

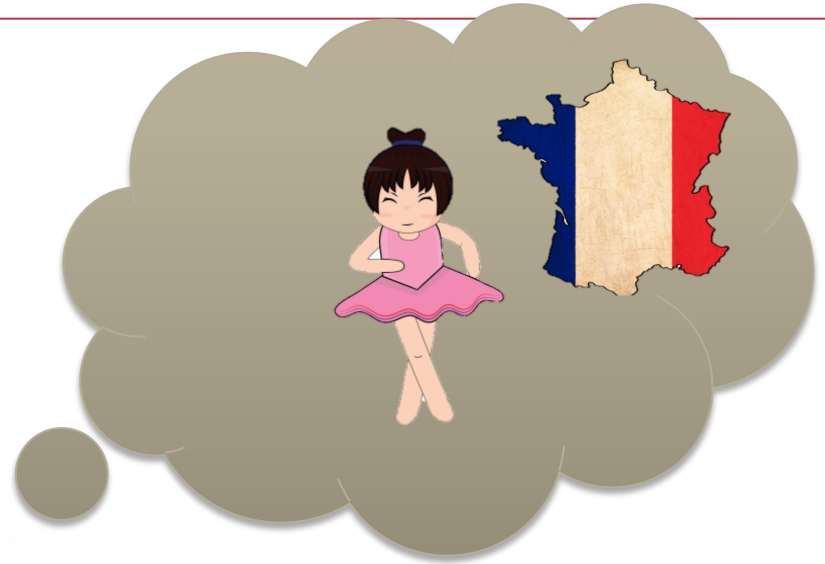


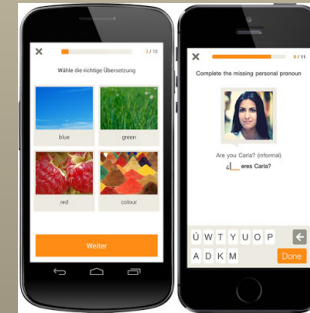
Self-Regulation and Cognitive Load in Multimedia Learning

