

# The differential development of epistemic beliefs in psychology versus computer science students

A four-wave longitudinal study

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- Individual conceptions about knowledge and knowing (Hofer & Pintrich, 1997)
  - *How is knowledge justified?*
  - *How “simple” is it?*
  - *How stable is it?*
  - etc.
- Different levels of specificity (Bråten & Strømsø, 2010; Buehl, Alexander, & Murphy, 2002; Muis, Bendixen, & Haerle, 2006):
  - Domain-general
  - Domain-specific
  - Topic-specific

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<b>Developmental stage</b>	<b>Description</b> (Kuhn & Weinstock, 2002; Hofer & Pintrich, 1997)
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Absolute beliefs	Knowledge ... <ul style="list-style-type: none"><li>- is based on facts → „objective“</li><li>- is conceptualized in dualistic contrasts (right-and-wrong or truth-and-untruth)</li><li>- is stable and permanent</li></ul>
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Multiplistic beliefs	Knowledge ... <ul style="list-style-type: none"><li>- is based on personal opinion and the generation of own ideas → „subjective“</li><li>- is dynamic, tentative, and preliminary</li><li>- Truth does not exist and everything is subjective (extreme form)</li></ul>
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Evaluativistic beliefs	Knowledge ... <ul style="list-style-type: none"><li>- is more or less objective resp. subjective – depending on the issue in question and on its context</li><li>- Individuals realize themselves to be part of the process of knowledge by evaluating and weighting knowledge claims</li></ul>
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**Stage models:** Absolute and multiplistic beliefs as obstructive for learning (Hofer & Pintrich, 1997; Hofer, 2001)

**But:** It strongly depends on **context** (e.g., the instructional environment) whether a certain belief may be seen as ... (Elby & Hammer, 2001)

- “correct” (according to an expert consensus), and
- “productive” (helping students to learn).

**Consistency Hypothesis** (Franco, Muis, Kendeou, Ranellucci, Sampasivam, & Wang, 2012; Muis & Franco, 2010)

Learning is facilitated if there is consistency between ...

... the **epistemic nature of a learning task**, and

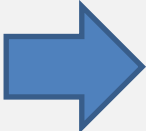
... the individual **epistemic beliefs** of a person.

## **Well-defined knowledge structure** (King, Wood, & Mines, 1990)

- Axiomatically founded and derived from formal reasoning
- Many claims can be proven mathematically
- Large consensus over accepted proofs and theorems

Absolute beliefs as “**correct**” and “**productive**” (Elby & Hammer, 2001) in computer science

Discipline-specific socialization towards a view of science as means of finding objective, demonstrable truths

 A linear increase in absolutism over the computer science curriculum is likely (**Hypothesis 1**)

## **Ill-defined knowledge structure** (Muis et al., 2006)

- Concepts are loosely structured
- Theories are often inconsistent
- Controversial findings are frequent

## **Central challenge for psychology students** (Rosman, Mayer, Kerwer, & Krampen, 2016)

- “Cope” with this ill-defined knowledge structure
- Evaluativistic beliefs as most correct and productive (Elby & Hammer, 2001) in psychology

“Coping” with ill-defined knowledge is hard for **freshmen** due to low domain-specific knowledge (Rosman et al., 2016)

- Reason: Students lack the skills to weigh evidence and evaluate theories and findings
- **Consequence:** Multiplism increases

