

# SHORT-TERM PLASTICITY IN EMOTIONAL FACE PROCESSING

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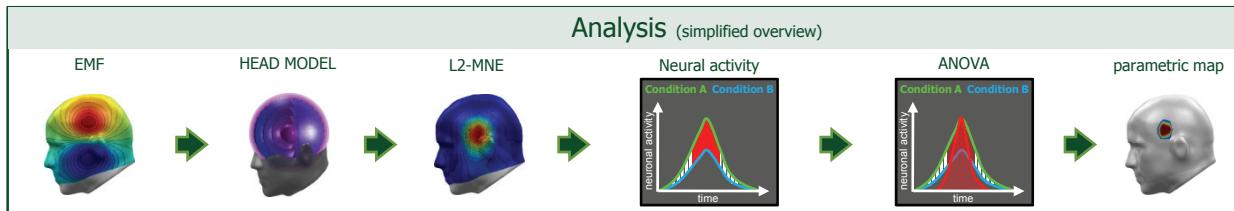
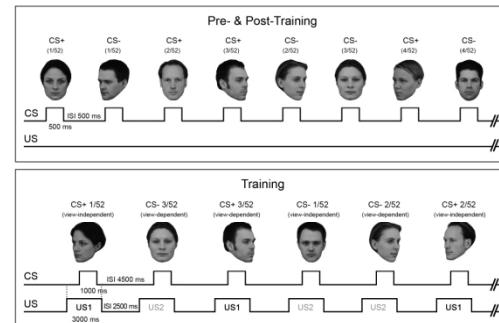
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## INTRODUCTION

- Functional magnetic resonance imaging (fMRI) studies have revealed increased activations by emotional stimuli in **occipital, parietal, frontal and inferior temporal cortex** (Vuilleumier et al., 2001; Sabatinelli et al., 2005; Junghöfer et al., 2005).
- Event-related potential (ERP) studies have shown that emotional stimuli modulate distinct **ERP components between 120-300 ms and 300-700 ms** (Junghöfer et al., 2001; Schupp et al., 2006; Kissler et al., 2007).
- Thus, **emotion modulates vision at mid-latency and late processing stages**, allowing for re-entrant processing and widespread activation, conveying stimulus information to many associative cortical regions.
- However, several recent studies indicate that **emotion may modulate visual processing through the rapid extraction of relevant features** at even earlier stages of processing for both simple geometric patterns and perceptually more complex faces (Stolarova et al., 2006; Morel et al., 2009).
- During aversive conditioning of faces, extrastriate visual cortex responses were also identified **earlier than 120 ms** (Pizzagalli et al., 2003). Thus, recent findings suggest that emotional relevance drives short-term plasticity in the visual cortex.
- The present magnetoencephalography (MEG) study investigates timing and regional distribution of cortical responses to a multitude (104) of different neutral facial stimuli that were associated with either an aversive odor or moistened air, challenging the system's resolving power and capacity limits.

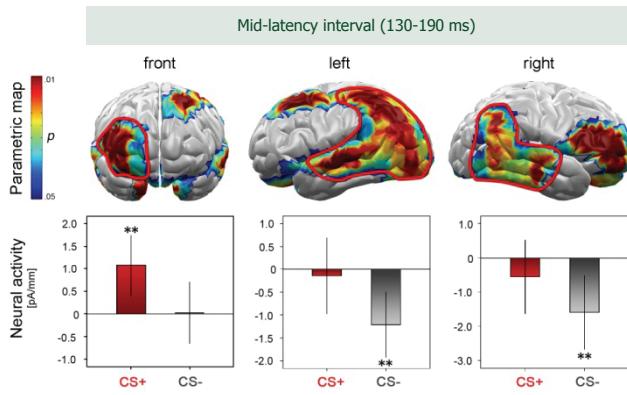
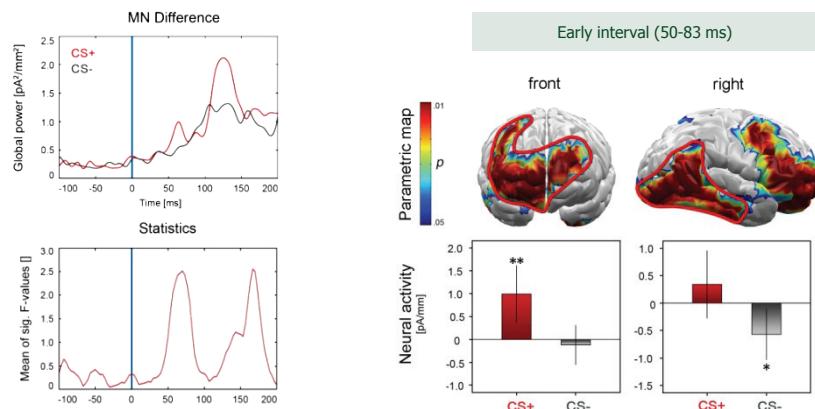
## METHODS

