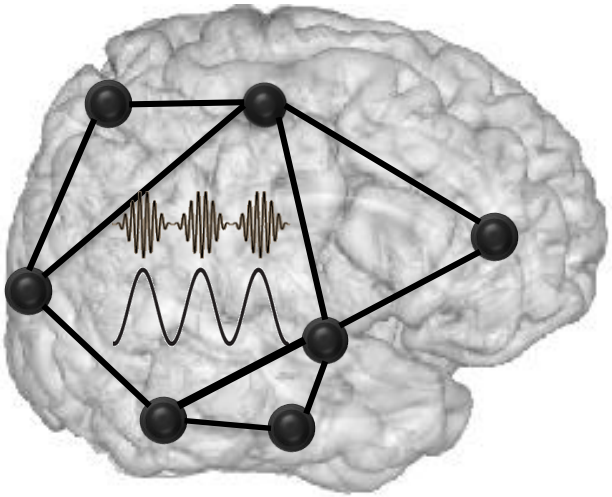
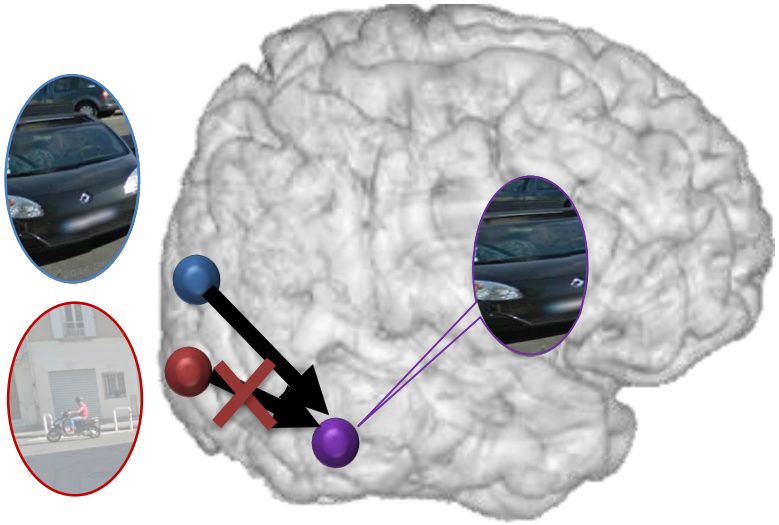
Sharpening attention through alpha and gamma oscillations

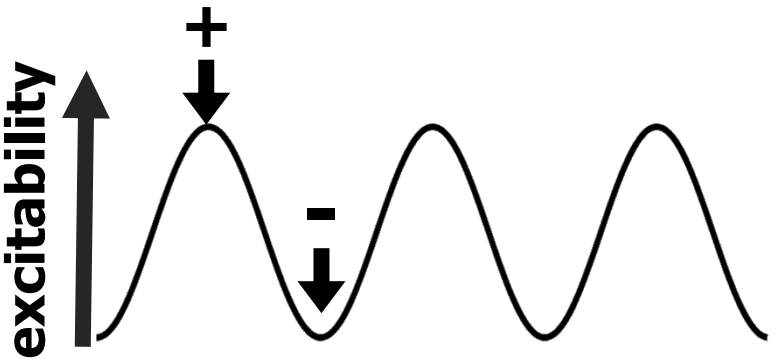


Mathilde BONNEFOND

Monthly Neuroimaging Meeting
Marseille, 21th of September 2017

Selecting information in a complex world





Attentional role of alpha and gamma oscillations

Alpha (10Hz)

Functional inhibition

Internally controlled

Gamma (>30Hz)

Active processing

stimulus-induced

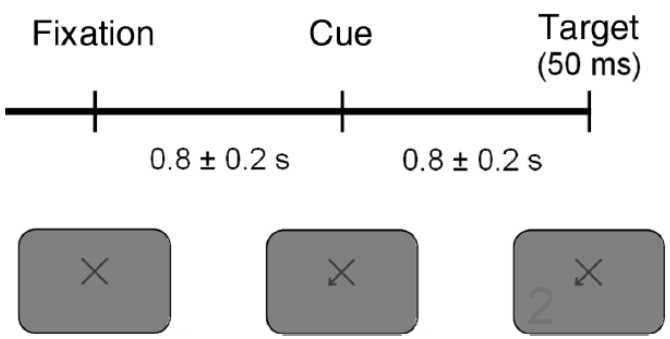
Fries et al. (2015, Neuron)
Varela et al. (2001, Nature Neuroscience)
Jensen et al. (2015, TINS)
Klimesch et al. (2007, BRR)

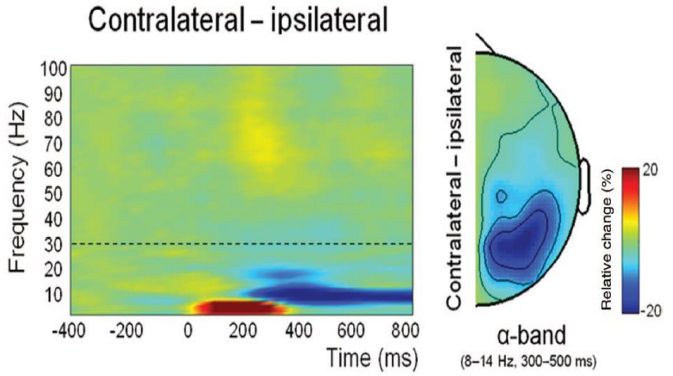
Alpha modulation by attention

Alpha (10Hz)

Functional inhibition

Internally controlled





Capilla et al.2012

Phase under control?

Jensen, Gips, Bergmann, Bonnefond (2015, TINS)
Klimesch et al. (2007, BRR)

