



SHORT COMMUNICATION

Oxytocin enhances implicit social conformity to both in-group and out-group opinions



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Summary People often alter their own preferences when facing conflicting opinions expressed by others. This is known as the social conformity effect and tends to be stronger in response to opinions expressed by in-group relative to out-group members. The hypothalamic neuropeptide oxytocin promotes in-group favoritism, elicits parochial altruism, and stimulates in-group conformity under explicit social pressure. In a double-blind, placebo-controlled design experiment using a facial attractiveness judgment task, we therefore investigated whether social conformity to either in-group or out-group opinions is influenced by intranasal oxytocin treatment when social pressure is implicit. After oxytocin or placebo treatment, male participants were asked to rate the attractiveness of unfamiliar Chinese female faces, and then they were informed of ratings given by peers from an in-group (Chinese) and out-group (Japanese) simultaneously. They were subsequently asked unexpectedly to re-rate the same faces. Results showed that oxytocin increased conformity to both in- and out-group opinions. Thus oxytocin promotes conformity to opinions of both in- and out-group members when social pressure is implicit, suggesting that it facilitates 'tend and befriend' behaviors by increasing the general level of social conformity.

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1. Introduction

People tend to alter their behavioral preferences to match the opinions of others in order to fit in. This effect is known as social conformity (Cialdini and Goldstein, 2004). A number of studies have reported that hypothalamic neuropeptide oxytocin can bias prosocial behavior toward in-group members. It promotes trust in contexts where individuals become categorized as in-group members (Baumgartner et al., 2008); enhances in-group favoritism, and parochial cooperation (De Dreu et al., 2011) and there is some evidence that it can also increase non-cooperation with members of potentially threatening out-groups (De Dreu et al., 2010). However, another study has reported that oxytocin can increase empathy toward out-group members (Shamay-Tsoory et al., 2013). Oxytocin has also been found to enhance conformity to in-group members when under the social pressure of conflicting ratings provided by in- and out-groups (Stallen et al., 2012), although whether it also does so during periods when social stress is minimal is unknown.

Overall these oxytocin findings may reflect a “tend and defend” pattern whereby it facilitates protection of in-group members but aggression or non-cooperation in response to out-group threat under circumstances where there is explicit inter-group conflict or competition involved. However, perhaps under circumstances where influences of in- and out-group are implicit, or where there are no explicit aspects of intergroup conflict or competition, then oxytocin may promote a more “tend-and-befriend” pattern of behavior. This “tend and befriend” pattern involves both in-group protection (tending) but also affiliating with other social groups, including out-groups, to reduce risk of harm (befriending) (Taylor et al., 2000). For example, studies have shown that oxytocin promotes affiliative behavior in response to stress, in conjunction with dopaminergic and opioid systems (Taylor et al., 2006; Taylor et al., 2000). In the present study, we therefore hypothesized that oxytocin would influence conformity to both in- and out-group opinions in a context where social pressure is implicit and therefore perceived inter-group conflict/competition is minimal.

2. Materials and methods

2.1. Participants

To examine effects of oxytocin on in- and out-group conformity, 85 male participants were recruited for a double-blind, randomized, placebo-controlled, mixed design. We administered oxytocin to 39 participants (mean age \pm SE, 20.26 ± 0.29 years) and placebo to the other 46 participants (mean age \pm SE, 20.54 ± 0.27 years). All participants were right-handed, had normal or corrected-to-normal vision, and were screened for neurological or psychiatric disorders. All participants gave written, informed consent and were informed of their right to discontinue participation at any time.

2.2. Experimental paradigm

Participants were first randomly assigned to either intranasal administration of oxytocin (24 IU; Syntocinon-Spray, Sichuan

Meike Pharmacy Co. Ltd, China; three puffs of 4 IU per nostril with a 30 s between each puff) or placebo (identical sprays with the same ingredients other than the neuropeptide). Participants and experimenter were blind to drug condition. The experimental task was carried out starting 45 min after intranasal treatment.