Prof. Dr. Tina Seufert, Ulm University



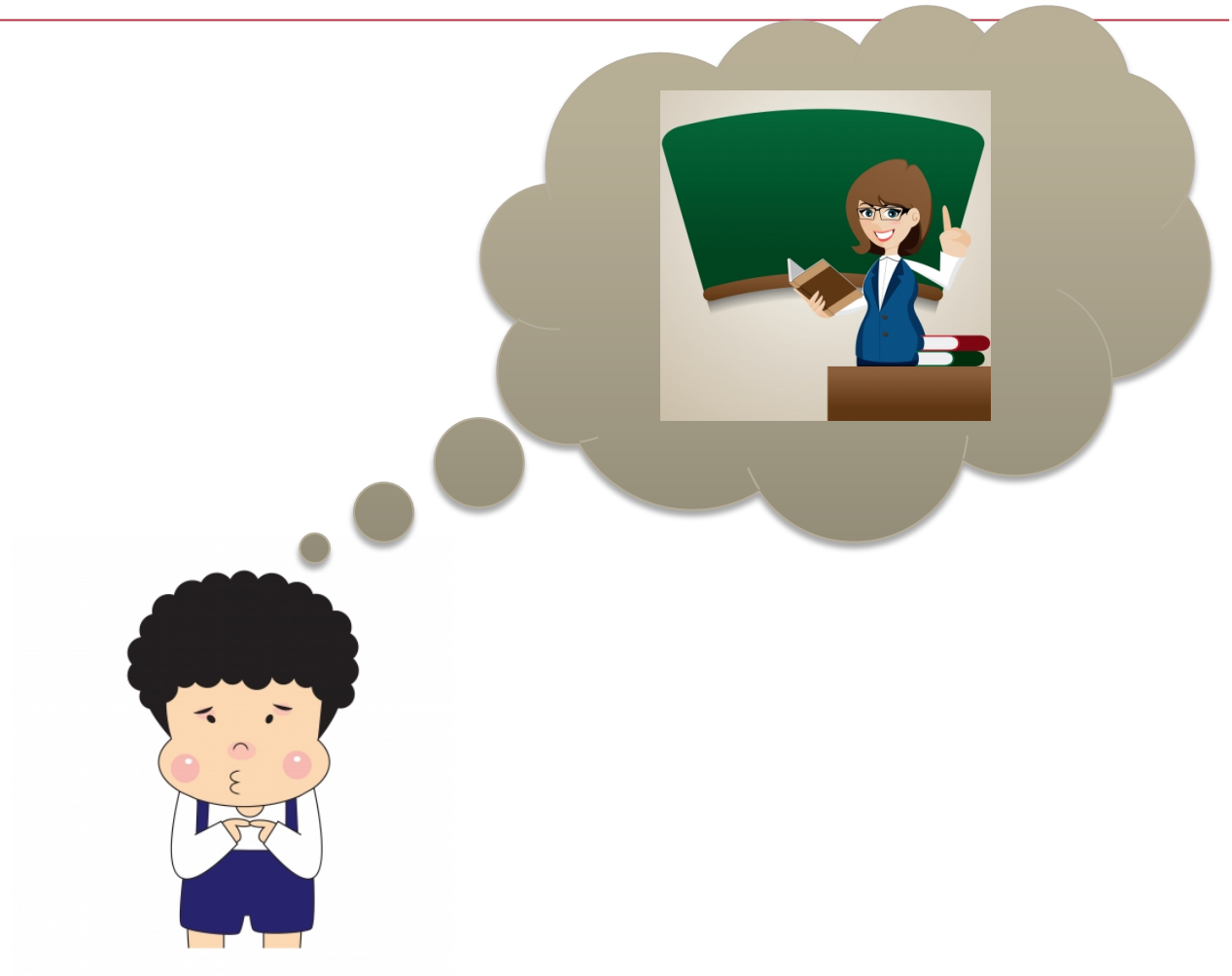




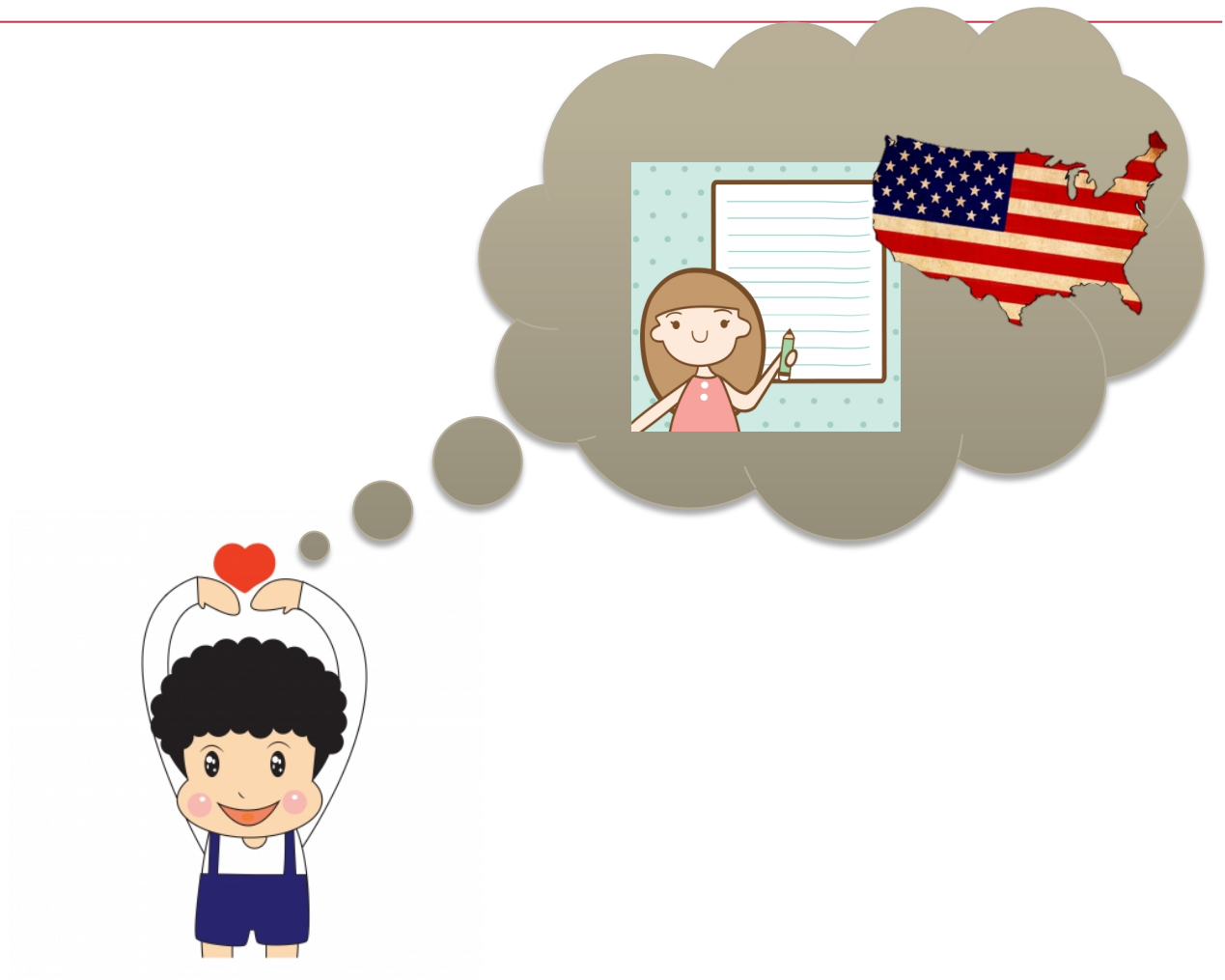






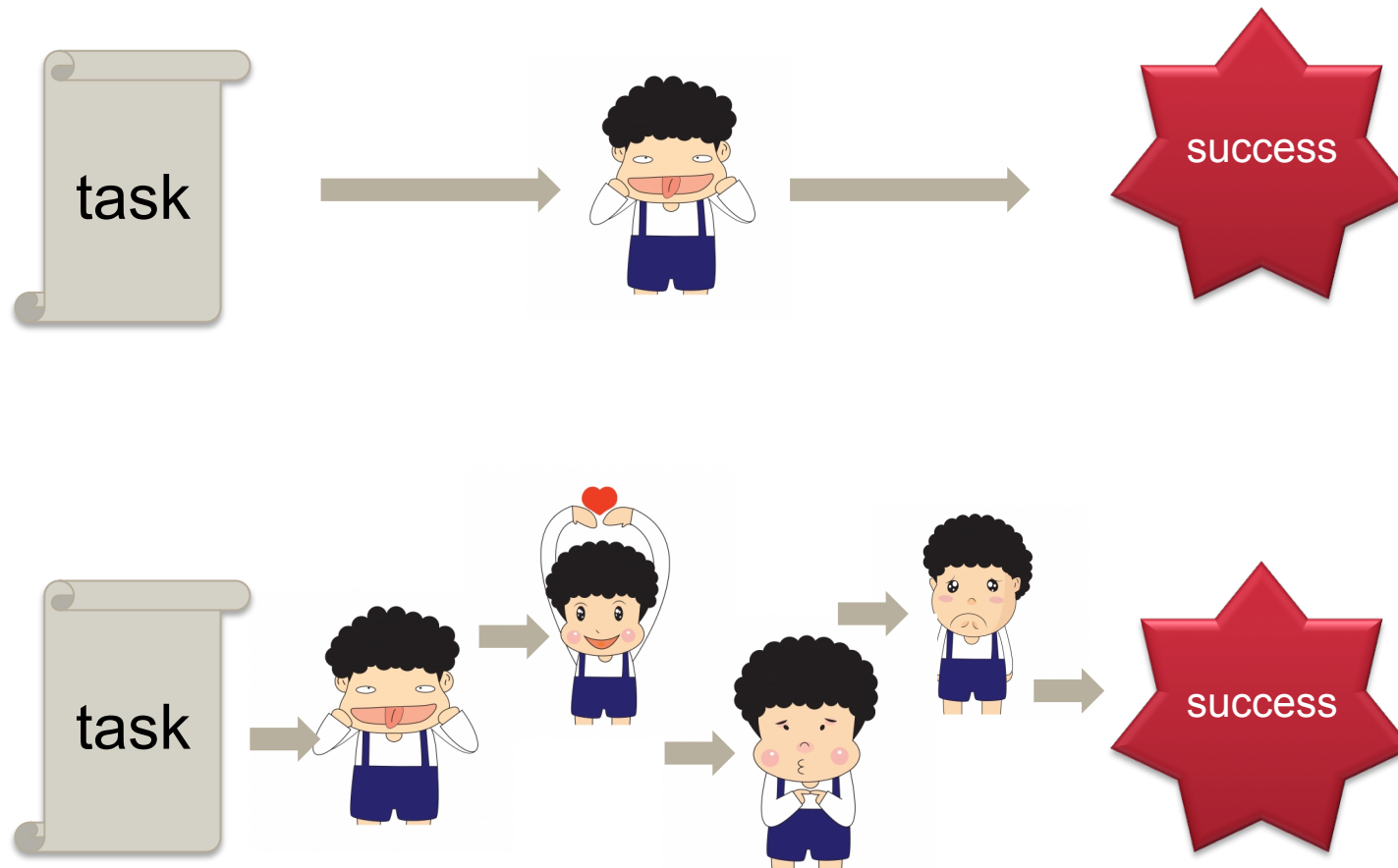




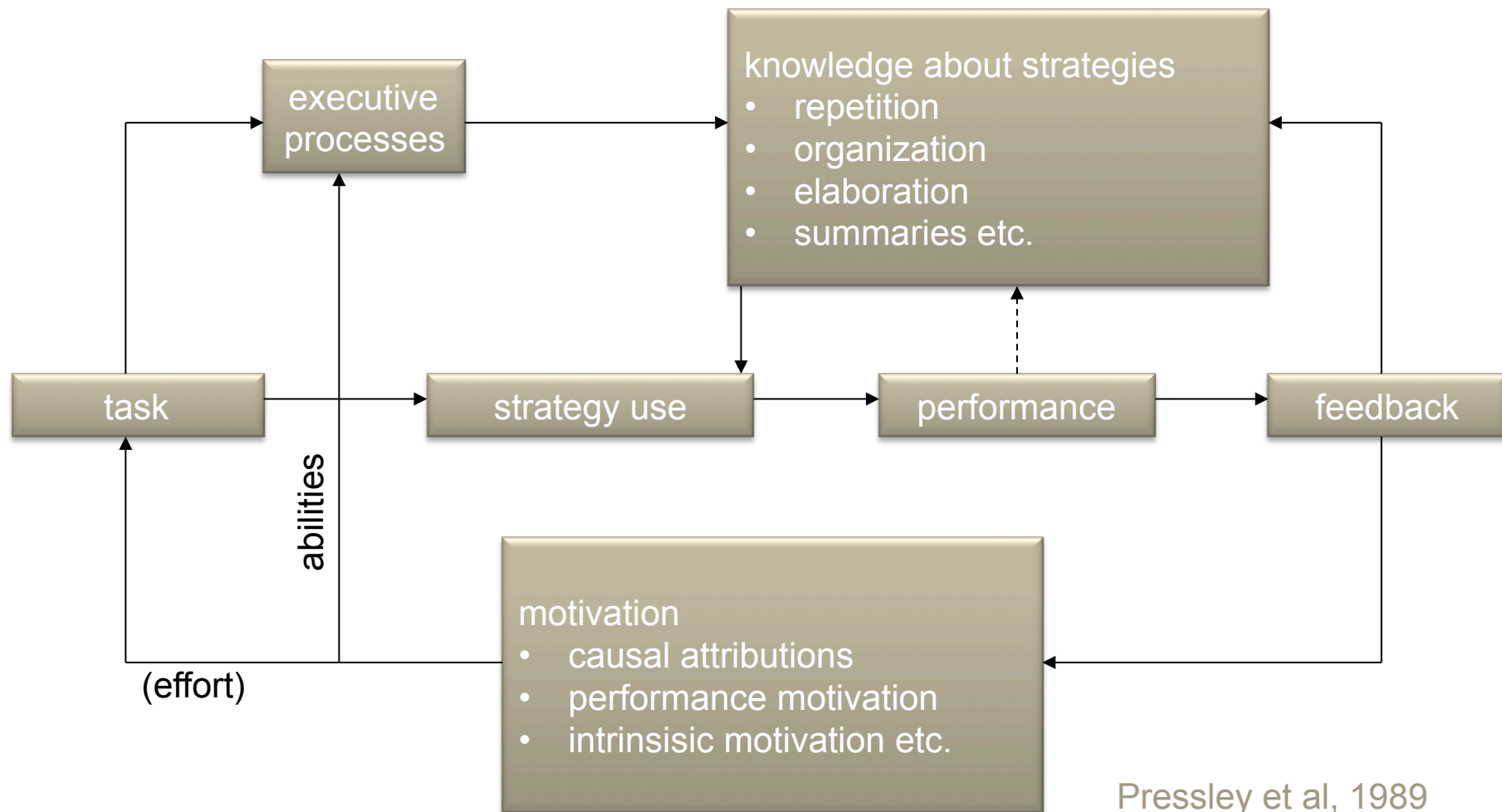




learning as a dynamic process



the Good Information Processor



Pressley et al, 1989
modified by Wirth, 2004

my inspiration

- self regulation became a raising issue in multimedia learning research
(e.g. Moreno, 2010 Cognitive affective theory of multimedia learning, CATML)

“...reconceptualization for complex learning...with a more flexible approach based on differentiating specific goals of various learner activities.”

