Donders Institute
for Brain, Cognition and Behaviour

FieldTrip

Alpha activity as a mechanism to preserve working memory integrity

Mathilde Bonnefond

Ole Jensen

ICON 2014

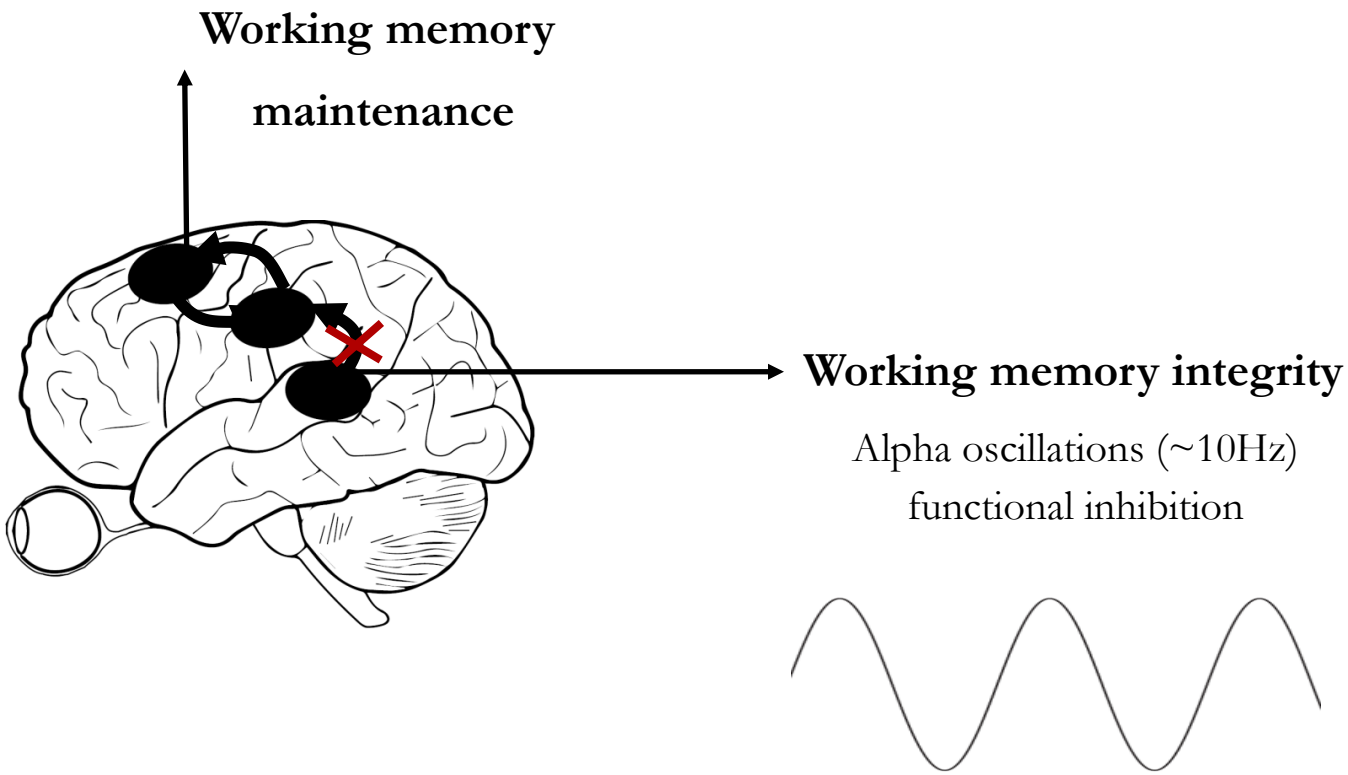
Working Memory 2014: 40 Years On Since Baddeley & Hitch

Radboud University Nijmegen

Protection of working memory

06 45 60 78 50

56 79 90

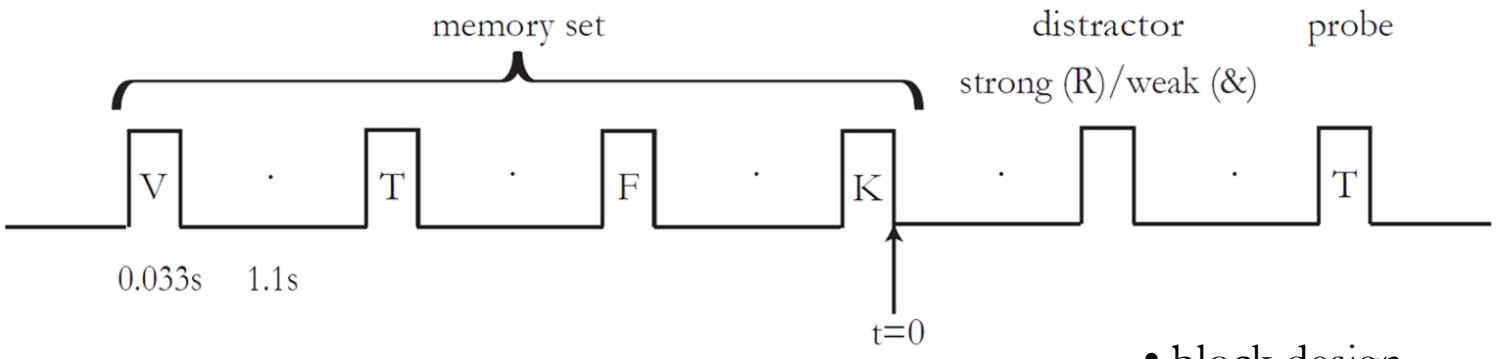


(1) Role of alpha activity before distractors presentation

(2) Role of alpha activity during distractors presentation

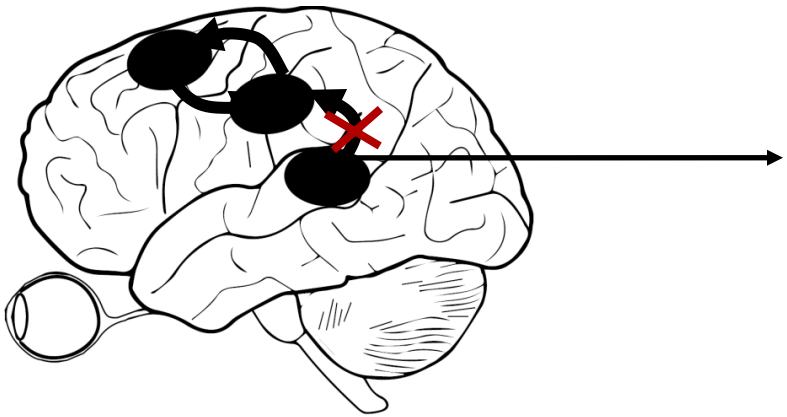
(Klimesch 2007; Jensen & Mazaheri 2010; Jensen, Bonnefond & Van Rullen 2012)

