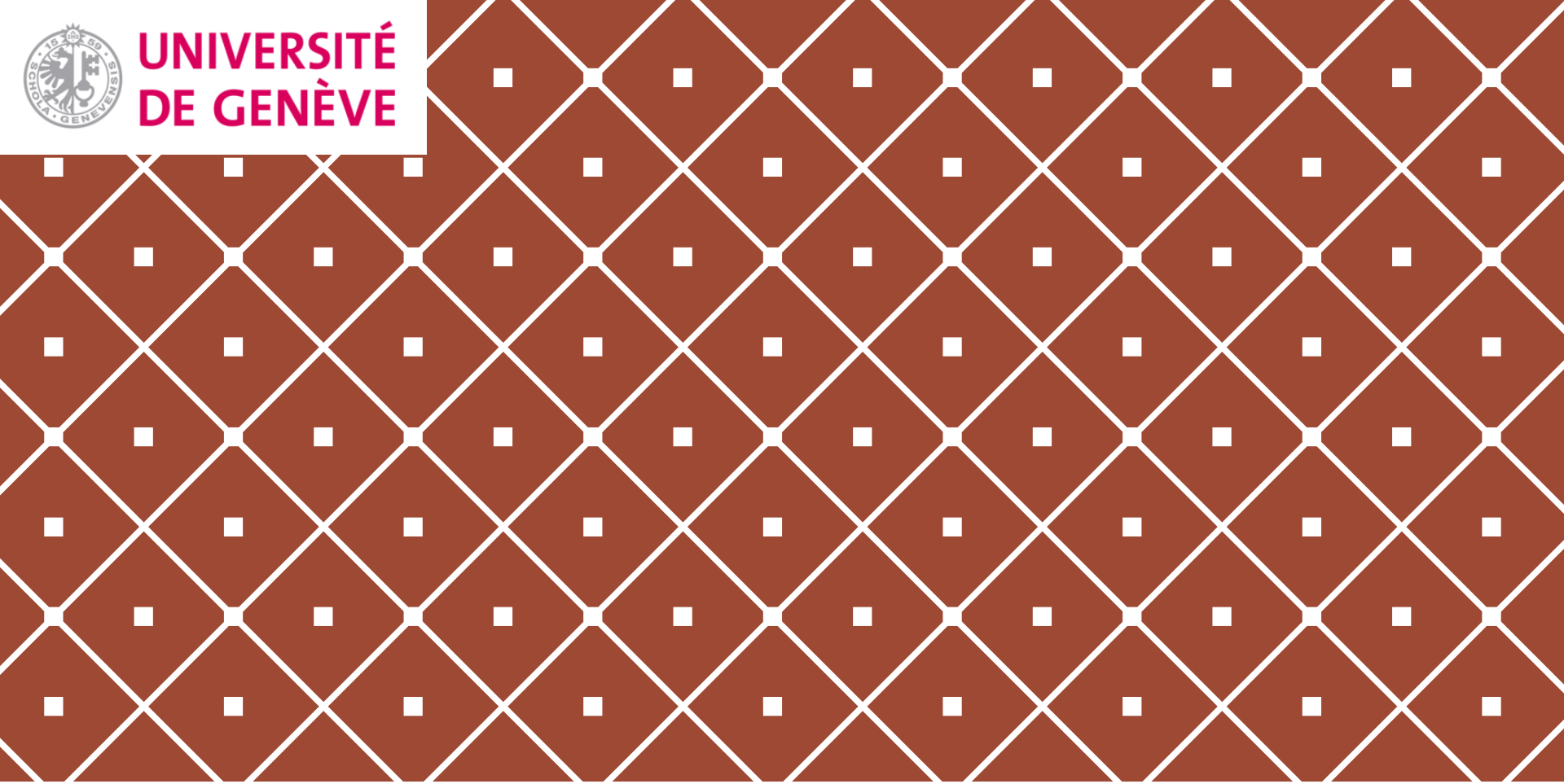

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EDUCATIONAL ILLUSIONS

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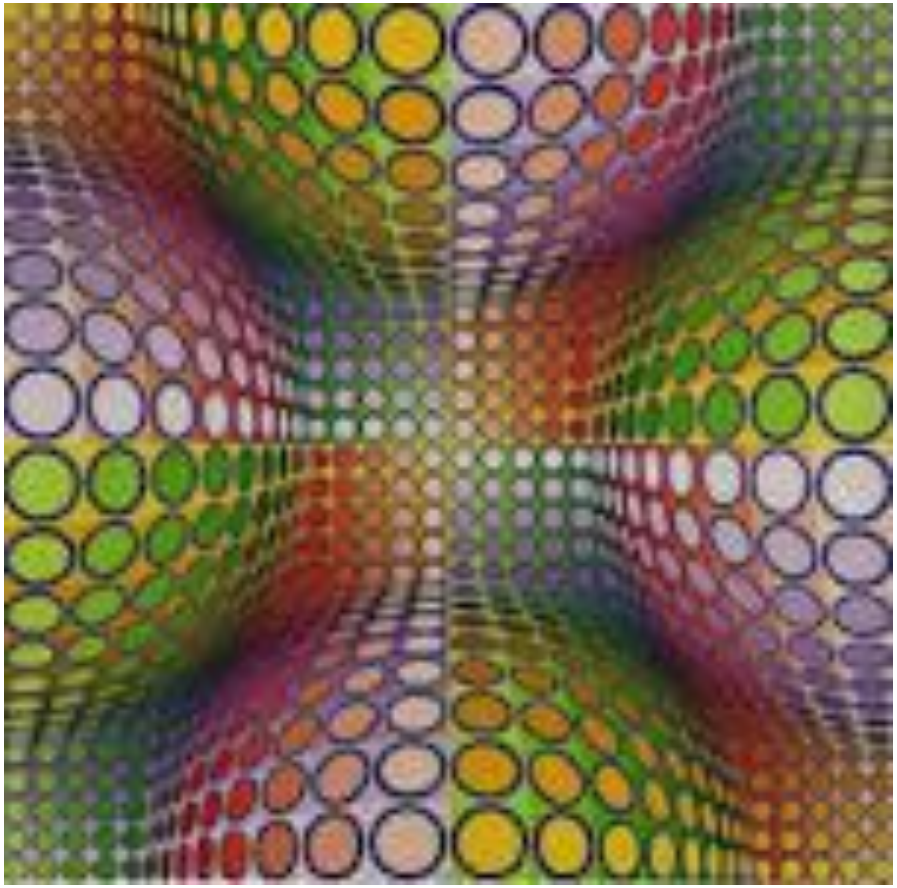
EDUCATIONAL ILLUSIONS: AN ANALOGY

I. Introduction
II. Dialogue and classroom questioning
    i. speaking time
    ii. wait time
    iii. question level
III. Interest and authenticity
IV. Discussion
V. Conclusions



V. Vaserely, Vega-Lep, 1970

OPTICAL ILLUSIONS

Systematic errors of perception and interpretation

EDUCATIONAL ILLUSIONS

In analogy with optical illusions

"Characteristic errors that may give clues to underlying mechanism" (Keil & Wilson, 2005).

Not individual beliefs or hopes in something that does not happen (Balzac, 1843/1983).