Kalyuga & Singh, 2015

„I argue that future research should focus more intensively on how learners deal with CL.“

Bannert, 2002

„...cognitive load theory might profit from extending their predominantly cognitive focus to one that additionally considers metacognitive and self-regulation demands.“

Schwonke, 2015

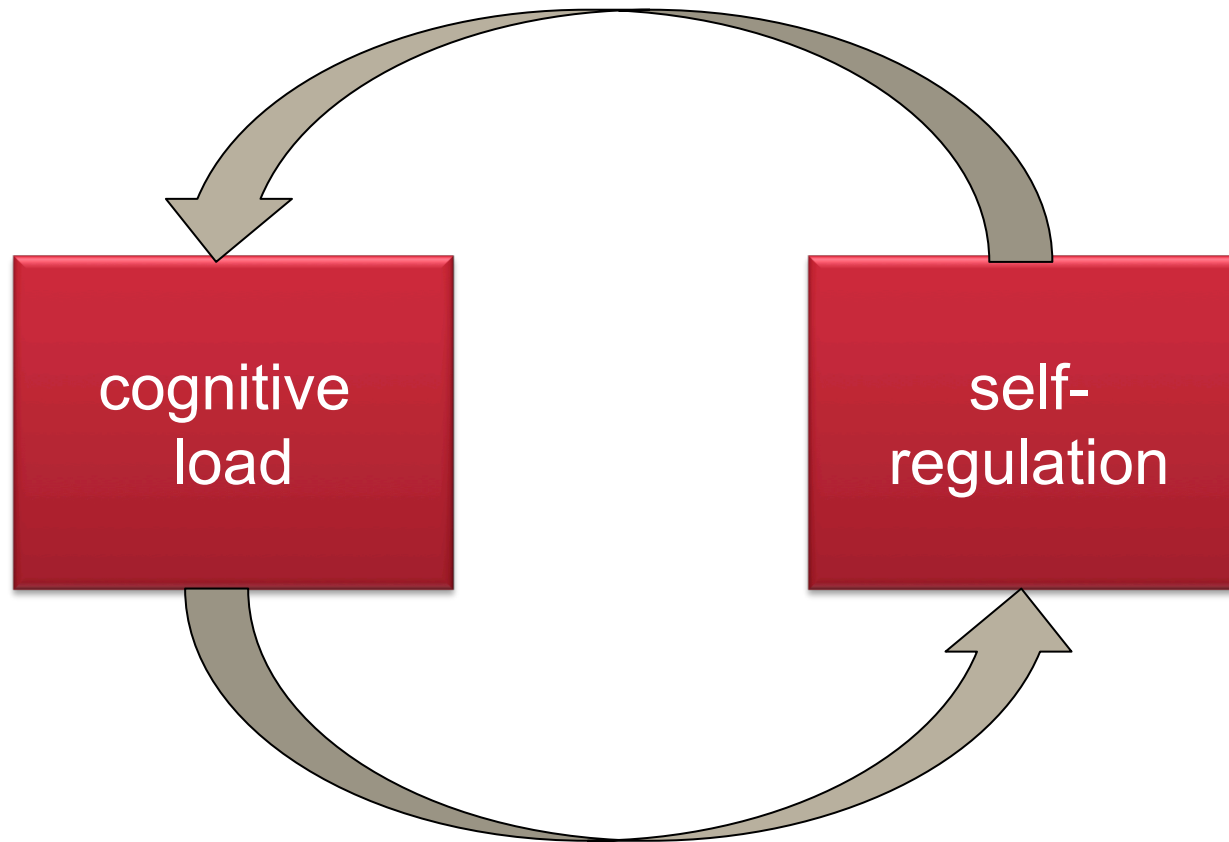
“An emerging topic in CLT, which is getting more attention, is self-regulation and the role of motivational and affective factors in learning.”

Ayres & van Gog, 2009

„CLT is remarkably silent about the relation among load, affect, and motivation.“

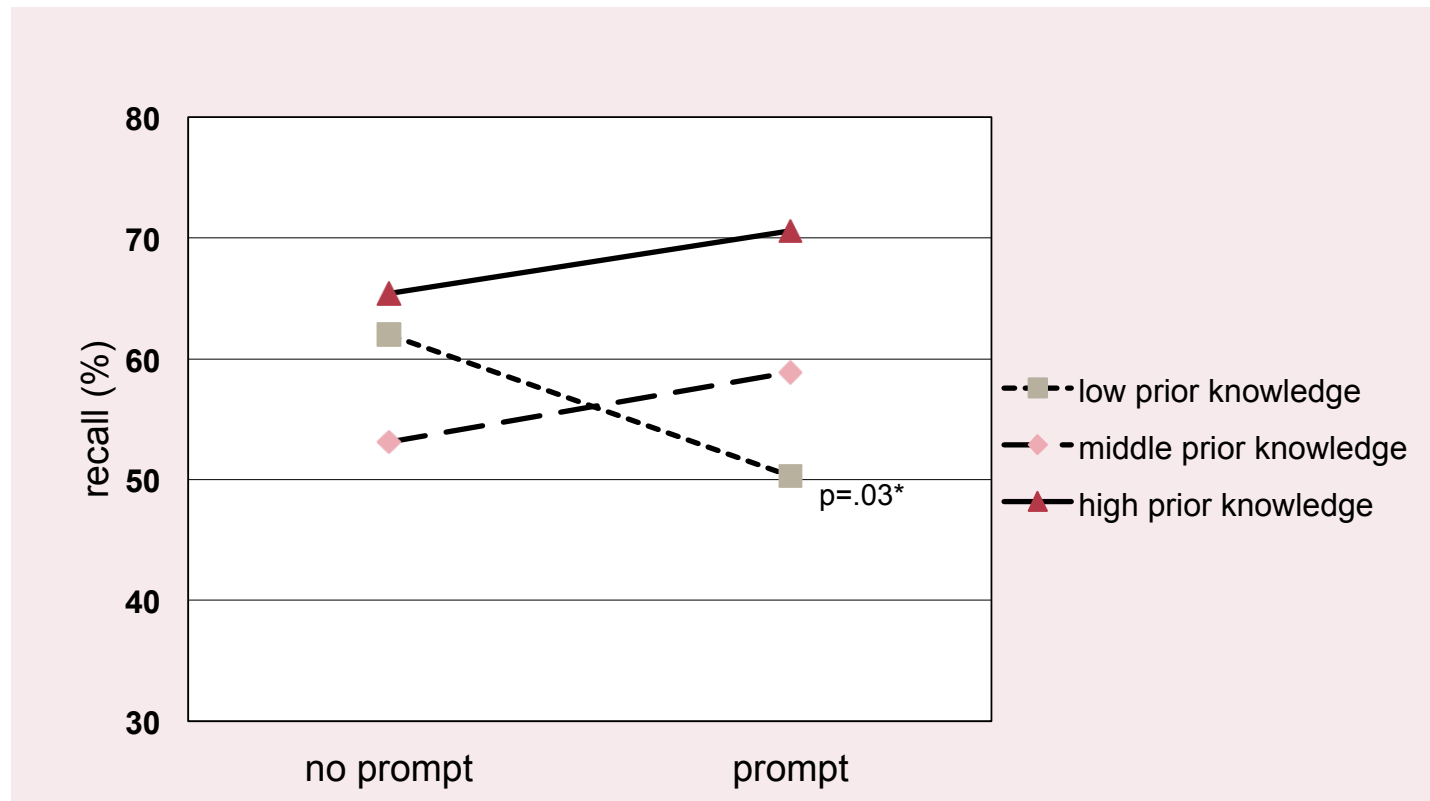
Moreno, 2010

cause and effect



self-regulation as a consequence of cognitive load

- Learners change their goals depending on the task (perceived difficulty) and their abilities (ressources)



self-regulation as a consequence of cognitive load

- learners change their strategies and goals depending on the perceived difficulty:

studies on learning with multiple representations:

- learners concentrate most times on only one representation
(e.g. Ainsworth, Wood & Bibby, 1997)
- they concentrate on familiar representations (Piez & Voxmann, 1997)
- they concentrate on less complex representations
(Wu, Krajcik & Soloway, 1999)