Experiment



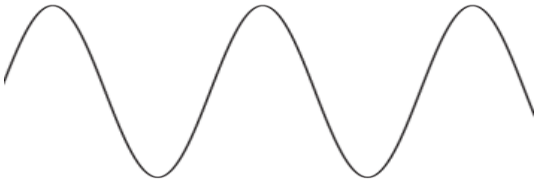
- block design
- 17 subjects

Protection of working memory



Working memory integrity

Alpha oscillations (~10Hz)
functional inhibition



(1) Role of alpha activity before distractors presentation

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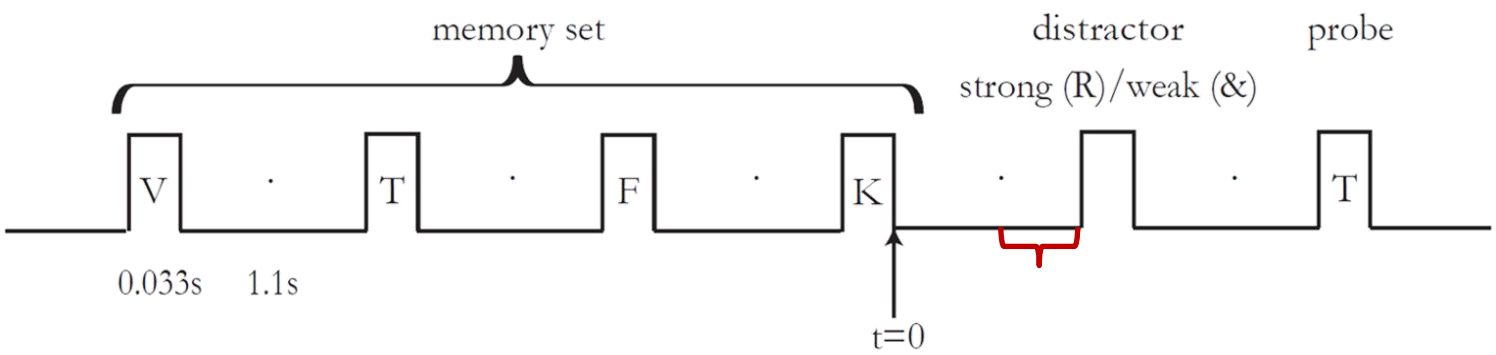
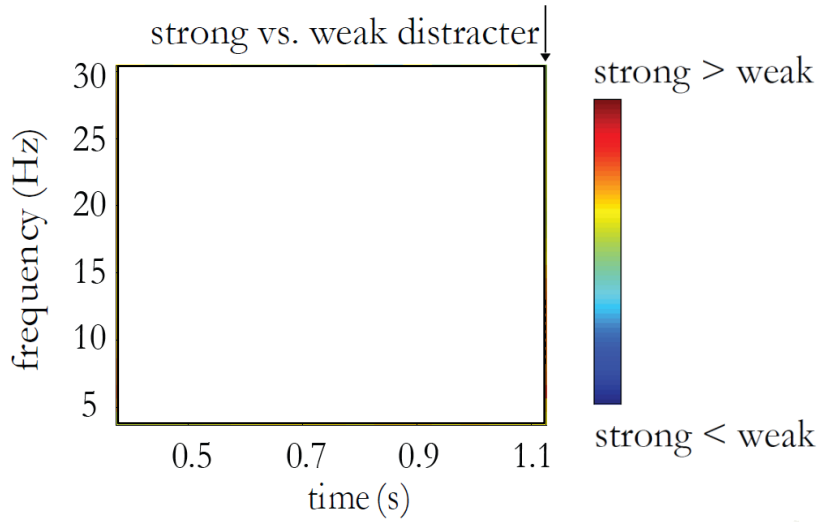
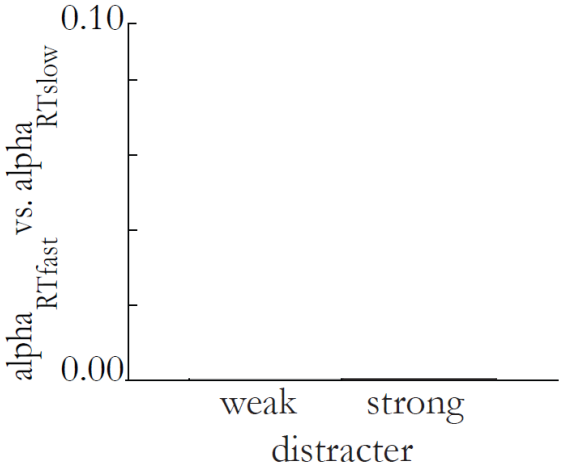
Alpha power protects WM against anticipated distractors

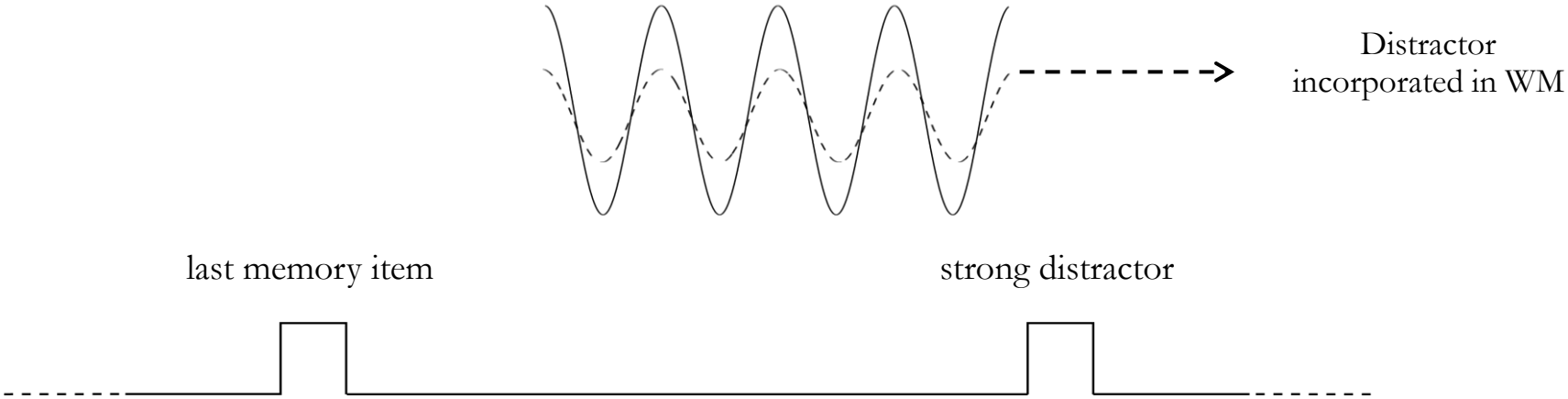






Bonnefond & Jensen 2012, *Current Biology*

Alpha power protects WM against anticipated distractors



Is high alpha power indeed associated with less engagement?

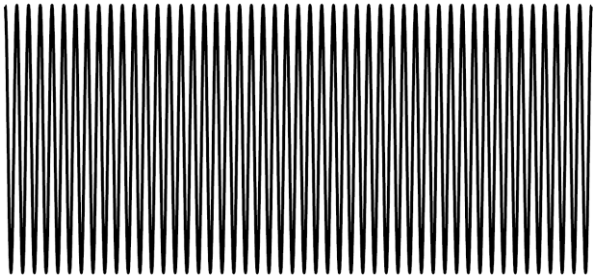
Bonnefond & Jensen 2012, *Current Biology*

Is high alpha power associated with less engagement?

Coupling between alpha activity and high gamma power

Gamma activity

(>80Hz)



Index of engagement

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

Is high alpha power associated with less engagement?

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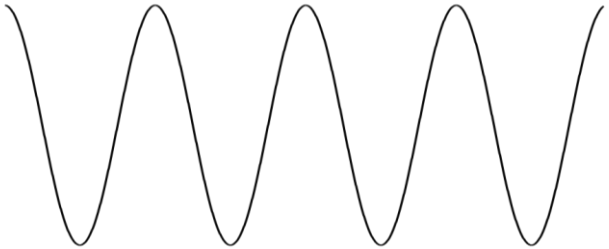
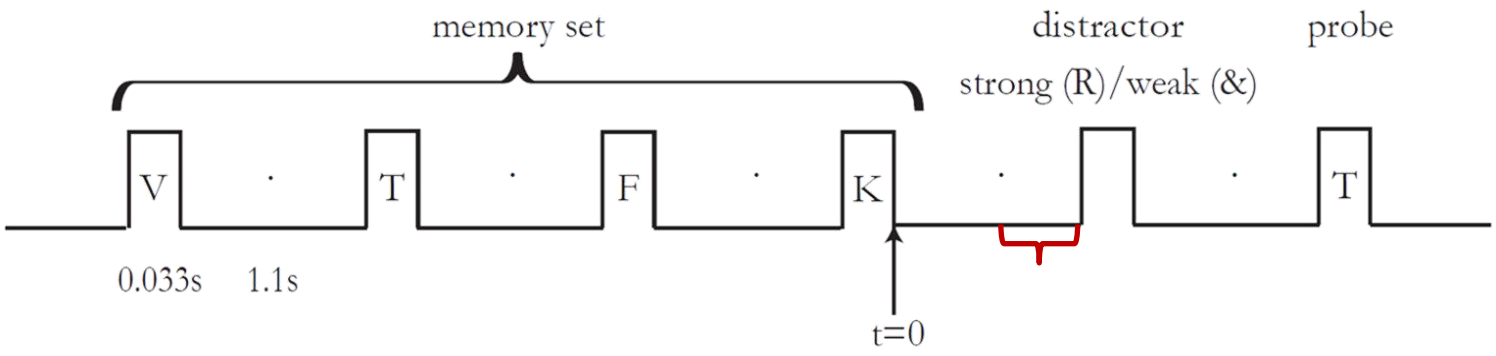
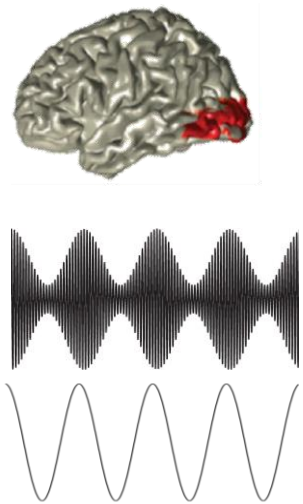
ha activity



