Prof. Dr. Michaela Sambanis
chair of English didactics, Free University Berlin

Brain matters –
Translating findings from neuroscience

Why „brain matters“?

- Since 2011:
  chair of English didactics at the
  Freie Universität **Berlin;**
  scientific advisory board at the
  Transfer Center
  for Neuroscience and Learning Ulm

- Before 2011:
  head of the largest
  interdisciplinary research unit at the
  Transfer Center for Neuroscience and Learning,
  University of Ulm

Overview

How does the brain

- Neurons, activity,

Body-movements & nal reserach)

- Effects, explanati classroom

Emotions & Learnin

- Positive & negativ

101 in Neuromythol

- Separating facts from fiction

How does the brain learn?

- Neuron =
  smallest functional unit of the brain, consists of
  - dendrites
  - cell body
  - axon

- Synapse = place where nerve cells communicate

- Back to the question at hand: How does learning happen?

→ Transmission of signals → strengthening of connections in the brain

Univ. Prof. Dr. Michaela Sambanis
Institut für Englische Philologie
Didaktik des Englischen

Learning on the neuronal level

Dendrites receive impulses

↓

Cell body sums up

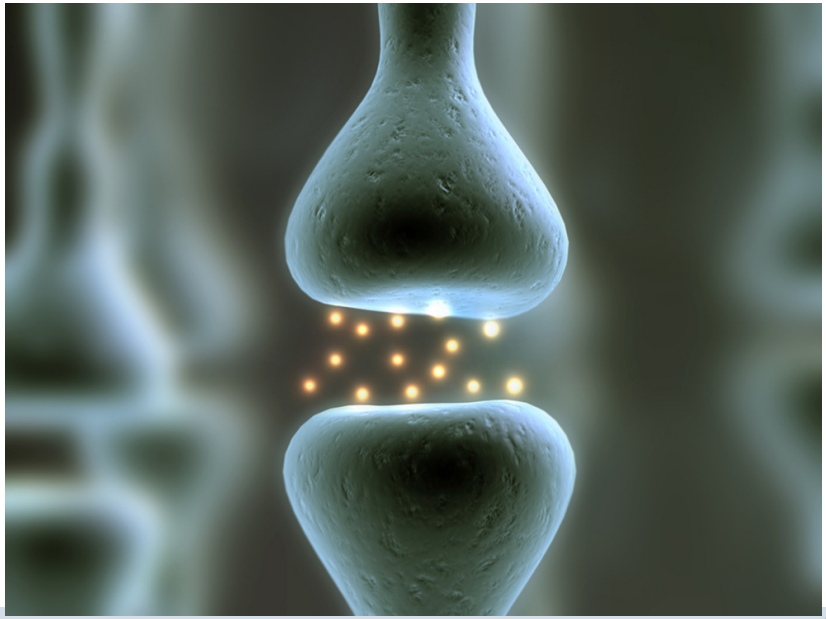
↓

Impulse travels along the axon

↓


Transmission at the synapse

Learning →
synapses & dendrites



Plasticity

- With use, pathways strengthen.

„Whenever students participate in a mental or physical activity that activates a specific pathway of neurons, the pattern that binds the connections is strengthened" (Willis 2010: 59).

- Neurons that fire together wire together (C. Shatz).
- Neurons out of sync fail to link.

"Unser Gehirn [...] ist Struktur gewordene Lebensgeschichte." (Altenmüller 2007: 44)

