

PRINCIPAL INVESTIGATOR RESEARCH TRAINING
SESSION 2:

Sample Size and Power

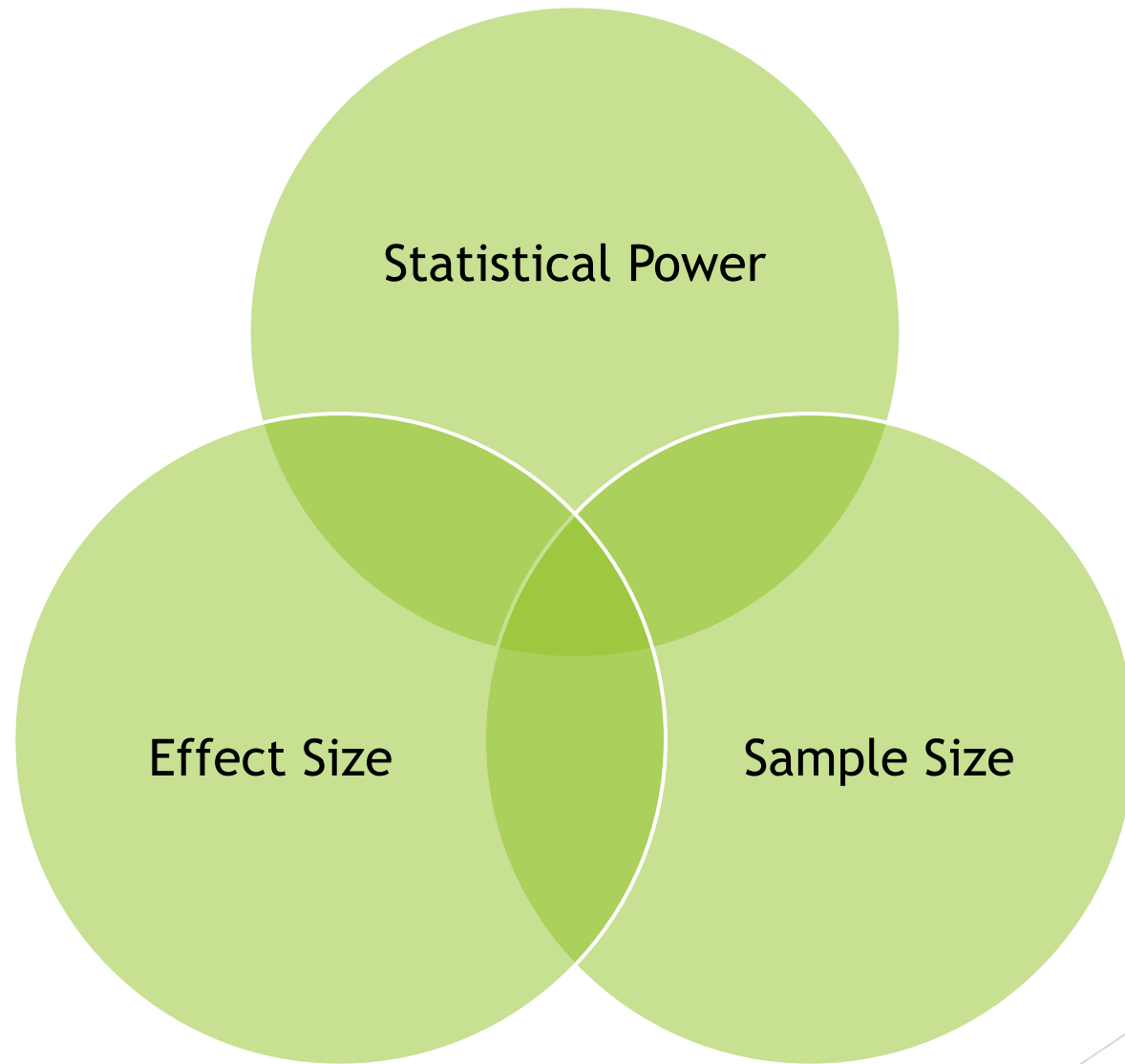
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Statistical Power

- ▶ Chance of finding a significant p -value!!!
 - ▶ Probability that a test will reject the null hypothesis
- ▶ Dependent upon:
 - ▶ Effect size (Large vs. small)
 - ▶ Sample size (Large vs. small)
 - ▶ Precision and accuracy of variables (Categorical/ordinal vs. continuous)
 - ▶ Variance in the population (Homogeneity vs. heterogeneity)
 - ▶ Research Design (Between-subjects, within-subjects, multivariate)
- ▶ Most studies are powered at .80

Effect Size and Statistical Power

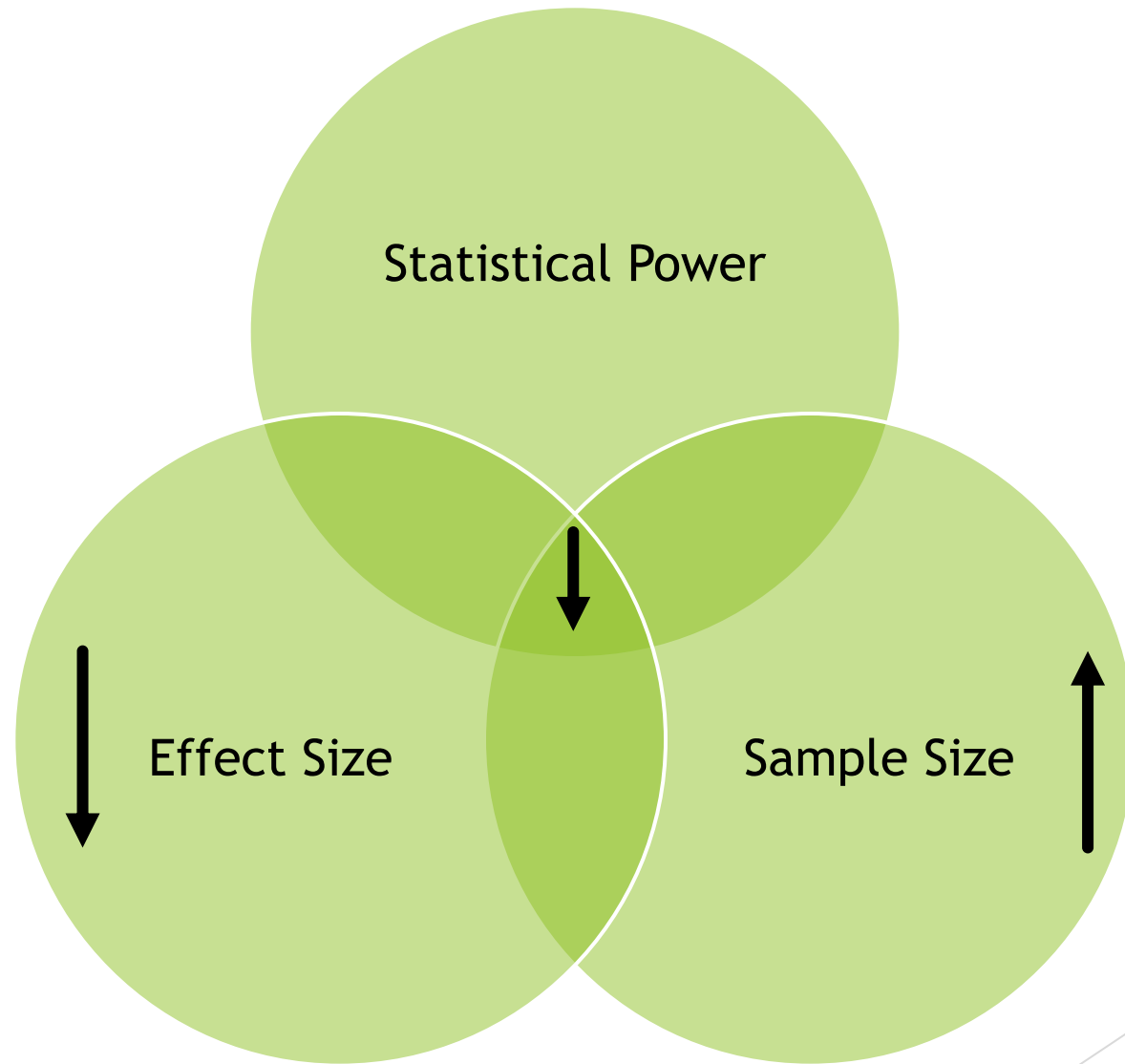
- ▶ The effect size is what researchers are attempting to detect in a research study
- ▶ The difference between means or proportions expected as a result of treatment
 - ▶ Categorical outcomes - Effect size is difference in proportions
 - ▶ Continuous outcomes - Effect size is difference in mean values and variances
- ▶ Large effect sizes are easier to detect, leading to increased statistical power, and decreased sample size
- ▶ Small effect sizes are harder to detect, leading to decreased statistical power and increased sample size
- ▶ HARDEST part of planning a study
- ▶ Often times, you're trying to find it out!
 - ▶ Literature review, clinical experience, educated guess