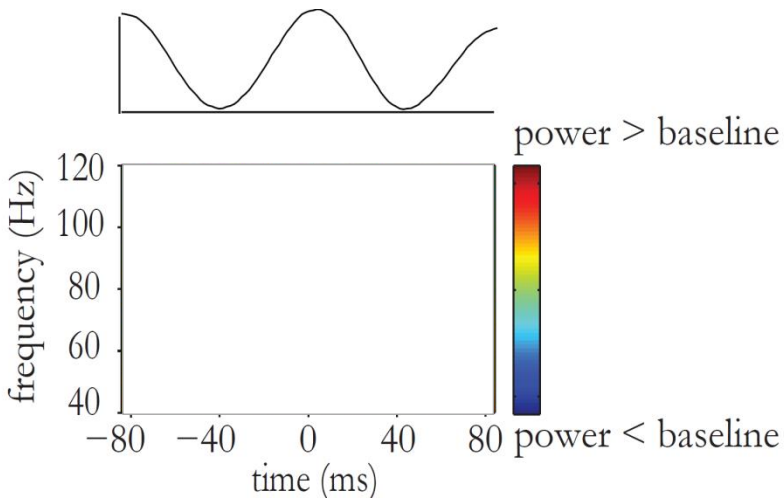
Osipova et al. 2008; Voytek et al. 2010; Spaak et al. 2012; Bahramisharif et al.2013

