

EMF, COGNITION, BRAIN

Experiences from studies on adults and children since 1999

Heikki Hämäläinen

Centre for Cognitive Neuroscience

Department of Psychology

University of Turku, Finland

Missing Abstract

- Try not to publish false positive findings!

meaning:

- false positive findings, which are nonreplicable, nonrepeatable
- which are due to type I error in statistics
- due to, e.g., uncorrected p-values in multiple comparisons and too liberal significance levels in general

Key researchers:

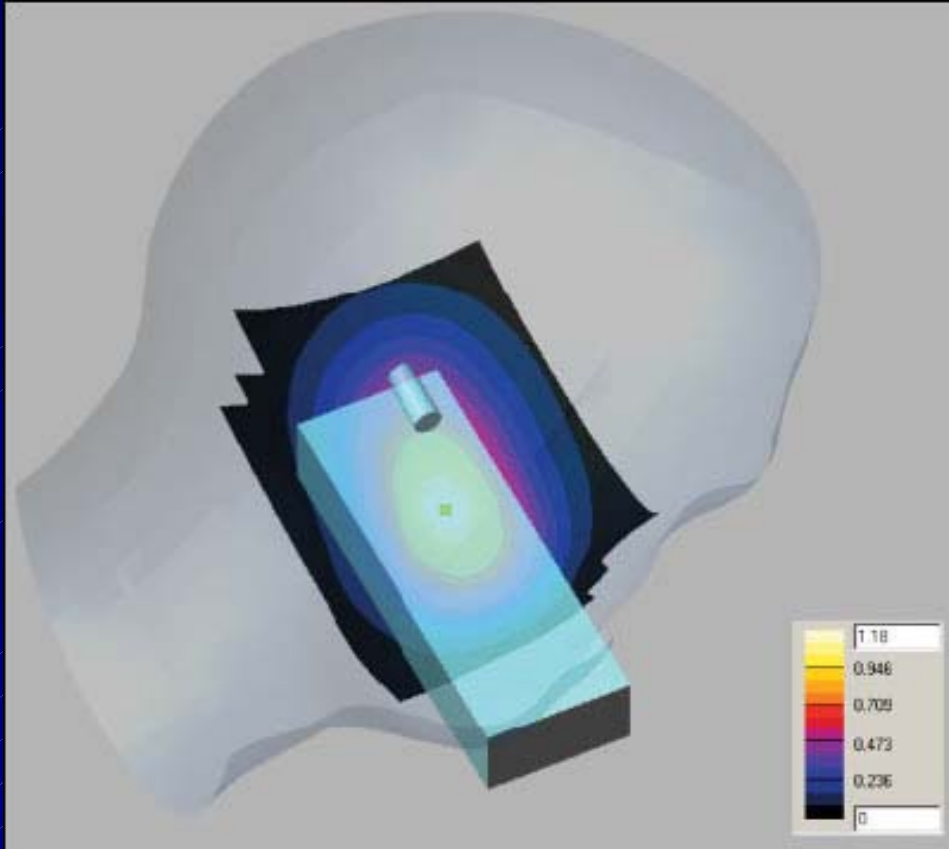
- Mika Koivisto
- Cristian Haarala Björnberg
- Christina Krause
- Myoung Soo Kwon
- Sargo Aalto
- Matti Laine
- Antti Revonsuo

Financing:

- Nokia Research Center: pilot studies 1999-2000
- Tekes (The Financial Funding Agency for Technology and Innovation): National research programs LaVita 2000-2003 and Hermo 2004-2007 (several universities and research institutions)
- FGF (Forschungsgemeinschaft Funk e.V.): research program 2002-2004

Exposure

- dummy Nokia 6110
- pulsed and continuous 902 Mhz EMF with 0.25 W power.
- SAR-distributions determined (see Fig. 1, Haarala et al. 2007)
- adults and children
- both hemispheres



Outcome

- 18 publications total (peer reviewed journals)
- 8 behavioral
- 8 EEG (ERD/ERS, ERP, BAEP)
- 2 PET (cognitive activation)

Behavioral: cognitive tasks

- simple and complex RT-tasks
- vigilance
- WM (n-back task)
- during EEG-measurements: Sternberg's memory search task (word lists)
- adults and children
- REPLICATIONS (nonrepeatable occasional effects)

Behavioral: subjective sensations

- measurements only from adults
- 1. what was experienced (dizziness, warmth, tickling, etc.) during the 60 min exposure (cognitive measurements)?
- 2. "can we (ordinary participants, not HS) sense the EMF?", 50 euros reward!

Did someone win the 50 euros?