**More advanced students** learn to weigh evidence and evaluate theories (Rosman et al., 2016)

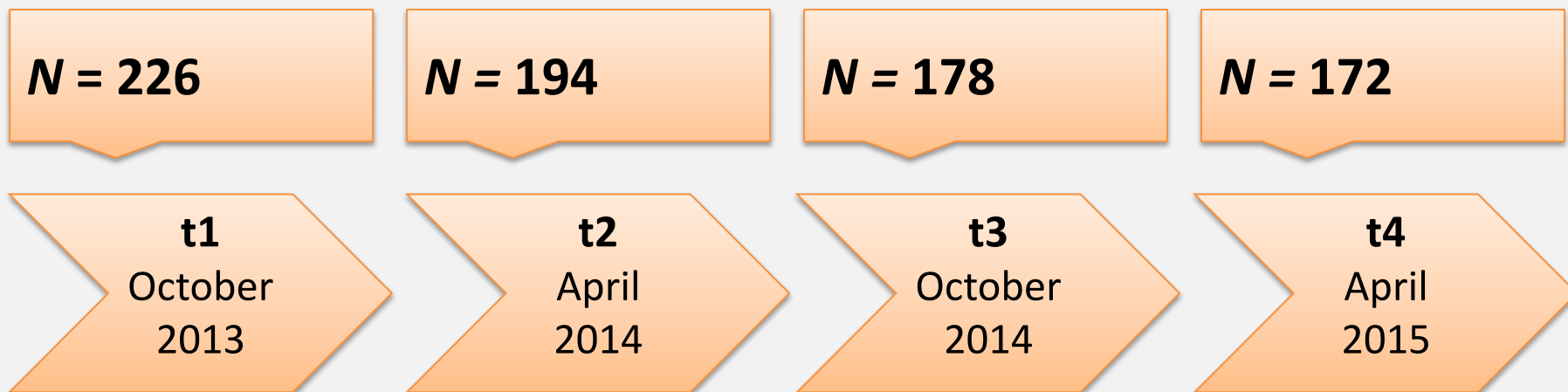
- Reason: Increase in research skills, information literacy, etc.
- **Consequence:** Multiplism decreases, evaluativism increases

 Inversely U-shaped developmental trajectory of multiplism in psychology students (**Hypothesis 2**)



## The WisE Study (Mayer, Rosman, Birke, Gorges, & Krampen, in press)

- Four-wave longitudinal study
- $N = 226$  first-semester Bachelor students (first wave)
- 137 psychology students (one single institution) and 89 computer science students (three different institutions)



## **Primary Measure: EBI-AM** (Peter, Rosman, Mayer, Leichner, & Krampen, 2015)

23 epistemic statements; 5-point Likert scales; discipline-specific:

- **Absolute scale:** e.g., *“There is always a true answer to questions in this subject.”*
- **Multiplistic scale:** e.g., *“In this subject, only uncertainty appears to be certain.”*

## **Secondary measure: CAEB** (Stahl & Bromme, 2007)

Semantic differential with adjective pairs of opposing terms; 5-point Likert scales:

- **Texture dimension:** e.g., *“exact – vague”*
- **Variability dimension:** e.g., *“stable – unstable”*

## **Multi-group growth modelling for parallel processes** (Muthén & Muthén, 2015)

Model development involved three steps:

- (1) explore if changes in epistemic beliefs generally differ between disciplines
- (2) assess the pattern of change for all subscales separately (linear vs. quadratic vs. cubic trajectory)
- (3) specify and investigate, based on this assessment, target (i.e., “final”) models for both questionnaires.