The stimuli were 98 digital photographs of neutral expression faces of young adult Chinese women. These photographs either were downloaded from free Internet sources or were pictures taken of university students (with consent). These photos had been pre-rated by the participants in our previous study (Huang et al., 2014b) and only those with moderate attraction ratings were selected. All photos were in color and of similar quality and general appearance. At the beginning of each trial, we presented a photograph of a female face on a computer monitor for 2 s. An 8-point Likert scale (1 = very unattractive, 8 = very attractive) was then added to the display, and the participants were asked to rate the face by pressing the corresponding key (within 4 s). A blue box confirmed the initial rating for 0.5 s. Finally, the Chinese and Japanese flags were shown simultaneously for 3 s indicating that they were seeing the average rating of the same face given by 200 other students from either a Chinese (in-group rating) or Japanese university (out-group rating, Fig. 1).

The ratings given by the in- and out-groups were assigned using the following criteria: in 25% of trials, in-group ratings agreed with the subject's ratings, whereas in the remaining 75% of trials, in-group ratings were equally likely to be above or below the participant's rating by ± 1 , ± 2 or ± 3 points, using an adaptive algorithm that kept the overall ratio of “more negative” or “more positive” in-group ratings approximately equal during the experiment. The out-group ratings were programmed using the same criteria as in-group ratings. There are 49 different conditions (7×7 matrix) of conflict between initial ratings and in/out-group ratings.

The assignment of faces to conditions was determined randomly for each participant. After 30 min, participants were asked to complete a second testing session, which they had not been told about previously. In this re-rating session, we asked the participants to rate the same faces again based on their current judgment. Faces were presented in randomized order, and participants were not reminded of the original in- and out-group ratings.

3. Data analysis and results

There was no significant difference between mean attraction ratings given by participants for the faces in the two treatment groups [$t(83) = 0.46$, $p = 0.65$], showing that oxytocin had no overall effect on increasing perceived attractiveness of the faces. For the reaction times (RTs) in the initial rating session, there was no significant difference between participants given placebo and oxytocin, $t(83) = 0.49$, $p = 0.63$. For the RTs in the re-rating session, a 3-way ANOVA using conflict condition (peers-lower vs. peers-higher) and influence type (in-group vs. out-group) as within-subject factors and treatment (placebo vs. oxytocin) as a between-subject factor revealed no significant effects ($ps > 0.5$).