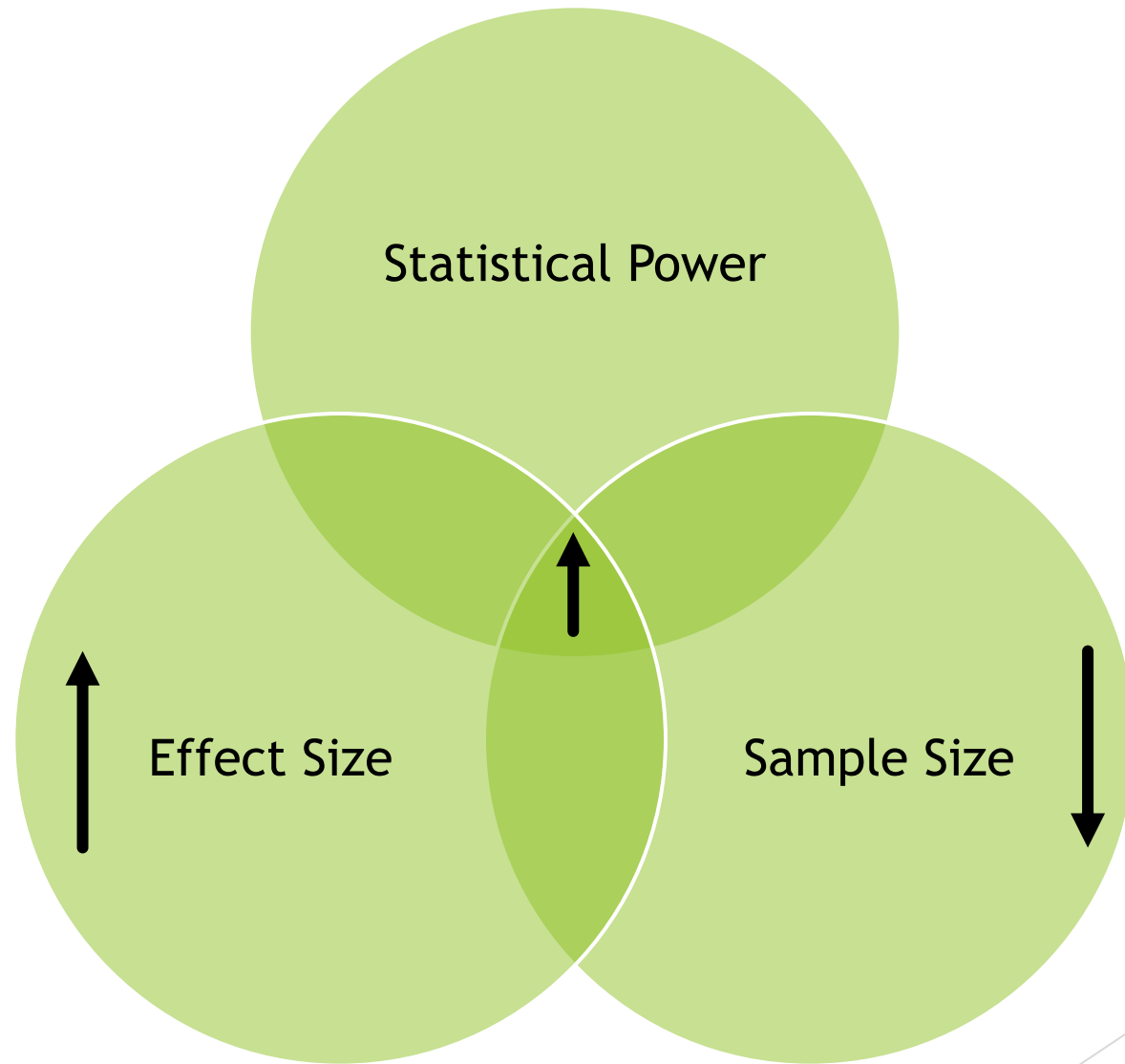


Statistical Power

Effect Size

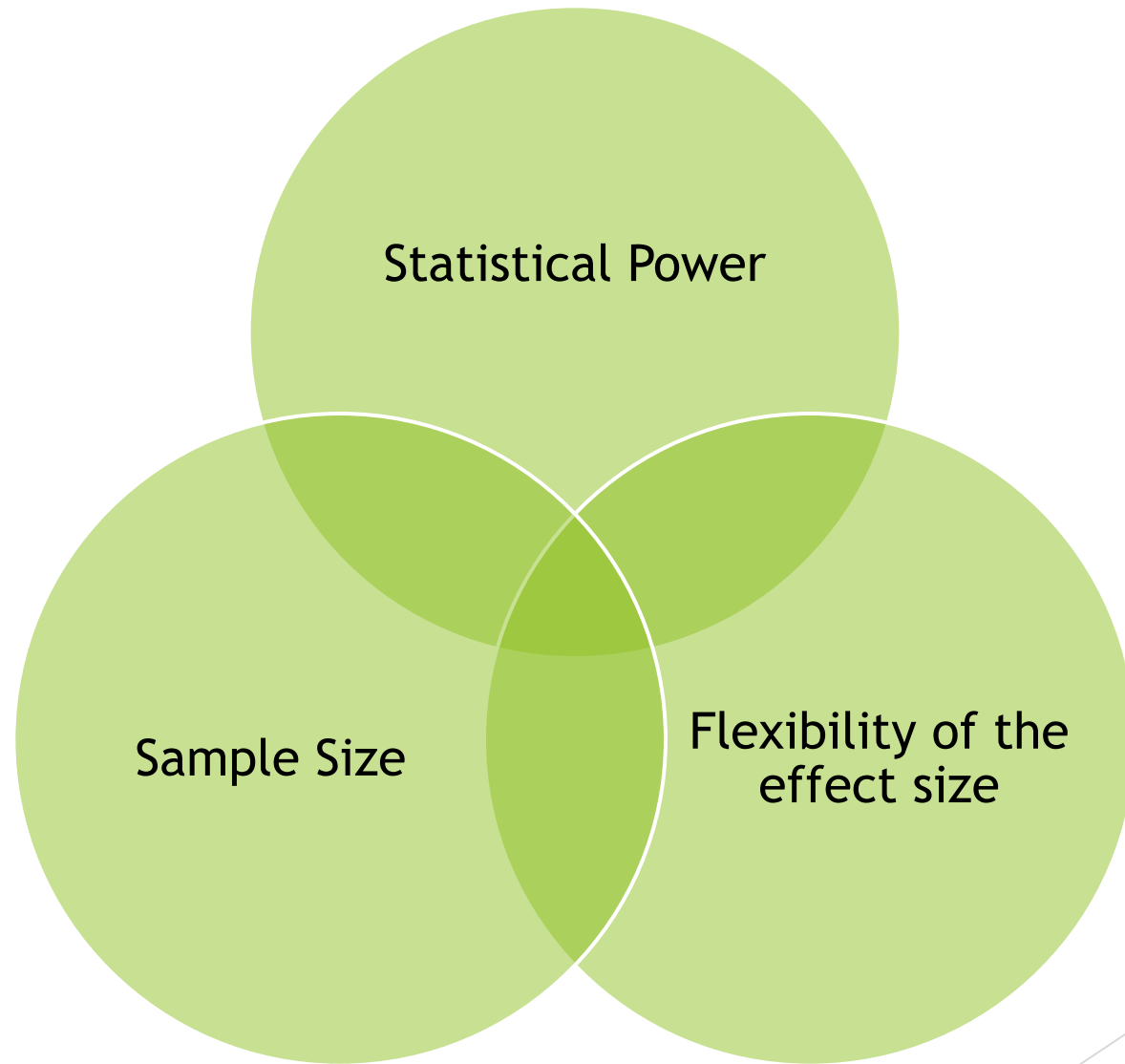
Sample Size





Sample Size and Statistical Power

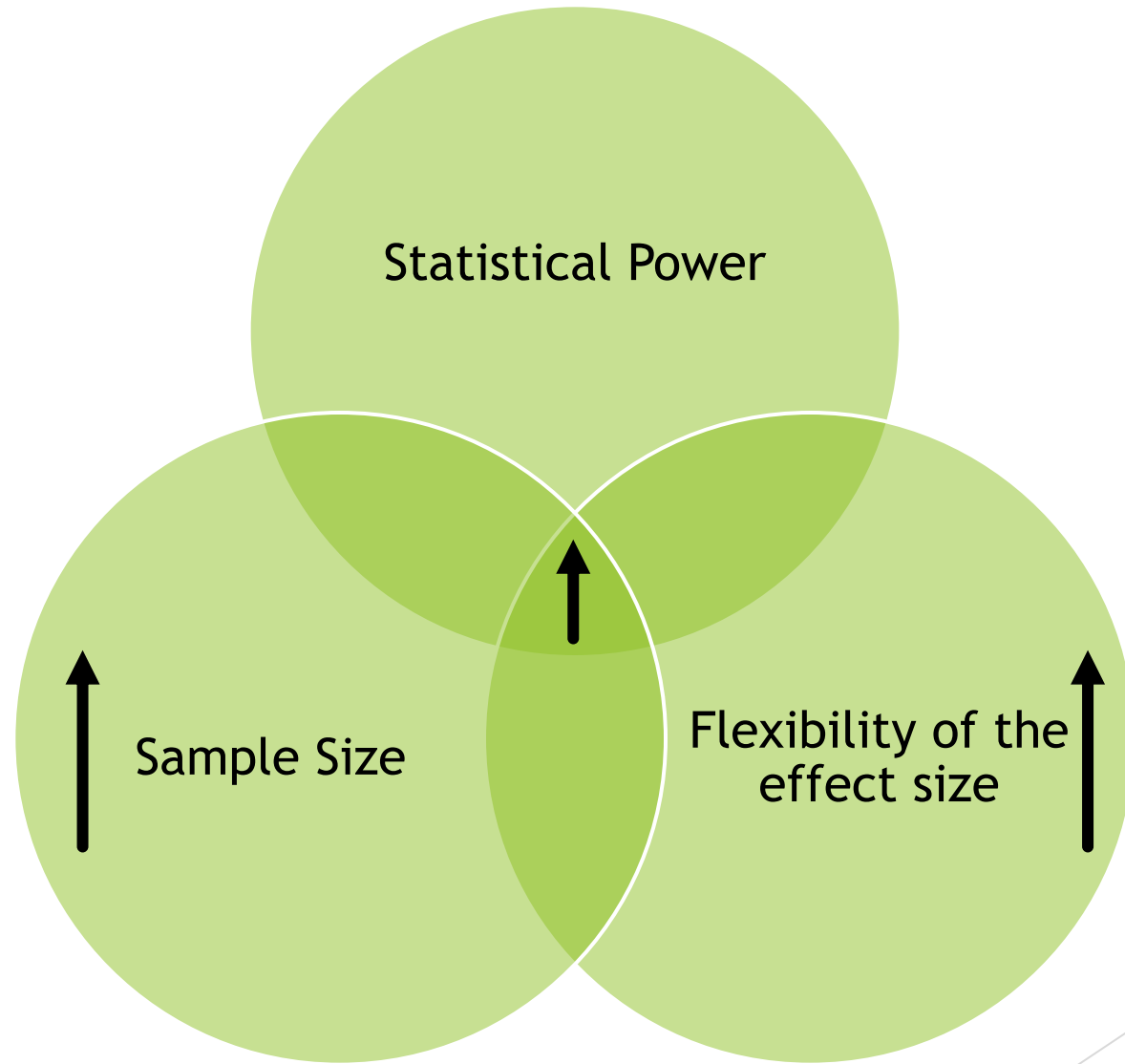
- ▶ Samples are taken from populations in order to make inferences
- ▶ Sampling methodologies dictate whether causal effects can be detected
- ▶ Probability sampling vs. non-probability sampling
- ▶ Larger sample sizes will always increase statistical power, and allow for the detection of both small and large effects sizes, regardless of variance in the population
- ▶ Smaller sample sizes will always decrease statistical power, and not allow for the detection of either small or large effect sizes

