Students' Types of Interest in Physics

Sarah Zoechling
Martin Hopf | University of Vienna, AT
Julia Woithe and Sascha Schmeling | CERN, Geneva, CH
sarah.zoechling@cern.ch

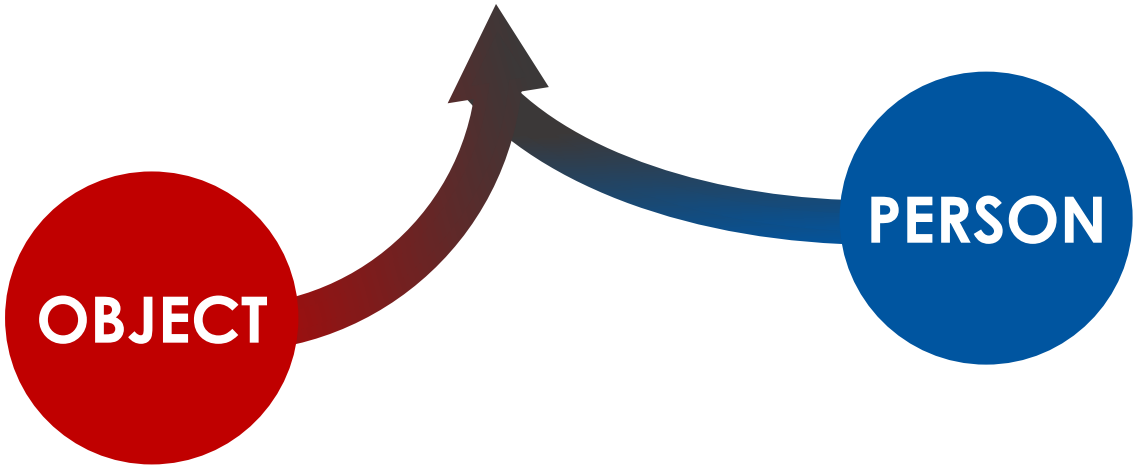
Most students can be categorised into **one single type of interest in physics**

Theoretical and Empirical Background

What is "Interest"?

Interest is …

- a **specific relationship** between a person and an object.
- **multidimensional:**
  - emotional,
  - value-related, and
  - cognitive-epistemic components

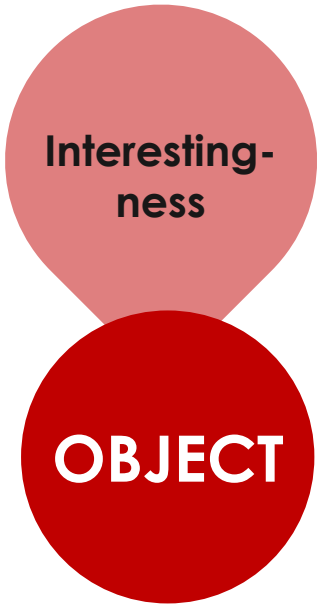


(Krapp, 2002; Hidi & Renninger, 2006)

Interest in Physics

"… most studies report a positive effect of context-based science education on students' interest …"

(Habig et al., 2018)



Types of Interest in Physics

The IPN study distinguishes between **3 types of interest**
(Sievers, 1999; Rost, Sievers, Häußler, Hoffmann, & Langeheine, 1999)

1. **Generally** and **highly interested**
2. **Highly interested** in relation to **nature** and **humans**, **applications**, and **relevance for society**
3. **Interest profiles** are **similar** to **Type 1** or **Type 2**
(depending on content area)

Types of Interest in Physics

The IPN study distinguishes between **2** **types of interest**
(Sievers, 1999; Rost, Sievers, Häußler, Hoffmann, & Langeheine, 1999)

1. **Generally** and **highly interested**

Physics!!!
<3 <3 <3

2. **Highly interested** in relation to **nature** and **humans**, **applications**, and **relevance for society**

Physics?
Only in the **right contexts**!

Research Gap

Previous studies did not …

- describe how interesting different contexts are relative to each other within the **students' different types of interest**.
- include **modern physics content areas,** such as particle physics.

