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Oxytocin attenuates the perception of cardiac signals and reduces fear learning at systole

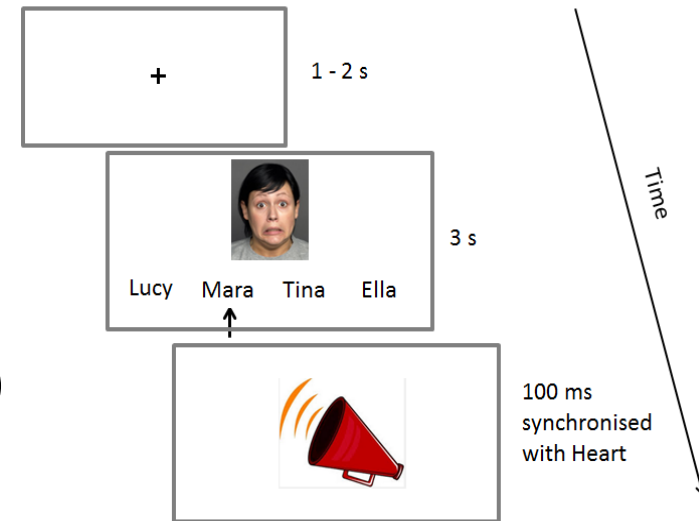
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Neuroscience

Brighton and Sussex Medical School

Background

- **Fear stimuli are salient**
 - Better retrieval and recognition of fearful relative to neutral stimuli
(Keightley et al., 2011; Sergerie et al., 2005; Righi et al., 2012)
 - **Associative memory**
 - Poorer emotional memory due to *attentional narrowing*
(Easterbrook, 1959; Rimmele et al., 2011; Bisby & Burgess, 2014; Pfeifer et al., 2017)



Arousal theory of emotion

- James – Lange Theory (late 19th century)

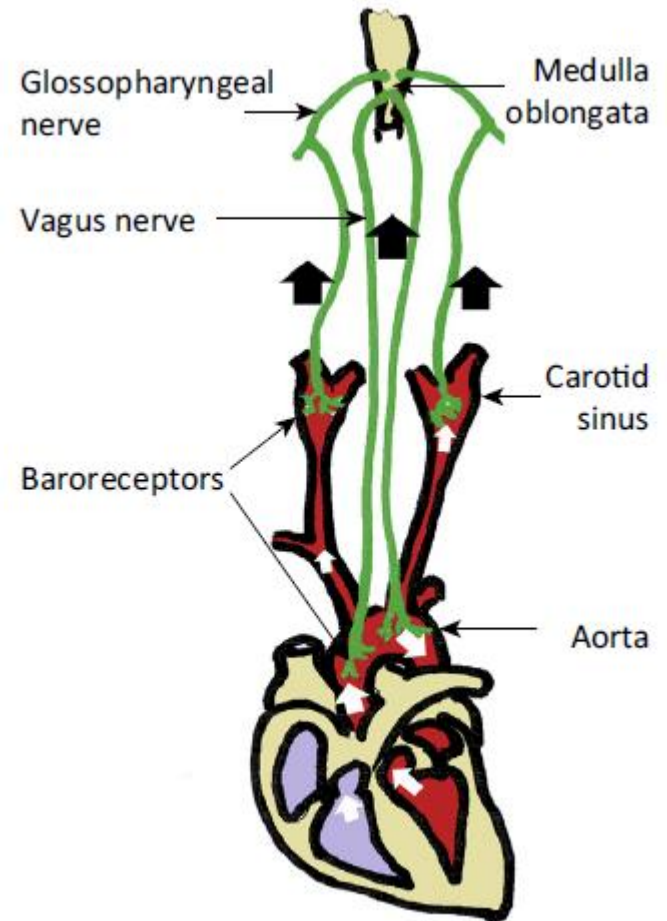


Emotion
(e.g. fear)

