

# Single-Case Experimental Designs for the Evaluation of Autism Technology

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**PURDUE**  
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SPEECH, LANGUAGE,  
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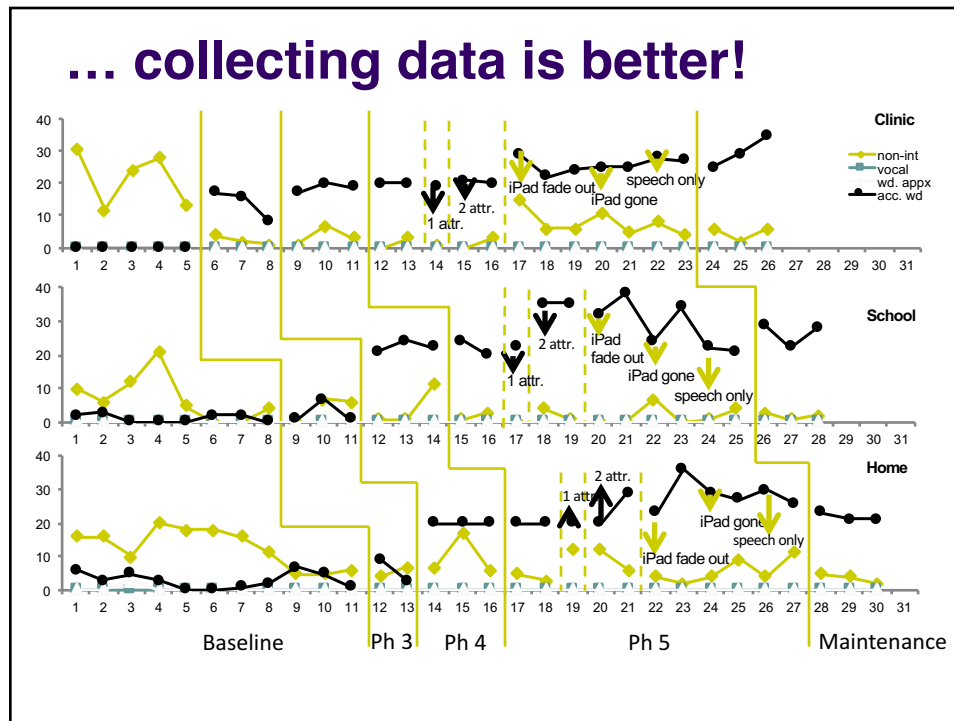
**Northeastern University**  
Bouvé College of Health Sciences



## Clinical observation can be powerful ...

- Participants before and after intervention  
Does AAC technology hinder speech  
production?





## Single-case Experimental Designs (SCEDs)



- Examines pre- versus post-treatment performance within a small sample (Kennedy, 2005)
- Uses an experimental approach
- Employs repeated and reliable measurement, within- and between-subject comparisons
- Works because participants serve as their own control.
- Compares performance prior to intervention to performance during and/or after intervention.

## An Adapted 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 <i>single-subject</i> experimental design – one intervention	2c. One <i>single-subject</i> experimental design – multiple interventions
3. Quantitative reviews that are non meta-analytic		
4. Narrative reviews		
5. Preexperimental group designs and single-case studies		
6. Respectable opinion		

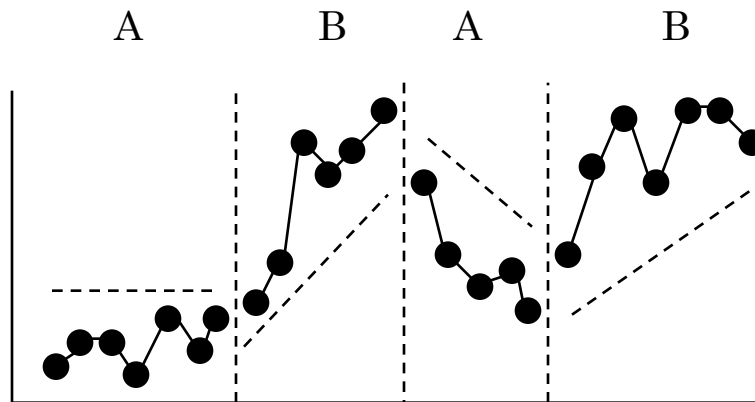
(adapted from Schlosser, 2003)

