Educational neuroscience: The importance of crossing disciplines to understand learning and development

Seminar: on the importance of Education Research and Innovation – strengthening the European knowledge base

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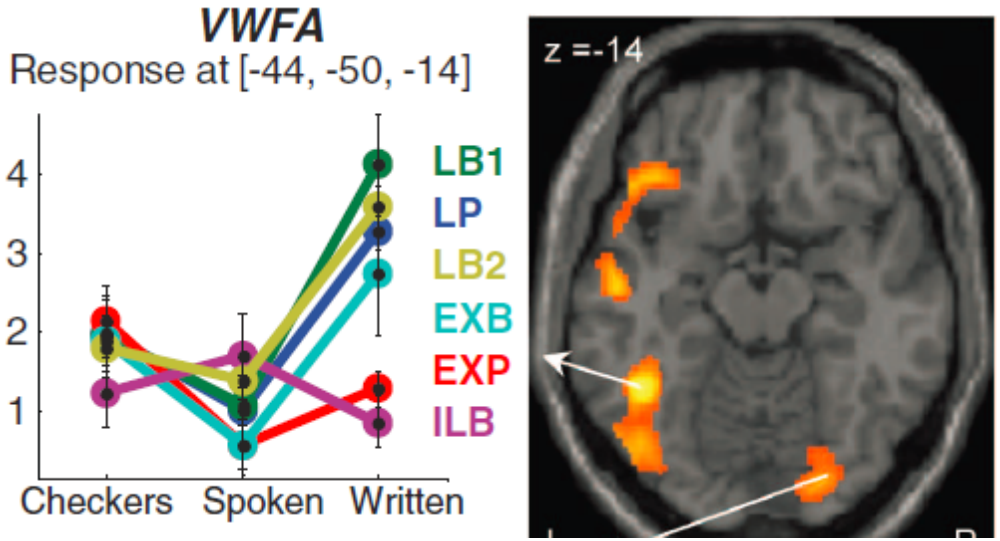
Learning in school ⟺ Learning in the brain

