Single-Subject Data, Part 2

Evidence-Based Practice in Speech-Language Therapy
(SHSC 2033)

Session 7

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Outline

1. Types of designs
   - Withdrawal (reversal) designs
   - Multiple baseline designs
   - Alternating-treatments designs
   - Other designs
2. Data analysis, reporting standards, critical appraisal
3. Group discussion

Key features of SSDs

- Good SSDs are logical in design. They should be designed so that alternative explanations for the results are minimised beforehand. This means trying to reduce **sources of bias** as far as possible.
- They are flexible intervention designs. The basic designs can be adapted to different clinical situations.

Judging intervention effectiveness

Two questions to ask:

1. Was there a change?
2. Was the change due to intervention?

Withdrawal Designs

Withdrawal designs[1]

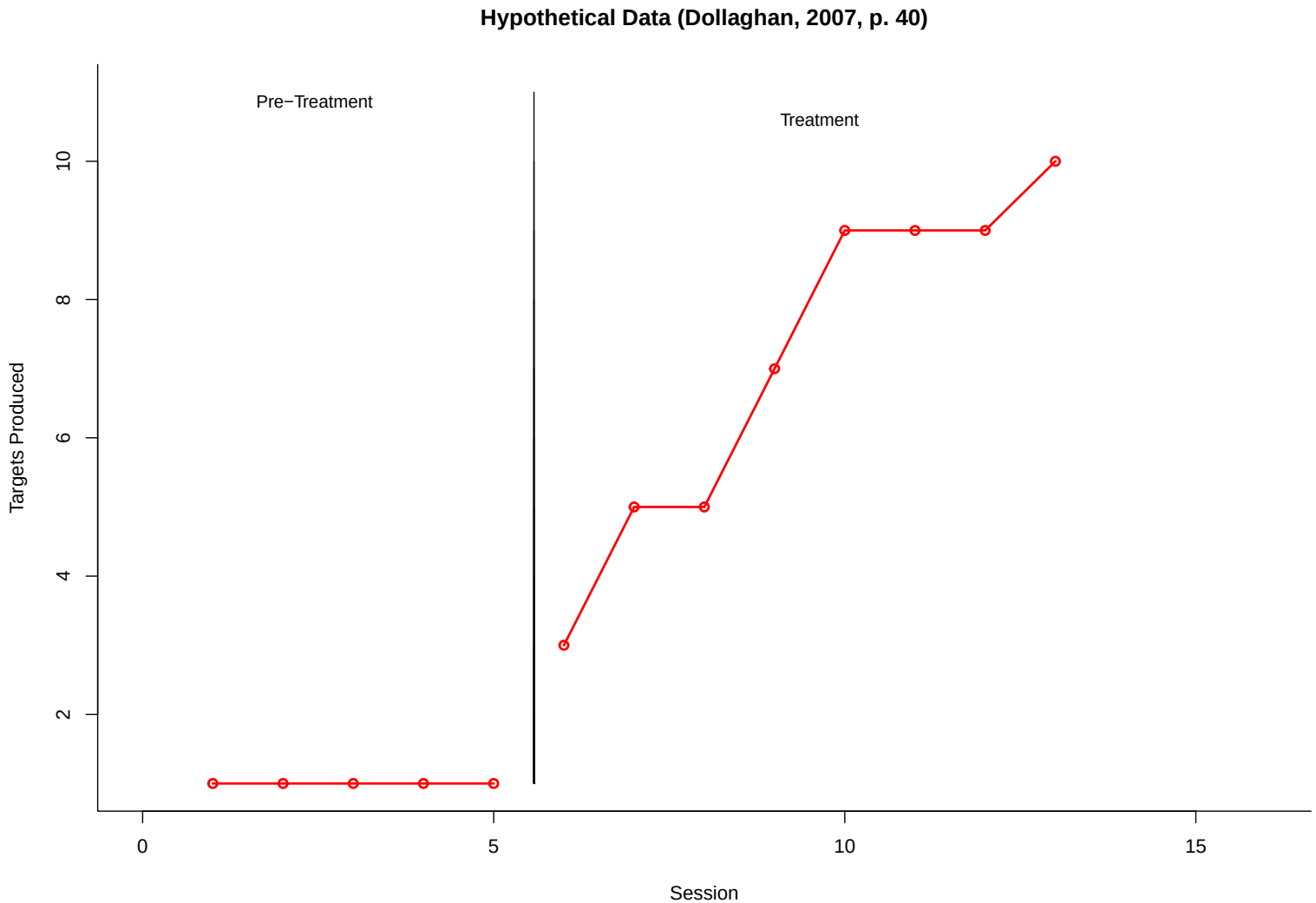
- A-B-A design (at a minimum)
- Allows a treatment–no treatment comparison
- Clinical research question:
  "Does treatment, with all of its components, result in improved performance relative to no treatment?"
- Can be used if it's logical to expect that the intervention effect is likely to reverse if it's withdrawn

