

Underlying neuronal mechanisms of bilateral alternating stimulations in EMDR therapy

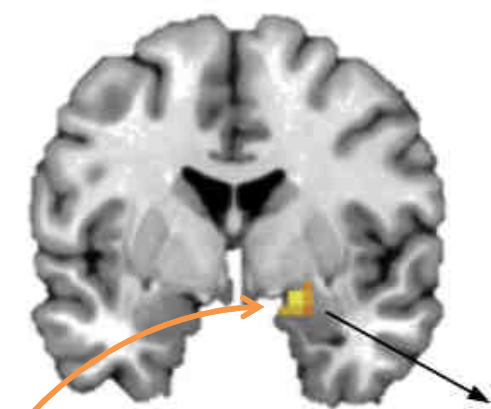
Dr Khalfa Stéphanie

PTSD & brain dysfunctions

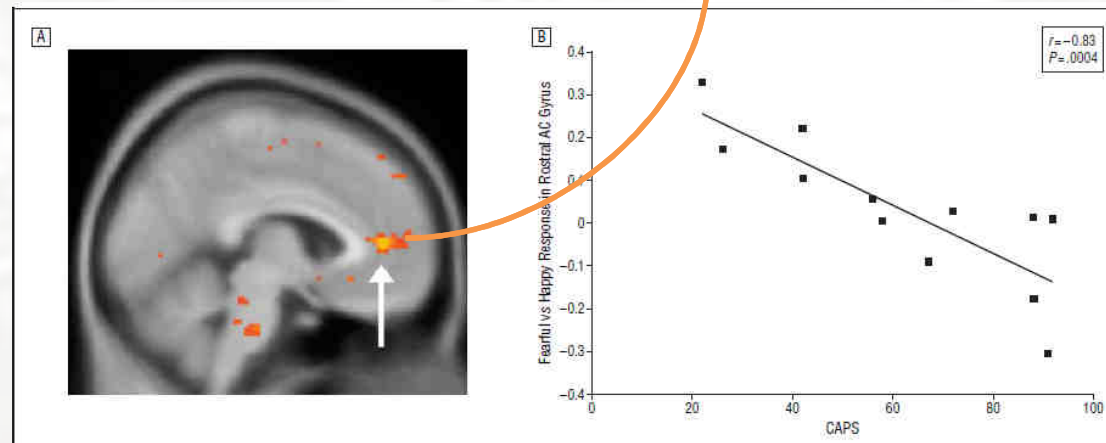
✓ PTSD: disruptions of brain mechanisms involved in fear processing
(Charney, 2004; Sartory et al., 2013; Hughes & Shin, 2011)

- Amygdala hyperactivity (Rauch, 2000)
- Prefrontal cortex hypoactivity (Shin, 2004)
 - OFC
 - vm PFC
 - ACC

✓ ↓ m PFC X ↑ Am X PTSD symptoms (Shin et al., 2004; Stevens et al., 2013)

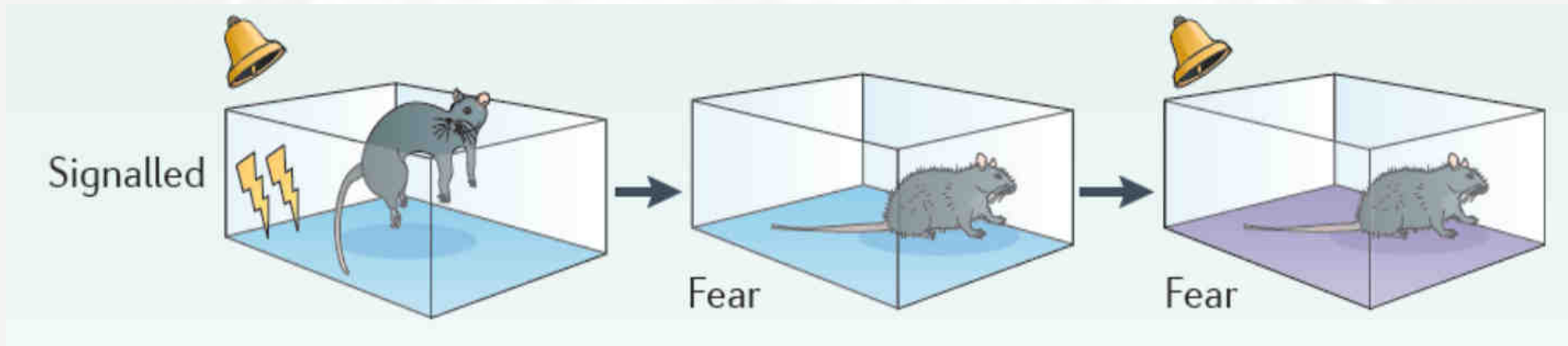


amygdala

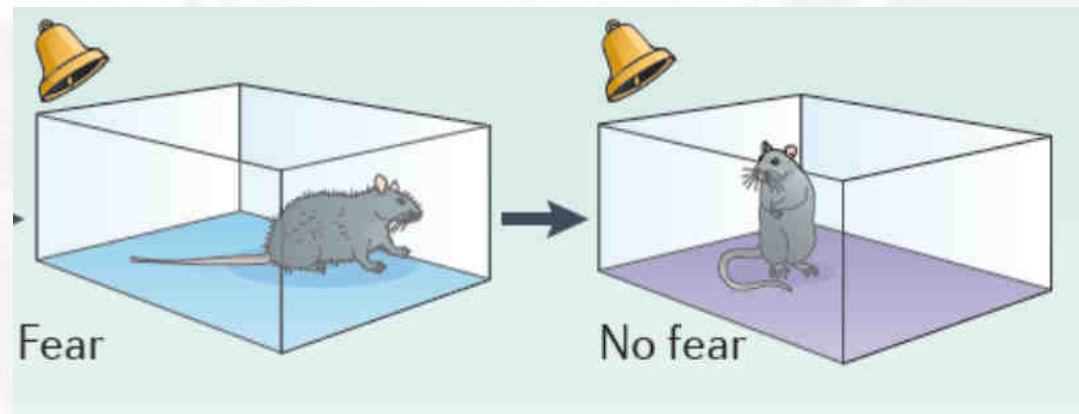


Fear conditioning and extinction paradigm

Fear conditioning



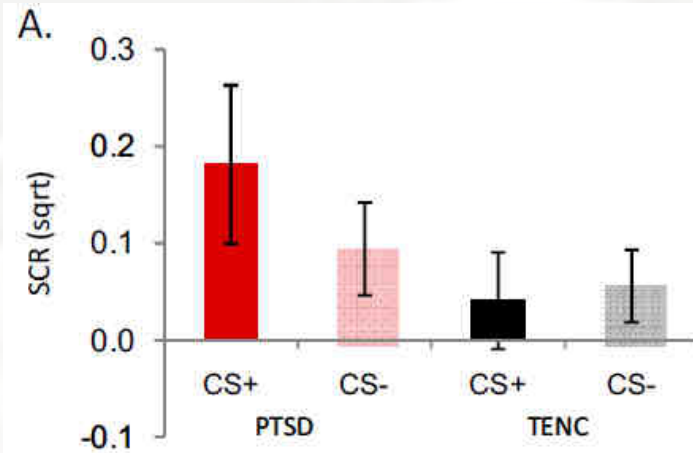
Fear extinction



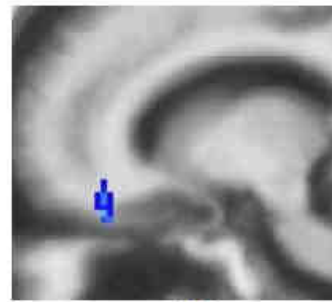
- Late extinction learning deficit in PTSD

(Milad et coll., 2009)

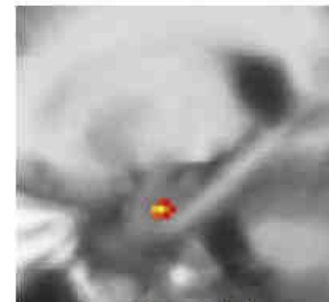
Is EMDR therapy able to restore fear extinction in PTSD?



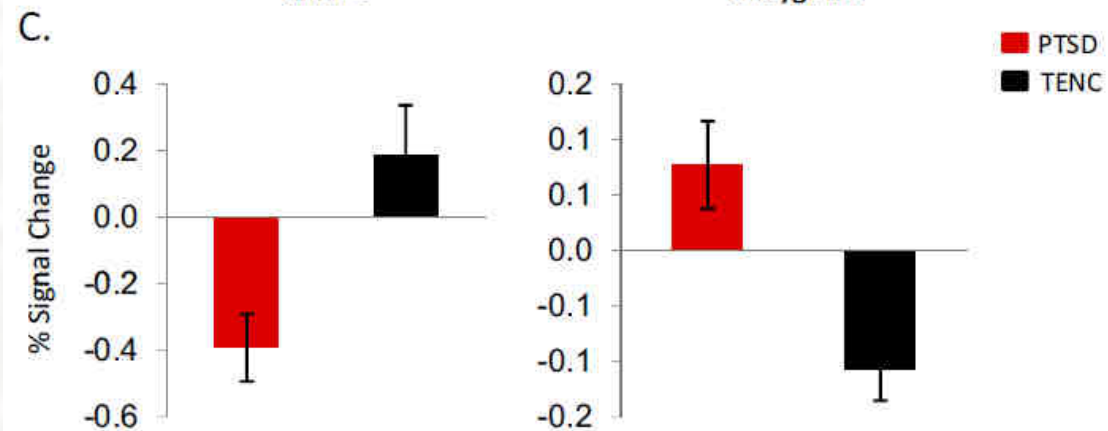
B. PTSD vs. TENC
CS+ > CS- (late extinction learning)