- 84 participants, 8 claimed to sense the field in pretest questionnaire (one had to use hands-free due to subjective symptoms)

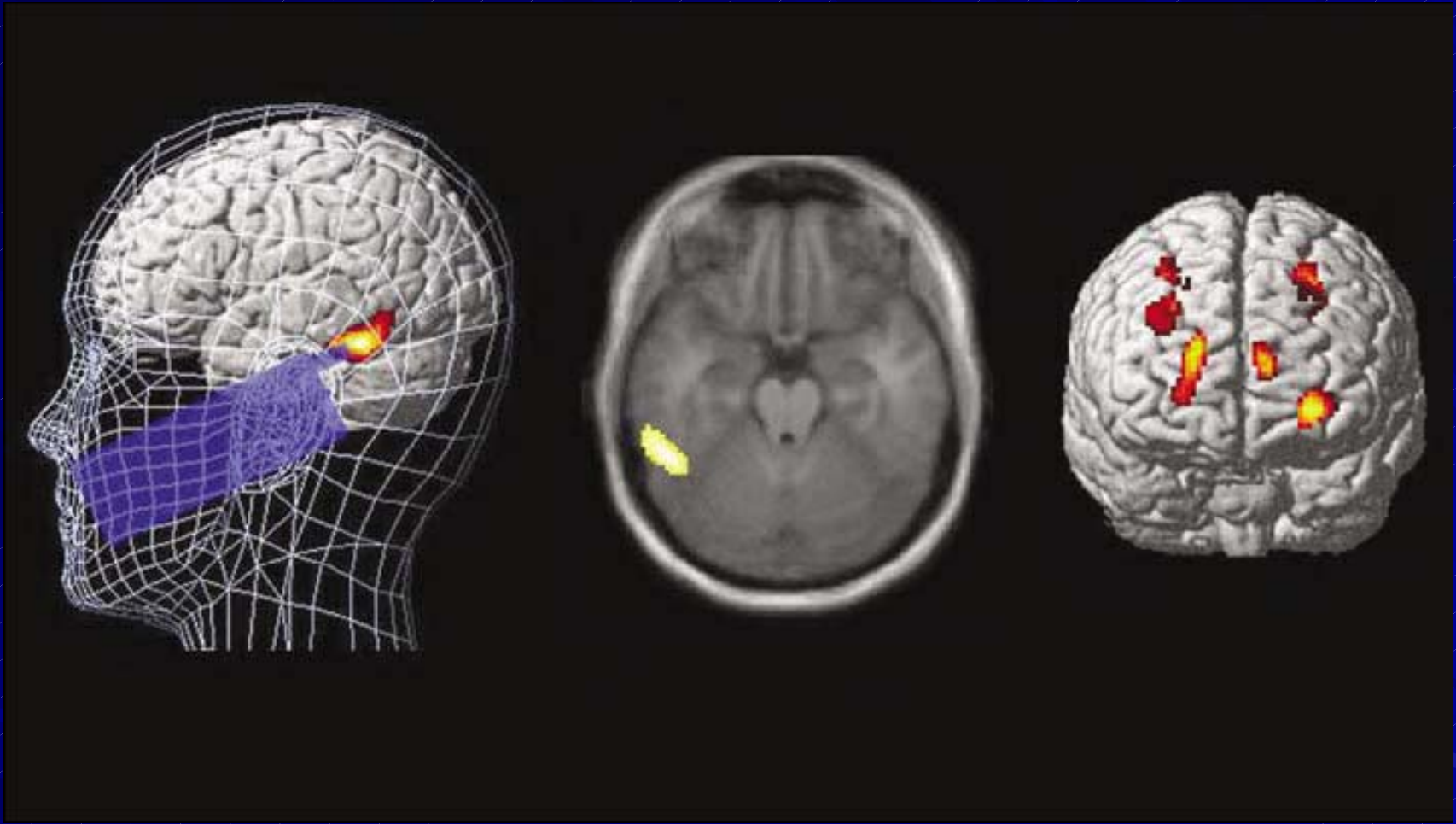
- no winners
- BUT: two ordinary participants showed in one session each extraordinary behavior
- replications failed
- the potential HS failed all tests
- the effect of study design!

Electric activity of the brain

- EEG-frequency bands, ERD/ERS, adults and children: occasional effects but not replicable
- mismatch-negativity responses (automatic, preconscious stimulus discrimination), adults, no effects
- BAEPs, conduction in auditory pathway (signals from cochlea), adults, no effects

Brain imaging

- fMRI does not allow simultaneous exposure
- PET shows interesting changes in blood/circulation/neuronal activation/metabolism
- tissue temperature?
- not applicable to normal healthy children



What have we learned?

- the literature in the field is contaminated by type 1 errors (uncorrected significance values)
- nonrepeateable false positive findings
- no effects in cognitive or brain functions
- unsensitive measures or truly no effects
- most sensitive measures have been applied so far????

Future directions:

- long exposure effects (children?)
- PET (adults)
- optical imaging (children)
- long exposure effects and PET in adults
- animal models (for children's brains)
- one final question of interest: is there subjective EMF (hyper)sensitivity also among children/at which age does it occur?

Some recommendations:

- Corrected p-values whenever applicable (at least in multiple comparisons)
- Effect sizes reported together with p-values
- Replications (when unsecure, and p barely at .05), either multiple research groups or longitudinal measurements)
- be aware of the effects of study design!