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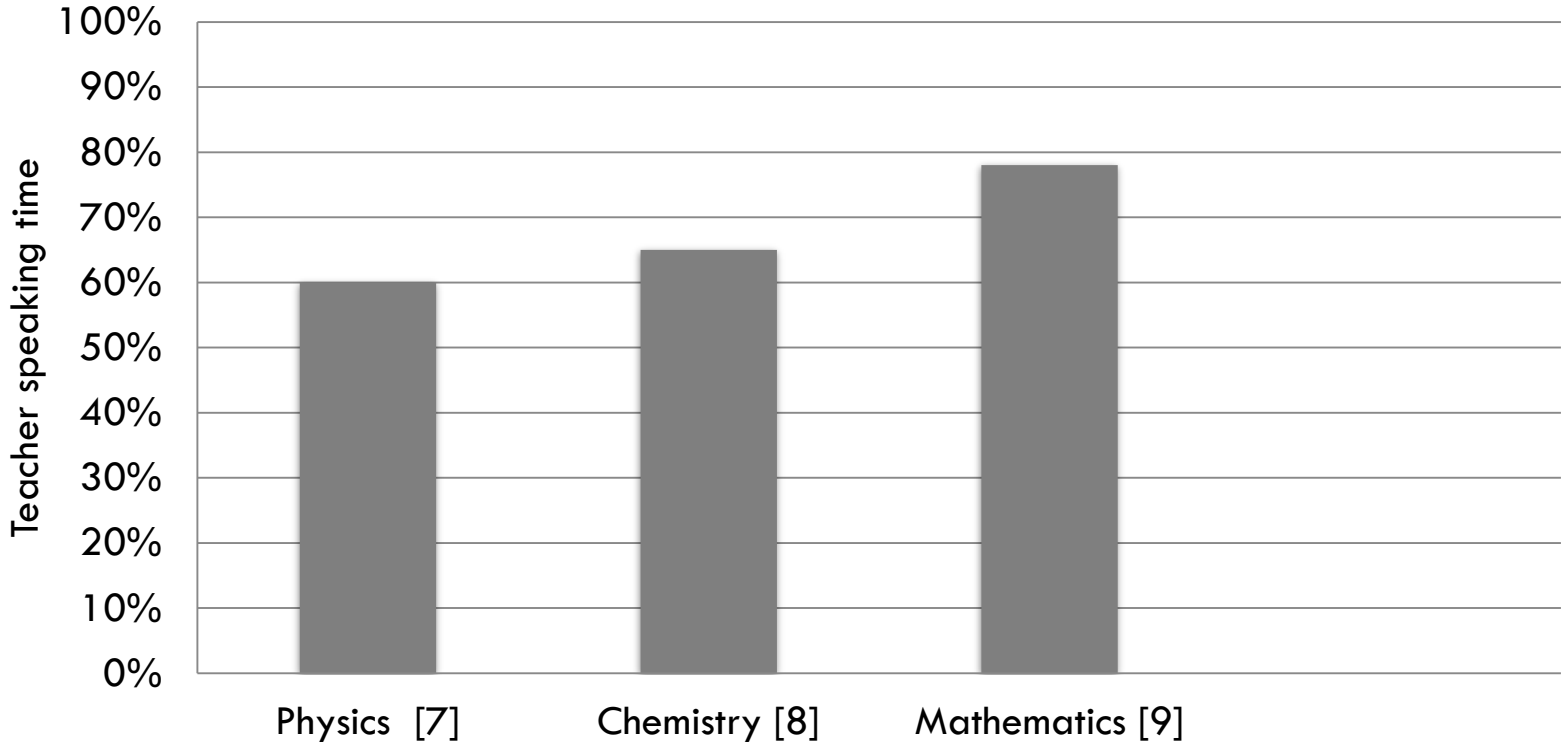
WHO SPEAKS IN SCIENCE LESSONS?



[7] Seidel (2003); [8] Sumfleth & Pitton (1988); [9] Klieme et al. (2006).
Comparative findings in EFL: number of words spoken by teachers = 83.4% (Getachew Tsegaye & Davidson, 2014).