Gamma power is coupled to alpha phase



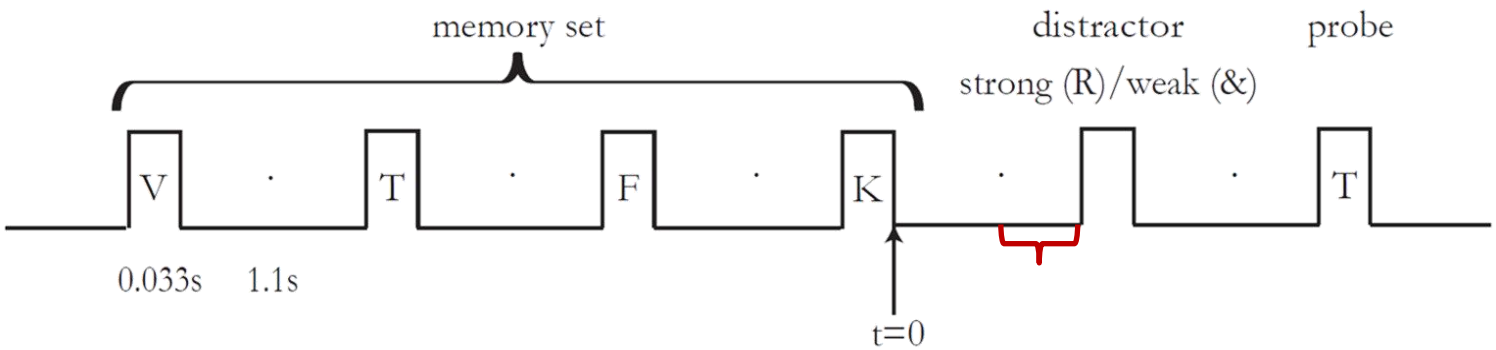


Peak-locked time frequency representation

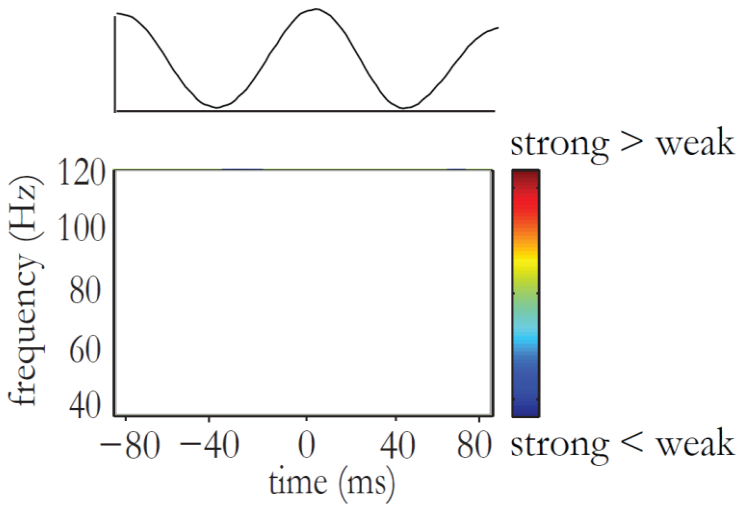


Bonnefond & Jensen, *under review*

Alpha increase is associated with a decrease of engagement

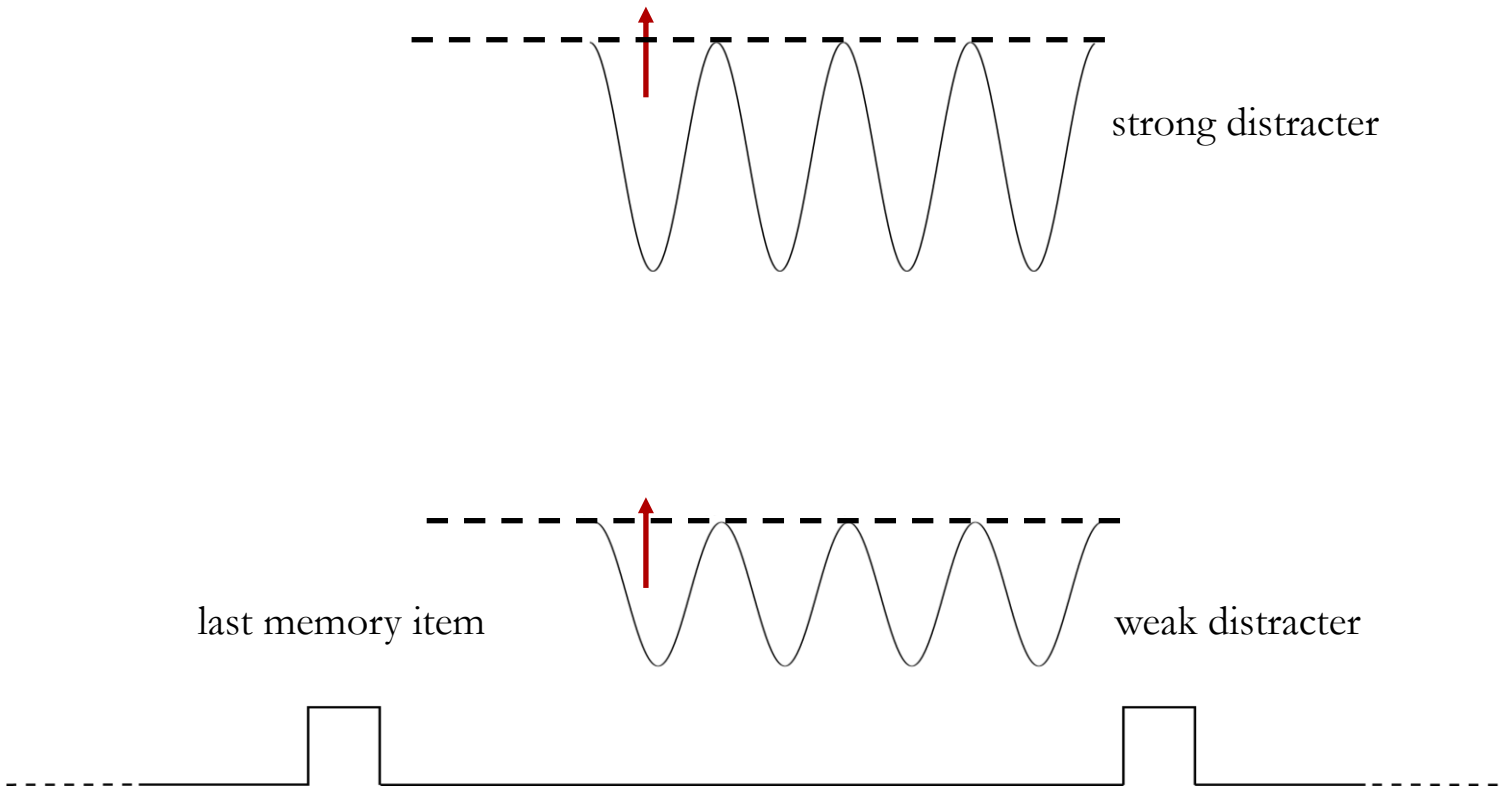


Peak-locked contrast strong vs weak distracter

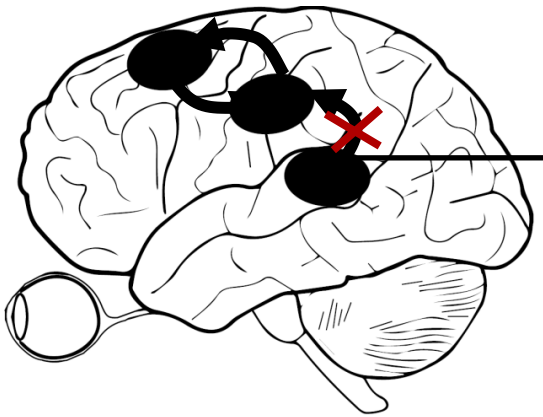


Bonnefond & Jensen, *under review*

Alpha increase is associated with a decrease of engagement

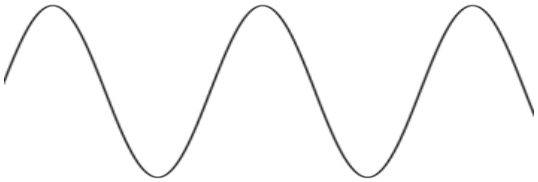


Protection of working memory



Working memory integrity

Alpha oscillations (~10Hz)
functional inhibition



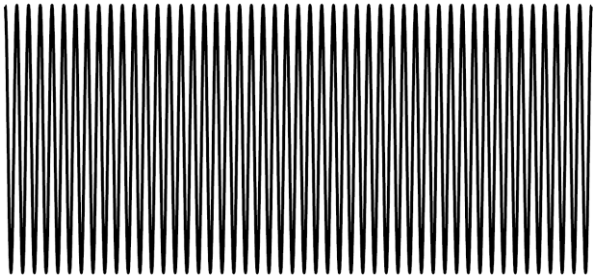
(1) Role of alpha activity before distractors presentation

(2) Role of alpha activity during distractors presentation

Gamma activity induced by a stimulus

Gamma activity

(60-80Hz)

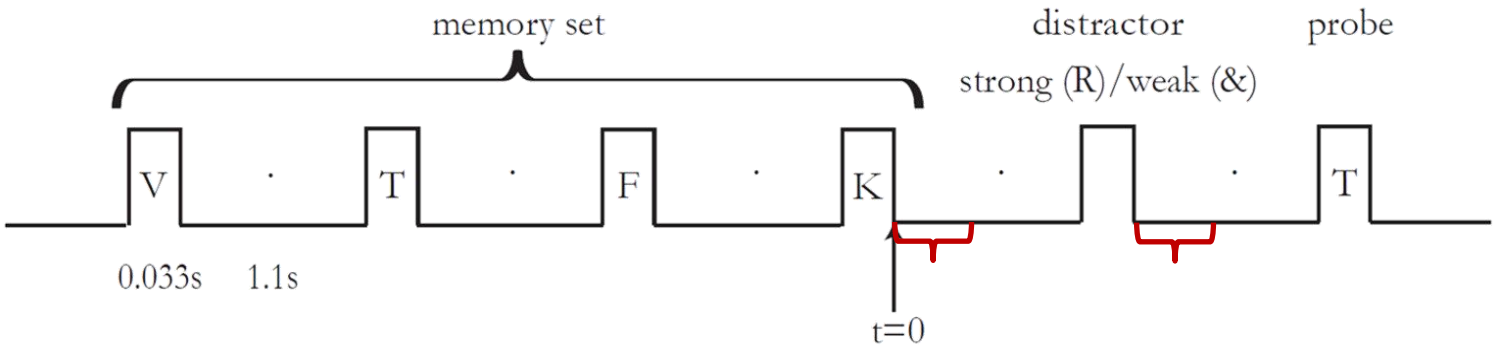


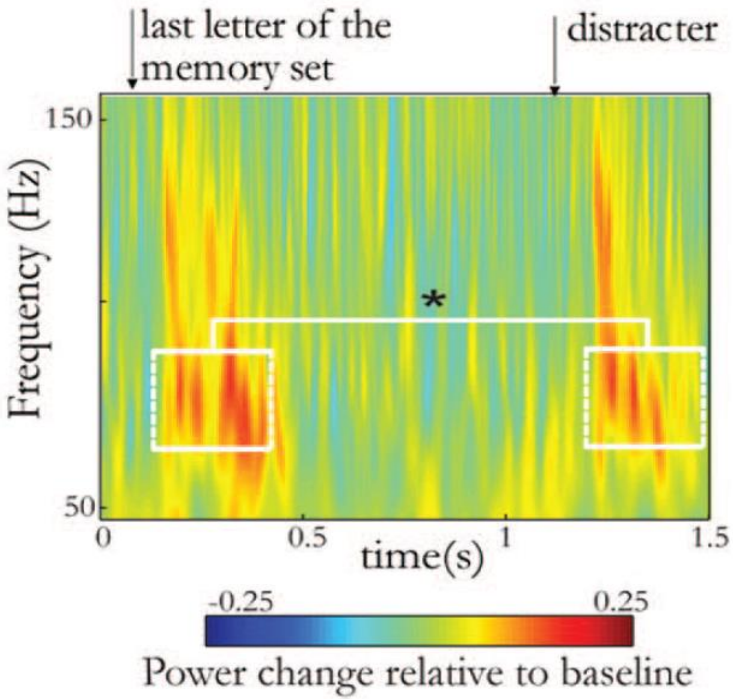
Associated with

stimulus processing

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

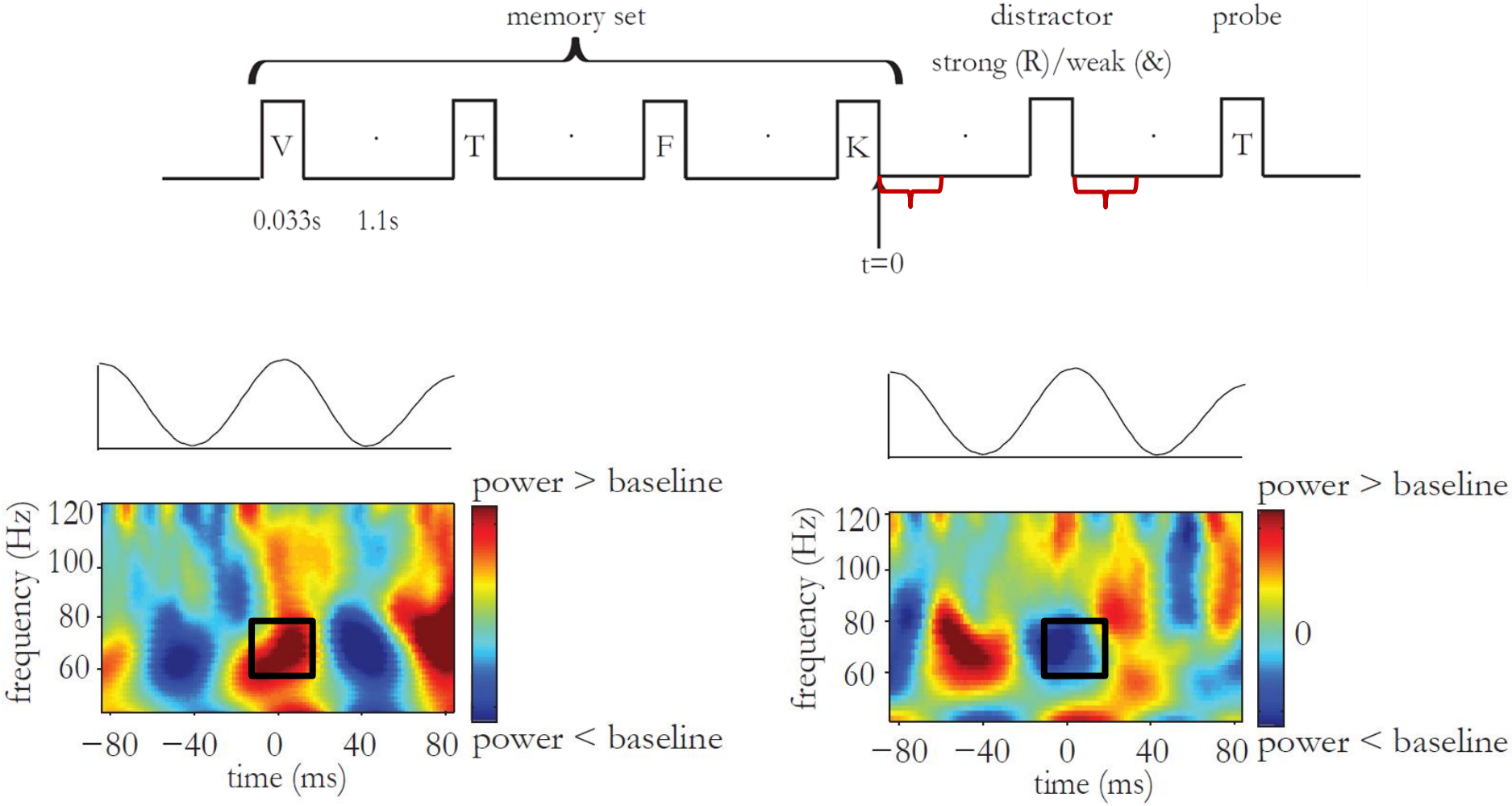
Distractors induce lower gamma activity than memory item





