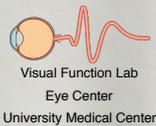




Patterns

Michael Bach

*Dedicated to
Emiko Adachi
with deep appreciation*



ISCEV

Jens Röver
Paul Sieving

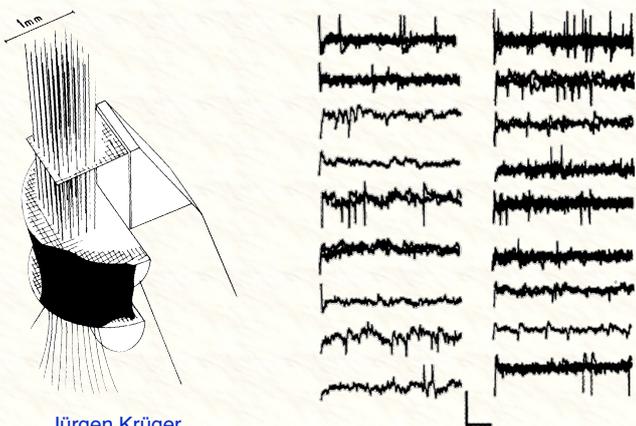
Criteria for the Adachi award

- The recipient shall be a member of ISCEV
- The recipient shall have a record of outstanding service to ISCEV over a long period
- The recipient shall have made a significant scientific contribution to clinical electrophysiology of vision
- The recipient shall undertake to deliver an interesting and informative scientific lecture at the next ISCEV symposium

Life before ISCEV –how I started in vision–

*Spikes in a primate model
– acute & chronic (=trained) –,
multielectrode*

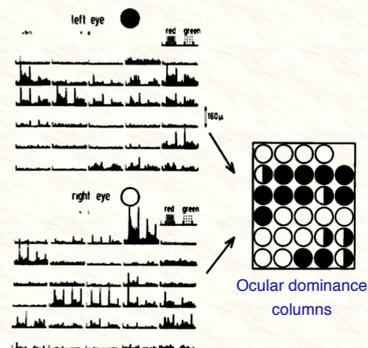
PhD Thesis: 30 microelectrodes in primate visual cortex



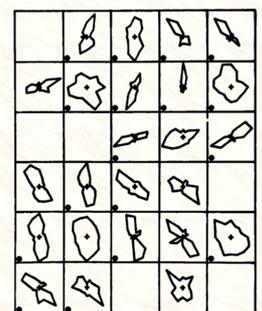
Jürgen Krüger

PhD Thesis: 30 microelectrodes, some results

Histograms → Eye dominance Map



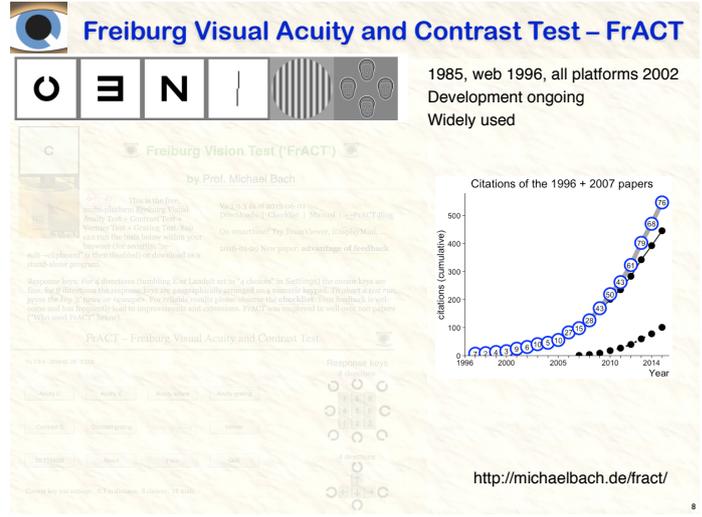
Orientation Map



Krüger & Bach 1981, 1982; Bach & Krüger 1986

Methods Development

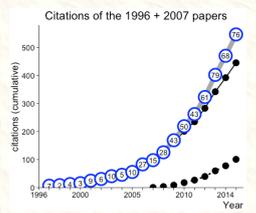
Unfortunately I suffer from “not invented here”,
I do like to develop methods myself.
Was somewhat useful, though:
3 examples.