1. Education changes the brain, as learning = reorganizing connections and networks

→Example: Literacy acquisition changes speech and visual processing in the brain



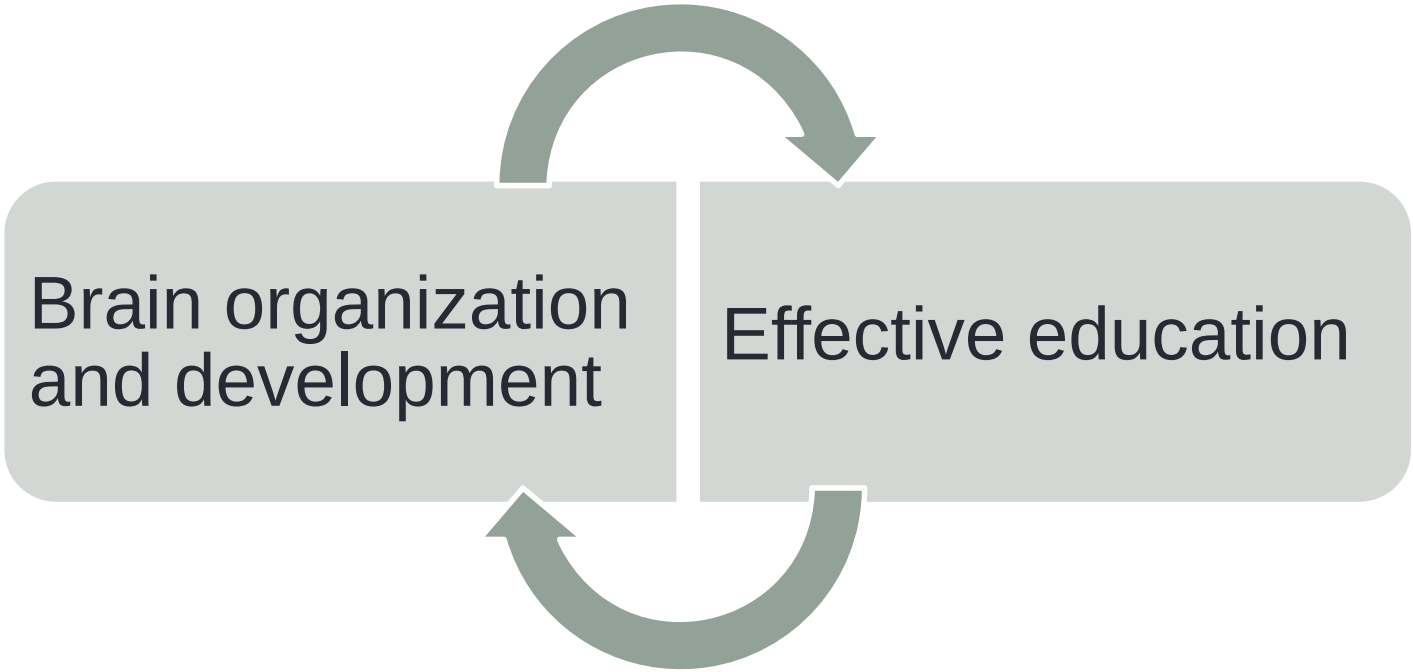
Dehaene et al, Science, 2010

Learning in school ⟺ Learning in the brain

2. The brain provides the **machinery** to learn, & learning disorders go together with (often subtle) changes in the brain

→Education is constrained by how the brain **works**, **develops**, **deviates**

Constraining: education is only effective if it connects to how the brain works and learns



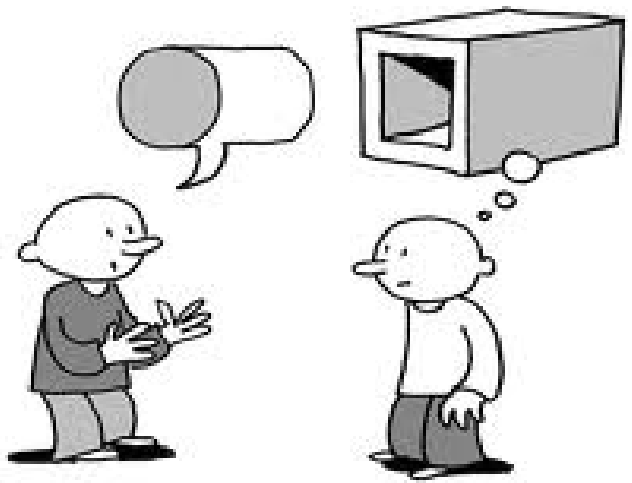
Influencing: Education (learning) changes the brain's organization and functioning