= learners are cognitive economists (Rescher, 1989)

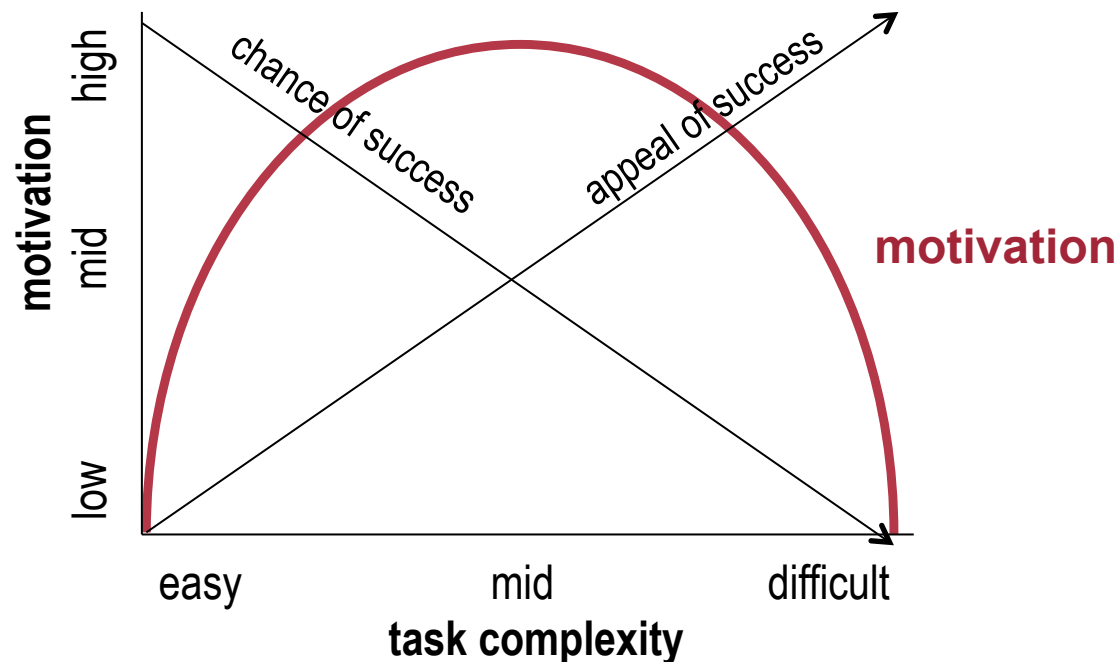
BUT: learners may also enhance their effort due to inconsistencies

→ e.g. more transitions between text and picture

(e.g. Schüler & Scheiter, 2016)

self-regulation as a consequence of cognitive load

- learners regulate their resources depending on task difficulty and motivation
 - load affects motivation – motivation affects mental effort

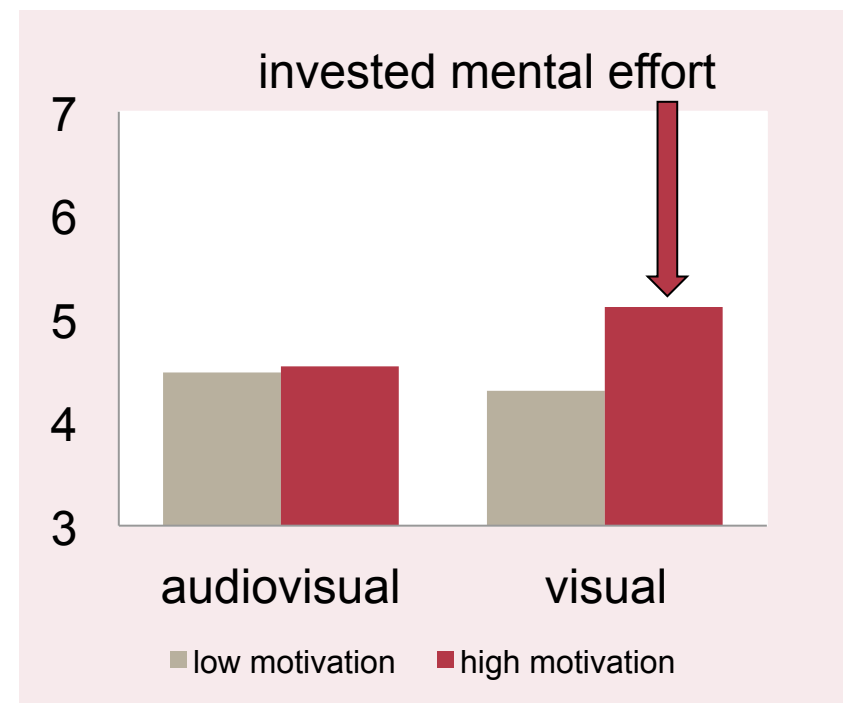
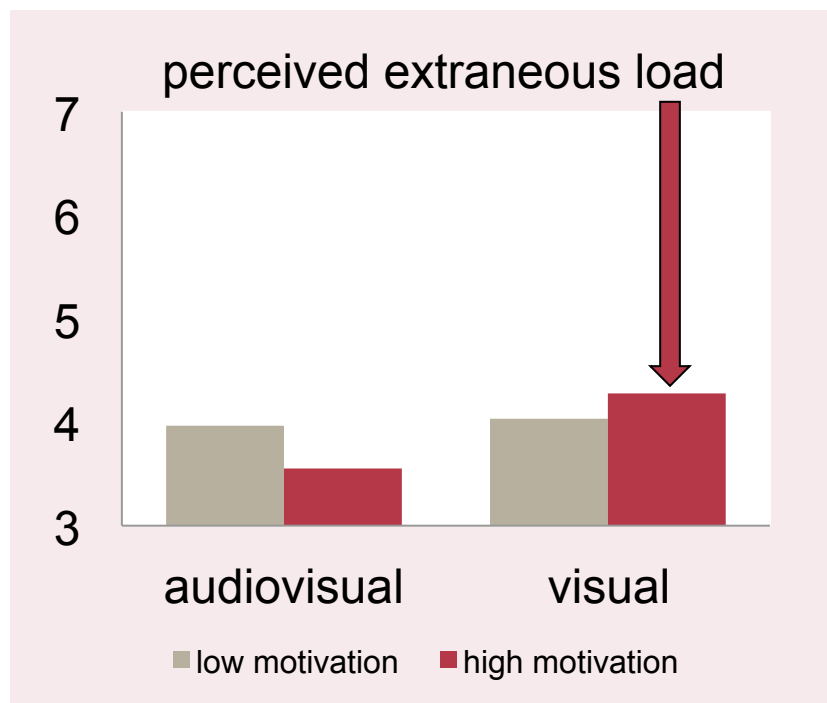


Atkinson, 1957

self-regulation as a consequence of cognitive load

- learners regulate their resources depending on task difficulty and motivation

→ load affects motivation – motivation affects mental effort



self-regulation as a consequence of cognitive load

- learners regulate their resources depending on perceived task difficulty / disfluency
 - metacognitive judgment of difficulty – activation of system 2 (James, 1950)
 - deeper, elaborated, analytical processing (Alter, Oppenheimer, Epley & Eyre, 2007)

fluent

The earth can be
considered as a globe.

slightly
disfluent

*The earth can be
considered as a globe.*

moderately
disfluent

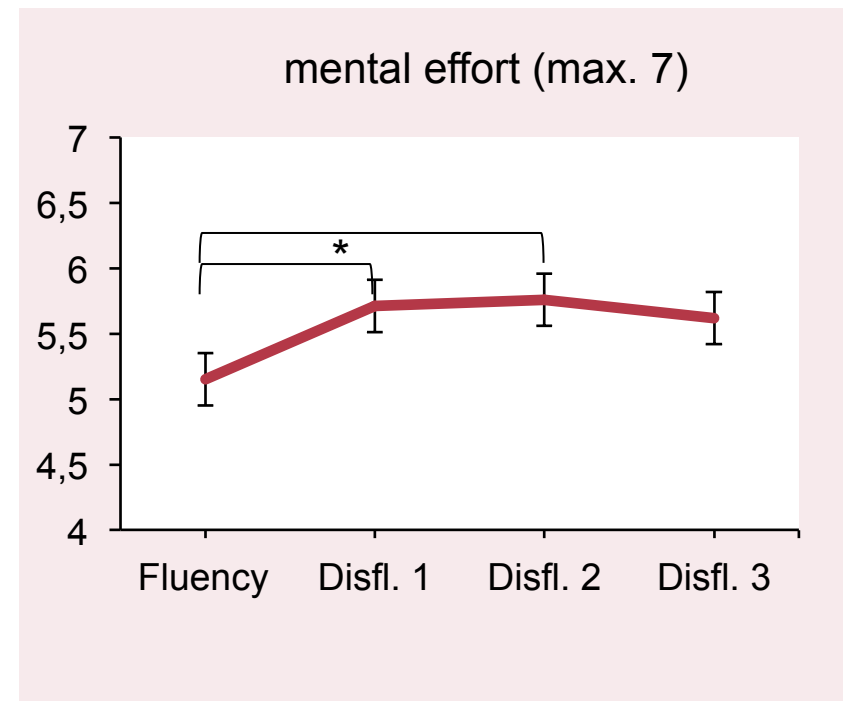
*The earth can be
considered as a globe.*