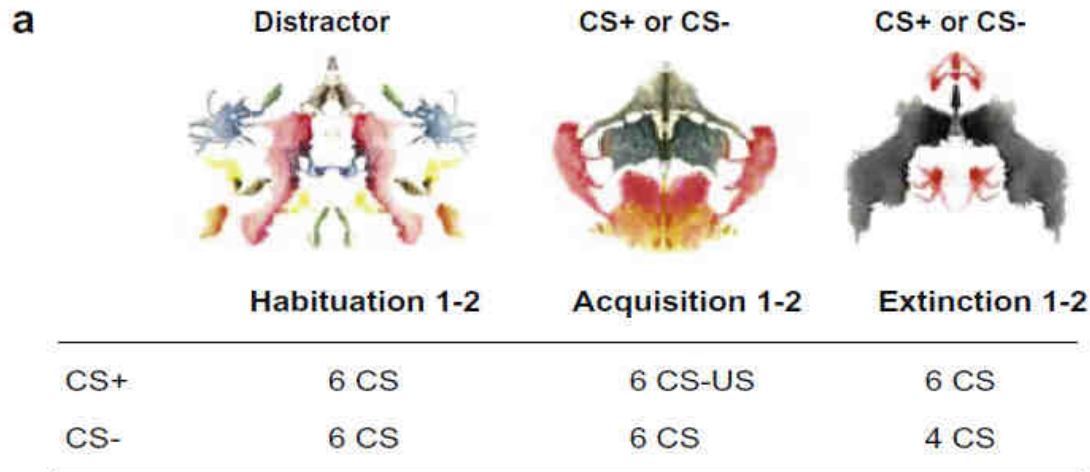


vmPFC



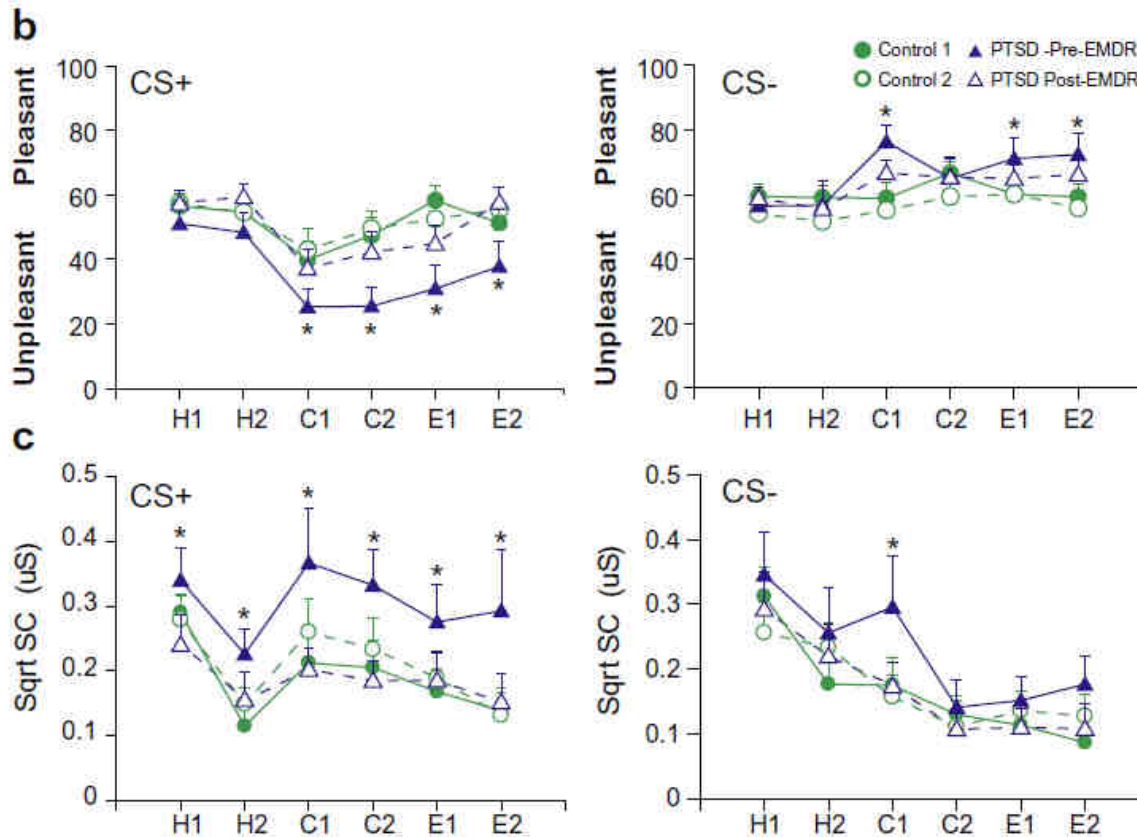
Amygdala





EMDR effects on fear conditioning and extinction

What's happen in the brain to obtain a fear facilitation?



(Wurtz et coll., 2015)

fMRI paradigm for fear conditioning and extinction

• Habituation

- 6 CS+ and 6 CS-



• Conditioning

- 24 CS+ (15 ⚡ on 24 CS+)
- 24 CS-



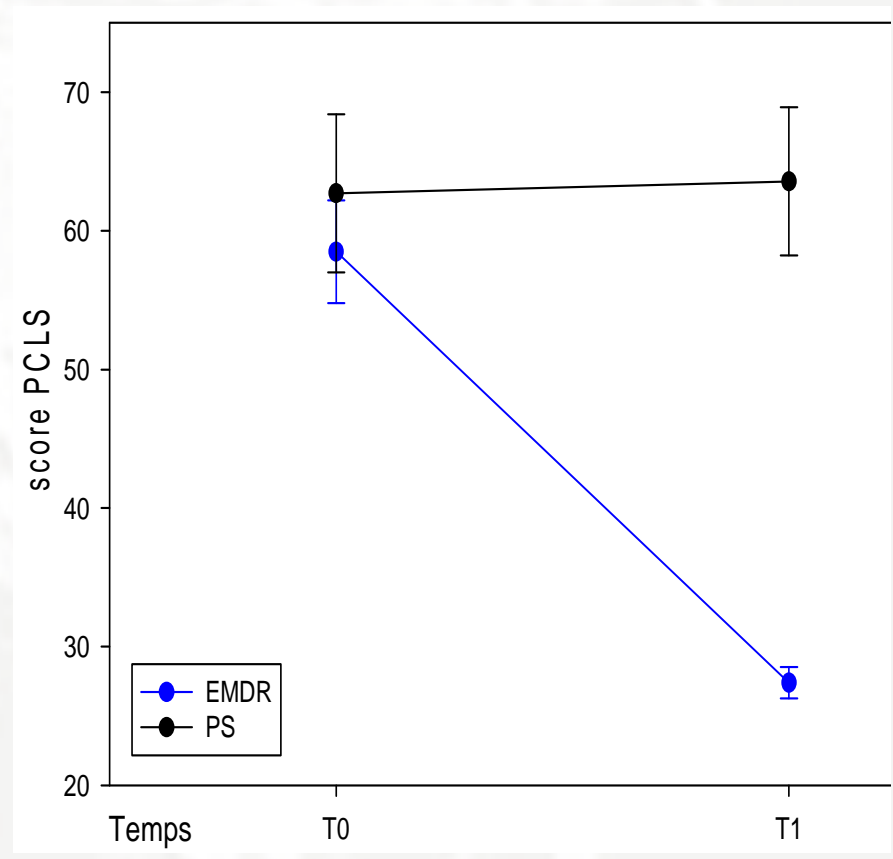
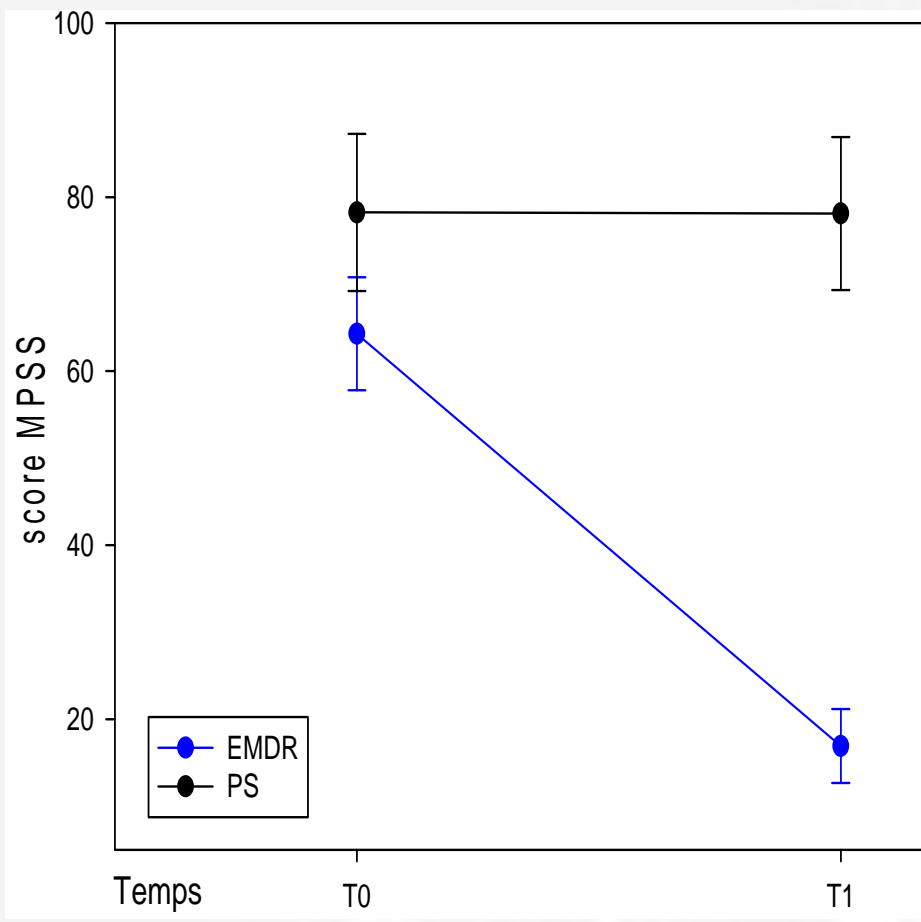
• Extinction