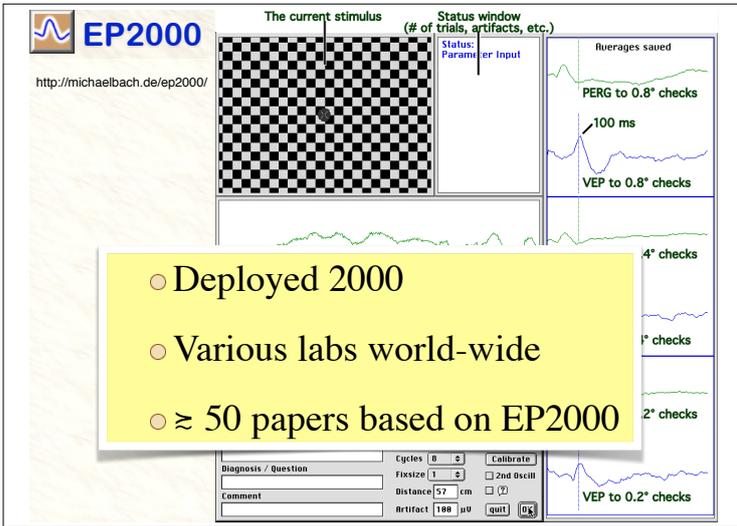
Freiburg Visual Acuity and Contrast Test – FrACT

1985, web 1996, all platforms 2002
Development ongoing
Widely used

Citations of the 1996 + 2007 papers



<http://michaelbach.de/fract/>



EP2000
<http://michaelbach.de/ep2000/>

The current stimulus: checkerboard pattern

Status window (# of trials, artifacts, etc.): Parameter Input

averages saved: PERG to 0.8° checks, VEP to 0.8° checks, 4° checks, 2° checks, VEP to 0.2° checks

100 ms scale bar

Deployment details:

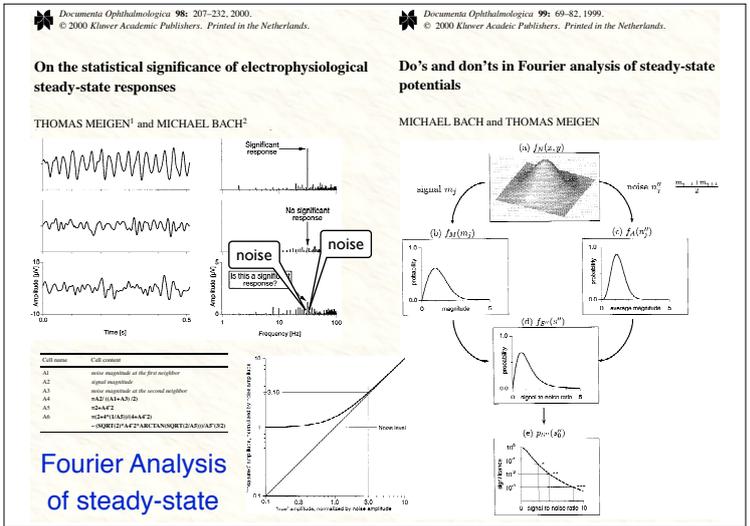
- Deployed 2000
- Various labs world-wide
- ≈ 50 papers based on EP2000

Documents Ophthalmologica 98: 207–232, 2000. © 2000 Kluwer Academic Publishers. Printed in the Netherlands.

Documents Ophthalmologica 99: 69–82, 1999. © 2000 Kluwer Academic Publishers. Printed in the Netherlands.

On the statistical significance of electrophysiological steady-state responses
THOMAS MEIGEN¹ and MICHAEL BACH²

Do's and don'ts in Fourier-analysis of steady-state potentials
MICHAEL BACH and THOMAS MEIGEN



Fourier Analysis of steady-state



Vinum Perg

Ein gewöhnliches Zeltfest gibt's doch jede Woche!
Willst du mal was Besonders erleben?
...dann komm zur

Beach-Party
nach Windhaag bei Perg!

Freitag, 25.06.2010
Rockies

Samstag, 26.06.2010
popfive
Showeinlage "KOJOTE AGLI"
jeweils um Mitternacht

Palmen, COCKTAILS und Stimmung wie im Urlaub!

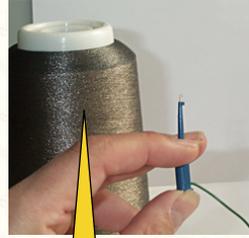
What is most difficult with the PERG?

Electrodes!

PERG – Electrodes



PERG – Electrodes



80 km
≈ 50 miles



As seen on German TV last year



PERG – Check size

ELECTRORETINOGRAPHIC AND VISUAL CORTICAL POTENTIALS IN RESPONSE TO ALTERNATING GRATINGS

1982
Bodis-Wollner "Evoked Potentials"

L. Maffei

DISCUSSION OF THE PAPER

G. CELESIA: In order to stimulate preferentially ganglion cells from the fovea versus the peripheral retina, could one vary spatial frequency?