very
disfluent

*The earth can be
considered as a globe.*

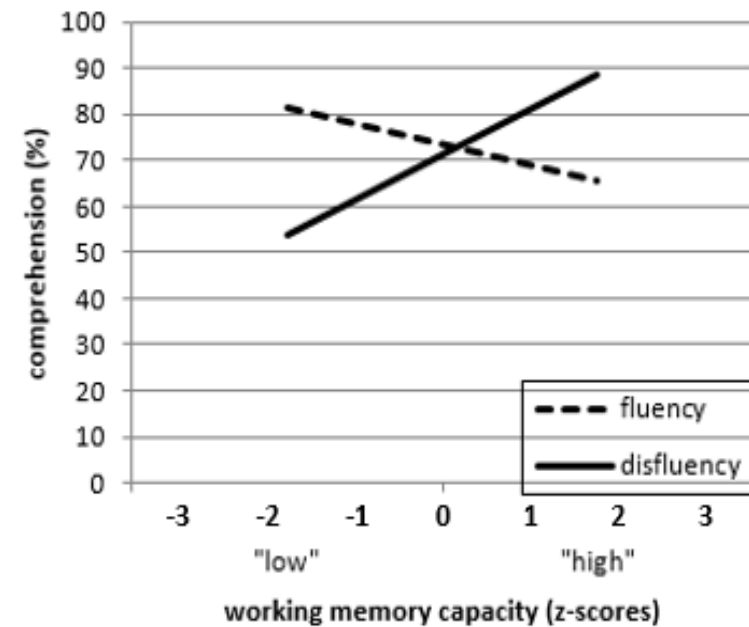
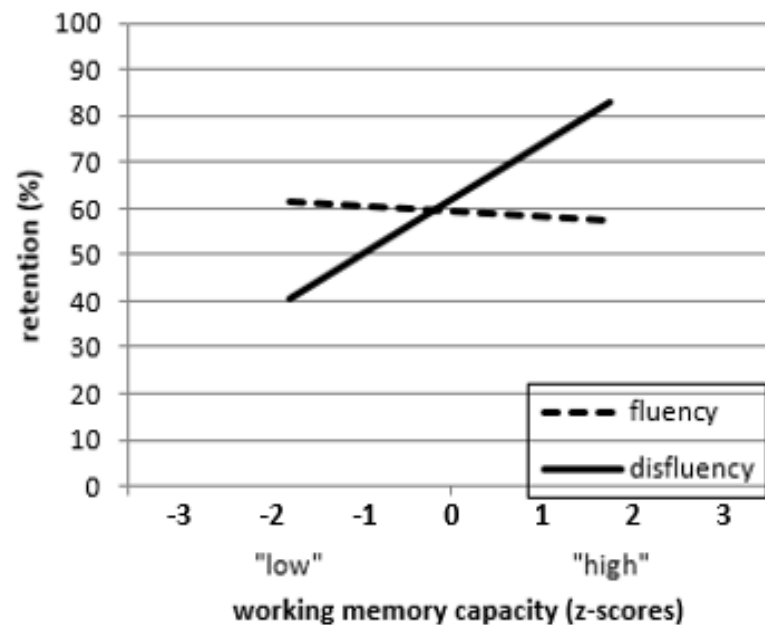
self-regulation as a consequence of cognitive load

- learners regulate their resources depending on perceived task difficulty / disfluency



self-regulation as a consequence of cognitive load

- learners regulate their resources depending on perceived task difficulty / disfluency and their resources



failure of self-regulation as a consequence of overload?

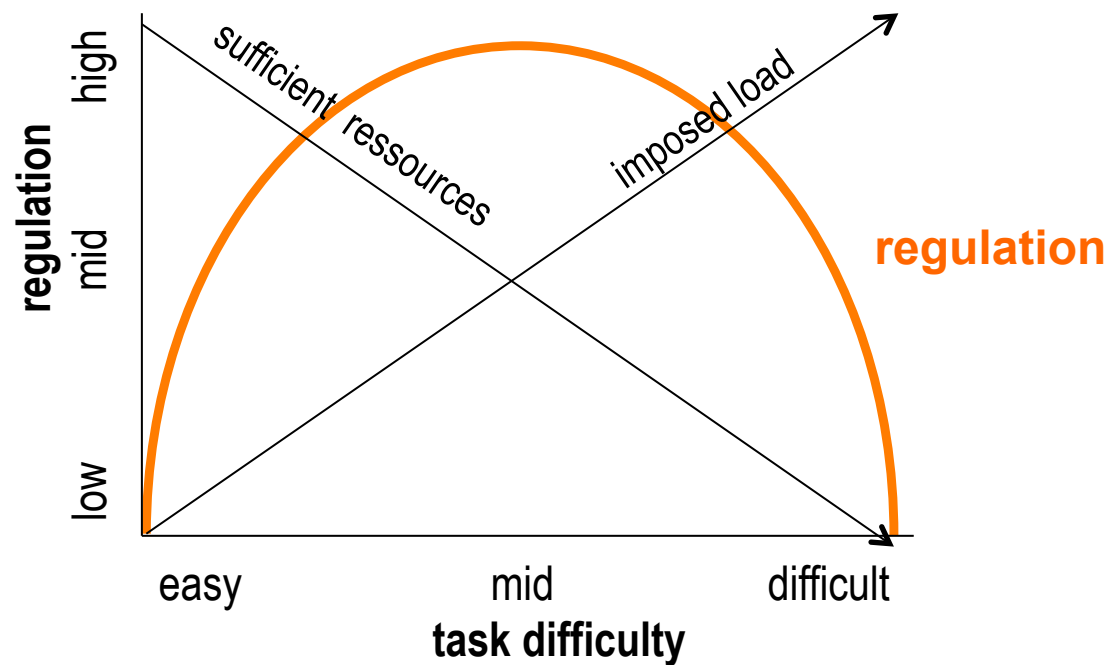
■ alternative scenario:

- overload leads to failure of effective self regulation
(Plass, Kalyuga & Leutner, 2010)
- type of goalsetting leads to different load levels and allows strategy use with varying intensity (Wirth, Künsting & Leutner, 2009)
- cognitive load in the beginning of the task was significantly associated with the use of fewer strategies, which was, in turn, significantly related to lower learning outcomes (Moos, 2013)

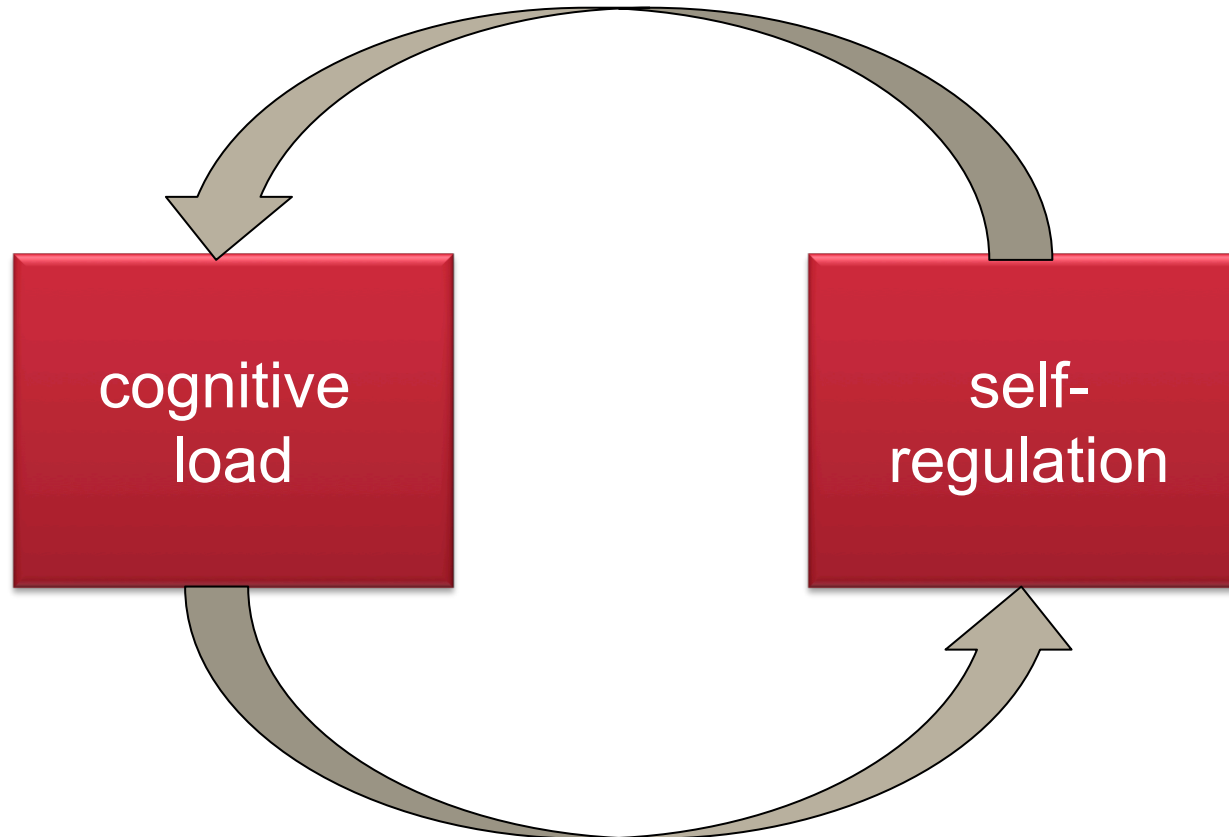
but what does succesful regulation mean?