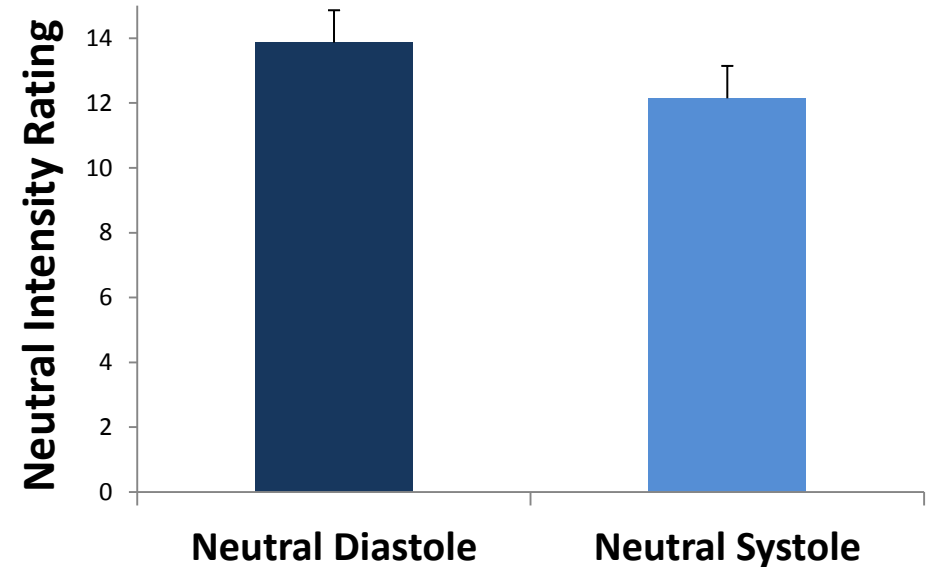
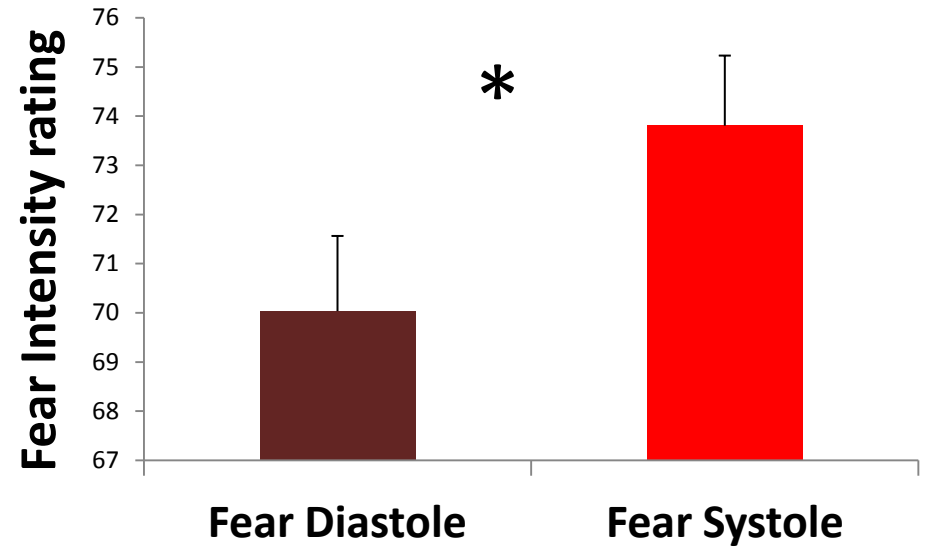
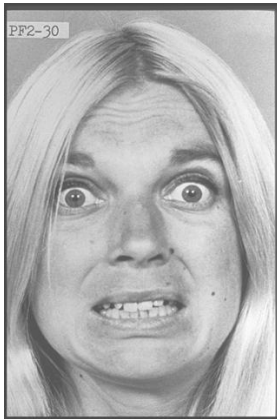
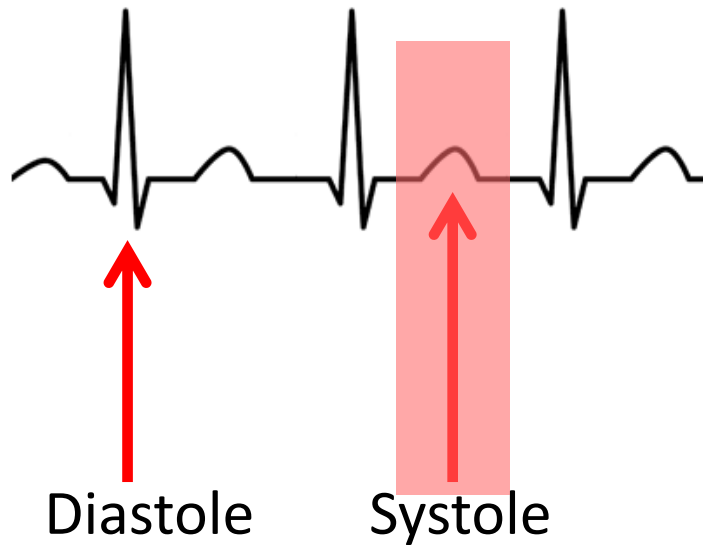
- Implications for translational research (Anxiety)

Cardiac Timing

Timing of stimuli at cardiac systole and diastole



Cardiac facilitation of fear



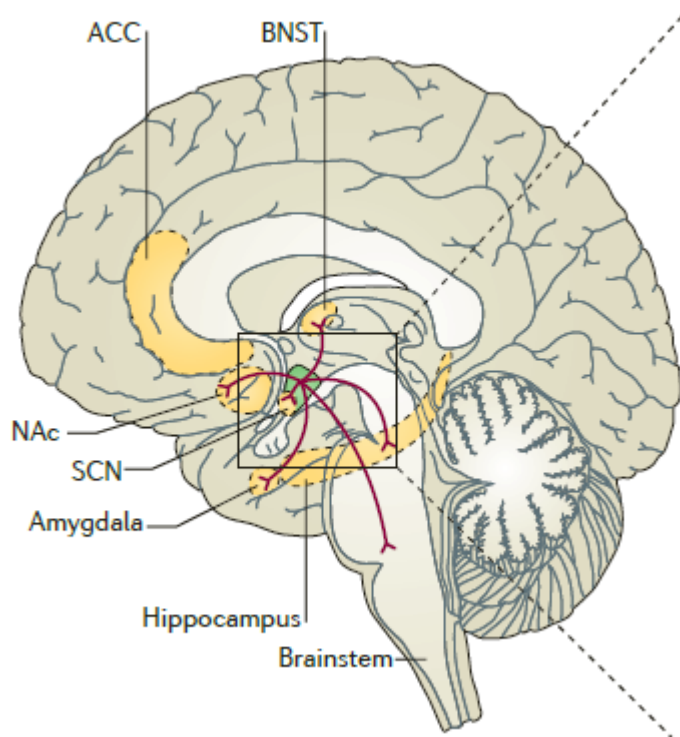
Interoception

- Sensory processing of internal bodily signals (Garfinkel et al., 2015).
- Tested using methods such as the **heartbeat counting task**.



