

# Neurofeedback Assisted Foreign Language Learning

## Upcoming Project 2011

Alexandra Kratschmer (AU)  
romak@hum.au.dk  
http://person.au.dk

Søren B. Andersen (Peakmind)  
soren@peakmind.co.uk  
www.peakmind.co.uk

Johanne C. van Hooff (VU Amsterdam)  
jc.van.hooff@psy.vu.nl  
www.psy.vu.nl

David Vernon (Canterbury University)  
david.vernon@canterbury.ac.uk  
www.canterbury.ac.uk

Philip Michael Zeman (Applied Brain & Vision Sciences)  
pzeman@abvsciences.com  
www.abvsciences.com

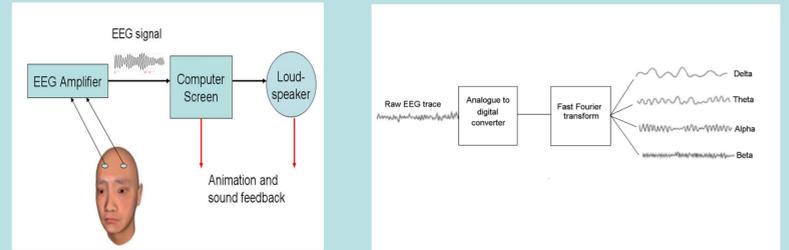
### Foreign Language Learning (FLL)

In today's globalized world, foreign language learning becomes a more and more important requirement for the *individual* citizen [Palmer et al. 2010], as much as, obviously, for social compounds with a common agenda (states, nations, federations, organizations, etc.).

Chose language:								
Arabic	Danish	Greek	Japanese	Maori	Polish	Swahili	Vietnamese	Yiddish
Bulgarian	English	Hungarian	Korean	Nahuatl	Quechua	Turkish	Wolof	Zulu
Chinese	French	Italian	Lithuanian	Occitan	Russian	Urdu	Xhosa	other

### Neurofeedback Training (NFT)

NFT is a technique that enables an individual to learn how to modify specific components of his/her brain activity (e.g. the alpha frequency component as measured by EEG).



### FLL depends on

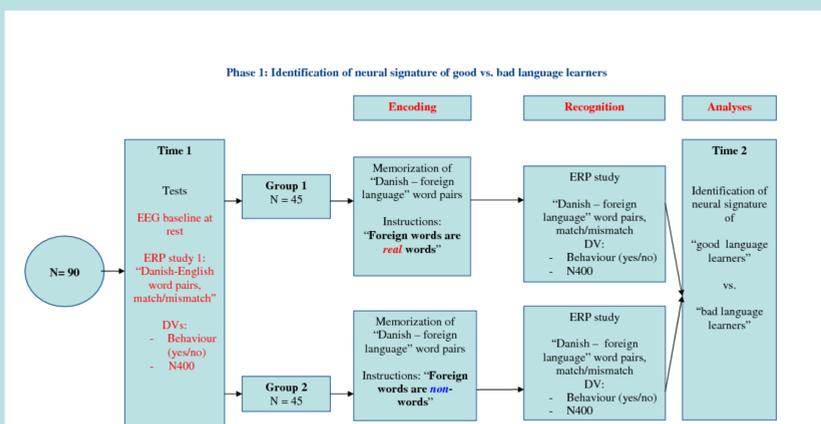
subject-external factors	subject-internal factors (= <b>Individual Factors</b> ) [Dörnyei 2006] <b>&gt;&gt; huge interpersonal differences</b>
classroom setting didactic approach didactic materials didactic processes etc.	personality + motivation + learning styles + learning strategies <b>+ Aptitude</b> ↓ Aptitude = phonetic coding ability + grammatical sensitivity + rote learning ability + inductive language learning ability <b>+ Working Memory (WM)</b> ↓ <b>WM</b> "may be one of (if not the) most central component of this language aptitude" [Miyaki/Friedman 1998]: <b>Attention Component</b> [Ellis 2001; Schmitt 2001] <b>Phonological Short Term Memory</b> [Ellis 2001]

