How engagement and motivation mediate effects of game elements on learning

Huber, S. E., Cortez, R., Leinonen, M., Pöschko, J., Rohrer, E., Pahovnikar, F., Gayduscheck, F., Lindstedt, A., Kiili, K., & Ninaus, M.

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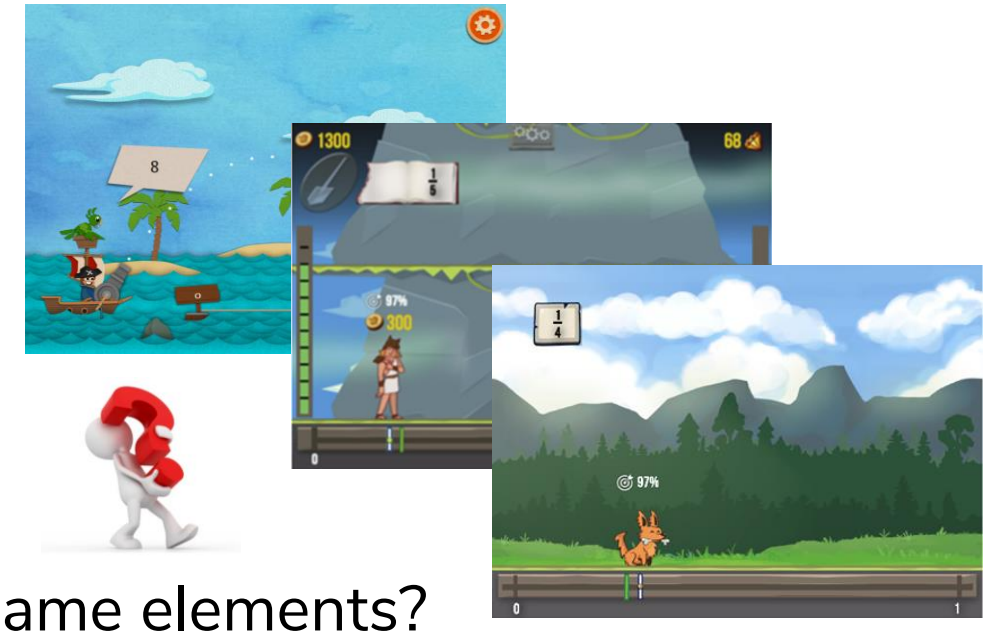
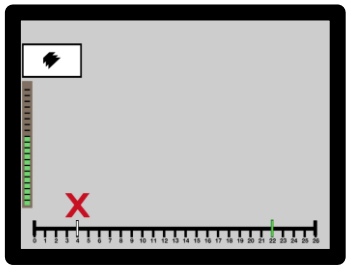
ICP 2024
Prague, Czech Republic

Content



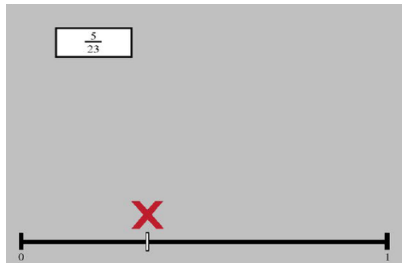
- Why game elements?
- How investigate the effect of game elements?
- **Online study 1**: little incentive
- **Online study 2**: “sufficient” incentive
- **Lab study**: lab situation/context



vs.

Why?

vs.