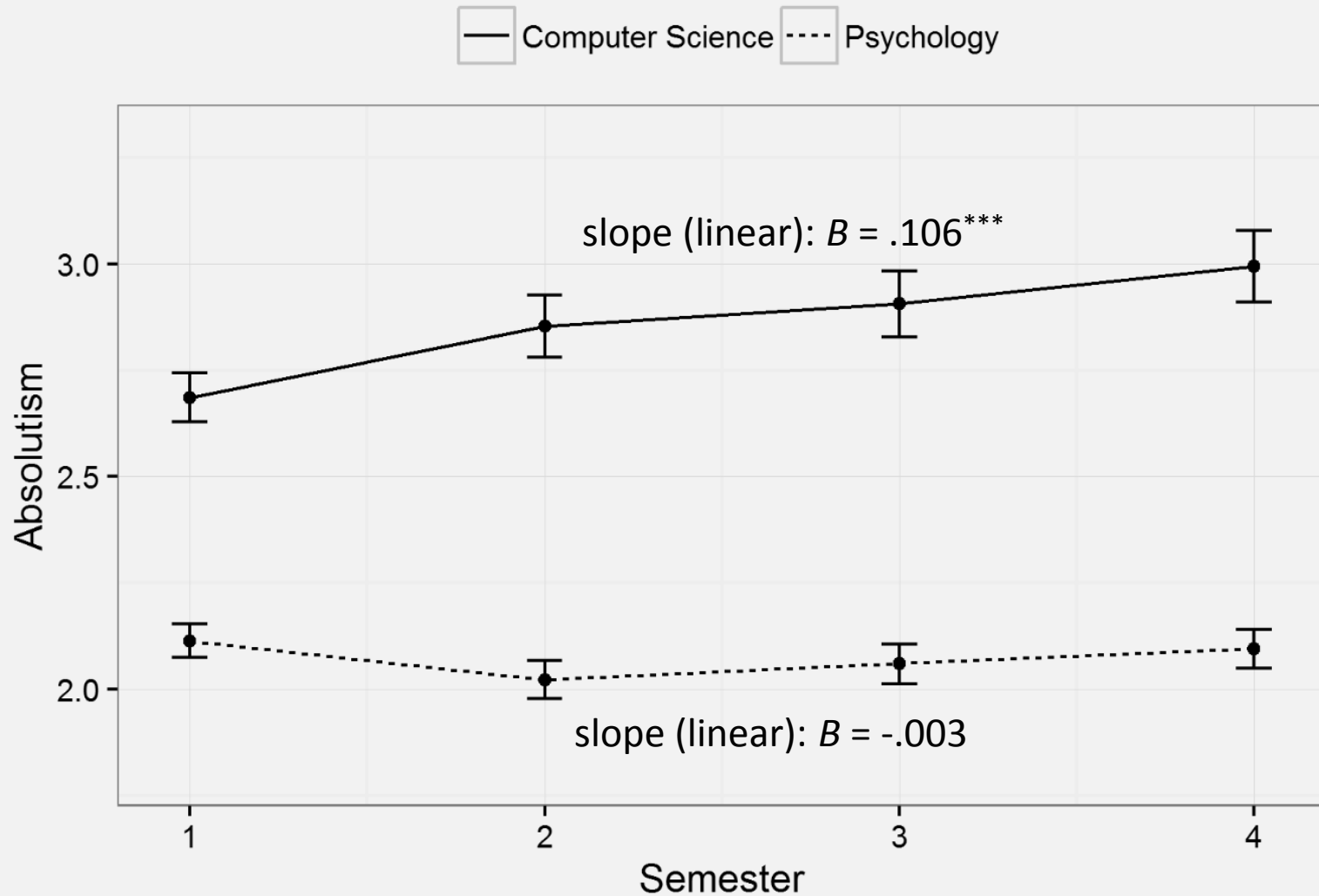
## EBI-AM target model:

- includes linear slope factor for absolutism and linear, quadratic and cubic slope factors for multiplism
- $\chi^2 = 50.25$ ,  $df = 47$ ,  $p = .346$ , CFI = .994, RMSEA = .025, SRMR = 0.095

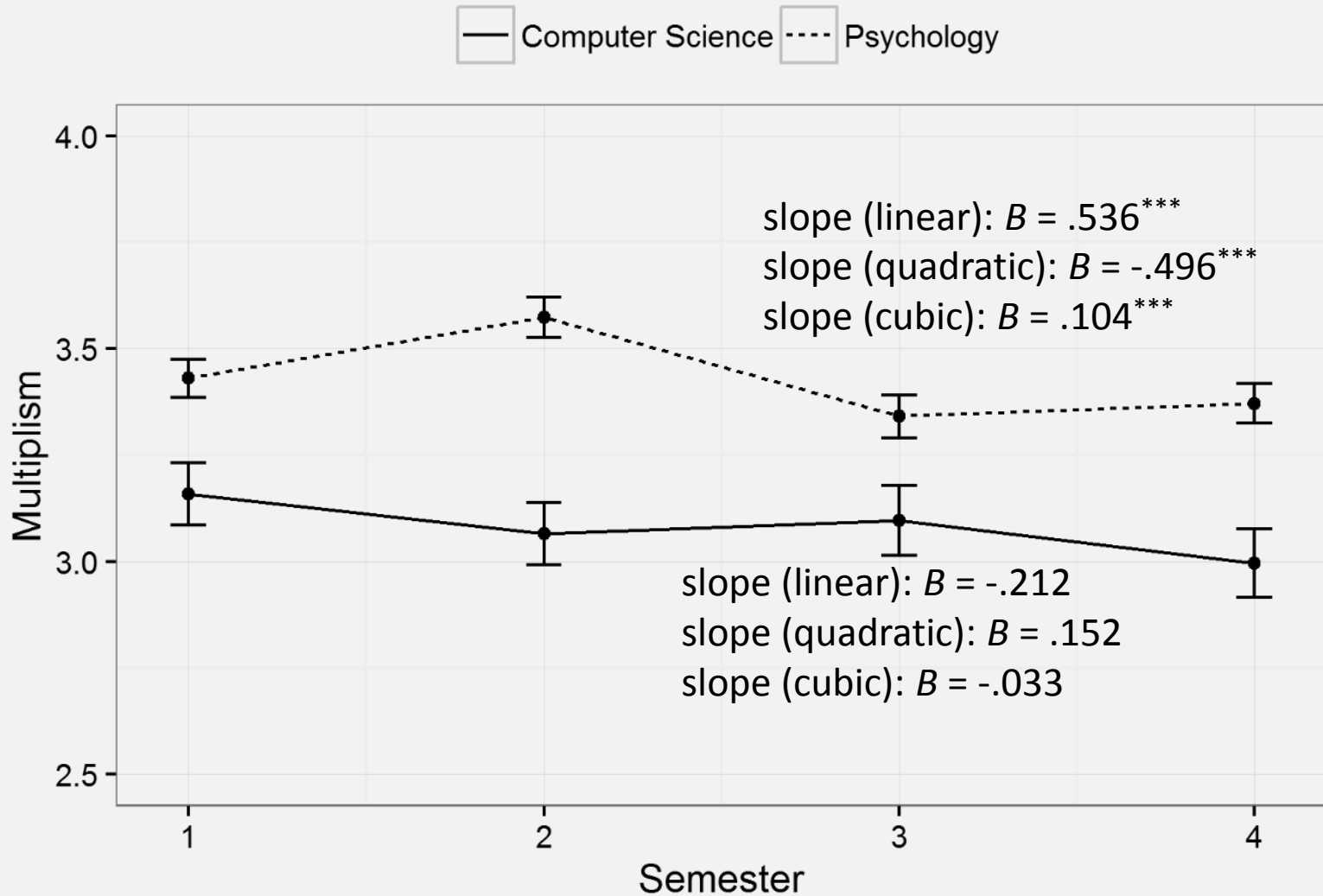
## CAEB target model:

