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

A four-wave longitudinal study

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Epistemic beliefs

- 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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### Developmental stage Description *(Kuhn & Weinstock, 2002; Hofer & Pintrich, 1997)*

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<thead>
<tr>
<th>Absolute beliefs</th>
<th>Knowledge ...</th>
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</thead>
<tbody>
<tr>
<td>- is based on facts → „objective“</td>
<td></td>
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<tr>
<td>- is conceptualized in dualistic contrasts (right-and-wrong or truth-and-untruth)</td>
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<tr>
<td>- is stable and permanent</td>
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<tr>
<th>Multiplistic beliefs</th>
<th>Knowledge ...</th>
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<tbody>
<tr>
<td>- is based on personal opinion and the generation of own ideas → „subjective“</td>
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<tr>
<td>- is dynamic, tentative, and preliminary</td>
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<tr>
<td>- Truth does not exist and everything is subjective (extreme form)</td>
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<tr>
<th>Evaluativistic beliefs</th>
<th>Knowledge ...</th>
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<td>- is more or less objective resp. subjective – depending on the issue in question and on its context</td>
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<td>- Individuals realize themselves to be part of the process of knowledge by evaluating and weighting knowledge claims</td>
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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).
Epistemic “sophistication”

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.
Epistemic beliefs in computer science

**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)
Assessing epistemic beliefs

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.
Results – Target models

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)

slope (linear): $B = -0.003$

slope (linear): $B = 0.106^{***}$
Results – Multiplistic beliefs (EBI-AM)

- **Slope (linear):** $B = .536^{***}$
- **Slope (quadratic):** $B = -.496^{***}$
- **Slope (cubic):** $B = .104^{***}$

- **Slope (linear):** $B = -.212$
- **Slope (quadratic):** $B = .152$
- **Slope (cubic):** $B = -.033$

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Results – CAEB-Texture

- Computer Science: slope (linear): $B = 0.143^{***}$, slope (quadratic): $B = -0.035^*$
- Psychology: slope (linear): $B = 0.045$, slope (quadratic): $B = -0.001$
Results – CAEB-Variability

slope (linear): $B = .235^{***}$
slope (quadratic): $B = -.056^{***}$

slope (linear): $B = -.003$
slope (quadratic): $B = -.026$
Conclusions

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!


