

# experiment sandbox



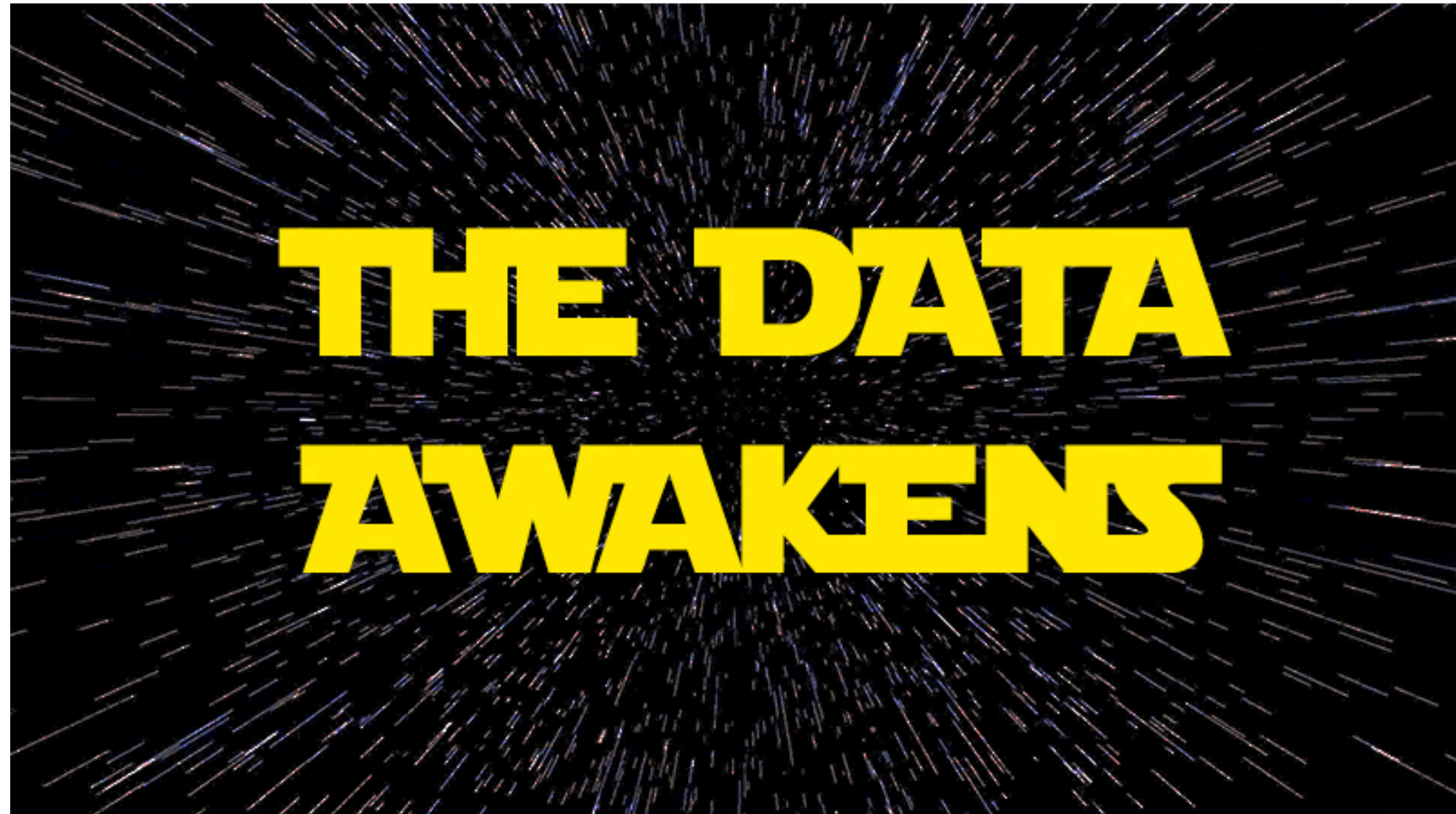
resource: experimental design 4 the life sciences 4e

**@cjlortie**

**power** thinking in experimental design



how much data do you need to collect?