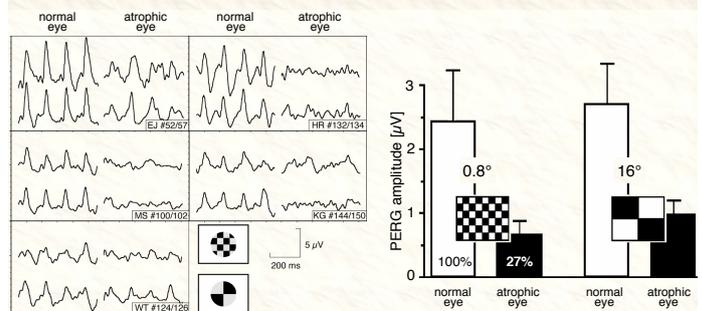
L. MAFFEI: For cats and for the human, probably yes. We have not done selective stimulation of the peripheral retina, but I would say that most of the pattern ERG waves come from the central part. When we stimulate the peripheral part, the ERG becomes a very small wave of the order of one microvolt or less.

H. SPEKRFIJS: I am particularly intrigued by your observation that, after cutting the optic n... and for, or most evident in... and the spatial frequency... and you would expect this to find a reduced luminance (micker) response. Yet, that one was not affected. So if you plotted the ERG amplitude curve as a function of decreasing spatial frequency, first it should decline, and then it has to go up as you observed. Have you

We did this poor experiment.

I agree ... if you go to very low spatial frequencies you run the risk of stimulating luminance detection. ... However, we never go below [0.1 cpd] because we think that is a poor experiment.

PERG in unilateral optic atrophy, 5 cases



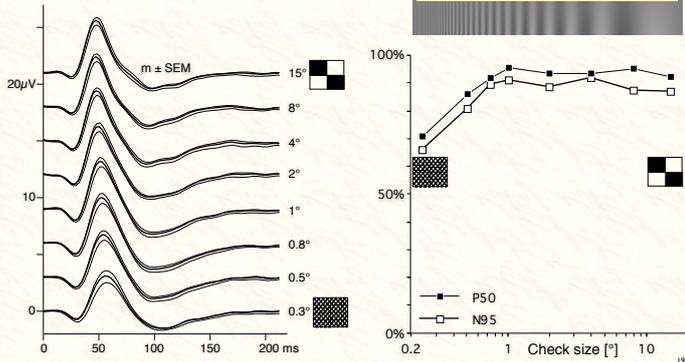
1. Loss of the retinal ganglion reduces the PERG for small & large check sizes similarly
2. PERG not completely lost in optic atrophy [In cats: complete loss.]

Bach et al. 1992

Check size: Little effect, no "LSFA"

