Empirical Research Methods 1

Experiment design, from research question to hypothesis

Miguel Rejón,

Room 1.14

m.rejon@edutech.uni-saarland.de

Before we start 1/5: This presentation

- Additional content. Interactive
- Will be shared to you all on moodle
- If you have a question or topic related to the weekly topic that you want to learn more about, let me know with anticipation and I can include it and discuss it here
- Same etiquette: mic off, emergent questions on the chat, Q&A section at the end, use „raise hand“ button for queuing participation order
- Webcam on during discussion sessions and for the goodbye

Before we start 2/5: Your topic presentation

- In groups, no individual presentations
- Remember to cover the subtopics mentioned in the file “ERM1 Overview of Weekly Presentation Topics” in your presentation
- Feel free to add interactive elements
- Keep it around 20 minutes. Be punctual
- Your presentation day should **NOT** be the first time you’re trying out your presentation on MS Teams
- Suggestion: turn on your webcam before and at the end of your presentation
- Don’t be afraid of being assertive and ask someone specific to respond

Before we start 3/5: Today we will be using

- Voting and (voluntary and direct) participation on MS Teams meeting either by chat or voice
- strawpoll.me/
- Course moodle (only briefly at the end)

Before we start 4/5: SPSS

Have you got already SPSS working on your PC/ laptop?

We will be using it **soon**!

In case not: ask the tutors and/or your fellow students (Team or private) for help. **DON'T LEAVE IT FOR THE LAST MINUTE!**

Before we start 5/5: Reminders

-Exercise sheets: Mind the new deadline (Mon 11:59 pm). Remember to confirm the assignment submission (2 people didn‘t do it last time)

-Presentations: Follow the draft deadlines. After presenting, send me your presentation to upload it to the moodle

-Register to all platforms!: LSF, Teams, and Moodle

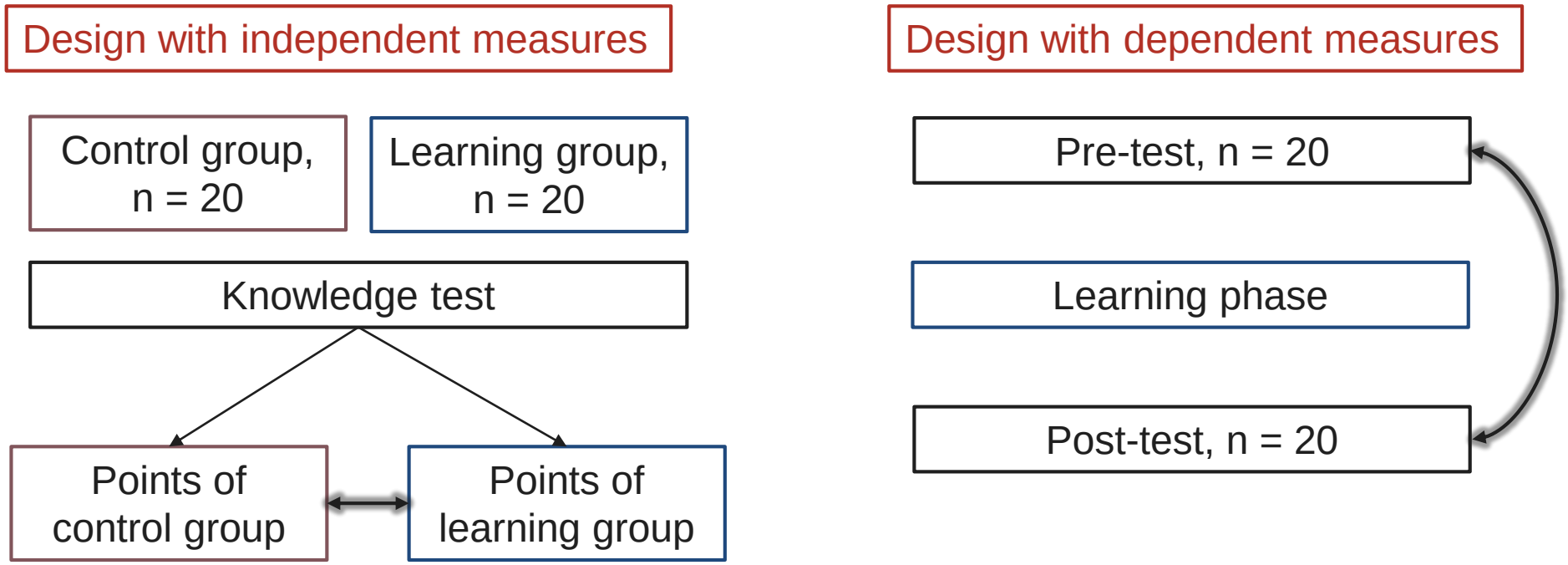
-If you know the case of a student who is not registered in one or more of the course platforms, help them

Now let‘s start...

