



Effects of oxytocin on human social approach measured using intimacy equilibriums

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ABSTRACT

Research in animals and humans suggests a role of oxytocin in social approach to strangers. We tested this by introducing undergraduate students to opposite-gendered strangers, with each member of the pair having taken either oxytocin or placebo. One hundred and four undergraduate students were paired up and engaged in a face-to-face conversation structured with a series of intimate topics for discussion. We found that oxytocin increased conversational intimacy in female but not male participants, but that this was matched with compensatory decreases in eye-contact (relative to placebo). Argyle and Dean (1965) conceptualise intimacy as a function of physical distance, eye-contact, and conversational intimacy, such that equilibrium is maintained when increases in one domain are matched by compensatory decreases in another domain. Based on this notion, our results suggest that oxytocin does not facilitate social approach by increasing the intimacy equilibrium between two strangers.

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Introduction

The peptide oxytocin is renowned for its effects on the peripheral nervous system (e.g., inducing contractions during labour), but there has been recent interest in its effects on the central nervous system — through oxytocin receptors in the brain. One of the most robust and important findings has been the central effect of oxytocin on *social approach*, or the willingness to approach a stranger (Lim and Young, 2006).

Research on oxytocin in social approach began with non-human animals, where species differences in social approach appeared to map onto species differences in oxytocin receptor distribution amongst macaque monkeys (Rosenblum et al., 2002) and voles (Insel and Shapiro, 1992; Smeltzer et al., 2006). Administration of oxytocin directly into the animal brain has also been found to increase social approach, with oxytocin rats showing increased investigative and huddling behaviour to new conspecifics of the opposite sex (Witt et al., 1992). Together, these findings suggest that oxytocin is able to facilitate social approach in animals (for reviews, see Lim and Young, 2006; Young, 2002).

Several lines of research suggest that as with animals, oxytocin may also influence the initial meeting between two human strangers, promoting mutual interaction between them. First, several studies have found that oxytocin administration reduces the normal increase in amygdala activation associated with the perception of threatening

situations (e.g., Petrovic et al., 2008; Singer et al., 2008). For example, seeing threatening faces or scenes typically increases amygdala activation relative to seeing neutral shapes; however, Kirsch et al. (2005) found that oxytocin administration attenuated this increase. To the extent that decreased amygdala activation relates to a decreased assessment of threat, and to the extent that any encounter with strangers is threatening, then oxytocin could promote social approach by decreasing the perceived threat associated with meeting strangers. In support of this, social interactions with other people are associated with greater amygdala activation than non-social interactions (i.e., having no other person interacting on a task; Nawa et al., 2008); however, this difference has been shown to be attenuated by oxytocin administration (Baumgartner et al., 2008).

A second line of research has explored the effects of oxytocin on interaction behaviours with strangers. For example, even in the absence of any information about or contact with a stranger, oxytocin was found to increase trusting behaviours to a stranger — as seen through increased money transferred in an economic game (Baumgartner et al., 2008; Kosfeld et al., 2005; Mikolajczak et al., 2010a, 2010b). Oxytocin may also increase trust and desire to interact by highlighting the value of cooperation — in particular, when there is a potential cost for not doing so (Zak et al., 2007), or when there has been a positive experience of inclusion (Alvares et al., 2010).

Finally, oxytocin has also been found to have a priori effects on the way socially-relevant information is gathered or processed (Guastella and Macleod, 2012). For example, studies have found that oxytocin increases gaze to the eye region of faces presented through photographs (Andari et al., 2010; Gamer et al., 2010; Guastella et al., 2008). The phenomenon of looking at people's eyes has been linked to the ability to understand what emotions others are experiencing

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(e.g., Adolphs et al., 2005). Thus, oxytocin – in focusing attention on the eye region – may be able to promote emotional understanding. In support of this idea, Domes et al. (2007) found that oxytocin improved the ability to interpret states of mind from photographs of strangers' eyes; similarly, Guastella et al. (2010) found that oxytocin improved emotion recognition in participants with autism. Thus, oxytocin may shape the initial experience of a stranger by guiding what is focused on and by improving understanding of the other person.

Taken together, oxytocin appears to exert a priori changes on attitude and information processing that could shape a first encounter between two strangers. This does not correspond directly to social approach in animals, which is typically operationalised as increased contact with, or a decrease in physical distance towards, a novel conspecific (e.g., Witt et al., 1992). However, the human findings of a priori oxytocin effects can be linked to social approach by framing them within a social psychological theory on interpersonal distance.

Oxytocin and the intimacy equilibrium

In 1965, social psychologists Argyle and Dean proposed that the interpersonal distance or *intimacy equilibrium* between two people can be conceived as a function of their physical distance, eye-contact, and conversational intimacy during an interaction: the closer the relationship between two people, the higher the equilibrium – expressed by less physical distance, more eye-contact, and higher conversational intimacy (Argyle and Dean, 1965). However, within a fixed equilibrium between two people, increased intimacy in one domain during the interaction will result in decreased intimacy in another domain, allowing the equilibrium to be maintained. For example, with no changes to a dyadic equilibrium, increasing eye-contact would result in decreased conversational intimacy between the pair.

