Exp. Design 1
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Experimental Design

- started as set of notes from guest lecture by Gene Gallistel (Psyc prof, now retired)

- Exp. design: how to design an experiment —
  what to measure, (metrics)
  treatment ⟷ indep. vars, control

- so... background: scope and & procedures are
  these narrows in a factorial design
  ⇓
  ANOVA analysis

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- First consideration:

formulate a hypothesis

"I bet that would happen if..." vs. "I wonder what would happen if..."

based on assumption, theory, lit review

— Galvucci called "empty-minded research" not based on any assumption

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- exp. design often drawn from Ho: the null hypothesis: you hypothesize no effect
  - no meaningful, observable difference between conditions
  - you hope to reject Ho

e.g. new drug:
Ho: no effect

e.g. headache pill
group1: gets placebo, group2: gets "madvil"

if there is a difference, you reject Ho, accept Ha - the alternative hypothesis that there is an effect

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- Forms of Inquiry
  - experiments vs. observational studies
  - lab vs. field
  - idiographic vs. nomothetic research
    - study of an individual
    - studying large populations } generalizability

single case studies / clinical studies ~ can still hope to generalize from this — e.g. Phineas Gage (chunk of brain missing ⇒ frontal lobe → "seat of personality"?)

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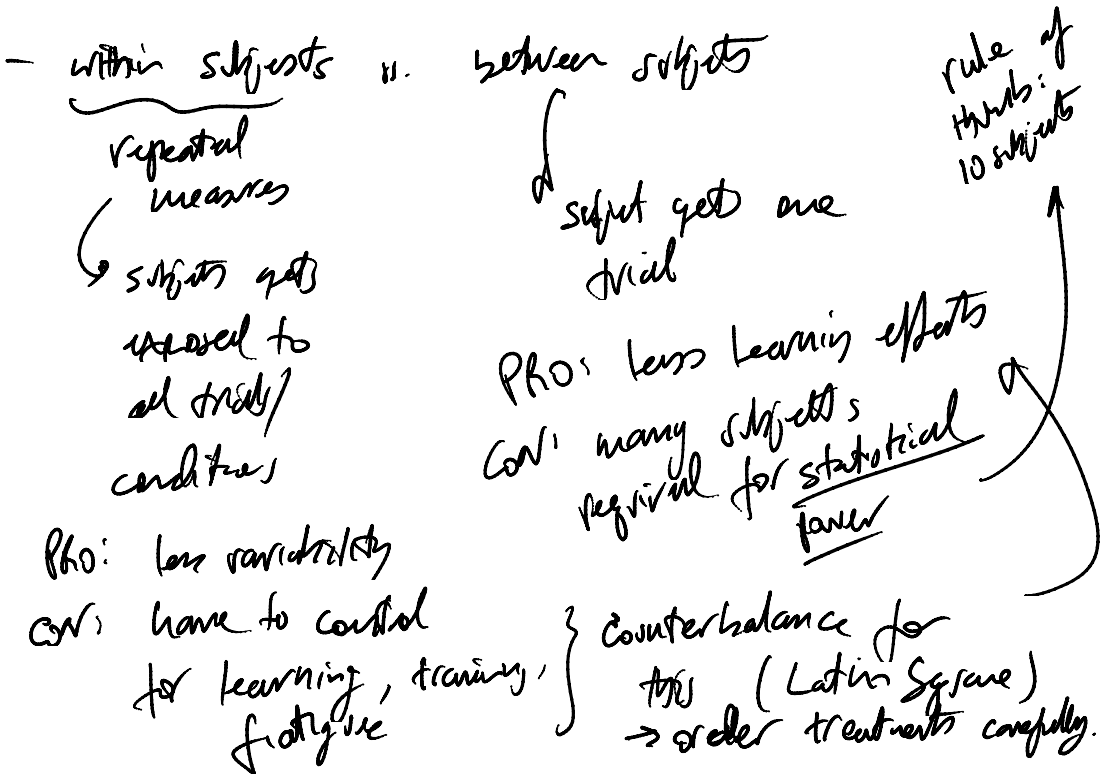


- rule of thumb: 10 subjects
- better: power study

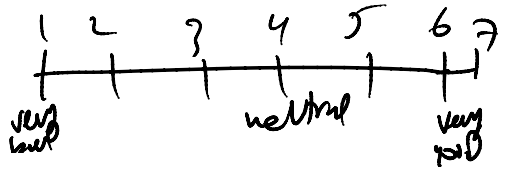
- important to know the nature of scale of what's being measured (dep. variable)

scales:

- equality ——— same numbers mean same measure
- rank order ——— higher values mean "more"
- equal interval ——— diff. (1,2) = diff. (5,6)
- equal ratio ———

Likert-type

e.g. quality of student's coffee:



Likert-type questionnaires:

scales for 1 – 5, 1 – 7

why not 1–10? usually want a point in middle – a neutral point.