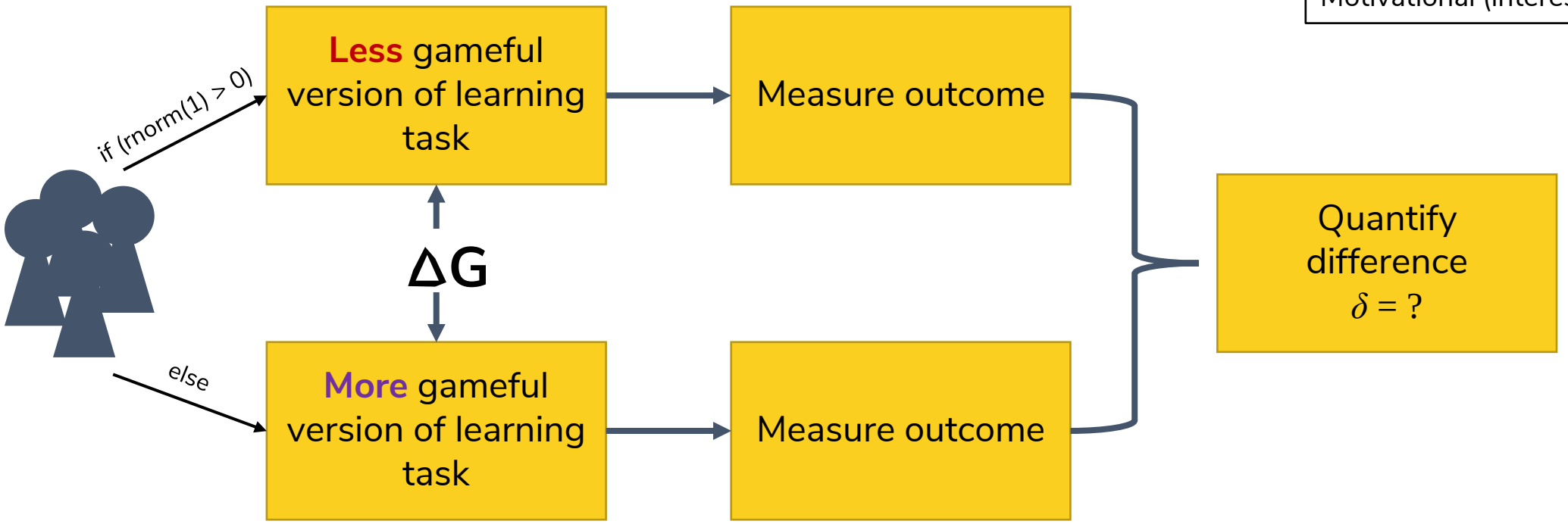


(Ninaus et al., 2023, https://doi.org/10.1007/s11423-023-10263-8)

- Why studying the effect of game elements on learning? Because game elements…
  - …can be associated with **increased motivation** (e.g., Sailer & Homner, 2020, https://doi.org/10.1007/s10648-019-09498-w)
  - …can be related to **increased engagement** (e.g., Ninaus et al., 2019, https://doi.org/10.1016/j.compedu.2019.103641; Huber et al., 2023, https://doi.org/10.1016/j.chb.2023.107948)
  - …might improve **learning performance** (e.g., Wouters et al., 2013, https://doi.org/10.1016/j.compedu.2012.07.018; Mayer, 2020, https://psycnet.apa.org/record/2020-10545-004)
- But game elements can also…
  - …**distract or disturb** (attention, learning) (e.g., Rey, 2012, https://doi.org/10.1016/j.edurev.2012.05.003)
  - …**occupy limited cognitive resources** (e.g., Mayer, 2014, https://doi.org/10.1017/CBO9781139547369.005)
- **What are the exact mechanisms? When have game elements (what kind of) effect?**

How?

- How can we study the effect of game elements?
  - **Value-added** research paradigm: (e.g., Mayer, 2020, https://psycnet.apa.org/record/2020-10545-004)



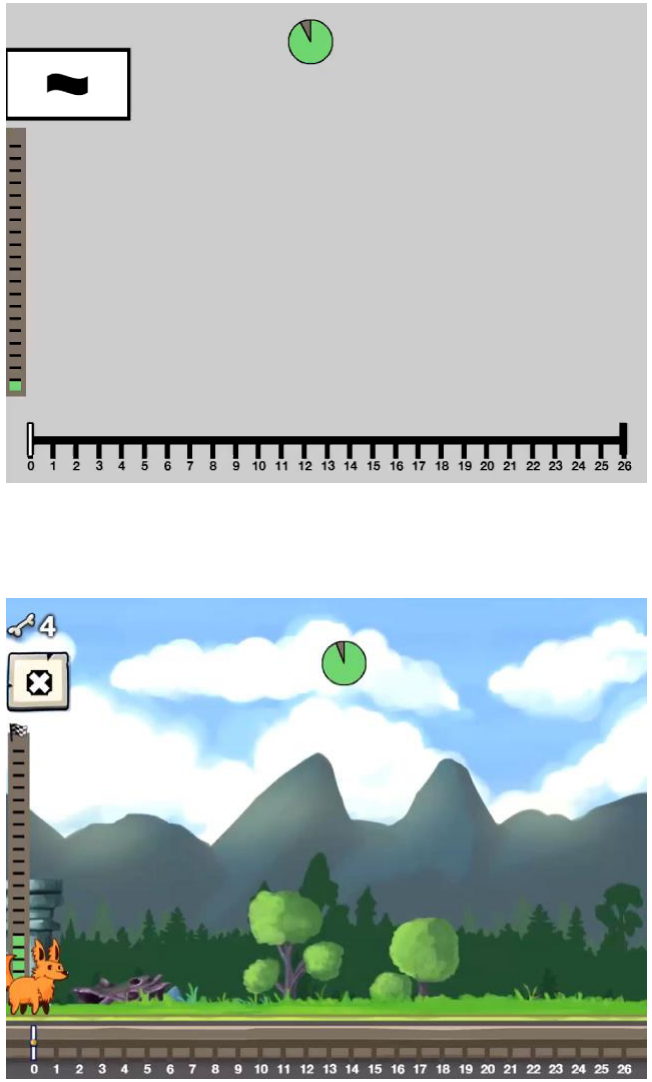
Outcomes:
Cognitive (memory, math)
Affective (curious, frustrated)
Motivational (interest, attrition)