# **workflow** for extent of replication



1. structured observation
2. check literature
3. power analysis



# power criteria checklist



effect sizes  
random variation  
number of replications (n)

**effect size** is the strength of an intervention  
or a factor in an experiment



magnitude and sign



**random variation** is the variation between samples/subjects

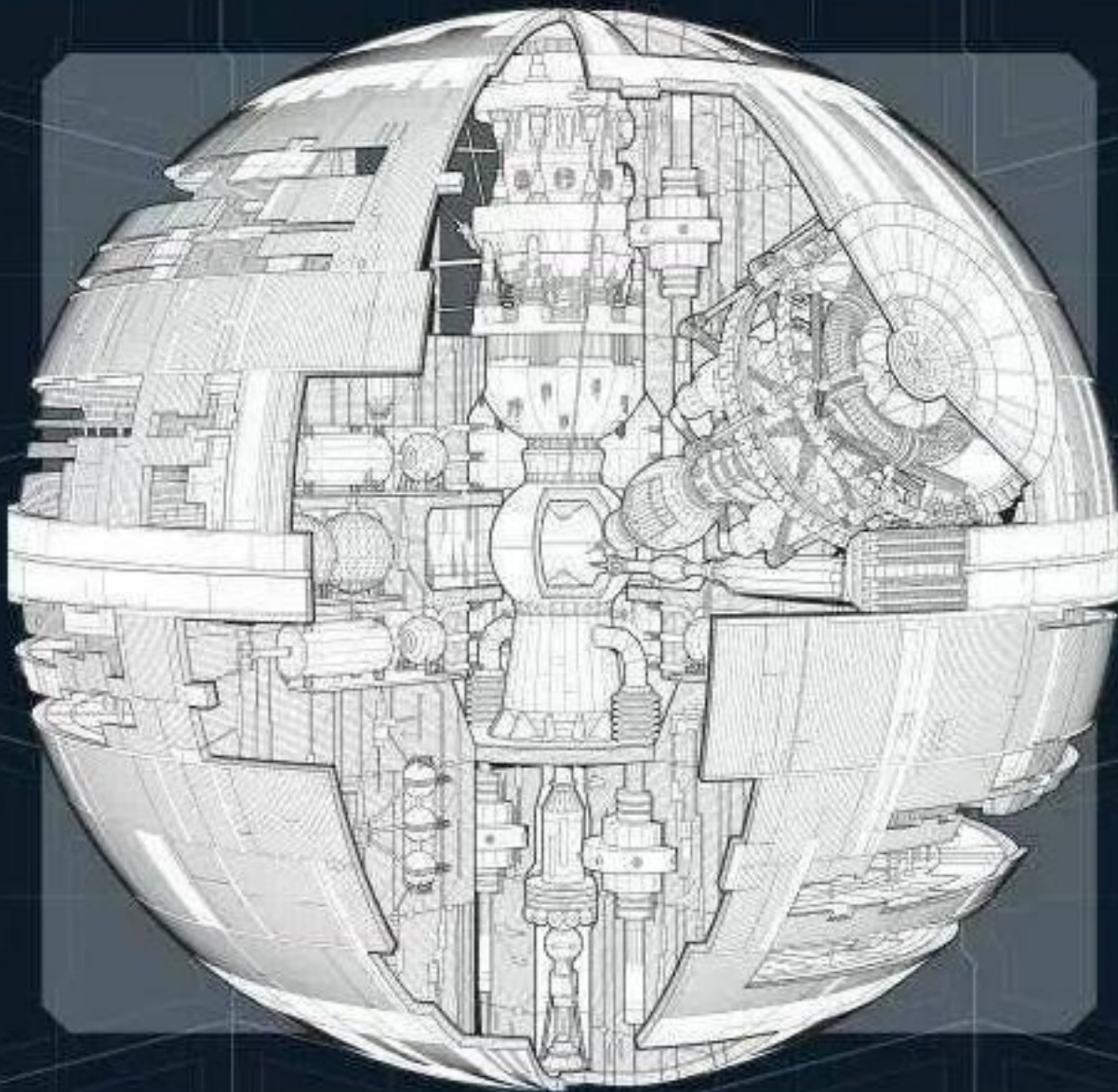