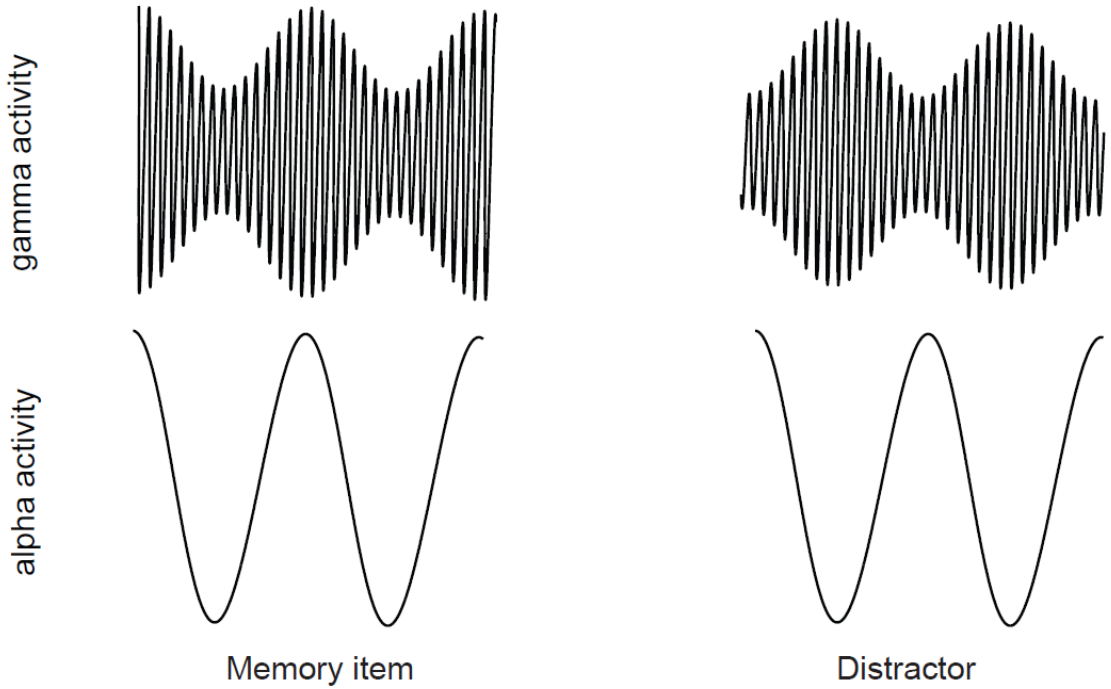
Bonnefond & Jensen 2013, *Communicative and Integrative Biology*

Phase shifts of gamma between memory item and distractor



Bonnefond & Jensen, *submitted*

Phase shifts of gamma between memory item and distractor



Jensen, Gips, Bergmann, Bonnefond 2014, *TINS*

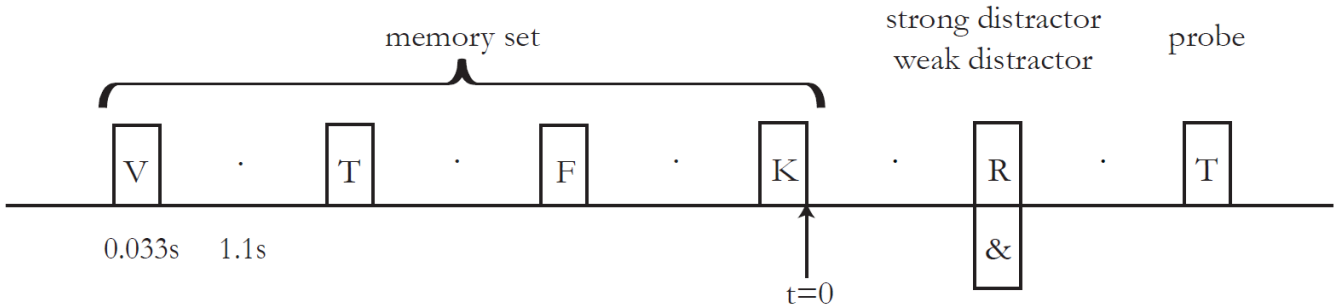
Two mechanisms to prevent incorporation of distractors in WM

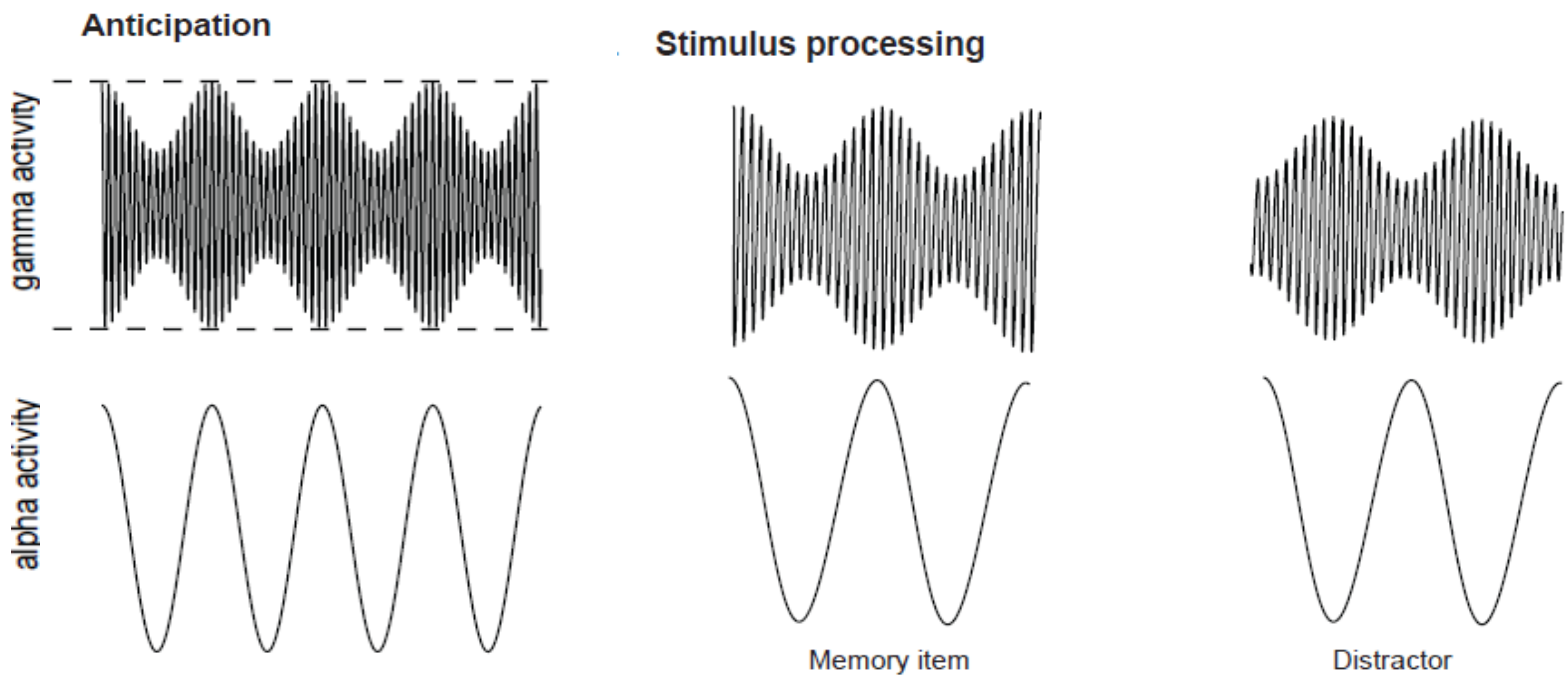
- Alpha activity is associated with a decrease of engagement in anticipation of a distractor
- Gamma activity induced by distractors and memory items burst at different alpha phases