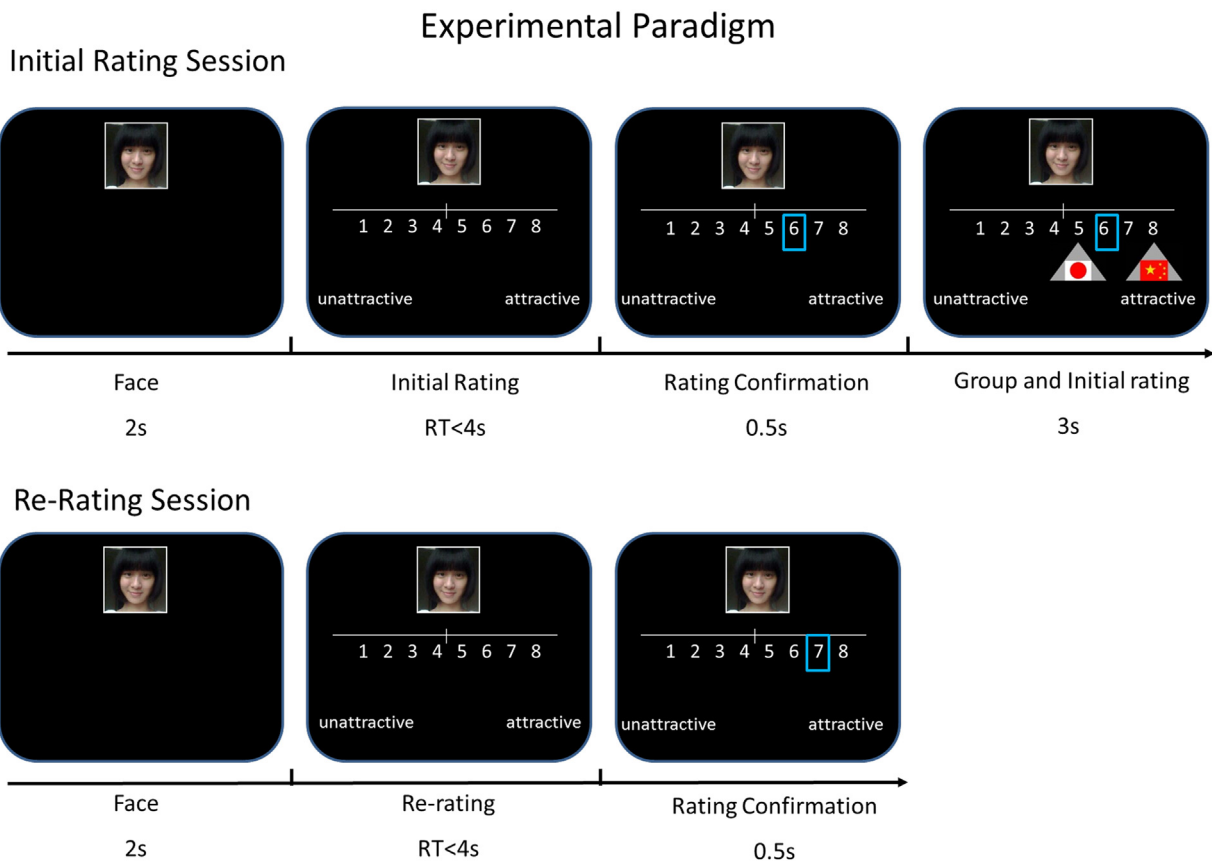


Figure 1 Experimental task design. During each trial of the initial rating session, participants viewed a photograph of a female face and used an 8-point Likert scale to rate the face. A blue box appeared to confirm the initial rating. Finally, a Chinese flag indicated the average rating of the same face given by other students in a Chinese university (in-group rating) or a Japanese flag indicated the average rating given by students in a Japanese university (out-group rating). In the re-rating session, participants rated the same faces again without being reminded of ratings given by the in-group or out-group members.

To examine the conformity effect and control for the effect of regression to the mean (Huang et al., 2014a), we followed the procedure of Zaki et al. (2011). For each participant we selected a subset of faces where the participant's initial ratings were matched across the in-peers-lower and in-peers-higher conditions and across the out-peers-lower and out-peers-higher conditions ($ps > 0.10$). We computed mean-corrected ratings of attractiveness for each session (Sharot et al., 2012) to control for the overall changes in ratings across sessions. The mean-corrected rating was the distance between a participant's rating of a particular face and the average rating for that participant and rating session. We created a rating change score per face (i.e. mean-corrected re-rating minus the mean-corrected initial rating).

In these subsets, the rating change scores (re-rating–initial rating, Fig. 2A) were analyzed by a 3-way ANOVA using conflict condition (peers-lower vs. peers-higher) and influence type (in-group vs. out-group) as within-subject factors and treatment (placebo vs. oxytocin) as a between-subject factor. This revealed a significant main effect of conflict condition, $F(1,83) = 17.50$, $p = 0.001$. The interaction effect between influence type and treatment was significant, $F(1,83) = 4.69$, $p = 0.033$. Participants given

oxytocin were more sensitive to the out-group influence than those given placebo, $t(1,83) = -2.32$, $p = 0.023$. There was no difference between the oxytocin and the placebo groups for the in-group influence, $t(1,83) = -1.33$, $p = 0.19$. We also found a significant interaction effect between conflict condition and treatment, $F(1,83) = 4.61$, $p = 0.035$. Specifically, the update difference (peers-higher condition minus peers-lower condition) was significantly larger for the oxytocin group (0.21 ± 0.04) than for the placebo group (0.07 ± 0.05), suggesting that participants given oxytocin demonstrated greater conformity to both in-group and out-group opinions than those given placebo. Other effects were not significant, $ps > 0.1$.