- Related to enhanced experience of emotions (Wiens et al., 2000) and emotional memory (Werner et al., 2010; Garfinkel et al., 2013; Pfeifer et al., 2017).

Oxytocin



- ✓ Increases parasympathetic activity.
- ✓ Improves social cognition and reduces anxiety.

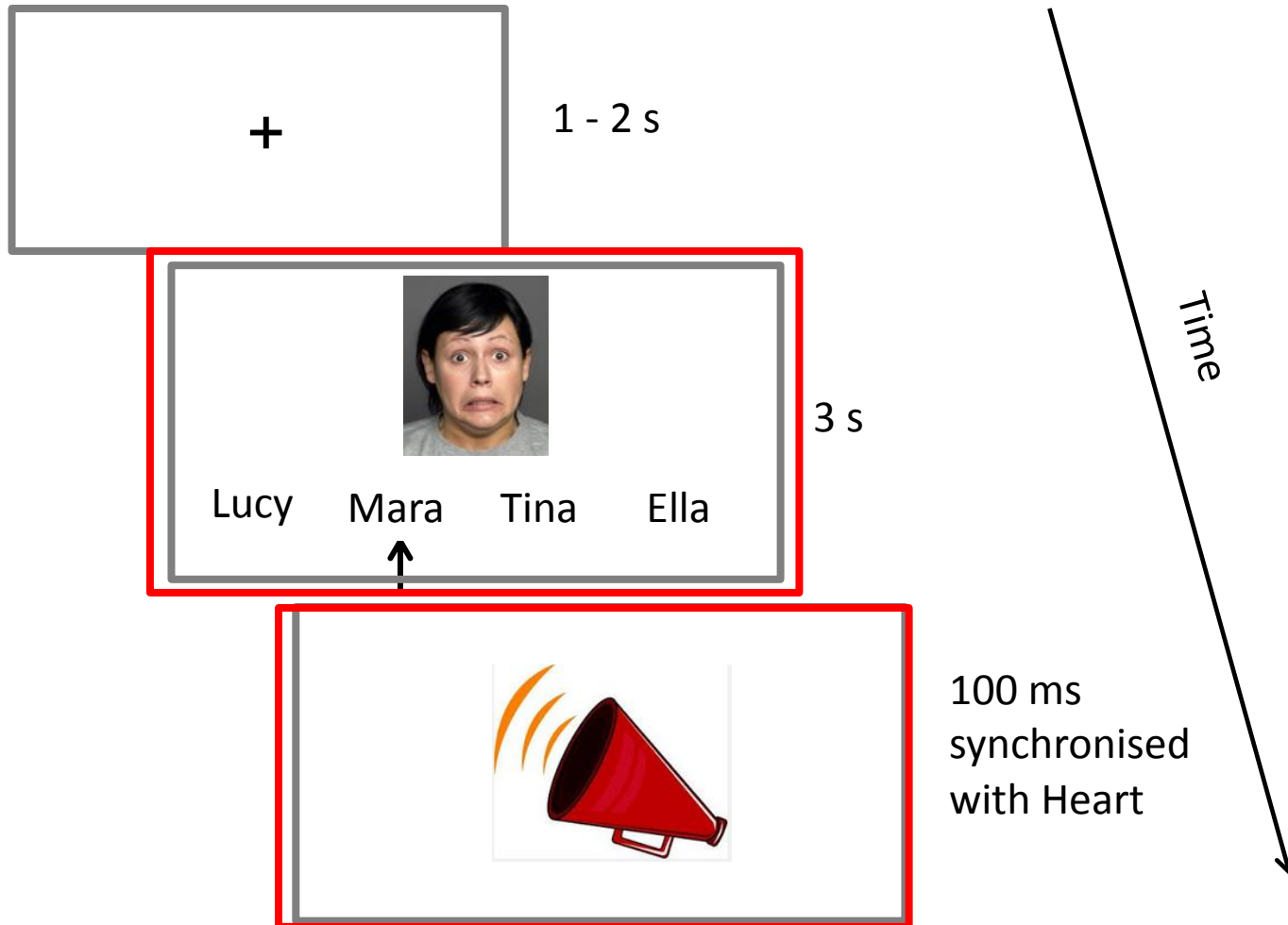
Participants

- N = 27 male
- Age (M = 24.83; SE = 0.76)
- Within-subject design (2 sessions: OX/PL)