Research Interest and Design

Research Interest

RQ: Into which different **types of interest** in physics can German-speaking students aged 14 to 16 years be categorised, while **comparing classical and modern physics content areas** (namely mechanics and particle physics)?

Hypotheses: **Interest types** (1, 2, 3) are **valid for today's students** and for **classical** as well as **modern physics content areas.** Within each type of interest, **different contexts** are **more or less interesting** relative to each other.

Research Design

Online questionnaire in German language to assess

- **Interest in Mechanics**
  from IPN study (Häußler, Lehrke, & Hoffmann, 1998)
- **Interest in Particle Physics**
  modelled on IPN study (Häußler, Lehrke, & Hoffmann, 1998)

Questionnaire

Mechanics

How interested are you in doing the following?

	My interest in it is ...				
	very high	high	medium	low	very low
Getting insight into the artificial organs (e.g., heart as blood pump) and joints used in medicine today	○	○	○	○	○

Questionnaire

Particle Physics

How interested are you in doing the following?

	My interest in it is ...				
	very high	high	medium	low	very low
Getting insight into the workflow in a medical diagnostic centre	○	○	○	○	○

Research Design

- **Cross-cohort study:** German-speaking students aged 14-16 years (May - September 2021)
- **Sample size:** 1214 students
  - **Different German-speaking countries represented**
    Austria (N=798), Germany (N=233), and Switzerland (N=183)
  - **Both sexes equally represented**
    Girls (N=595), boys (N=529), prefer not to say (N=90)
- **Analysis method:** Mixed Rasch rating scale model