- 24 CS+ and 24 CS-

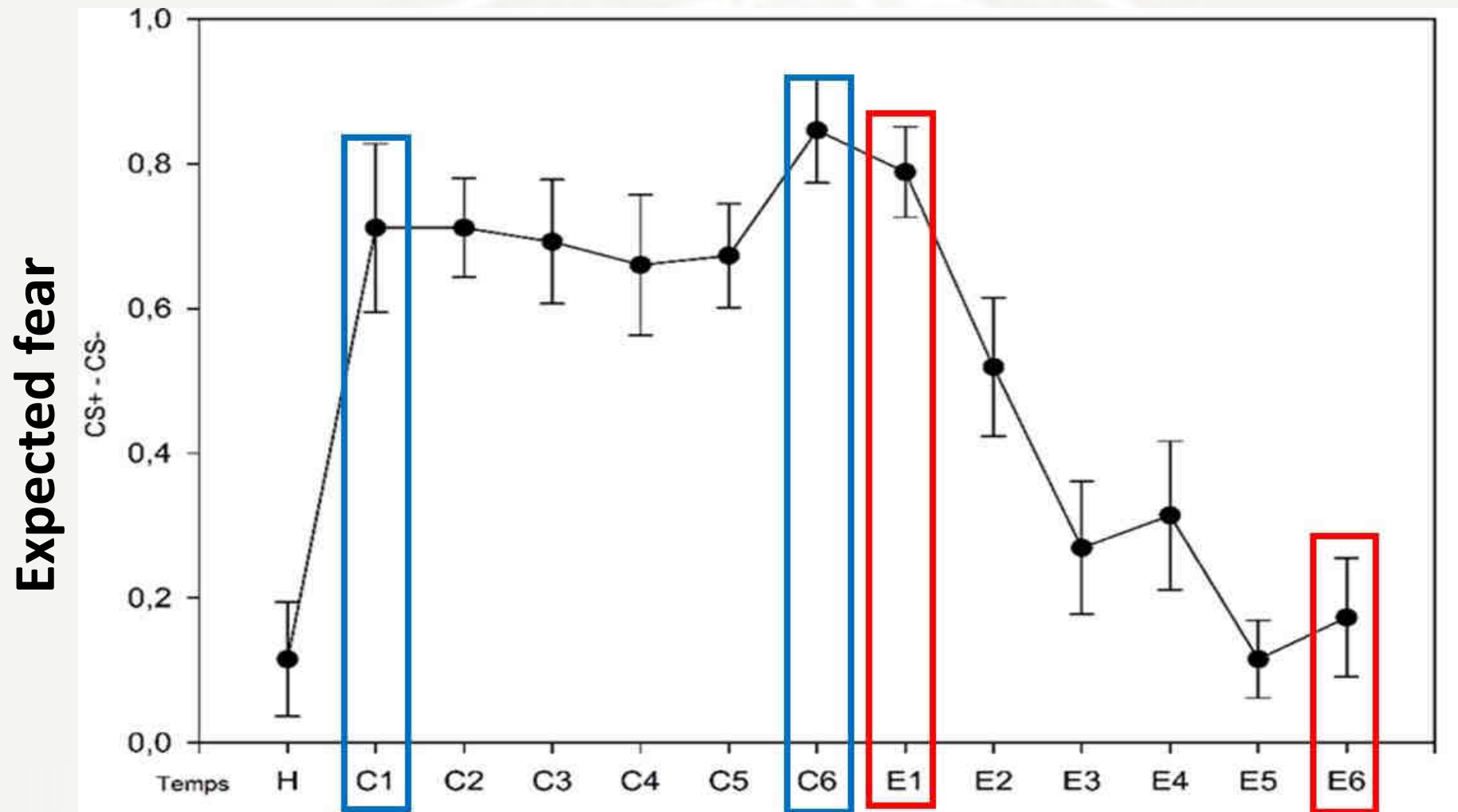
Before EMDR

After EMDR

Final: 10 PTSD + 8 WL



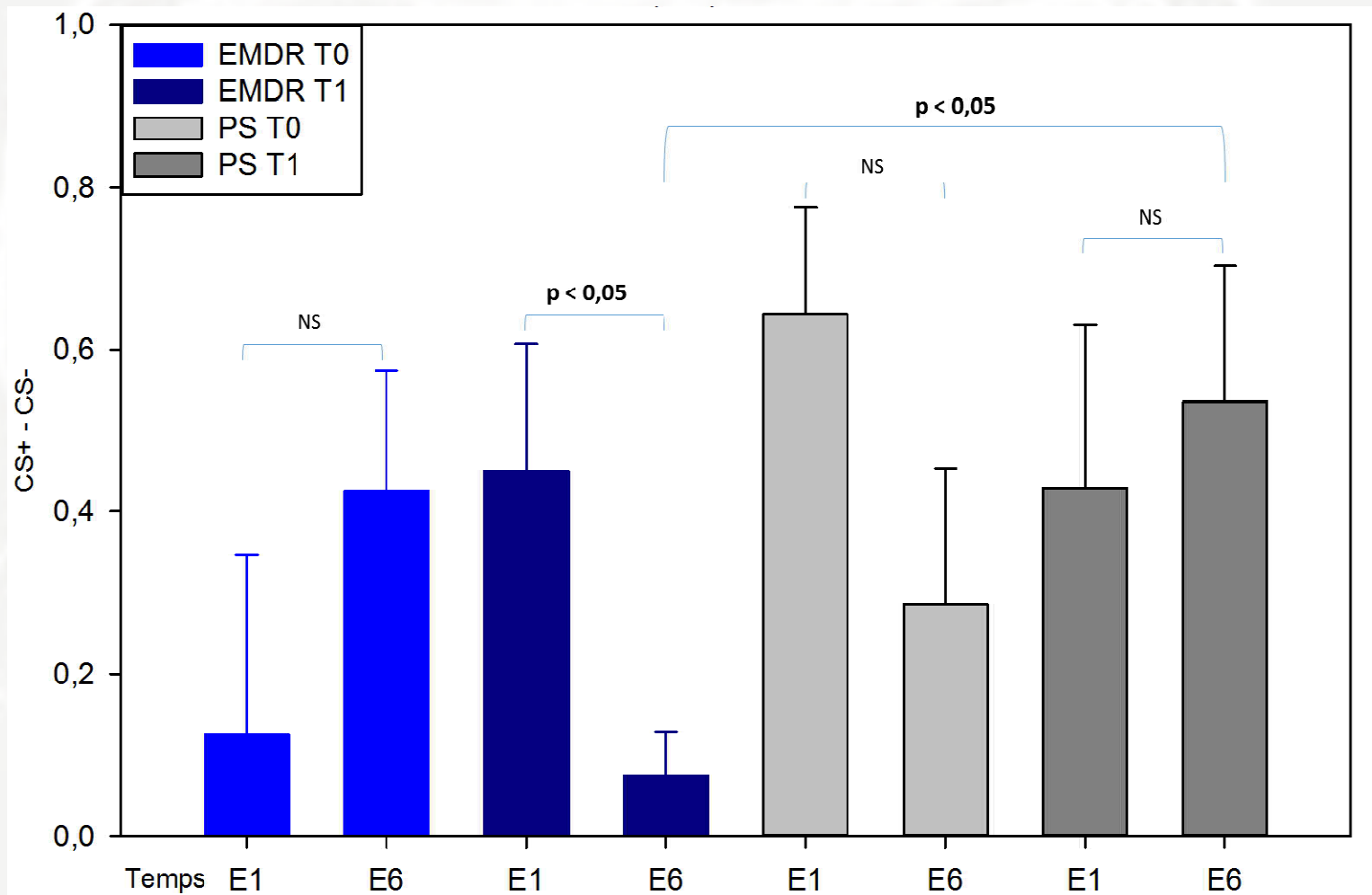
METHOD



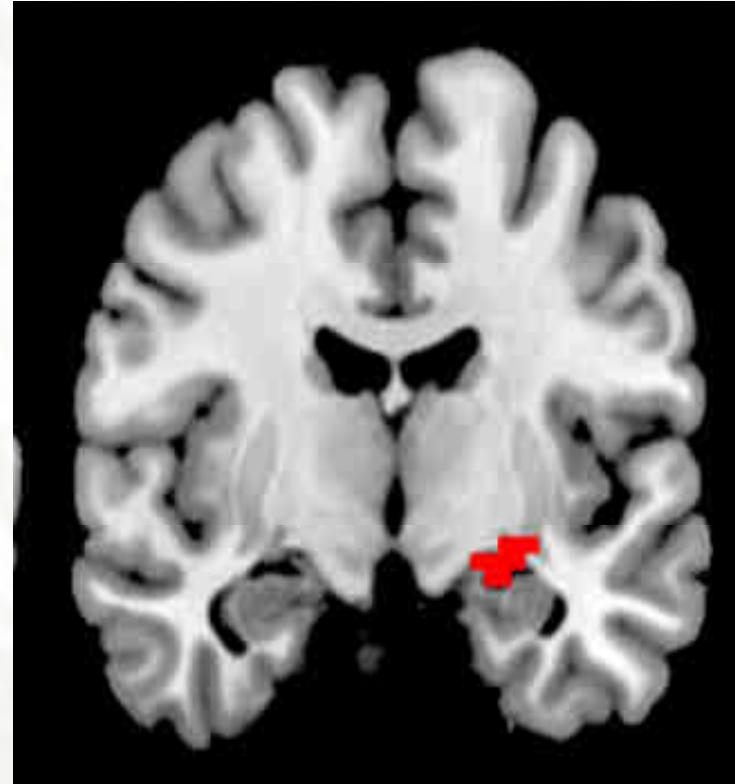
Controls

Fear extinction facilitation after EMDR therapy but no EMDR effect on fear conditioning