Associative Learning

In MRI



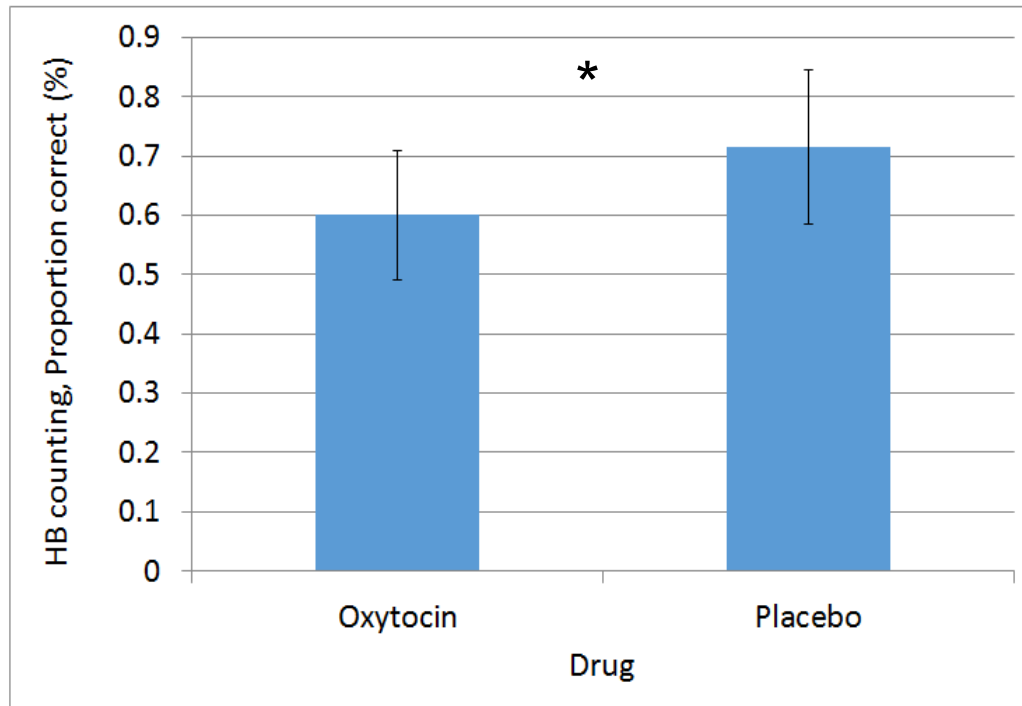
Hypothesis

- ✓ Learning of emotional faces will be poorer than neutral faces (attentional narrowing).
- ✓ Feedback at systole will lead to better learning of fearful faces.
- ✓ Oxytocin will reduce fear learning when feedback is presented at systole.

Results

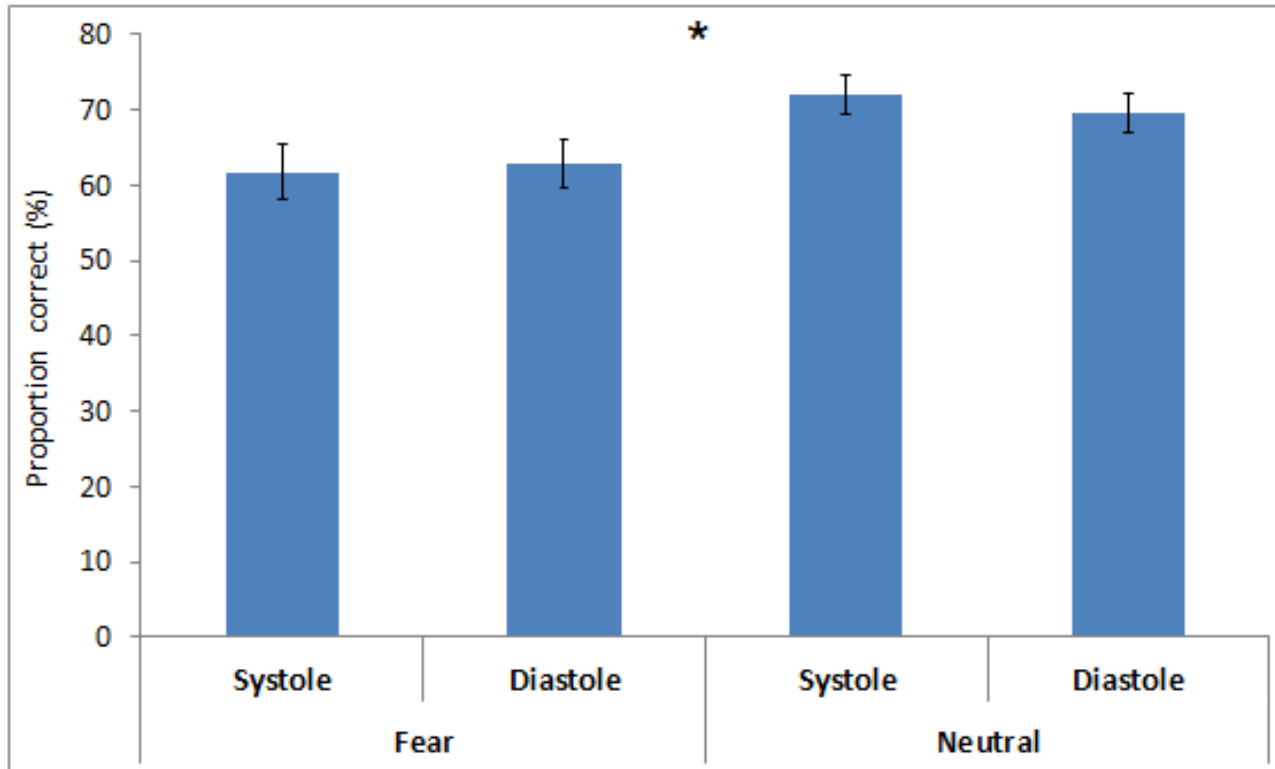
Interoception

HB counting accuracy



- Main effect of drug, $F[1,28] = 5.62, p = 0.034$
- With HR included as covariate, $F[1,28] = 4.67, p = 0.039$
- No sign. effect of order of administration, $F[1,13] = 0.228, p = 0.641$
- No sign. Interaction between drug * order, $F[1,13] = 0.785, p = 0.392$