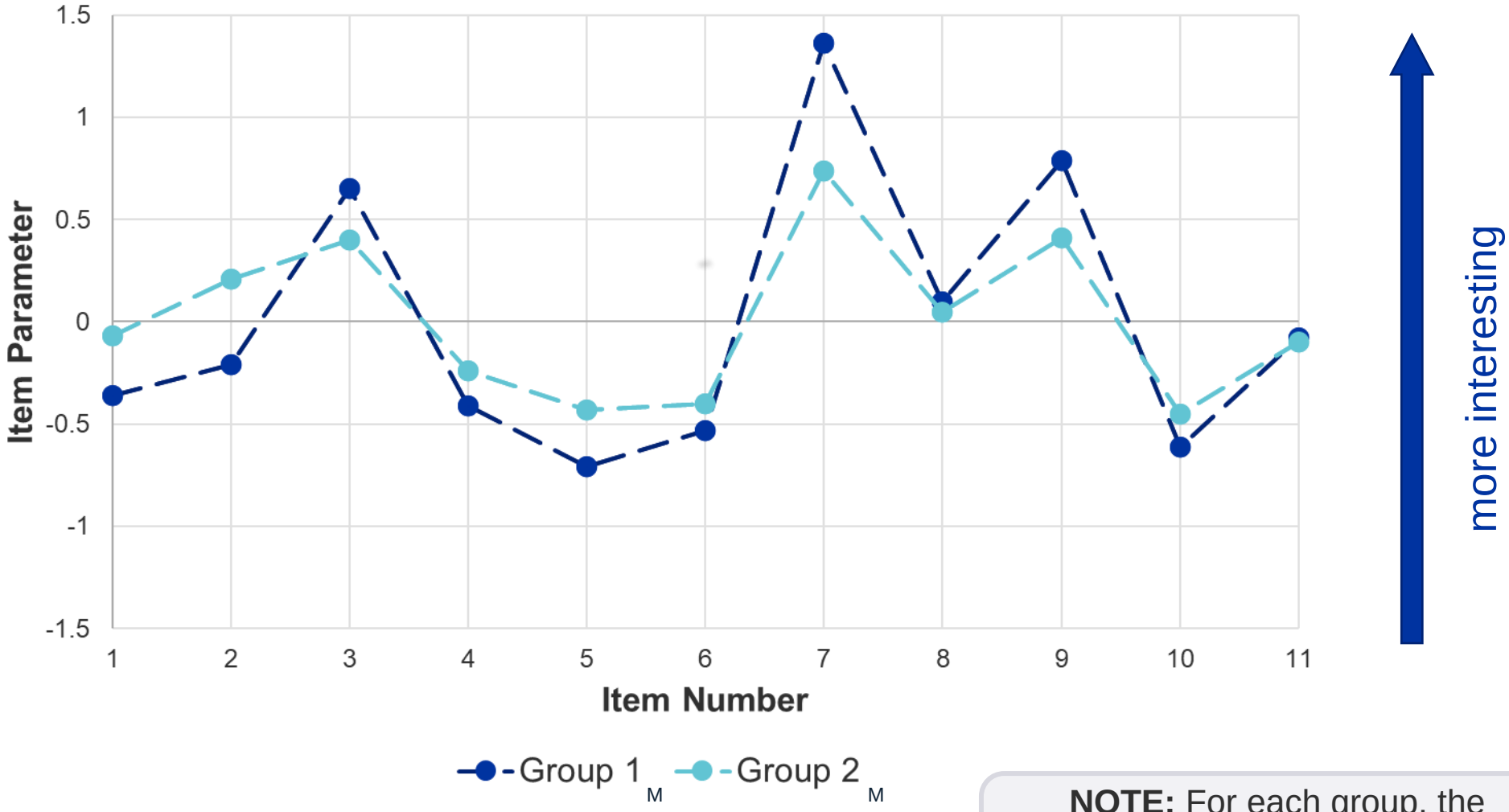
Results

Results

Students' Interest in Mechanics

- Model of **two latent groups** describes the data the best
  - **Group 1_M:** 49% of the sample
  - **Group 2_M:** 51% of the sample
- **Different mean interest** (Group 1_M > Group 2_M)
- **Similar interest profiles**

Mechanics Interest Profiles



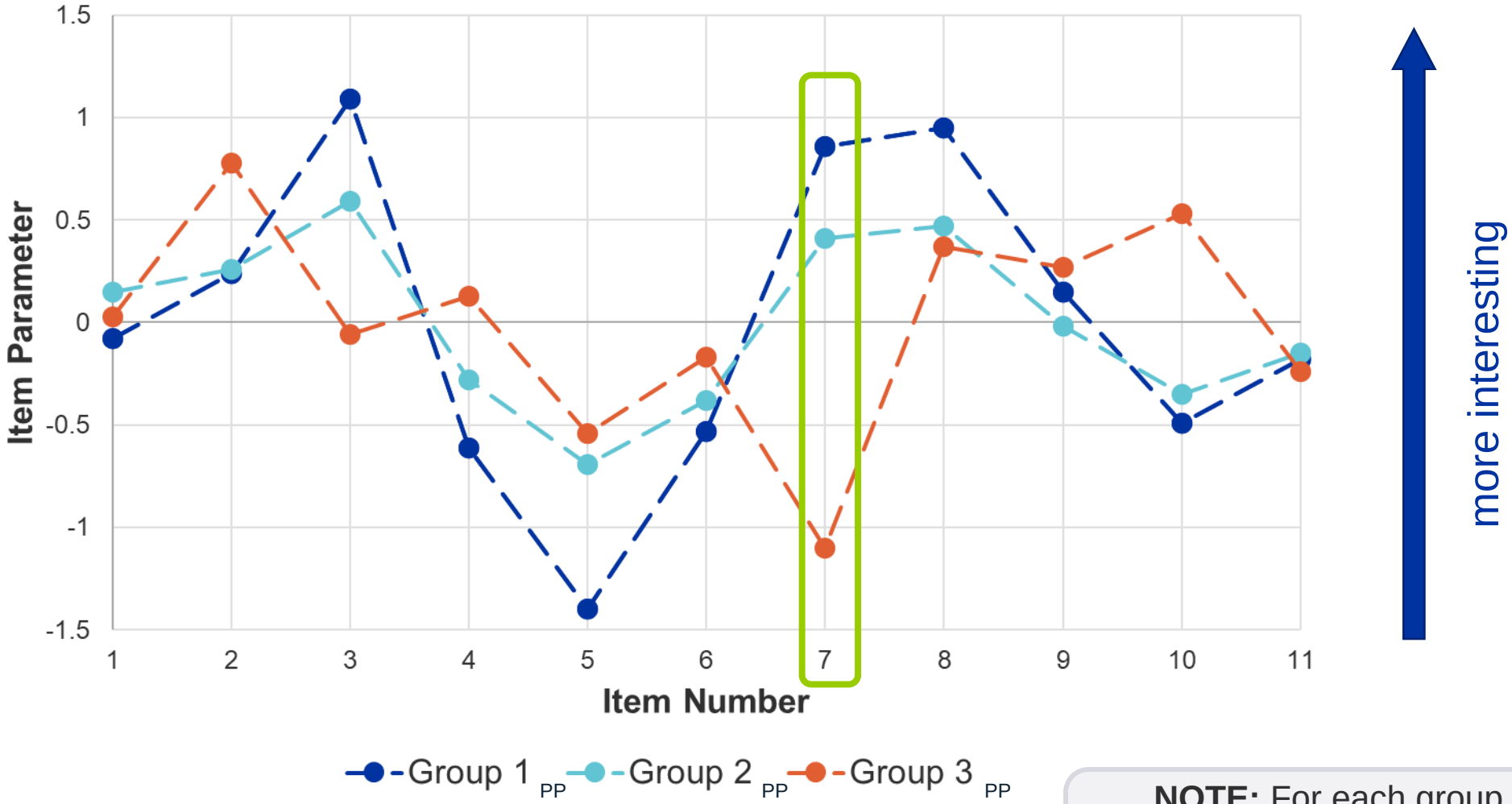
NOTE: For each group, the **item parameter means** are **normalised to 0** in Rasch analysis.

