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

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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; Rimmiele et al., 2011; Bisby & Burgess, 2014; Pfeifer et al., 2017)
Arousal theory of emotion

• James – Lange Theory (late 19th century)

• Implications for translational research (Anxiety)
Cardiac Timing

Timing of stimuli at cardiac systole and diastole

Garfinkel & Critchley (2016)
Cardiac facilitation of fear

Garfinkel et al., 2014 *J. Neuroscience*
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

1 - 2 s

Lucy  Mara  Tina  Ella

3 s

100 ms synchronised with Heart
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

x = -9

x = 30
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

Drug * Emotion * Cardiac Cycle
p < 0.005 (unc.), k = 20 vox

$z = -13$

$x = -27$
Results: Main effect of Drug

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

z = 2

x = -9
Results: Main effect of Cardiac Cycle

Diastole > Systole
p < 0.005 (unc.), k = 20 vox

z = 6
x = 5
Results at Feedback: Main effect of Drug

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

$x = 36$
$z = -16$
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

• European Research Council

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