# STAR WARS DEATH STAR



Imperial DS-1 Orbital Battle Station

## Owner's Technical Manual



**tools**

estimate strength of  
treatment effects

literature  
pilot experiment  
mechanism  
re-sampling random data



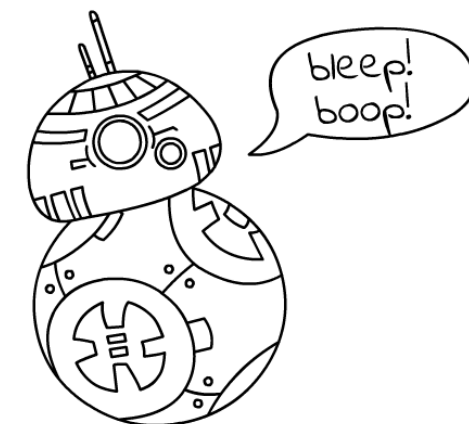
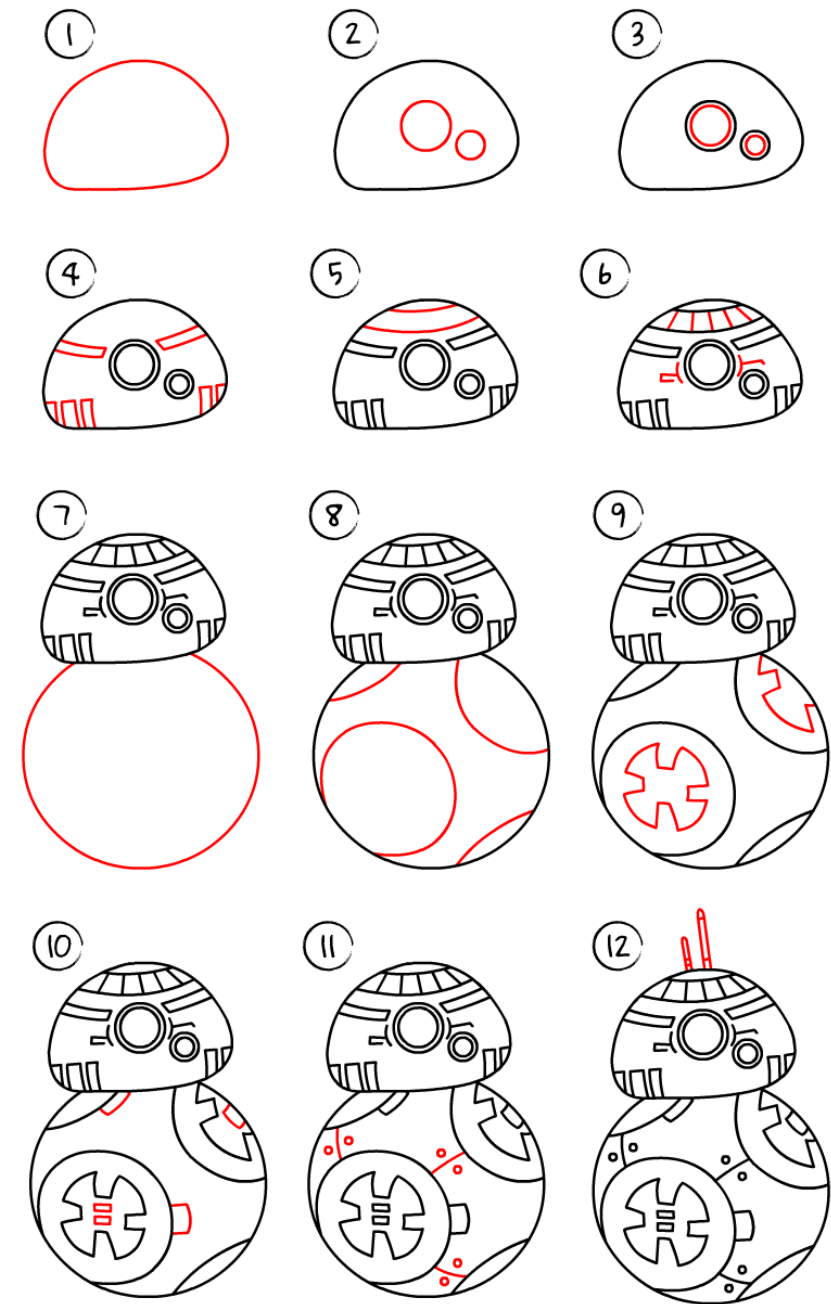
repeat estimation of effect sizes as needed  
& test for different designs too