Results

Students' Interest in Particle Physics

- Model of **three latent groups** describes the data the best
  - **Group 1_{PP}:** 45% of the sample
  - **Group 2_{PP}:** 34% of the sample
  - **Group 3_{PP}:** 21% of the sample
- **Different mean interest:** (Group 3_{PP} > Group 1_{PP} > Group 2_{PP})

Particle Physics Interest Profiles



NOTE: For each group, the **item parameter means** are **normalised to 0** in Rasch analysis.

Results

Students' Interest in Particle Physics

- **Interest profiles of Group 1_{PP} and 2_{PP} are similar!**
  (79% of the sample)
- **Different interest profile of Group 3_{PP},** which has the **highest mean interest in particle physics!**
  (21% of the sample)

Discussion and Implications for Practice

Discussion

Mechanics

- **100% of the sample** (Groups 1_M and 2_M) have a **similar interest profile!**

Discussion

Mechanics

- **100% of the sample** (Groups 1_M and 2_M) have a **similar interest profile!**

Particle Physics

- **79% of the sample** (Groups 1_{PP} and 2_{PP}) have a **similar interest profile!**
- **21% of the sample** (Group 3_{PP}) are **highly interested in Particle Physics!**

Discussion

Physics? Only in the **right contexts**!

Mechanics

- **100% of the sample** (Groups 1_M and 2_M) have a **similar interest profile!**

Particle Physics

- **79% of the sample** (Groups 1_{PP} and 2_{PP}) have a **similar interest profile!**
- **21% of the sample** (Group 3_{PP}) are **highly interested in Particle Physics!**

Physics!!! <3 <3 <3

Discussion

Physics? Only in the **right contexts**!