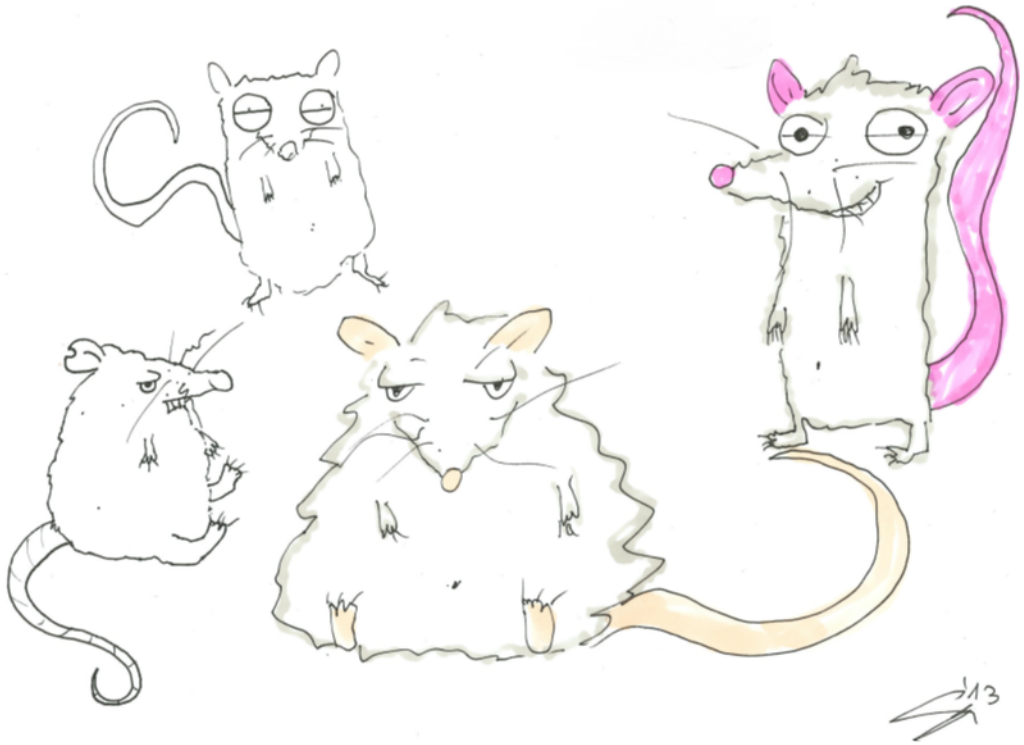
Plasticity

„Even when she has fallen, she feels she is still falling, perpetually, into an infinite abyss“ (Doidge 2007: 2)

Plasticity

- The brain is plastic at any age.

  Experiment (Godde, Berkefeld et al. 2002)



Interim Conclusion

- The brain is plastic, able to adapt , even at an older age. (*Plasticity*)
- The brain learns usage-dependently. (*Use it or lose it*-principle)
- Usually, it takes repetetive activation of the same pathways to influence the brain‘s architecture & for learning to occur. (repetetive activation, *many action potentials*)

What could that mean in the EFL-classroom?

What could that mean in the EFL-classroom?