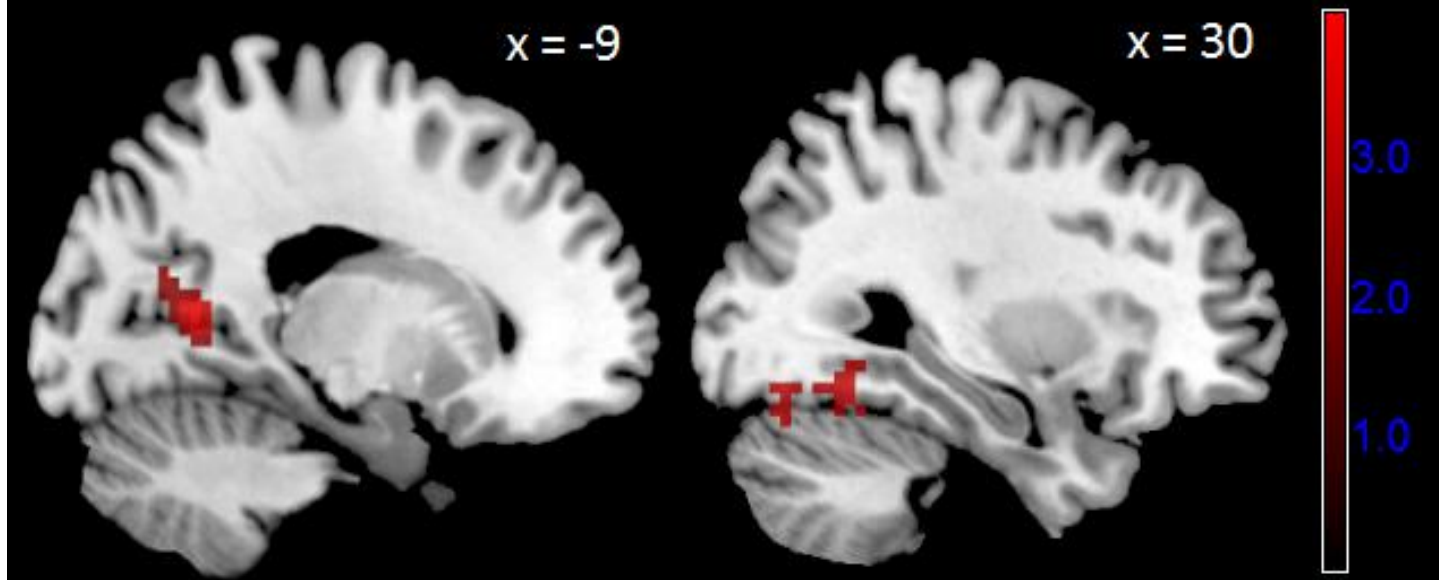
Results: Associative Learning



- Sign. main effect of emotion, $F[1,29] = 24.78, p < 0.001$: **Neutral > Fear**
- No sign. main effects of drug, cardiac cycle (all p 's > 0.05).
- No interaction effects (all p 's > 0.05).