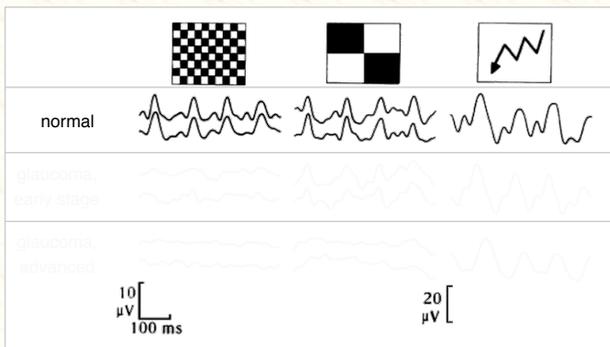
Bach & Holder 1996

n = 14



PERG – Glaucoma

ERG & PERG in glaucoma

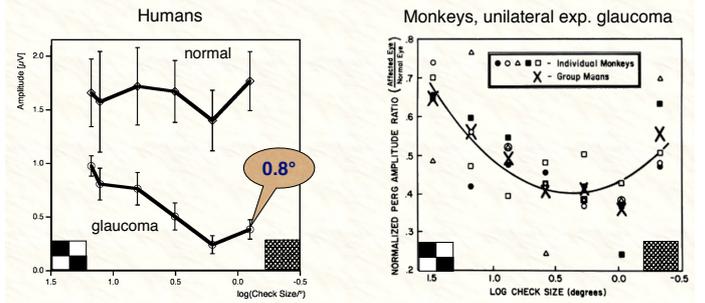


Bach, Hiss & Röver 1988

Glaucoma – check-size effect in humans and monkeys

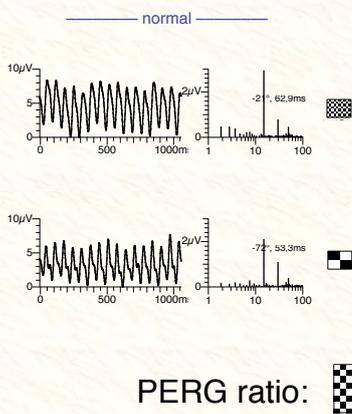
Bach, Hiss & Röver 1988

Johnson et al. 1989



In early glaucoma, PERG loss depends on check size

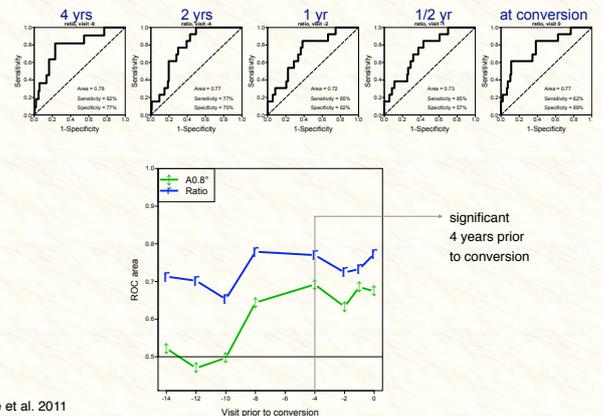
Example recordings from 2 eyes



23

Longitudinal OHT study, 14 years

PERG-ratio ROCs relative to conversion (OHT → glaucoma)



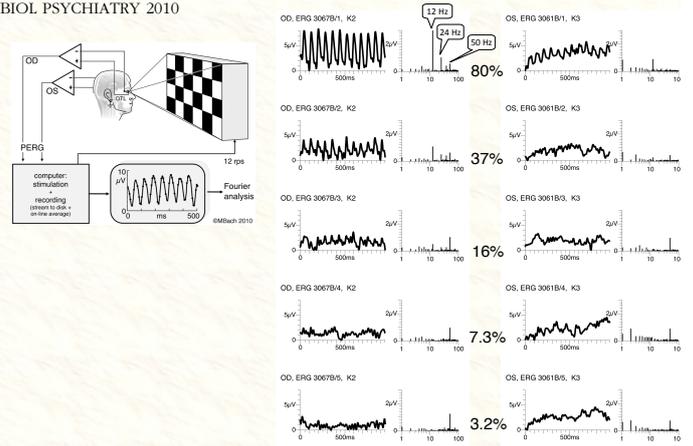
Bode et al. 2011

24

PERG in Depression, ADHS, Autism

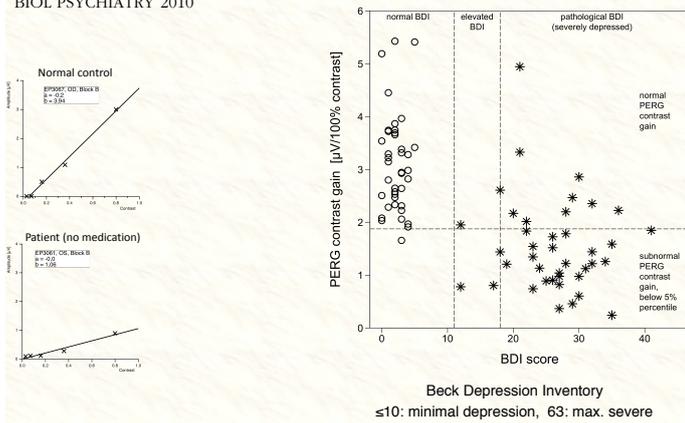
Seeing Gray When Feeling Blue? Depression Can Be Measured in the Eye of the Diseased

Emanuel Bubl, Elena Kern, Dieter Ebert, Michael Bach, and Ludger Tebartz van Elst
BIOL PSYCHIATRY 2010



Seeing Gray When Feeling Blue? Depression Can Be Measured in the Eye of the Diseased

Emanuel Bubl, Elena Kern, Dieter Ebert, Michael Bach, and Ludger Tebartz van Elst
BIOL PSYCHIATRY 2010

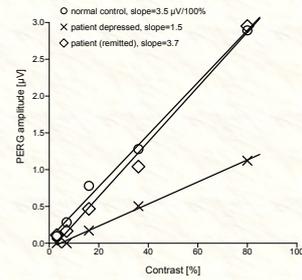


BJPsych The British Journal of Psychiatry 2012; 201, 153-158. doi: 10.1192/bjp.bp.111.100560 2012

Effect of antidepressive therapy on retinal contrast processing in depressive disorder

Emanuel Bubl, Dieter Ebert, Elena Kern, Ludger Tebartz van Elst* and Michael Bach*

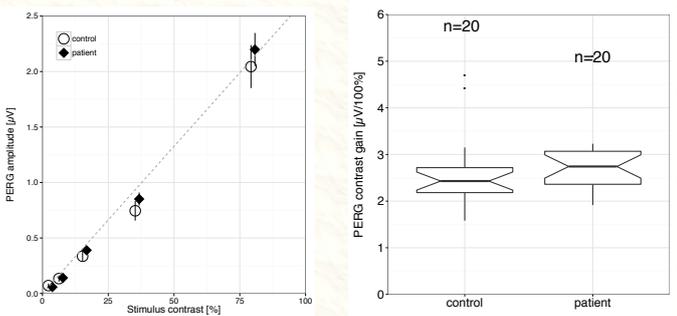
PERG: state marker



OPEN ACCESS Freely available on [PLOS ONE](https://doi.org/10.1371/journal.pone.0171111) 2013