[1] Kearns (1986)

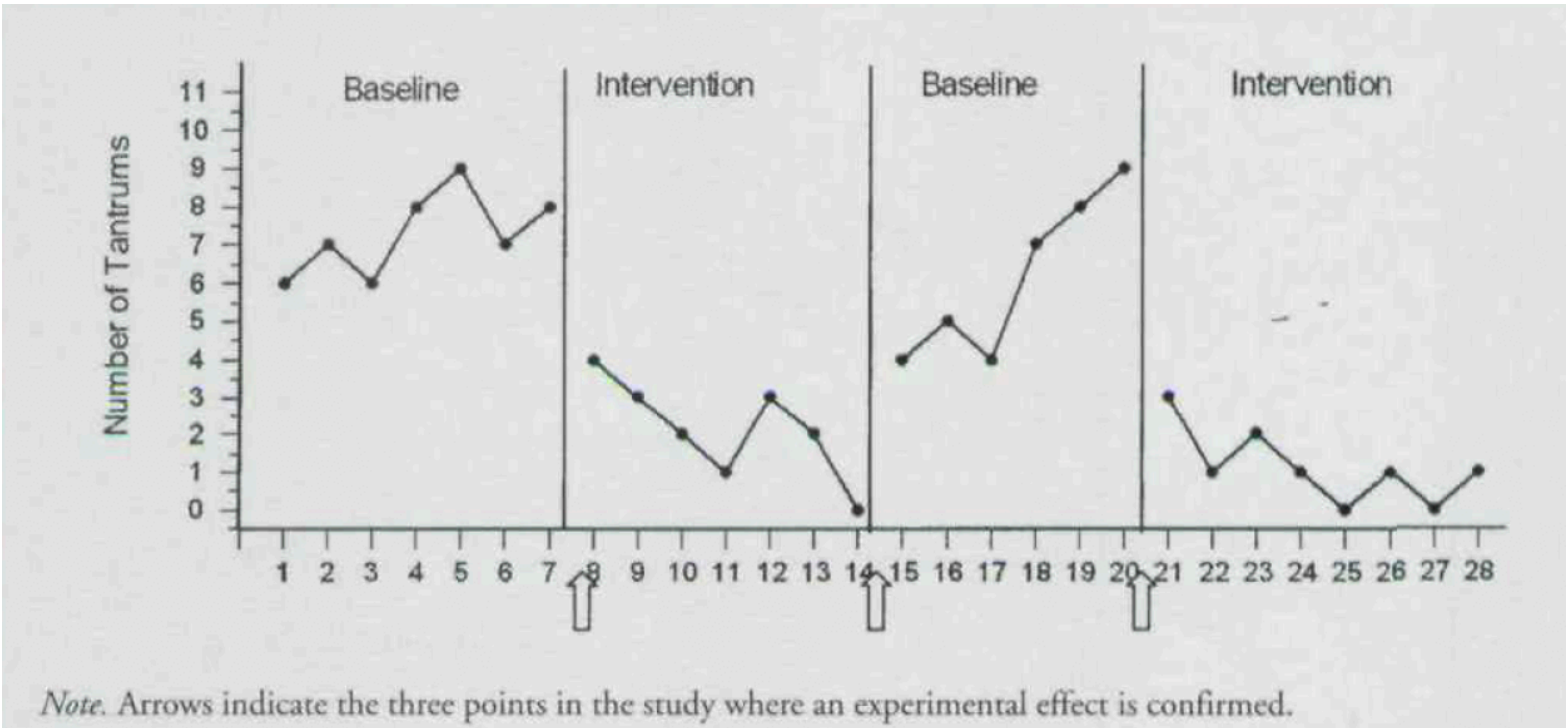
Example

- Is X effective in treating hypertension (high blood pressure)?
  - X could be exercise, diet, meditation, medication, etc.
- What evidence exists at a group level?
  - Is there a recent SR of RCTs available?
  - If not, has an RCT been done?
  - If not, have other kinds of studies been done?
- Example clinical question:
  "Does X lower this patient's blood pressure?"

AB design


Hypothetical Data (Dollaghan, 2007, p. 40)
Pre−Treatment
Treatment
Targets Produced
2
4
6
8
10
0
5
10
15
Session

AB design with replication[2]



Note. Arrows indicate the three points in the study where an experimental effect is confirmed.

[2] Although graph is from Horner et al. (2005, p. 169), it might also illustrate lowered blood pressure as a result of intervention, if the y-axis were changed to systolic blood pressure, for instance.