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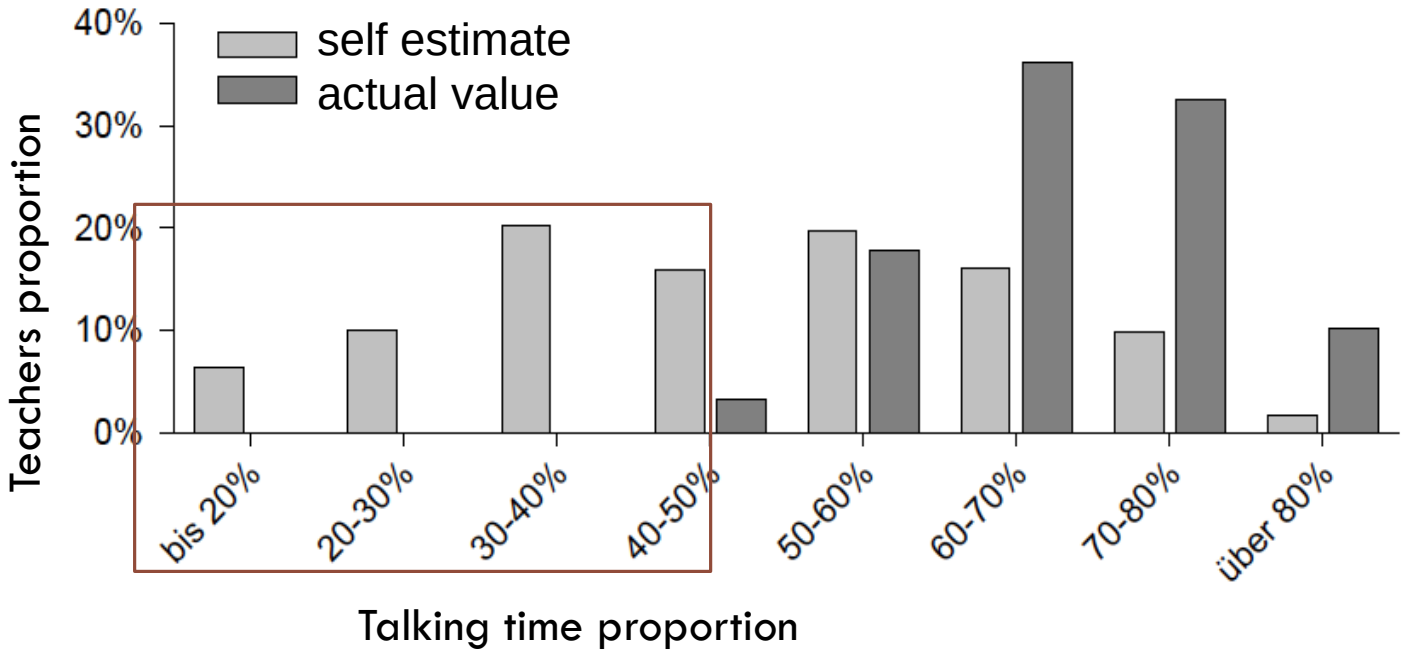
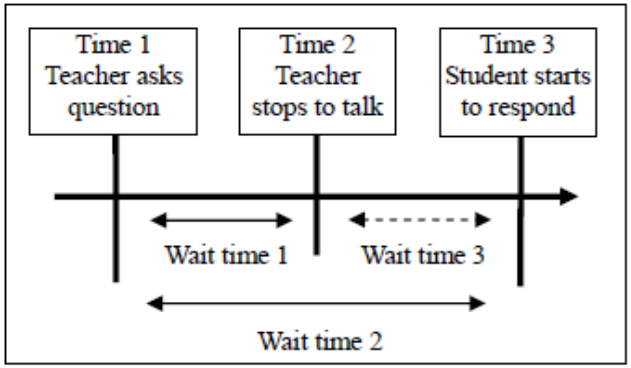
ARE TEACHERS AWARE OF THEIR TALKING TIME?



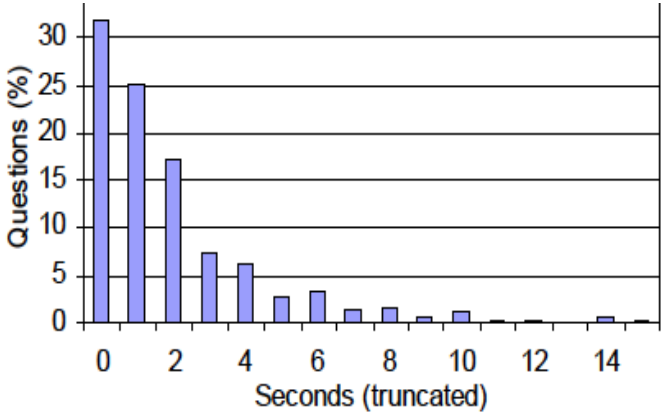
Strong underestimation 50% vs 70% of teacher talking time (English and German lessons)

1/3 of teachers thinks that they are under 40% of the lesson time (Klieme et al, 2006).