Fear expectation



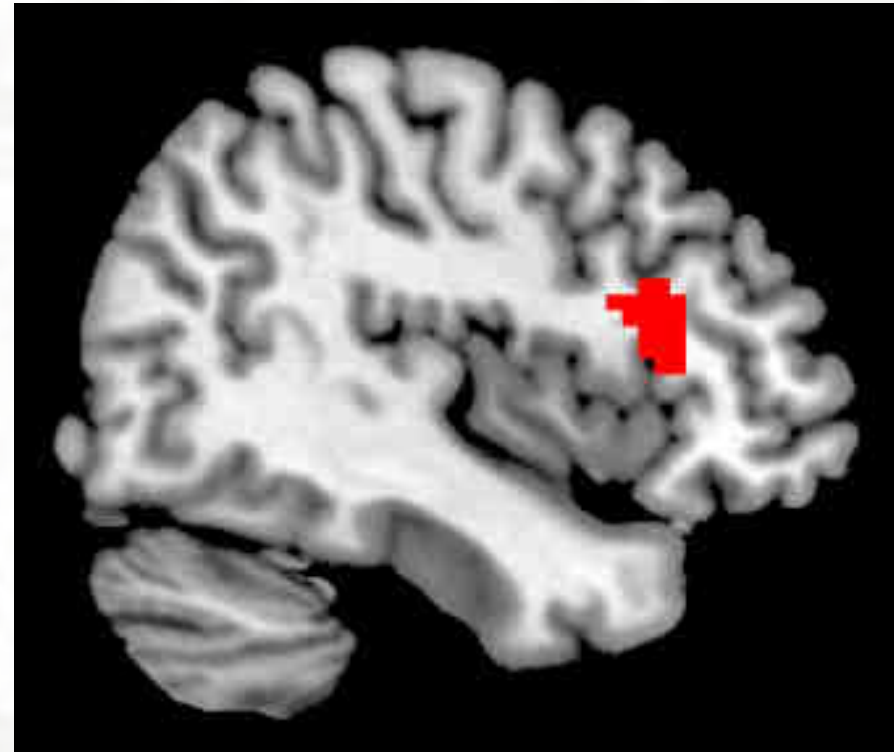
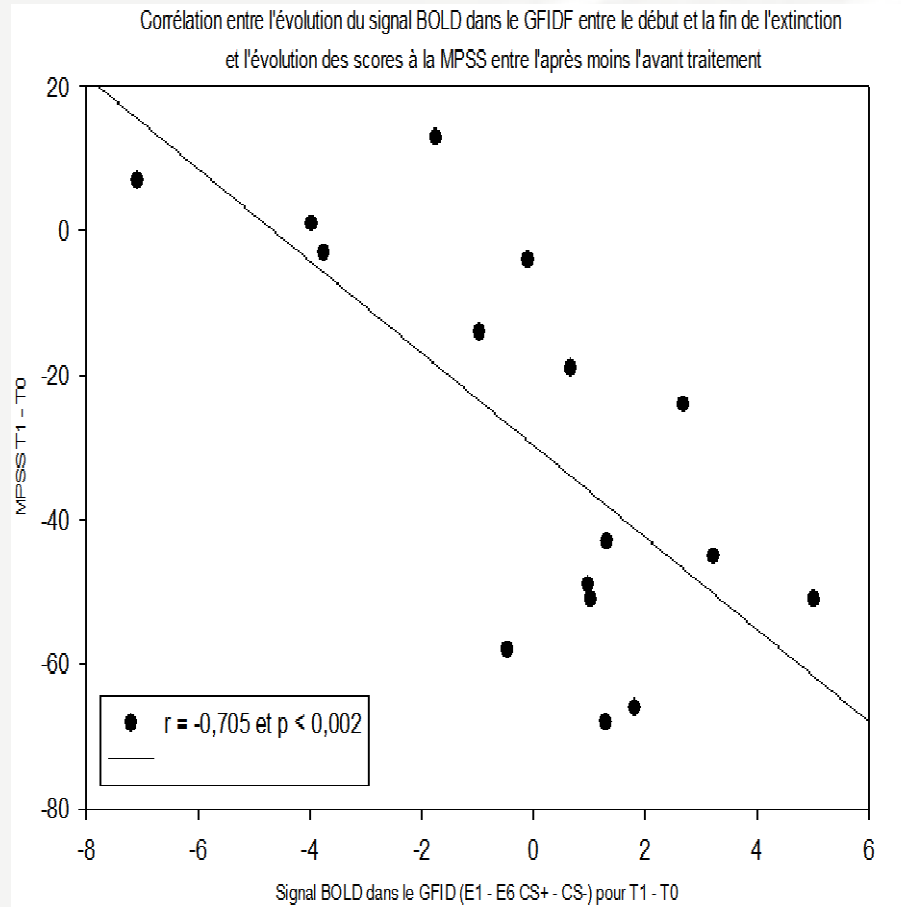
Bilateral amygdalae and left hippocampus



Hipp: formation of new memories of events

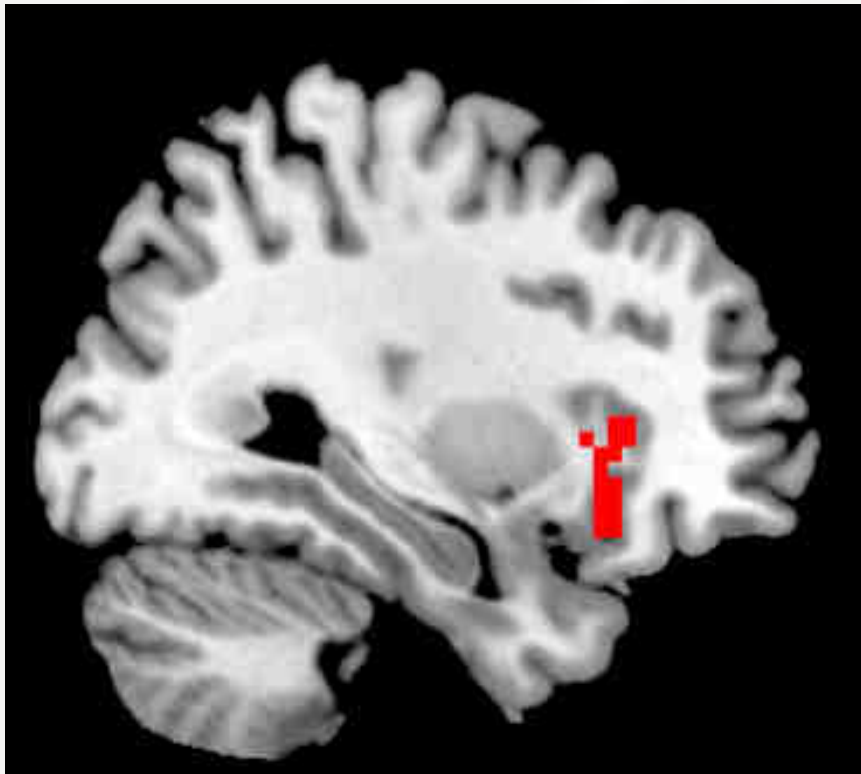
Am: emotional reaction (especially fear), fear extinction memory

dI PFC

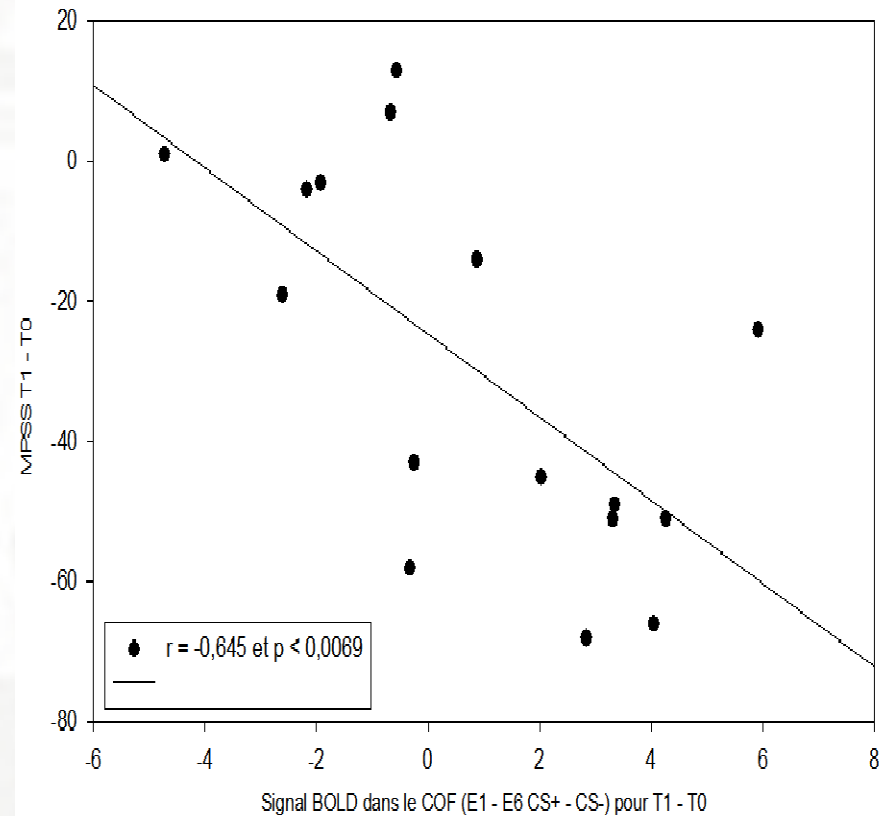


Area 46 (dIPFC): planification, inhibition, regulation of action

Right Orbitofrontal cortex



Corrélation entre l'évolution du signal BOLD dans le COF entre le début et la fin de l'extinction
et l'évolution des scores à la MPSS entre l'après moins l'avant traitement



OFC: expectations (value of event), decision making, adaptative learning, emotion regulation

Lateralization (RH): negative emotions

To Summarize

- Effect of EMDR therapy on the general fear mechanisms => especially a facilitation of extinction corresponding to functional modifications of brain regions involved in emotion processing and memory
- What's happen during EMDR therapy and notably during Desensitization?
 - ✓ Recall of memory
 - ✓ bilateral alternating stimulations (BAS)
- What is the role of these BAS?