We also conducted a regression analysis with the re-rating score as dependent variable and the initial rating, in-group rating and out-group rating as independent variables in each treatment group. For the participants given placebo, results showed that only initial rating ($B = 0.68$, $p < 0.001$) and in-group rating ($B = 0.021$, $p < 0.05$) significantly predicted re-rating score, the regression coefficient of out-group rating was not significant ($B = 0.002$, $p = 0.79$). For the participants given oxytocin, the initial rating ($B = 0.63$, $p < 0.001$), the in-group rating ($B = 0.047$, $p < 0.001$) and the out-group rating ($B = 0.035$, $p < 0.001$) all significantly

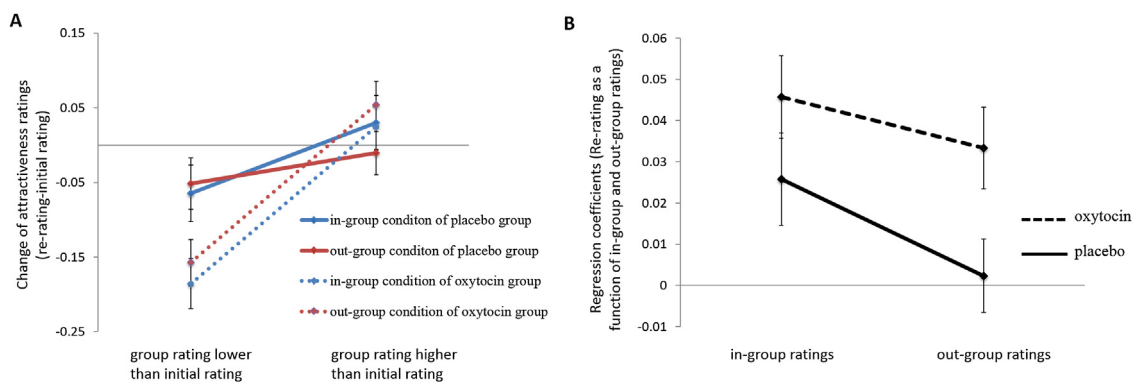


Figure 2 Conformity effect of oxytocin and placebo groups. (A) Change in mean-corrected ratings as a function of conflict condition, influence type and treatment group. Oxytocin enhances both in-group and out-group conformity especially when groups' ratings are lower than participants' own initial ratings. (B) Regression analysis showed that the average regression coefficient in the oxytocin group is larger than in the placebo group, regardless of group affiliation. Error bars indicate ±1 SE.

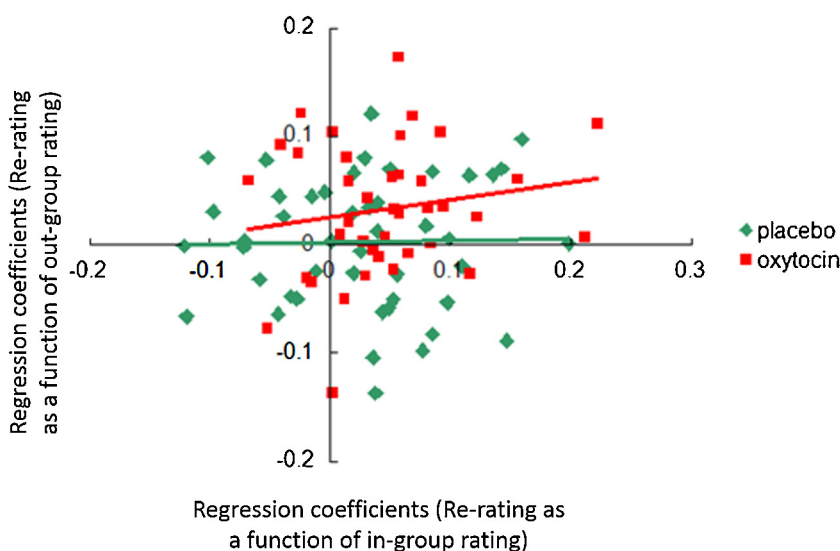


Figure 3 The conformity effect for each participant. The dotted line indicates the same regression coefficients in both in-group and out-group conditions.