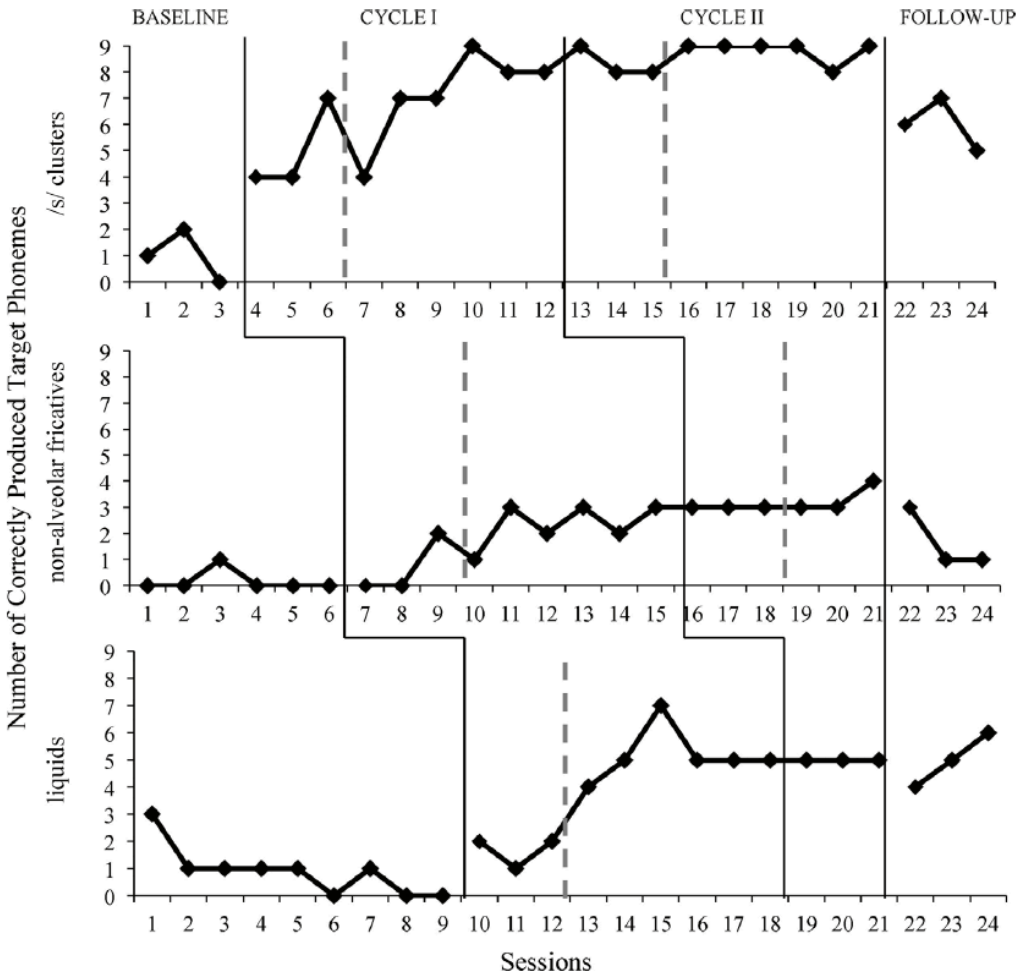
Multiple Baseline Designs

Multiple baseline designs[3]

- Allows a treatment–no treatment comparison
- Clinical research question:
  "Does treatment, with all of its components, result in improved performance relative to no treatment?"
- Can be used if functionally independent behaviours or settings are available, or if similar clients are available.
- Types of multiple baseline designs
  - across behaviours
  - across settings
  - across subjects

[3] Kearns (1986)

Example[4]



[4] Rudolph and Wendt (2014, Fig. 1)