Importance of alternance and of bilaterality

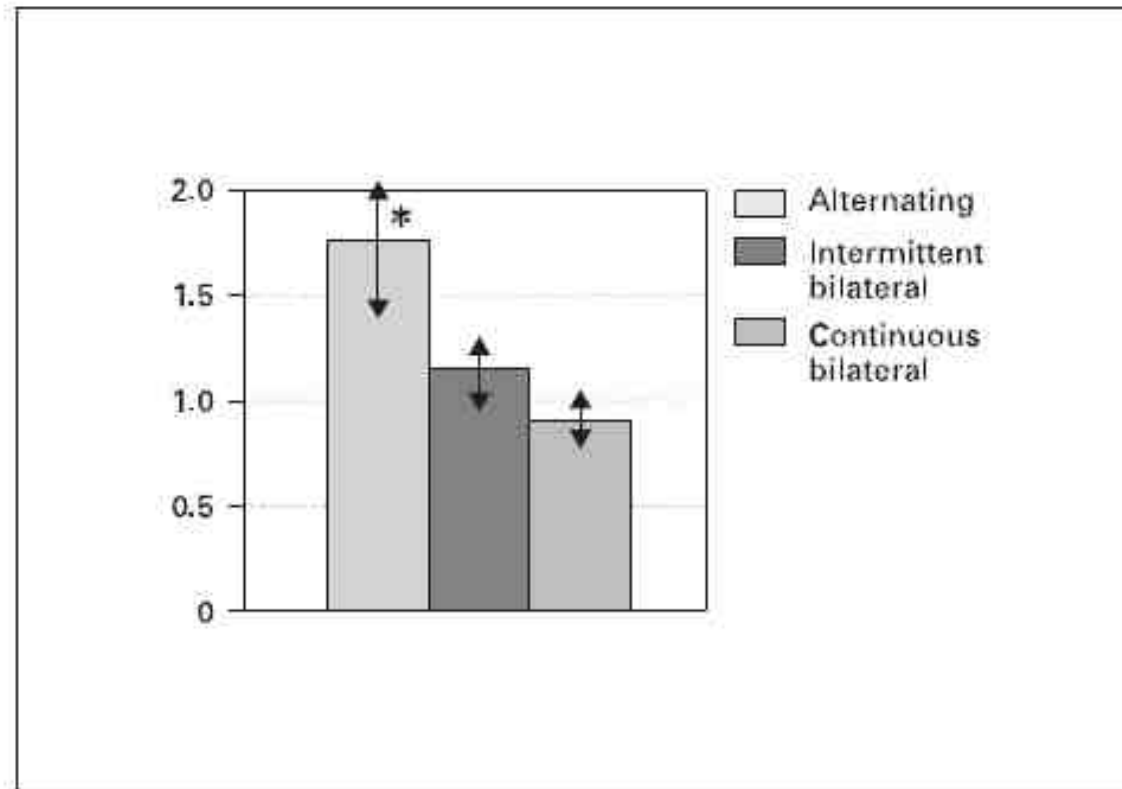


Fig. 2. Rate of SUD level reduction (average decrement in SUD per set of stimulation) on a new target memory, after eliminating data from targets that were worked on in more than one session [$F(2, 5) = 11.28$; * $p < 0.025$].

(Auditory + tactile stimulation)
(Servan-Schreiber et coll., 2006)

Importance of the BAS rate

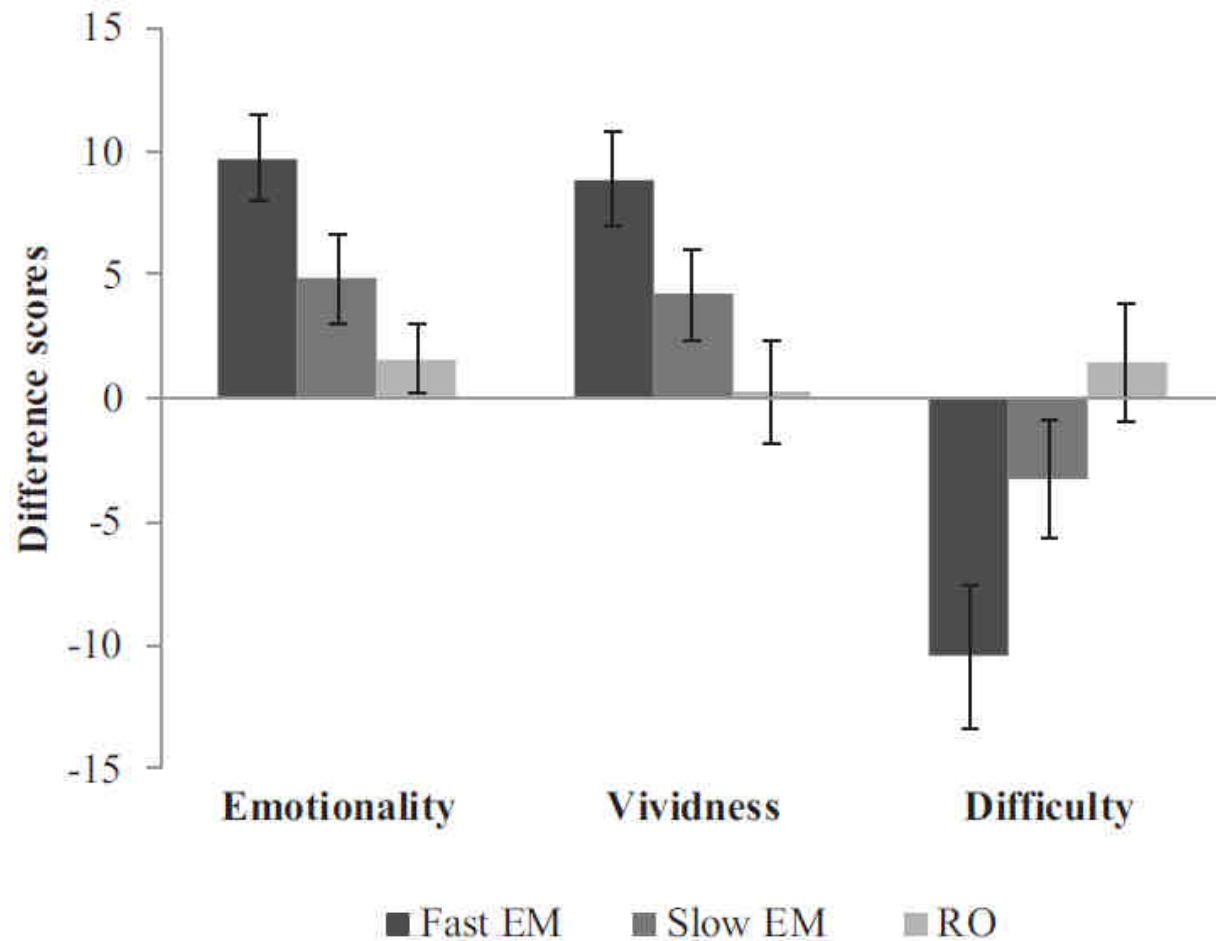


FIGURE 3 | Mean difference scores (post-test minus pre-test) and SEs of fast EM, slow EM, and RO on emotionality, vividness, and difficulty.

3 negative memories and 6 x 24 sec de MO or RO (Recall Only)

The more information (and/or cognitive demand), the more the changes for the negative event (less emotional, less vivid, more difficult to remind) (Van Veen et coll., 2015)

Objectives

- Verify whether we can observe a BAS effect in the fear conditioning and extinction model?
- Is this model relevant to animals?
- What are the brain structures involved in this BAS effect?