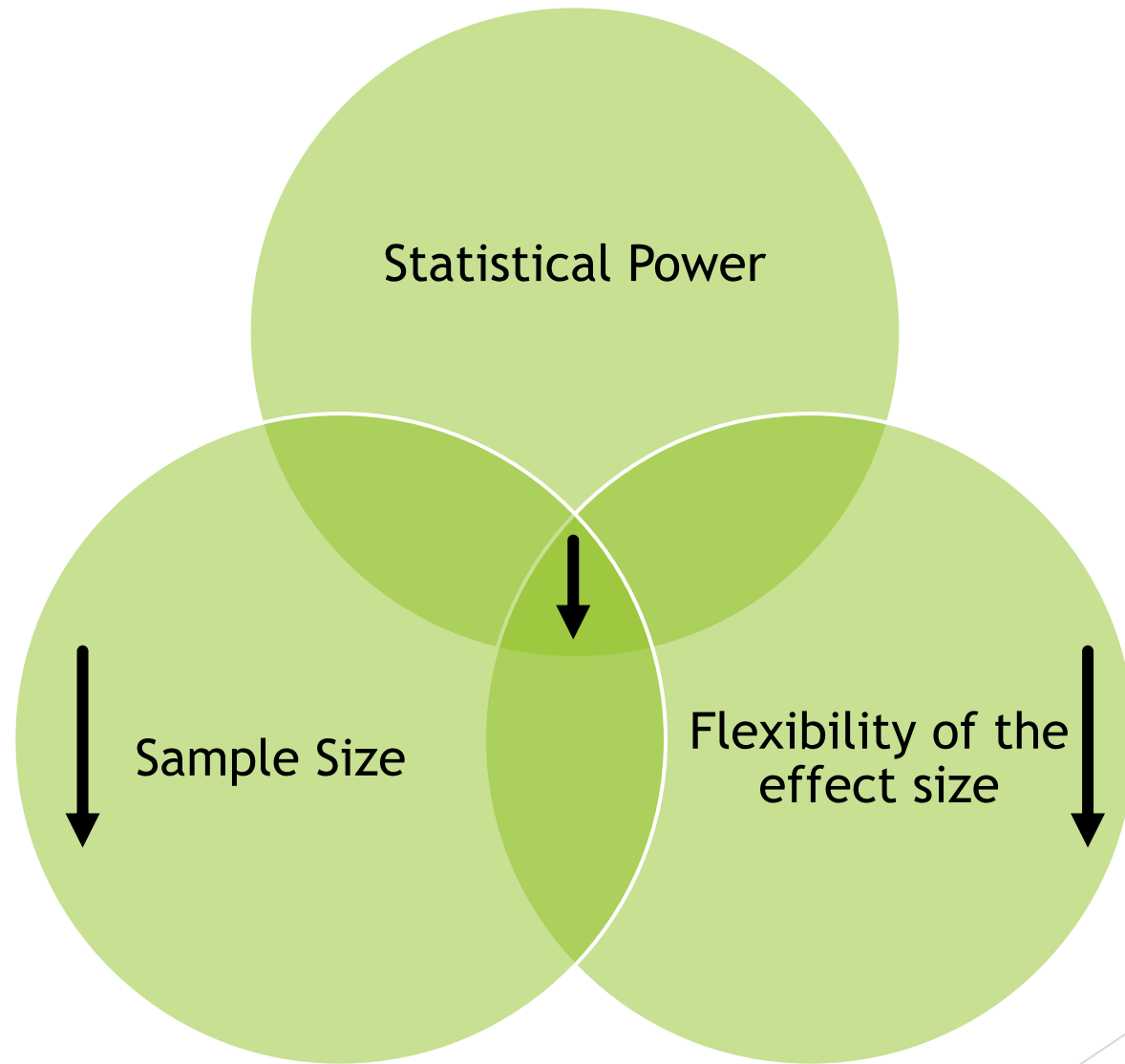


Statistical Power

Sample Size

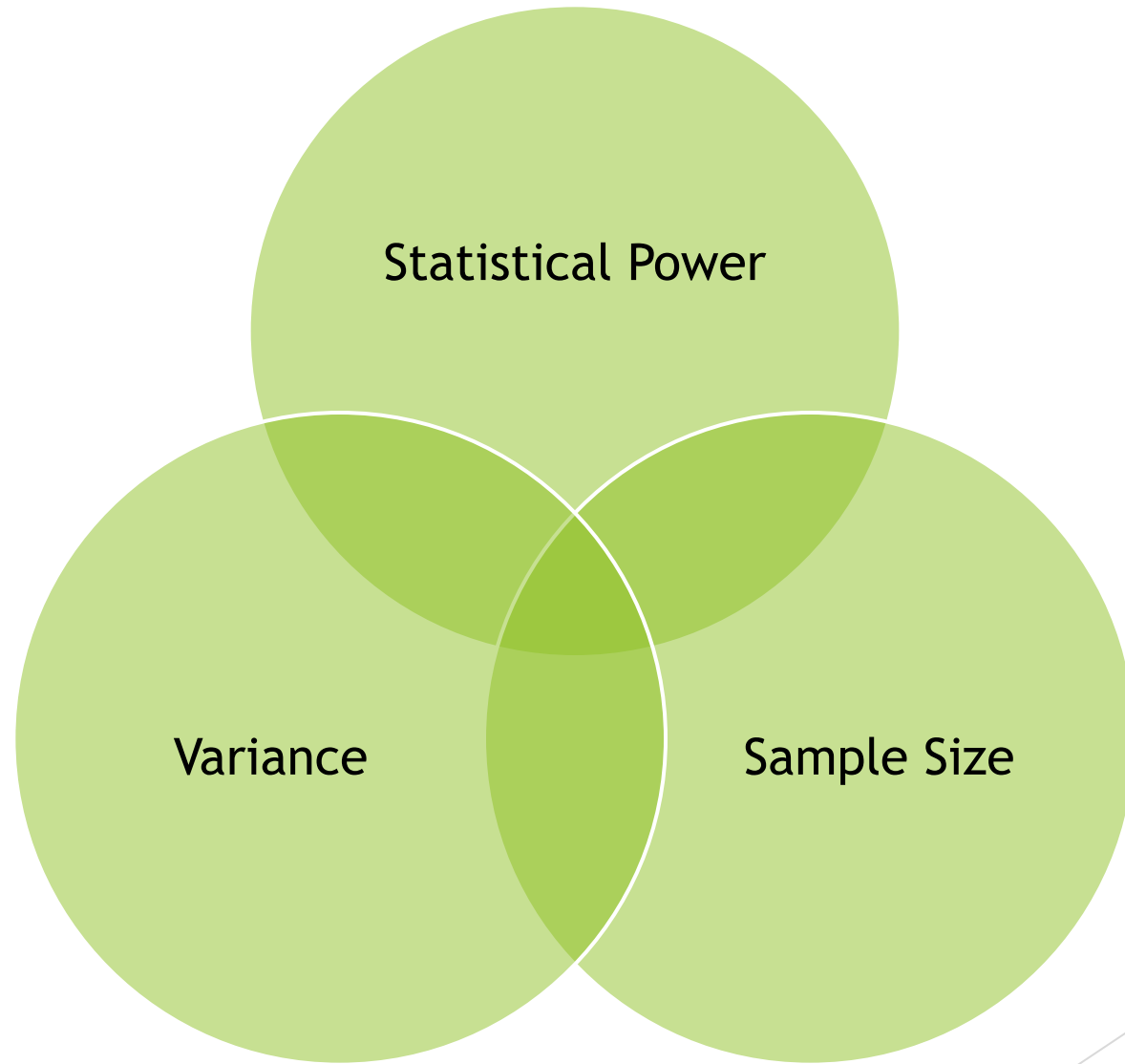
Flexibility of the
effect size





Variance of Population and Statistical Power

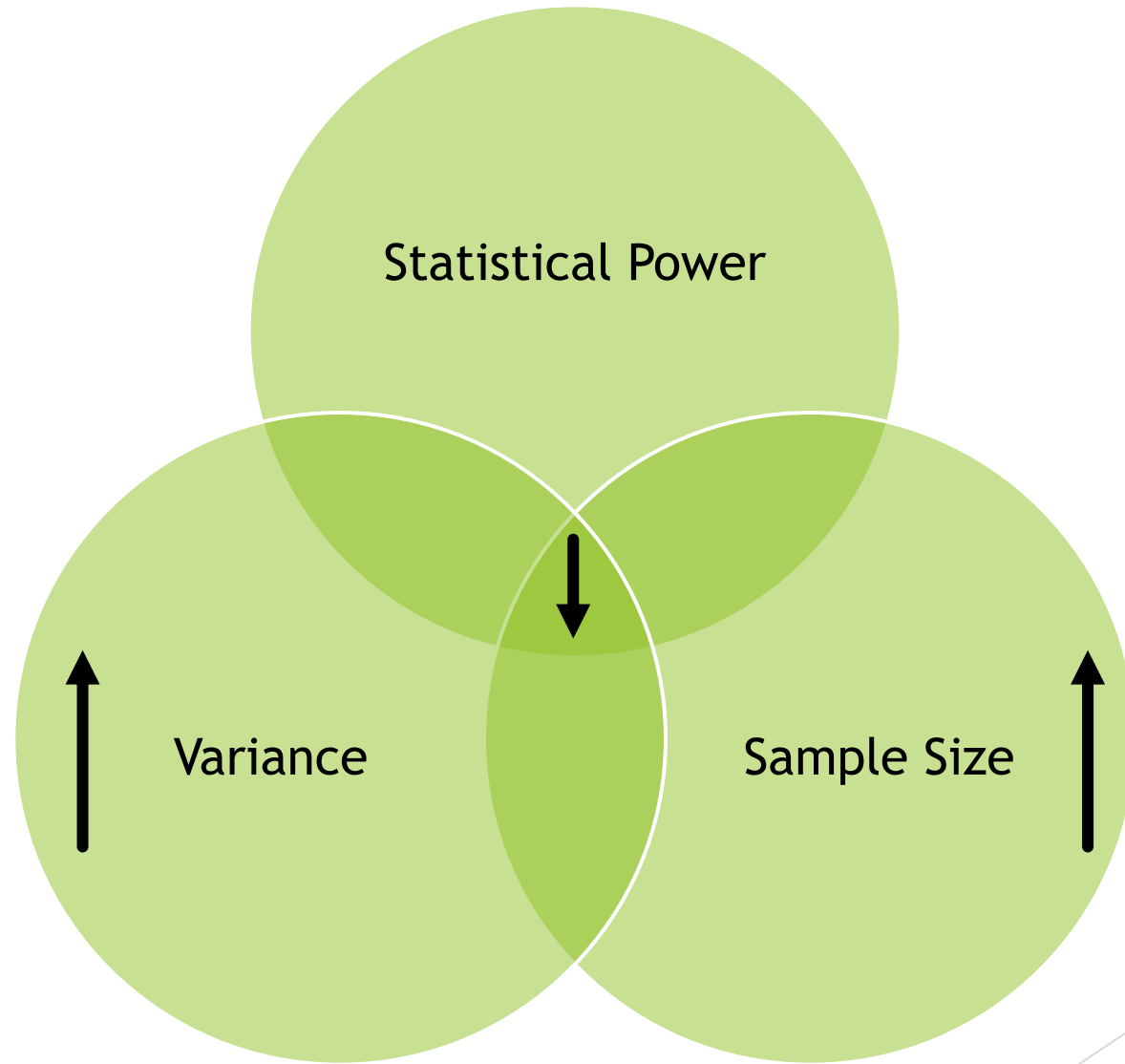
- ▶ Homogeneous populations, sometimes based on strict inclusion and exclusion criteria, will not possess a lot of variance, they are naturally similar and have the same level of exposure to the predictor of interest at allocation. Homogeneity increases statistical power.
- ▶ Heterogeneous populations, sometimes based on vague inclusion and exclusion criteria, will possess more variance, they are naturally diverse and have differing levels of exposure to the predictor of interest at allocation. Heterogeneity decreases statistical power.
- ▶ Best practices in research...
 - ▶ Work with homogeneous populations, unless there is a large enough pool of participants to study so that outliers and diversity do not detract for detecting significance
 - ▶ When an effect size is not known, researchers should over-estimate the variance so that they are forced, by default, to collect more observations