- with respect to the task? (better learning outcomes)
- with respect to the learner? (balanced mental state)

Regulation as a function of resources and imposed cognitive load



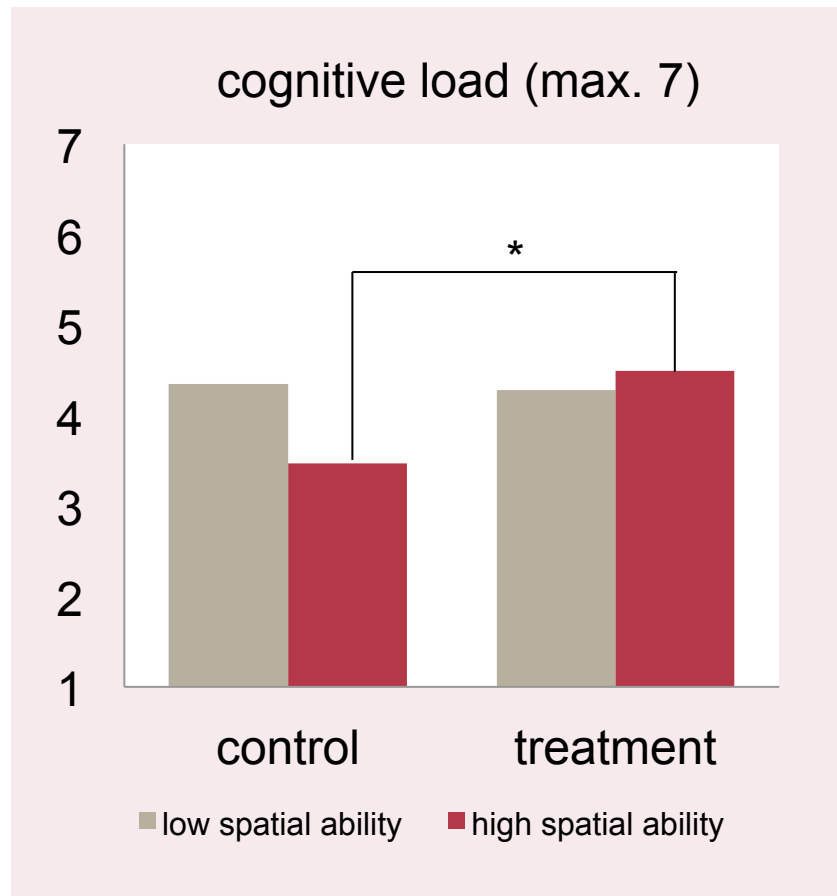
cause and effect



cognitive load as a consequence of self-regulation

- The possibility to regulate enhances frustration and perceived task difficulty for novices (Saw, 2011)
 - actual regulation leads to more mental effort
 - „successful learners reported deeper cognitive elaboration, more intensive monitoring processes as well as higher mental effort“ (Stark, Mandl, Gruber & Renkl, 2002)
 - metacognitive load (Schwonke, 2015, Valcke, 2002, Bannert, 2002)
 - „monitoring significantly decreased performance and increased cognitive load on complex, but not on simple tasks“ (van Gog, Kester & Paas, 2011)
- differential effects depending on
- learners skills
 - task difficulty
 - load measure

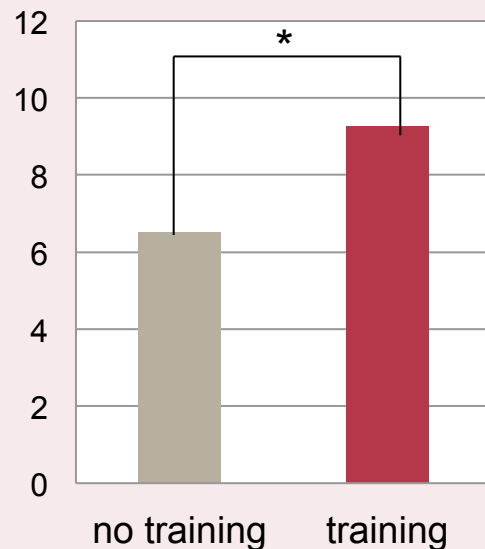
cognitive load as a consequence of self-regulation



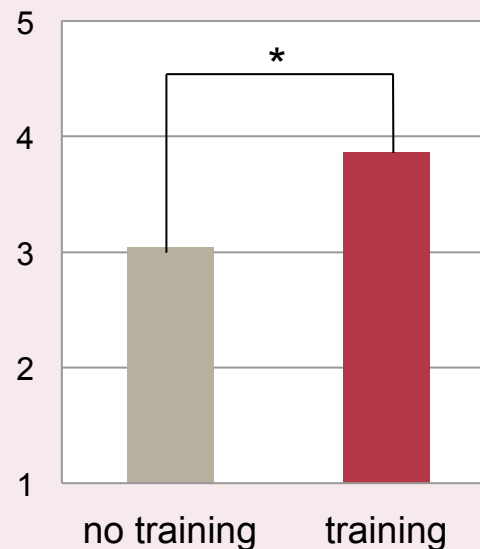
- drawing instruction
(Wagner & Seufert, 2010)
 - load is induced for highly skilled learners
- differential effects for drawing and imagery
(Leutner, Leopold, Sumfleth, 2009)
 - imagery reduces load
 - drawing enhances load
- mental animation instruction
(Park, Münzer, Seufert, Brünken, accepted)
 - enhances load for high spatial ability learners

cognitive load as a consequence of self-regulation

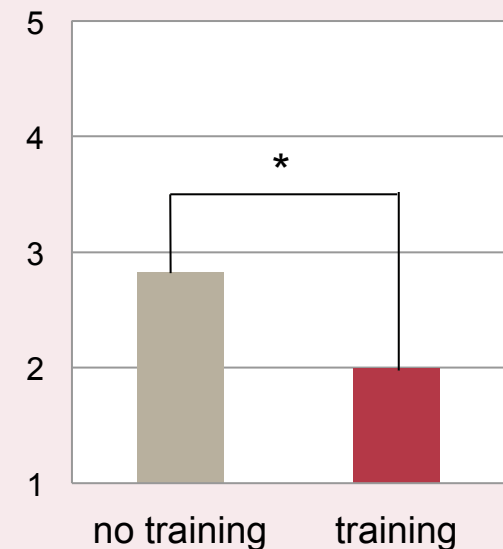
Learning Outcomes
tested during the training



Cognitive Load (effort)
rated after the training



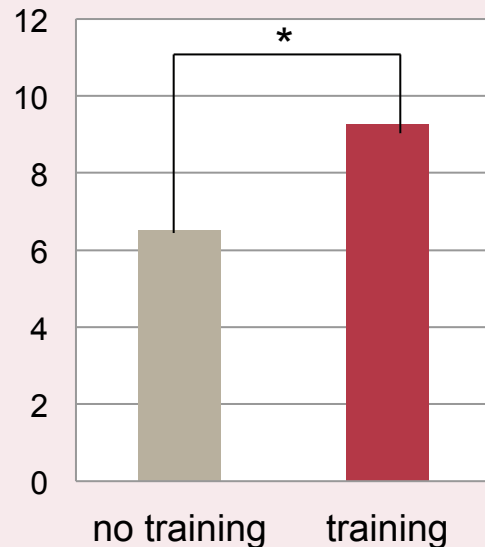
Cognitive Load (extraneous)
rated after the training