# how to draw bb-8

random draw  
to plot treatment differences  
or generate more formal  
power curves





# tools



many other tools to solve  
challenge of increasing  
power (i.e. likelihood of  
detecting differences)

# **design thinking**

reduce random variation

improve experimental techniques

homogenize conditions

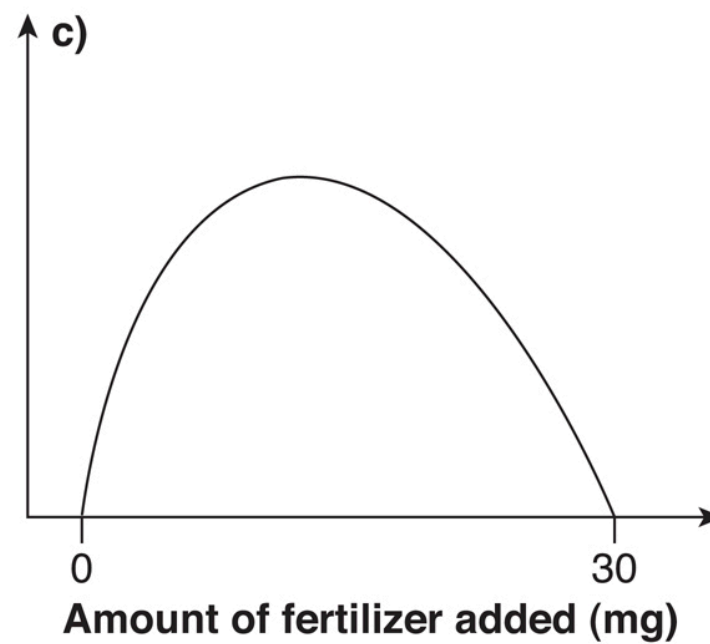
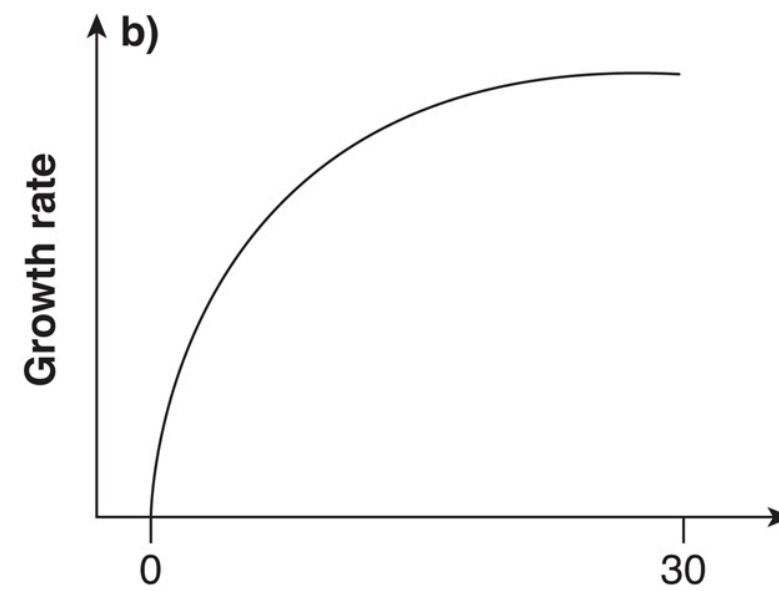
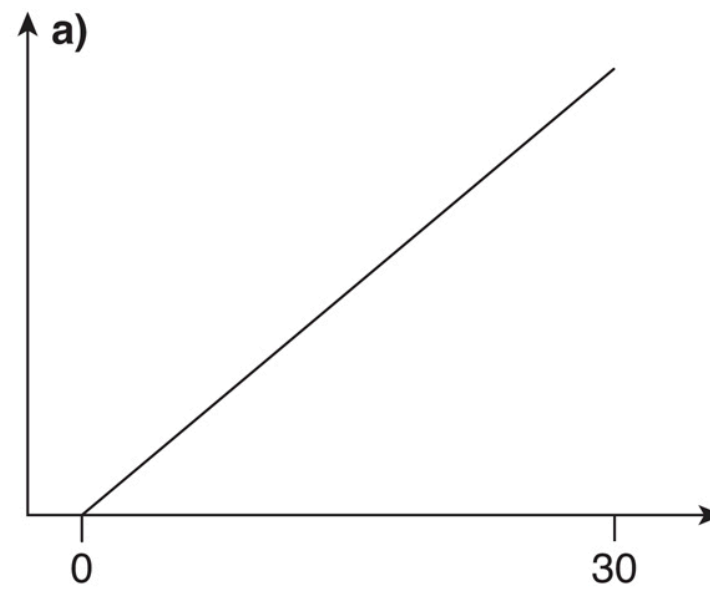
limit subset of population sampled