Mechanics

- **100% of the sample** (Groups 1_M and 2_M) have a **similar interest profile!**

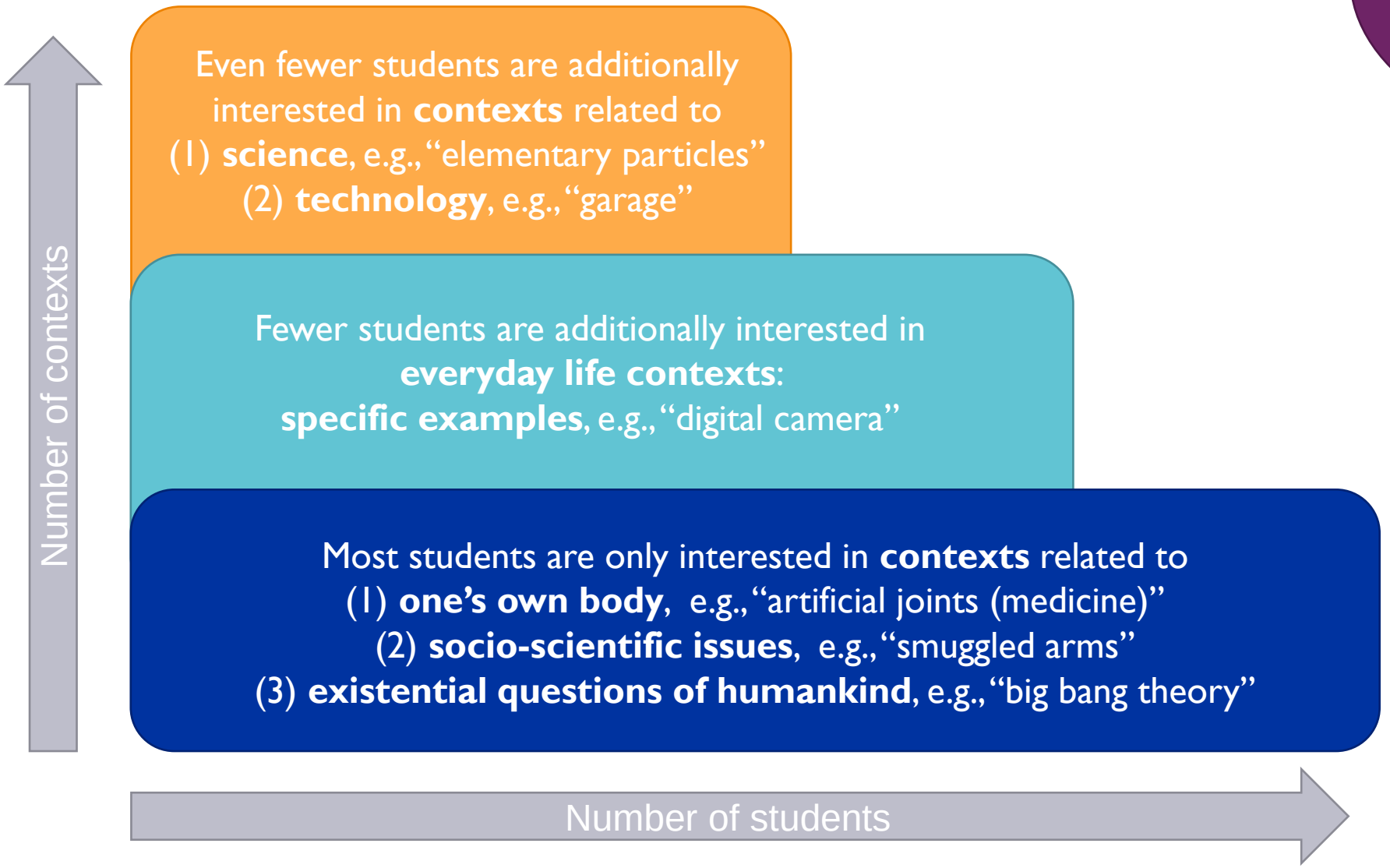
Particle Physics

- **79% of the sample** (Groups 1_{PP} and 2_{PP}) have a **similar interest profile!**
- **21% of the sample** (Group 3_{PP}) are **highly interested in Particle Physics!**

Physics!!! <3 <3 <3

Conceptualisation of Interest in Physics

Physics?
Only in the **right contexts**!