Retinal Contrast Transfer Functions in Adults with and without ADHD

Emanuel Bubl¹, Michael Dörr¹, Alexandra Phillipsen¹, Dieter Ebert¹, Michael Bach^{2*}, Ludger Tebartz van Elst^{1,3*}



Elevated Background Noise in Adult [PLOS ONE](https://doi.org/10.1371/journal.pone.0171111) 2015

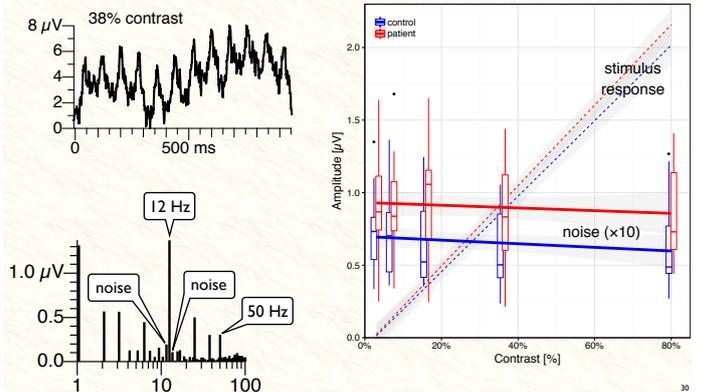
Attention Deficit Hyperactivity Disorder Is Associated with Inattention

Emanuel Bubl^{1*}, Michael Dörr¹, Andreas Riedel¹, Dieter Ebert¹, Alexandra Phillipsen¹, Michael Bach^{2*}, Ludger Tebartz van Elst^{1*}

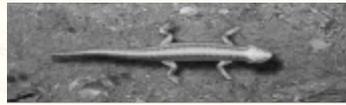
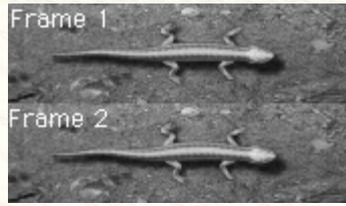
in monkeys DRD1 stimulation

→ noise reduction

→ dopamine level



VEP – Motion

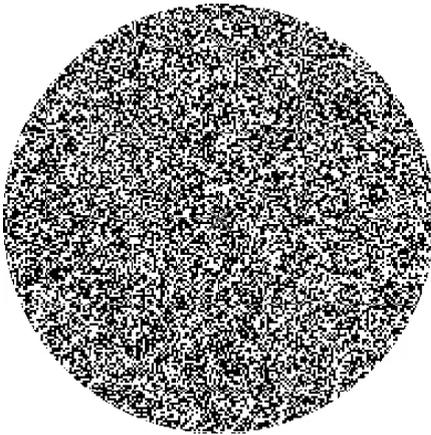


31

Phenomena

32

Texture Segregation by Motion Gradients



33

Sigma Motion – Eye movements



O. J. Grüsser

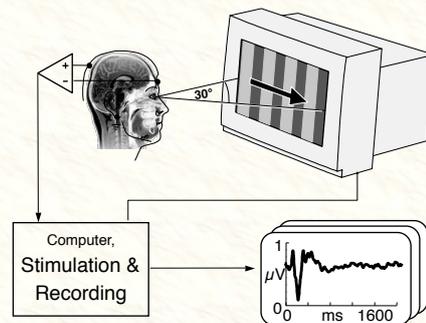
^ 8

34

Motion adaptation in the VEP

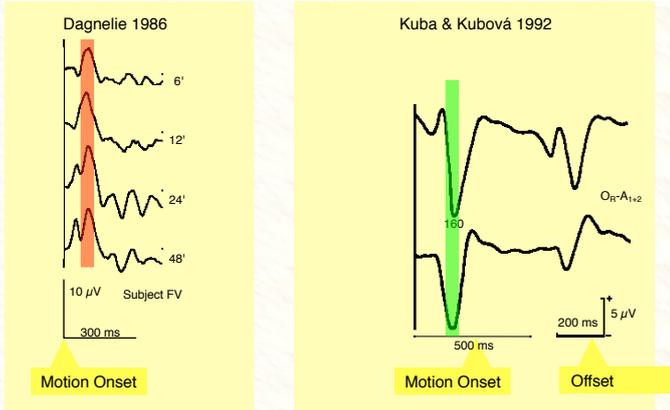
35

Generic methods for motion-VEPs



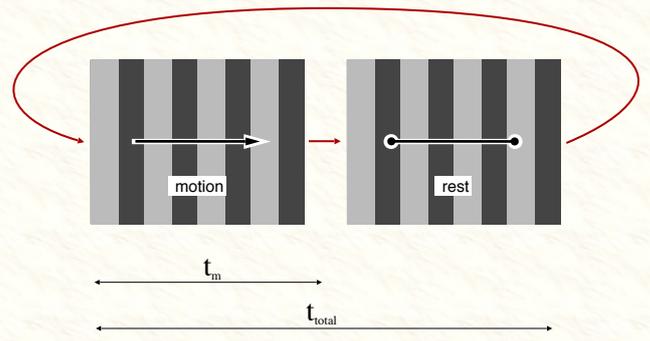
36

The "polarity war" – motion-VEPs positive or negative?