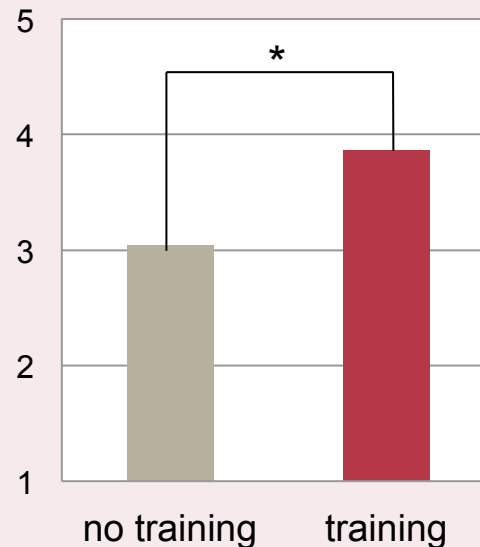
Effects of an overall training of cognitive, metacognitive and motivational strategies

cognitive load as a consequence of self-regulation

Learning Outcomes
tested during the training

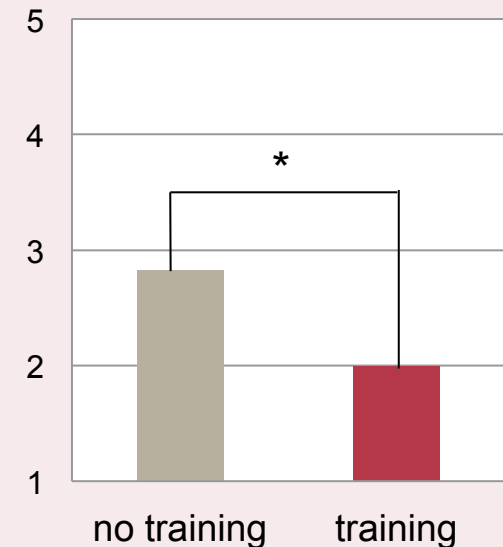


Cognitive Load (effort)
rated after the training



“I invested mental effort”
= active

Cognitive Load (extraneous)
rated after the training

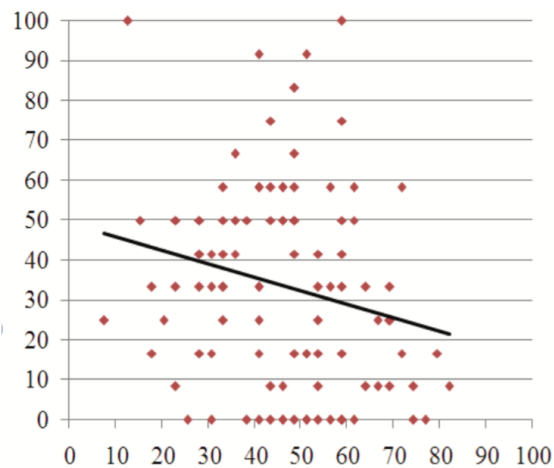


“The material was straining”
= passive

cognitive load as a consequence of self-regulation

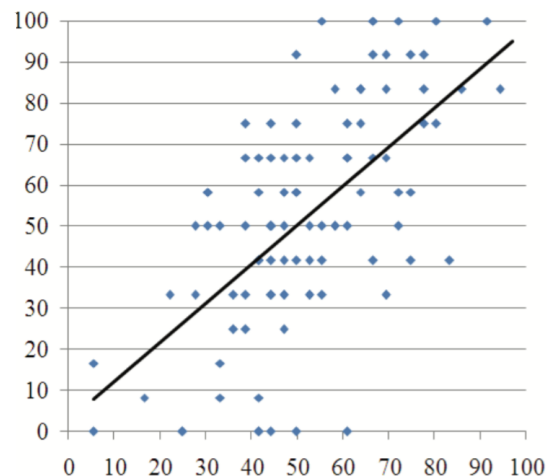
- Differential effects of different learning strategies on different load measures

extraneous load (%)



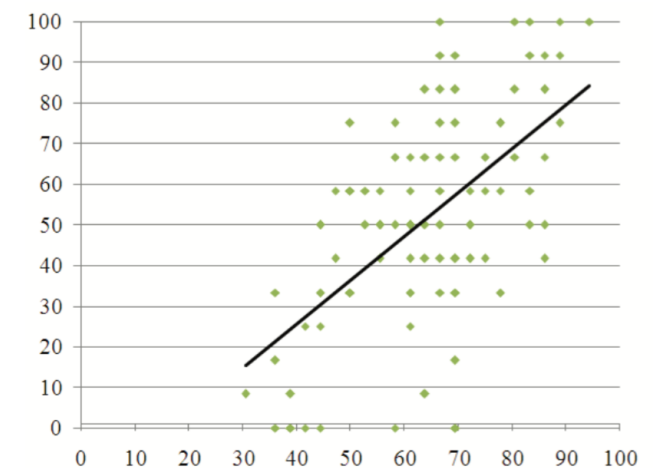
cognitive learning strategies

mental effort (%)



metacognitive learning strategies

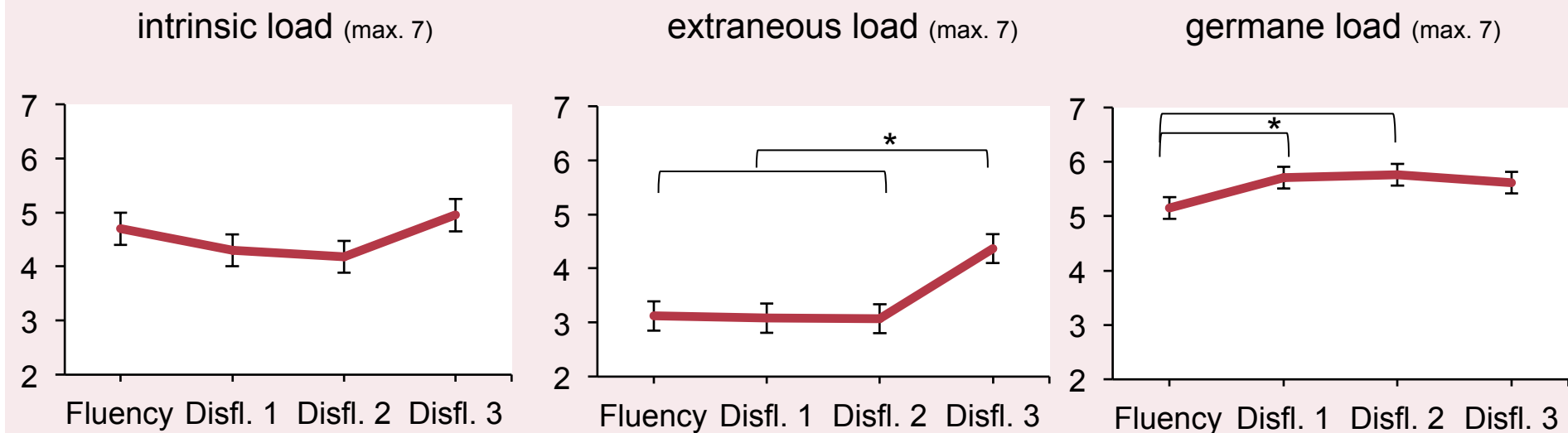
mental effort (%)