Learning in school ⟺ Learning in the brain

3. To prevent miscommunication

→Neuromyths and malpractices in education

→Negative impacts new research findings



Learning as multi-level phenomenon

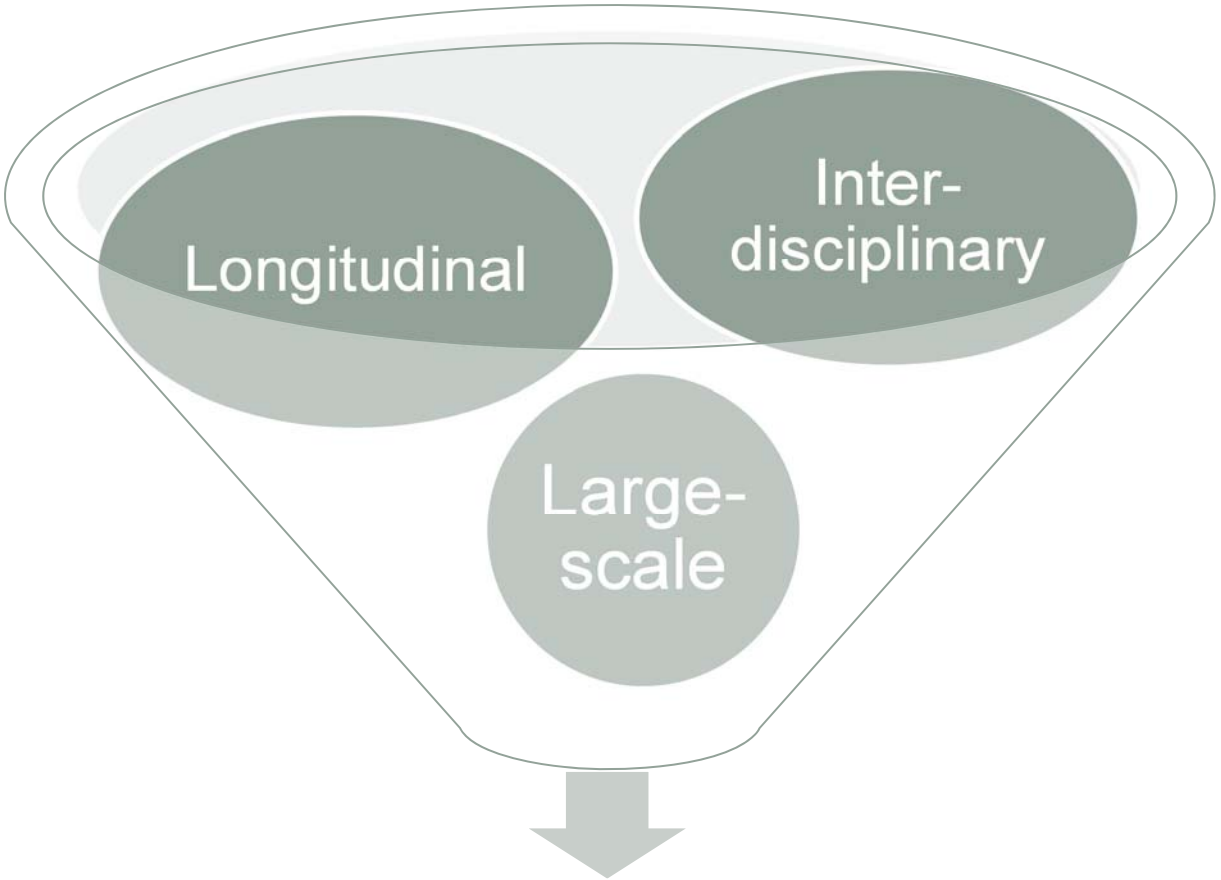
- Neurobiology of learning
- Individual learning history
- Students' personal beliefs and goals
- Peer and family context
- Teacher expectations/feedback
- Culturally mediated knowledge

Important future research aims

We want education to change the brain optimally, for this we need to increase understanding of:

- The neurobiology of (typical and atypical) learning and development
- How multiple levels interact during learning & development
- What each child's best learning environment is to optimize brain changes by education (i.e., learning)
- How to integrate research and practice to maximize benefits and minimize negative impacts

These aims call for research that is:



How education optimally connects to each child's learning machinery

Promising directions

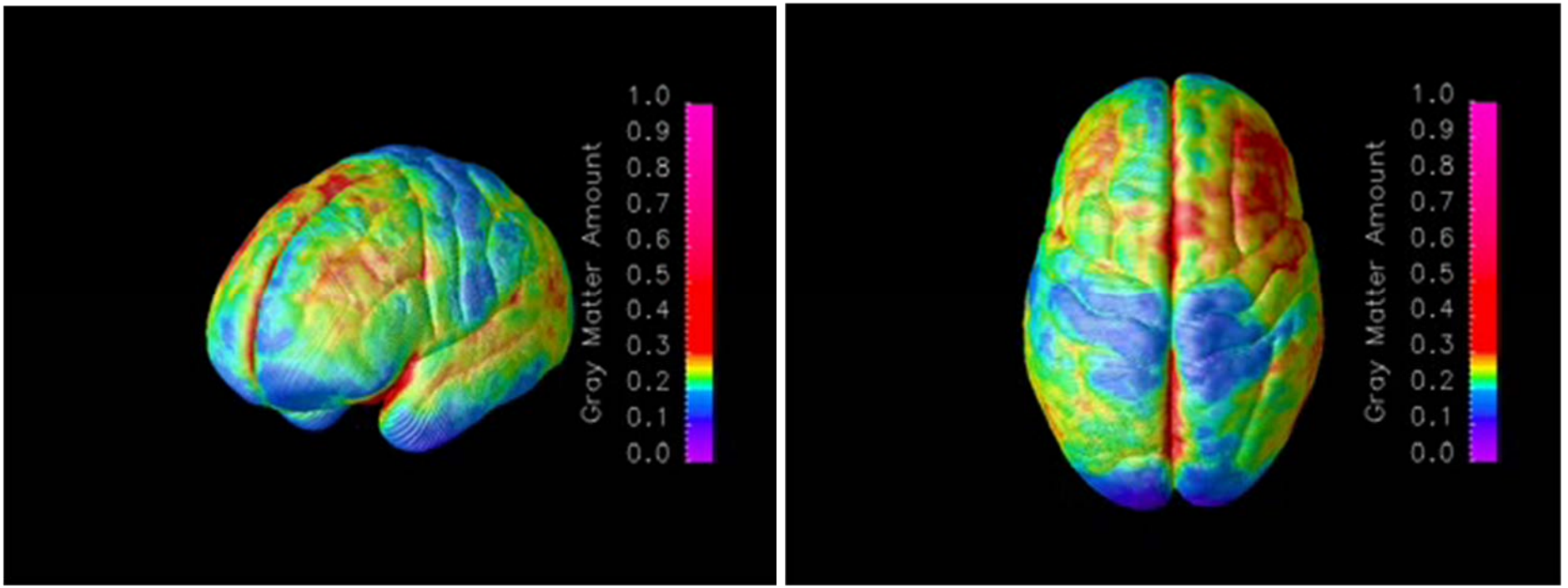
1. **Brain research in the lab**: understanding learning and brain development
   - **Guided** by psychological theories, **complemented** by other methods, and **followed** by field research