Habituation



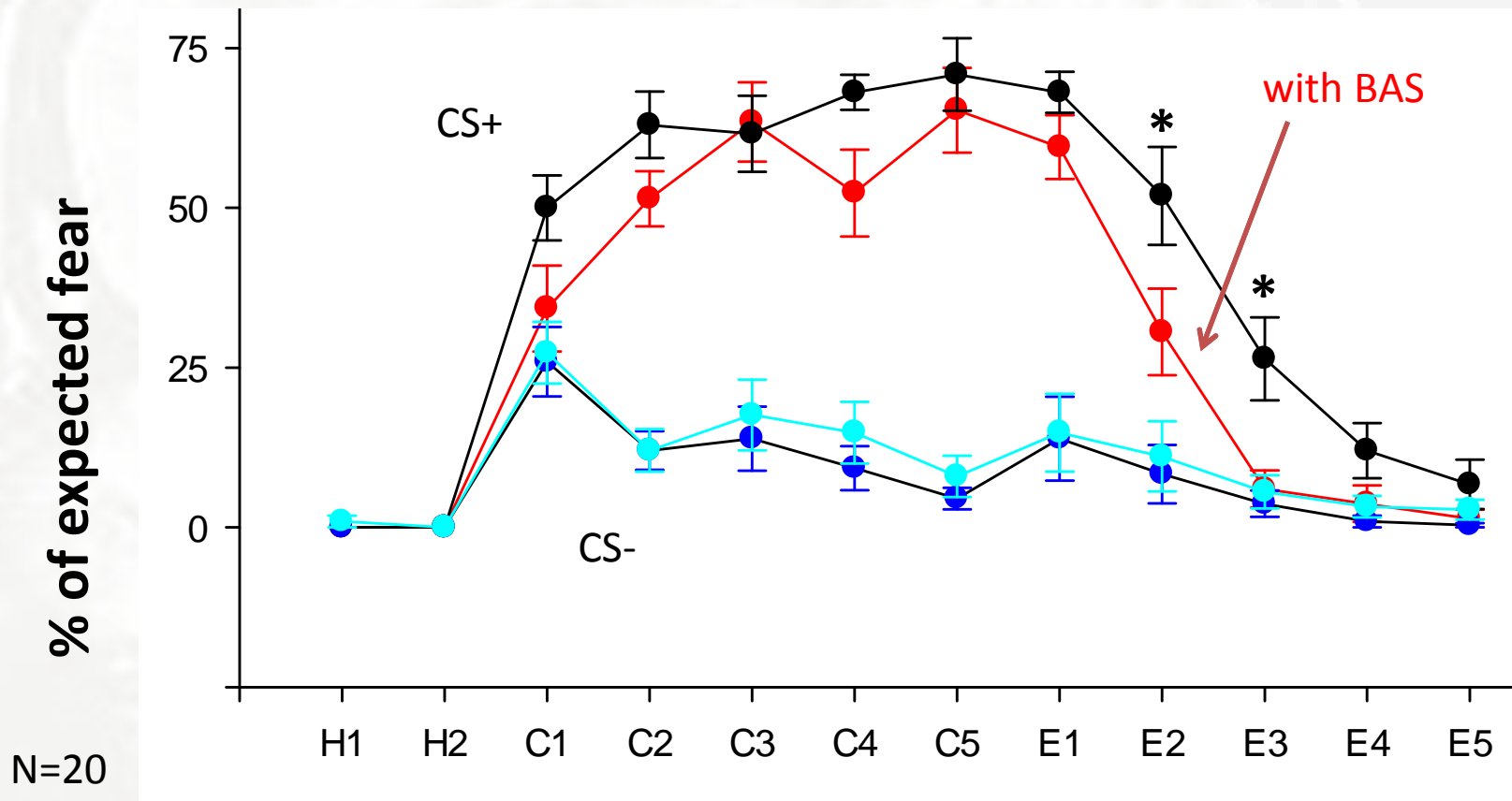
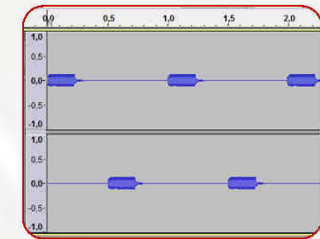
Acquisition



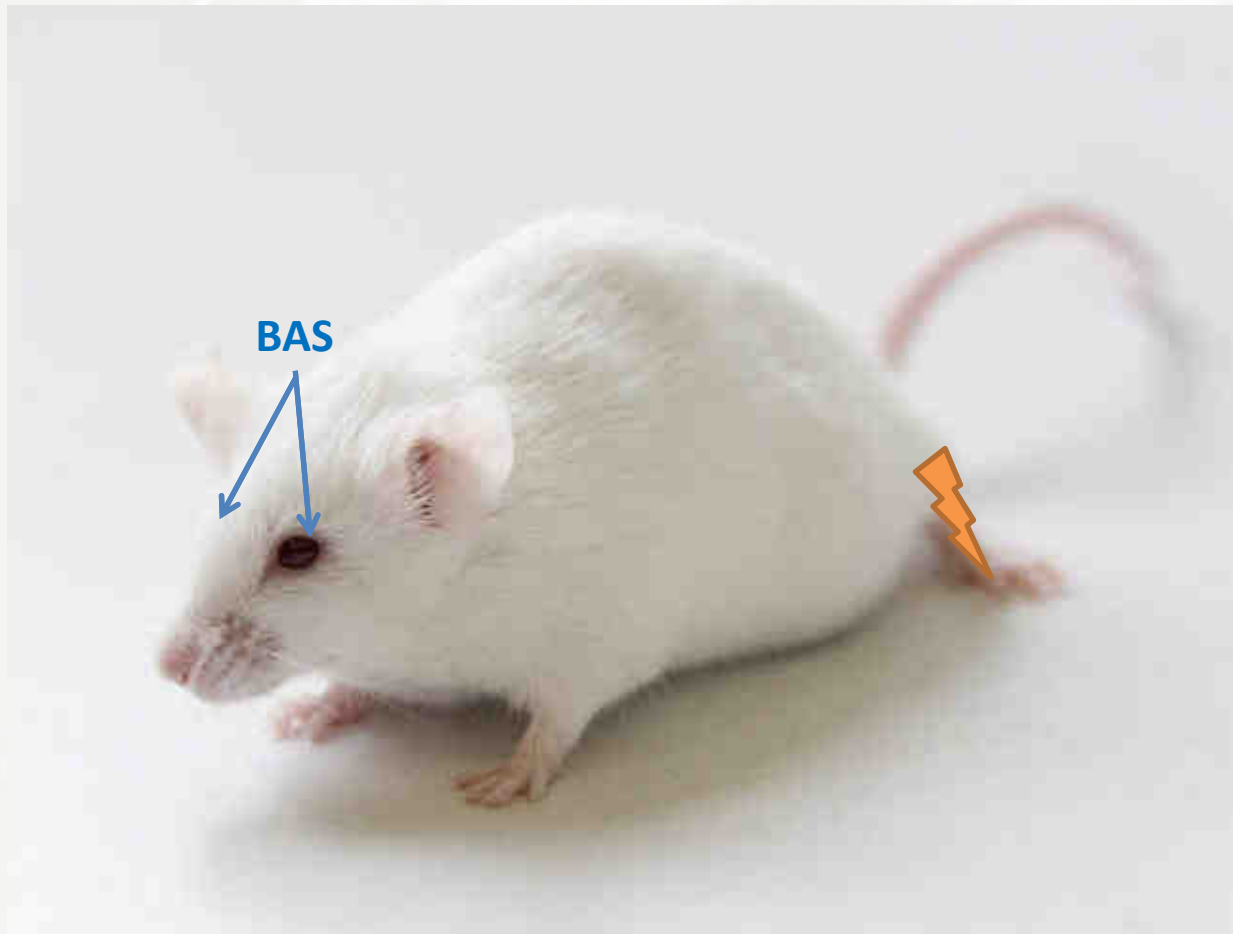
Extinction ± BAS

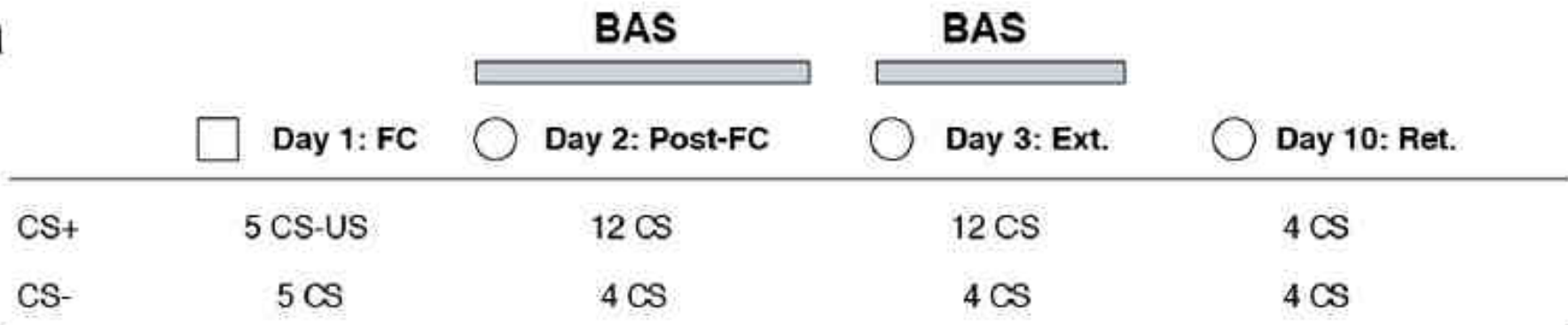
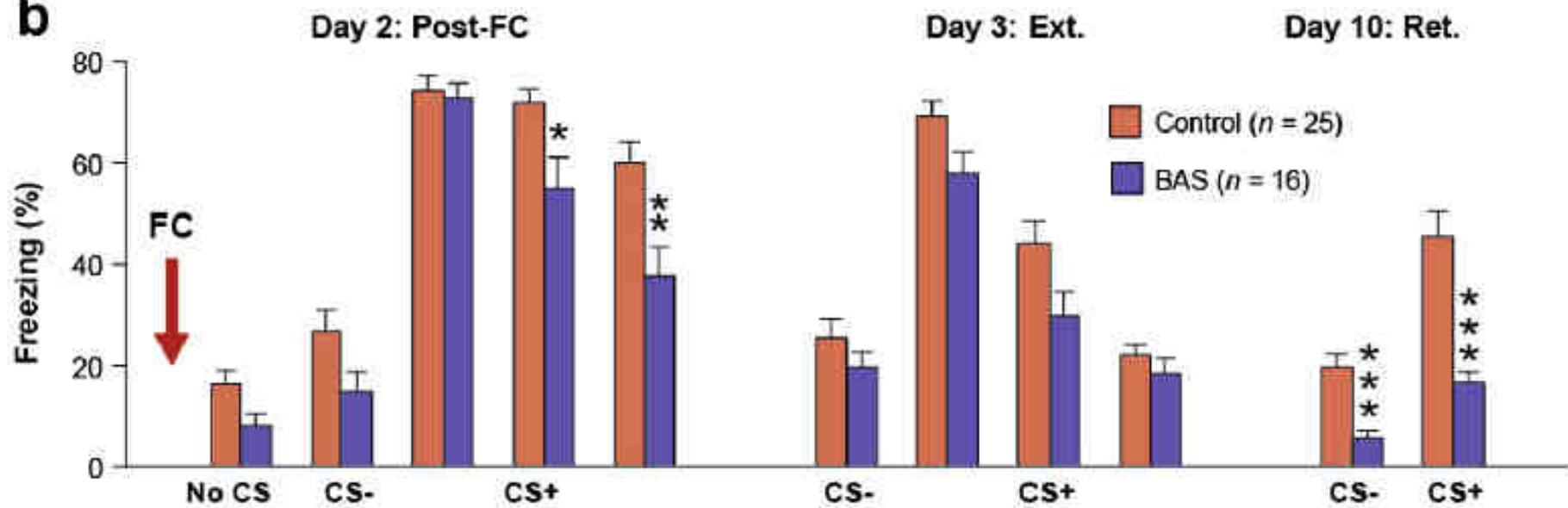