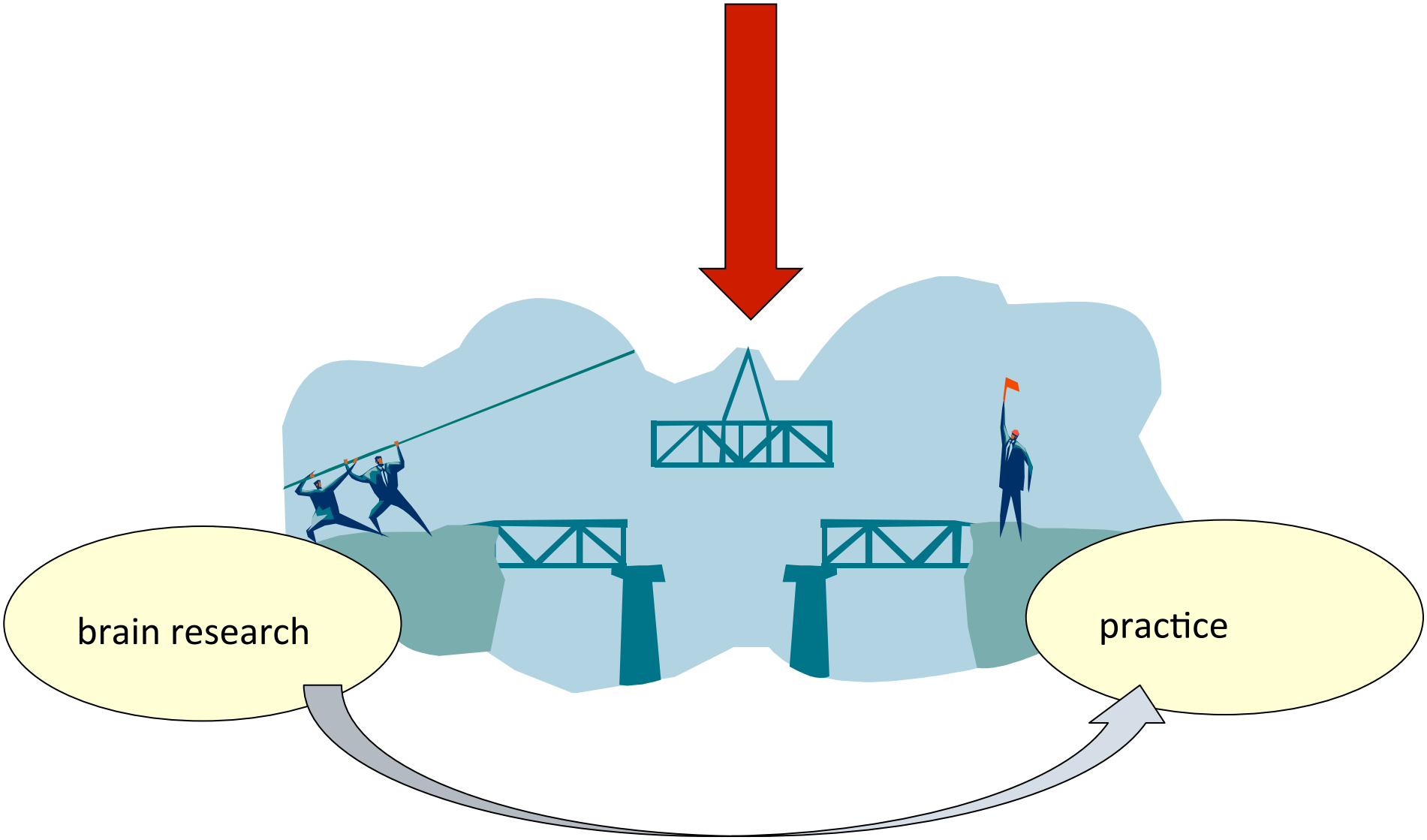
- It matters what you are doing, and what you are learning (and how!)
  → Plasticity
- Repetitions and exercises could be useful to trigger repetetive use and strengthen pathways in the brain.
  → *Use it or lose it*-principle

What else can we learn from neuroscientific research?

How can we minimize the danger of misapplication?

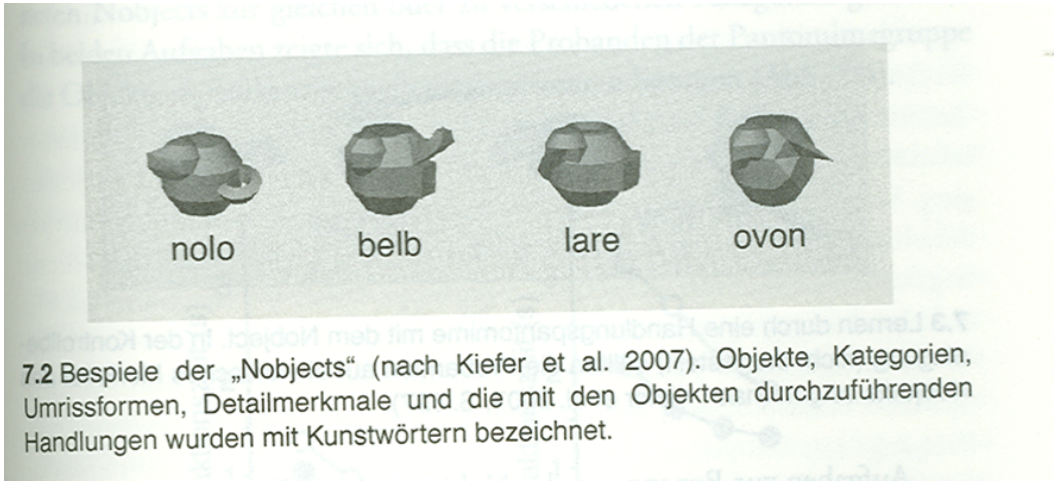
Freie Universität Berlin

Translational research



Findings from neuroscience on movements & learning

„Nobject-study“ (Kiefer et al. 2007):



7.2 Bespiele der „Nobjects“ (nach Kiefer et al. 2007). Objekte, Kategorien, Umrissformen, Detailmerkmale und die mit den Objekten durchzuführenden Handlungen wurden mit Kunstwörtern bezeichnet.

64 Nobjects

- Design:

  experimental group & control group

  Experimentals: gestures while learning

  Controls: no gestures

Results

- The experimental group scored better (correctness, rapidity)
- EEG:

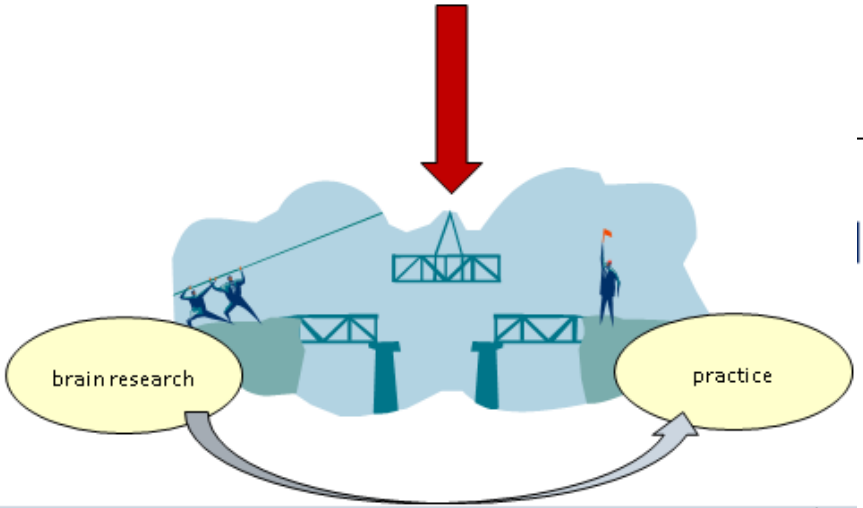
  higher activity in frontal motor regions of experimentals (movement-based learning)

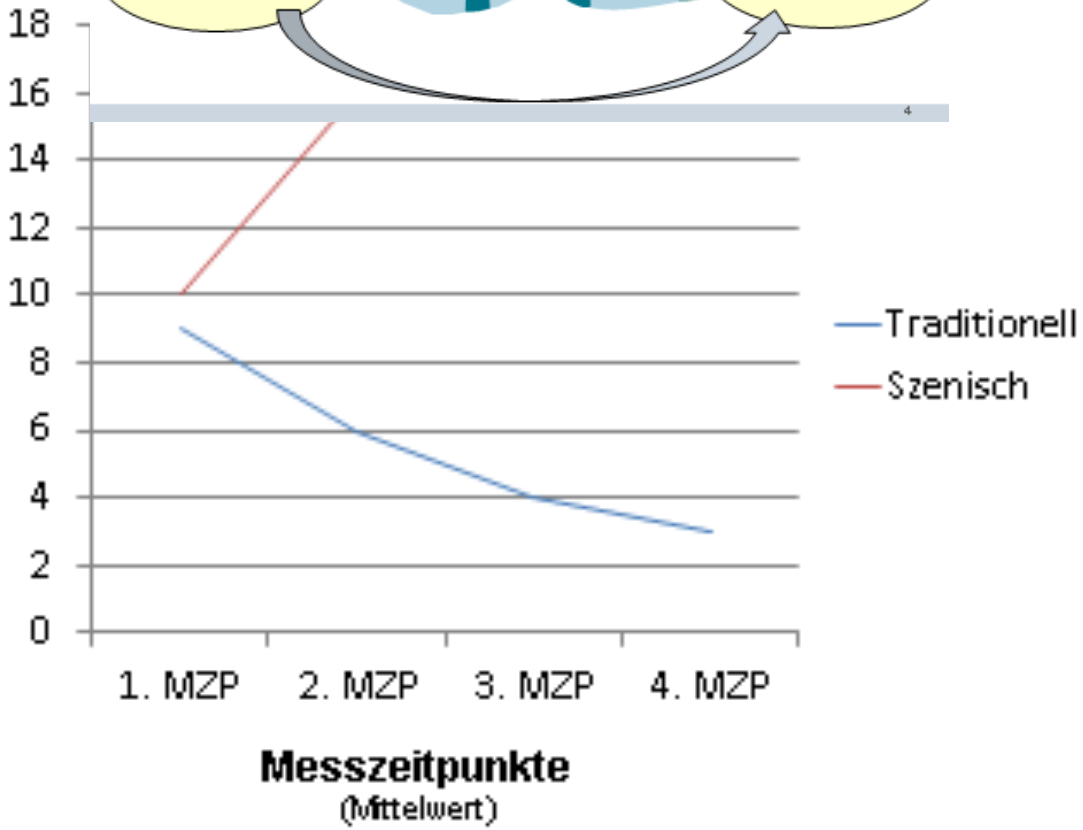
→Significance?

The use of gesture/movements during learning influences the way in which the brain processes, links and stores the information.

→ Desirable effects

(higher retention , better access, subtle transfer of the acquired knowledge etc.)


brain research
practice


18
16
14
12
10
8
6
4
2
0
1. MZP
2. MZP
3. MZP
4. MZP
Traditionell
Szenisch
Messzeitpunkte
(Mittelwert)

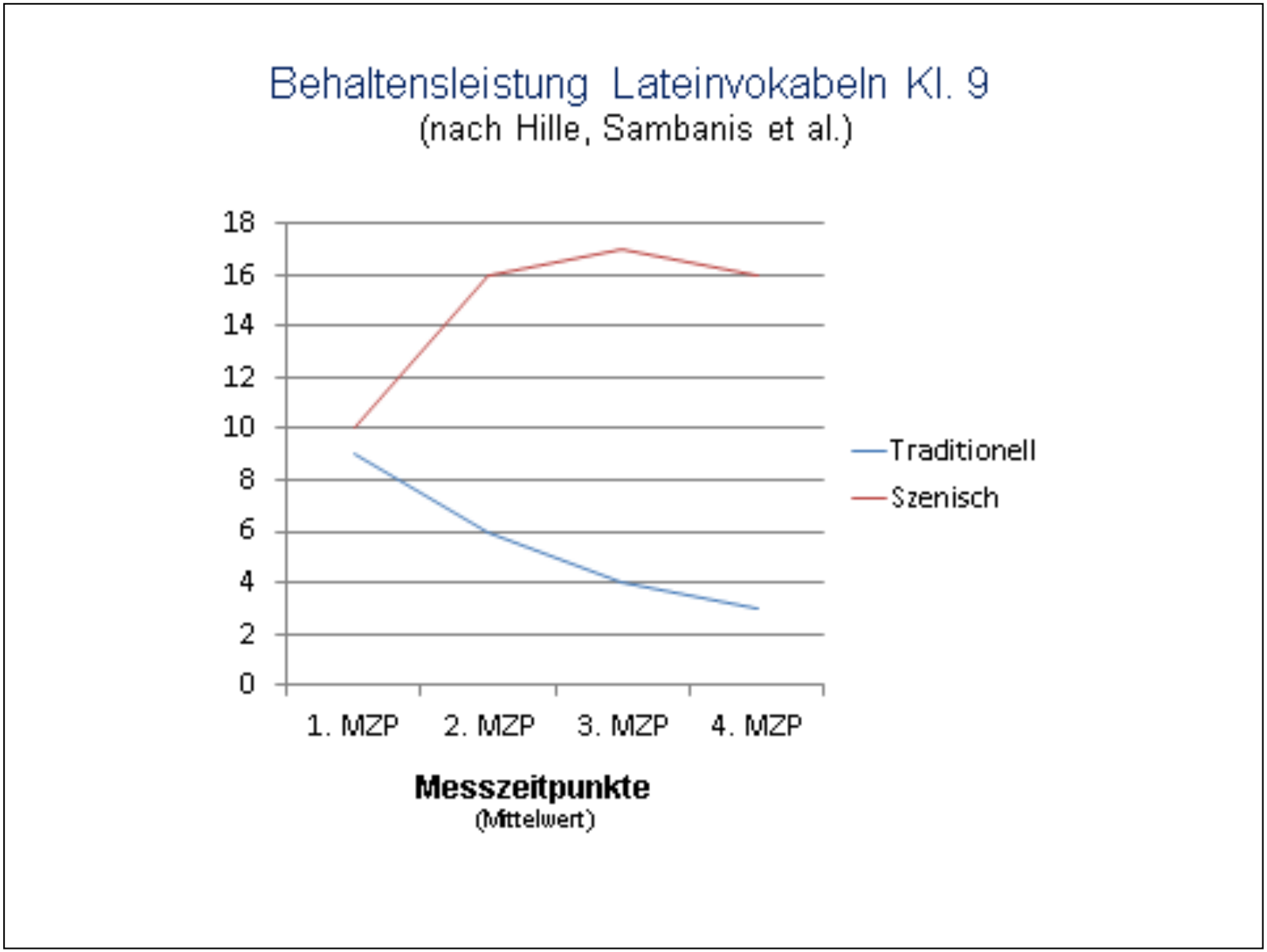
Add movements…

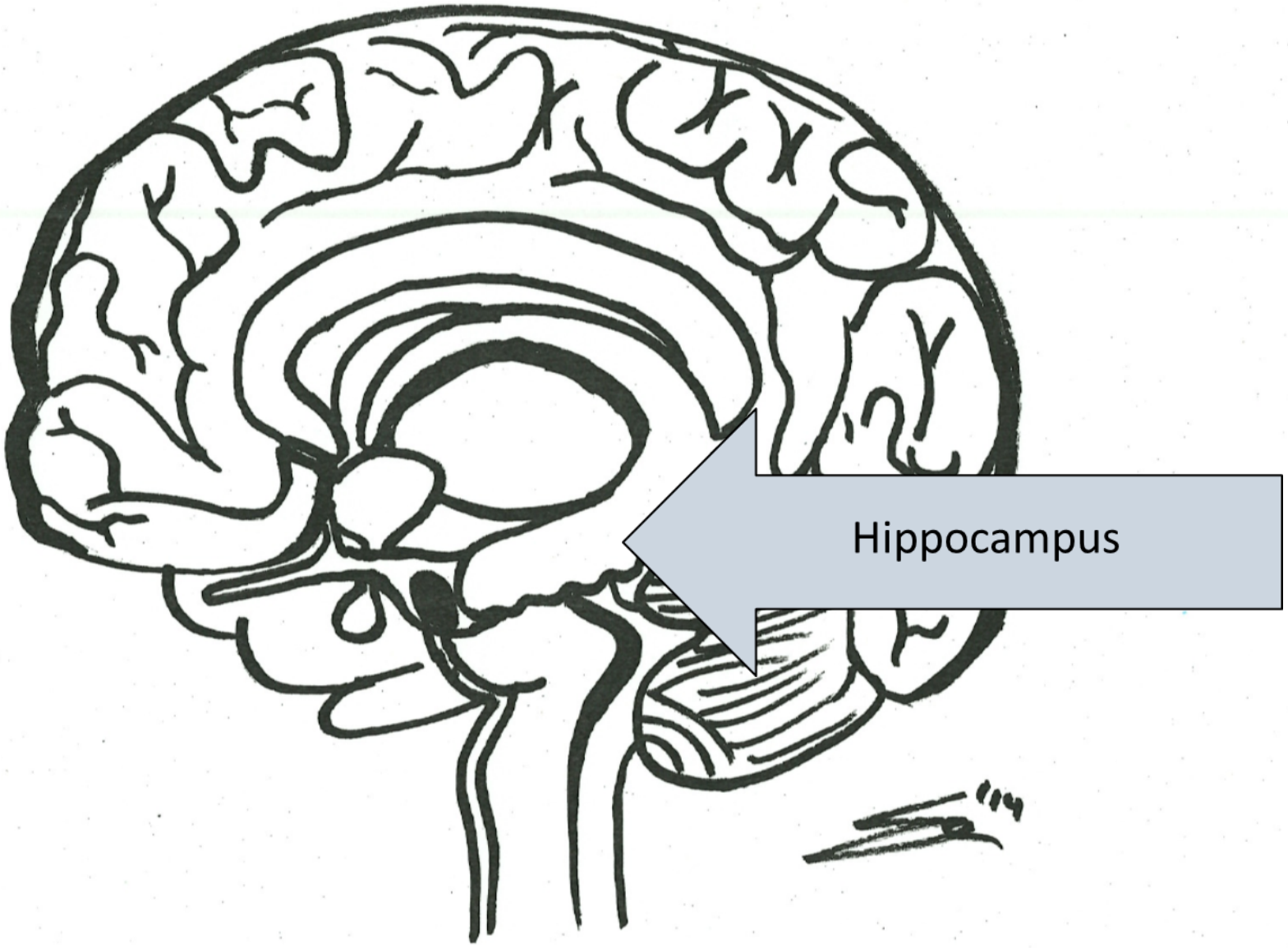
Quelle: Englisch in der Grundschule-leicht gemacht.

photographic memory

guilty conscience

rebel against parental authority


Behaltensleistung Lateinvokabeln Kl. 9
(nach Hille, Sambanis et al.)
18
16
14
12
10
8
6
4
2
0
1. MZP
2. MZP
3. MZP
4. MZP
Traditionell
Szenisch
Messzeitpunkte
(Mittelwert)


Hippocampus

ffects of movement-based/scenic learning:

- Positive effects on retention when students learn content together with corresponding movements.
- Weaker effects if students do not perform the movements on their own (→ mere observation is not enough – move!)
- Strongest positive effects on long-term retentior (cf. Hille/Sambanis et al. 2010, Sambanis 2011).

Quelle: Englisch in der Grundschule-leicht gemacht.

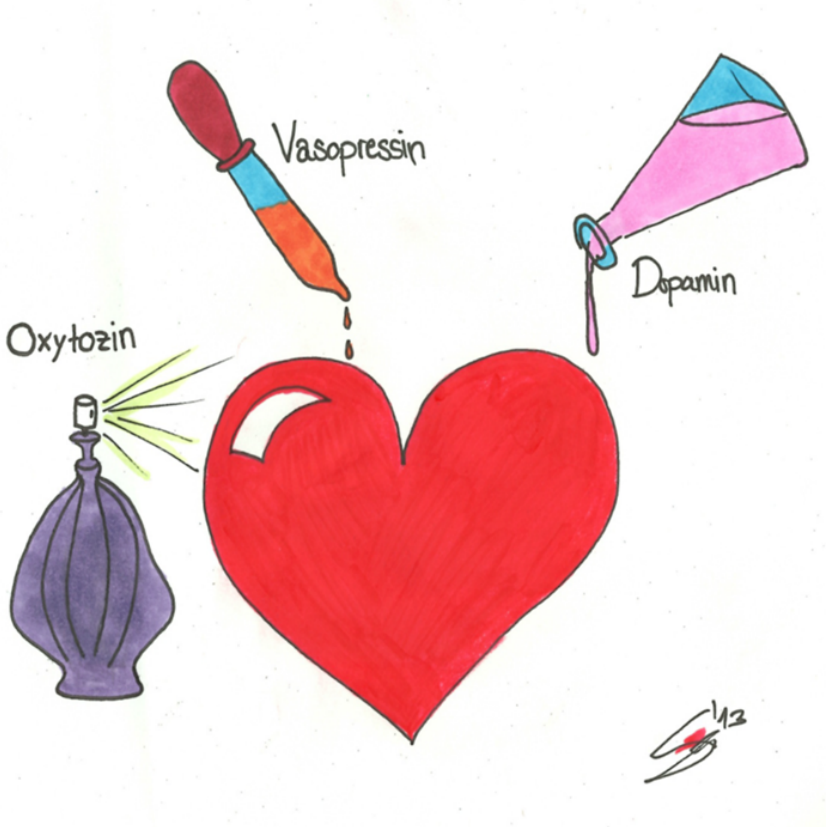
How can we explain the effects?

neuroscientific & didactic perspective combined

- Multimodal Encoding-Processes/Multisensory Learning
- Activation of all students
- Movements trigger unconscious reactivation of knowledge
- Consolidation
- Links, connotations, pictures in the mind

Emotions

… influence learning processes.



- What we learn.
- How we learn.
- How stimuli are processed and stored in the brain.
- Whether we remember or forget.


SIEMENS
MAGNETOM


AMYGDALA

Freie Universität Berlin

Interim Conclusion

We learn best with positive emotions!

Oberview

- ✓ **How does the brain learn?**
  - Neurons, activity, pathways & plasticity

- ✓ **Body-movements & learning** (→ translational reserach)
  - Effects, explanations, application to the classroom

- ✓ **Emotions & Learning**
  - Positive & negative emotions

101 in Neuromythology

- Separating facts from fiction

Neuromythology

According to the OECD, neuromyths are defined as "a misconception generated by a misunderstanding, a misreading, or a misquoting of facts scientifically established (by brain research) to make a case for use of brain research in education and other contexts."

(OECD 2002)

Myth #1

I‘m a sleep-learner.

Encoding

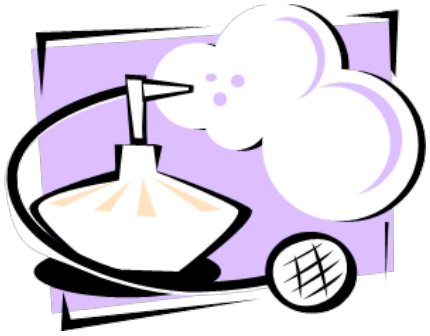
Consolidation

„Während sich die Annahme, im Schlaf könnten aktive Aufbau-prozesse stattfinden, also beispielsweise über Kopfhörer Wörter gelernt werden, als irrig, wenn auch marktstrategisch reizvoll erwiesen hat, wird im Schlaf intensiv nachbereitet, letztlich also doch gelernt, allerdings eben konsolidierend.“

(Sambanis: *Fremdsprachenunterricht und Neurowissenschaften*, p. 85).

Myth #2

I sleep with the book under my pillow.



Myth #3

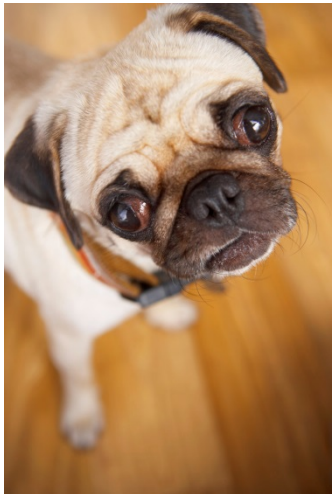
Music makes me clever! – The Mozart Effect

Wie schlau macht Mozart? (Focus 2007)

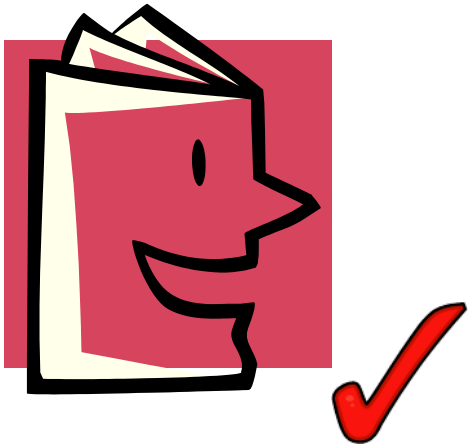
Warum Musik die Kinder schlauer macht (Hamburger Abendblatt 2007)

Klügere Babys durch klassische Musik […]

A lot of Mozart, but still not the brightest kid in class?



...



20-30 Minuten

Readings

Sambanis, M. (2013): Fremdsprachenunterricht und Neurowissenschaften. Tübingen: Narr.

Altenmüller, E. (2007): Macht Musik schlau? Zu den neuronalen Auswirkungen musikalische Lernens im Kindes- und Jugendalter. In: Musikphysiologie und Musikermedizin 12 (2 & 3); 40-50.

Diekelmann, S. (2014): Der Traum eines jeden Schülers und Studenten – Lernen im Schlaf. In: Forschung & Lehre 3, 184-185.

Doidge, N. (2007): The Brain That Changes Itself. New York: Penguin.

Godde B. / Berkefeld T. et al. (2002): Age-related changes in primary somatosensory cortex of rats: evidence for parallel degenerative and plastic-adaptive processes. In: Neuroscience & Biobehavioral Reviews 26, 743-752.

Jäncke, L. (2008): Macht Musik schlau? Neue Erkenntnisse aus den Neurowissenschaften und der kognitiven Psychologie. Bern: Hans Huber, Hogrefe (2. Nachdruck 2012).

Organisation for Economic Co-operation and Development (2002): Understanding the Brain: Towards a New Learning Science. Paris: OECD.

Willis, J. (2010): The Current Impact of Neuroscience on Teaching and Learning. In: Souse, D.A. et al. (Hrsg.): Mind, brain, and education: neuroscience implications for the classroom, 45-66.

Univ. Prof. Dr. Michaela Sambanis
Institut für Englische Philologie
Didaktik des Englischen

Freie Universität Berlin

That‘s it!

Brain matters – Translating findings from neuroscience

Thank you very much for your attention.