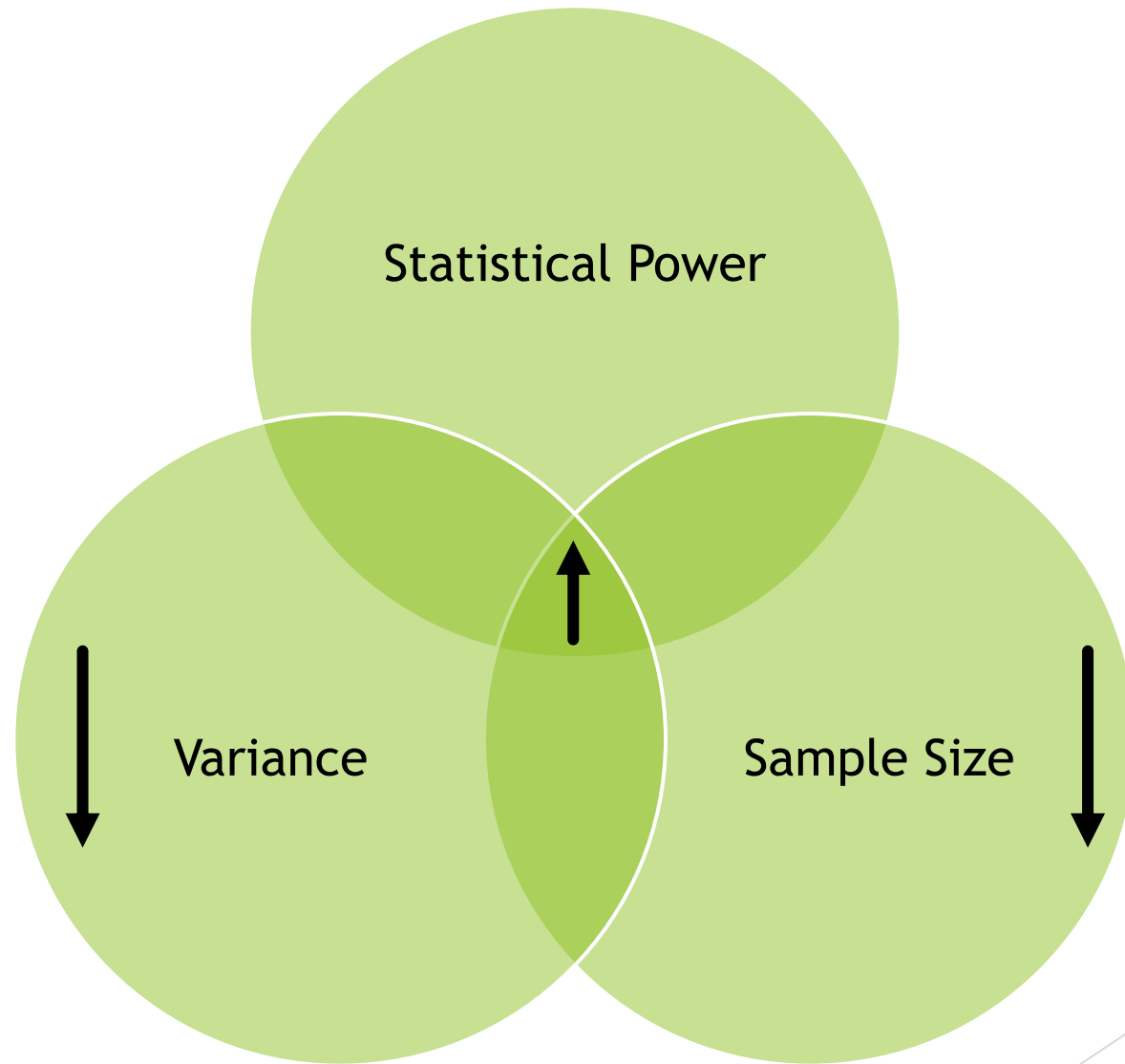


Statistical Power

Variance

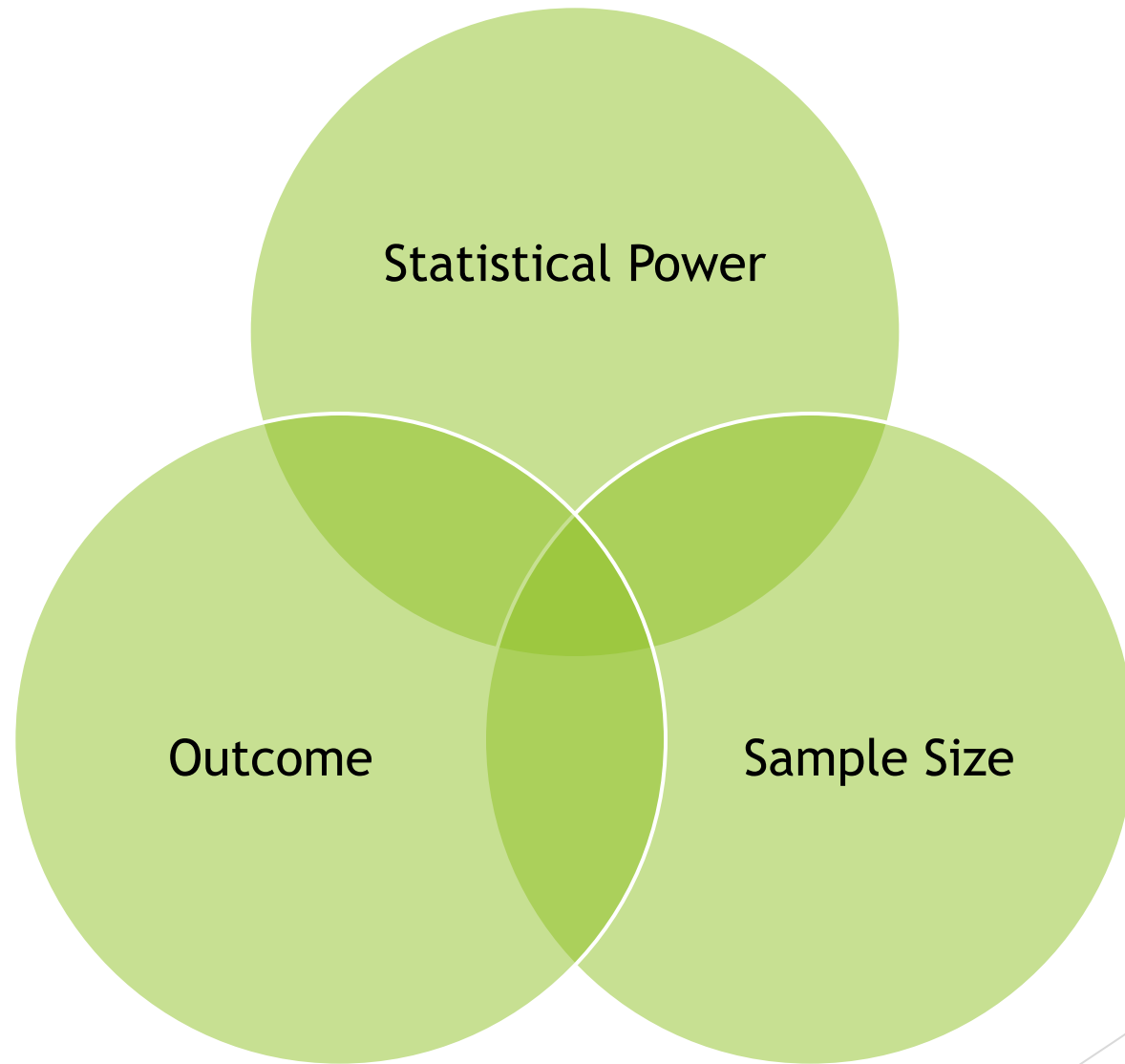
Sample Size





Measurement and Statistical Power

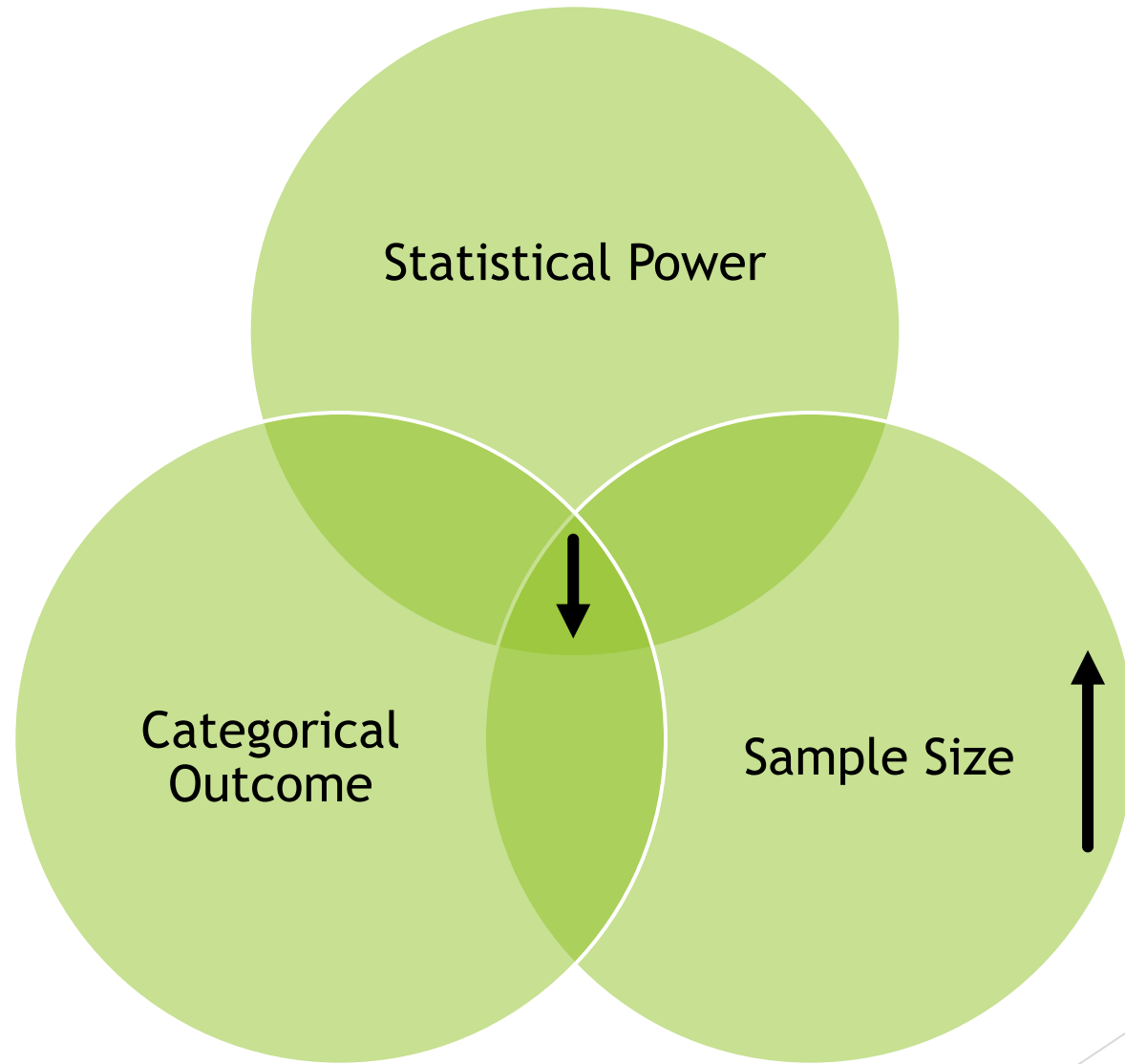
- ▶ Measurement of variables has drastic implications on statistical power
- ▶ Outcomes should be measured for using the current “gold standard” to increase generalizability of inferences
- ▶ Categorical outcomes lack precision and accuracy because of observation biases
- ▶ Ordinal outcomes lack precision and accuracy because of the subjective nature of ratings, observation biases
- ▶ Continuous outcomes possess the most precision and accuracy because of the “true zero” that allows for measures of both distance and magnitude