Alternating Treatments Designs

Alternating treatments designs[5]

- Useful for comparing different intervention approaches
- Treatments to be compared are administered in a rapid, alternating manner.
- Confounding factors that may influence treatment effectiveness are counterbalanced.
  - Examples: clinicians, order of treatment presentation
- This design does not require a baseline measure, but including one makes it possible to compare treatment conditions with no treatment.
- ATDs are procedurally complex to conduct.

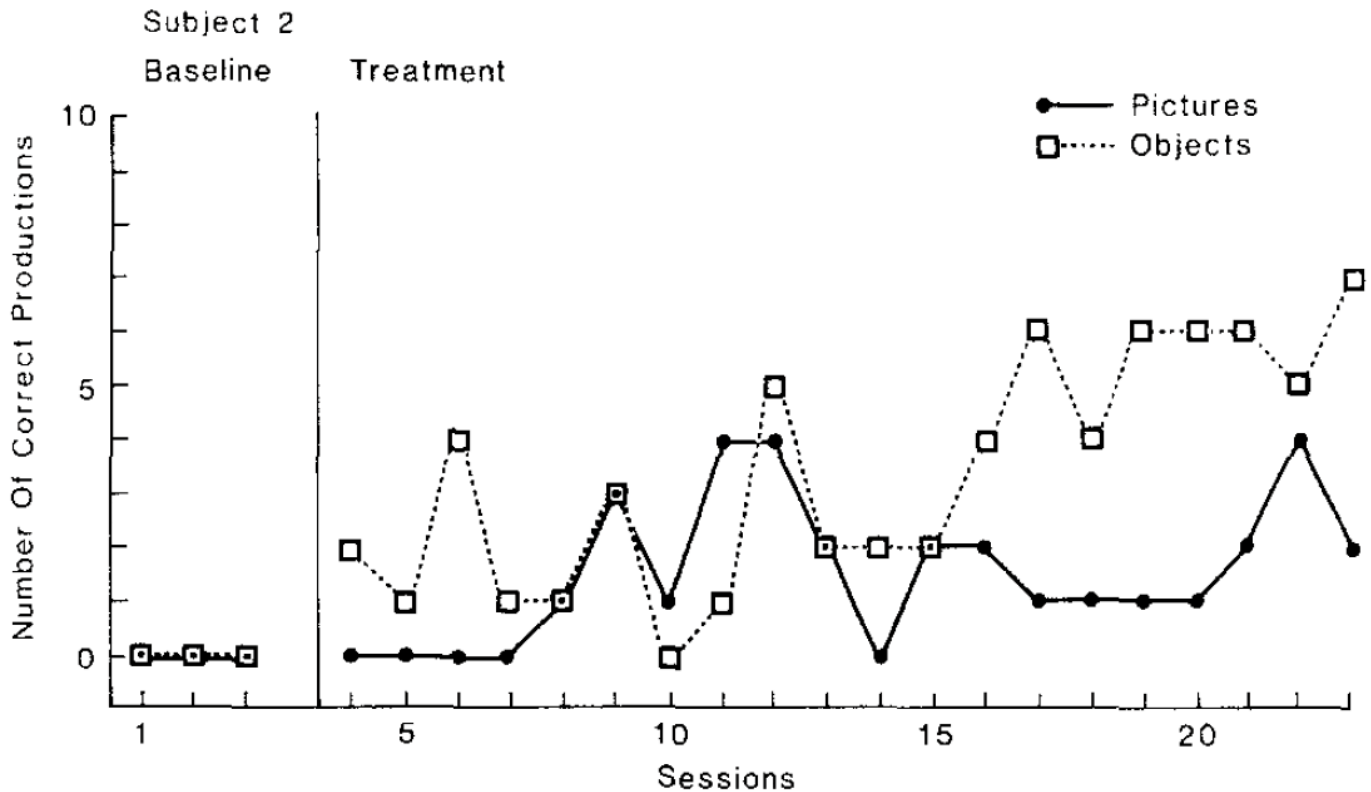
[5] Kearns (1986, p. 211)

