

## Quasi-experimental Designs

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## Experimental Designs

- Pre-experimental designs
  - Lack random assignment and a control group
- Experimental designs
  - Randomly assign participants to treatment conditions
- Quasi-experimental designs
  - Partial control over independent variables
  - Lacking random assignment

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## Quasi-experimental Design

- Time-series design
  - Interrupted time series
  - Multiple time series
- Nonequivalent groups design
- Developmental research
  - Longitudinal
  - Cross sectional

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## Interrupted Time Series Design

- Effects of “treatment” (IV) inferred from comparison of outcome measures (DV)
- Outcome measures obtained at different time intervals
  - Before and after treatment is introduced

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## Interrupted Time Series Design

1. Define period of observation broadly
  - Observe DV **before**, **during**, and **after** intervention
2. Same units used throughout analysis
  - Observations and time points **equally spaced**
3. Time points have to be sensitive to the particular effects of interest
4. Measurements can't fluctuate much
  - No “instrument” changes

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## Interrupted Time Series Design

- If you can't control who is exposed to the treatment
  - Try to control when observations are made
- More than one pre-and-post-measure
  - Equally spaced observations
  - Rule out maturation by looking at trends in pretest

Group 1    $Y_1$     $Y_2$     $Y_3$     $Y_4$     $X$     $Y_5$     $Y_6$     $Y_7$     $Y_8$

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## Strengthening the ITS Design

- Adding control groups can be helpful

Group 1  $Y_1$   $Y_2$   $Y_3$   $Y_4$  X  $Y_5$   $Y_6$   $Y_7$   $Y_8$

Group 2  $Y_9$   $Y_{10}$   $Y_{11}$   $Y_{12}$   $Y_{13}$   $Y_{14}$   $Y_{15}$   $Y_{16}$

**OR**

Group 1  $Y_1$   $Y_2$   $Y_3$   $Y_4$  X  $Y_5$   $Y_6$   $Y_7$   $Y_8$

Group 2  $Y_9$   $Y_{10}$   $Y_{11}$   $Y_{12}$   $Y_{13}$  X  $Y_{14}$   $Y_{15}$   $Y_{16}$

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## Example of ITS Design



- Early 1970's
  - Drinking age lowered from 21 to 18
- 35% increase in the number of alcohol related crashes
  - MI drivers aged 18-21
- Drinking age returned to 21 in 1979

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## Example of ITS Design:(Question)

- Effect on alcohol-related traffic accidents of raising the drinking age in Michigan
- Questions
  - Did alcohol-related accidents decrease when drinking age changed back to 21?
  - Could this decrease (if it occurred) be attributed to the change?

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### Example of ITS Design (Results)

- Could not make series of observations following change
  - Reasons of public policy
- Examined number of accidents reported by police as “had been drinking”
  - One year after change back to 21
- 26% fewer accidents for those 18-20
  - Lowest figure in 5 years

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### Example of ITS Design (Alternative Hypotheses)

- Instrumentation
  - Police changed criterion for reporting that driver had been drinking
- History
  - Economic recession and high gas prices reduced the amount of driving
  - Mild winter made driving safer

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### Example of ITS Design Instrumentation Hypothesis

- Compared single-vehicle nighttime crashes to similar daytime crashes
  - 60% of nighttime crashes known to be alcohol-related
- Both decreased after change
  - Nighttime crashes decreased twice as much as daytime crashes

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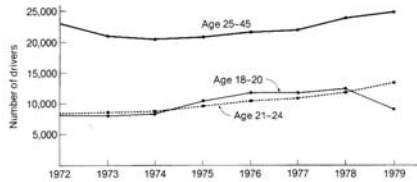
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## Example of ITS Design History Hypothesis

- Compared accident data for different age groups
  - 18-20 age group
    - Saw a decrease in “had been drinking crashes”
  - Other groups
    - Saw an increase



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## Example of ITS Design (Other Factors)