- Participants:** 24 healthy right-handed non-smoking adults (12 female; mean age 25).
- Conditioned stimuli (CS):** Frontal and lateral views of 104 individual neutral faces.
- Unconditioned stimuli (US):** Hydrosulfide ( $H_2S$ ) and moistened air ( $H_2O$ ).
- Measures:** EMFs & behavioral ratings (SAM-rating of faces & odors; CS-US matching)



## RESULTS

- SAM faces:** Session x US Valence interaction ( $F(1,21) = 5.2$ ;  $p = .033$ ) indicating a relatively more negative classification of CS+ as compared to the CS- faces.
- CS-US matching:** Overall performance as measured by the sensitivity index  $d'$  (mean: 0.074; SD: 0.52) did not exceed chance level (one sample t-test (test value = 0):  $t(23) = 0.7$ ;  $p = .49$ ).
- SAM odors:** H<sub>2</sub>S was perceived as being more unpleasant ( $t(21) = -17.813$ ,  $p = .000$ ) and arousing ( $t(21) = 4.582$ ,  $p = .000$ ) as compared to the neutral odor.
- MEG:** Conditioning effects were explored by contrasting neural activity for CS+ (hydrosulfide) and CS- (moistened air) faces in the post-training relative to the pre-training phase.



## DISCUSSION

- In the absence of contingency awareness, with a stimulus set overwhelmingly exceeding working memory capacity, and with only two learning instances, reliable visual short-term plasticity was observed to CS+ stimuli in extra-striate visual as well as prefrontal areas.
- Referring to amplified processing of aversively conditioned faces in occipito-temporal visual areas after 120 ms our results accord with findings from previous studies (Pizzagalli et al., 2003; Dolan et al., 2006).
- The rapid PFC activation occurred rather early in the processing stream (~50 ms), even preceding enhanced CS+ processing in inferotemporal regions implicated in object recognition.
- In line with non-sequential models of visual processing, rapid prefrontal discrimination evidently preceded full visual analysis.
- By suggesting new associative learning paradigms with multiple "dual" or even "single trial learning" our findings may open new avenues in the area of human and animal learning research. It may also have consequences for clinical neuroscience as disturbances of "low-road" processing are discussed in affective disorders.

## References

- Dolan RJ, Heinze HJ, Hurlmann R, Hinrichs H. (2006) *Neuroimage* 32:778-89.  
 Stolarova M, Keil A, Morel S (2006) *Cereb Cortex* 16:876-887.  
 Vuilleumier P, Eickhoff SB, Jr. Jirka J, Dobrov R, Lang PJ (2004) *NeuroImage* 22:829-841.  
 Sabatinelli D, Bradley MM, Fimiani S, Lang PJ (2005) *NeuroImage* 24:1265-1270.  
 Junghöfer M, Schupp H, Stark R, Vaitl D (2005) *NeuroImage* 25: 520-526.  
 Junghöfer M, Bradley MM, Elbert TR, Lang PJ (2001) *Psychophysiology* 38:175-178.  
 Pizzagalli DL, Grégoire L, Dolan RJ (2003) *NeuroImage* 18:475-489.  
 Schupp H, Finken T, Staudtberger J, Junghöfer M (2000) *Progress in Brain Research* 156:31-51.  
 Kissler J, Herbert C, Peysk P, & Junghöfer M (2007) *Psychological Science* 18:475-80.  
 Morel S, Ponz A, Mercier M, Vuilleumier P, George N (2009) *Brain Res* 1254:84-98.

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