➢ Alpha activity protects working memory integrity

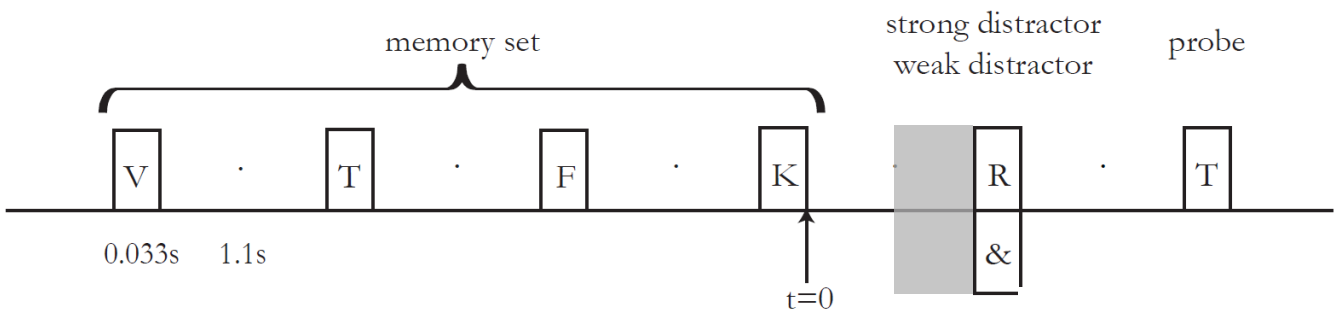
Thank you for your attention

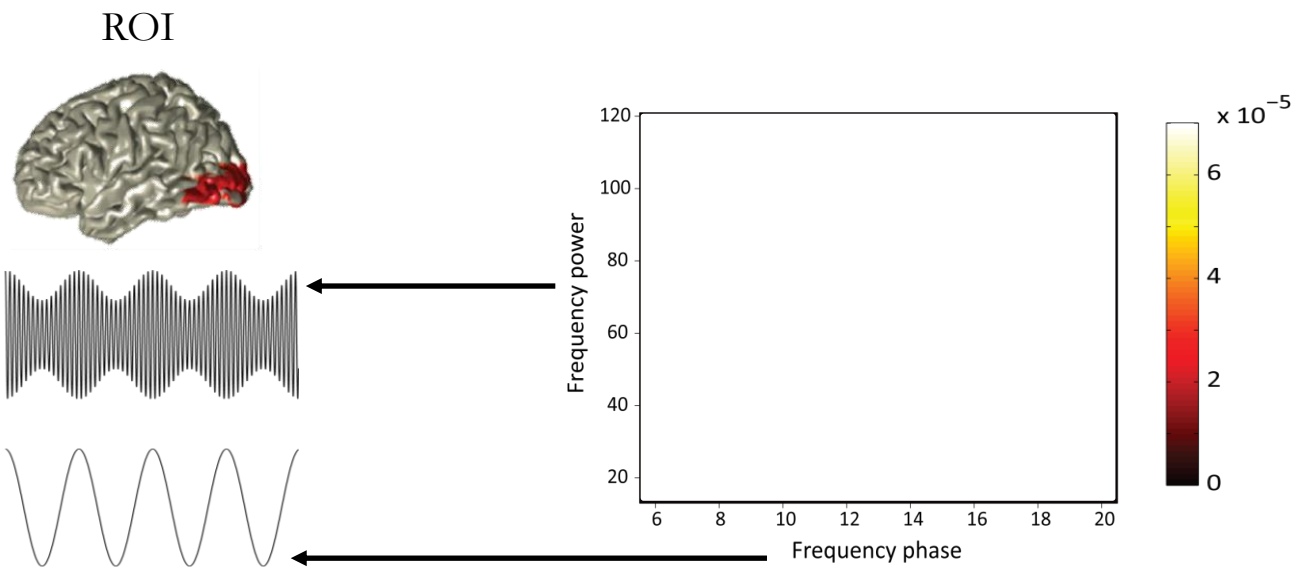
Two mechanisms to prevent incorporation of distractors in WM