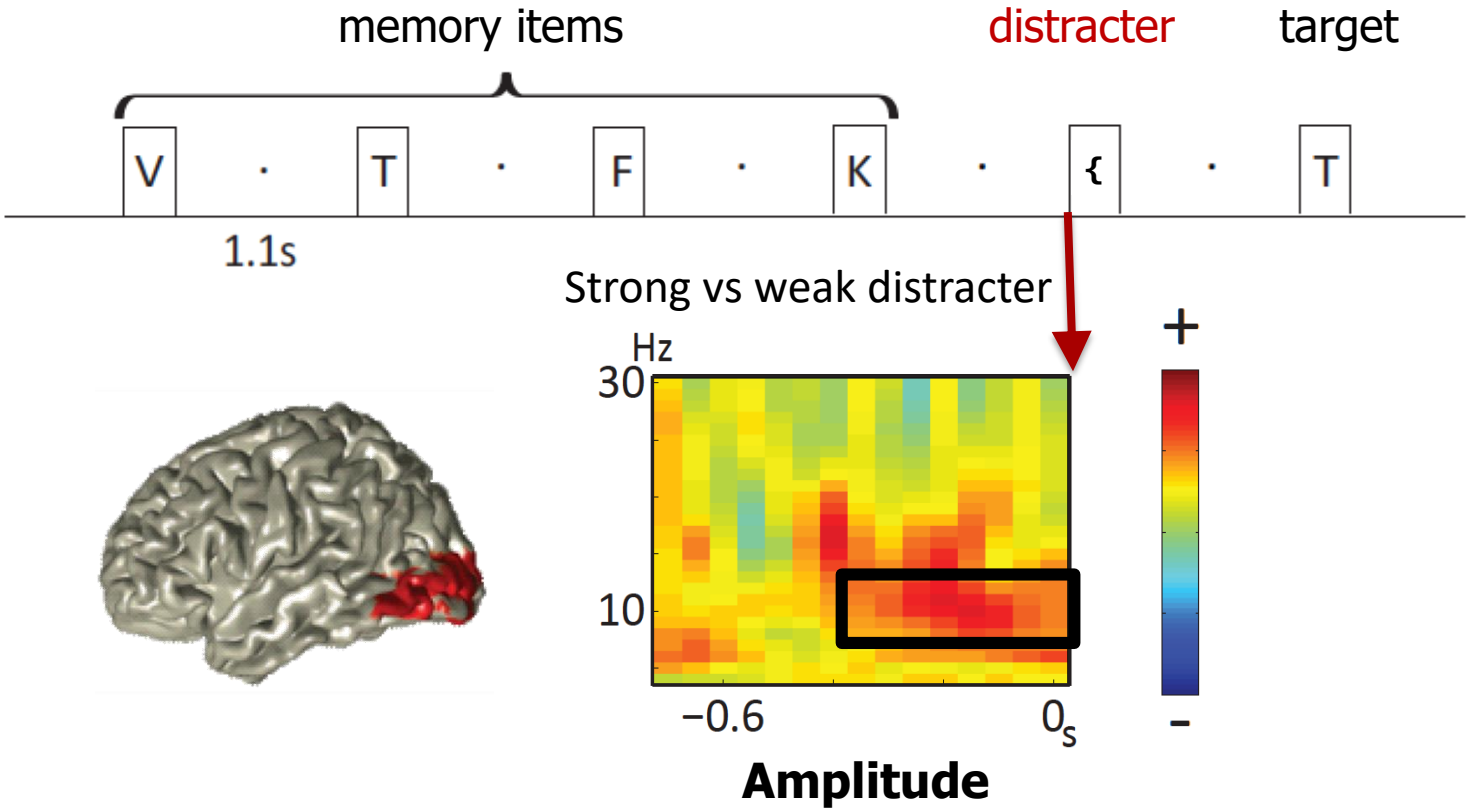
MEG

Alpha modulation by attention

Alpha (10Hz)

Functional inhibition

Internally controlled



Bonnefond and Jensen (2012, Curr. Biol.)
Bonnefond and Jensen (2013, Comm. Int. Biol.)

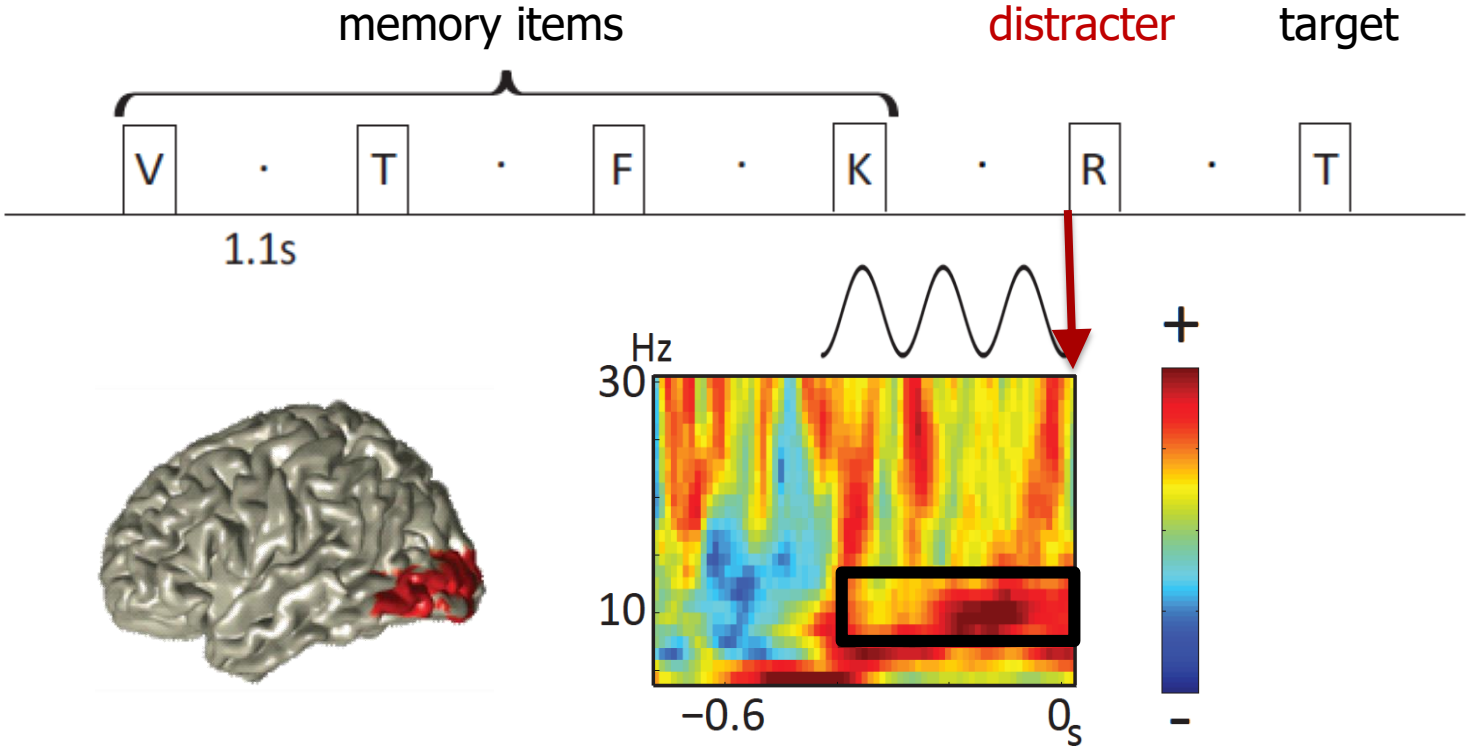
MEG

Alpha modulation by attention

Alpha (10Hz)

Functional inhibition

Internally controlled



Phase locking across trials

Bonnefond and Jensen (2012, Curr. Biol.)
Bonnefond and Jensen (2013, Comm. Int. Biol.)