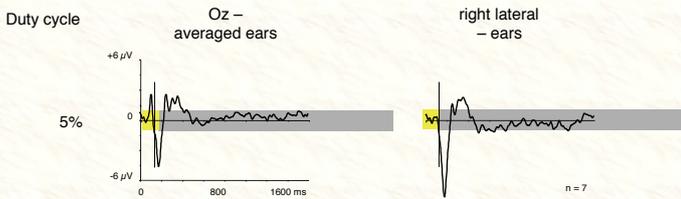
37

$$\text{Duty Cycle} = t_m / (t_m + t_{\text{rest}}) \cdot 100\%$$



38

Effect of duty-cycle on the motion VEP



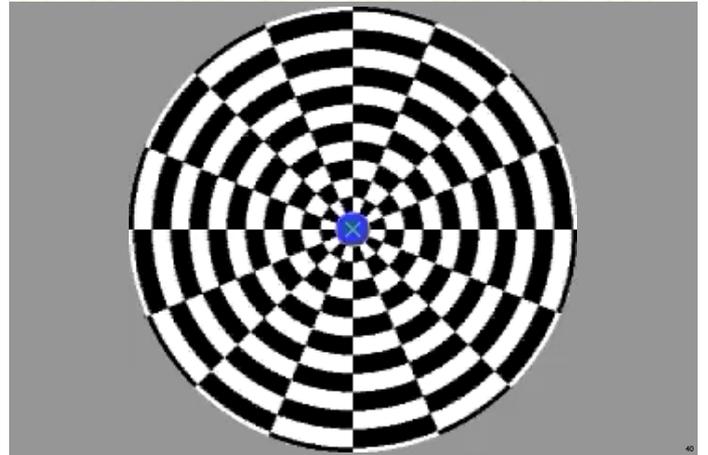
- "Polarity war" over
- It's 'just' adaptation!