### NFT has beneficial effects on

clinical conditions	mood	cognitive performance
ADD/ADHD (NFT increases activation and sustained attention) [Lubar et al. 1995; Monastra et al. 2002; Fuchs et al. 2003; Heinrich et al. 2007]  Dyslexia (NFT reduces orthographic problems by reduction of supposed deficit in representation, storage and recall of <b>phonemes</b> ) [Breteler et al. 2010]	Anxiety (Alpha NFT reduces anxiety) [Hardt and Kamiya 1978; Moore 2000; Allen et al. 2001; Singer 2005]  General mood (energy, composure, agreeable, elevated, confident) [Raymond et al. 2005]	Mental rotation (spatial attention) [Hanslmayr et al. 2005; Zoefel et al. 2010]  <b>Increased auditory ability (music)</b> [Bazanova et al. 2007] <b>&gt; language?</b>  <b>Semantic Working Memory</b> [Vernon et al. 2003]  <b>Attention</b> [Egner et al. 2001, 2004]

Exploring the beneficial effects of **Neurofeedback Training** on **Working Memory** and **Attention** in relation to **Foreign Language Learning**  
**>> No such Research to Date !**

### Experimental design

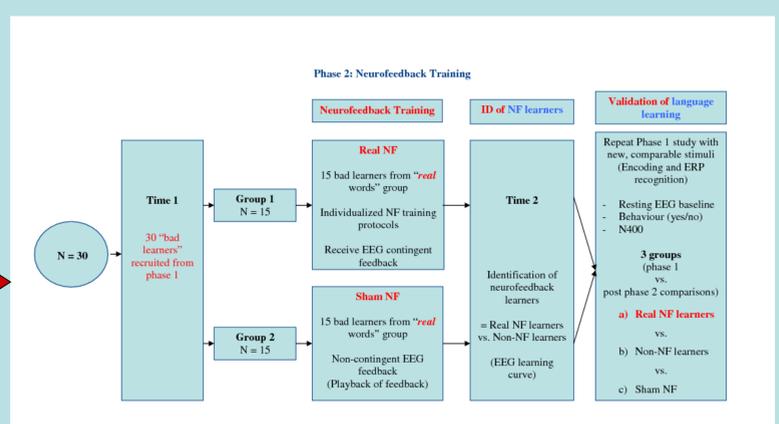


#### Premise: vocabulary learning as an ideal starting point

- highly memory related ["phonological STM [short term memory] span predicts vocabulary acquisition [...]", Ellis 2001: 48]
- efficient test paradigms already existing [e.g. Palmer et al. 2010]
- "vocabulary development is a strong predictor of subsequent achievement in morphology and syntax" [Marchman/Bates 1994 quoted following Ellis 2001: 47]

#### Experiment Phase 1:

- pre-experimental data on subjects: EEG baseline at rest; ERP signature (N400) on task (= Danish-English word pairs: match/mismatch assessment); behaviour (yes/no) on task
- Danish-foreign word pair encoding (instruction: "foreign words are **real words** vs. **non-words**" > different learning efficiency due to activation of different cognitive functions/strategies and/or motivation?)
- Danish-foreign word pair recognition: **significant individual performance differences expected** (behaviour and ERPs) >> **identification of neural signature good vs. bad language learners**



#### Experiment Phase 2:

- Time 1: bad language learners** from phase 1 (**real word** group) receive either **contingent EEG feedback training** by individualized (i.e. adapted to pre-experimental individual EEG signature) NFT protocols or **Sham** (i.e. non-contingent) **EEG feedback training**

- Time 2:** expected outcome within **contingent EEG feedback training group**
- "**Real NF learners**" (learn to modify their brain activity)
- "**Non-NF learners**" (do not (significantly) learn to modify their brain activity)

**Validation of language learning ability** according to subject groups (Real NF learners vs. Non-NF learners vs. Sham NF receivers): **repetition of phase 1 study** (EEG baseline; behaviour and ERPs (N400) on task) with **new, comparable stimuli** (different vocabulary with similar features)

**Hypotheses: Real NF learners** will do better at trial 2 than they did themselves at trial 1, better than Non-NF learners and better than Sham NF receivers; Non-NF learners and Sham NF receivers will remain on their performance level of the first trial.

**If these hypotheses can be verified, Neurofeedback Training will have earned its first credits as a viable tool to enhance individual performance in the field of Foreign Language Learning.**