2 Hz

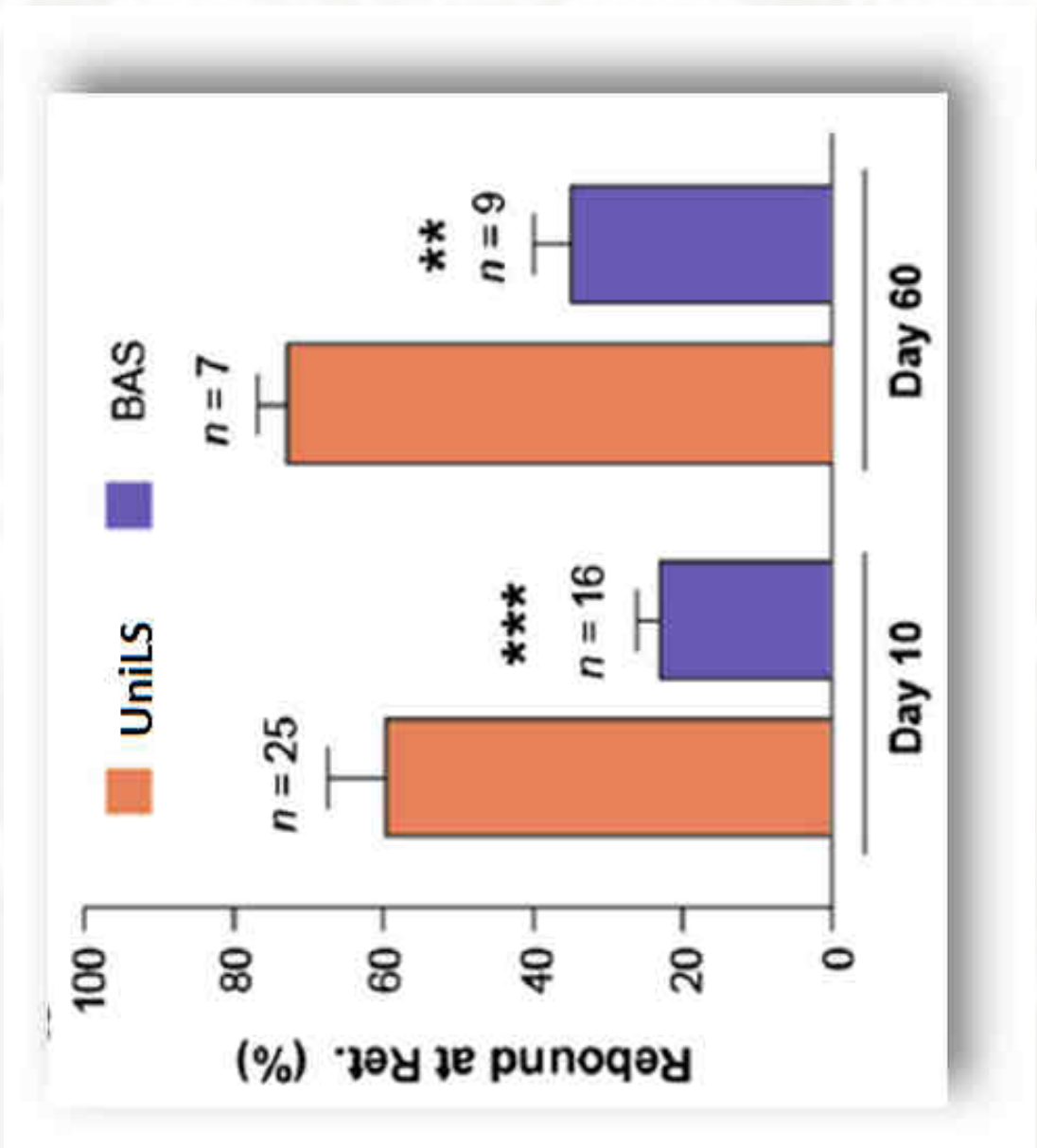


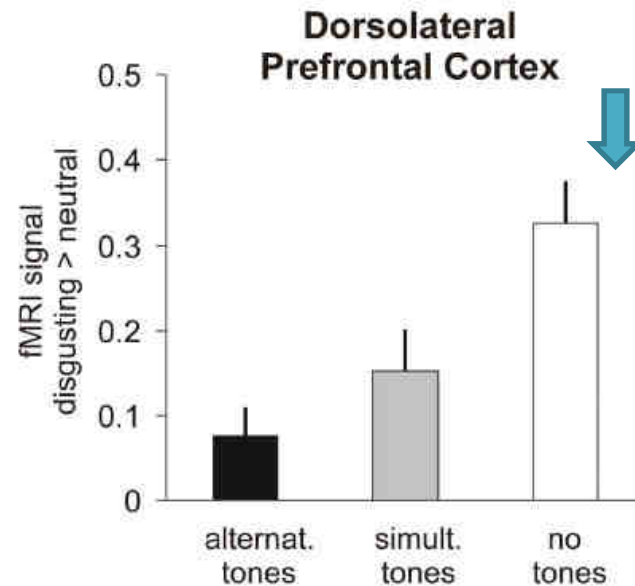
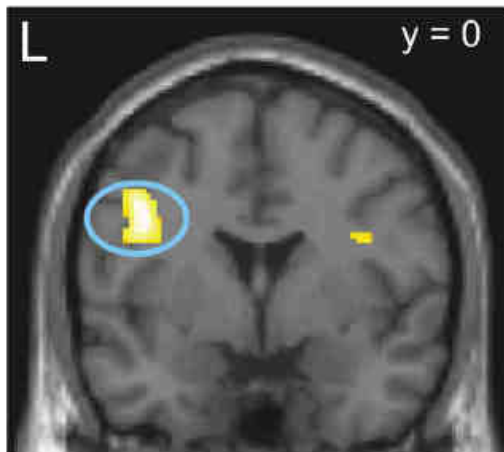
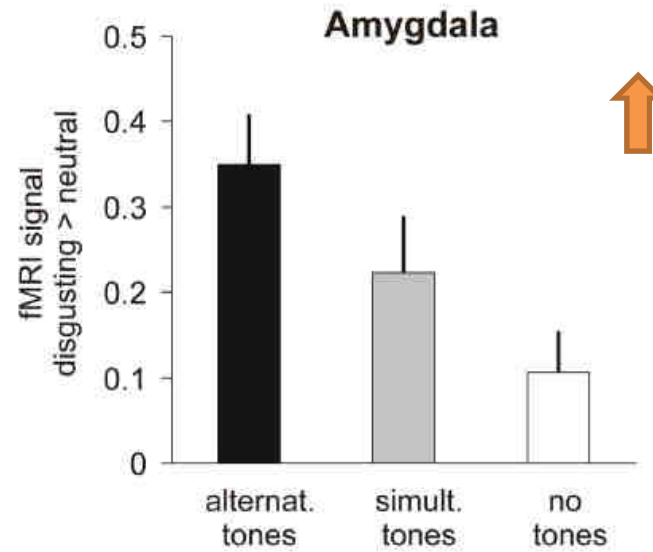
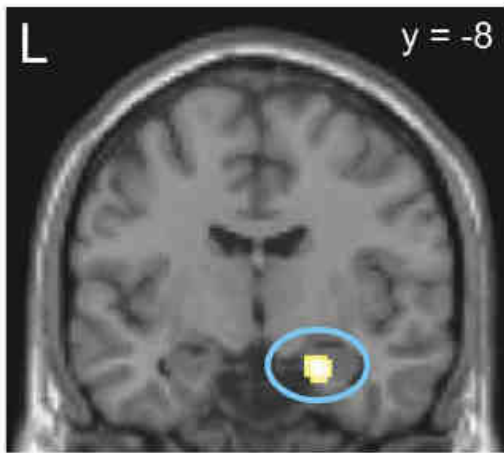
Fear conditioning and extinction with BAS in mice



a**b**

(Wurtz et
coll., 2015)