motivational learning strategies

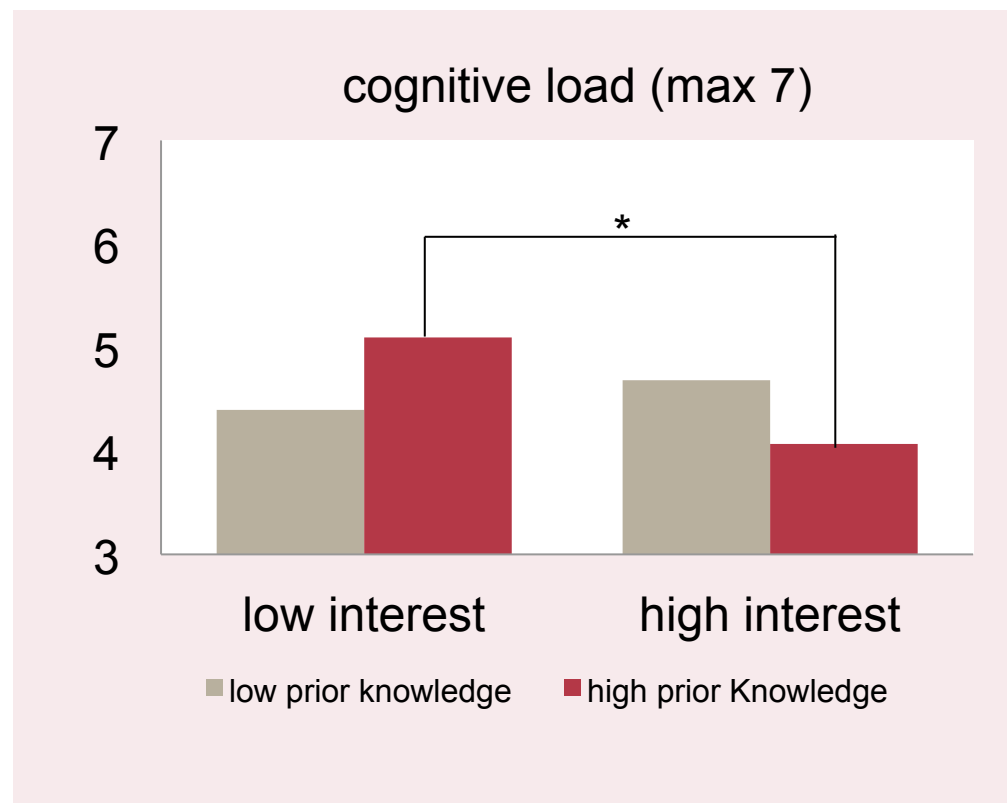
cognitive load as a consequence of self-regulation

- Differential effects of disfluency on different load measures



cognitive load as a consequence of self-regulation

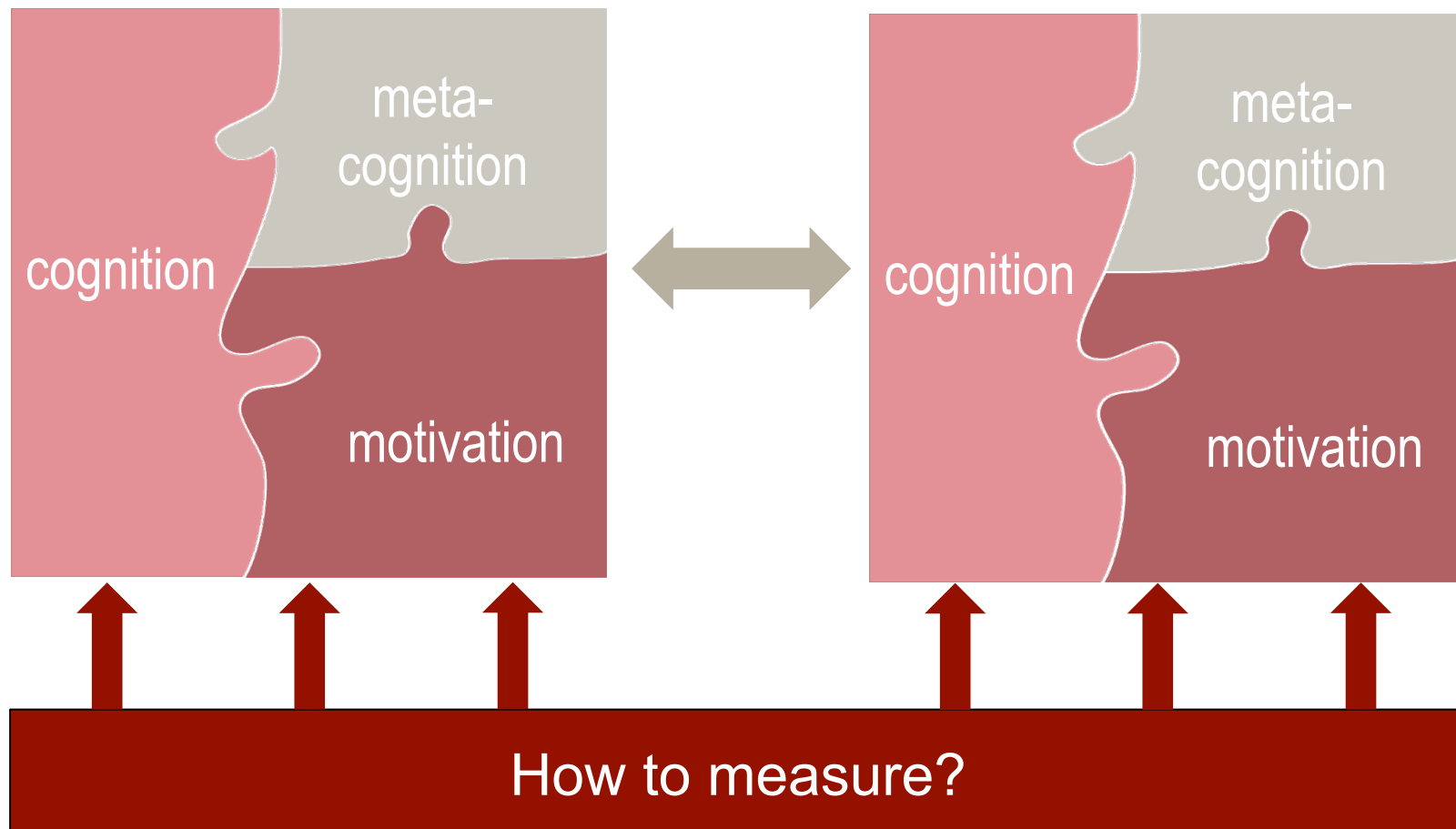
- interest and prior knowledge reduces perceived load



conclusion

task

learner

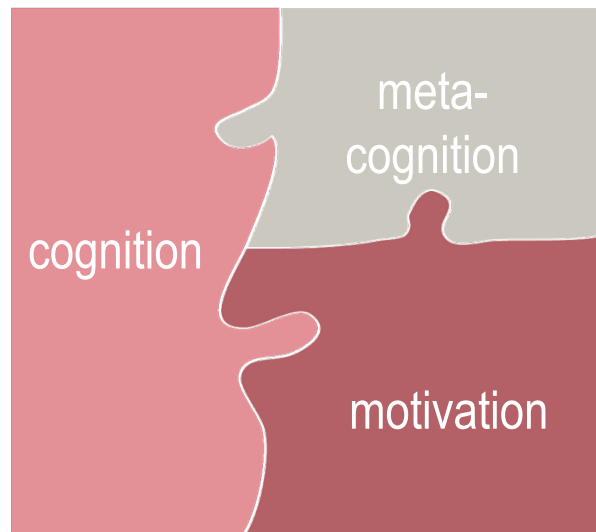


how to measure load and self-regulation?

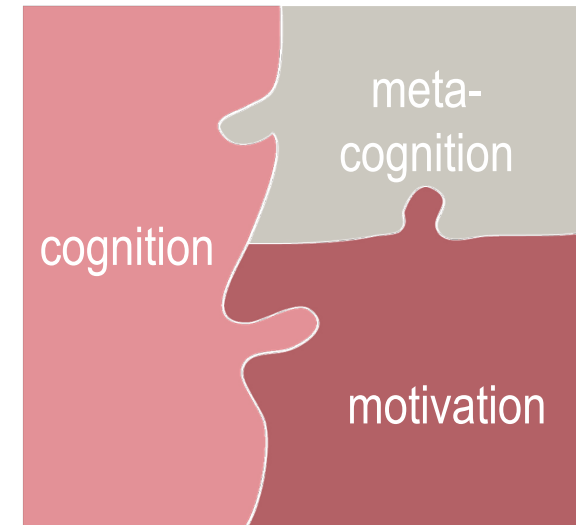
- Learning as a dynamic process → process measures
 - rapid assessment (Kalyuga, 2008)
 - thinking aloud (Bannert, 2002)
 - dual task (Brünken, Steinbacher, Plass & Leutner, 2002)
- Load as a differentiated concept of affordances
 - differentiated measures for germane/extraneous/intrinsic load
(e.g. Cierniak, Scheiter & Gerjets, 2009; Leppink, 2012; Klepsch & Seufert, 2012)
- broader concept of capacity for learning
 - prior knowledge
 - cognitive characteristics
 - strategy skills
 - metacognitive skills and knowledge
 - motivational characteristics

conclusion

task



learner



→ Improving the match between task affordances and learner

- further investigation of the interplay between motivation and load (Zander, 2010; Leutner, 2014)
- emotional design (Plass et al., 2014)
- adaptive design (Blayney, Kalyuga & Sweller, 2015; Corbalan, Kester & van Merriënboer, 2009)
- matching load and resources – enhances motivation and might even produce flow (Leppink, 2010)



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Thanks for your attention

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