2. **Brain research in more realistic environments**
   - Incorporating real-life complexity in lab, or mobile neuroscience

3. **Communication to and involvement of stakeholders**:
   - Study how useful knowledge is best communicated
   - Integrating knowledge and perspectives of stakeholders in designing and interpreting brain research

1. Understanding development and learning

Longitudinal neuro-imaging studies reveal valuable insights



Gogtay et al.,
PNAS, 2004

1. Understanding development and learning

No **direct** applications, but raises hypotheses that we can test in the educational practice

- Example: “Adolescent brain is not able to plan school work”

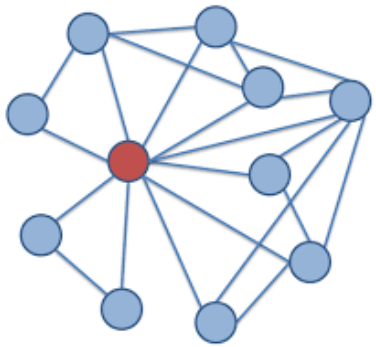
- BUT: How can we use this insight? Can/should we coach adolescents to plan their school work, and how?
- Field study: Intervention, RCT

2. More realistic environments

Including complexity real-life in neuroscience experiments

Example: ongoing work at Vrije Universiteit

Krabbendam et al use the complexity of real-life social networks of adolescents as variable in fMRI analysis