ENOUGH TIME TO THINK?



Heinze & Erhard (2006) after Rowe (1969)



Time 3 (Heinze & Erhard, 2006)

- "wait time" in the teacher/student interaction largely investigated since the 1970's in different subjects areas (Rowe, 1969; 1986; Tobin, 1987)
- "think time" (Stahl, 1990) "We need processing time when asked a question, to hear the question, assimilate it and compare it to others that we have been asked, formulate a response from a possible range and surface the response in language. All of which takes time - processing time" (Smith, 2002).
- Science lessons: wait time < 3s, often 1s or less (Rowe, 1969; Tobin 1987; Caillé, 1995)
- Math lessons: wait time = 2.5s (1564 questions in 22 lessons, 1 question every 38s) (Heinze & Erhard, 2006)
- "needed time" (individual interview) = 2.8s; divergent questions (see below) = 6.9s (Jones, 1980)

QUESTION LEVEL: WHAT KIND OF QUESTIONS?

- Problems (for instance in mathematical lessons) solved step by step, by answering simple and closed teacher-guided questions, requiring student responses mostly only on an elementary level.
- Therefore complex problem are transformed into a series of closed simple question (Voigt, 1984; Klieme, Schümer, & Knoll, 2001).
- Types of questions (Heinze & Erhard, 2006)

Reproductive	Convergent (unique answer)	Divergent	Evaluative
39,2%	54,7%	2,1%	4,0%

- Up to 80% of purely factual questions ("low order thinking") (Gal, 1970; Hattie, 2009).
- Several studies show better achievement with higher order questions.

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WHAT KIND OF KNOWLEDGE?

"[M]uch of daily classroom life is "knowledge telling", and thus surface knowledge is sufficient. Students soon learn that studying or learning with surface strategies or methods [e.g. re-reading…] leads to success.

In contrast, teachers claim to prefer a deep view of learning, usually focused on academic and cognitive development … while at the same time they emphasize surface methods of teaching, usually with the defence that this is what is required in order to prepare students for high-stakes qualification examinations or assessments. This emphasis on surface approaches means that students tend to experience very few opportunities or demands for deep thinking in contemporary classrooms" (Hattie, 2009).

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INTEREST AND AUTHENTICITY

PISA 2006 – Science competencies for tomorrow's world

AUTHENTICITY ACCORDING TO PISA

Authenticity

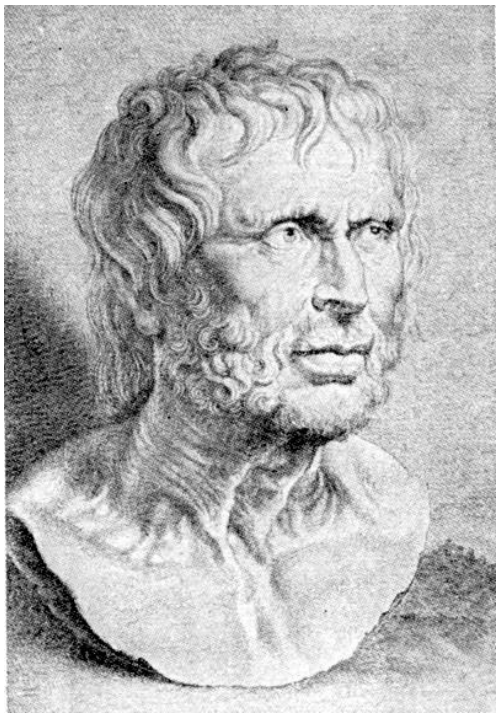
- Greek: authentikós – „true “
- related to actual, real(istic), genuine contexts and experiences learners are supposed to encounter

PISA 2006: a central concept!