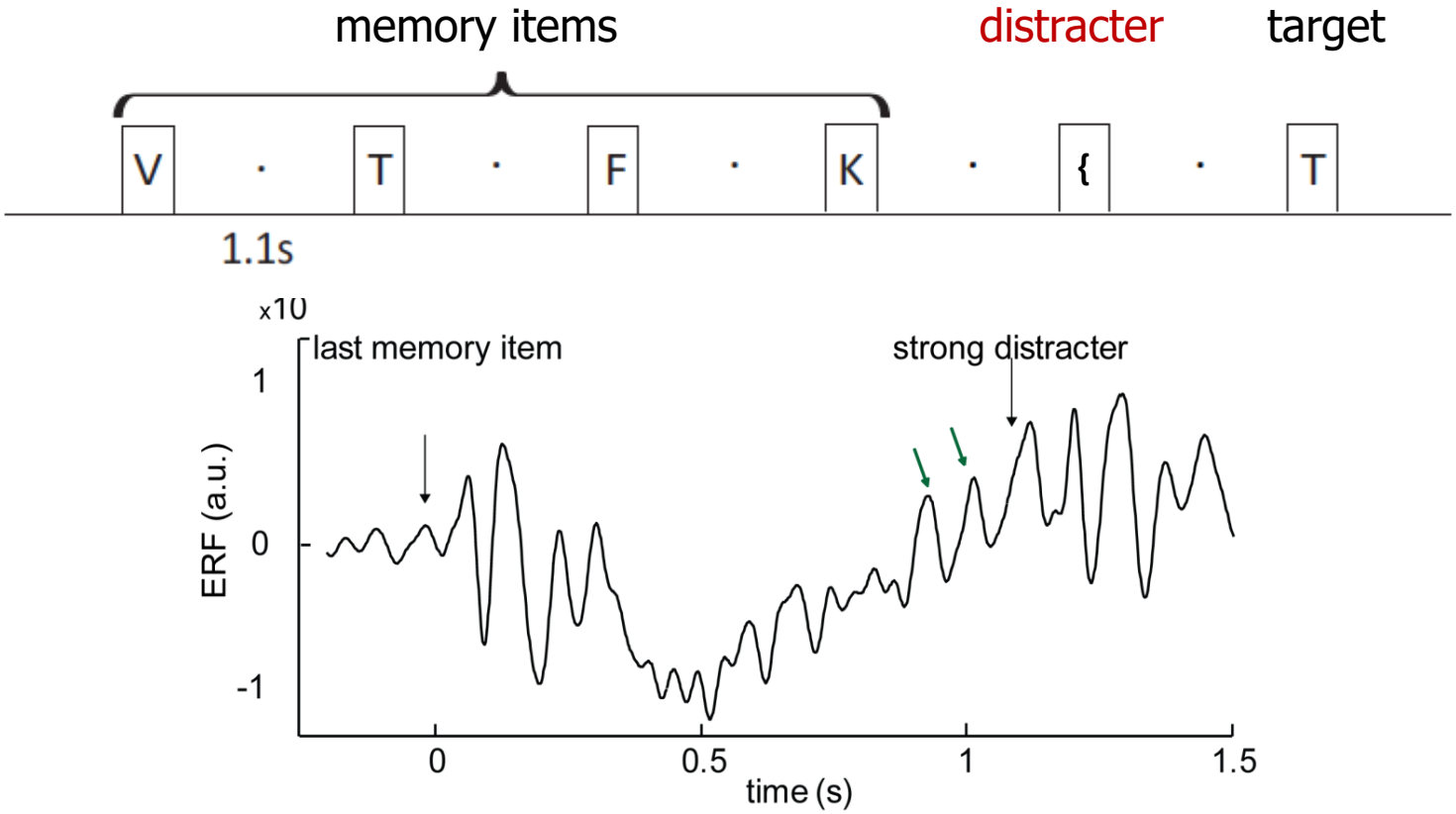
MEG

Alpha modulation by attention

Alpha (10Hz)

Functional inhibition

Internally controlled



Bonnefond and Jensen (2012, Curr. Biol.)
Bonnefond and Jensen (2013, Comm. Int. Biol.)

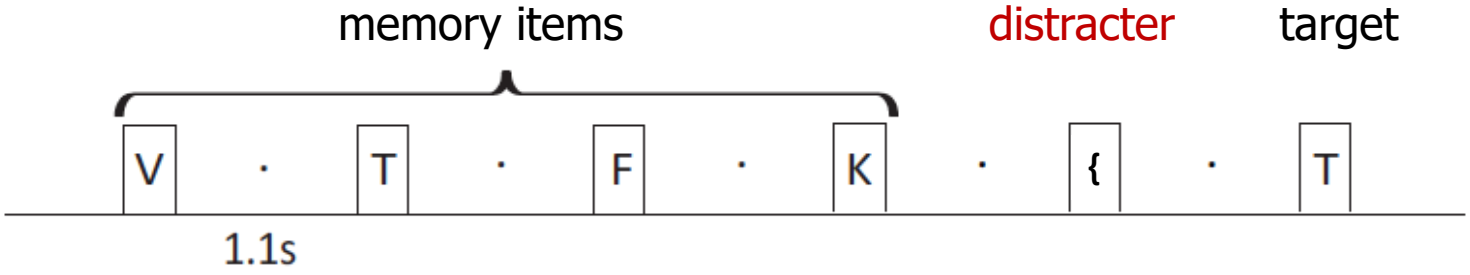
MEG

Alpha modulation by attention

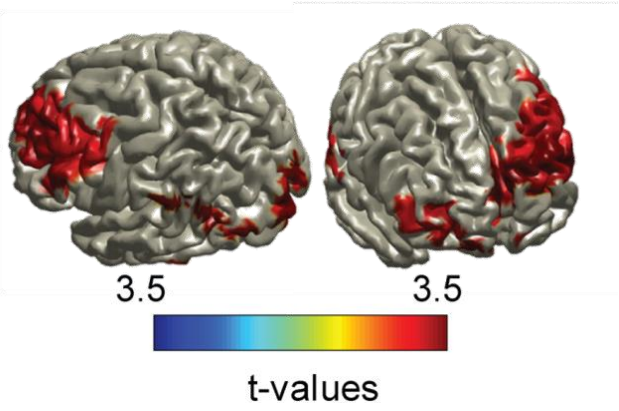
Alpha (10Hz)

Functional inhibition

Internally controlled



Network with alpha phase adjusted



Bonnefond and Jensen (2012, Curr. Biol.)
Bonnefond and Jensen (2013, Comm. Int. Biol.)

MEG

Alpha modulation by attention

Alpha (10Hz)

Functional inhibition

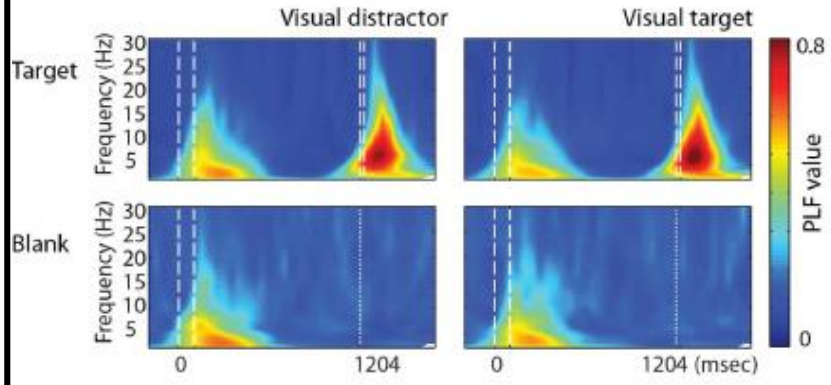
Internally controlled

Is alpha phase top-down controlled?

NO

Attention and Temporal Expectations Modulate Power, Not Phase, of Ongoing Alpha Oscillations

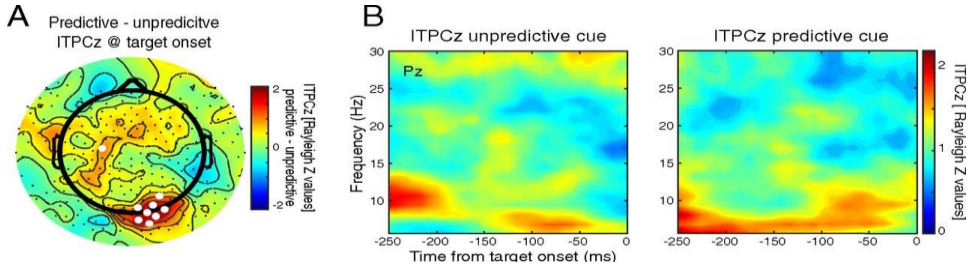
Rosanne M. van Diepen[1], Michael X. Cohen[1], Damiaan Denys[1,2], and Ali Mazaheri[3]



YES

Top-down control of the phase of alpha-band oscillations as a mechanism for temporal prediction

Jason Samaha[a,1], Phoebe Bauer[b], Sawyer Cimaroli[a], and Bradley R. Postle[a,c]