block variation

apply/sample treatments that the most different



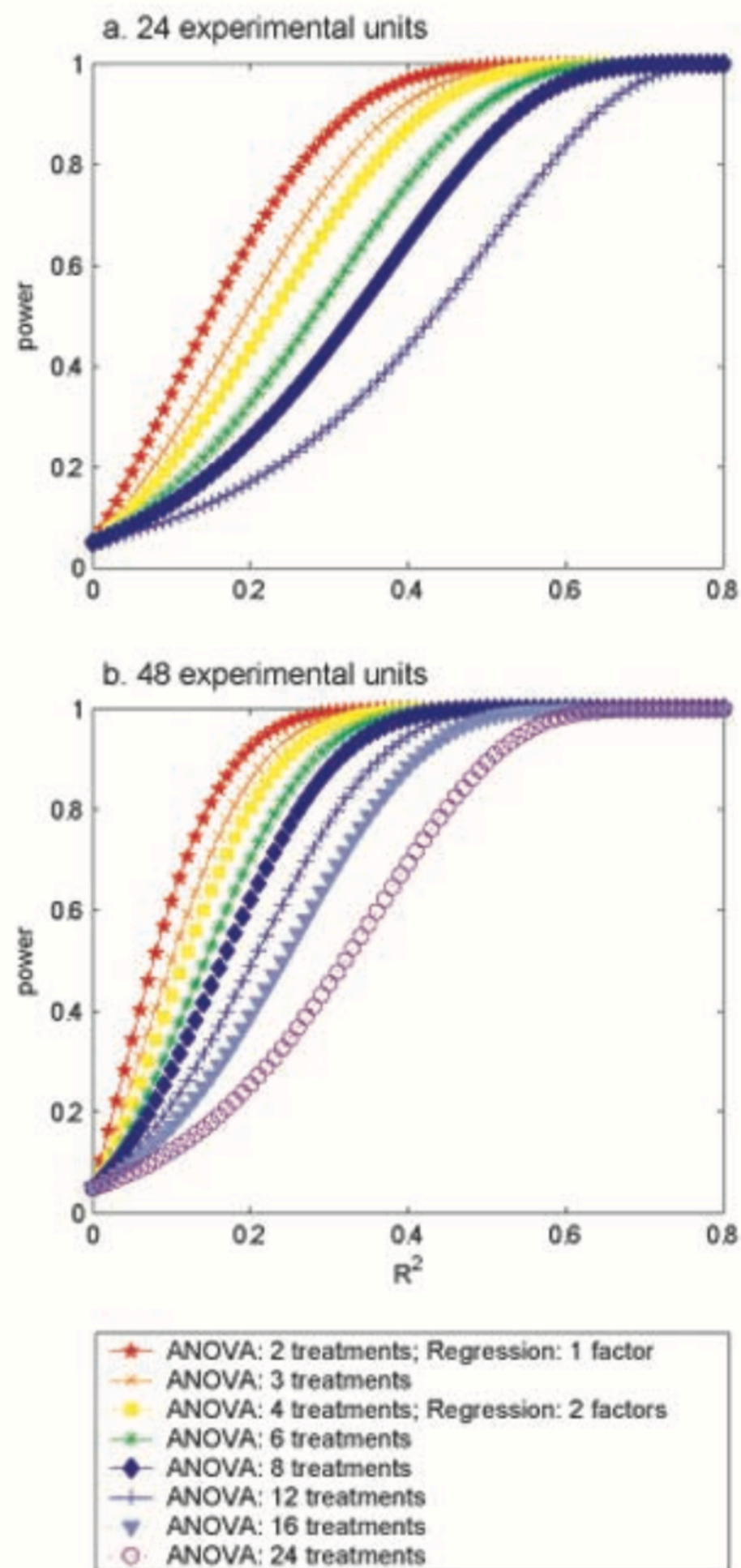
how you spread out replications across a gradient  
(replication AND how many levels you test)