Learning task

- **Associative learning task**:
  - Unknown associations between symbols and numbered positions on number line
  - In each trial a symbol is presented and a position/number on bottom line must be selected
  - Corrective feedback after each trial
  - 20 symbols per level (except online study 1), 20 s per symbol
  - 5 consecutive levels
  - *Goal:* Learn as many associations as possible over 5 levels
- **Game elements (ΔG)**:
  - Visual aesthetics
  - Narrative
  - Scoring system

Typically affecting engagement/motivation (e.g., Toda et al., 2019, https://doi.org/10.1109/ICALT.2019.00028)

Based on the NumberTrace engine (https://www.youtube.com/watch?v=T7s7xSlLrac)

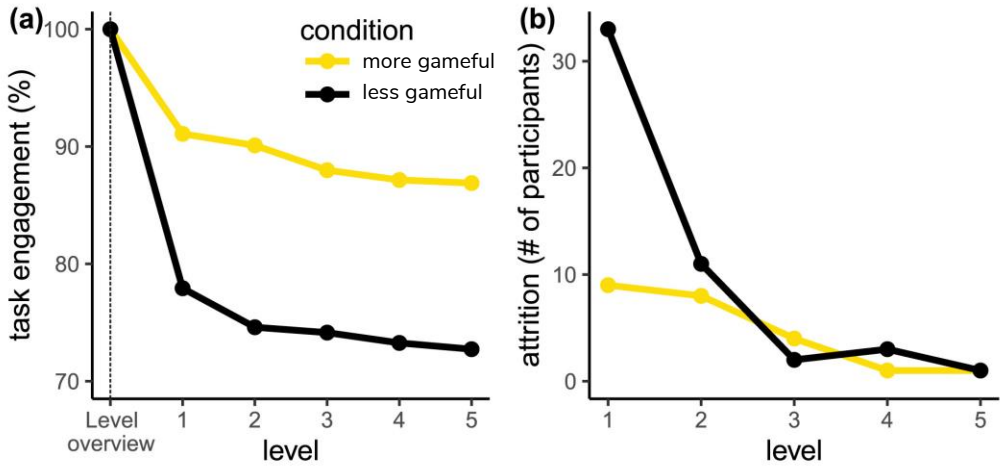


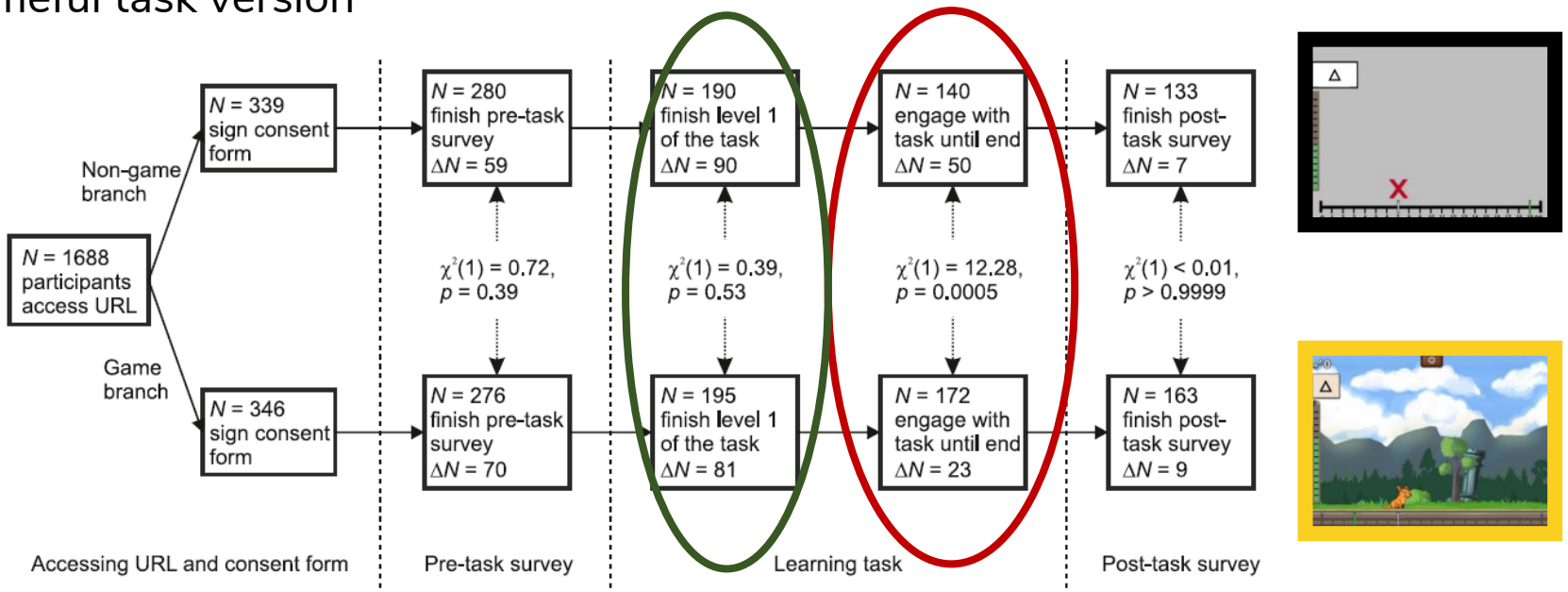