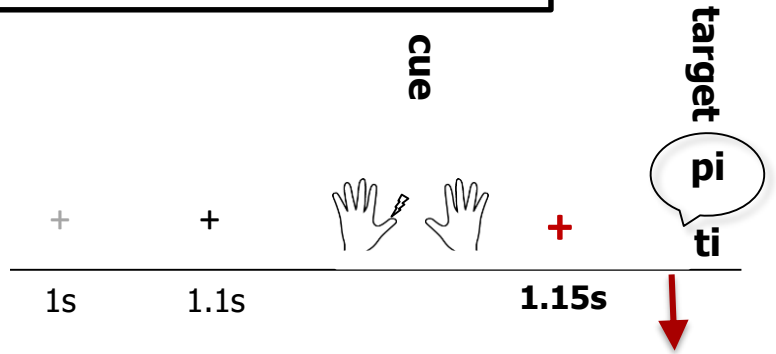
EEG

Alpha modulation by attention

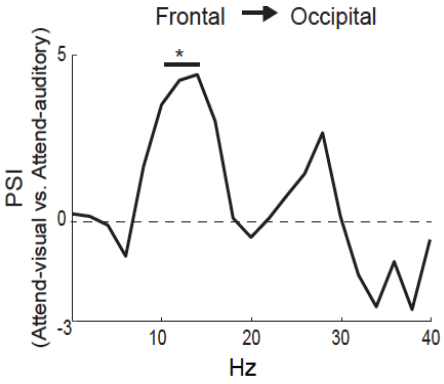
Alpha (10Hz)

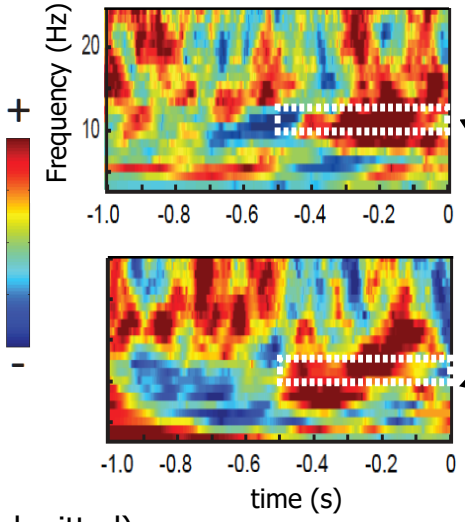
Functional inhibition

Internally controlled

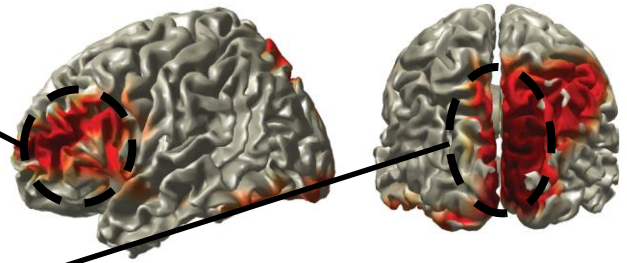


- Three possible syllables:
- 'pi', 'ti', 'ki'
- 75% incongruent pairs
- 25% congruent pairs





Visual vs. auditory



Solis-Vivanco, Jensen & Bonnefond (submitted)

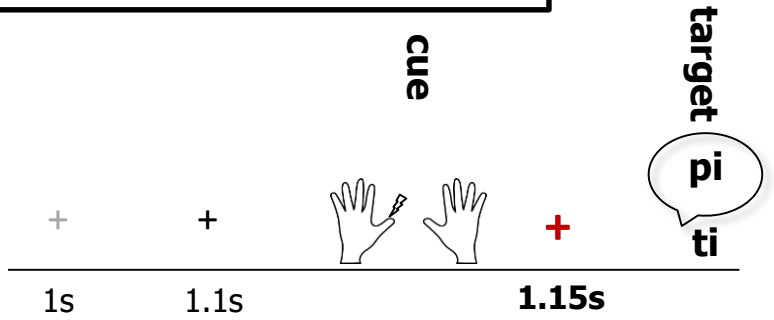
MEG

Alpha modulation by attention

Alpha (10Hz)

Functional inhibition

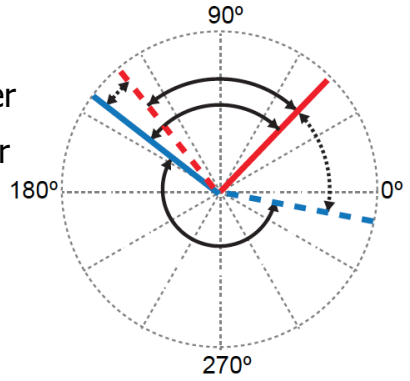
Internally controlled

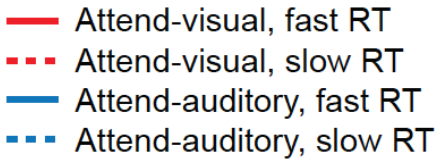


- Three possible syllables:
- 'pi', 'ti', 'ki'
- 75% incongruent pairs
- 25% congruent pairs

Condition*power*phase effect:

- Fastest reaction time for good phase and low power
- Slowest reaction time for bad phase and high power





Solis-Vivanco, Jensen and Bonnefond (submitted)

MEG

Gamma modulation by attention

Alpha (10Hz)

Functional inhibition

Top-down controlled

Gamma (>30Hz)

Active processing

stimulus-induced

Change in gamma power, frequency and inter-areal synchrony with attention

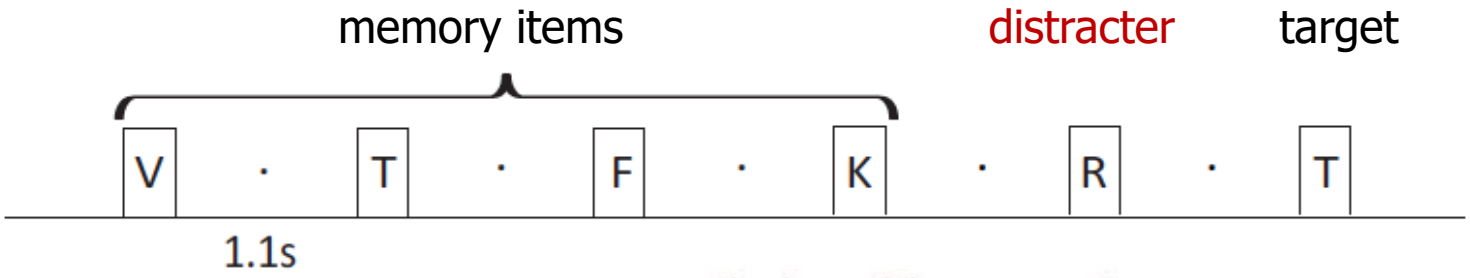
Fries(2016, Neuron)

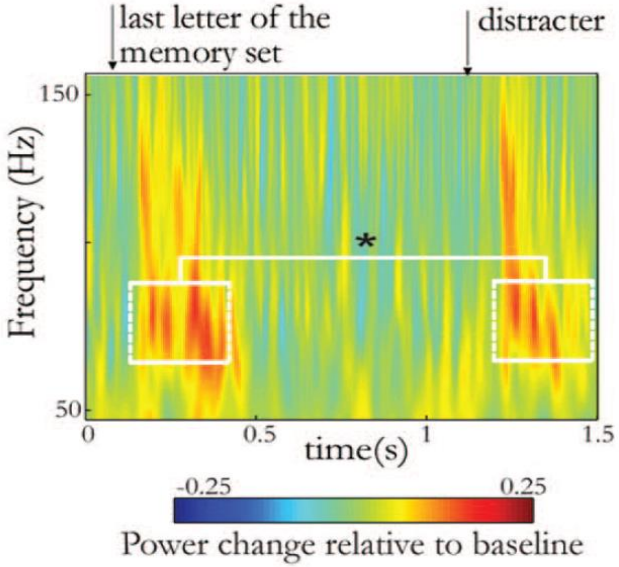
Gamma modulation by attention

Gamma (>30Hz)

Active processing

stimulus-induced





Bonnefond and Jensen (2012, Curr. Biol.)
Bonnefond and Jensen (2013, Comm. Int. Biol.)

