

## ⊕ Repeated-Measures ANOVA ⊕

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## Repeated-Measures

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- ⊕ *Repeated-measures designs* occur when a participant participates in every condition of the study
  - ⊕ Increased statistical power
    - ⊕ More likely to reject a false  $H_0$  for a given sample size
      - Removes individual differences
  - ⊕ Must worry about carryover or order effects
    - ⊕ Does participating in one condition influence how you participate in another condition?

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## $H_0$ and $H_1$

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- ⊕ Same as the independent samples ANOVA
  - $H_0$  and  $H_1$
- ⊕  $H_0: \mu_1 = \mu_2 = \mu_3 = \dots = \mu_k$ 
  - ⊕  $k$  = number of levels to the IV
- ⊕  $H_1$ : not  $H_0$ 
  - or
  - $H_1$ : at least one treatment mean ( $\mu$ ) is different from another

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## *F*-Ratio

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$$F = \frac{\text{variance between treatments}}{\text{variance expected if there is no treatment}}$$

$$= \frac{\text{variance between treatments with individual difference removed}}{\text{variance expected by chance with individual differences removed}}$$

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## Numerator of *F*-Ratio

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- ⊗ The numerator of the *F*-ratio measures the variance between treatments
- ⊗ This variance can only be caused by
  - ⊗ Systematic differences caused by the treatment
  - ⊗ Random, unsystematic differences
- ⊗ In a repeated measures design, this variance cannot be caused by differences between individuals
  - ⊗ Same people in all conditions

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## Denominator of *F*-Ratio

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- ⊗ The denominator of the *F*-ratio measures the amount of differences expected by chance
- ⊗ Within a condition, there are different individuals and there will be variation in the DV due to differences in the individuals
  - ⊗ This variability can be calculate and removed from the denominator
    - ⊗ This makes the denominator smaller which will increase the size of the observed *F*

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## Denominator of $F$ -Ratio

- ⊗ In a repeated-measures ANOVA, the denominator of the  $F$ -ratio is called the *residual variance* or the *error variance*, and measures how much variance is expected if there are no systematic treatment effects and no individual differences contributing to the variability of the scores.

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## Repeated-Measures ANOVA Example

- ⊗ Participants see a question followed by a word and have to respond whether the word makes the question true or not
- ⊗ There are three types of questions
  - ⊗ Is the word in upper case (surface processing)
  - ⊗ Does the word rhyme with \_\_\_\_ (phonemic processing)
  - ⊗ Is the word a type of \_\_\_\_ (semantic processing)

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## Repeated-Measures ANOVA Example

- ⊗ After seeing 60 questions / words (20 of each type of question in a random order) the participants receive a surprise recognition test of the words
- ⊗ Do different types of questions lead to different amounts of recognition?
- ⊗ 5 students participated

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