- authenticity defined as “relevance to students’ interests and lives” (OCDE, 2007)
- “Real world contexts have [...] been ***a central feature of the PISA project*** for the assessment of scientific literacy among young people“ (Fensham, 2009)

- other and more far-reaching understandings of authenticity exist (CTVG, 1990; Mims, 2003; Herrington & Herrington, 2006; Shaffer and Resnick, 1999).

AUTHENTICITY: AN AGE OLD ISSUE OF SCHOOL



Non vitae, sed scholae discimus

(*We learn not for life, but for school*)

Seneca, ca. 62- 64 a.C.

Epistulae morales ad Lucilium 106, 12

… a complaint arguing (already!) for more practical and authentic education

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PISA: CONSIDERABLE EFFORT FOR AUTHENTICITY

5 areas of today's science application: health, natural resources, environment, hazard, frontiers of science and technology

… instead of classical issues belonging to the specific science disciplines

- Example: The acid rain problem

Here is a photo of statues on the Acropolis in Athens more than 2500 years ago. The statues are made of a type of rock called marble. Marble is composed of calcium carbonate. In 1980, the original statues were transferred inside the museum of the Acropolis and were replaced by replicas. The original statues were being eaten away by acid rain.

Normal rain is slightly acidic because it has absorbed some carbon dioxide from the air. Acid rain is more acidic than normal rain because it has absorbed gases like sulphur oxides and nitrogen oxides as well.

Where do these sulphur oxides and nitrogen oxides in the air come from?

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ARE PISA SCIENCE QUESTIONS AUTHENTIC ACCORDING TO STUDENTS AND TEACHERS?

A SURVEY

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SAMPLE

- 156 pupils (70f, 76m), 14 classes (gr. 8,9), 4 schools
- 20 science education teachers and lecturers/researchers
- 3 PISA units:
  - Sunscreens: *description of an experiment to measure the efficiency of sunscreens. Items on the objective of the experiment, the experimental method and the results*
  - Greenhouse: *comparison between graphics on CO_2 emissions and the atmosphere temperature during the 20th century*
  - Clothes: *newspaper article about smart textiles*

SURVEY QUESTIONNAIRE

Students (S)

- Instruction: "Here are 3 questions of the PISA 2006 test. You aren't asked to answer the items, but please give your opinion on interest of the questions."
  - Personal authenticity (RA), links to real life: 7 items, $\alpha_C = 0.92$
  - Intrinsic interest and engagement (IE): 7 items, $\alpha_C = 0.88$
  - based on large scale validated German questionnaire ($N \geq 1700$, α_C [0.93-0.95] for RA, [0.86-0.92] for IE);