MEG

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

Internally controlled

↔

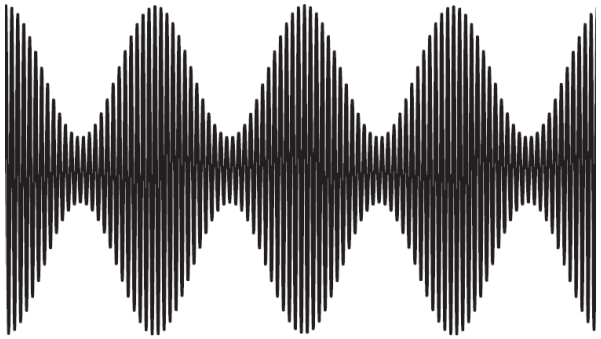
Gamma (>30Hz)

Active processing

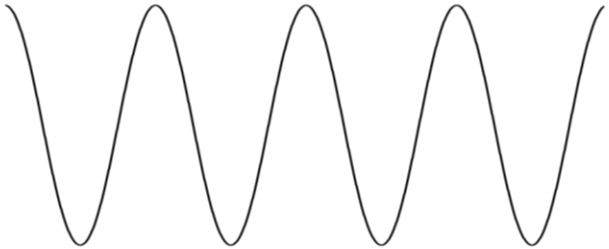
stimulus-induced

Cross-frequency coupling

Gamma activity



Alpha activity



Osipova et al. 2008; Voytek et al. 2010; Spaak et al. 2012; Bahramisharif et al.2013

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

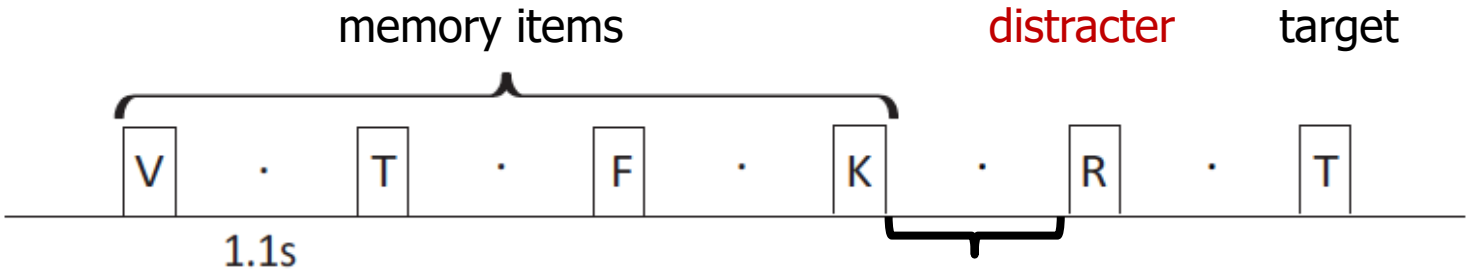
Internally controlled

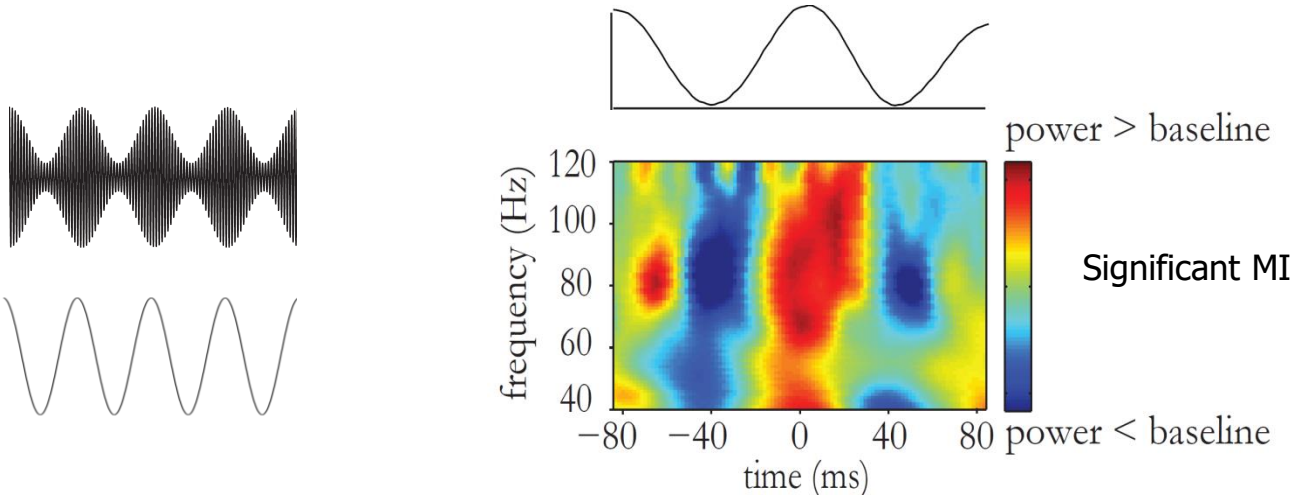
↔

Gamma (>30Hz)

Active processing

stimulus-induced





Peak-locked time frequency

Bonnefond and Jensen (2015, Plos One)

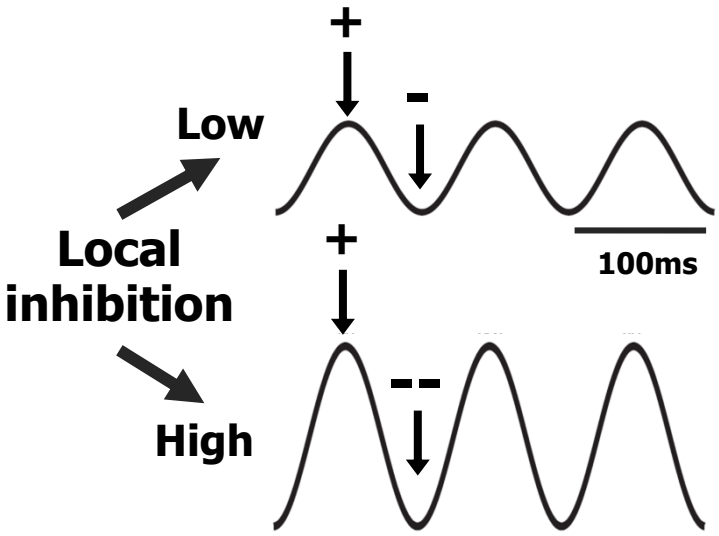
MEG

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

Internally controlled



Fries et al. (2015, Neuron)
Varela et al. (2001, Nature Neuroscience)
Jensen et al. (2015, TINS)
Klimesch et al. (2007, BRR)