ΔG

Online study 1

(Huber et al., 2023, https://doi.org/10.1016/j.chb.2023.107948)

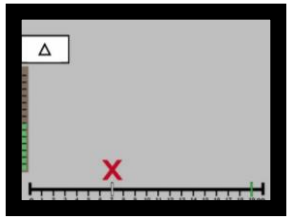
- Little incentive: Raffle of 5 times 10 EUR
- 1688 people accessing landing page
- 385 commencing with task
- 312 finishing the task
  - 50 dropping out in less gameful task version
  - 23 in more gameful task version





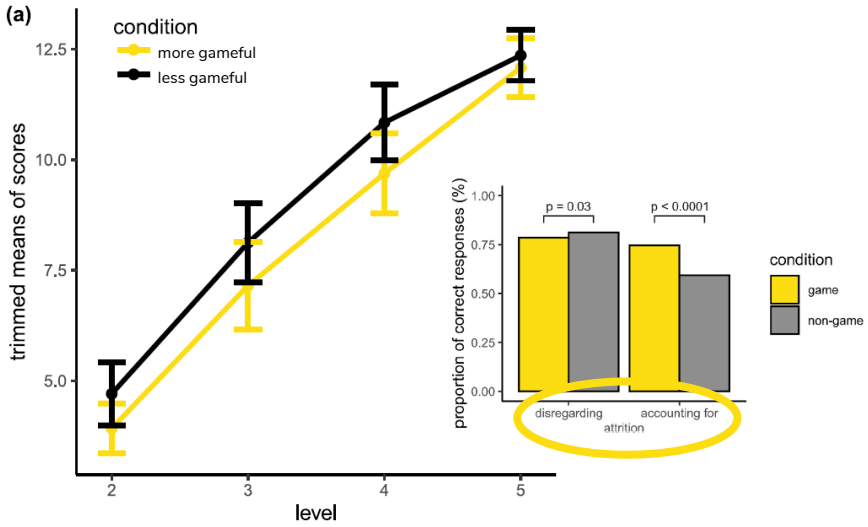
Online study 1

(Huber et al., 2023, https://doi.org/10.1016/j.chb.2023.107948)



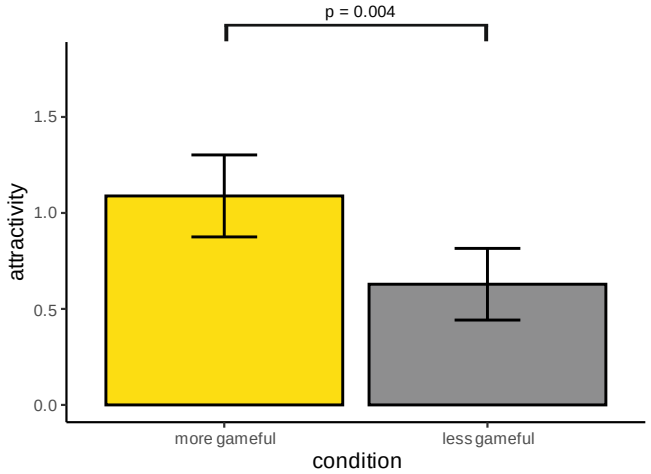
vs. (online)

- What about cognitive and motivational outcomes?
- Cognitive outcomes:



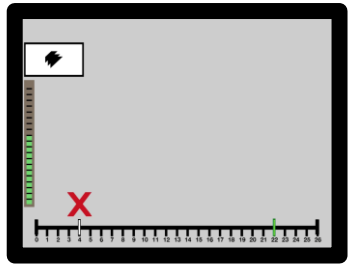
- Motivational outcomes:
  - Task attractivity: $\delta = 0.37$, $p = .004$
  - Stimulation: $\delta = 0.16$, $p = .218$