- Compared results from different states
  - **Maine**: Raised legal drinking age
    - Results same as Michigan
  - **New York**: Did not raise legal drinking age
    - No changes
  - **Pennsylvania**: Did not raise legal drinking age
    - No changes

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## Nonequivalent-Groups Design

- Between-subjects design
- No random assignment of participants to experimental and control conditions
- Tested before and after treatment

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## Nonequivalent-Groups Design (Control)

- Matching
  - Match groups as closely as possible on relevant variables
- Historical control groups
  - Recently examined
  - Similar to control group
  - Not participating in study

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## Example of Nonequivalent-Groups Design

- Effect of flextime schedule on productivity
- Worker work 40 hour weeks
  - Can begin and end each day at a different time
  - Can work four days and have three off



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## Example of Nonequivalent-Groups Design

- Two plants: Cleveland and Pittsburg
- Pretest
  - Average productivity in both plants, 1 month prior to instituting flextime in Pittsburg plant
- Treatment
  - Institute flextime in Pittsburg plant for 6 months
- Posttest
  - Average productivity in both plants in 6th month flextime instituted in Pittsburg plant

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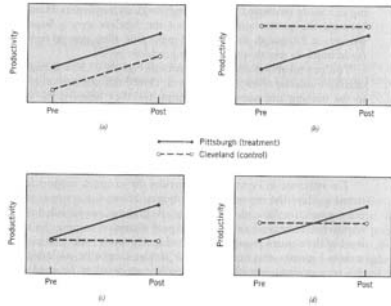
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### Example of Nonequivalent-Groups Design (Possible Outcomes)




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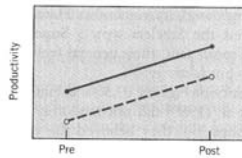
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### Example of Nonequivalent-Groups Design (Outcome 1)

- Both plants show same degree of improvement
- Improvement probably due to other variables




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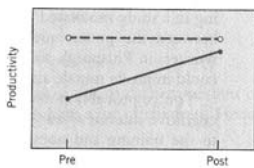
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### Example of Nonequivalent-Groups Design (Outcome 2)



- Possible ceiling effect
  - Cleveland scores so high they can't show improvement
- Pittsburg low pretest scores result of abnormality
  - Situation returned to normal during 6 months

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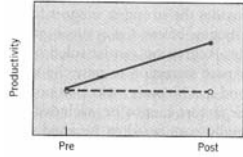
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### Example of Nonequivalent-Groups Design (Outcome 3)

- Satisfactory outcome
- Potential selection and history interaction



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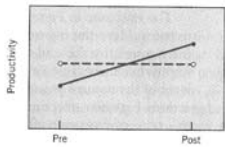
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### Example of Nonequivalent-Groups Design (Outcome 4)

- Best outcome
- Provides strongest support for program effectiveness



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### Example #1

- Stop an 18 year old, profoundly retarded woman from hyperventilating
- Punish episodes of hyperventilation
  - Briefly present ammonia



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## Example #1

- First 5 days
  - Record instances of hyperventilation
    - ½ hour intervals
    - 4 different settings
- Institute punishment in first setting on 6th day
  - Institute punishment in new setting every 5th day
- Stop punishment but still record hyperventilation
- Simultaneously reinstate punishment in all settings
- After 15 days, generalize procedure

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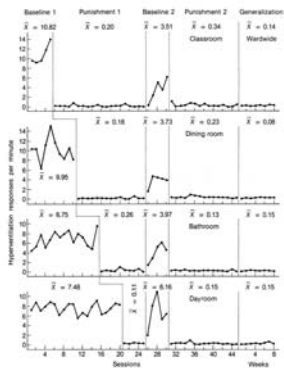
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## Example #1 Results




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## Identify Design of Example #1

- What is the IV and the DV?
- Are participants randomly assigned to condition?
- What is the design?
- Identify the characteristics of the example that allowed you to identify the design.