Example[6]

- Treatment efficacy study of 4 children with developmental language disorder
- Study aim: to compare object manipulation and picture identification for facilitating single-word production
- Alternating treatment design
- Ages of children: 23–40 months
- Expressive vocabulary size: 6–50 words

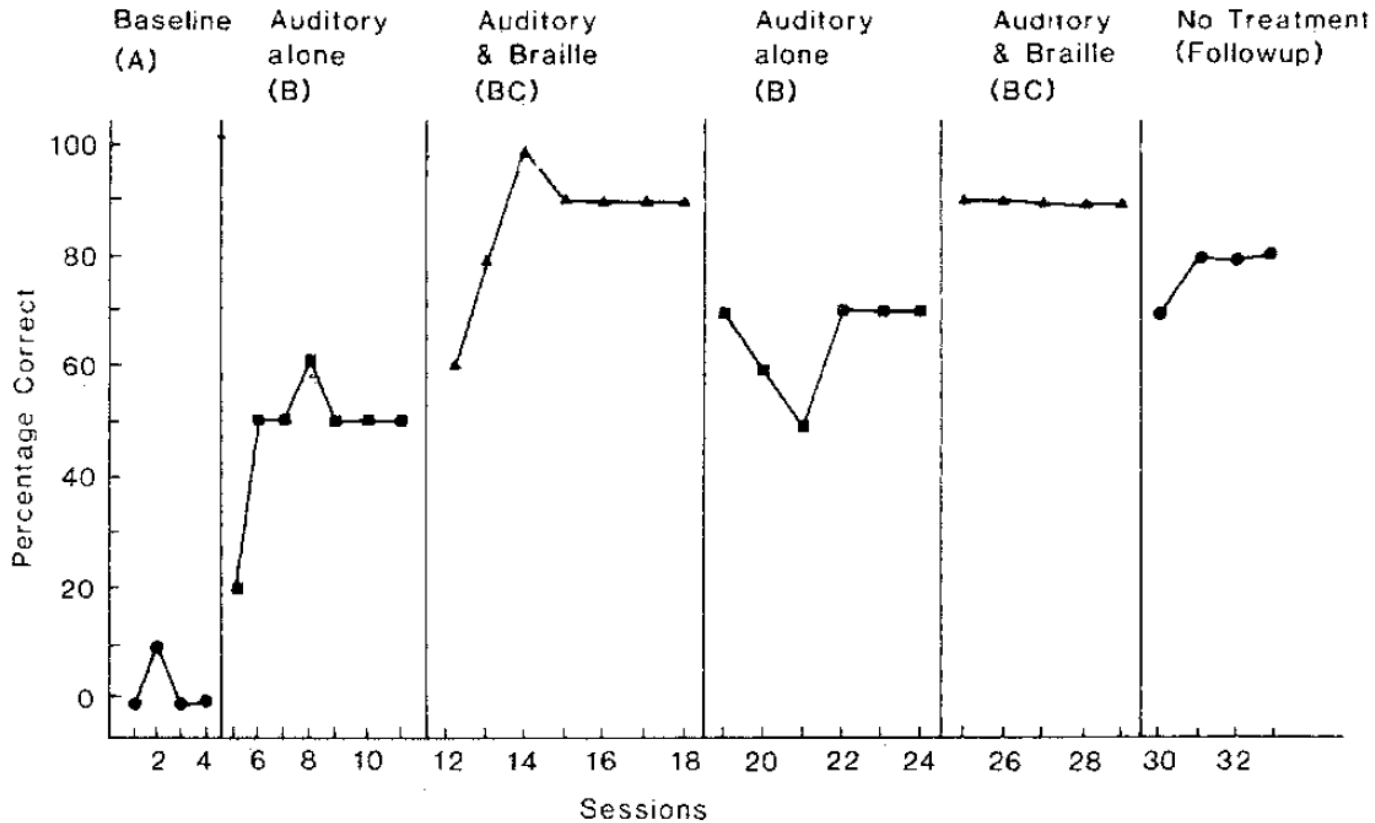
[6] Olswang, Bain, Dunn, and Cooper (1983)