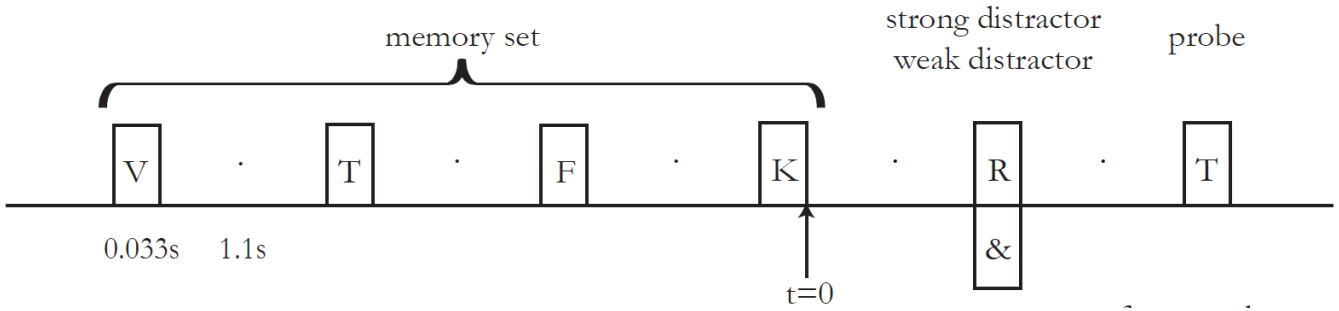
Gamma power is coupled to alpha phase

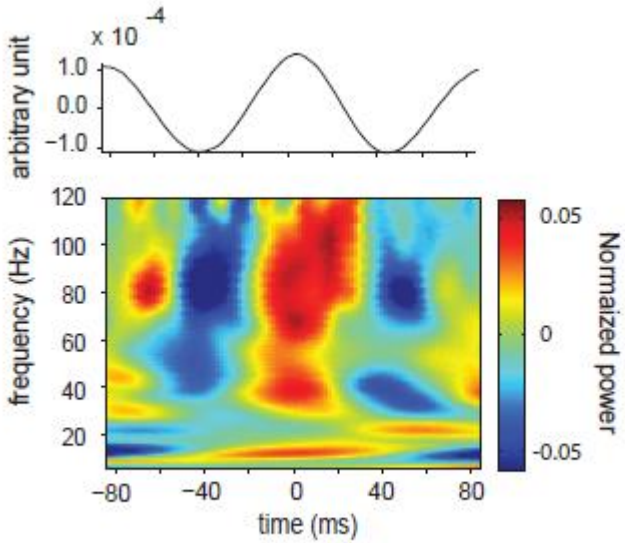


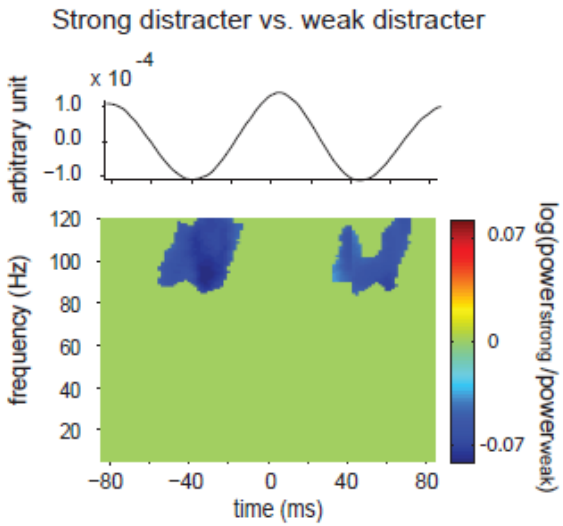


Bonnefond & Jensen, *submitted*

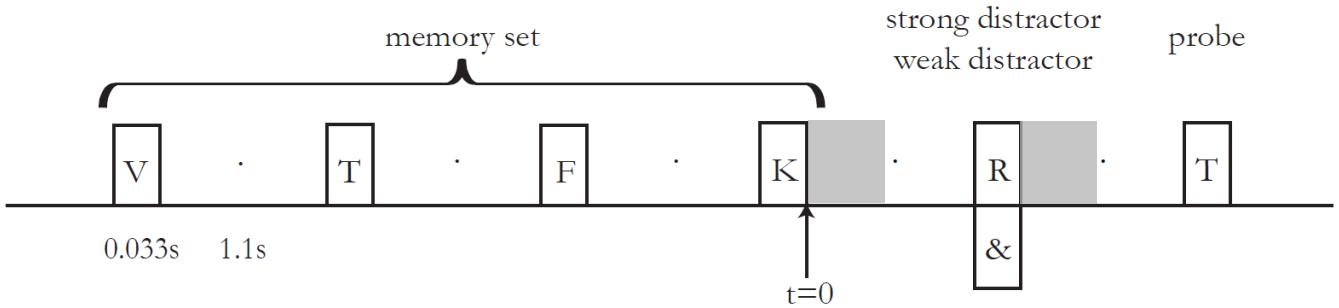
Gamma power is coupled to alpha phase

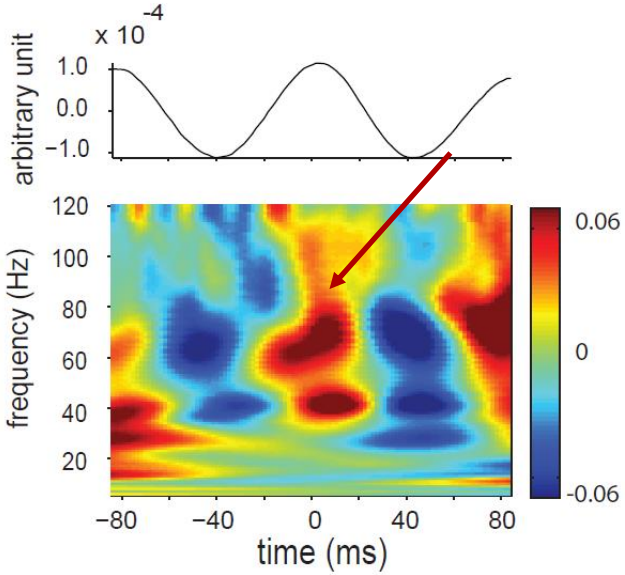


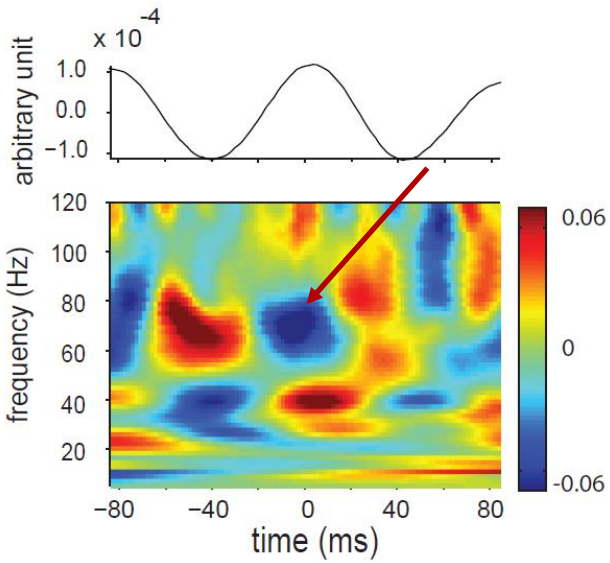




Phase preference of gamma activity shifts between memory item and distractor

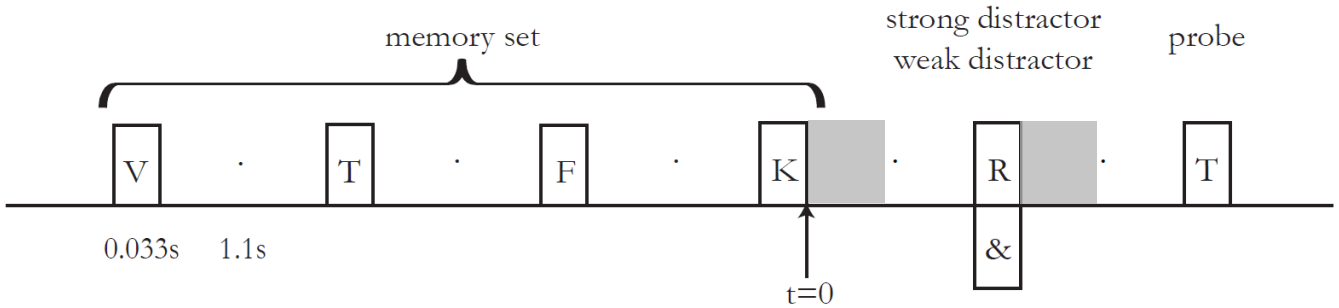


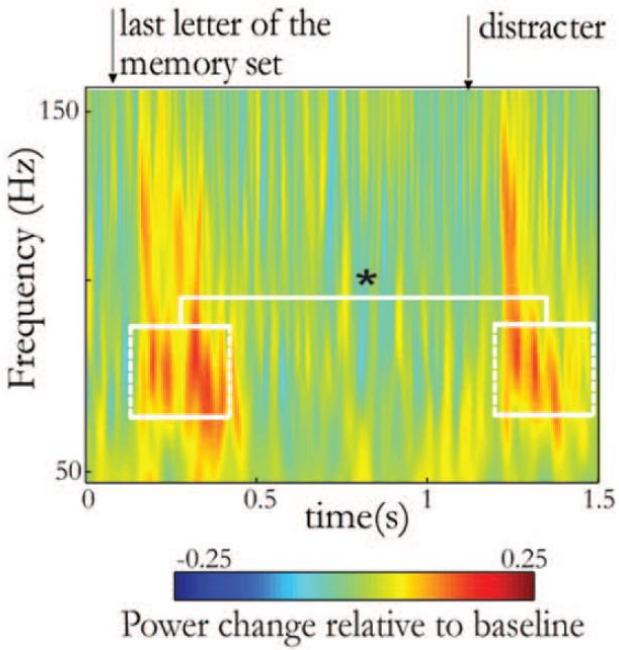




No effect of power

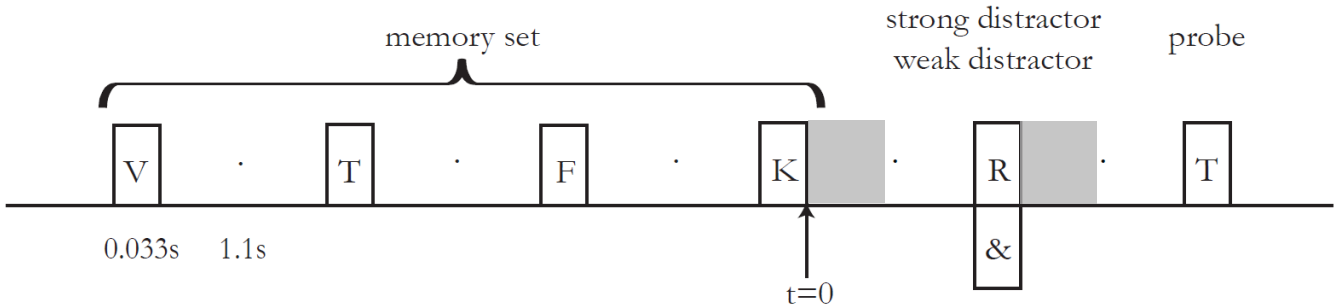
Distractors induce lower gamma activity than memory item

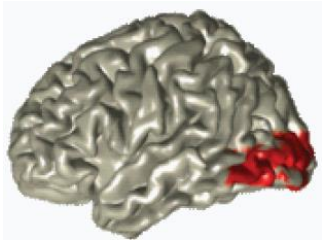


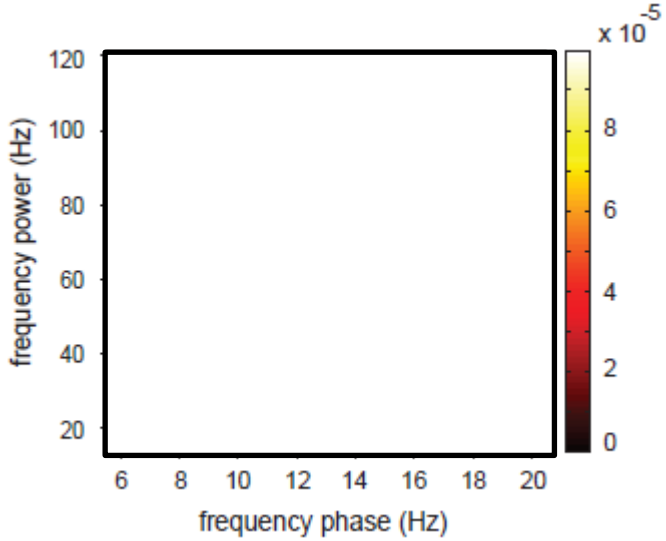


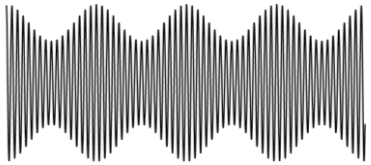
Bonnefond & Jensen 2013, *Communicative and Integrative Biology*

