Single-Case Experimental Designs (SCEDs)

- AKA: N of 1 randomized controlled trials
- Intra-subject replication designs
- Single-subject designs
- Intensive designs

used for many decades in psychological, educational, and rehabilitation research

Group designs vs. SCED

<table>
<thead>
<tr>
<th>Group designs</th>
<th>Single case designs</th>
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<td>generalize from sample to population</td>
<td>generalize from one individual to another similar individual</td>
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Advantages of SCEDs

- useful with small numbers of subjects
- emphasize recognizable clinical change
- flexible under a variety of conditions
- provide data for evidence based practice
- focus on the individual patient and his or her specific behaviors
Advantages (continued)

λ. Provide a detailed description of the process necessary to effect significant change
λ. Useful when investigating the effectiveness of alternative treatments without having to resort to control groups

Data Collection

λ. Individually defined behaviors and their reliable measurement
λ. Behavior characteristics are related directly to the question being asked or the problem to be solved (e.g. frequency, latency, intensity, duration)

Dependent and Independent Variables

λ. Dependent variable: some characteristic, behavior, or symptom of an individual
λ. Independent variable: the application of an intervention

Experimental Controls

λ. Individuals are their own controls
λ. Replication across subjects, settings, or behaviors strengthens experimental control and demonstrates intervention effects.
SCEDs are response guided

Decisions about intervention may change on the basis of the measurement of a targeted behavior or characteristic.

Misconceptions about SCEDs:

1. Only one subject is used in each study. (Most use multiple subjects to emphasize the strength of replicability in producing valid and generalizable results)
2. SCEDs cannot reveal causal relationships between variables

Conditions needed to infer causal relationships from SCEDs

1. There must be a logical relationship between the variables
2. Only one independent variable at a time should be changed
3. A change must be observed between the baseline phase (when there is no intervention) and the intervention phase

To maximize interpretability of results:

1. Behaviors must be clearly specified and observable
2. Conditions within an experiment should be clearly defined and standardized
3. Frequent measurements should be obtained to ensure a representative sampling of outcomes
4. Multiple measurement methods should be used to increase the validity of the results
5. Other sources of extreme variability in behaviors (e.g., cyclical changes) must be considered
Data Analysis

λ Visual analyses of graphed data is most common
  Y ordinate value - the level of the behavior;
  Y slope - how rapidly a behavior increases or decreases;
  Y trend - the direction of change;
  Y variability - the magnitude of changes from one session to the next.

Data analysis

λ Statistical analysis
  Y Helpful when there is excessive variability, limited change in level, slope, or trend, carryover, or overlap between conditions.
  Y May provide information about whether the changes from baseline to intervention, or differences between interventions, were reliable.

Data Analysis

λ Social Validity:
  Y what others think of a behavioral change or of the intervention used to achieve the change e.g. side effects of an intervention

DESIGN TYPES

λ AB Design
λ Withdrawal Design - ABA
λ Multiple Baseline Design
λ Changing Criterion Design
λ Multiple Probe Design
λ Crossover Design or Multi-Treatment Design
λ Alternating Treatments Design
AB Design

λ. A - baseline phase, time interval in which environmental conditions are constant and the behavior of interest is observed to occur at a stable rate.
λ. B - intervention phase, time interval in which the environmental conditions change and an associated change in behavior is observed.
λ. The logical inference - the environmental condition has influenced the change in behavior.

AB Design

λ. Strengths of design:
- Simple.
- Causal relationship can be inferred if:
  - Target behavior is clearly specified
  - Measurement and assessment are objective
  - Pre-intervention stability
  - Continuous and repeated measurement
  - Marked change in trend from baseline to intervention phases
  - Replication across several individuals.

AB Design

λ. Weaknesses of design
- In most cases, does not control for many extraneous variables, e.g., maturation, history, testing, instability, selection, selection-maturation interaction
- Often considered quasi-experimental or a "pre-experimental design."

AB Design- Effect of intervention on duration of tantrums?
Withdrawal Design- ABA

λ. Three-phase
   Y A-baseline interval (no-intervention)
   Y B- introduction of an intervention condition
   Y A- return to baseline by withdrawing the intervention condition.
λ. Requires repeated measures on at least one behavior, other behaviors may be measured to analyze other effects of treatment
λ. Often adapted to ABAB for ethical reasons

Withdrawal Design- ABA

λ. Strengths
   Y Repeated definitive changes between baseline and intervention phases are unlikely to occur by chance (e.g. because of a child’s development, an event that occurred during one of the phases, or a change in the child’s performance to match his or her “true” performance, etc.)