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what the choice of scale boils down: what statistical techniques can you use to perform analysis

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From Coolican's text:

Measurement Level	samples: Independent	samples: Non-Independent
Nominal	chi-square	(binomial) sign test
Ordinal	Mann-Whitney test	Wilcoxon signed rank
Parametric	z-test, t-test ~~for indep means~~	t-test

usually testing for differences in the data

t-test of difference of sample pairs (df = 1)

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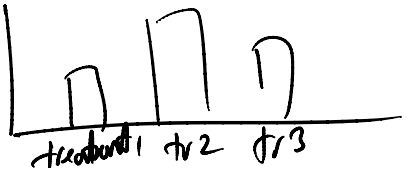
Measurement Level	Samples: Indep.	Samples: Non-Indep.
Non-para	chi-square	Kruskal-Wallis
Parametric	ANOVA	ANOVA

For multivariate data ($df > 1$)

Most often used — multivariate data

why? — parametric data

granularity
means such
as performance
speed / accuracy
time # errors



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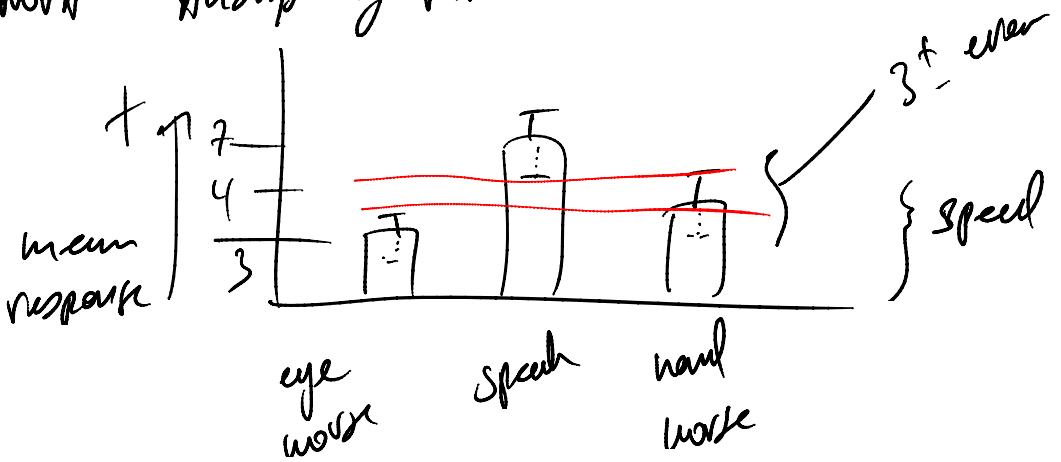
ANOVA: Analysis of variance



ANOVA: is there a difference between the means or is there overlap

- if no overlap, ANOVA reports stat. significance

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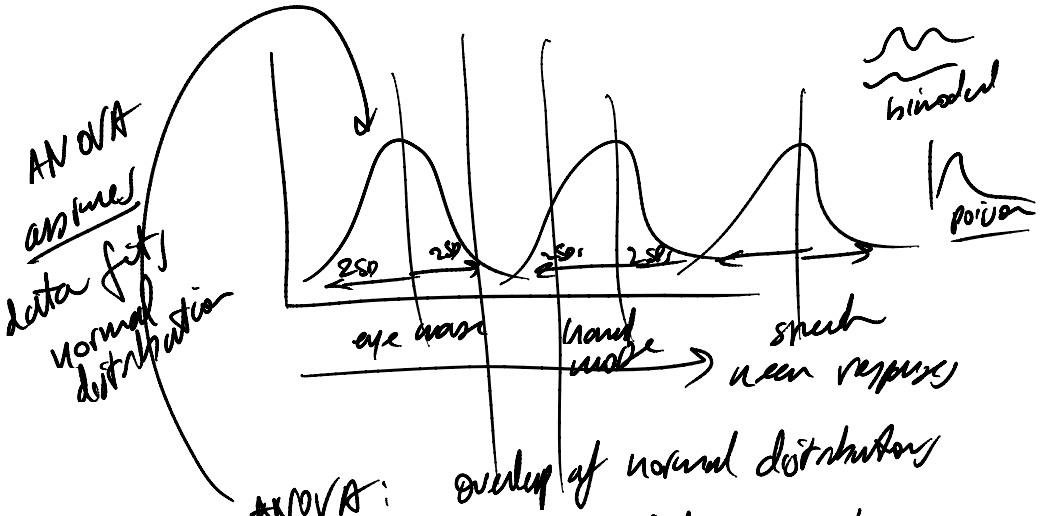

ANOVA: overlap of normal distributions
- if no overlap, then difference between means is not due to chance alone

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- why is ANOVA used so much in HF especially?

most human activities fit the bell curve