So I retracted an accepted (!) motion paper from Documenta Ophthalmologica

Schlykova et al. 1993

Bach & Ullrich 1994

Motion Aftereffect



40

VEP – Bistability

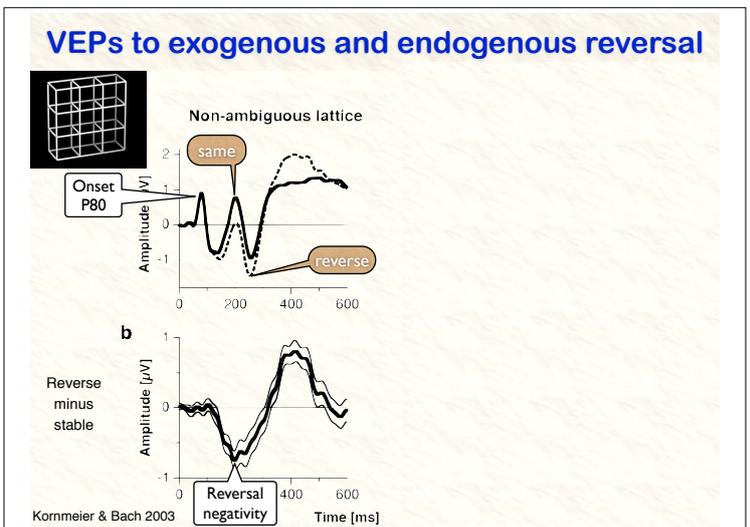
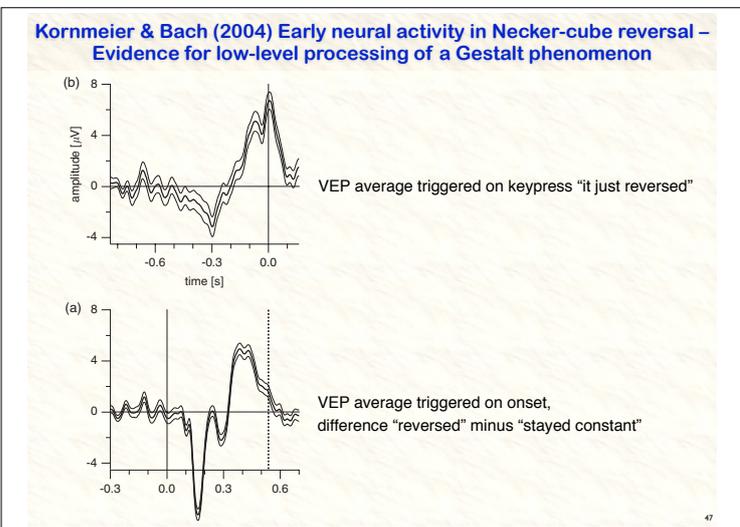
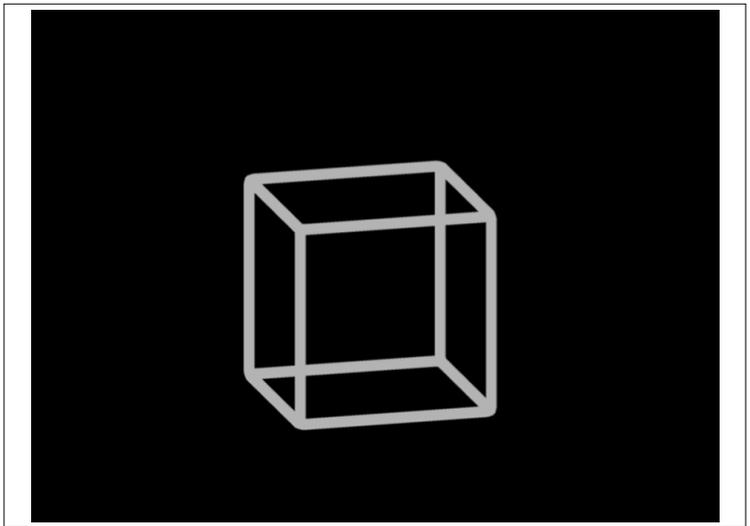
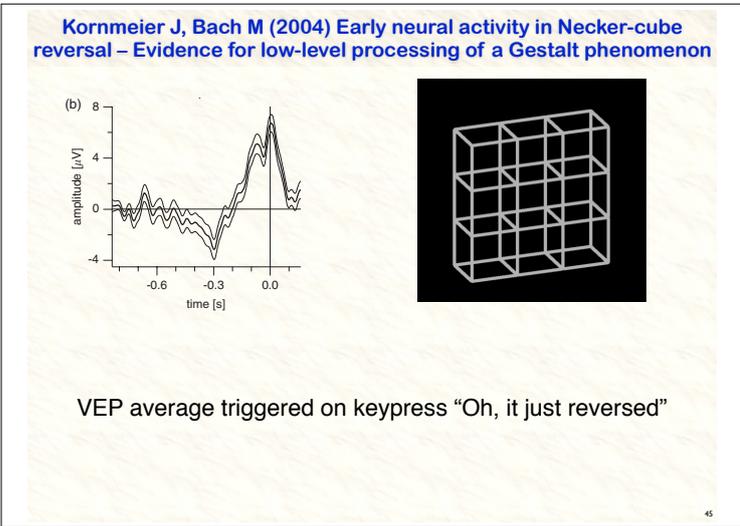
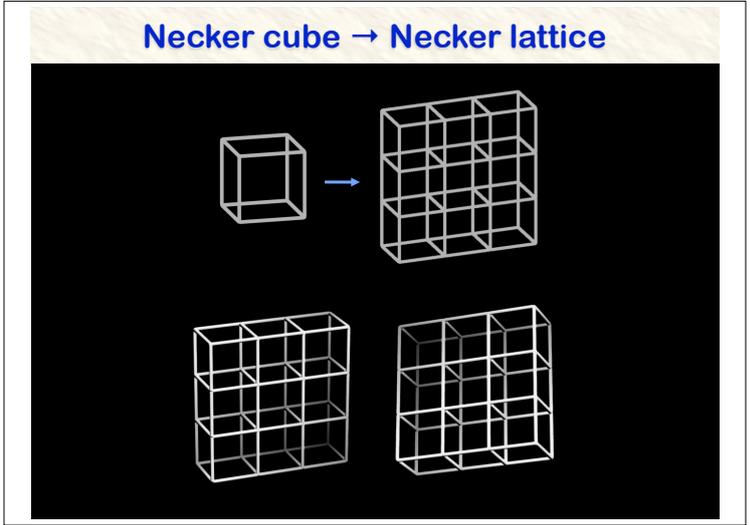
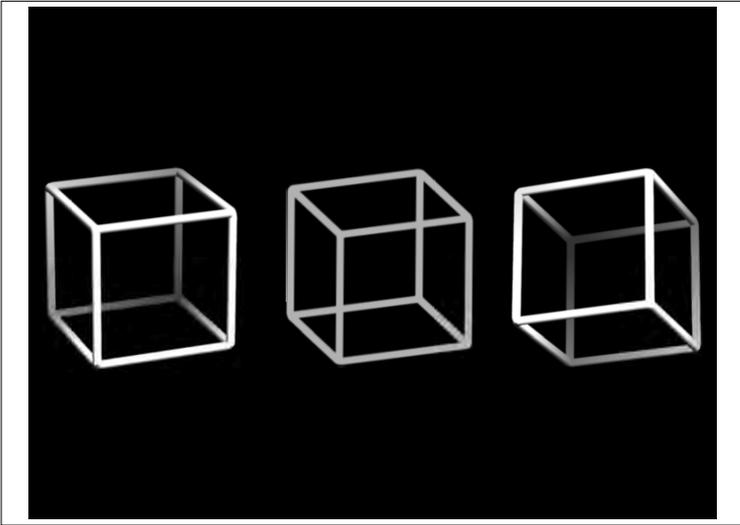