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

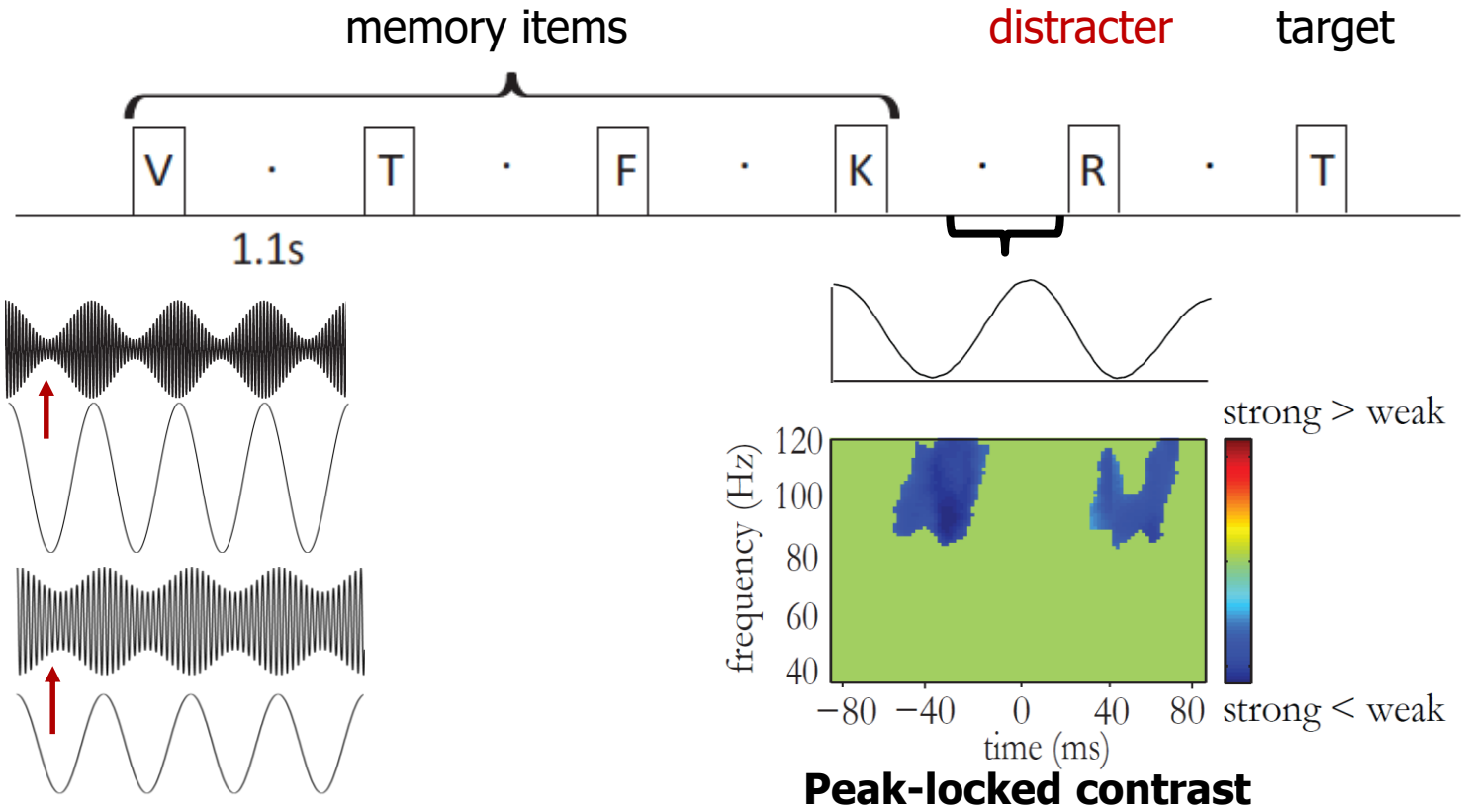
Internally controlled

↔

Gamma (>30Hz)

Active processing

stimulus-induced



Peak-locked contrast

Bonnefond and Jensen (2015, Plos One)

Implementation?

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

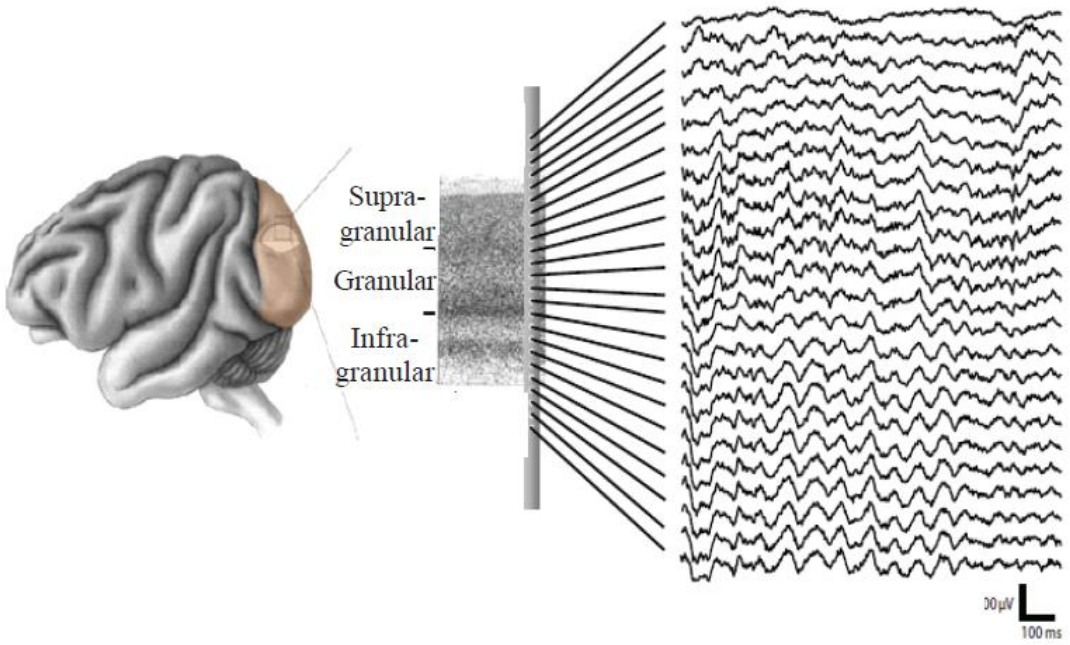
Internally controlled

↔

Gamma (>30Hz)

Active processing

stimulus-induced



Monkey

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

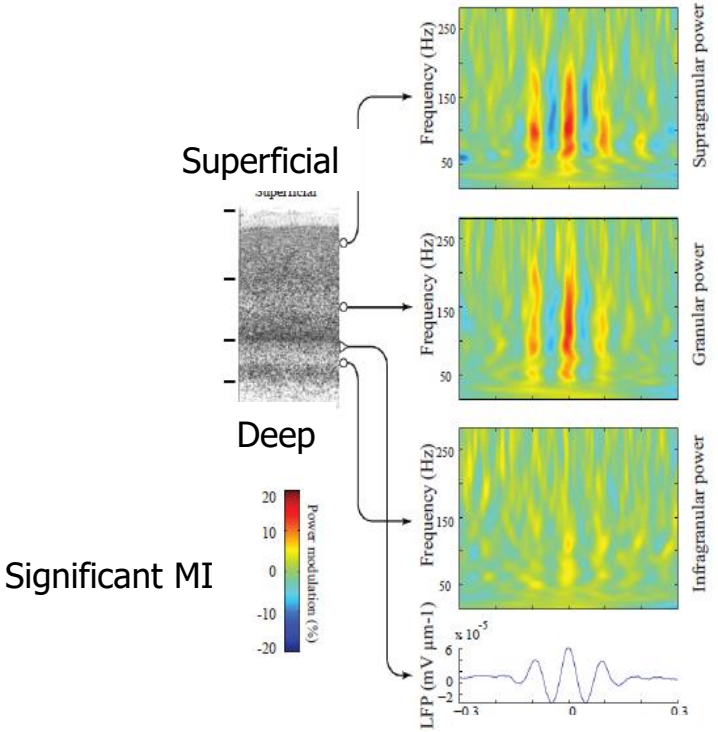
Internally controlled

↔

Gamma (>30Hz)

Active processing

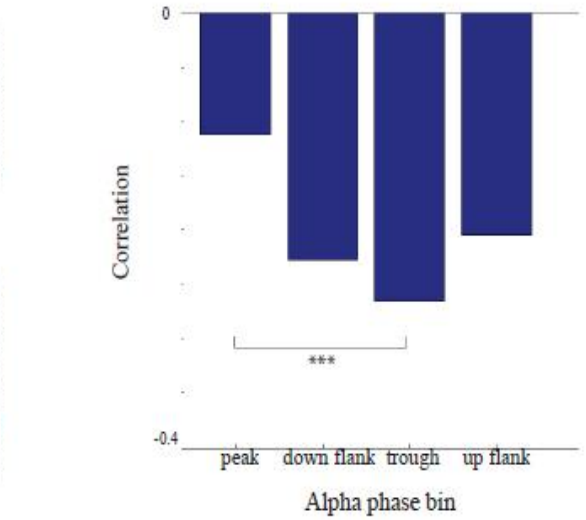
stimulus-induced



Time relative to alpha peaks

Infragranular alpha

Phase dependent Alpha-Gamma correlation



During stimulus processing?