Implications for Practice

Educators trying to increase their students' interest can match the **design of their learning activities** with the **conceptualisation of interest**.

Most students can be categorised into **one single type of interest in physics**

Thank you very much for your attention!

Looking forward to your comments and questions!

CERN | universität wien

References

1. Drechsel, B., Carstensen, C., & Prenzel, M. (2011). The Role of Content and Context in PISA Interest Scales: A study of the embedded interest items in the PISA 2006 science assessment. International Journal of Science Education, 33(1), 73–95. https://doi.org/10.1080/09500693.2010.518646
2. Habig, S., Blankenburg, J., van Vorst, H., Fechner, S., Parchmann, I., & Sumfleth, E. (2018). Context characteristics and their effects on students' situational interest in chemistry. *International Journal of Science Education, 40*(10), 1154-1175. https://doi.org/10.1080/09500693.2018.1470349
3. Häußler, P., Lehrke, M., & Hoffmann, L. (1998). *Die IPN-Interessenstudie Physik*. Kiel: IPN.
4. Krapp, A. (2002). Structural and dynamic aspects of interest development: theoretical considerations from an ontogenetic perspective. *Learning and Instruction, 12*, 409. https://doi.org/10.1016/S0959-4752(01)00011-1
5. Levrini, O., De Ambrosis, A., Hemmer, S., Laherto, A., Malgieri, M., Pantano, O., & Tasquier, G. (2017). Understanding first-year students' curiosity and interest about physics—Lessons learned from the HOPE project. European Journal of Physics, 38(2), 025701. https://doi.org/10.1088/1361-6404/38/2/025701
6. Rost, J., Sievers, K., Häußler, P., Hoffmann, L., & Langeheine, R. (1999). Struktur und Veränderung des Interesses an Physik bei Schülern der 6. bis 10. Klassenstufe. *Zeitschrift für Entwicklungspsychologie und pädagogische Psychologie, 31*(1), 18-31. https://doi.org/10.1026//0049-8637.31.1.18
7. Sievers, K. (1999). *Struktur und Veränderung von Physikinteressen bei Jugendlichen.* (Doctoral thesis). Universität Kiel, Kiel.
8. Student group photo created by lookstudio - www.freepik.com

Back-up Slides

IPN Interest Study

- **Germany**
- **Cross-sectional** and **longitudinal study**
  - **Longitudinal**: 51 classes participated annually (**1984 – 1989, 5th - 10th grade**)
  - **Cross-sectional:** 24 classes each participated once (**1984, 5th - 10th grade**)
  - **Cohort:** 24 classes (**9th grade**) participated once (**1984 – 1989**)

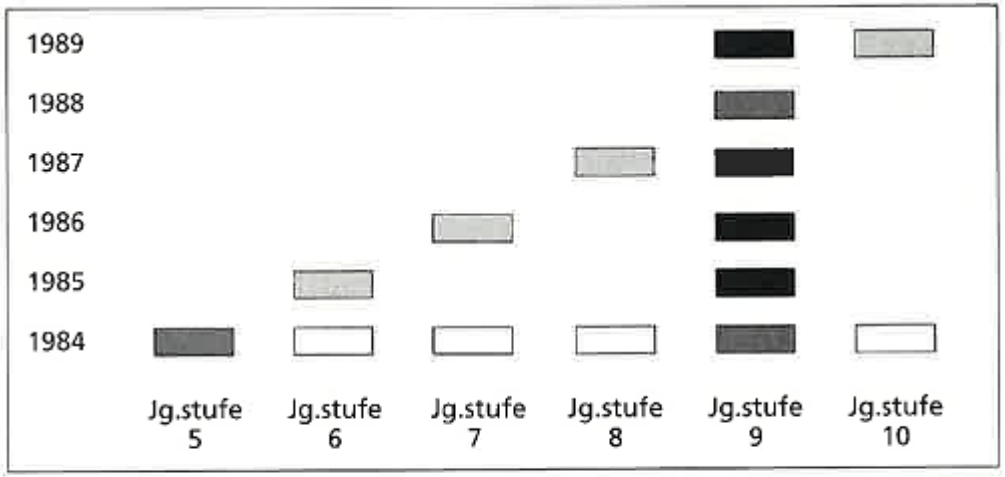


Abb. 3.1: Übersicht über den Erhebungsplan. Die treppenförmig ansteigenden Kästchen stellen den Längsschnitt, die Kästchen in der unteren Zeile den Querschnitt und die dunklen Kästchen über der 9. Jahrgangsstufe den Kohortenquerschnitt dar.