UEQ (Laugwitz et al., 2000, https://doi.org/10.1007/978-3-540-89350-9_6)

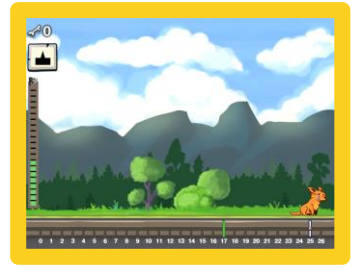


Online study 2

(Huber et al., 2024, https://doi.org/10.1007/978-3-031-49065-1_23)



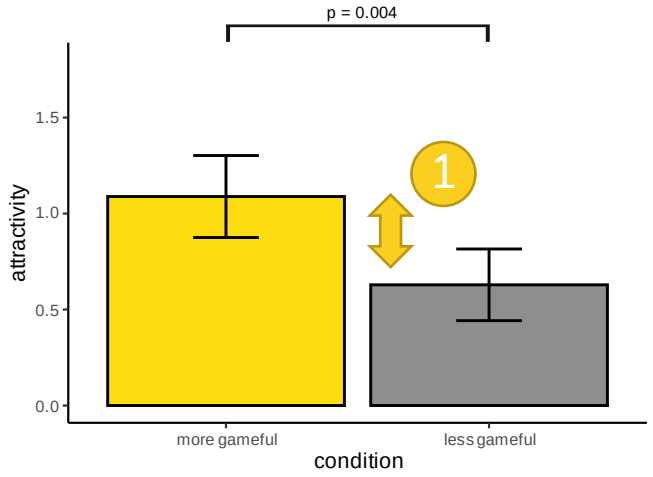
vs. (online)

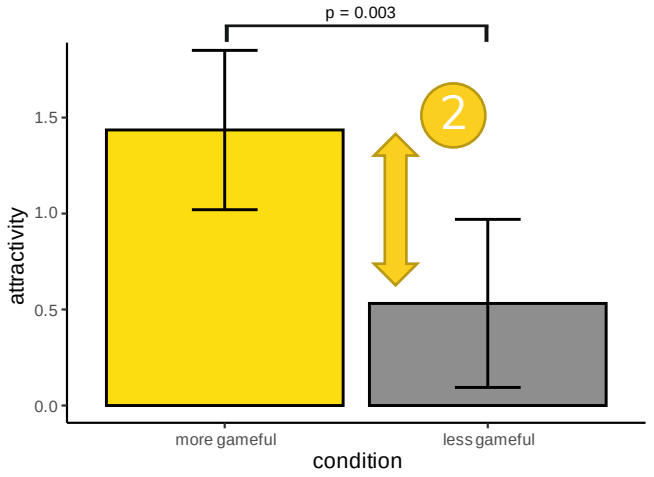


- 61 participants
- Mostly students, taking part for course credit

- Online study 1:
  - Task attractivity: **δ = 0.37**, p = .004
  - Stimulation: **δ = 0.16**, p = .218

- **Online study 2**:
  - Task attractivity: **δ = 0.82**, p = .003
  - Stimulation: **δ = 0.87**, p = .002