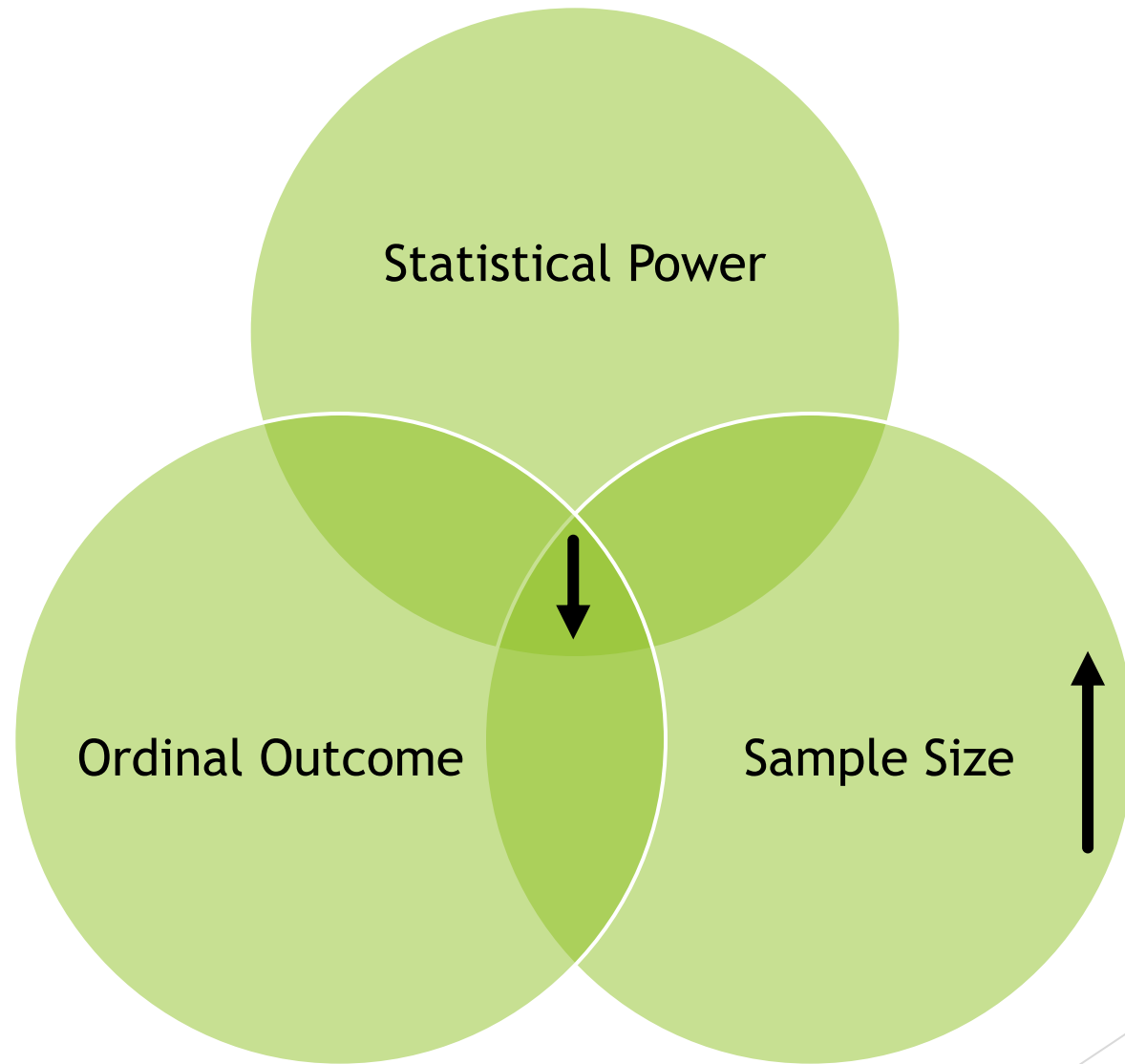


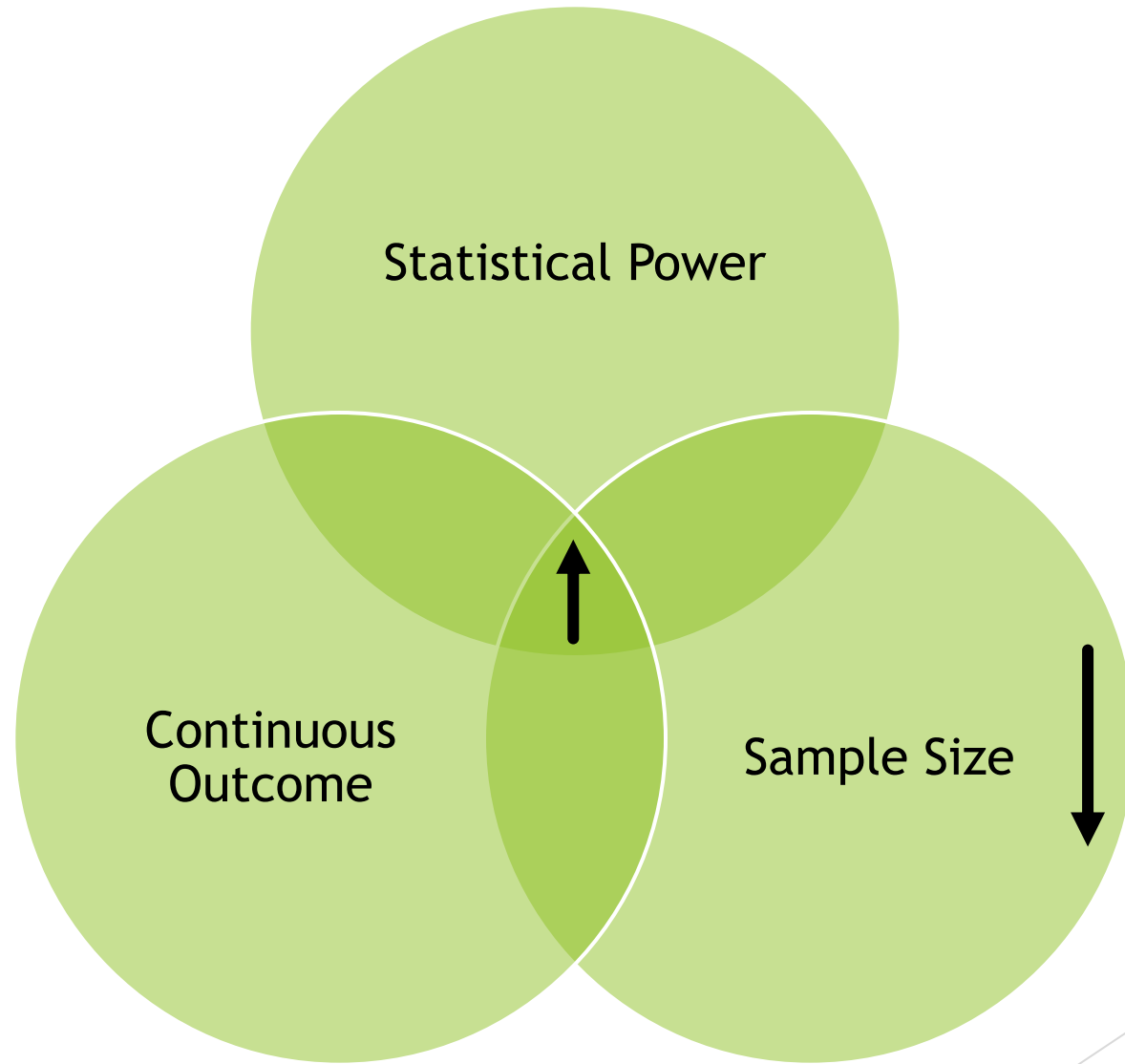
Statistical Power

Outcome

Sample Size

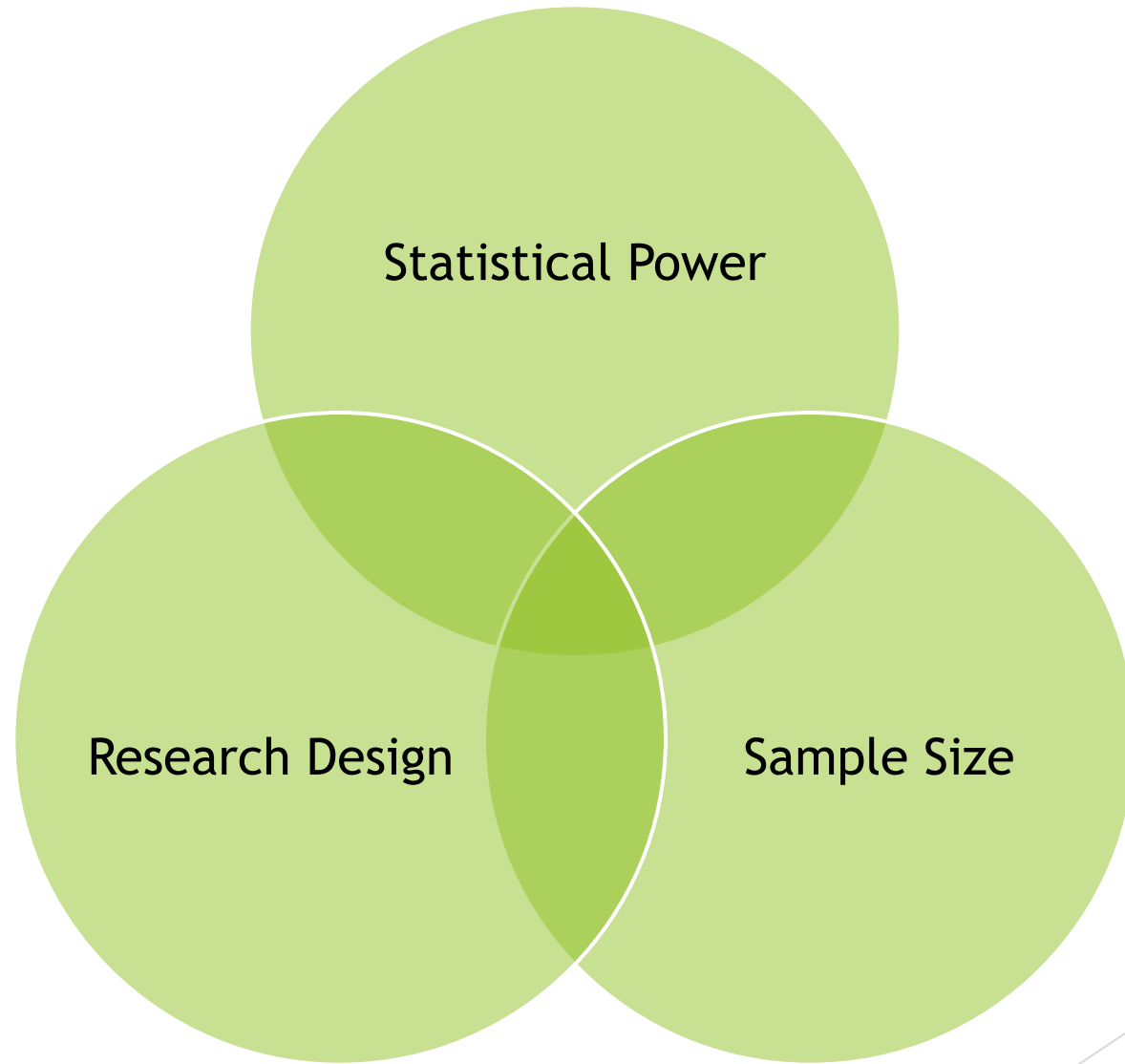






Research Design and Statistical Power

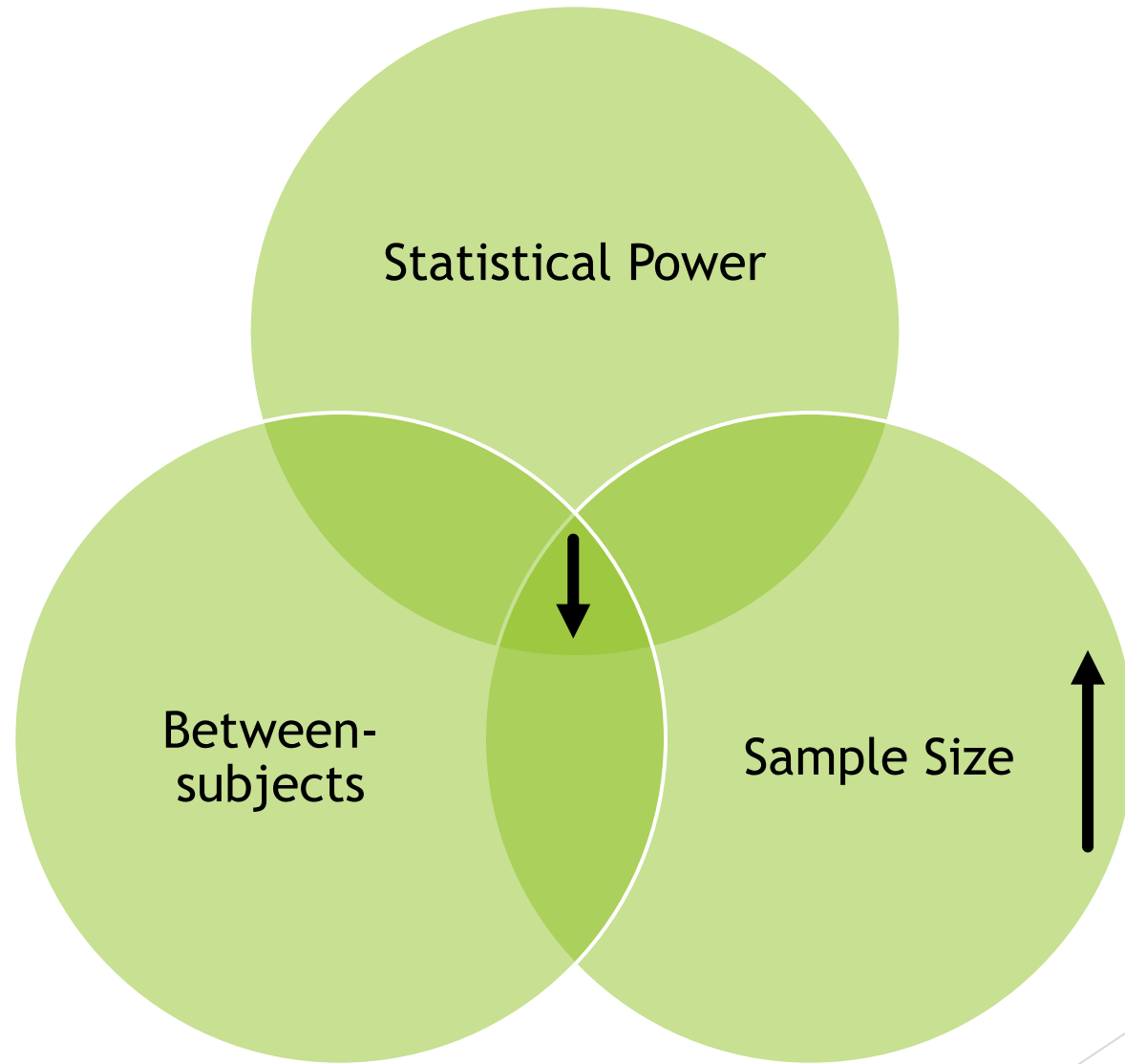
- ▶ The choice of research design is 100% dependent upon answering the research question
- ▶ Between-subjects designs decrease statistical power and increase the sample size because you have to populate multiple independent groups
- ▶ Within-subjects designs increase statistical power and decrease the sample size because each participant serves as their own control
- ▶ Multivariate designs decrease statistical power and increase the sample size because more observations are needed to detect confounding effects



