

Oxytocin: Envy or Engagement in Others?

To the Editor:

Shamay-Tsoory *et al.* (1) reported that intranasal oxytocin administration to healthy participants increased ratings of negative interpersonal emotions. In their double-blind, placebo-controlled, within-subject study, 56 participants played a game of chance with another (fake) participant who either won more money (relative gain; envy manipulation), lost more money (relative loss; gloating manipulation), or won/lost equal amounts of money (equal gain). In comparison with the placebo, oxytocin increased the envy ratings in the relative loss conditions and increased ratings of gloating during relative gain conditions. The results seem to suggest that oxytocin facilitates negative social emotions, such as envy and gloating, and thus contrast with the prevailing belief that the oxytocinergic system is specifically involved in positive prosocial behaviors. However, although the results of Shamay-Tsoory *et al.* are interesting and provocative, a closer look at their results suggests an alternative interpretation. And even though the alternative interpretation is more in line with prevailing beliefs about oxytocin function, it would nevertheless be very relevant and consequential to studies of oxytocin, empathy, and game playing and informative about mechanisms of psychopathological disorders.

Table 1 in the Shamay-Tsoory *et al.* article shows that one of the envy-related emotion items was much more affected by oxytocin administration than all other items: "Would like to be in the other player's shoes?" From placebo equal gain to the condition of presumably largest effect, oxytocin relative loss, the increase is 1.12 points on a 6-point scale, which is twice the largest increase of all other items. Interestingly, this item already appears to be affected by oxytocin administration in the equal gain condition; its increase of .28 is one of the largest oxytocin-induced increases in the table, explaining more than half of the oxytocin-induced increase of this item in the relative loss condition (.52). Oxytocin even increases scores of this item .25 in the relative gain condition, a condition in which no feelings of envy would be expected. In fact, Shamay-Tsoory *et al.* report that oxytocin increased the average envy-related emotions score in the relative gain condition ($p = .051$). As the "other's shoes" item contributed most to this oxytocin-related increase, this suggests that the increases in this item are significant in all conditions.

This is a very interesting result! It suggests that oxytocin increases willingness to be in the other player's shoes irrespective of condition, i.e., it may increase a form of empathy. Previous studies found that intranasal oxytocin administration only affects behavior when the participant thinks he is playing against a human but not when he thinks he is playing against a computer (2). Hence, oxytocin may increase the willingness to absorb in a socially interactive game, including taking the perspective of others. This is in line with previous results that suggest that oxytocin stimulates and is associated with social attachment, involvement, concern, and empathy (3,4). This may result in slightly increased scores of envy, but only when compared with a more detached placebo condition in which the participant does not emotionally engage with the anonymous and invisible opponent.

So, it appears that the results can be explained by oxytocin-induced increases in social engagement and perspective taking, without indications that oxytocin increases negative social emotions independently of this increased social engagement. Indeed, oxytocin seemed to increase emotion ratings in general, irrespective of the condition. For the gloating-related emotions, for

instance, the interaction between treatment and condition was not significant ($p = .615$), suggesting oxytocin increased the emotions in all conditions. The increase in scores of the envious item in the relative loss condition is only .16 larger compared with the relative gain condition (in which no envy is expected!), a difference (interaction) that is probably not significant. Moreover, the small extra oxytocin-induced increases in the items envious and other's shoes in the relative loss condition can be explained by the relative absence of any interpersonal emotions in the participants in the placebo condition, who are detached from the opponent.

Even though this alternative interpretation is more in line with prevailing beliefs about oxytocin function, it nevertheless is very relevant to studies of oxytocin and empathy. It is exciting that oxytocin administration may increase social engagement and perspective taking and this result certainly deserves replication. Support for this function of oxytocin was recently reported in a study of 145 healthy participants in which increases in plasma oxytocin induced by an emotionally moving video were associated with increased feelings of empathy, higher dispositional empathic concern, and decreased feelings of distress (3). These associations were significant in women but not in men. In the Shamay-Tsoory *et al.* study, the average envy-related emotions score displayed a three-way interaction between treatment, condition, and gender ($p = .067$) that approached significance, leaving the possibility of significant gender differences regarding the other's shoes empathy item.

