Single-Case Designs (SCDs)
SCDs

• Time series, used to test interventions in psychotherapy, behavioral treatments, education, autism, and medicine (N-of-1 trials).
• Typically, much more control over intervention than most time series.
  – Sometimes even randomized
• Fisher’s Lady Tasting Tea Experiment is SCD
• Four basic forms:
Multiple Baseline Designs

Time of intervention systematically varied
- Over cases
- Over outcomes
- Over settings

Outcome should decrease (increase) at a different time in each series

Most commonly used (50%)

Most useful when treatment has a permanent (or large carryover) effect
Example: DiCarlo and Reid (2004)

Five toddlers with disabilities

DV is to increase play behaviors
Reversal Design \((AB^k, \text{e.g., ABAB})\)

Same logic about causation

Most useful when treatment has temporary effects

More power with more AB replications (seldom more than \(k = 2\), though)
Teaching children to raise hands and be called on when answering questions

Example: Lambert
Alternating Treatments Design

Alternate treatments within or between sessions

Most common SCD to use random assignment

Most useful with temporary effects
Elementary school children with math problems

MSWO and Teacher-selected are two different treatments (reward conditions)

Experimental condition is different in each session

No reward is control condition
Changing Criterion Design

Least frequently used

Outcome contingent on reward

When outcome reaches a preliminary criterion level, then change the criterion to demand higher performance for reward.

Continue until desired outcome is achieved
Example: Ganz & Flores 2008

Children with Autism

Treatment is a prompt card with script to read

Baseline
First criterion: respond to one card to get reward
Second criterion: Respond to two cards
Third criterion: Respond to three cards

Note generalization phase

Two outcomes:
Response to card
Intervals with no response at all
More Complex SCDs

• Usually combinations of the basic four
  – E.g., baseline followed by ATD

• Often ending with
  – Generalization phase (e.g., to other setting)
  – Maintenance phase (e.g., without the treatment)

• In education, the median SCD has
  – 20 timepoints within case
  – 3 cases

• Professional standards for “meets methods standards”
  – WWC SCD Pilot Standards
Example of More Complex Design: Ayllon et al., A Behavioral Alternative to Drugs for Hyperactive Students

- Drugs control hyperactivity, but can interfere with academic performance

- Ayllon et al. used a behavioral intervention to try to control hyperactivity while improving academic performance as measured by
  - Math
  - Reading
Medication decreased hyperactivity, but also affected academic performance.

Removal of medication increased hyperactivity but allowed academic performance to recover a bit.

The behavioral reinforcement program reduced hyperactivity but allowed academic performance to increase even more.
Use in Evidence-Based Practice Reviews

• The National Center for Special Education Research (IES) allows SCDs instead of randomized experiments for some efficacy studies

• Various education professional societies do too.
  – APA Division 16 Task Force on Evidence Based Interventions in School Psychology

• The Centre for Evidence-Based Medicine at Oxford University in the United Kingdom (works closely with BJM), ranks N-of-1 studies as Level 1 studies along with randomized experiments (Howick et al., 2011).

• WWC Pilot Standards for SCDs
ITS Analyses: Challenges

• Any ITS analysis has to deal with
  – Autocorrelation
  – Trend
• If multiple time series, then variability over series (e.g., random treatment effect)
• Power given all this
  – More observations per time series
  – More time series in the analyses
  – Other factors less under control (ACF, intraclass correlation, number of phase reversals)
ITS Analyses: Overview

• N ≥ 100: ARIMA Modeling
  – But see Velicer McDonald 1984, Velicer Colby 2005 if N ≥ 40

• Regression and Multilevel Models
  – Generalized Additive Models and Nonlinearity

• Difference in Differences (DiD)

• Effect Sizes
  – Within case
  – Between case (in the same metric as between groups designs)