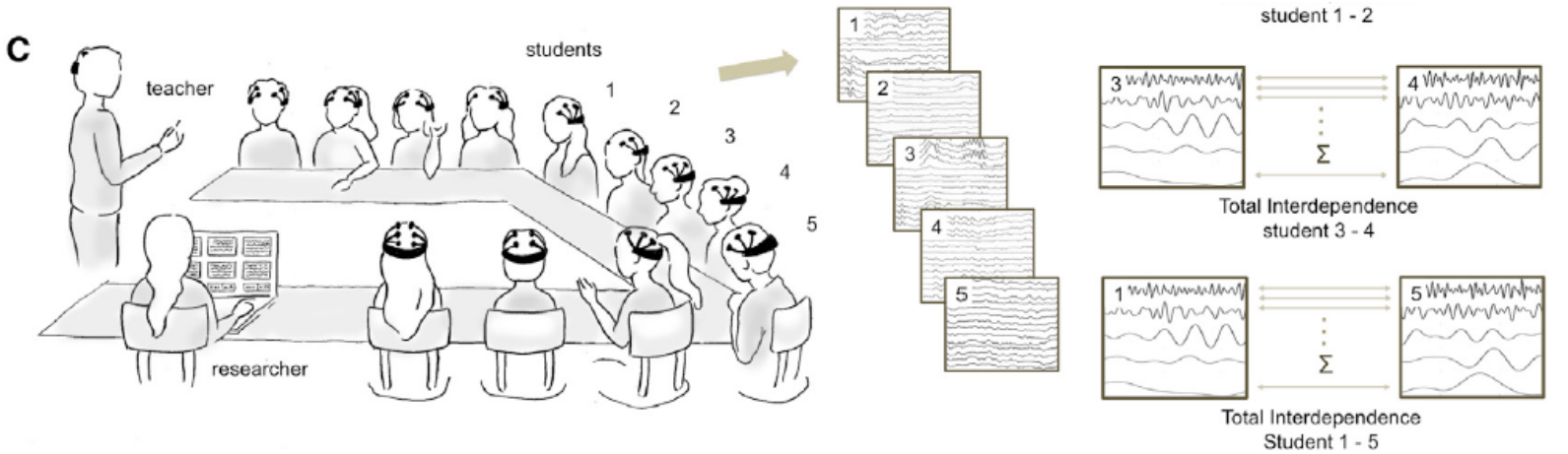


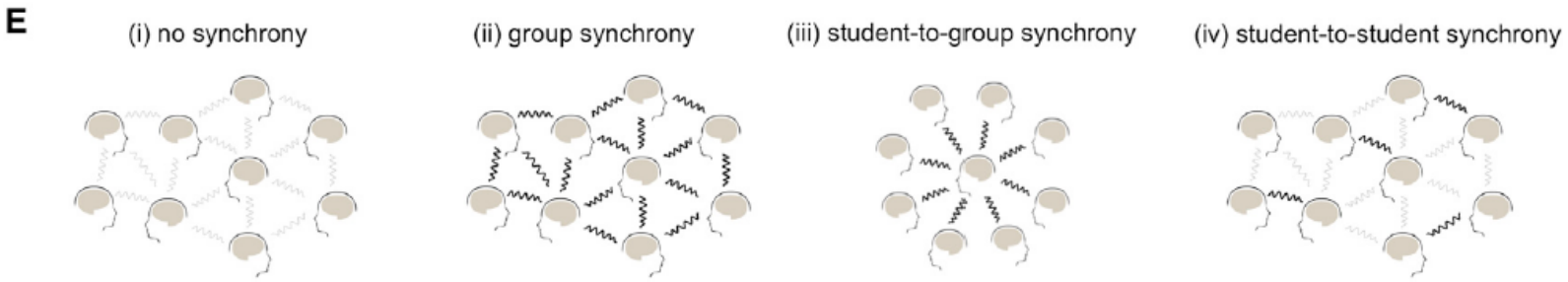
Longitudinal

Social networks: peer context (peer nominations)

Trust game in fMRI

2. Neuroscience in the classroom



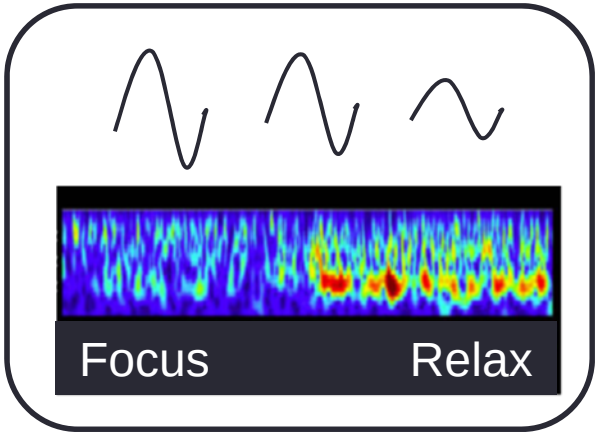


Dikker et al., 2017 Current Biology: link between brain-to-brain synchrony and classroom engagement

2. Neuroscience in the classroom

- Experiencing brain plasticity using mobile EEG-neurofeedback
- Work in progress, my lab, funded by ERC StG

Wow, my brain activity changes with learning!