Alternating treatment design[7]



[7] Olwang et al. (1983) results redrawn by Kearns (1986, p. 211)

Interaction design[8]



[8] Kearns (1986, Fig. 3)

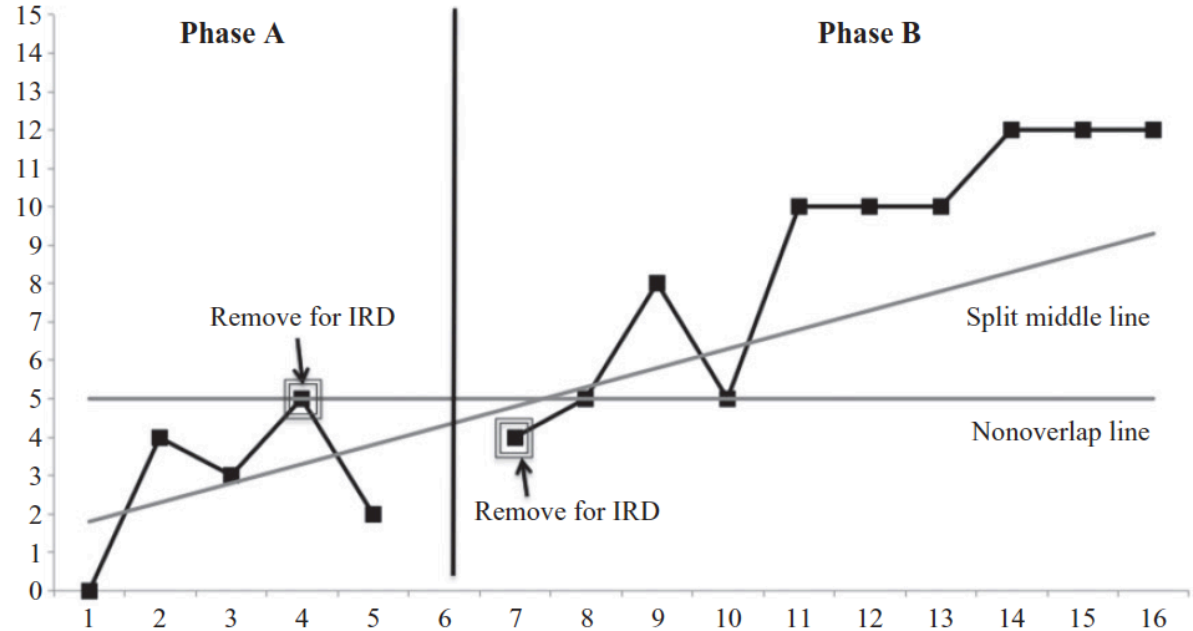
Data analysis and interpretation

- Graph baseline and intervention probe results and visually interpret it (covered in last session)
- Calculate an effect size measure[9]
  1. Percentage of non-overlapping data (PND)