Statistical Power

Research Design

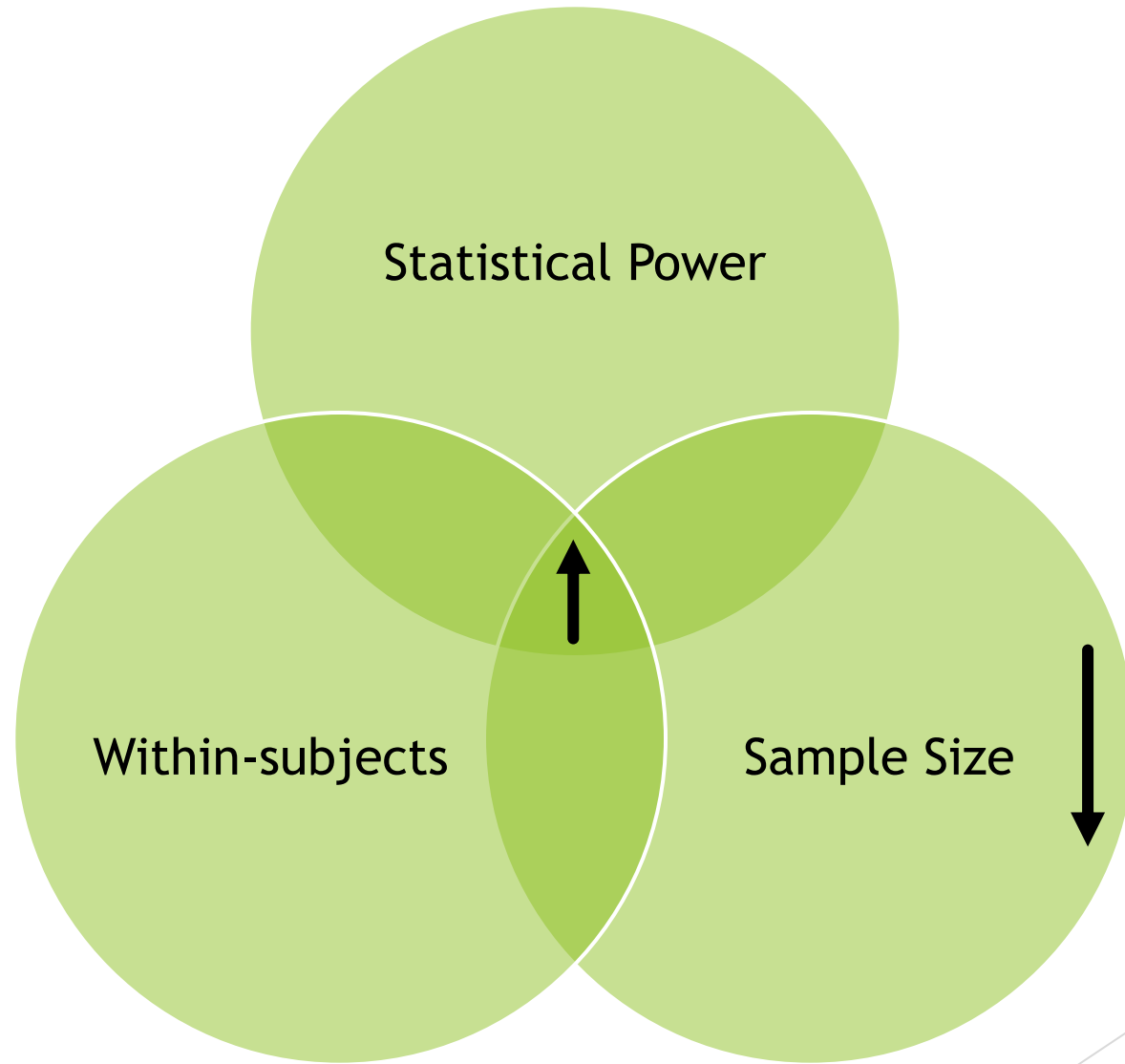
Sample Size

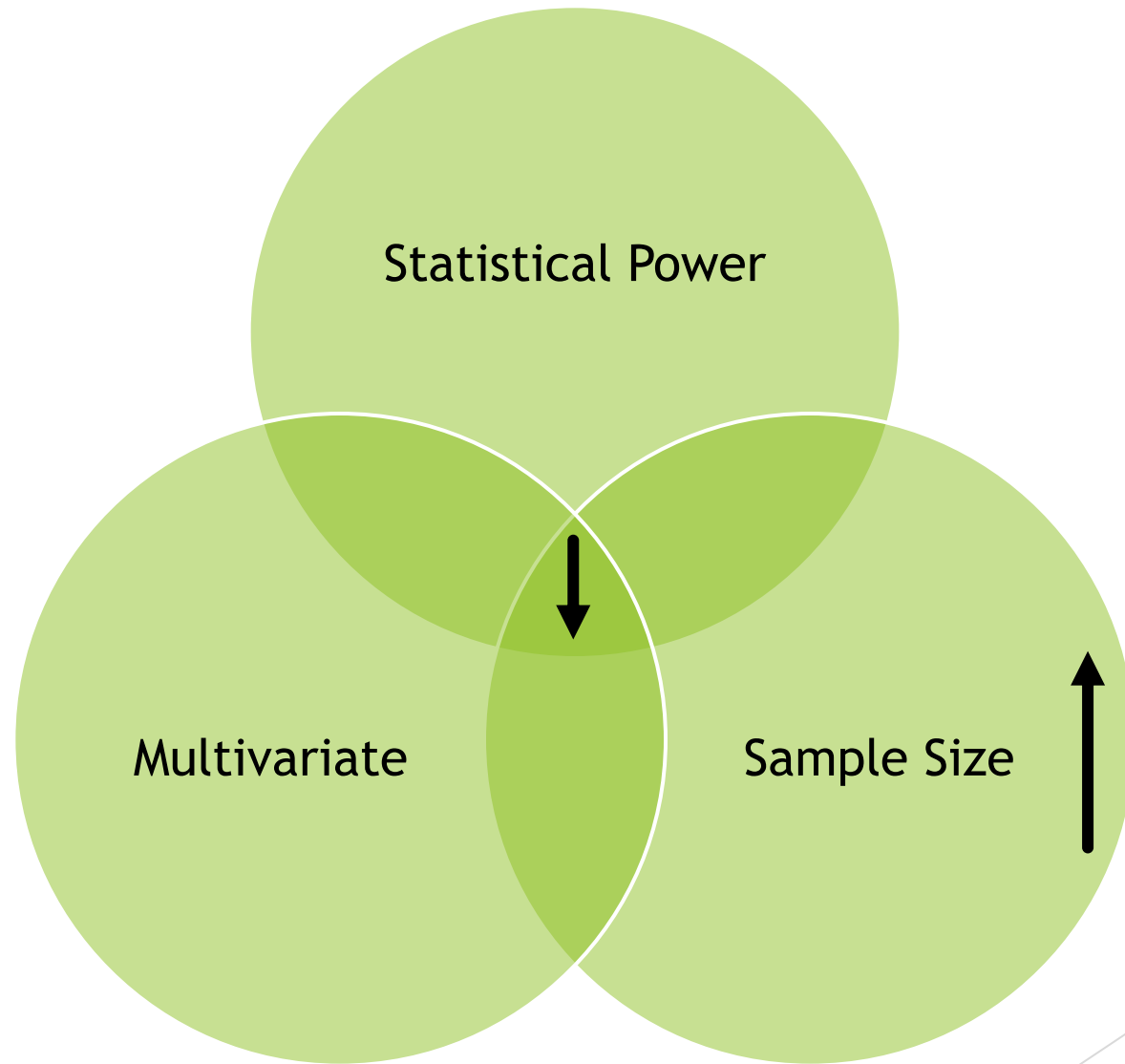


Statistical Power

Between-subjects

Sample Size





Statistical Power Reasoning

- ▶ Effect Size
 - ▶ Large effect size -> More statistical power
 - ▶ Small effect size -> Less statistical power
- ▶ Sample Size
 - ▶ Large sample size -> More statistical power
 - ▶ Small sample size -> Less statistical power
- ▶ Variance in population
 - ▶ Homogenous -> More statistical power
 - ▶ Heterogeneous -> Less statistical power
- ▶ Measurement
 - ▶ Continuous -> More statistical power
 - ▶ Ordinal -> Less statistical power
 - ▶ Categorical -> Less statistical power
- ▶ Research Design
 - ▶ Between-subjects -> Less statistical power
 - ▶ Within-subjects -> More statistical power
 - ▶ Multivariate -> Less statistical power