effect of the IV on the DV. Measurements taken at baseline serve as the measurement of the control condition; measurements taken during treatment serve as the measurement of the treatment condition. In this way, the study is a pre-test/post test/ control design in which subjects experience both the treatment and control conditions.

Analysis occurs through *visual examination* of the graphed data.

- *Visual examination* "allows viewers to see regression or progression in behavior, assess setting events, and draw a conclusion from the interventions on whether or not they are applicable to the individual" (McCormick, 1995, p.18).

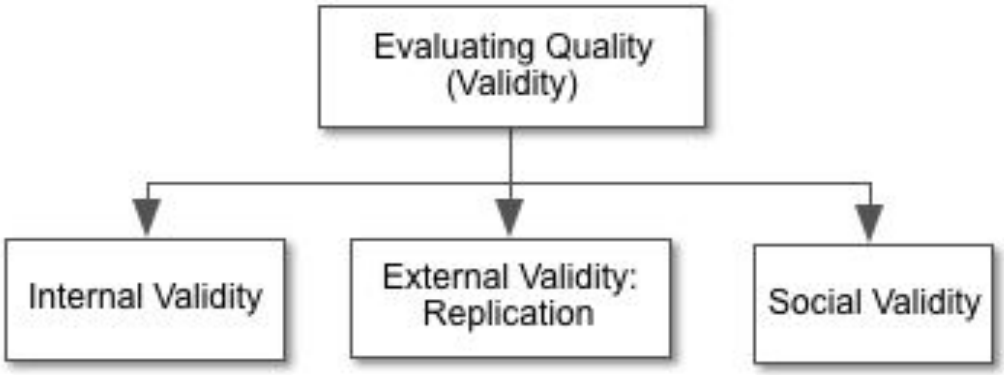
Regression or progression is analyzed in terms of level, trend, and slope.

- *Level* is the value of the dependent variable at different points of the experiment. It recommended that the researcher collect data at a minimum of three data points during treatment phases to establish changes in level.
- *Trend* is the direction of change in patterns of data. A positive trend line provides evidence of effective treatment.
- *Slope* is the gradient or steepness of the line drawn between two data points. A pronounced slope provides evidence of the magnitude of the effect.

The underlying assumption of single subjects research is that the levels of measurements taken at baseline and during treatment would be the same if the treatment had not been effective. Conversely if the levels are different at baseline

and at least three points of treatment and show a positive trend, then the researcher could conclude that the IV caused a change in the DV. In order to draw conclusions about the magnitude of the effect, the researcher would examine the slope of the line of best fit. Because this analysis depends so much on the interpretation of the researcher conducting the study, a peer review of the visual examination is highly recommended.

Evaluating Quality (Validity) of Single Subjects Research



- *Internal validity* in single subjects research is the degree to which the experiment demonstrates that change in a targeted behavior is due to the treatment. It answers the question: did the intervention worked**?**
- *External validity* in single subjects research is the degree to which the methodology of the study can be applied to other subjects and settings; this is known as *replication.*
    - *Replication* occurs when the effects of an intervention are reproduced "across participants, conditions, and /or different measures" (Horner, Carr, e t al, 2005). This allows practitioners

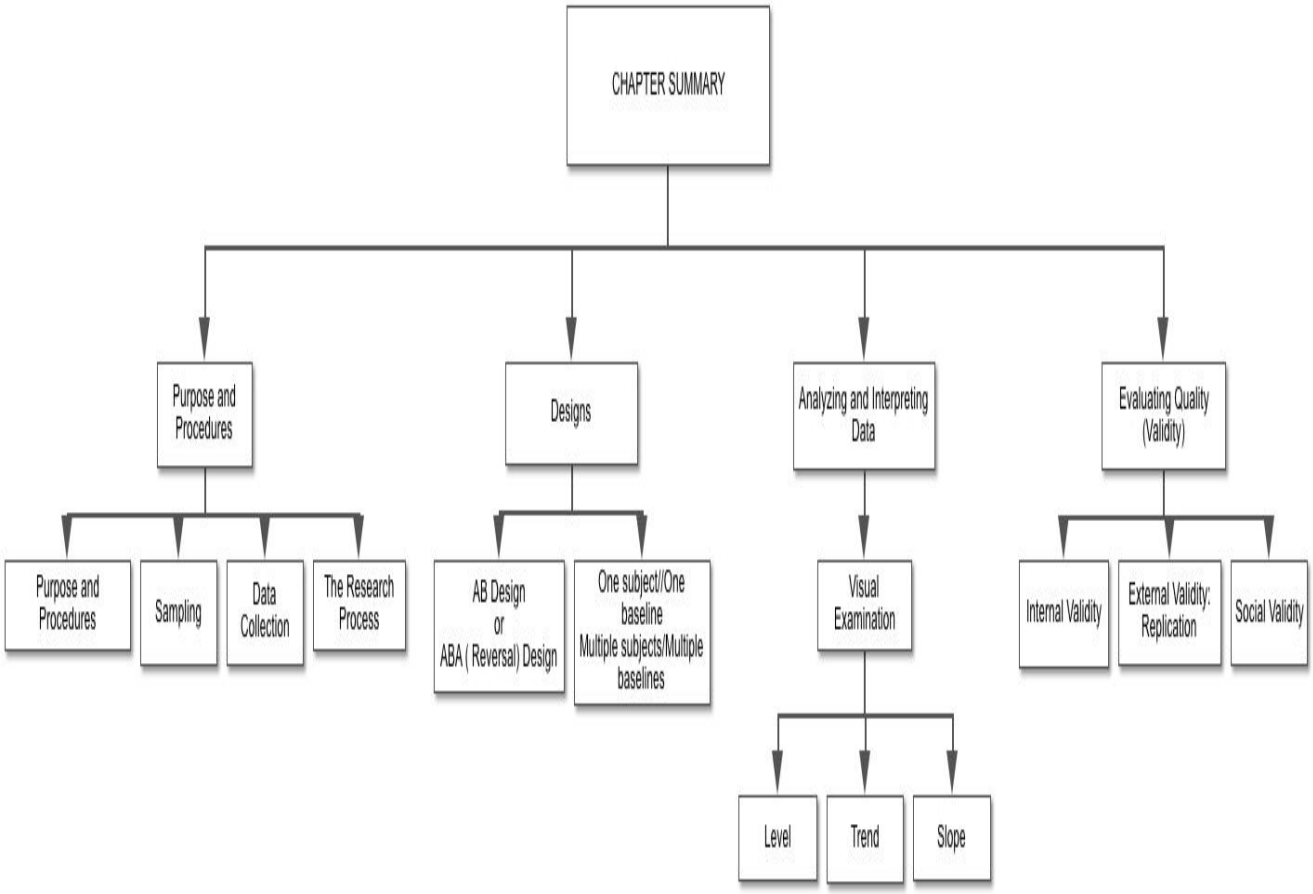
to adopt interventions that have been found to be effective with multiple subjects and in multiple settings.