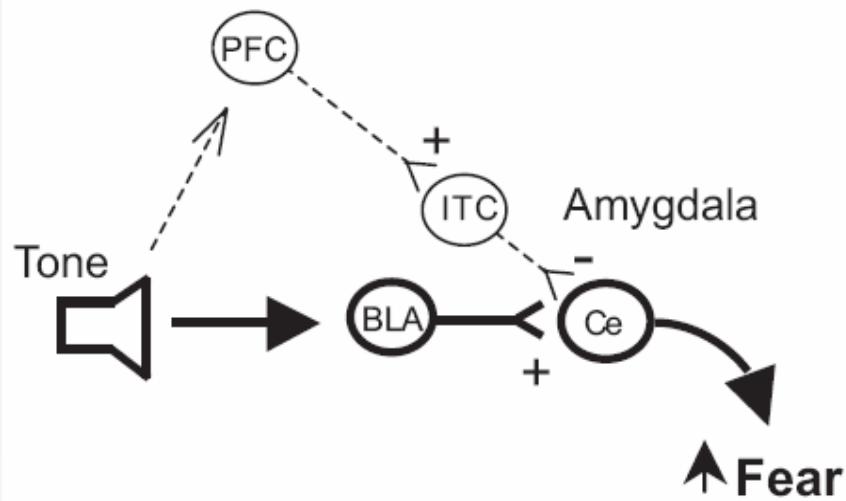
(Herkt et al., 2014)

left dlPFC is elicited in the storage of specific features of individual events (Huey et al., 2006)

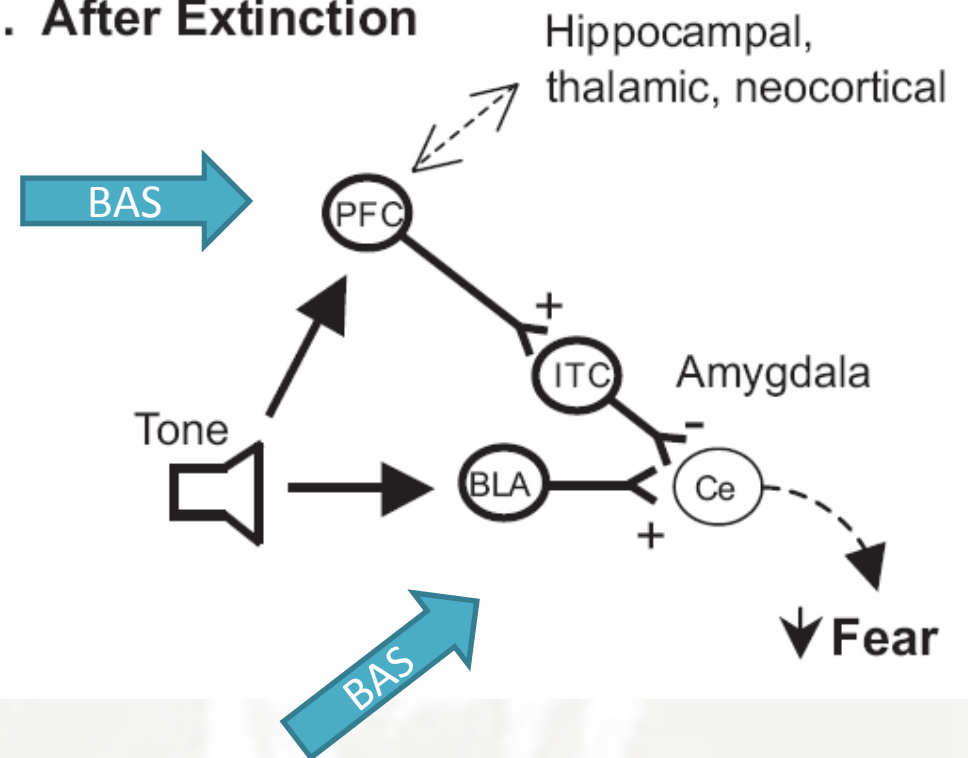
=> BAS may decrease this focusing

Fear conditioning and extinction model

A. Before Extinction



B. After Extinction

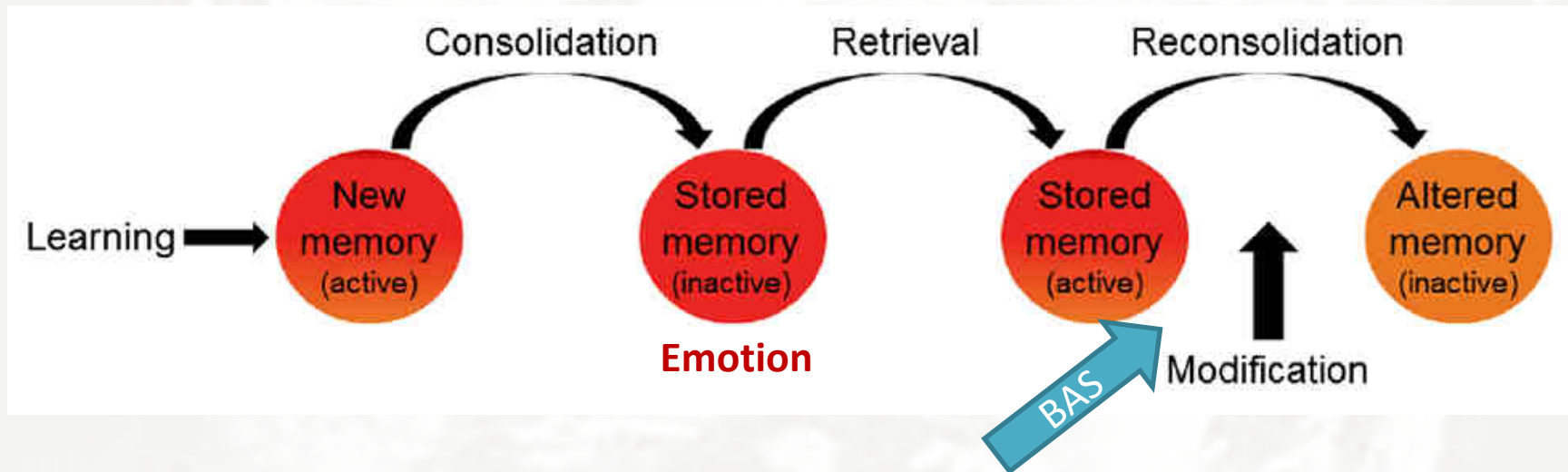


Quirk et al. (2006)

Hypothesis of Memory Reconsolidation

(Oren & Solomon, 2012)

Schwabe et al., 2014: « Nothing is written in stone!! »



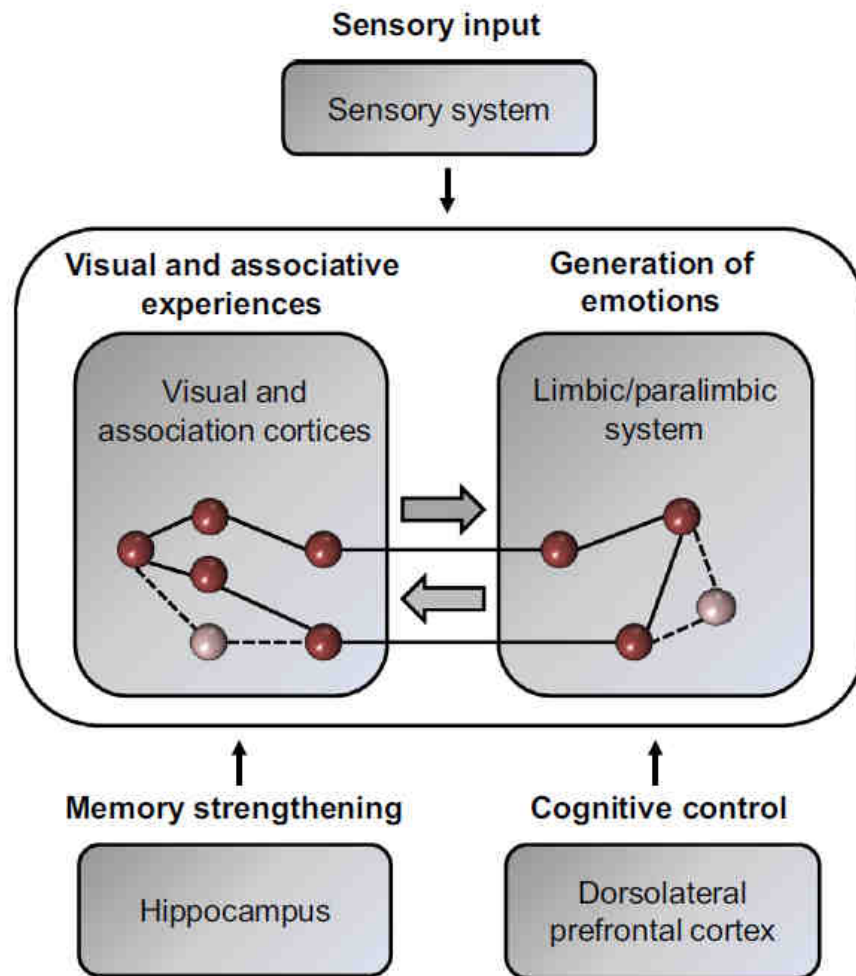


Fig. 1. Memory reorganization in different memory systems during REM sleep. In the declarative memory system, newly acquired memories are initially stored in the hippocampus, before they are transferred to more permanent neocortical storage sites during NREM sleep (memory strengthening). During REM sleep, the hippocampal readout is attenuated, leading to a functional isolation of limbic/paralimbic structures and the neocortex, resulting in intracortical spreading of neural activation between previously encoded memory representations, which may lead to memory reorganization. In contrast to declarative memory, emotional memory processing depends on other neural networks, including emotion processing areas in the amygdala and other networks of the limbic system, that show high activation during REM sleep.

REM sleep => reorganization of memory via spreading of neural activation

(Landmann et al., 2015)

Conclusions

- Despite the specificity of the trauma, all the Fear neuronal network is modified in PTSD
- EMDR by acting specifically on the trauma event restores this fear network
- Extinction learning is facilitated by the only BAS both in animals and humans
- BAS could modulate brain regions involved in emotions and memory processing (amygdala, PFC) by a spreading of neuronal activation in these regions, thus allowing memory reorganization and reconsolidation

Collaborators

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 - ✓ Nathalie Gimenez-Castelli
 - ✓ Guillaume Guérineau de Lamérie

Thank you for your precious attention