Agenda

- Independent and dependent measures
- Factorial design
- Alpha and beta errors
- Q&A

Independent vs. dependent (repeated) measures



Factorial design

- Factors vs. factor levels
  - Let’s find examples…

Factorial design

- Examples:
  - Factor: Time of the day; factor levels: morning, noon, evening
  - Factor: Way of learning; factor levels: individually, collaboratively
  - Factor: Study subject; factor levels: computer science, psychology, learning science

Factorial design

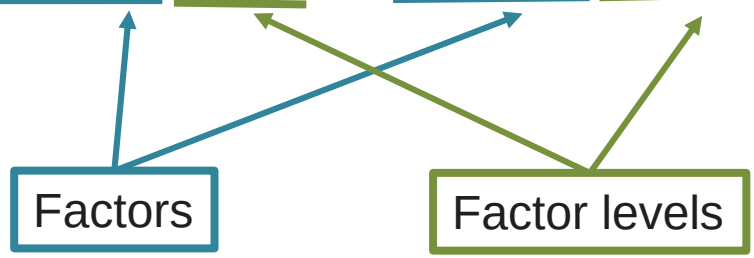
Often used design and the most basic one: 2×2

Number of numerals = number of factors

Quantity of numeral = number of factor levels

→ two factors with two factor levels each

e.g.: prompt A on/off and prompt B on/off



Factor 2: Prompt B		Factor 1: Prompt A: on	Factor 1: Prompt A: off
	Prompt B: on	A-B	B
	Prompt B: off	A	Control group

Factorial design

- Which design do we have here?

Factor: Size of technology

Factor: Group size	Smartphone (S)	Tablet (M)	Tabletop (L)
Groups of three (3)	S-3	M-3	L-3
Groups of five (5)	S-5	M-5	L-5

→ 2 × 3 design

Factorial design meets DV and IV

Question: Is there any relationship or similarity between factors and levels, and DV and IV?

Answer: Yes, factors are IV’s

Factorial design meets research questions, hypotheses, and IV and DV (again!)

- Which are some possible research questions and hypotheses for this factorial design? Define (or create) the IV's and DV's for this factorial design

Factor: Size of technology

Factor: Group size	Smartphone (S)	Tablet (M)	Tabletop (L)
Groups of three (3)	S-3	M-3	L-3
Groups of five (5)	S-5	M-5	L-5

→ 2 × 3 design

Factorial design: Exercise

- How many factors, factor levels, and conditions are on each factorial design?
  1. 2 × 4
  2. 3 × 2 × 3
  3. 6 × 3
- Remember the coffee example? How would it look like on a 2x4 factorial design?

Factorial design: Exercise

- You would like to know if scaffolding (with, without), time of the day (morning, evening), and prior knowledge (low, medium, high) influence learning.

  1. What are factors and the factor levels (of each factor)?
  2. How would the factorial design (e.g. 2x2) look for this experiment?
  3. If you need 10 people per level, how many participants would your sample have?

Alpha and Beta errors recap and aliases

Alpha error = false positive = Type I error: Rejection of a true H0

Beta error = false negative = Type II error: Acceptance of a false H0

Alpha and Beta error

- In your experiment, you find that collaborative learning is more motivating than individual learning (i.e. support for your H1). However, in reality, this effect does not exist and both forms of learning are equally motivating. Which error happened?
  - Alpha = Type I = false positive
- In your experiment, the results show no effect of different instructional materials on learning gains. In reality though, there are significant differences between the materials. Which error happened?
  - Beta = Type II = false negative
- Based on the statistical test you perform, you reject your null hypothesis, and decide for the alternative hypothesis. However, this decision was wrong. Which error happened?
  - Alpha = Type I = false positive

Alpha level

- Describe the function of the Alpha level
- To which value is Alpha usually set?
- Example:

determine statistical difference, we compared the centroids. At the alpha=0.05 level, the t-test (t(4.22)=4.13; p=.01) revealed a significant difference between NEW teachers (M=-0.74, SD=1.06, N=5) and EXP teachers (M=1.24, SD=0.14, N=3). NEW teachers reflected a positive perception of online PD—this was intertwined with a positive perception of their colleagues. EXP teachers had negative perceptions of the online PD and positive perceptions of face-to-face PD.

Bressler, D. M., Yoon, S., Miller, K., Shim, J., Wendel, D., Schoenfeld, I., … Reider, D. (2019). Perceptions of Online Professional Development: Do Newer and Experienced Teachers Differ?. In K. Lund, G. Niccolai, E. Lavoué, C. Hmelo-Silver, G. Gweon, & M. Baker (Eds.), *A Wide Lens: Combining Embodied, Enactive, Extended, and Embedded Learning in Collaborative Settings, 13th International Conference on Computer Supported Collaborative Learning, Volume 2* (pp. 821-822). Lyon, France: The International Society of the Learning Sciences. Abstract retrieved from https://cscl2019.com/

Alpha level trivia

Who decided that 0.05 was an adequate alpha level?

Is an alpha always 0.05?

Q&A:
TODAY‘S TOPIC; ERM1 IN GENERAL

Reminders (again)

- Exercise sheets: deadline and confirm submission
- Register to everything ERM1
- SPSS!
- Use and keep an eye on the course Team for out-of-class info
- Can you open the exercise assignment 3.1 to check if the deadline is visible? You may need to click “submit”. Screenshot?

WEBCAMS ON FOR THE GOODBYE