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Oxytocin's impact on social face processing is stronger in homosexual than heterosexual men

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Summary Oxytocin is an evolutionarily highly preserved neuropeptide that contributes to the regulation of social interactions including the processing of facial stimuli. We hypothesized that its improving effect on social approach behavior depends on perceived sexual features and, consequently, on sexual orientation. In 19 homosexual and 18 heterosexual healthy young men, we investigated the acute effect of intranasal oxytocin (24 IU) and placebo, respectively, on the processing of social stimuli as assessed by ratings of trustworthiness, attractiveness and approachability for male and female faces. Faces were each presented with a neutral, a happy, and an angry expression, respectively. In heterosexual subjects, the effect of oxytocin administration was restricted to a decrease in ratings of trustworthiness for angry female faces ($p < 0.02$). In contrast, in homosexual men oxytocin administration robustly increased ratings of attractiveness and approachability for male faces regardless of the facial expression (all $p \leq 0.05$), as well as ratings of approachability for happy female faces ($p < 0.01$). Results indicate that homosexual in comparison to heterosexual men display higher sensitivity to oxytocin's enhancing impact on social approach tendencies, suggesting that differences in sexual orientation imply differential oxytocinergic signaling.

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1. Introduction

The hypothalamic oxytocin system, in addition to releasing the hormone into the system via the posterior pituitary, projects to widespread brain areas including hippocampus, amygdala, and nucleus accumbens (Ludwig and Leng, 2006). Findings in animals and humans consistently indicate a strong involvement of oxytocin in the regulation of affiliative and social approach behavior, including postpartum mother-infant bonding (e.g., Feldman et al., 2007), the processing of social stimuli (e.g., Guastella et al., 2009; Domes et al., 2012) and the induction of sexual arousal (for reviews see Carter, 1998; Heinrichs et al., 2009; Panksepp, 2009; Bartz et al., 2011; Meyer-Lindenberg et al., 2011). A promoting influence of intranasal oxytocin administration on trusting behavior was demonstrated in experiments assessing the participants' willingness to take social risks (Kosfeld et al., 2005; Baumgartner et al., 2008). In accordance, experimental studies of couple interactions have indicated an enhancing effect of oxytocin on behaviors maintaining social ties (Grewen et al., 2005; Ditzen et al., 2009; Taylor et al., 2010; Ditzen et al., 2012; Scheele et al., 2012).

The impact of oxytocin administration on the processing of facial stimuli as an essential feature of social interactions has been addressed in a number of previous studies. In imaging studies in male participants, intranasal oxytocin dampened the amygdala response to threatening social stimuli like negative facial expressions (Kirsch et al., 2005; Domes et al., 2007; Gamer et al., 2010) and attenuated the deterioration of ratings of likeability for male faces induced by aversive conditioning, likewise in parallel to a reduction in amygdala activation (Petrovic et al., 2008). In contrast, increased amygdala activation in response to fearful faces was found in female subjects (Domes et al., 2010). In a study focusing on the social appraisal of faces in subjects of both sexes (Theodoridou et al., 2009), intranasal oxytocin administration increased the perceived trustworthiness and attractiveness of facial stimuli independent of the respective sex of the participant and the presented face, suggesting that the impact of oxytocin treatment on face processing is not modulated by the sexual attitude toward a facial stimulus. However, this conclusion remains preliminary as the study did not control for possible influences of menstrual cycle phase and hormonal contraception.

Against this backdrop and considering the strong sexual component of oxytocin's role in human physiology, the present study aimed at clarifying to which extent sexual orientation modulates the effect of oxytocin administration on face processing. In order to exclude confounding influences of sex differences unrelated to sexual orientation, we compared oxytocin effects between male participants with either homosexual or heterosexual orientation, rather than between heterosexual men and women. In response to female faces, heterosexual men and homosexual women in comparison to heterosexual women and homosexual men exhibit stronger activation of reward-processing thalamic and orbitofrontal structures, and this pattern is reversed when male faces are presented (Kranz and Ishai, 2006). We therefore expected our approach to provide insight into interactions between oxytocin effects and sexual orientation toward men or women in general. Moreover, the ongoing discussion on the relationship between neuroendocrine factors and sexual orientation up to now has largely ignored the potential role of oxytocin (for review see Balthazart, 2011). In detail, we hypothesized that oxytocin administration generally enhances the approach-related appraisal of faces, yet depending on sexual orientation, i.e., that heterosexual men rate female faces higher for attractiveness and approachability after oxytocin administration, whereas in homosexual men this effect is observed for male faces. In contrast, the effect of oxytocin on ratings of trustworthiness was expected to be independent of the face's sex and the rater's sexual orientation, assuming that oxytocin modulates facial processing subject to the sexual component involved.

2. Methods

2.1. Participants

Thirty-seven healthy young male volunteers were recruited on site (i.e., via the university's mailing list and word-of-mouth advertising), online (part-time job websites), and via gay media outlets. Participants were assigned to two experimental groups according to their sexual orientation as indicated by their mean scores across the dimensions 'sexual attraction', 'sexual behavior', 'sexual fantasies', and 'self-identification' of the Klein Sexual Orientation Grid (KSOG; Klein et al., 1985) that categorizes sexual orientation from 1 (exclusively heterosexual) to 7 (exclusively homosexual). The homosexual and the heterosexual groups comprised 19 and 18 men, respectively. None of the subjects was on any medication and all relevant illness was excluded by clinical examination taking place within one week before the first experimental session. Groups were comparable regarding psychological and endocrine markers except for slightly increased serum testosterone concentrations in homo- as compared to heterosexual subjects (see Table 1 for group characteristics). Participants gave written informed consent to the study which conformed to the Declaration of Helsinki and was approved by the local ethics committee.

2.2. Design and experimental procedure

According to a 2×2 experimental design, subjects of both groups participated in two conditions (oxytocin and placebo) that were spaced apart at least two weeks. The order of conditions was balanced across subjects and all experiments were performed in a double-blind fashion. Subjects were instructed not to eat or drink (except water) for 2 h before the experiment and not to ingest alcoholic or caffeinated drinks after 2000 h on the preceding day. Experimental sessions (Fig. 1) started around 1600 h with baseline assessments of the control parameters mood, vigilance, memory function, and anxiety. At 1630 h, subjects were intranasally administered 24 IU oxytocin (0.6 ml Syntocinon®, Novartis, Basel, Switzerland) and placebo (0.6 ml vehicle containing all Syntocinon ingredients except for the peptide), respectively, at 6 individual puffs (volume 0.1 ml; 3 per alternating nostril) with 30-s intervals in-between. After intranasal administration, neuropeptides like vasopressin, a nonapeptide with high structural similarity to oxytocin reach the central nervous