Spaak, Bonnefond, Maier, Leopold, Jensen (2012, Curr. Biol.)

Monkey

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

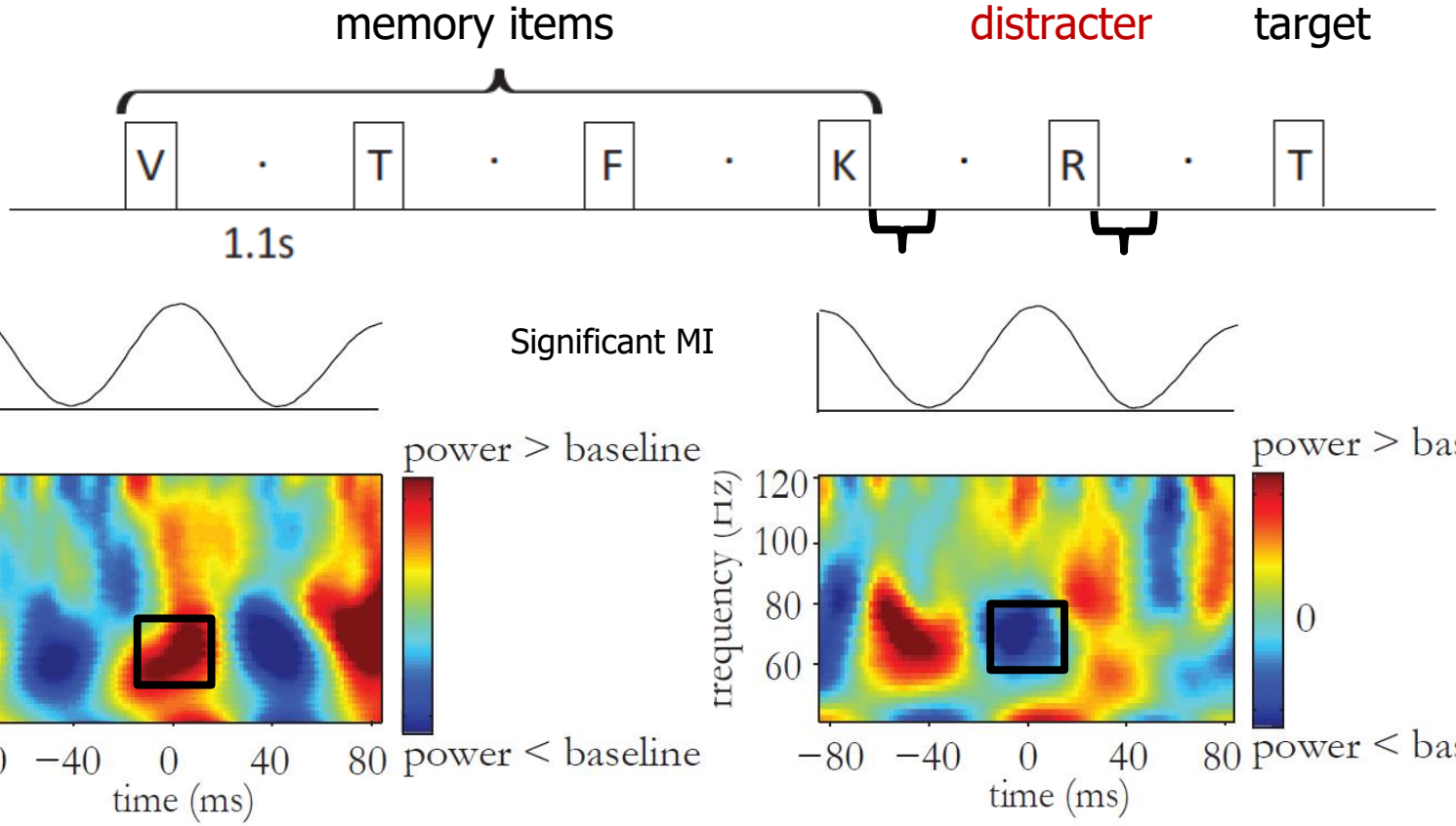
Internally controlled

↔

Gamma (>30Hz)

Active processing

stimulus-induced



Bonnefond and Jensen (2015, Plos One)

MEG

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

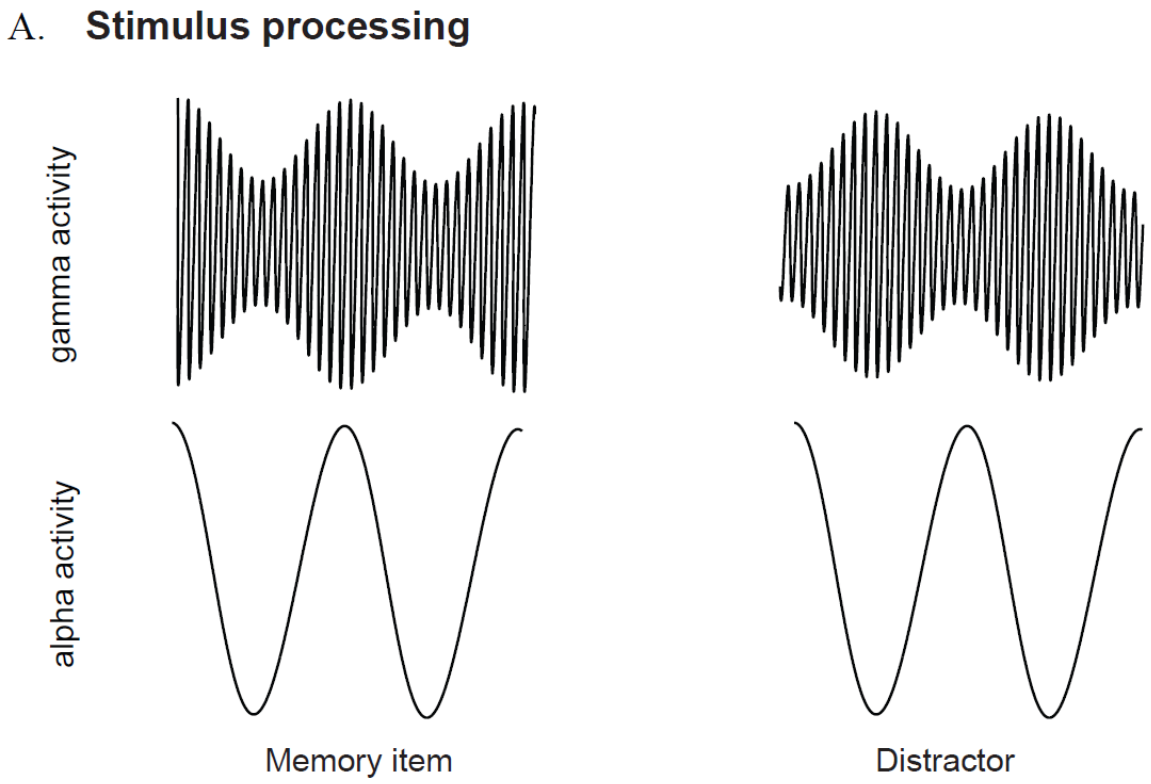
Functional inhibition

Internally controlled

Gamma (>30Hz)

Active processing

stimulus-induced



Jensen, Gips, Bergmann, Bonnefond 2014, *TINS*
Bonnefond, Kastner, Jensen 2017, *eNeuro*