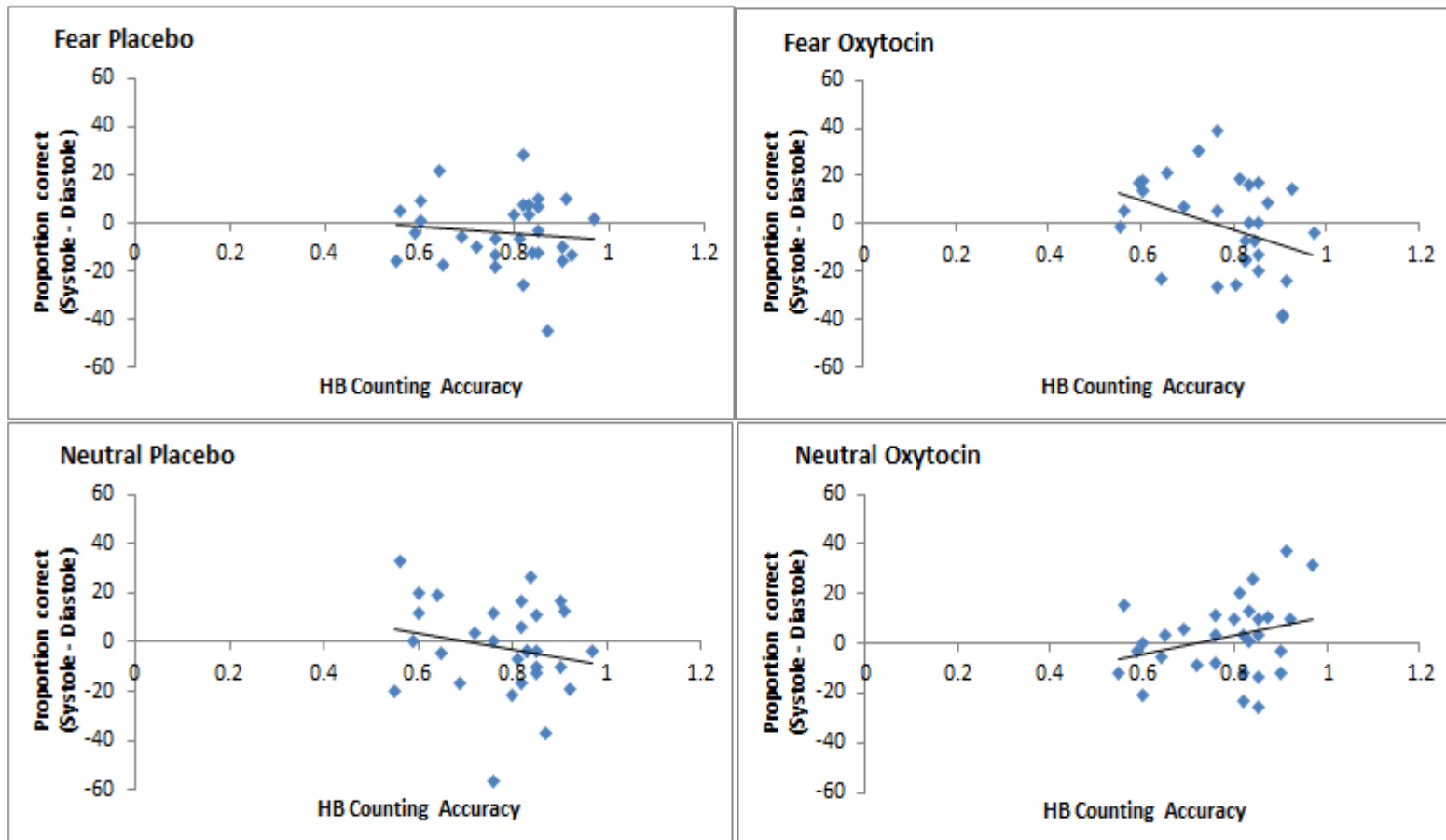
Results: Main effect of Emotion

Neutral > Fear
 $p < 0.005$ (unc.), $k = 20$ vox

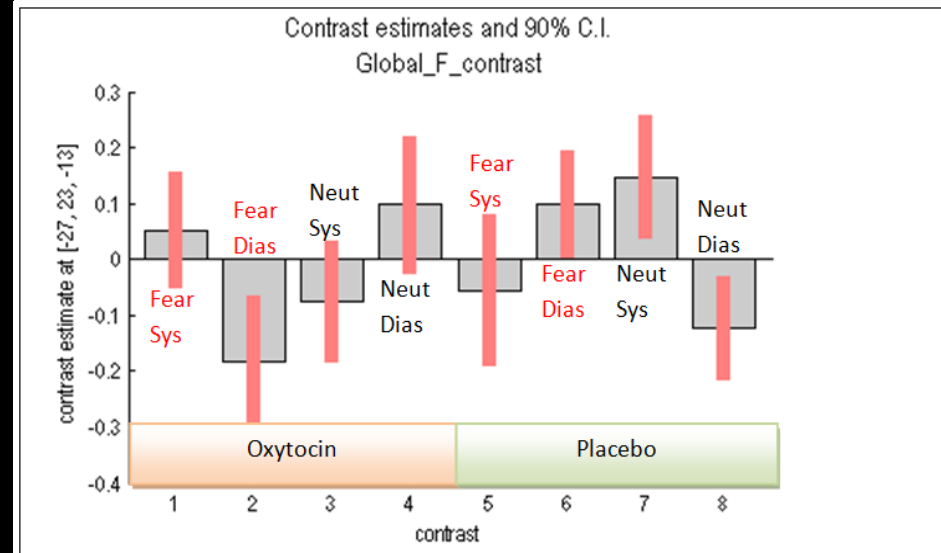
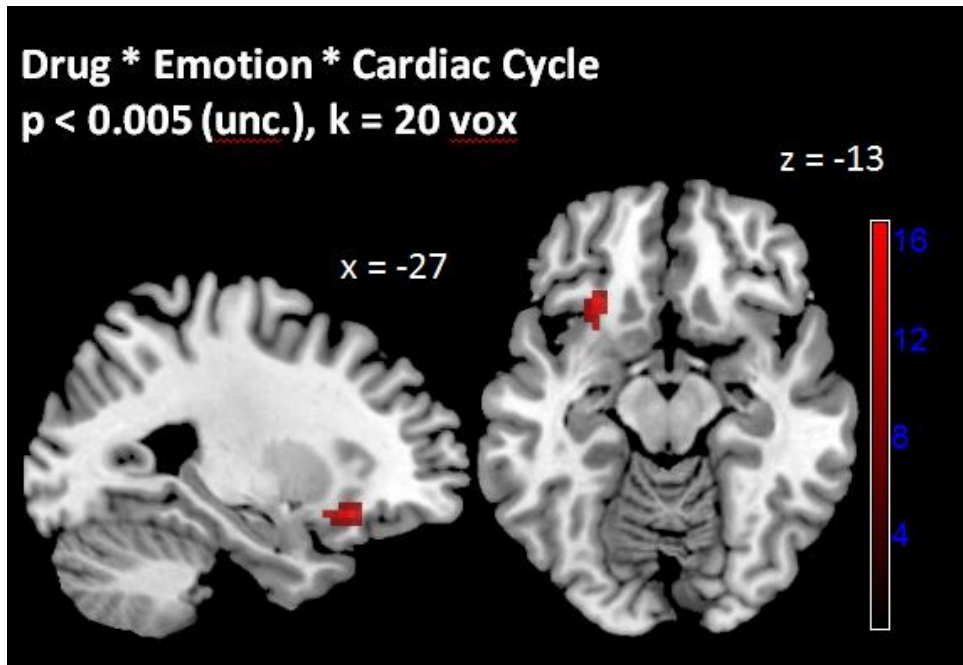


Results: Associative Learning

Four-way Interaction between
Drug*Emotion*Cardiac Timing * HB-Counting Accuracy
($F[1,27] = 8.37, p = 0.007$)