Withdrawal Design- ABA

λ. Weakness
   Y Sequential confounding
   Y Carryover effects
   Y Limited to reversible interventions

ABAB Design- 2 subjects
Multiple Baseline Design

- The basic AB format that is time-lagged
- Experimental control - demonstrated when the intervention results in a behavioral change and concurrent baselines, or baselines introduced at staggered times, remain stable until the subsequent implementation of the intervention.

When evaluating

- Participants’ behaviors - participants should be matched, behaviors being measured and settings should be the same
- Effect of an intervention on different behaviors - behaviors should be compared within a participant, with consistent setting
- Different settings - only one behavioral change should be implemented for one participant

Multiple Baseline Design

- Concurrent baselines:
  - Monitored from the first day to the conclusion of the experiment.
- Time-staggered baselines:
  - Monitored before the intervention is introduced to the conclusion of the experiment.
- Intervention effects are evaluated through replication across participants, treatment conditions, or target behaviors

Multiple Baseline Design

- Strengths:
  - Useful for evaluating situations in which an intervention leads to enduring change
  - Allows several concurrent target behaviors to be simultaneously measured.
Multiple Baseline Design

\* Weaknesses:

\* If behaviors, settings, or subjects are interdependent, behavioral changes may occur before the implementation of the intervention and effects of the intervention may be difficult to interpret.

\* Ethical or clinical problems if baselines are prolonged while awaiting implementation of the intervention.

Changing Criterion Design

\* Similar to a multiple baseline design but focuses on a single behavior that is changed incrementally throughout intervention.

\* Experimental control is demonstrated by a consistent shift in the rate of the target behavior with each successive change in criterion.

\* Theoretically, each achieved criterion of a behavior functions as the baseline for the next targeted criterion of the behavior.

Multiple Baseline- 2 subjects

Changing Criterion Design

\* Strengths

\* Useful when a target behavior cannot be reversed or an intervention cannot be withdrawn

\* Does not require measurement of multiple behaviors, settings, or subjects

\* Particularly suitable to demonstrate the effectiveness of interventions for shaping behaviors.
Changing Criterion Design

λ Weaknesses:
Y Challenging to identifying an appropriate length for each phase and an appropriate magnitude for each criterion change.

Multiple Probe Design

λ A variation of the multiple baseline design - does not require continuous measurement of all baselines.
λ Baseline measures are taken on the behavior that precedes the implementation of each intervention; Baseline probes of the other behaviors are taken periodically when measuring intervention
λ Experimental control is demonstrated if a behavior change is measured after implementation of the intervention and not during any of the baseline probes preceding intervention.
Multiple Probe Design

λ Weaknesses: Same as for Multiple Baseline
- If variables are not independent, the effects of the intervention may not be clear
- Prolonged baselines may present ethical or clinical problems

Crossover Design or Multi-Treatment Design

λ Evaluates the effect of two or more interventions on one or more behaviors.
λ Interventions are implemented consecutively several times, each for several sessions.
λ A randomly presented sequence (ABBAABAB) or a counterbalanced intervention sequence with multiple participants is preferred
λ Targeted behaviors must be reversible.
λ Especially applicable for evaluating a range of pharmacological interventions
Alternating Treatments Design

- Directly compares two or more interventions that are repeatedly administered in a rapidly alternating fashion.
- Requires measurement of one behavior and an intervention that produces an immediate effect (e.g. not a complex skill that gradually develops such as walking or talking).
- Experimental control is demonstrated when the trend or level of the data during one treatment condition are consistently different from the trend or level of the data during the other treatment condition.

Alternating Treatments Design

- Strengths:
  - Interventions can be compared within the context of uncontrolled, extraneous variables, which are presumed to change more slowly than the experimental variables.
  - Can answer the experimental question more rapidly than a withdrawal design - can be important in clinical settings.
  - Baseline may be used but is not required - useful when baseline measures are likely to be unstable.

Alternating Treatments Design

- Weaknesses:
  - Multiple treatment interference, i.e. the influence of one treatment on another treatment (sequence, carryover, and alternating effects).
  - External validity concerns that can be addressed through replication with additional individuals in different settings.
  - Generalizability from the experimental situation of alternating treatments to an intervention presented in isolation and in a natural setting.
  - Generalizability from one individual to the next is limited.