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## Identify Design of Example #1

- What is the IV and the DV?
  - Punishment (smelling salts)
  - Hyperventilating behavior
- Are participants randomly assigned to condition?
  - No, just one participant
- What is the design?
  - Single case experimental design (A-B-A-B)

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## Example #2

- Hypothesis
  - State of anxiety results from interaction between anxiety trait and anxiety-provoking situations
    - Trait – long-lasting, consistent
    - State –temporary manifestation
- Study examines the effect of **trait** anxiety and anxiety-provoking situations on **state** anxiety

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## Example #2

- Administer anxiety trait
  - **Group 1**: Scored high
  - **Group 2**: Scored low
- Measured pulse rate during a psychology exam
  - Threatening situation
- Measured pulse rate in non-threatening situation
  - 2 weeks after exam



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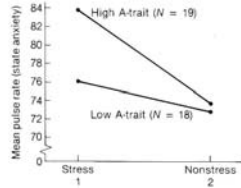
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## Example #2 Results

- Non-threatening situation
  - High group = low group
- Threatening situations
  - High group > low group



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## Identify Design of Example #2

- What is the IV and the DV?
- Are participants randomly assigned to condition?
- What is the design?
- Identify the characteristics of the example that allowed you to identify the design.

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## Identify Design of Example #2

- What is the IV and the DV?
  - Trait anxiety (high and low)
  - Situation (threatening, non-threatening)
  - State anxiety (as measured by pulse rate)
- Are participants randomly assigned to condition?
  - No
- What is the design?
  - Nonequivalent control-groups design

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### Example #3

- Contract to empty NYC parking meters
  - Brinks Inc.
  - Found guilty of “skimming”
  - NYC launched civil action
- Contract given to CDC
  - In first 10 months
  - \$1million collected than when Brinks held contract

From Fairley, W. B. and Glenn, J.E. "A question of theft" in DeGroot, M. H., Fienberg, S. E. and Kadane, J. B., eds., *Statistics and the Law*. New York: Wiley, 1986

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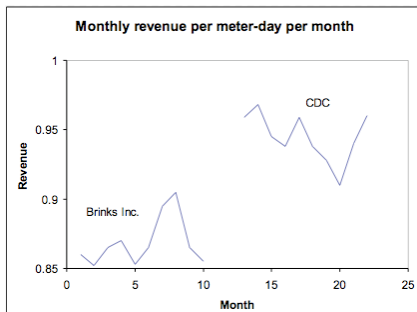
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### Example #3 (Results)



From Fairley, W. B. and Glenn, J.E. "A question of theft" in DeGroot, M. H., Fienberg, S. E. and Kadane, J. B., eds., *Statistics and the Law*. New York: Wiley, 1986

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### Example #4

- Effect of stiff drunk driving laws on the reduction of traffic fatalities and DWI citations
- Arizona instituted a tough drunk driving law in 1982
  - Mandatory jail sentences, stiff fines, license suspension even for 1<sup>st</sup> time offenders

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## Example #4

- Examined **Phoenix, AZ** and two comparable cities
  - **El Paso, TX**
    - Control group city – no change in DWI laws
  - **San Diego, CA**
    - Replication city – change in DWI laws 6 months prior to change in AZ law
- Data on traffic fatalities and DWI citations collected from 1976 to 1984

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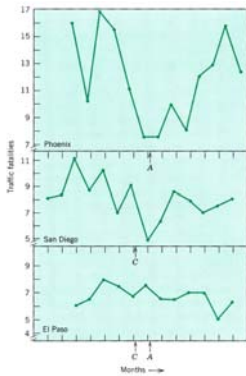
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## Example #4 Results



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## Identify Design of Example #4

- What is the IV and the DV?
- Are participants randomly assigned to condition?
- What is the design?
- Identify the characteristics of the example that allowed you to identify the design.

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## Identify Design of Example #4

- What is the IV and the DV?
  - Change in DWI laws
  - Number of fatalities and DWI citations
- Are participants randomly assigned to condition?
  - No
- What is the design?
  - Interrupted time series design

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