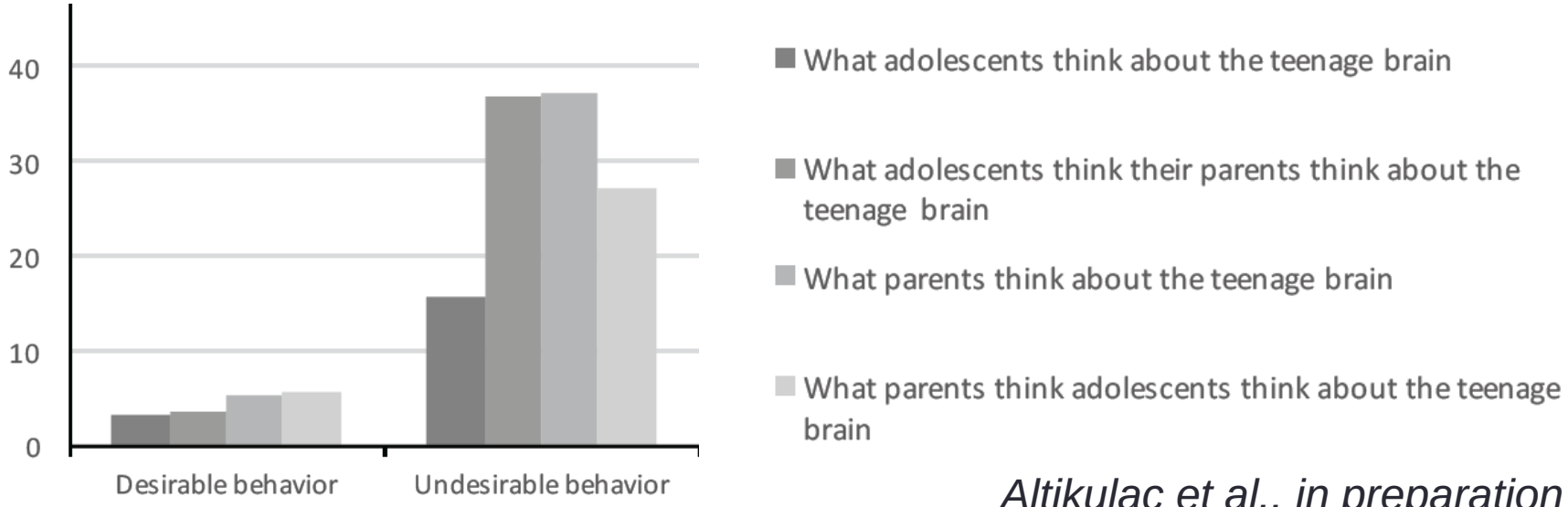
And I can influence my brain waves! Cool!

So maybe it **is** useful to practice...

3. Communication, including stakeholders

- How do neuroscientific findings impact society?
- Example: public perceptions of the adolescent brain

→Risky and impulsive behavior, or creativity and flexibility?

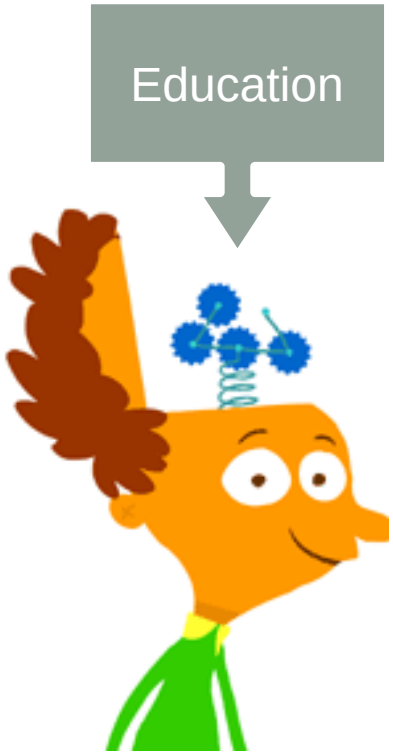


Altikulac et al., in preparation

→Project-specific reflection on/anticipation of possible impact, e.g. using Responsible Innovation (RRI) approach

Conclusions

- Learning in school ⟷ learning in the brain
- Should be studied in integration to unravel how education optimally connects to each child's learning machinery



- Challenging: many levels interact, communication complicated
- Challenges tackled only if research is:
  - Interdisciplinary
  - Longitudinal
  - Large-scale
  - Including reflection/research on impact and validity in practice → responsible innovation