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

A four-wave longitudinal study

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EARLI SIG Metacognition conference 2016
Nijmegen, August 23-26 2016
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
### Developmental stage | Description (Kuhn & Weinstock, 2002; Hofer & Pintrich, 1997)

<table>
<thead>
<tr>
<th>Absolute beliefs</th>
<th>Knowledge ...</th>
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<tbody>
<tr>
<td>- is based on facts → &quot;objective&quot;</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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<tr>
<td>- is based on personal opinion and the generation of own ideas → &quot;subjective&quot;</td>
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<td>- is dynamic, tentative, and preliminary</td>
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<td>- Truth does not exist and everything is subjective (extreme form)</td>
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<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 “unsophisticated” and obstructive for learning (Hofer & Pintrich, 1997)

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).
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 (Expectation 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 (Expectation 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”

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

Model development involved three steps:

1) explore if changes in EBI-AM (and CAEB) generally differ between disciplines

2) assess the pattern of change for the EBI-AM (and the CAEB) subscales separately (linear vs. quadratic vs. cubic trajectory)

3) specify and investigate, based on this assessment, target (i.e., “final”) model(s) 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)

slope (linear): $B = .106^{**}$

slope (linear): $B = -.003$
Results – Multiplistic beliefs (EBI-AM)

**Graph: Multiplism over Semesters**

- **Computer Science**:
  - Slope (linear): $B = 0.536^{***}$
  - Slope (quadratic): $B = -0.496^{***}$
  - Slope (cubic): $B = 0.104^{***}$

- **Psychology**:
  - Slope (linear): $B = -0.212$
  - Slope (quadratic): $B = 0.152$
  - Slope (cubic): $B = -0.033$

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

What are “sophisticated” beliefs?

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!


Results – CAEB-Texture

slope (linear): $B = .143^{***}$
slope (quadratic): $B = -.035^{*}$

slope (linear): $B = -.045$
slope (quadratic): $B = -.001$
Results – CAEB-Variability

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