Online study 2

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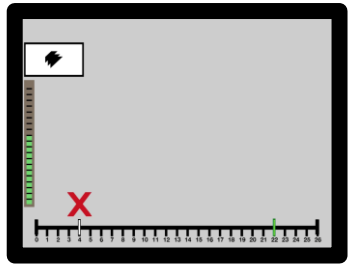
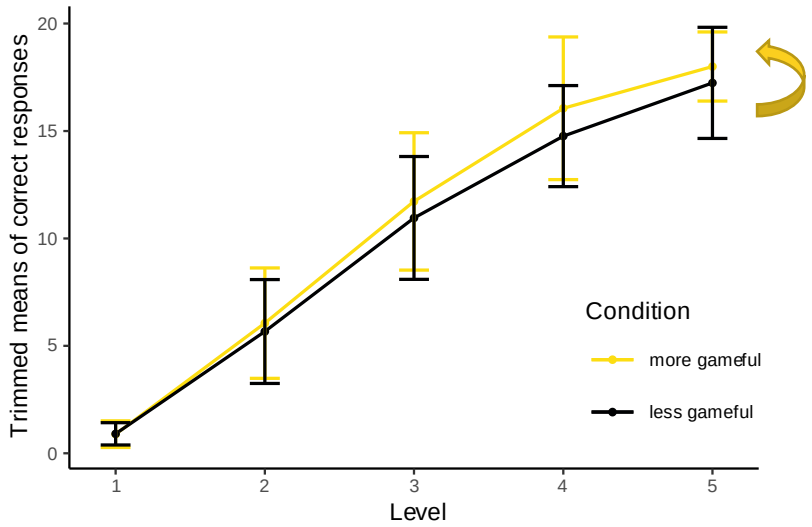
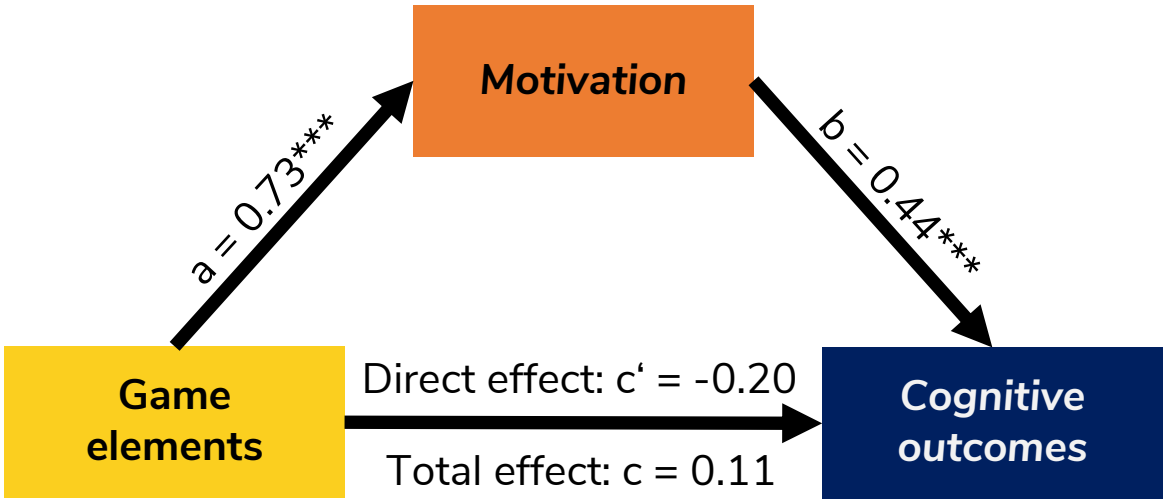


vs. (online)

- Cognitive outcomes:



- Motivation partially mediates cognitive effect of game elements

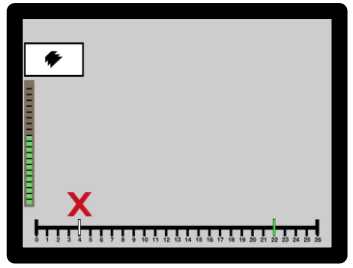


Indirect effect: ab = 0.45*** [0.15, 0.85]

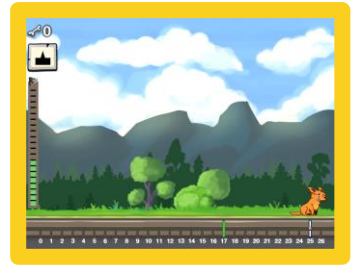
* p < .05, ** p < .01, *** p < .001

Lab study

(Huber et al., 2024, unpublished)



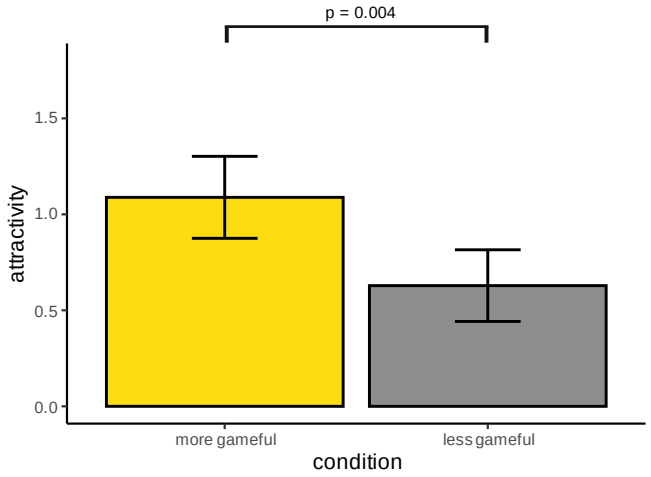
vs. (lab)