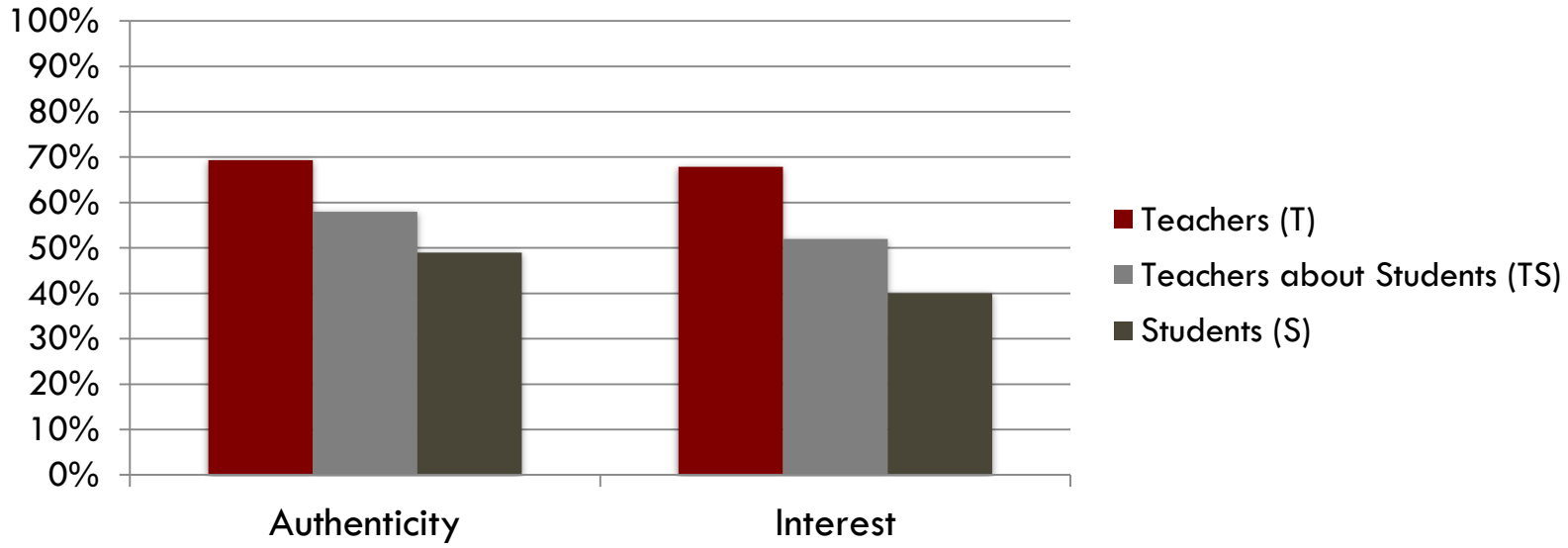
Teachers (T)

- 4 "double" questions about the perception of PISA units
  - their own perception (T, "parallel items" to students)
  - their opinion about students perception (TS)

Sample questions: Students, Teachers, Teachers -> Students

- (S) *The answers to these questions are useful for everyday life*
- (S) *I would be more interested by these questions than by school exercises*
- (T) *According to you, are the answers to these questions useful for everyday life?*
- (TS) *According to you, would the students consider that the answers to these questions are useful for everyday life?*

TEACHERS OVERESTIMATE STUDENTS PERCEPTIONS



(Weiss & Müller, 2015)

Comparing TS and S

- interest: Cohen d = 0.85 (high effect)
- authenticity: *Cohen d* = 0.66 (medium to high effect)

DISCUSSION

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- Risk of "dialogue illusion" ("pseudo dialogue")
  - who speaks? enough time to think? what kind of questions?
  - risk of a "deaf dialogue"
  - considerable effects on student achievement:
    $d = 0.9$ longer wait time (Schröder et al, 2007)
    $d = 0.7$ higher order questions (Marzano et al , 2001)
- Risk of "authenticity illusion"
  - subjects highly interesting for teachers, less engaging for students
  - again a deaf dialogue when teacher passion not shared by students
- Risk of "learning illusion"
  - students understand sometimes much less than their teachers think (Brousseau's Jourdain effect)

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CONCLUSION

- to the best of their knowledge, teachers systematically overestimate important classroom characteristics
  - talking time, wait time (physical parameters)
  - question level
  - learning progress
  - motivation
- maybe, a *slight* overestimation can be useful
- however, acquaintance with "educational illusions" can be a protection against feelings of
  - frustration
  - culpability
  - incompetence
- importance for teacher education:
  - awareness
  - observation tasks
- importance for research:

  small, practical tools for measurement of relevant classroom parameters

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COMING BACK TO VISUAL ILLUSIONS

Visual illusions reveal visual truths (Purkinje)*

Educational illusions reveal educational truths

*The Purkinje effect, sometimes called the Purkinje shift or dark adaptation, is the tendency for the peak luminance sensitivity of the human eye to shift toward the blue end of the colour spectrum at low illumination levels. The effect is named after the Czech anatomist Jan Evangelista Purkyne.

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