Characteristics of SCEDs

- N = 1, but...
- Time series data
- Intervention-focused
- Experimental
- Controlled

Design Types: AB Design

Design Types: ABA Design

Design Types: ABAB Design
Design Types: Multiple Baseline Design

Design Types: Alternating Treatments Design

Design Types: Adapted Alternating Treatments Design

Arbitrary Logographs

Design Types: Parallel Treatments Design
Role of Single-Subject Research Designs for Evidence-based Practice

- Examining pre-versus treatment performance within a small sample (Kennedy, 2005)
- Experimental approach to reveal causal relationships between IV and DV
- Emphasis required on reliable measurement, within- and between-subject comparisons, to control for unique threats to internal validity
- Requires systematic replication to enhance external validity
- Basis for determining treatment efficacy, used to establish EBP (Horner et al., 2005)

Role of Single-Subject Research Designs for EBP (cont.)

- Take a close look at several important features of this methodology
- Quality indicators that may be used to assess if an individual study is an acceptable example of single-subject research (Horner et al., 2005)
- What Works Clearinghouse standards (Kratochwill et al., 2010)
- Reporting standards (Tate et al., 2016)

The Individual Participant is the Unit of Analysis

- SCEDs may involve only one participant, but typically include multiple participants (3 to 8) in a single study
- Each participant serves as his or her own control
- Performance prior to intervention is compared to performance during and/or after intervention

Participant and Setting Description

- SCEDs require operational descriptions of the participants, setting, and the process by which participants were selected
- Another researcher should be able to use the description of participants and setting to recruit similar participants who inhabit similar settings

An Adapted and Abbreviated Hierarchy of Evidence for Low-Incidence Populations

1. Meta-analysis of (a) single-subject experimental designs, (b) non RCTs
2a. One well-designed non RCT
2b. One single-subject experimental design - one intervention
2c. One single-subject experimental designs - multiple interventions
3. Pre-experimental group designs and single-case studies
4. Respecable opinion

(adapted from Schlosser & Raghavendra, 2004)

Dependent Variable

- Dependent variables (DVs) are operationally defined to allow:
  - valid and consistent assessment of the variable
  - replication of the assessment process
- DVs are measured repeatedly to allow:
  - identification of performance patterns prior to intervention
  - comparison of performance patterns across conditions/phases
- DVs recording is assessed for consistency
- DVs are selected for their social significance

Independent Variable

- The independent variable (IV) typically includes:
  - practice,
  - intervention, or
  - behavioral mechanism under investigation
- IVs are operationally defined to allow both valid interpretation of results and accurate replication of the procedures.
- Specific descriptions of procedures typically include:
  - documentation of materials,
  - documentation of actions

Independent Variable (cont.)

- The treatment integrity of the independent variable is documented in SCED research.
- Treatment integrity is a significant concern within SCEDs because the IV is applied over time.
- As a result, documentation of adequate implementation fidelity is expected, ideally through continuous direct measurement of the IV.
- Distinguish reporting treatment fidelity from "reliability" thereof

Independent Variable (cont.)

- Treatment fidelity affects (a) internal validity; (b) construct validity, and (c) external validity.

Baseline/Comparison Condition

- Measurement of the DV during baseline should occur until the observed pattern of responding is sufficiently consistent to allow prediction of future responding.
- Documentation of a predictable pattern during baseline typically requires multiple data points (≥5) without substantive trend, or with a trend in the direction opposite that predicted by the intervention.
Experimental Control

- In most cases experimental control is demonstrated when...
- Documentation of experimental control is achieved through:
  - the introduction and withdrawal of the independent variable
  - the staggered introduction of the independent variable at different points in time
  - the iterative manipulation of the independent variable across observation periods

External Validity

- External validity of results from SCED research is enhanced through replication of the effects
  - across different participants,
  - different conditions,
  - and/or different measures of the dependent variable.
- Selection and attrition bias can be a threat to external validity

Social Validity

- The social validity of SCED research is assisted by a conceptual framework involving:
  - Who (direct, indirect, immediate community, extended community stakeholders)
  - What (goals, methods, outcomes)
  - How (subjective evaluation, social comparison)

Design Strategies for Assessing Generalization

• Single-generalization probes
  • Post-treatment
  • Pre- and post-treatment

• Multiple generalization probes
  • Post-treatment
  • Pre- and post-treatment
  • Pre- and within-treatment
  • Pre-, within- and post-treatment

• Continuous generalization probes
  • Across regular (a) phase lengths, or (b) intervals
  • Across irregular (a) phase lengths, or (b) intervals

Table 3 in Schlosser & Braun (1994)
Planning and Appraising Comparative SCEDs

- Choose an appropriate design
- Learning or teaching criterion?
- Creating equivalent sets
- Keeping procedures consistent except IV
- Use the Comparative Single-Subject Experimental Design Appraisal Rating System (CSSEDARS) (Schlosser, Sigafoos, & Belfiore, 2014)

Planning and Appraising Comparative SCEDs

- Table 3 in Schlosser & Braun (1994)

Continuous Generalization Probes

<table>
<thead>
<tr>
<th>Types of AAD Generalization Assessment Possible via Multiple-Baseline Designs</th>
<th>Setting Generalization</th>
<th>Subject Generalization</th>
<th>Communicative Partner</th>
<th>Experimenter</th>
<th>Response Generalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Baseline Across Settings</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Setting</td>
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</tr>
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<td>+</td>
</tr>
<tr>
<td>Experimenter</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

This factor is being used to demonstrate experimental control. Thus, it cannot be used as a dimension across which generalization occurs.