## Types of SCEDs



- Withdrawal
- Multiple Baseline
- Alternating Treatments

## Withdrawal or A-B-A-B Design

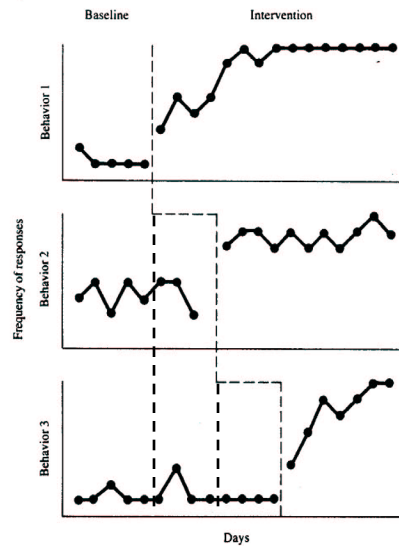


## Characteristics



- Intervention is withdrawn without presuming that a change in behavior will occur
- If levels of dependent variable(s) co-vary with the presence and absence of the independent variable  $\Rightarrow$  high degree of experimental control over responding
- Watch out for carry-over effects and reversibility
  - Level of behavior should reverse to baseline pattern of responding

## Multiple Baseline Design

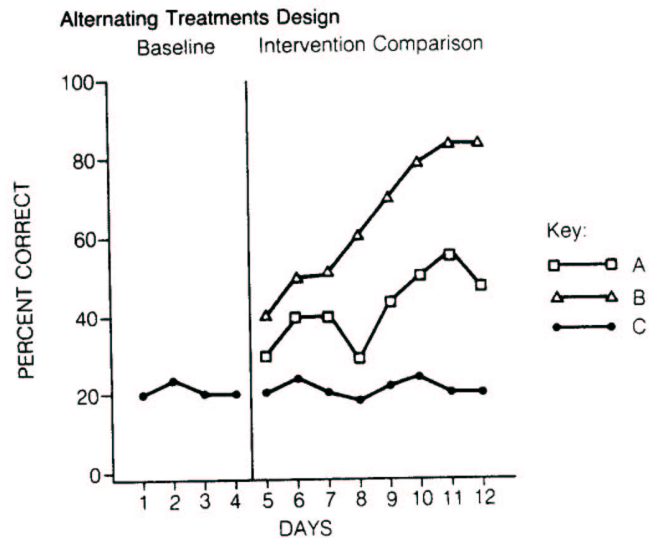


**Figure 6-1.** Hypothetical data for a multiple-baseline design across behaviors in which the intervention was introduced to three behaviors at different points in time.

## Characteristics

- Does not require the withdrawal, reversal, or repeated alternation of conditions.
- Two or more baselines are concurrently established & the independent variable is sequentially introduced across the baselines; once introduced, the intervention is not removed.
- Replication can occur across participants, settings, or behaviors.

## Alternating Treatments



## Characteristics

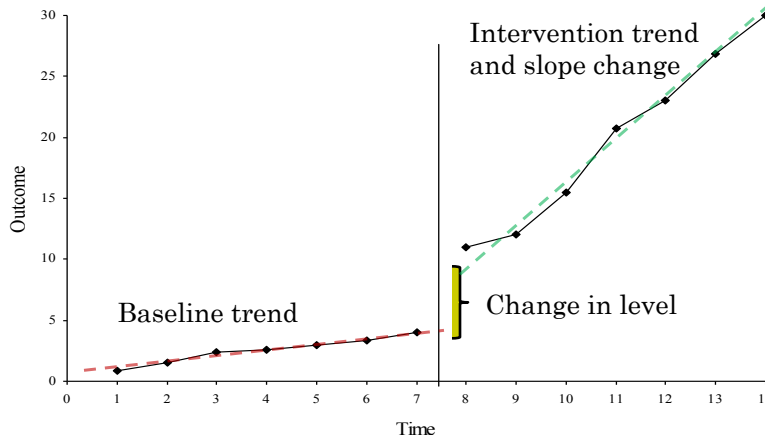
- Each intervention is plotted separately to provide a graphic representation of the effects each intervention has on the target behavior
- Data analysis examines if behavior levels different across conditions
- If response differentiation occurs ⇒ functional relation has been demonstrated

