Single Case Research Designs

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Today's Agenda

- Introductions
- What are SCDs?
  - Rationale for use and the types of research questions we can answer
- Salient features of SCD
  - Quality standards
- Visual analysis of Graphs
  - Examples
- Overview of different types of SCDs
  - Multiple probe, reversal designs, alternating treatment

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What are Single-Case Designs

- Derived from the field of behavior analysis (Baer et al., 1968)
- Used to study human behavior
  - predominately within education and related fields, but that is changing
- Individuals are the unit of analysis
  - All variables are consistent except the independent variable (e.g., instructional strategy)
  - Experimental control demonstrated by changes in behavior
- Main goal: demonstrate causal relation between introduction of a manipulated independent variable (i.e., intervention) that causes a change in the dependent variable (i.e., outcome)
  - Called a functional relation

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Why use SCD?

- Used in applied and clinical settings
- Small sample size
  - Low incidence disorders/behaviors
- Unable to have cross matched groups
- Useful when withholding treatment would be unethical
- Methodologies demonstrate high levels of experimental control

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Questions that SCD Answer

- Is there a causal relationship between introduction of IV on DV?
- Is the intervention effective?
- Are there other interventions that are more effective?
- Are there parts of an intervention package that are more or less effective?
- Do outcomes of intervention maintain over time or generalize across different settings, people or materials?

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The Importance of Generalization

- Generalization is the phase of learning where a person can apply the newly learned skill in different settings, situations, and materials
  - Within education, we can't say a person "learned" something if they cannot generalize
  - Example: driving a car
- Because of the small sample size, studies must address generalization or else "so what"
  - Established through generalization probes across conditions
  - Indicated by different types of data points (e.g., circles, triangles)

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Salient features of SCD

- Participants
  - The individual "case" or cluster of "cases"
  - Unit of intervention and data analysis
- Baseline
  - At least 5 data points within each phase
- Intervention
  - Staggered across different points in time
  - Manipulated across different phases
- Data Analysis- visual analysis on graph
  - Trends- increasing or decreasing slope
  - Level- mean for data within a phase
  - Variability- how much the data fluctuates

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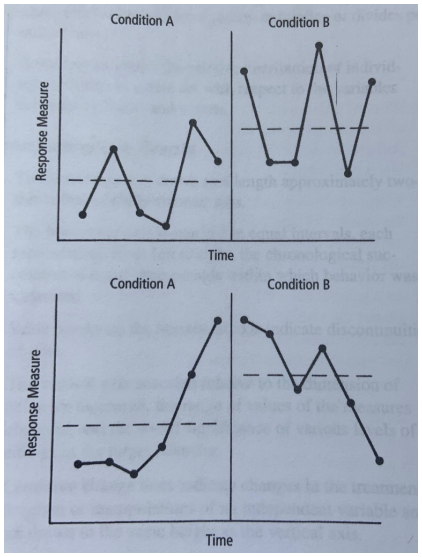
Level

- Level represents the mean of all data points (y-axis values) in that phase
- Often a change in level and/or trend indicate the robust change in behavior you expect to see following introduction of intervention
  - Called immediacy of effect



(Cooper et al., 2020)

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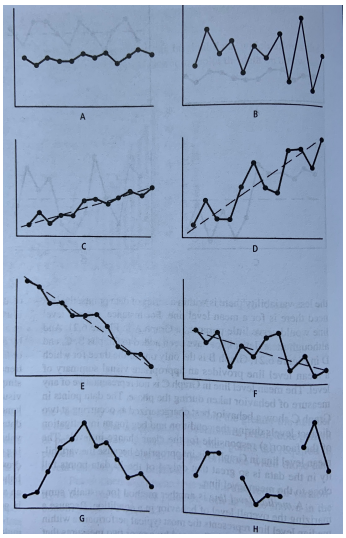
Trend



- Dotted line represents the "trend line"
- A & B have no slope or trend
  - Need to collect more data
- C & D both show increasing trends
- E & F both show decreasing trends
- What does G show?
- What does H show?