Results: Drug*Emotion*CC

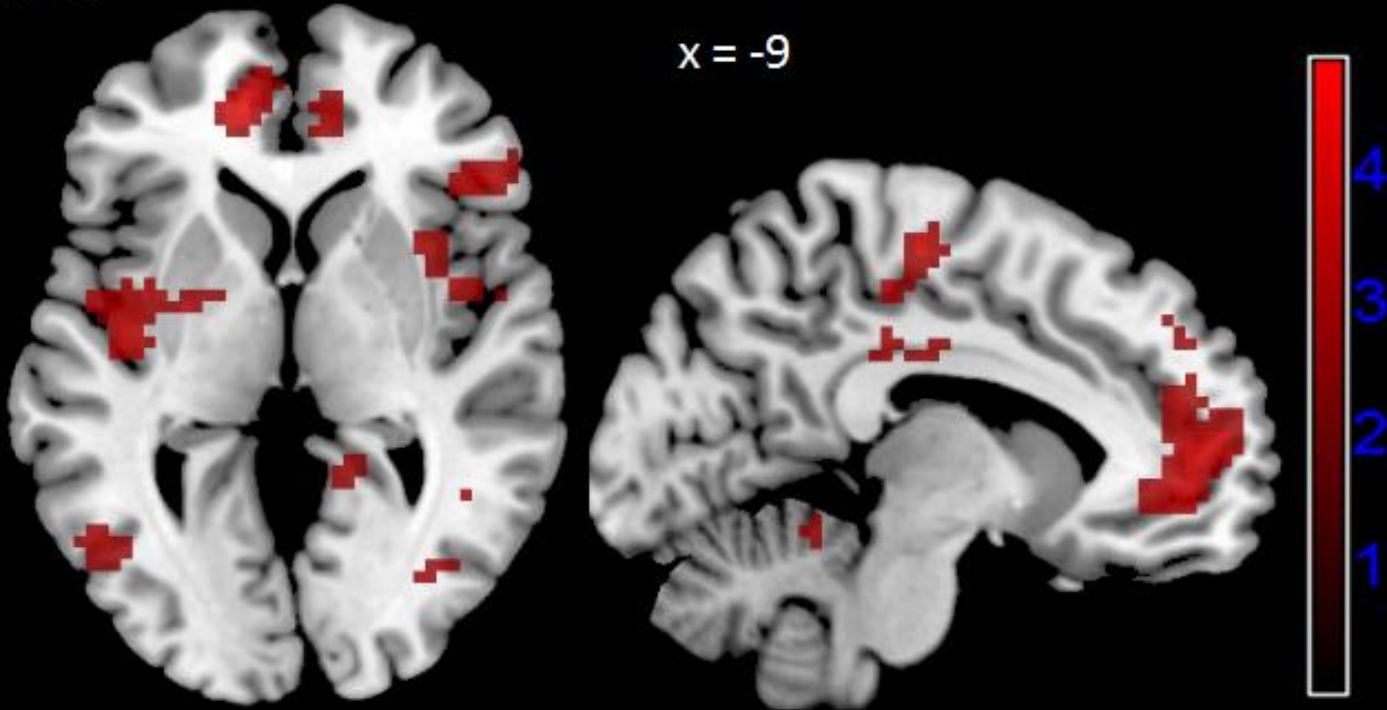


Results: Main effect of Drug

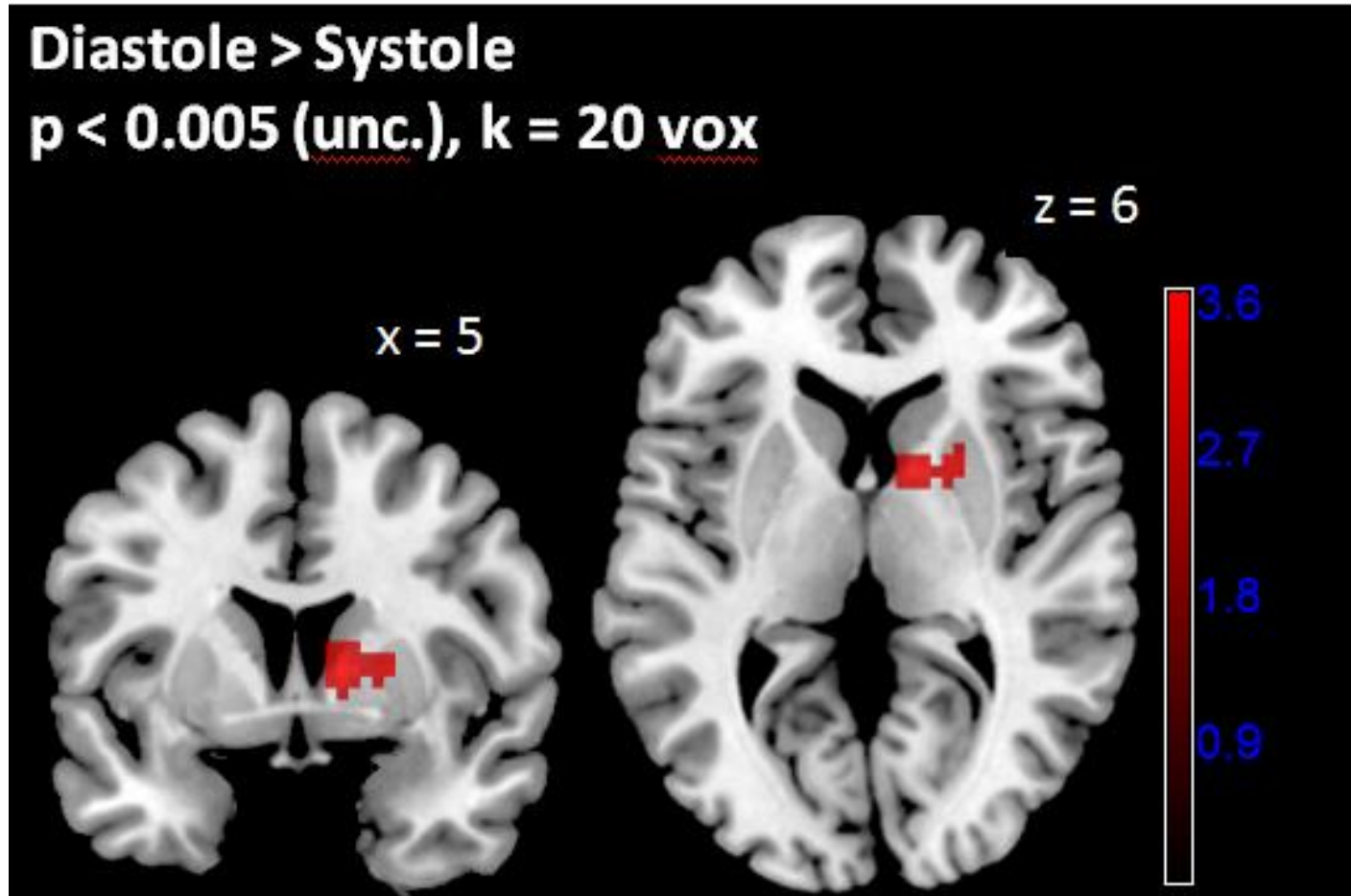
Oxytocin > Placebo
 $p < 0.005$ (unc.), $k = 20$ vox