## Data Analysis in SSEDs



- Visual Inspection
  - Change in level
  - Change in trend
- Statistics
  - Traditional significance tests (assumptions!)
  - Effect size estimates
    - Regression approaches (parametric)
    - Non-overlap approaches (non-parametric)

## Regression-based Approaches: Illustration



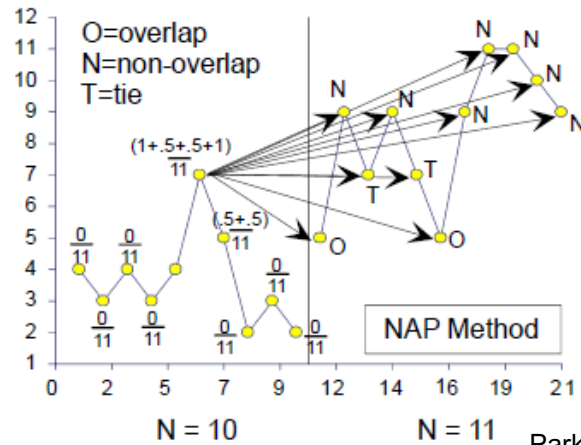
Piece-wise regression procedure

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 D_t + \beta_3 T_t (D_t - n_a) + e_t$$

## Non-overlap of All Pairs (NAP): Illustration



$$\text{NAP} = (10 \times 11) - (0 + 0 + 0 + 0 + 0 + 3 + 1 + 0 + 0 + 0) / (10 \times 11) = 106/110 = 96\%$$



## Conclusions



- SCEDs have strong internal validity and provide experimental control over individual behavior throughout observation period
- External validity can be enhanced through systematic replication
- SCEDs can be an essential element to document treatment efficacy on autism technologies and establish evidence-based practice



## Questions ???



## Further Readings

### **Evidence-based Practice with respect to SCEDs:**

- Schlosser, R. W. (2003). *The efficacy of augmentative and alternative communication: Toward evidence-based practice*. San Diego, CA: Academic Press.
- Schlosser, R. W., & Raghavendra, P. (2004). Evidence-based practice in augmentative and alternative communication. *Augmentative and Alternative Communication*, 20(1), 1-21.



## Further Readings



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

- Wendt, O., & Miller, B. (2012). Quality appraisal of single-subject experimental designs: An overview and comparison of different appraisal tools. *Education and Treatment of Children, 35*(2), 109-142.

### Role of randomization in SCEDs:

- Heyvaert, M., Wendt, O., Van den Noortgate, & Onghena, P. (2015). Randomization and data-analysis items in tools for reporting and evaluating single-case experimental studies. *Journal of Special Education, 49*, 146-156.

## SCED Books



- Barlow, D. H., Nock, M. K., & Hersen, M. (2005). *Single-case experimental designs: Strategies for studying behavior change* (3<sup>rd</sup> ed.). Boston: Allyn & Bacon
- Gast, D. L. (2010). *Single subject research methodology in behavioral sciences*. New York, London: Routledge.
- Kennedy, C. H. (2005). *Single-case designs for educational research*. Boston: Allyn & Bacon.

## Data Analysis Tools



- Statistical Tools KU Leuven  
<https://perswww.kuleuven.be/~u0053535/>
- SCED Online Calculators  
<http://www.singlecaseresearch.org/calculators>
- Assessing Visual Analysis of Single Case Research Designs  
<http://www.singlecase.org/#>

## Contact & Resources



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