(Cooper et al., 2020)

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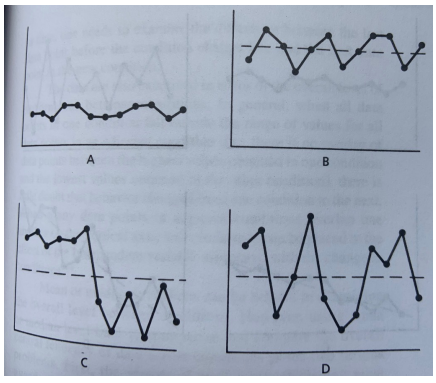
Variability



- Standard rule: The less data points fluctuate, the better
- If data are variable, it indicates the need to collect more data

- A & B shows low variability
- C shows some variability but also steady trends at the beginning and end of data path
- D shows a stead trend, but high levels of variability

(Cooper et al., 2020)

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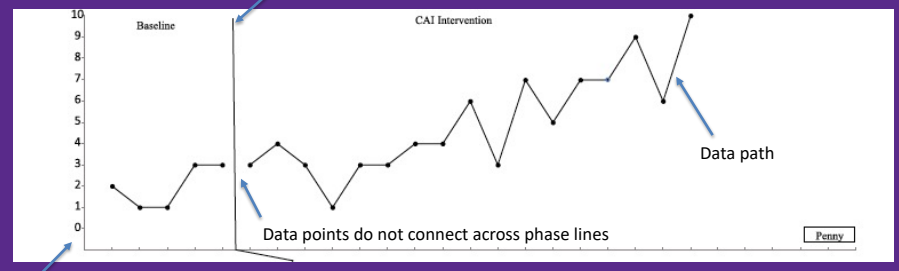
Understanding Visual Analysis



What is the trend of the CAI Intervention data?

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Prediction, Verification, Replication

- How SCDs control for threats to internal validity
  - Prediction- anticipated outcome
  - Verification- impact on data when intervention is removed or added
  - Replication- repeated effect of intervention
    - Requires three consistent demonstrations of effect and/or at three different points in time
    - Trends in data points (increase or decreasing; changes in level for data path)

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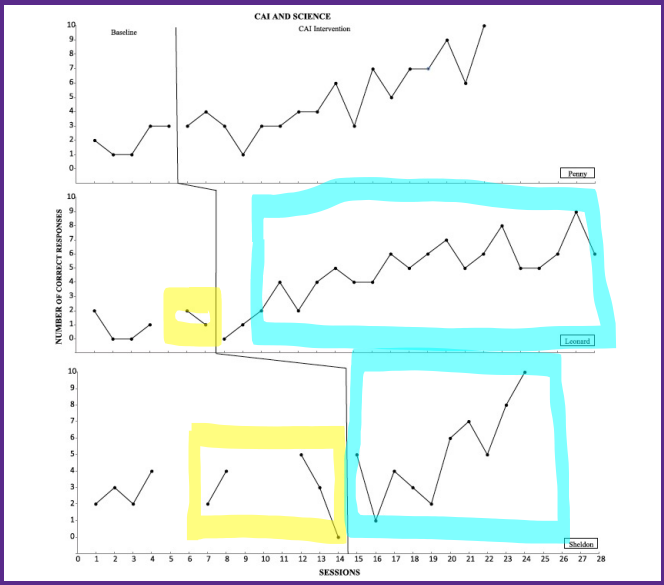
Prediction, Verification, and Replication on the Graph



Look Fors:

- Stable or decreasing trend prior to intervention
- Baseline data on other tiers remains unchanged when Penny enters intervention (same for Sheldon as Leonard enters)
- Leonard enters once Penny shows change in level; Sheldon enters once Leonard shows same change

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SCD Standards

1. Are there predictable baseline patterns?
   - Steady trends? High variability?
2. Are there at least 5 data points within each phase?
   - Is there a series prior to introduction to intervention?
3. Are there patterns within phases?
   - Trend, level, variability
   - Prediction, verification, replication
4. Was there an immediacy of effect when comparing adjacent phases?
   - If so, was that change (e.g., level and trend) predicted?
5. Are there at least three demonstrations of effect at different points in time?

Kratochwill, et al. 2010

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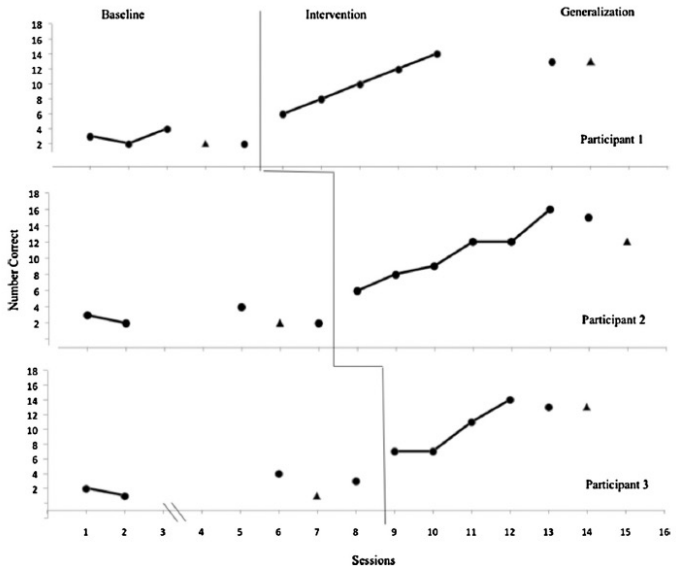
Let's analyze….