$z = 2$

$x = -9$

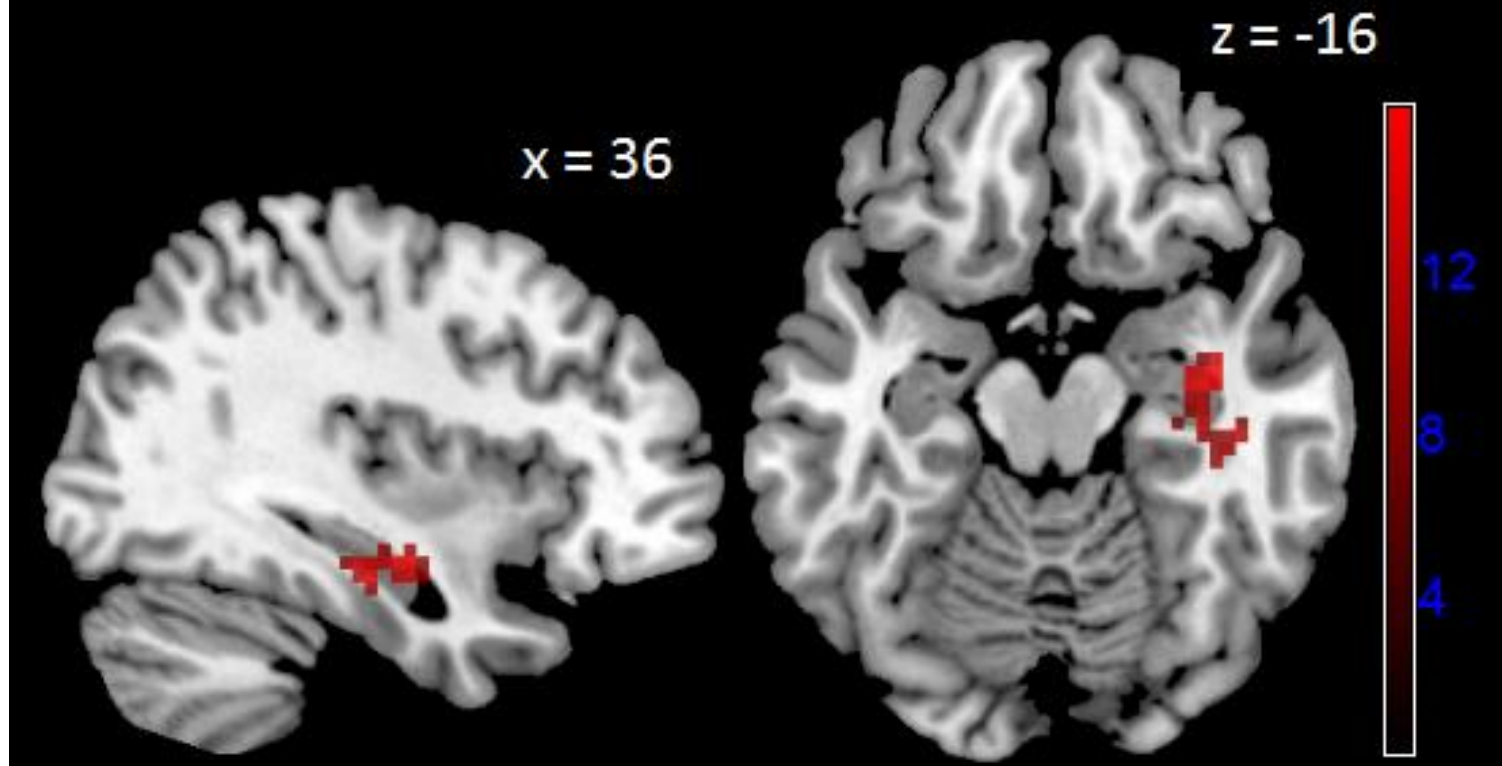


Results: Main effect of Cardiac Cycle



Results at Feedback: Main effect of Drug

Oxytocin > Placebo
 $p < 0.005$ (unc.), $k = 20$ vox



Summary

- Oxytocin attenuated the perception of cardiac signals → shown by poorer interoceptive accuracy
- Oxytocin selectively reduces fear learning at lower states of cardiovascular arousal (i.e. with feedback at diastole).
- Potential treatment for anxiety disorders?



Thank you



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