41

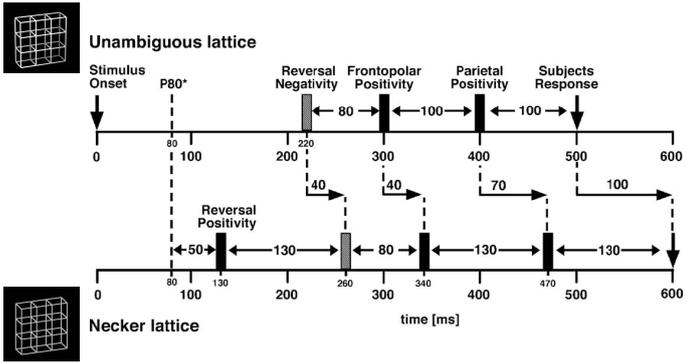
Well-known bistable images



42

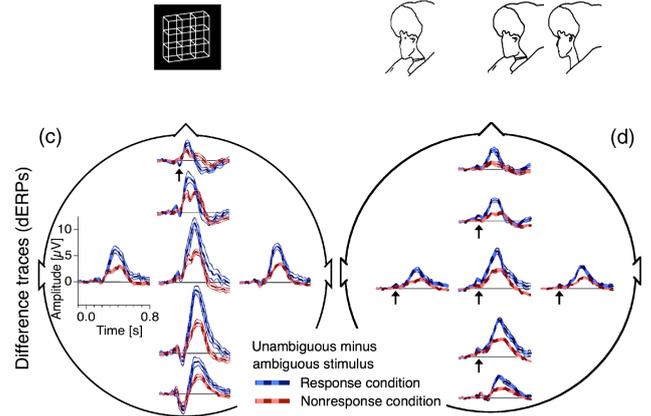


Processing chain



Kornmeier & Bach 2006

More ambiguous figures

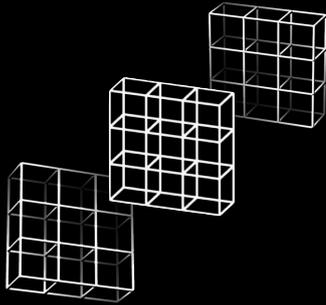


Kornmeier & Bach 2009

50

EEG correlates of multi-stable perception,

"Necker Wall"

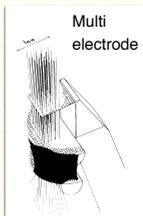


- Kornmeier, Wörner & Bach (2016) *Psychophysiol*
- Liaci, Wörner, Bach, ..., Kornmeier (2016) *PLoS ONE*
- Kornmeier & Bach (2014) *Perception*
- Kornmeier, ..., Bach & Tebartz van Elst (2014) *PLoS ONE*
- Kornmeier & Bach (2012) *Frontiers Human Neurosci*
- Ehm, Bach & Kornmeier (2011) *Psychophysiol*
- Kornmeier, Pfäffle & Bach (2011) *J Vision*
- Kornmeier & Bach (2009) *J Vision*
- Kornmeier, Hein & Bach (2009) *Brain & Cognition*
- Atmanspacher, Bach, Filk, Kornmeier ... (2008) *Open Cybernetics & Systemics J*
- Kornmeier, Ehm, Bigalke & Bach (2007) *Psychophysiology*
- Kornmeier & Bach (2006) *Int J Psychophysiol*
- Kornmeier & Bach (2005) *Vision Res*
- Kornmeier, Bach & ... (2004) *Int J Bifurcations & Chaos*
- Kornmeier & Bach (2004) *Psychophysiology*

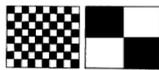
Now you know what happens in your head when...



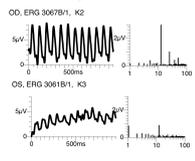
Things we heard about



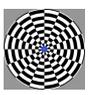
PERG to large checks, glaucoma



PERG: state marker of depression, etc.



Motion VEP, adaptation, etc.



EP in multi-stable perception