- includes linear and quadratic slope factors for both texture and variability
- $\chi^2 = 71.11$ ,  $df = 46$ ,  $p = .010$ , CFI = .962, RMSEA = .070, SRMR = 0.095

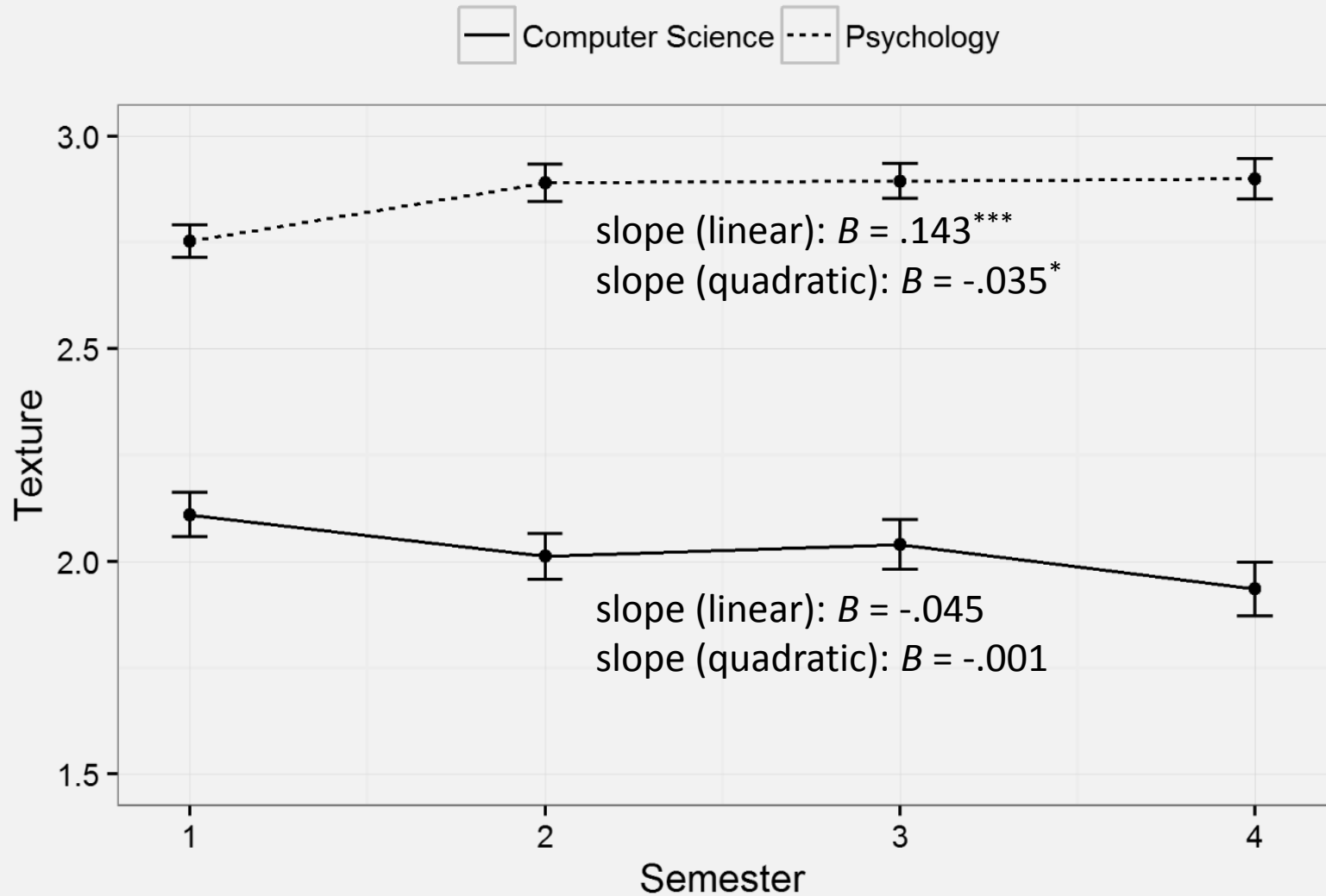
# Results – Absolute beliefs (EBI-AM)