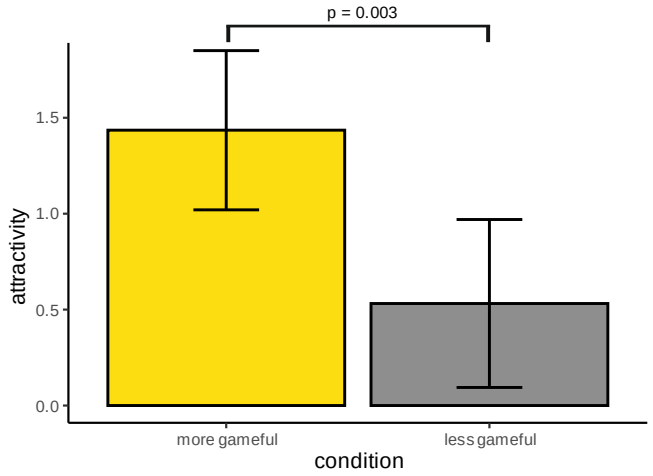
- 121 participants, mostly students taking part for course credit, but this time in the lab
- Motivational outcomes:

Online study 1 → Online study 2 → **Lab study**

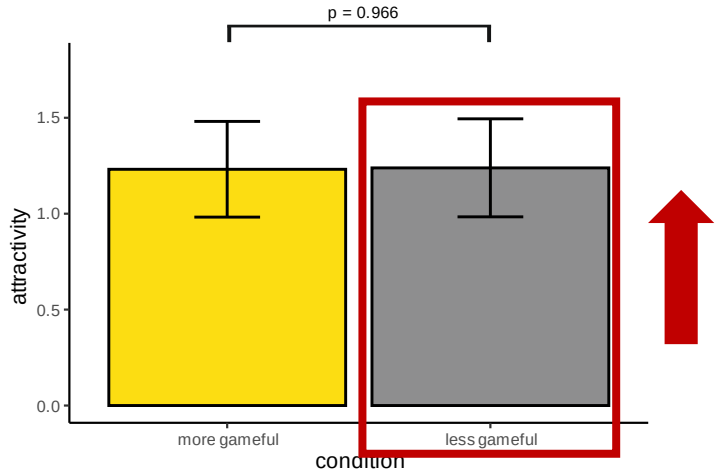
Diff. in motivation: $\delta \leq 0.37$



Diff. in motivation: $\delta \leq 0.87$

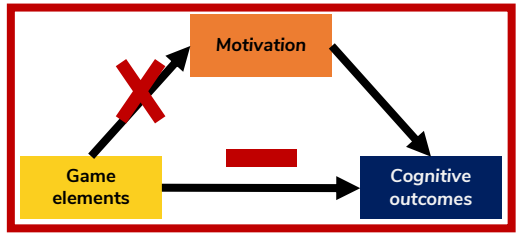


Diff. in motivation: $\delta \leq 0.02$



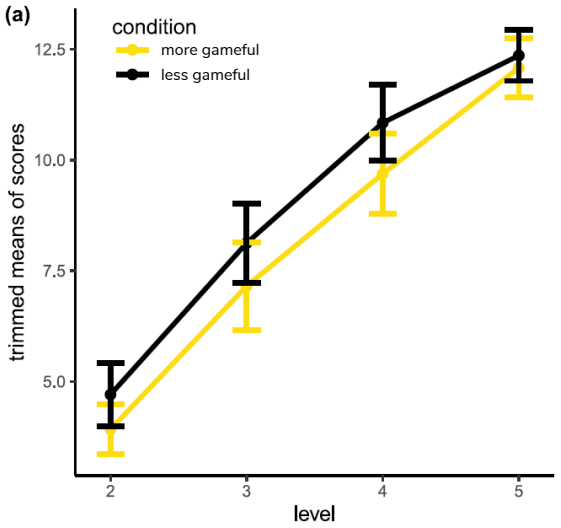
Lab study

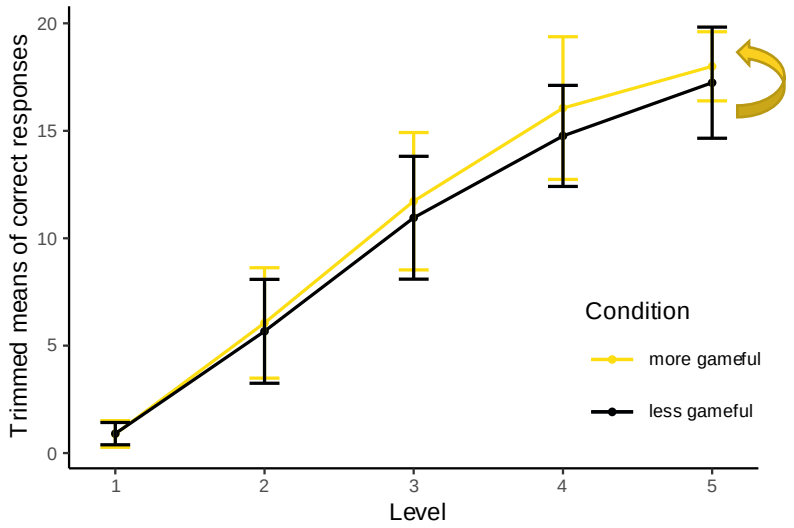
(Huber et al., 2024, unpublished)