- *Social validity* is the perceived importance of the target behavior for the participant, for those who know and interact with the participant, and for society in general. It is usually assessed with a survey or interview after the study has ended.

The table below summarizes the criteria for rating the three types of validity in terms of treatment, sampling, and measurement.

	Internal validity	**Replicability (External Validity)**	**Social Validity**
Treatment	An intervention (IV) that is supported by an extensive research review and actively manipulated by researcher	Precise & replicable description of the intervention and manipulation of the IV	Practicality: the degree to which the intervention can be embedded in non-experimental conditions
Sample	Detailed description of subject characteristics and background	Precise description of subjects and of the setting	Appropriateness of subjects for treatment & target behavior. Experimenter effect?
Measure	Valid and reliable measurement of target behavior (observational protocol) Description of baseline conditions, repeated baseline measurements, and changes in target behavior at three or more baseline points in time Consistent recording and graphing of data and peer review of visual examination	Precise & replicable description of the observational protocol and methods for monitoring inter- observer agreement	Valid and reliable measurement of a socially important outcome Use of a social validity assessment

Table 1. Evaluating Validity of Single Subjects Research



- Single subjects research is quasi-experimental research that aims to establish the effects of an intervention on an individual subject; it is a repeated measures design applied to individual rather than to groups
- Single subjects research uses small convenience samples (n= 1 to 9) and cannot randomly assign subjects to the treatment condition.
- He most common single subjects designs are AB and ABA (reversal)
- Single subjects designs may be one subject / one baseline or multiple subjects/multiple baselines.

- Single subjects studies use graphs to show changes in the DV and depend on visual examination rather than statistical analysis to make inference.
- Visual examination involves looking at level, trend, and slope.
- Validity is determined by internal validity, external validity: replication, and social validity.

Terms and Concepts

single subjects research	repeated measures
single subjects/single baseline	multiple subjects/multiple baselines
AB	ABA
level	trend
slope	internal validity
external validity	replication
social validity	

Review, Consolidation, and Extension of Knowledge

1. In your own words, describe the purpose of single subjects research and why it is quasi-experimental.
2. Why is single subjects research also called ABA research?
3. Why are threats of mortality, testing, and history controlled in single subjects research? Why are they more susceptible to threats of maturation, and regression ?

4.

Using an electronic database, search for a single subjects study. Read the article and answer the questions in the Guide below.

5.

Using the Guide as a template, write a critique of about 750 words of the single subjects study you selected. See the Appendix for an exemplar.

Guide to Reading and Critiquing a Single Subjects Study

Research Review / Theory and Purpose:

Does the review establish a theory-based treatment for the identified target behavior?

What is the purpose of the study?

Design:

What is the design employed in the study?

What is target behavior (DV)?

What is the theory-based treatment that is being applied (IV)? Describe the treatment in detail

Sampling:

How is the sample selected?

Who is in the sample? What are the characteristics of the sample?

What is the sample size?

Data Collection:

How are observations conducted?

Are the observational protocols vetted for inter-relater reliability?

Is the treatment validated for fidelity?

When and how often do observations (A) and treatment (B) occur?

When and under what conditions did maintenance occur?

Data Analysis and Results:

How are data displayed and analyzed?

What conclusion does the researcher draw?

Evaluation of Quality (Validity)

How do you evaluate internal validity?

How does the researcher address issues of external validity/ replication?