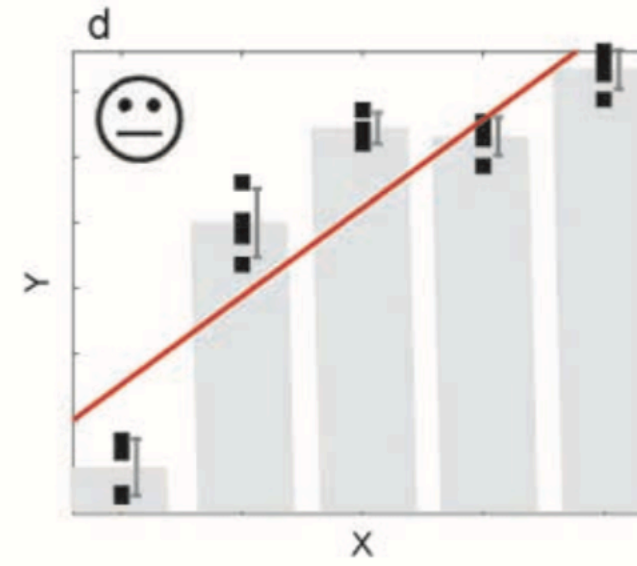
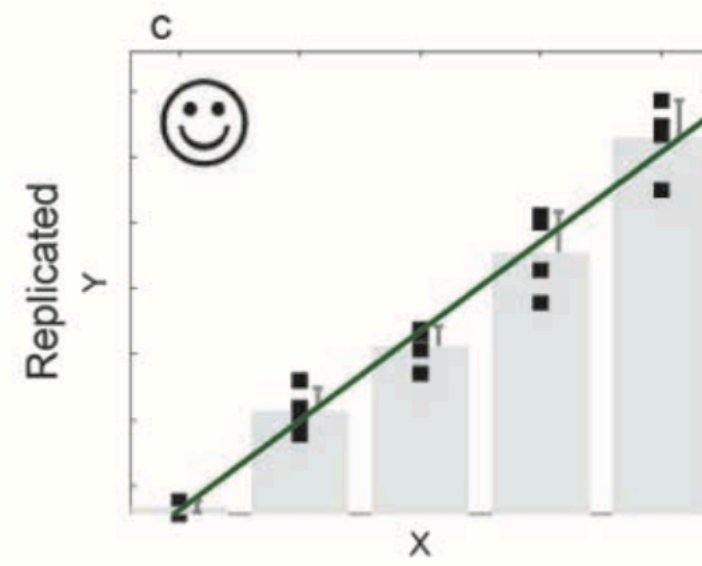
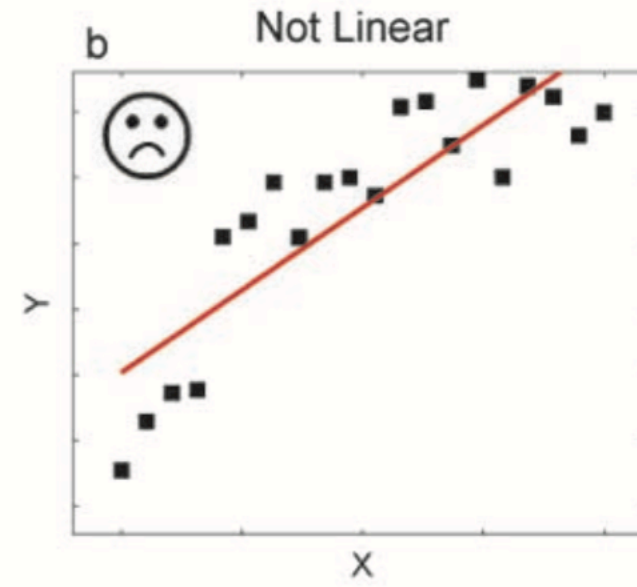
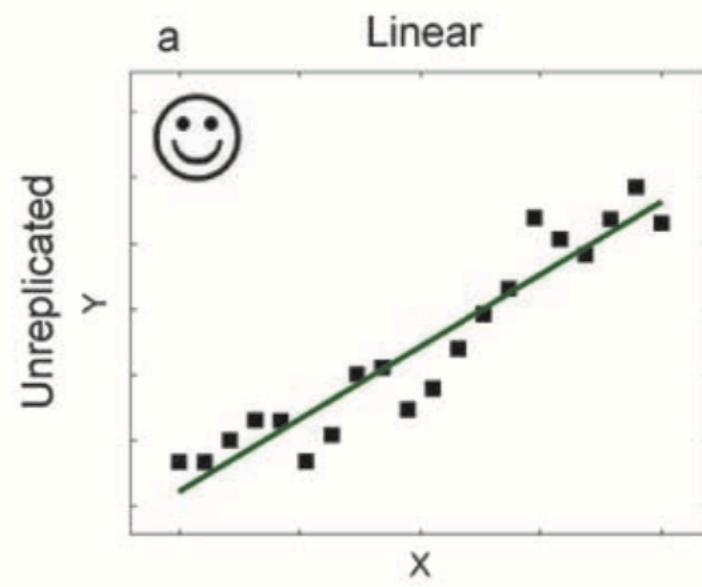
shape of curve  
critical concern



**replicated regression** is an  
incredible solution  
for natural sciences



Cottingham et al. 2005





A photograph showing a LEGO Star Wars character, specifically a Jedi, hanging upside down from a metal paperclip. The paperclip is attached to a ruler that is placed horizontally on a wooden surface. The character is holding a black lightsaber. The background is a plain, light-colored wall.

**STAR WARS**

SCIENCE

*Defying Gravity*

[kidminds.org](http://kidminds.org)

experiment with designs before experimenting



## Type I Error



false positive

## Type II Error



false negative



	$H_0$ True	$H_0$ False
Reject $H_0$	Type I Error	Correct Rejection
Fail to Reject $H_0$	Correct Decision	Type II Error



too many replicates can be a crime