Induced gamma power coupled to alpha phase during stimulus processing



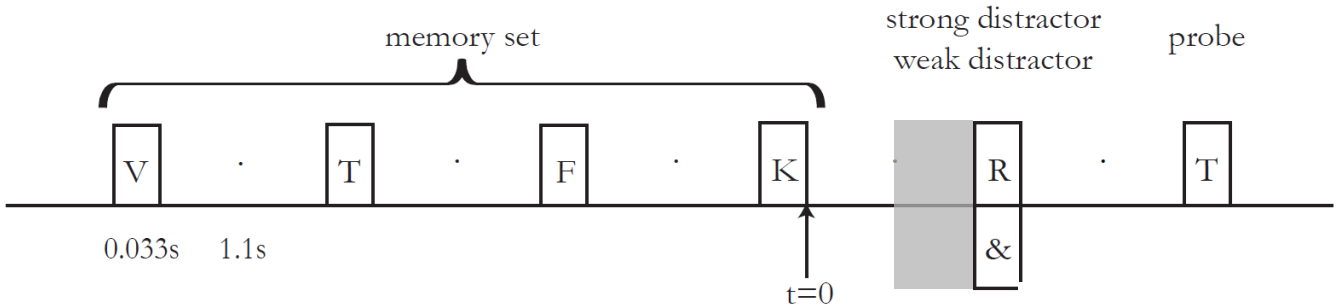


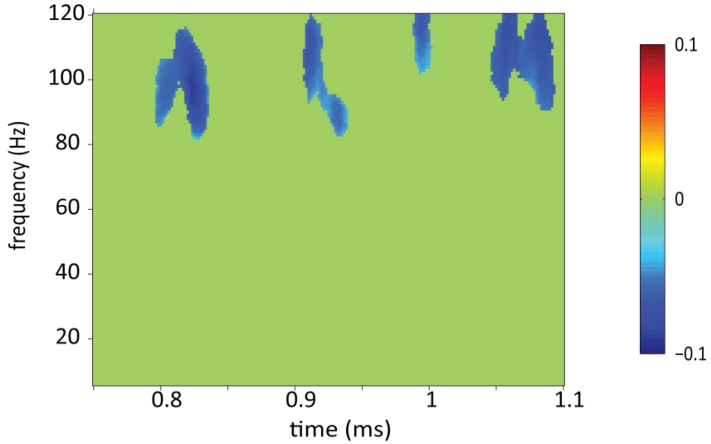


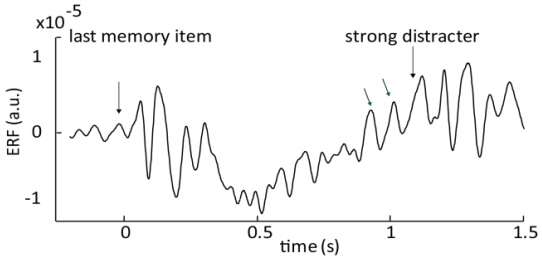


Bonnefond & Jensen, *submitted*

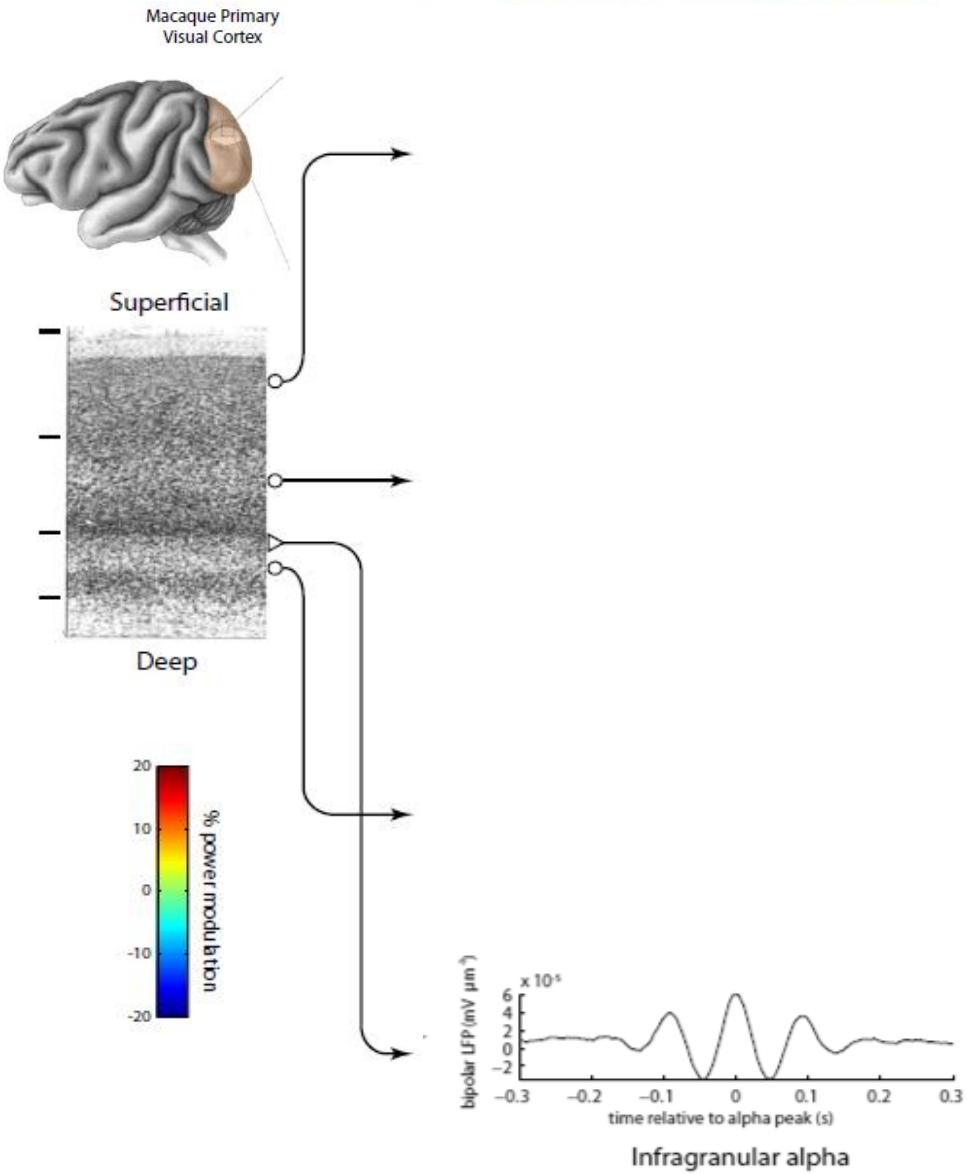
Rhytmical dcrease of gamma activity in anticipation of strong distractor

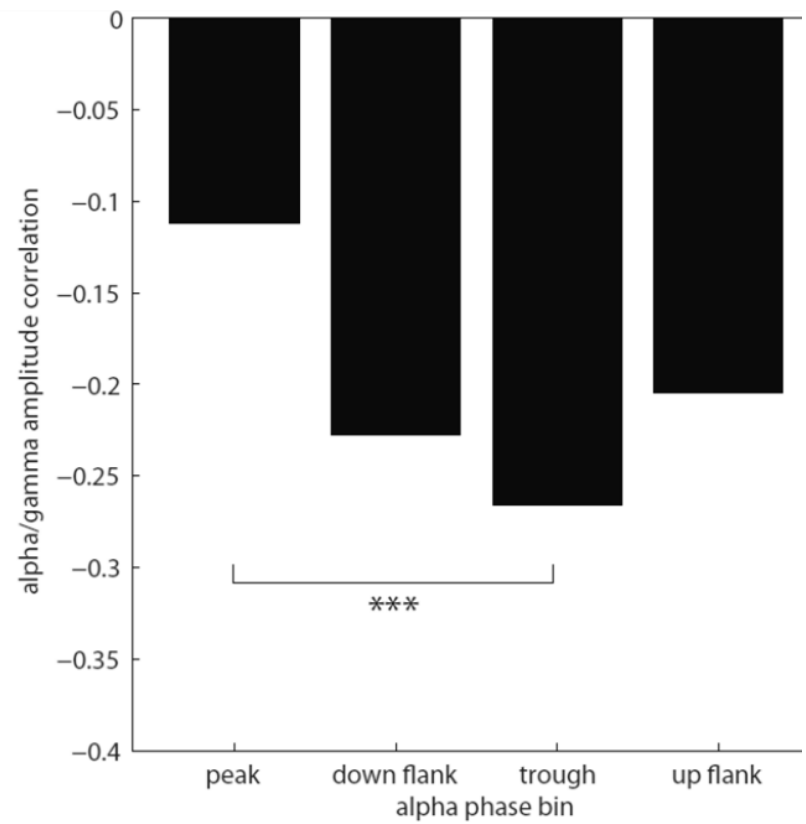






Alpha steps on gamma in a phasic manner: evidence from resting state in Macaque





Spaak, Bonnefond, Maier, Leopold, Jensen (2012)