Planning and Appraising Comparative SCEDs

- Use the Comparative Single-Subject Experimental Design Appraisal Rating System (CSSEDARS) (Schlosser, Sigafoos, & Belfiore, 2014)

Planning and Appraising Comparative SCEDs

- Baselines are provided for each of the compared conditions.
- Documentation: p __

Rationale:

Mark N/A if the design does not require a baseline or (b) if the design does not utilize multiple sets, e.g., as is the case with an ATO rather than an AATDS.
Mark yes if there are baselines for each of the treatments that are being compared (e.g., if two treatments are compared and each is assigned to a different instructional set, there should a baseline for each set).
Mark no (a) if the design requires a baseline (e.g., a PTD) but not all compared conditions have a baseline or (b) if the design does not require a baseline, but a baseline is provided anyways (e.g., AATDS) but not for all conditions.
Planning and Appraising Comparative SCEDs

Identification of “Evidence-based Practices” from SCEDs (Horner et al., 2005)

- SSED research documents a practice as evidence based when
  - The practice is operationally defined
  - The context and outcomes associated with a practice are clearly defined
  - The practice is implemented with documented fidelity
  - The practice is functionally related to change in valued outcomes
  - Experimental controls demonstrated across a sufficient range of studies, researchers, and participants to allow confidence in the effect

Identification of Evidence-based Practices (cont.)

- Standard for evidence-based practice:
  - A minimum of five single-subject studies that meet minimally acceptable methodological criteria and document experimental control have been published in peer-reviewed journals
  - The studies are conducted at least three different geographical locations
  - The five or more studies include a total of at least 20 participants

WHAT WORKS CLEARINGHOUSE (WWC) SINGLE CASE DESIGN STANDARDS


WWC Standards: Intro

- Supported by US Dept. of Education, Institute of Education Science
- Contains (1) Design Standards, and (2) Evidence of Effect Standards
- Studies need to meet Design Standards first, then evaluation via visual analysis using Evidence of Effect Standards
- Rating of the strength of effects on a 3-point scale:
  - 1. Strong Evidence of a Causal Relation
  - 2. Moderate Evidence of a Causal Relation
  - 3. No Evidence of a Causal Relation

This is how its done

ible or to manipulate an object or a toy. Approximately 10 reinforcing objects were identified for each child. These objects included food, toys, and activities (e.g., playing with a toy 'r' bar or a Barney stuffed animal). For each child, the reinforcing objects were randomly divided into two groups of equally desired objects and activities. One group of reinforcing was randomly chosen for use with the VOCA intervention and the other with the PREC intervention.

To Meet Evidence Standards:

- The independent variable must be systematically manipulated.
- Each dependent variable must be measured systematically over time by more than one observer; interobserver agreement must be calculated in each phase and on at least 20% of data points in each condition, and meet minimal thresholds.
- The study must include at least three attempts to demonstrate an intervention effect.
- An attempt must have a minimum of three data points to demonstrate an effect.

### Demonstration of Intervention Effects

<table>
<thead>
<tr>
<th>Demonstration of Evidence Level</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong evidence</td>
<td>A minimum of 3 demonstrations of the intervention effects; no non-effects by documenting the consistency of level, trend, and variability within each phase; no non-effects by documenting the immediacy of the effect; the proportion of overlap the consistency of the data across phases; no non-effects by examining residual factors and covariates.</td>
</tr>
<tr>
<td>Moderate evidence</td>
<td>A minimum of 3 demonstrations of the intervention effects; no non-effects by documenting the consistency of level, trend, and variability within each phase; no non-effects by examining the overlap of the intervention phases.</td>
</tr>
<tr>
<td>No evidence</td>
<td>Less than 3 demonstrations of the intervention effects.</td>
</tr>
</tbody>
</table>

### Special Notes for Multiple Baseline Designs

- **Strong evidence:**
  - The time in which a basic effect is initially demonstrated with one series (e.g., first 5 days in intervention for participant #1) is associated with change in the data pattern over the same timeframe in the other series of the design (e.g., first 5 days in intervention for participants #2, #3, #4).

- **Moderate evidence:**
  - A basic effect in one series and a change in another series.

### Identification of a Non-Effect

1. Baseline data do not provide a clearly defined pattern of responding for prediction.
2. Failure to establish a consistent pattern within any phase.
3. Long latency between introduction of the independent variable and change in the dependent variable.
4. Overlap between patterns of the dependent variable between baseline and intervention phases.
5. Inconsistent patterns across similar phases.
6. Comparing patterns of the dependent variables between phases does not demonstrate evidence of a causal relation.

### Visual Analysis – 4 Steps

- **First step** – documentation of a predictable baseline pattern of data.
- **Second step** – assessing within-phase pattern(s).
- **Third step** – comparing the data from each phase with the data in the adjacent phase to assess the effects of manipulating the independent variable.
- **Fourth step** – integrating information to determine a minimum of three demonstrations of an effect.
Visual Analysis – 6 Variables

1. Level
2. Trend
3. Variability
4. Immediacy of the effect
5. Overlap
6. Consistency of data patterns across similar phases

Within-Phase Analysis

- **Level** – mean score for the data within a phase
- **Trend** – slope of the best-fitting straight line for the data within a phase
- **Variability** – range or standard deviation of data about the best-fitting straight line

Purpose of within-phase analysis:
- To describe the observed patterns of a unit’s performance
- To predict performance over time

Between-Phase Analysis

- **Immediacy of the effect** – change in level between the last 3 data points in one phase and the first 3 data points of the next (the more rapid, the better)
- **Overlap** – proportion of data from one phase that overlaps with data from the previous phase (the smaller, the better)
- **Consistency of data patterns across similar phases** – consistency in the data patterns from phases with the same conditions, e.g., all baseline phases (the greater, the better)

Further Reading

Overview on critical appraisal and standards for single-subject experimental designs: