Neurodidactics, a relatively new interdisciplinary research field, represents an interface between neuroscience, didactics, educational science and psychology. It is based on the findings of brain research and provides proposals for effective (brain-based) learning and teaching. Yet, neurodidactic research shows that there is no unique, singular, “one-and-only” effective brain-based way of teaching or learning.

Rovereto
How do we learn?

What should be considered? Including Course and Workbooks

Brain-based language tasks
In short:

Brain studies show that there is no „one right way“ of learning!

I will show you how the brain works and why we have to accept that there is no concept for one „brain-adapted“ learning.

Yet, knowing how the brain works, makes it easier to teach languages and I will give you examples of methods and factors that most learners consider as very helpful when learning a language.

And finally, I want to stress that

neurosciences confirm the gains of psychology and educational studies and, thus, is not be considered a „new“ approach to education, but a field that helps to explain the process of learning.
Learning = Setting up of populations of neurons (= nerve cells)

100 billion of neurons; 1 neuron has up to 10,000 synaptic connections
In the mother’s womb the 100 billions of neurons are developed

Within the first months of pregnancy: approximately 500,000 neurons occur per minute

Language perception begins within the last three months of pregnancy

In the womb: the child can detect whether the mother or another person is talking
- measured using heart rate
- increases when the mother starts talking

Reading a story prior to birth: -> the baby is going to love the story when born

Shortly after birth, babies very well know if they hear their mother tongue or a foreign language
- known languages – heard while in their mothers’ womb
- rise of sucking (high sucking studies, soothers)
Babies between 2 and 9 months of age can hear all the sounds (phonemes) of any language spoken in the world.
An ability soon lost again – the older, the more you substitute with sounds of your mother tongue -> severe pronunciation problems.

Brain grows from 250g to 750g within the first year (1400g adults; 1300g women, 1400g men; yet, women have a much! better linkage between left and right hemisphere and language areas within the brain are about 30% huger)

During the first three years, the synaptic connections between the neurons go very very fast.

Thus, during the age of 4 to 7 years, the brain needs twice as much energy than the brain of an adult.
Stimulus appears and triggers the limbic systems which checks whether the information seems to be relevant.

If relevant, first neuronal connections are set up; they are still very weak.

Neuronal network is strengthened by means of repetition, multi-channel presentation and emotions.

The neuronal transformation process is strengthened during sleep; then, more repetition is necessary.

In order to store vocabulary that doesn’t have a linkage to the mother tongue, it needs to be perceived about 20 times and used approximately 80 times in order to be stored properly within the brain.
You remember: Learning is defined as the setting up of populations of neurons.

To give an example: Already after 20 minutes of first learning how to play the piano, we can detect a new neuron population in the subcortical area - it goes on into the cortex by means of repetition and the conviction that the information is of relevance or emotionally encoded as positive.
Synapses: they grow larger and then pass on more neurotransmitters

BUT: Different learners need different amounts of neurotransmitters

-> the teacher needs to know his students in order to evoke the ideal neurotransmitter-cocktail for each student (empathy, “reading the learner”)
Acetylcholine: responsible for attention span (max. 20 minutes) & capacity to store information

Dopamine: responsible for motivation, curiosity, concentration -> feed-back, compliments, praise, positive emotions, laughing ...

The release of too little dopamine leads to the reduction of all cognitive abilities

Noradrenaline: responsible for attention, alertness, flexibility and responsiveness and: stress
An example:

In Germany, we often use a small ball during language lessons -> there are many students who love to catch the ball, and solve the given task -> they need noradrenaline.

There are students who catch the ball and we detect a small raise of noradrenaline.

And there are students whose noradrenaline goes up that fast and high, that they even forget their names -> black out.
The **limbic system** (amygdala und hippocampus)

is the detector of relevance and emotions

Can I dock on the information on to existing information in the brain? Yes / No

Is the information relevant/fascinating/profitable/does it cause positive emotions?

Is the teacher motivated?

known?

relevant?

Is the teacher motivated?
The stronger the emotions, the better information are passed on from one neuron to the next neuron -> synapses enlarge -> more neurotransmitters are passed -> more synaptic connections are set up (up to 10.000!)

Transfer or memory speed is fast with negative emotions (fear, anxiety), too BUT:

Anything learned while feeling anxiety, causes anxiety or fear again, when the information is recalled from the brain (i.e. mathematics -> fear -> anxiety recalled even after 30 years when asked to solve a mathematic task) Fear and creativity are mutually exclusive -> creative problem solving is excluded
On the other hand: Positive emotions (meaning that anything goes better than expected) release dopamine -> you feel happy, are motivated

And positive emotions also trigger the so-called endogenous opioid production (like opium) within the prefrontal cortex -> which then leads to an enormously increased efficiency, a better capacity to store information, better cognitive abilities and a strong motivation to learn even more in order to experience the same “good feeling” again (endogenous opioid strengthen self-confidence, emotional well-being and the common vitality or joy of life, and they eliminate stress hormones).
Emotions

In German, the following works efficiently

It will last for about 5 days

= Masse (mass, overweight)
Activity causes positive emotions in most learners

Those learners not used to activity when learning need to be „introduced“ to these methods in a soft and gentle way – otherwise, their limbic system will reject this approach and they won‘t learn efficiently.
1) Neurotransmitters have to be in balance (lack of dopamine -> depression; surplus of dopamine -> schizophrenia)

2) Different actions trigger different reactions (-> ball throwing, more to come)

3) Basic principle: „acceptance of the approach/teaching method -> motivation -> learning success“ vs. „rejecting the approach/teaching method“ -> Distress -> learning blockages

4) Brain reactions are displayed in certain areas (EEG electroencephalography)

What can we observe?

i.e. “happiness“ -> prefrontal cortex

Areas where reward stimuli are activated -> motivation

i.e. Music
The role of the so-called neurotransmitter-cocktail?"?

Remember the ball?:

Even though the brain has the same structure, each brain seems to be in need of different approaches when learning. The same action (i.e. throwing the ball) causes different neurotransmitters passing from neuron to neuron. Caused by this diversity, there is no one recipe which can be considered the best.

What and why are there differences?

Factor 1: learning biography -> which experiences have been made so far? Traditional grammar-translation method? [benefit of young learners!] -> either the learning biography matches the learning style or is contrary, which implies that the learner will soon accept the “new” learning method.
Factor 2: learning styles according to the “onion model” by Curry (1987)

Learning styles are hardly ever taken into account, whereas learner types (visual, auditory, and kinesthetic) – which are questionable are often discussed.

Basic principle:
When learners are confronted with a learning style they dislike, their “stress level” rises (→ Noradrenaline) and the learning success / learning progress becomes less likely.
Selection of learning styles (seen as a continuum)

i.e. cognitive (analytical vs. functional):
• Rules (i.e. grammar rules) have to be presented vs. have to be discovered (discovery based learning/exploratory learning)
• I want my sentence to be perfectly correct vs. As long as I am understood that’s perfectly okay

i.e. executive
• I want to do all tasks within the course book and workbook vs. It’s perfectly okay when we skip some tasks [seldom in all cultures!]
• I feel better when vocabulary is translated vs. I rather want to deduce the meaning from the context

i.e. social (different social forms / classroom formats)
• Individual work, whole class, pair work, group work – role of feedback!
Neurodidactics

- I want to be corrected vs. Corrections are a face-threatening act (FTA)
- Teachers have to show authority vs. teachers have to be good friends
- I need regular tests vs. tests are demotivating me
- Activity makes learning more effective vs. activities make me nervous
- Language games are effective vs. language games are a waste of time

Even though it is a fact that docking on of new stimuli is reinforced by activities (action-oriented learning, task-based learning) due to a greater oxygen concentration (→ greater storage performance), action- and production oriented teaching can be counter-productive

Completion texts (cloze texts), pattern drills or matching tasks do not result in any communicative competence BUT they offer security. Thus, any course- and workbook should offer an equal mix of closed and open exercises and creative tasks
Two concrete results

1) **The limbic system** - the functional unit in the brain that regulates mood and motivation - has to be reached and the differences concerning the neurotransmitter cocktail have to be taken into account – how?

- Motivation due to relevance
- Positive emotions -> approval, praise, feedback, pleasant atmosphere
- Motivation & charisma of the teacher: „it’s worth to have the same knowledge as my teacher“! -> teacher personality -> empathy of the teacher
- Voice of the teacher -> meaningful intonation -> not changing the speed and pitch of the voice, tells the limbic system not to listen any longer -> voice training
- Change of exercises and tasks, different classroom formats, laughter, music after approximately 20 minutes -> outwit the attention span of 20 minutes
- Docking on to previously acquired knowledge (in the cortex)-> associogramm/ mind maps, repetitions, cyclical approach
2. New or rather old interpretation of **methodological competence**

Neurobiology shows that the elderly concept of David Hunt (1976) is still very valid

**Reading**

Ability to read the learners’ needs and the overall situation in the classroom (via verbal and nonverbal clues & several methods)

**Flexing**

Professional competence, i.e. the knowledge and deployment of different approaches (sometimes at the cost of their own teaching concept)

**EMPATHY and PROFESSIONAL COMPETENCE**
Brainstorming (10 minutes)

Part of the „flexing process“ is done by course and workbooks nowadays. What do you think is important within the teaching materials? Discuss with those sitting close to you!
„Flexing“ support of the teaching material

- motivation: short textbook lessons (10-12 pages); inspiring or emotional pictures -> incentive to talk about the impressions
- Solid Structure (variation, but yet structured -> the brain favors structure)
- Motivation (next to CEFR): learning goals / objectives
- Motivation: addressing the learners (i.e. how would you spend your summer holidays? Would you like to work at ...?)
- Integration of learning techniques and learning strategies (life long learning, learner autonomy)
- Integration of mother tongue (5-10% till B1+), language comparison -> language awareness
- Integration of various channels of perception: pictures, audio texts, songs, movie clips – combining pictures with audio texts, even none authentic songs
- Regular repetitions, cyclical structure
 „Flexing“ support of the teaching material

- Activity / task orientation (30%): projects, language games, crossword puzzles
- Variation within the exercises (drill, closed exercises, open exercise -> tasks)
- Grammar: systematic presentation as well as opportunity to discover and formulate rules
- Pronunciation training
- [Digital versions, integration of the worldwide web, apps, learning content management systems, i.e. Moodle]
Brain studies show that there is an inter-hemispheric interaction in the human brain, when using visual-verbal processing or motor activity and verbal activities – the memorizing effect improves!

Furthermore, the common aging process is slowed down when the brain is confronted with unfamiliar tasks, i.e. combing your hair or shaving with your weak hand or reading the newspaper upside-down.
1. Introducing yourself – any vocabulary repetition (word or semantic fields)

Arms stretched upwards = consonants
Arms stretched to the sides = vowels
Clapping your hands = Umlaute/special sounds

Stand up, walk around and introduce yourself to three people
2. Introduce yourself: Throw the ball between two or three people, keep eye contact and don’t keep the ball in your hands! And keep talking to one another.

- Introduce yourself
- Talk about your weekend activities
- Talk about your dreams
- Describe your family
- Any subject of last weeks lessons
3. Counting and movement (spelling possible, too)

Stand up

1. Draw the numbers 1-9 into the air with your strong hand and tell them out loud (in a foreign language)

2. Now draw the numbers again, using your strong and weak hand, one hand drawing them back to front and again tell them out loud

3. Now use either your strong or weak hand and draw the numbers back to front, again telling them out loud

Alternative: spelling letters and drawing them
4. Spelling backwards

Pair work

Define the subject or topic (i.e. vocabulary introduced within the last lesson)

Define the number of the letters

Person A chooses a word and spells it backwards (by heart!), person B writes it down

More than 7 letters is quite a task!
5. Postcards or real objects put down on the floor / connection either to your self or to the language taught

As an introduction: Choose two cards/items – one related to yourself, one to the course and start talking
Alternative 1: Take two cards and tell a true and a fake story about yourself – have the others guess which story is true

Alternative 2: Divide the cards into two halves. The two people who have half of the cards get to know each other and find something they have in common – in relation to the picture – this is presented in the plenary.
6. Packing your suitcase (writing down the first letter on the board can be a great help)
7. The special present

Each participant / student has 7 pieces of paper. On the first piece of paper he/she writes down any word (verb, adjective, noun) he/she likes and puts the piece of paper aside.

Now, every one walks around and asks six people for a word as a present “Would you give me a word, please?”

The respondent hands him/her one piece of paper with a word (any word is okay)

The recipient says “Thank you for the present” and moves on till he/she has six presents and his/her own word.

On the basis of these seven words, every one is to set up a story or a poem (written/spoken) – the others have to guess the “donated words”
8. ABC-Ball

The participants have to catch the ball and have to find words with the letter on top, i.e. verbs, adjectives, nouns or noun + adjective + verb

- Kids – kill – kindly
- King – kiss – knowing
9. Music – positive atmosphere

http://www.lovesongcreator.com/
I want to sing it in every language for you, Baby
Play on every instrument to say this
words to you.
Believe me it is true,
I love you.

Wherever you are,
somewhere you’ve got to be,
the one I’ll fall in love with
and who’ll fall in love with me.

And no matter where you are,
from the moment that we meet,
I’m gonna learn for you, dear,
the language that you speak.

Create an Italian version!

English – Middle English – Shakespeare English

Danish – Swedish - German
10. Station learning – choose your station: which further training would you like to attend / which topic would you like to discuss in class

- Shoot a coverage / report with your smartphone
- Compose a song / rap with your wishes and sing it out loud
- Write a letter to the executive board listing your wishes
- Draw a poster / bill for a demo – demonstrate for your favorite topics
- Set up a debate / dispute with your wishes
- Write / Give an impassioned speech for your interests
- Write and present a lovely about your desire
Short summary

Learning is defined as the firm linkage between neurons, the rise of neuron-populations.

These populations only come to existence if the limbic system considers the impulse as relevant and worth learning -> most important is the teacher and the emotions he or she evokes within his students.

Linkage between the neurons is enhanced by activities:

- A mixture of different social methods (single, partner, group activities)
- Action-oriented and/or problem-oriented teaching introducing projects and interesting activities
- Implementation of music and movies
- Implementation of language games and puzzles
Thank you very much for your attention
And I hope that you have gained some new neuron binds!

www.marionneurodidaktik.wordpress.com