  2. Improvement rate differences (IRD)
  3. Percentage of data exceeding a median trend (PEM-T)
  4. Tau for non-overlap with baseline trend control (Tau-U)

[9] See Rakap (2015) for further information and sample calculations.

Example from Rakap (2015)

Figure 1: Steps for calculating each nonoverlap method for an AB design graph



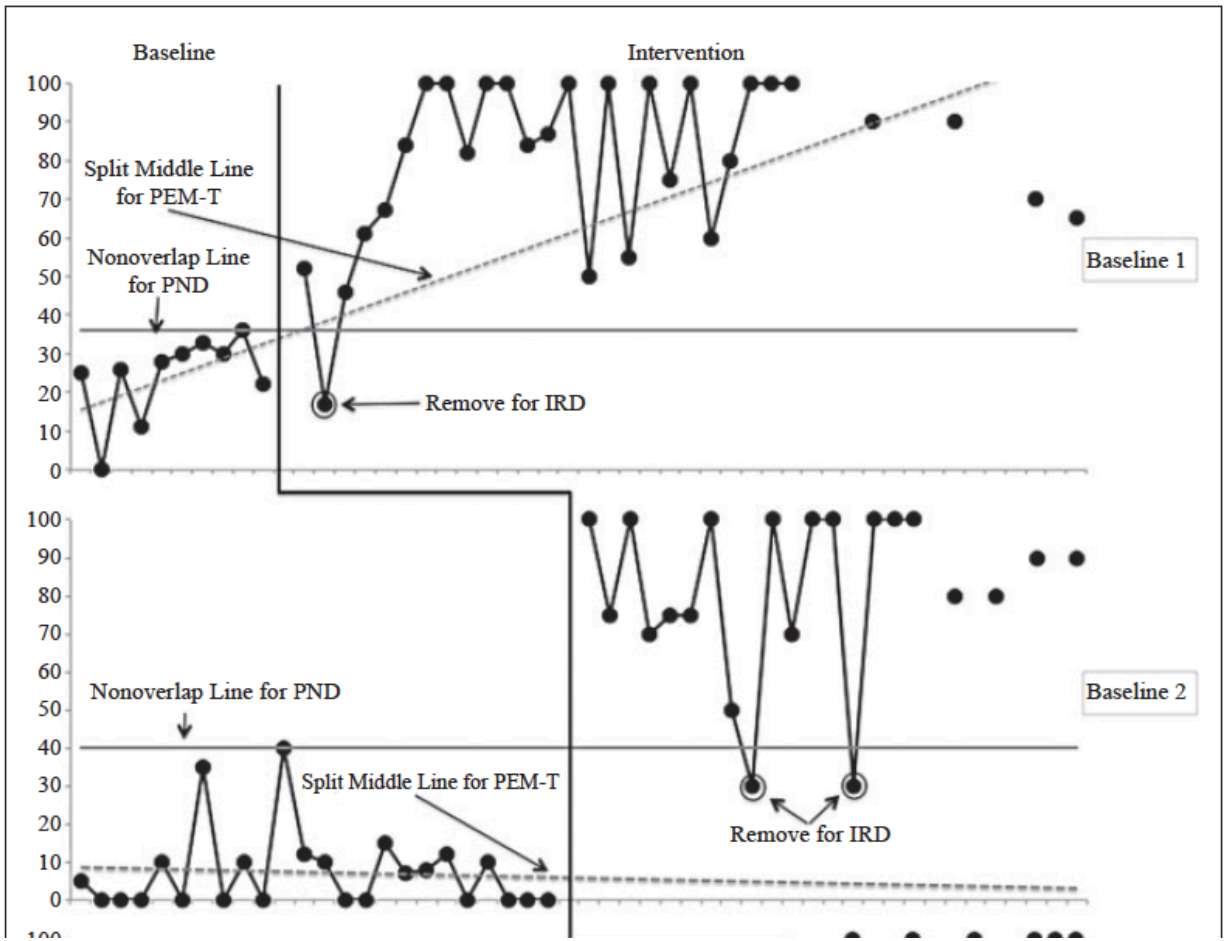
Phase A $N = 5$, Phase B $N = 10$, Total no. of pairs = 50