(Häußler, Lehrke, & Hoffmann, 1998)

Research Interest

RQ: Into which different **types of interest** in physics can German-speaking students aged 14 to 16 years be categorised, while **comparing classical and modern physics content areas** (namely mechanics and particle physics)?

Research Interest

RQ2: To what extent is **physics-related self-concept** a better clustering variable than gender for distinguishing between different types of interest in mechanics and in particle physics?

Hypothesis: **When using self-concept instead of gender** as clustering variable, the **interest types** are **described better.**

Research Interest

RQ3: Which **physics content area** is overall more interesting, particle physics or mechanics?

Hypothesis: **Modern physics contents** are **more interesting** for high-school students **than classical ones.**

Research Interest

RQ4: To what extent does the **introduction text** about the physics content area mechanics **affect** students' **expressed interest**, when using the same items?

Hypothesis: Students' **expressed interest in mechanics changes**, when using a **different version of** the **introduction text** in combination with the same items.

Examplary Item Categories

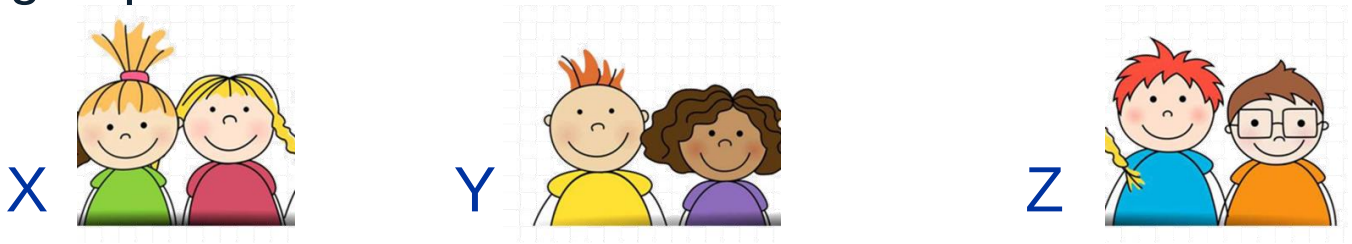
Item category	Exemplary item
Learning more about the function principle of technical devices	Learning more about how a particle accelerator works
Learning more about qualitative physics	Learning more about which interaction binds together the elementary particles in the nucleus space
Constructing technical devices	Building a particle detector out of daily life objects

Analysis of the Main Study

Mixed Rasch Analysis:

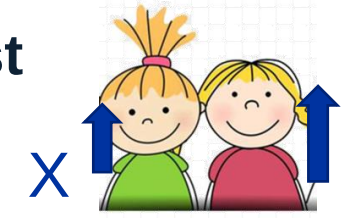
1. *Latent class analysis:* latent, "**qualitative"** person variable, according to which persons are sorted into groups

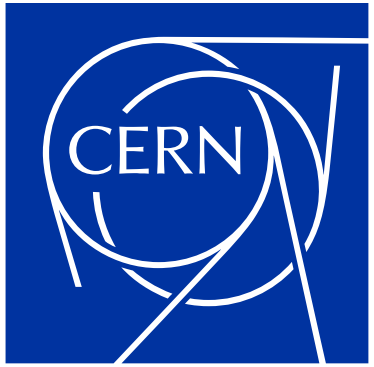
   ⇨ **Type of interest**



2. *Rasch analysis:* individual **quantitative** parameter within each class

   ⇨ **Degree of interest**





home.cern