

Hurlemann, R., Patin, A., Onur, O. A., Cohen, M. X., Baumgartner, T., Metzler, S., Dziobek, I., Gallinat, J., Wanger, M., Maier, W., Kendrick, K. M. (2010). Oxytocin Enhances Amygdala-Dependent, Socially Reinforced Learning and Emotional Empathy in Humans. *The Journal of Neuroscience*, 30, 4999-5007.

Summary by Emma Seppala, Ph.D.; Postdoc

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The authors investigated whether the neuropeptide oxytocin (OT), whose administration has been linked to human bonding, generosity, and trust, and whose effects on learning have been mixed, would strengthen:

- 1) learning in a category association task involving social vs. nonsocial targets in the reinforcement associative learning task (RALT) with either social or nonsocial feedback and
- 2) cognitive or emotional empathy in the Multifaceted Empathy Test (MET).

The first study was a between-subject, double-blind, randomized, placebo-controlled investigation involving 48 healthy males. The participants received intranasal OT or a placebo at two intervals and engaged in the RALT and the MET administered in random order. The authors found that the control group showed facilitated learning when social reinforcements were used. Administering OT to the experimental group further facilitated the social learning and increased emotional empathy, but not cognitive empathy, in response to both positively and negatively valenced stimuli. The participants were exclusively male and the results suggest that administering OT raises men's emotional empathy to that of untreated women.

The authors then investigated whether selective bilateral damage to the amygdala (which shows substantial OT receptor expression and appears to be responsible for socially reinforced learning and empathic responding) would impact social learning and empathy. The second study therefore compared female monozygotic twins with selective and bilaterally symmetrical amygdala calcification damage and compared their performance on RALT task to 16 healthy female controls matched for age and IQ. The authors found that this bilateral amygdala damage impairs OT-sensitive aspects of socially reinforced learning but not nonsocially reinforced learning. The third study compared the monozygotic twins with 10 healthy female controls matched for age and IQ for performance on the MET. Results indicated that the bilateral amygdala damage impaired emotional empathy but did not impair cognitive empathy. These findings suggest that a healthy amygdala may be an important mediator of OT's effects on learning and empathy. Other researchers have found different effects in aversive or stressful laboratory contexts. The authors conclude that the amygdala may facilitate learning and empathy under positive and prosocial conditions but may inhibit learning under more aversive conditions.