PND

1. Identify the highest datum point in the baseline phase (e.g. value of highest baseline datum point = 5)
2. Draw a horizontal line (parallel to the X axis) from the value of the datum point identified as the highest in the baseline phase through the intervention phase data
3. Count the number of data points in the intervention phase above the line drawn in Step 2 (n = 7)
4. Divide the count from Step 3 by total number of data points in Phase B (e.g. $7 \div 10 = 0.70$)
5. Multiply the quotient from Step 5 by 100 (e.g. PND = $0.70 \times 100 = 70\%$)

Example from Rakap (2015)

Figure 2: Demonstration of calculation of nonoverlap methods for a multiple baseline design



SSD evidence hierarchy[10]

Table I: Levels of evidence for single-subject research designs (SSRDs)

Level	*Evidence*
I	Randomized controlled *N*-of-1 (RCT), alternating treatment (ATD), and concurrent or non-concurrent multiple baseline designs (MBDs)[a] with clear-cut results; generalizability if the ATD is replicated across three or more subjects and the MBD design consists of a minimum of three subjects, behaviors, or settings. These designs can provide causal inferences.
II	Non-randomized, controlled, concurrent MBD[a] with clear-cut results; generalizability if design consists of a minimum of three subjects, behaviors, or settings; limited causal inferences.
III	Non-randomized, non-concurrent, controlled MBD[a] with clear-cut results; generalizability if design consists of a minimum of three subjects, behaviors, or settings; limited causal inferences.
IV	Non-randomized, controlled SSRDs with at least three phases (ABA, ABAB, BAB, etc.) with clear-cut results; generalizability if replicated across five or more different subjects; only hints at causal inferences.
V	Non-randomized controlled AB single-subject research design with clear-cut results; generalizability if replicated across three or more different subjects; suggests causal inferences allowing for testing of ideas.

[a]If the intervention(s) is known to be successful, a baseline or control phase is not required.

[10] Logan, Hickman, Harris, and Heriza (2008, p.100)

Reporting standards for SSDs

- To promote transparent and complete reporting of SSDs
- The *Single-Case Reporting Guideline in BEhavioural Interventions* (SCRIBE) 2016 checklist (Tate et al., 2016)
  - For authors of SSDs
  - 26-item checklist + flow diagram
- The *Journal Article Reporting Standards for Quantitative Research in Psychology* (JARS) (Appelbaum et al., 2018)
  - Now includes section on reporting SSDs (see Table 3)

Options for critically appraising SSDs

- Single Case Experimental Design Scale (SCED) Scale (Tate et al., 2008)
- Logan et al.'s 14-item checklist (Logan et al., 2008, p. 102)
- CATE (Dollaghan, 2007)

Group discussion

- Break up into your assigned groups.
- Use SCED (Tate et al., 2008, pp. 400-1) to critically appraise the study.
- Document where you found information in the research article addressing each point.

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