Interestingly, the first study of the neuromodulation by intranasal oxytocin in women (5), quite contrary to previous results in men, found increased activation by both positive and negative emotional facial expressions in areas including the superior temporal gyrus (STG), inferior frontal gyrus (IFG), insula, and amygdala. These areas have been implicated in the processing of facial emotions and eye gaze and contain so-called "mirror-neurons" believed to process the emotional state of others (6). Indeed, women have been found to activate the IFG and STG more strongly than men in an empathy task involving emotional expressions (7) and in response to disgusting stimuli (8). This may underlie sensitivity to social emotions in women and increased prevalence of psychiatric disorders such as anxiety disorders, atypical depression, eating disorders, and the cleaning variant of obsessive-compulsive disorder. Increased prevalence of these disorders in premenopausal women and preliminary results showing associations between plasma oxytocin and sensitive parenting (9) suggest that oxytocin-facilitated emotional empathy may be an adaptation to facilitate child care in women.

Taken together, the alternative interpretation of the results of Shamay-Tsoory *et al.* seems a better fit to both the results themselves and other recent findings. They suggest that oxytocin may facilitate emotional empathy and may be involved in increased susceptibility of women to certain psychiatric disorders. In contrast, autistic spectrum disorders and psychopathy are characterized by decreased emotional empathy and decreased IFG/insula and STS activation by social stimuli and may benefit from oxytonergic augmentation (10).

Mattie Tops

Centre for Child and Family Studies
University of Leiden
PO Box 9555
2300 RB Leiden
The Netherlands
E-mail: mtops@fsw.leidenuniv.nl

This research was supported by a Veni Grant of the Netherlands Organization for Scientific Research (NWO) (451-07-013).

The author reported no biomedical financial interests or potential conflicts of interest.

1. Shamay-Tsoory SG, Fischer M, Dvash J, Harari H, Perach-Bloom N, Levkovitz Y (2009): Intranasal administration of oxytocin increases envy and Schadenfreude (gloating) (published online ahead of print July 27). *Biol Psychiatry*.
2. Kosfeld M, Heinrichs M, Zak PJ, Fischbacher U, Fehr E (2005): Oxytocin increases trust in humans. *Nature* 435:673–676.
3. Barraza JA, Zak PJ (2009): Empathy towards strangers triggers oxytocin release and subsequent generosity. *Ann N Y Acad Sci* 1167:182–189.
4. Tops M, van Peer JM, Korf J, Wijers AA, Tucker DM (2007): Anxiety, cortisol and attachment predict plasma oxytocin levels in healthy females. *Psychophysiology* 44:444–449.
5. Domes G, Lischke A, Berger C, Grossmann A, Hauenstein K, Heinrichs M, Herpertz SC (2009): Effects of intranasal oxytocin on emotional face processing in women [published online ahead of print July 24]. *Psychoneuroendocrinology*.
6. Rizzolatti G, Fabbri-Destro M (2008): The mirror system and its role in social cognition. *Curr Opin Neurobiol* 18:179–184.
7. Schulte-Rüther M, Markowitsch HJ, Shah NJ, Fink GR, Piefke M (2008): Gender differences in brain networks supporting empathy. *Neuroimage* 42:393–403.
8. Caseras X, Mataix-Cols D, An SK, Lawrence NS, Speckens A, Giampietro V, et al. (2007): Sex differences in neural responses to disgusting visual stimuli: Implications for disgust-related psychiatric disorders. *Biol Psychiatry* 62:464–471.
9. Feldman R, Weller A, Zagoory-Sharon O, Levine A (2007): Evidence for a neuroendocrinological foundation of human affiliation: Plasma oxytocin levels across pregnancy and the postpartum period predict mother–infant bonding. *Psychol Sci* 18:965–970.
10. Bora E, Yucel M, Allen NB (2009): Neurobiology of human affiliative behaviour: Implications for psychiatric disorders. *Curr Opin Psychiatry* 22:320–325.

doi:10.1016/j.biopsych.2009.08.032