predicted the re-rating score. When reaction time was included as another independent factor, the effects of initial rating and in-group rating remained significant for the placebo group ($ps < 0.05$), the effects of initial rating, in-group rating and out-group rating remained significant for the oxytocin group ($ps < 0.001$). The conformity effect for each participant is shown in Fig. 3. 17 out of 46 participants in the placebo group and 24 out of 39 participants in the oxytocin group demonstrated positive conformity effects for both in-group and out-group conditions. 21 participants in the placebo group and 12 participants in the oxytocin group exhibited differential conformity effects across in-group and out-group conditions. For the average regression coefficients of each participant, a 2-way ANOVA using influence type (in-group vs. out-group) as a within-subject factor and treatment (placebo vs. oxytocin) as a between-subject factor revealed a significant main effect of treatment, $F(1,83) = 5.84, p = 0.018$, with larger coefficient in the oxytocin group (0.039 ± 0.008) than the placebo group (0.014 ± 0.007). The main effect of influence type

was marginally significant, $F(1,83) = 3.38, p = 0.07$, showing a tendency that participants were more sensitive to the in-group influence than the out-group influence. There was no interaction effect between influence type and treatment, $F(1,83) = 0.32, p = 0.57$. The results indicate that oxytocin enhances both in-group and out-group conformity (Fig. 2B).

In order to compare the influences of peers-lower and peers-higher ratings, we performed an additional 3-way ANOVA using conflict condition and influence type as within-subject factors and treatment as a between-subject factor, with the size of the conformity effect (the absolute update of mean-corrected scores) as a dependent factor. Results showed a significant main effect of conflict condition, $F(1,83) = 14.78, p < 0.001$. The influence of peers-lower ratings (0.11 ± 0.02) was greater than that of peers-higher ratings (0.02 ± 0.02). The main effect of treatment was also significant, $F(1,83) = 4.61, p = 0.035$. In general, the participants given oxytocin (0.11 ± 0.02) showed a larger conformity effect than those given placebo (0.03 ± 0.02). The interaction effect between conflict condition and

treatment was marginally significant, $F(1,83)=3.19$, $p=0.078$. The absolute update difference (peers-lower condition minus peers-higher condition) was significantly larger for the oxytocin group (0.13 ± 0.04) than for the placebo group (0.04 ± 0.03). We also found a significant interaction effect of conflict condition, group type and treatment, $F(1,83)=4.69$, $p=0.033$. Further analyses demonstrated that for participants given oxytocin the absolute update difference (peers-lower condition minus peers-higher condition) in the in-group condition was significantly larger than in the out-group condition, $t(38)=2.13$, $p=0.04$. The absolute update difference did not differ significantly between in-group and out-group conditions for the participants given placebo, $p=0.33$. No other effects were significant, $ps>0.1$. These results suggest that oxytocin increased the influence of group ratings, especially when group ratings were lower than participants' initial ratings.

4. Discussion

Our study demonstrates that oxytocin increases conformity regardless of the membership of social groups when social pressure is minimal (other people's opinions are not presented during the re-rating session). In the case of socially sensitive issues, individuals may hold two separate attitude systems termed explicit and implicit attitudes. When individuals exert a conscious control over their actions, the behavior is likely to be mainly driven by explicit attitudes. However, when such conscious control is prevented, implicit attitudes are more likely to automatically influence responses (Wilson et al., 2000). In terms of intergroup conformity, a previous study has shown that at an implicit level, participants feel greater similarity with an in-group member who uses stereotype-consistent information and are more likely to conform to them (Castelli et al., 2003). On the other hand at a more explicit level participants report greater similarity with an in-group member who uses stereotype-inconsistent information. Furthermore, under general circumstances, because interacting with in-group members is more rewarding, people tend to favor in-group over out-group (Yzerbyt and Demoulin, 2010). Thus oxytocin may strengthen the reward of in-group preference. However, implicit conformity does not relate to any conflict of interest, and so it is reasonable that under these circumstances oxytocin enhances implicit conformity to both an in-group and out-group opinion.