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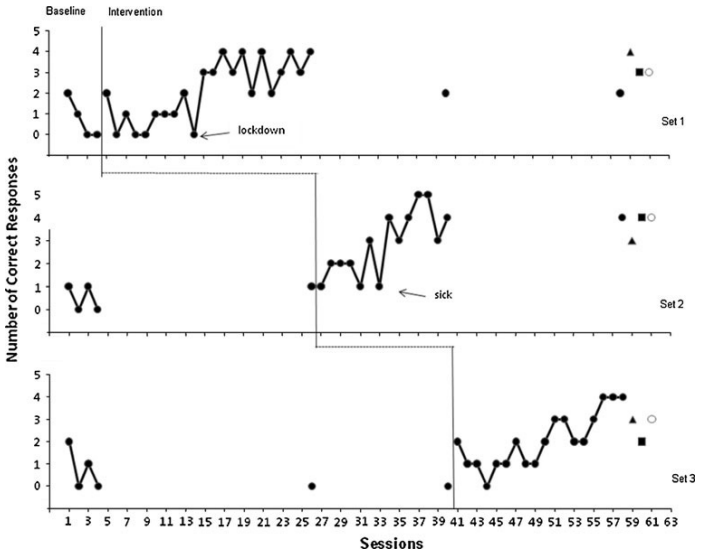
Let's analyze….



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Need a break?

DIFFERENT SCR DESIGNS

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Different SCR Designs

- There are various different types of designs and variations of those designs, but three are most common
  - Multiple baseline/probe designs
  - Reversal designs
  - Alternating treatment designs

Remember, the goal of the presentation is to walk away knowing if SCD can answer your research question(s)……

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Multiple Baseline/Probe Designs

- Multiple baseline- collect probe data every session
- Multiple baseline- collect probe data every X session
  - Most common design
- Good for behaviors that cannot be unlearned
  - Instructional interventions (e.g., learning to read)
- Multiple probe is most beneficial to limit potential for memorization
  - Students on the spectrum
- Potential replication across different skills or across different participants or both
- Allows for component analysis
  - Comparison across different phases

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Multiple Probe Graph

- No less than 3 tiers on the graph
- Functional relation is demonstrated by level and trend
- Introduction of intervention is staggered in time
- At least 2 phases, potential more
- Look for generalization probes across all phases

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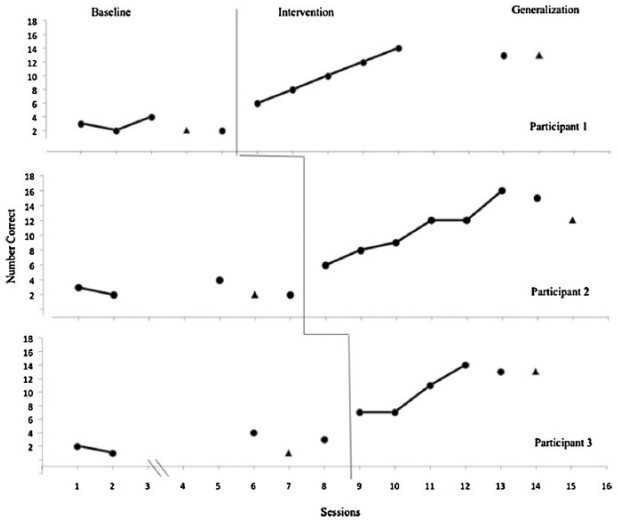
Multiple Probe Example



Smith et al., 2012

Is CAI effective for teaching science vocabulary

What do you see?
Trend, Level, Variability

Prediction, Verification, Replication

Is there a functional relation?