Framing the effects of oxytocin within Argyle and Dean's theory, the finding that oxytocin increases eye-contact could mean that oxytocin merely increases one domain within the intimacy equilibrium. If so, for the equilibrium to be maintained, oxytocin may result in compensatory mechanisms in the other domains (i.e., increased physical distance and decreased conversational intimacy). On the other hand, because oxytocin decreases amygdala activation in social contexts, increases trust and cooperation, and promotes emotional understanding, it seems likely that oxytocin's effect in increasing eye-contact is indicative of the entire equilibrium being raised. That is, oxytocin may facilitate social approach behaviour by making two people start off with a higher intimacy equilibrium (and thereby with decreased interpersonal distance) – simultaneously decreasing their physical distance, increasing their eye-contact, and increasing their conversational intimacy.

To test the effects of oxytocin on social approach, we used a well-known social psychology method to introduce strangers to each other – the *Relationship Closeness Induction Task* (RCIT; Sedikides et al., 1998, 1999). With this task, two people meet for the first time and are asked to discuss a series of questions that increase progressively in intimacy (from low to high intimacy). By inducing different levels of conversational intimacy, the RCIT allows a test of the social approach hypothesis: the intimacy equilibrium theory would predict that as conversational intimacy increases, eye-contact should decrease and physical distance should increase. If oxytocin can increase social approach, then the whole intimacy equilibrium should be raised such that these compensations would be reduced. That is, as conversational intimacy increases, oxytocin participants should show more eye-contact and have less physical distance than placebo participants.

To summarise, the present study was designed to test whether oxytocin can increase social approach during a first encounter with a stranger. In the language of intimacy equilibriums, we tested the hypothesis that oxytocin could increase approach by increasing the

intimacy equilibrium between the pair – that is, by simultaneously increasing conversational intimacy, increasing eye-contact, and decreasing physical distance during an initial meeting.

Methods

Participants

Participants were 104 students from the University of New South Wales who participated in exchange for course credit in an introductory psychology course. All experimental procedures were approved by the university's Human Research Ethics Committee (#06074 and #08348). Participants were excluded if they: were pregnant; had epilepsy, severe depression, severe anxiety, or psychosis; smoked more than 15 cigarettes a day; or were addicted to illegal substances. To control for menstrual cycle variations, all female participants were asked to participate one week before their next expected menses (during the mid-luteal phase of the cycle, when endogenous plasma oxytocin levels were at their lowest; Salonia et al., 2005), or anytime if they were on oral contraceptives (since plasma oxytocin levels would then be stable across the menstrual cycle; Salonia et al., 2005). All participants also had to agree to the conditions of participation: abstaining from alcohol, caffeine, and recreational drugs on both days of the experiment; abstaining from food and drink 2 h before the first session; and being willing to abstain from driving if drug consumption made them drowsy. Finally, each participant signed up at the same time as an opposite-gendered participant he or she had not met before, and each pair of participants was randomly allocated to one of four drug-pairing groups.

In the first group, 13 men (M age = 19.08 years, SD = 1.89 years) and 13 women (M age = 19.54 years, SD = 1.61 years) each received oxytocin. In the second group, 14 men (M age = 18.85 years, SD = 1.51 years) who received placebo were paired up with 14 women (M age = 18.64 years, SD = 1.39 years) who received oxytocin. In the third group, 12 men (M age = 19.17 years, SD = 3.56 years) and 12 women (M age = 19.17 years, SD = 1.40 years) were administered placebo. Finally, in the fourth group, 13 men (M age = 19.72 years, SD = 1.01 years) who received oxytocin were paired up with 13 women (M age = 19.23 years, SD = 1.74 years) who received placebo. In total, the oxytocin group had 53 participants (26 men and 27 women), and the placebo group had 51 participants (26 men and 25 women).

Consistent with previous research (MacDonald et al., 2011), oxytocin and placebo participants did not differ in their beliefs about which drug they had received ($\chi^2(3, N = 103) = 2.80, p = 0.09$), nor in terms of self-reported calmness following drug administration ($t(101) = 0.15, p = 0.88$). Additionally, oxytocin and placebo participants did not differ in terms of: relationship status (oxytocin group: 28 single and 23 non-single; placebo group: 26 single and 25 non-single), sexual orientation (oxytocin group: 47 heterosexual and 4 non-heterosexual; placebo group: 50 heterosexual and 1 non-heterosexual), nor ethnicity (oxytocin group: 32 Caucasian, 12 Asian, and 7 others; placebo group: 19 Caucasian, 22 Asian, and 10 others); smallest $p = 0.08$. Finally, female participants in both oxytocin and placebo groups did not differ by: usage of oral contraceptives (15 oxytocin and 9 placebo participants; $\chi^2(3, N = 52) = 2.00, p = 0.16$), nor of stage of menstrual cycle for participants not on oral contraception (at test, number of days since their last menstrual period: M for oxytocin group = 20.58, SD = 12.01 and M for placebo group = 20.5, SD = 6.99; $t(26) = -0.02, p = 0.98$).

Materials

Drug

Oxytocin administration involved 24 IU of synthetic oxytocin delivered intranasally in four puffs per nostril (with 3 IU per puff). The

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