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

Internally controlled

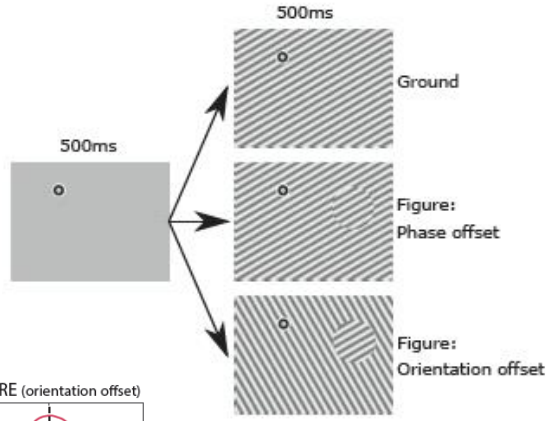
↔

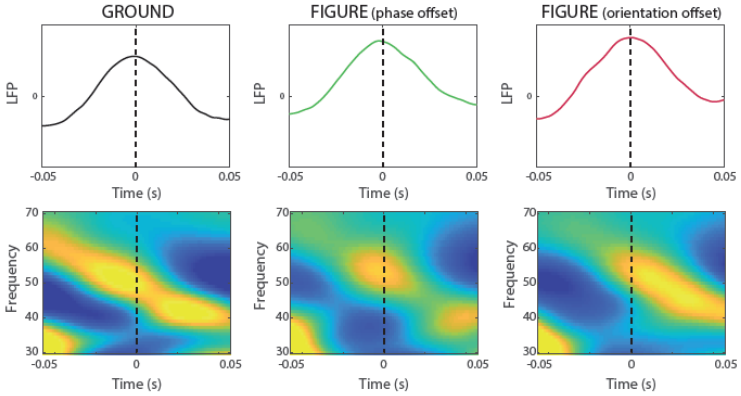
Gamma (>30Hz)

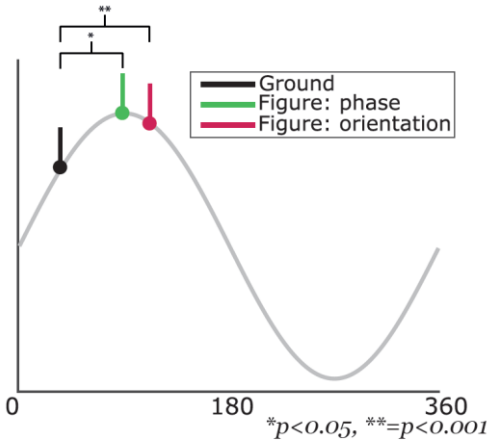
Active processing

stimulus-induced

V2/V3







Gutteling, Bonnefond, Self, Jensen (in prep.)

iEEG

Alpha-gamma coupling modulation by attention

Alpha (10Hz)

Functional inhibition

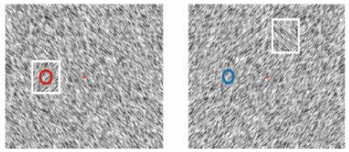
Internally controlled

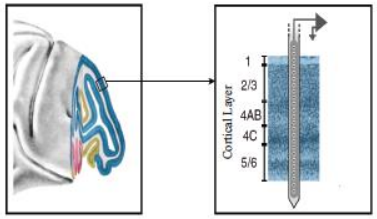
↔

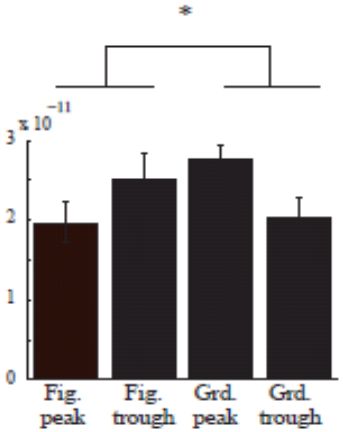
Gamma (>30Hz)

Active processing

stimulus-induced







Bonnefond, Van Kerkoerle, Roelfsema, Jensen (in prep.)

Monkey

Framework

Alpha (10Hz)

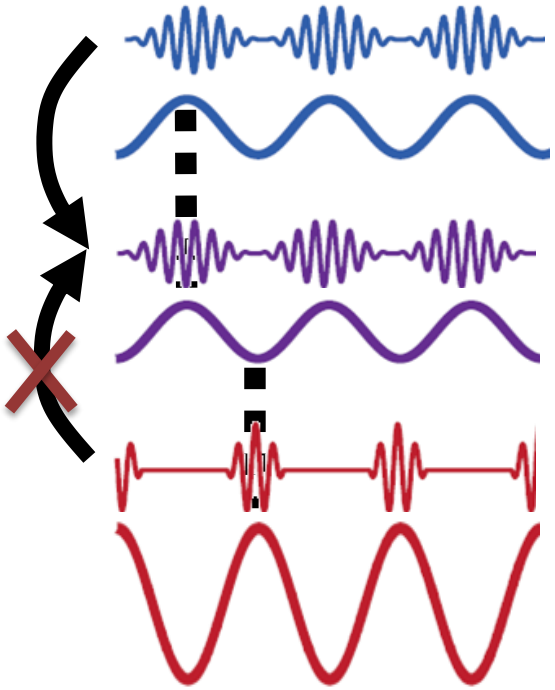
Functional inhibition

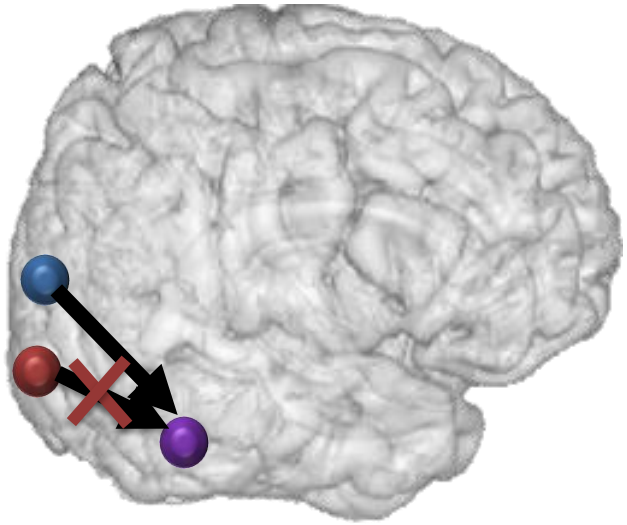
Internally controlled

Gamma (>30Hz)

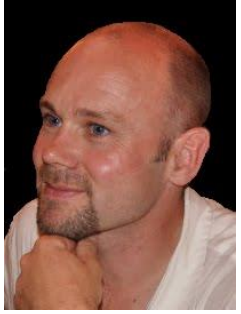
Active processing

stimulus-induced





Bonnefond, Kastner and Jensen (2017, eNeuro)



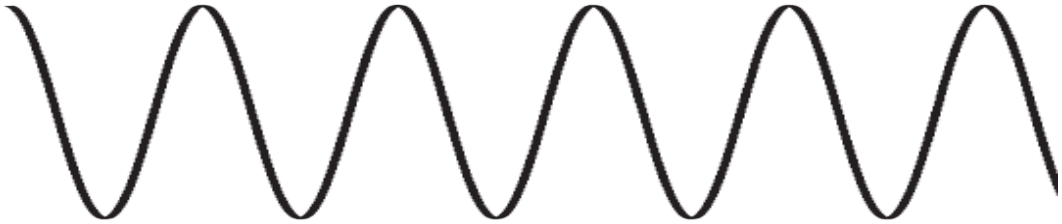
Ole Jensen

Eelke Spaak

Tjerk Gutteling

Rodolfo Solis-Vivanco

Thank you for your attention



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