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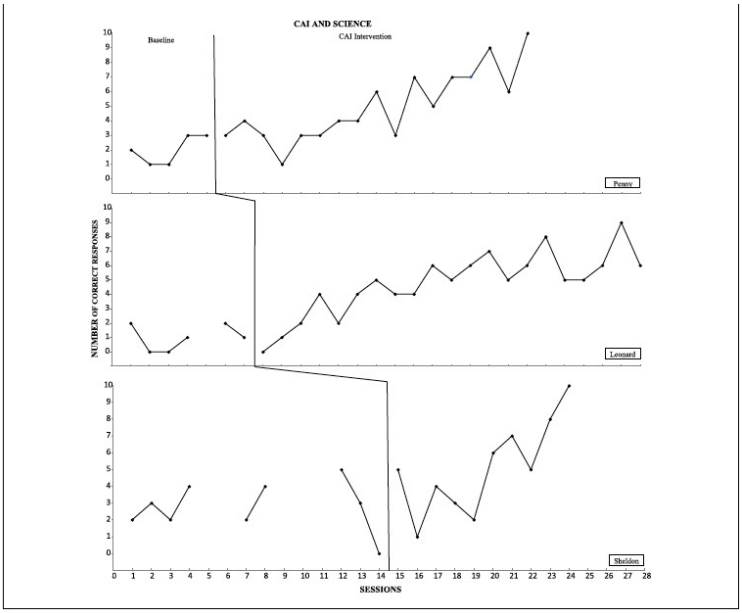
Multiple Probe Example (component analysis)



Smith et al. (2013)

Same intervention with video added to the CAI intervention

What do you see?
Trend, Level, Variability

Prediction, Verification, Replication

Is there a functional relation?

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Reversal Designs

- Strongest design to demonstrate "experimental control"
  - Only 1 IV
- Can only use for a behavior that can be unlearned or where the intervention can truly be removed
  - Shouldn't be used when withdrawing the intervention is problematic
- Particularly useful for interventions focused on addressing challenging behavior
  - The use of check in/check out intervention to decrease noncompliance

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Reversal Graph

- Functional Relation is demonstrated by separation in level and trend between phases
- Graphs only have 1 tier, but many phases
- Generalization happens across settings and people

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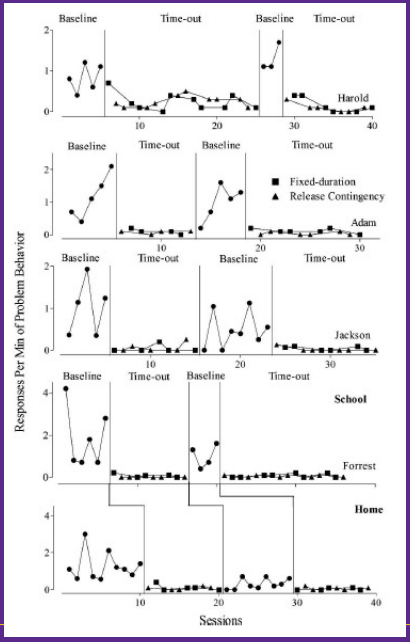
Reversal Example



Donaldson & Vollmer (2011)

Comparing fixed-duration timeout and Release contingency timeout

What do you see?
- Trend, Level, Variability
- Prediction, Verification, Replication

Is there a functional relation?

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Alternating Treatment Designs

- Used when you want to compare different treatments
  - Multiple Ivs
  - Must randomize implementation of IVs
- Can be used when doing nothing or withdrawing the intervention is unethical
  - Different types of aggression

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Alternating Treatment Graphs

- Graphs may have one tier, but multiple data paths within phases
- Graphs may have multiple tiers, with two phases
- Functional relation is demonstrated by slope, trend, and separation between the IV data paths

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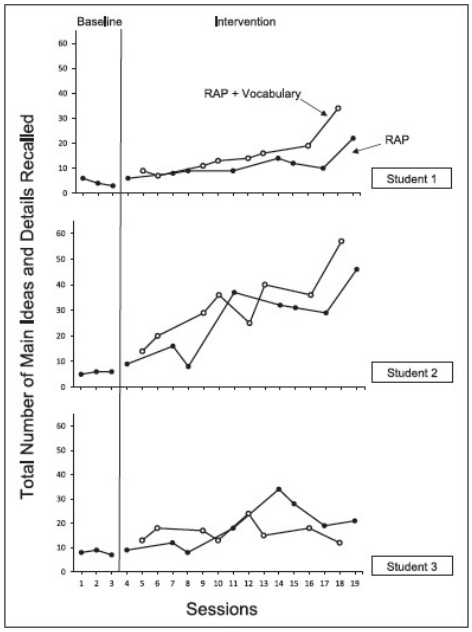
Alternating Treatment Example



Hua et al., 2020

Comparing randomized read-ask-paraphrase (RAP) and RAP with vocab instruction

What do you see?

Trend, Level, Variability
Prediction, Verification, Replication

Is there a functional relation?

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References

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- Hua, Y., Hinzman, M., Yuan, C., & Balint Langel, K. (2020). Comparing the effects of two reading interventions using a randomized alternating treatment design. *Exceptional Children*, *86*(4), 355-373.
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