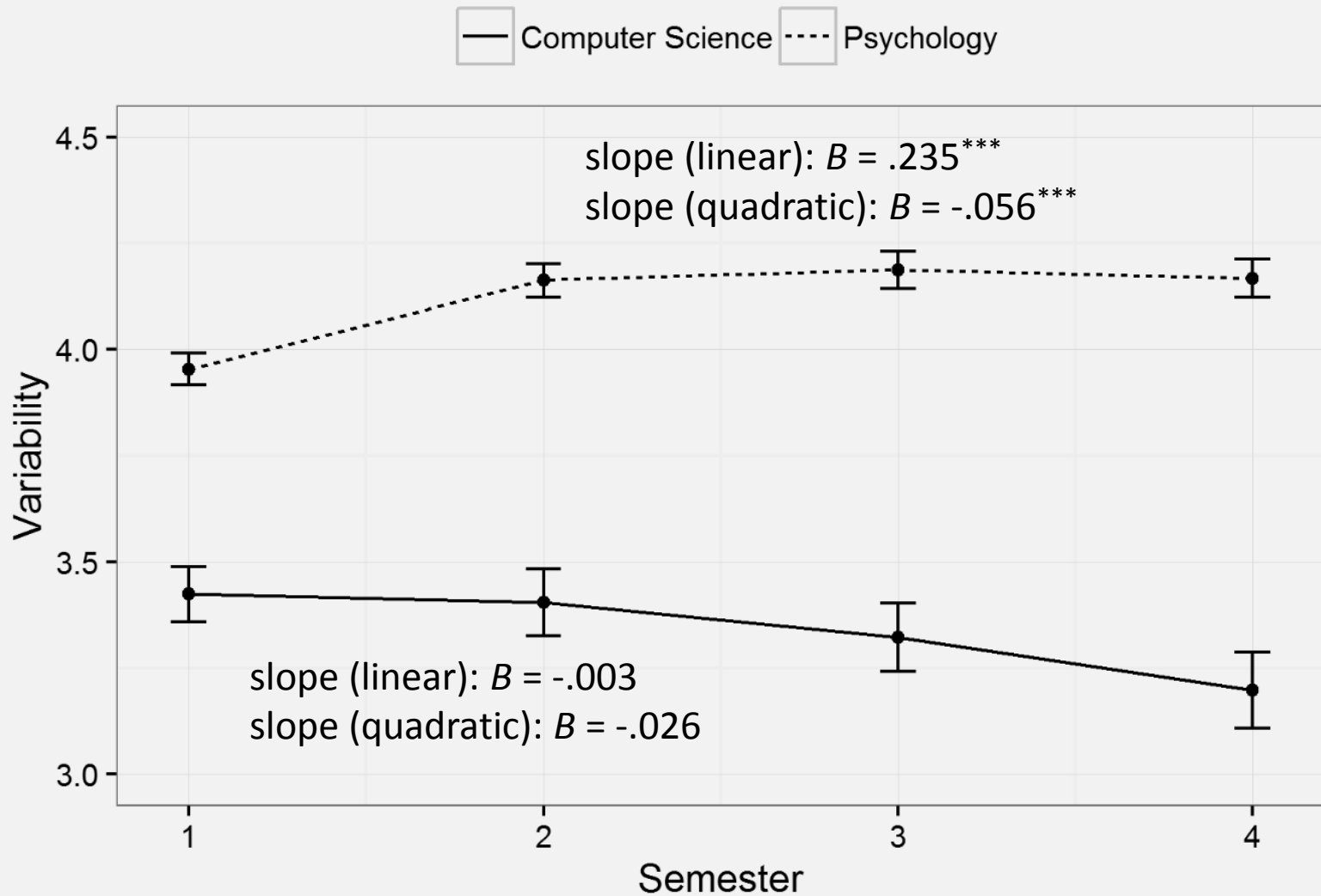
# Results – Multiplistic beliefs (EBI-AM)