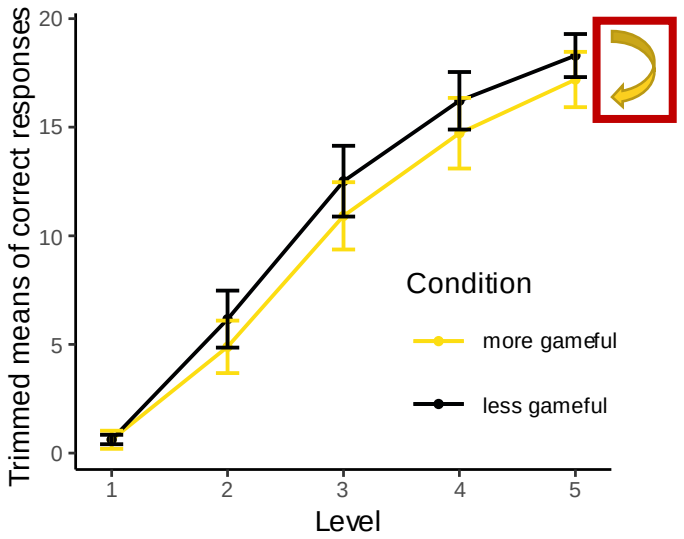


- Cognitive outcomes:

Online study 1 → Online study 2 → **Lab study**







Conclusions

- **Context matters. Maybe a lot.**

- If your goal is **research** about the effect of game elements:
  - Game elements can have various effects interacting with each other.
  - Effects of game elements can differ between lab, online, classroom(?) settings.

- If your goal is learning or **education**:
  - Devise your learning activity as an intrinsically appealing activity.
  - For how appealing a learning activity appears overall, again, context matters. Possibly a lot.

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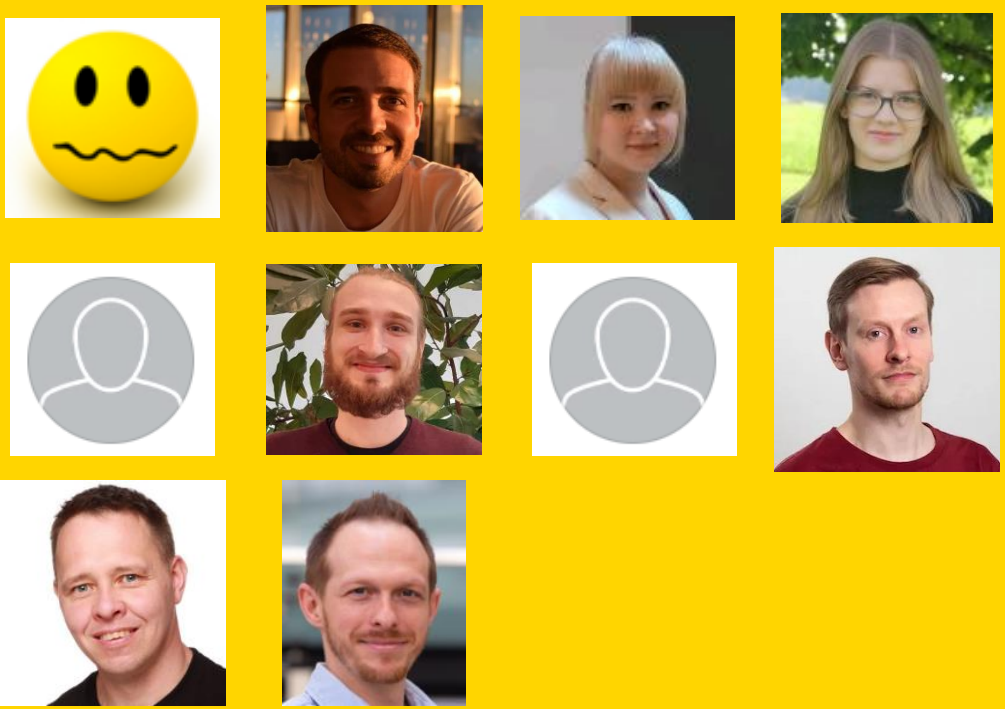
Looking for a PhD student!!!

- **well-being**
- **games**
- **sustainability**

Contact: manuel.ninaus@uni-graz.at

Thank you!



Questions?

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