Our present results are inconsistent with a previous study that oxytocin only stimulates in-group conformity in a situation where peers' opinions are presented (Stallen et al., 2012). In this study, participants first viewed a symbol and also the attractiveness ratings of this symbol from in-group and out-group members. Then they were asked to rate the symbol by themselves. Although such a group setting did not employ face-to-face interaction, and did not require subjects to make public responses, they did see other people's opinions at the same time as they made their own judgments, and they also knew that both in- and out-group members could see their decision. Thus, the social pressure in this study was relatively explicit. However, in our experimental task participants rated female faces first, and then they were simply informed of the average ratings from both

the in-group and out-groups. Only after they had rated all the faces were they then given the unexpected opportunity to re-rate the faces again, but without being reminded of the group ratings. Under these circumstances it is virtually impossible for participants to remember all the ratings the in- and out-group members had made, and so the social pressure in our study was relatively implicit. It is quite possible that a different manipulation of social pressure (explicit vs. implicit) led to discrepant results in the two studies. Further, since the study did not have an initial baseline rating included in the design it is also difficult to judge the magnitude of any conformity effect on individual stimuli other than by comparison with ratings on stimuli where no in- or out-group ratings were given.

The alternative explanation that oxytocin promoted socially-sensitive memorization is highly unlikely. The instruction stressed that the study focus on participants' own opinion. During the experiment, the participants were not required to use any specific strategies such as an attempt to predict or remember others' ratings. We also did not assume that participants implicitly memorized every in-group and out-group ratings. The memory effect would suggest that during the whole experiment, a participant remembered 98 faces with their associated ratings and the conflict with both in-group and out-group opinions. Taking into account that the large number of stimuli ($n=98$), three rating scores for each trial, a long break between two sessions (30 min), and the subjects were not forewarned of the re-rating session, we can conclude that a simple memory effect cannot be entirely excluded but is nevertheless implausible. Thus, the re-ratings should reflect the participants' own opinions at the re-rating stage rather than the memorized rating. Our findings suggest that oxytocin enhance implicit conformity effect to both in-group and out-group opinions.

From an evolutionary perspective, when out-group threat is not imminent, conformity to everyone can facilitate social harmony by avoiding any potential conflicts (Ebitz and Platt, 2013). Our results suggest that oxytocin may promote 'tend and befriend' behaviors by increasing the general level of social conformity. Oxytocin may be at the core of "tending" when response to pressure. Evidence from a large number of animal studies shows that administration of oxytocin enhances maternal behavior (Taylor et al., 2000). Previous studies have demonstrated that "befriending" leads to substantial mental and physical health benefits in times of stress, including reduced risk of mortality (Rutledge et al., 2004). Little is known about whether oxytocin is implicated in this process. One study revealed that social contacts can protect against stress through oxytocin (Detillion et al., 2004).

Social groups can be divided based on different criteria, such as age, gender, nationality, race, and even trivial criteria, like the order in which subjects signed-up for the task (Bliuc et al., 2007; Stallen et al., 2012). It is possible that the role of oxytocin in guiding inter-group conformity is related to the different criteria of group membership. The group membership manipulation in our current study may be not salient enough. Future studies using this type of social conformity paradigm, but different criteria of group membership, are needed to further investigate the oxytocin effect of inter-group conformity.

In summary, we have found evidence that oxytocin increases conformity to the opinions of both in-group and out-group members under implicit circumstances where overt social pressure to conform is minimal. Our findings suggest that under situations where there are no immediate perceived threats by out-group members then oxytocin promotes an in-group “tending” and out-group “befriending” pattern of behavior.

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Conflict of interest

None declared.

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