# Results – CAEB-Texture



# Results – CAEB-Variability





Increase in absolutism in computer science students → Contradicts the assumptions by Kuhn and Weinstock (2002)

Inversely U-shaped trajectory of multiplistic beliefs in psychology students

Fixed developmental sequence assumed in stage models (Kuhn & Weinstock, 2002) vs. flexible adaptation of epistemic judgments to contexts (Bromme, Kienhues, & Stahl, 2008)

Disciplinary differences should be taken into account when ...

- conceptualizing interventions to change students' epistemic beliefs
- Developing theoretical models on the development of epistemic beliefs

## Thank you for your attention!

- Bråten, I., & Strømsø, H. I. (2010). When law students read multiple documents about global warming: Examining the role of topic-specific beliefs about the nature of knowledge and knowing. *Instructional Science*, 38(6), 635-657.
- Bromme, R., Kienhues, D., & Stahl, E. (2008). Knowledge and epistemological beliefs: An intimate but complicated relationship. In M. S. Khine (Ed.), *Knowing, knowledge, and beliefs: Epistemological studies across diverse cultures* (pp. 423-444). New York, NY: Springer.
- Buehl, M. M., Alexander, P. A., & Murphy, P. K. (2002). Beliefs about schooled knowledge: Domain specific or domain general? *Contemporary Educational Psychology*, 27(3), 415-449.
- Elby, A., & Hammer, D. (2001). On the substance of a sophisticated epistemology. *Science Education*, 85(5), 554-567.
- Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67(1), 88-140.
- King, P. M., Wood, P. K., & Mines, R. A. (1990). Critical thinking among college and graduate students. *Review of Higher Education*, 13(2), 167-186.
- Kuhn, D., & Weinstock, M. (2002). What is epistemological thinking and why does it matter? In B. K. Hofer & P. R. Pintrich (Eds.), *Personal epistemology: The psychology of beliefs about knowledge and knowing* (pp. 121-144). Mahwah, NJ: Lawrence Erlbaum Associates.
- Mayer, A.-K., Rosman, T., Birke, P., Gorges, J., & Krampen, G. (in press). *Development of novices' professional knowledge networks within the contexts of classroom teaching and information searches on the internet. Research data from a longitudinal study 2013-2015*. [Translated Title] (Version 1) [Files on CD-ROM]. Trier, Germany: Center for Research Data in Psychology: PsychData of the Leibniz Institute for Psychology Information ZPID.
- Muis, K. R., Bendixen, L. D., & Haerle, F. C. (2006). Domain-general and domain-specificity in personal epistemology research: Philosophical and empirical reflections in the development of a theoretical framework. *Educational Psychology Review*, 18(1), 3-54.
- Peter, J., Rosman, T., Mayer, A.-K., Lechner, N. & Krampen, G. (2016). Assessing epistemic sophistication by considering domain-specific absolute and multiplicistic beliefs separately. *British Journal of Educational Psychology*, 86(2), 204-221.
- Muthén, L. K., & Muthén, B. O. (1998-2015). Mplus User's Guide. Seventh Edition. Los Angeles, CA: Muthén & Muthén.
- Rosman, T., Mayer, A.-K., Kerwer, M., & Krampen, G. (2016). *The differential development of epistemic beliefs in psychology versus computer science students: A four-wave longitudinal study*. Manuscript submitted for publication. Leibniz Institute for Psychology Information, Trier, Germany.
- Stahl, E., & Bromme, R. (2007). The CAEB: An instrument for measuring connotative aspects of epistemological beliefs. *Learning and Instruction*, 17(6), 773-785.