

Alignment of Power and Data Analysis

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Learning objectives

Define alignment in the context of power analysis.

Learn what features must be aligned to compute power and sample size correctly.

Understand what problems can happen if power and data analysis are not aligned.

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Alignment means that the power analysis and data analysis describe the same experiment

The power analysis and the planned data analysis must share the same data collection, scientific goal, hypothesis, analysis, statistical model, statistical test, and Type I error.

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We will discuss how to conduct an aligned power analysis for the longitudinal study of pain recall

Vignette

Researchers conducted a study to determine if participants who were instructed to use a sensory focus had a different pattern of long-term memory of pain than participants who did not use a sensory focus.

Logan, Baron, and Kohout, 1995

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Vignette, continued

Participants were selected and randomly assigned to either intervention, i.e. sensory focus, or no intervention.

Logan, Baron, and Kohout, 1995

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Vignette, continued

Those in the intervention group listened to automated audio instructions to pay close attention only to the physical sensations in their mouth. Patients in the no intervention group listened to automated audio instruction on a neutral topic to control for media and attention effects.

Logan, Baron, and Kohout, 1995

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Recall, this study analyzed the impact of treatment on the memory of pain

Null hypothesis:

Participants receiving the sensory focus treatment experience the same pattern of pain over time as participants receiving the standard of care treatment.

Logan, Baron, and Kohout, 1995

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The scientists wished to compare the experience of the two groups

What was measured: Patients were asked to rate their memories of pain at baseline, and at 3 and 6 months.

Scientific goal: The goal of the study was to compare the intervention group to the standard of care group in terms of their pattern of memory of pain over time.

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The scientists wished to compare the experience of the two groups

Null hypothesis: No difference in pattern of pain over time between groups, or no group by time interaction.

Planned analysis: The scientists planned a repeated measures analysis of variance.

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The scientists planned a repeated measures analysis of variance

Model: The scientists planned to fit a general linear multivariate model, with the repeated measurements of memory of pain as the outcome, and indicator variables for group as the predictors.

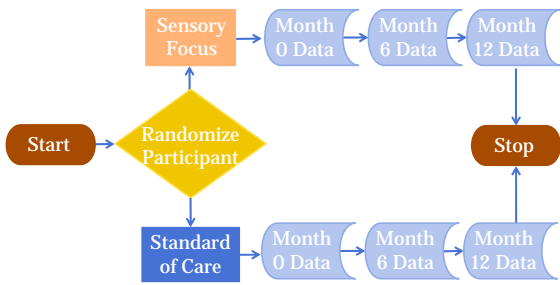
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The scientists planned a repeated measures analysis of variance

Statistical test: The scientists planned to use a Hotelling-Lawley statistic to test interaction between group and time with an 0.01 Type I error rate.

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Observed pain after root canal was measured at 0, 6, and 12 months



Logan, Baron, and Kohout, 1995

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Power analysis must be aligned with the planned data analysis

Study Component	Power Analysis	Data Analysis
Type I error	0.01	0.01
Hypothesis	Time x treatment interaction using repeated measures ANOVA and Hotelling-Lawley trace	Time x treatment interaction using repeated measures ANOVA and Hotelling-Lawley trace

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CONSEQUENCES OF MISALIGNMENT

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Power and sample size analysis can be incorrect for a variety of reasons

Three common reasons are:

1. Wrong event criterion
2. Wrong correlation structure
3. Wrong hypothesis

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Power Depends on the Hypothesis Tested and Pattern of Cell Sizes
 Approximate Power ($\times 100$)

Cell Sizes	Hypothesis Tested		
	Difference at Last Time	Linear Trend	Linear and Quadratic
Balanced	83	35	26
IHDP Ratios	51	18	14

From Table 11 in Muller et al. (1992). Means (\mathbf{B} multiplier=0.5), standard deviations and correlations based on IHDP control data. IHDP spread within intervals, cubic polynomial predictors model, and between test of all slopes for $N=100$.

REVIEW OF LEARNING OBJECTIVES

- List the components of studies that must match to achieve alignment**
- Same scientific goal
 - Same experimental design
 - Same model
 - Same hypothesis
 - Same statistical test
 - Same Type I error