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Evaluating self- vs. other-owned objects: The modulatory role of oxytocin

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ABSTRACT

Previous research has shown that the neuropeptide oxytocin promotes various prosocial sentiments, such as trust, generosity and cooperation. Here we investigate whether it plays a role in evaluating self- vs. other-owned objects. Brain potentials were recorded in participants who judged the ownership of objects that were described in either positive or negative terms. Results showed that self-owned objects framed by positive adjectives elicited more positive-going brain responses than those framed by negative adjectives, irrespective of oxytocin or placebo being administrated. Negatively described other-owned objects evoked more positive-going responses than positively described other-owned objects, but the opposite pattern was found with the administration of oxytocin. Thus, oxytocin abolishes other-derogation but does not affect self-enhancement in object evaluation, consistent with the proposal that oxytocin enhances affilliative and approach motivations during social interaction.

et al., 2008; Kosfeld et al., 2005), generosity (Zak et al., 2007) and cooperation (Declerck et al., 2010). For instance, in a seminal study, Kosfeld et al. (2005) demonstrated that intranasal administration of oxytocin substantially increased trust in a social–economic game, although the positive effect of oxytocin on trust-related behavior is constrained by various social or situational factors (De Dreu et al., 2010; Mikolajczak et al., 2010). The present study aimed to extend this line of research by investigating whether brain responses to the ownership of objects would be modulated by the administration of oxytocin. Specifically, we investigated whether the administration of oxytocin would affect individuals' self-enhancement motivation in evaluating self-owned objects and affect individuals' attitude toward the objects owned by others.

To this end, we used a $2 \times 2 \times 2$ mixed design, with the between-participant factor referring to the treatment (oxytocin vs. placebo) and the within-participant factors referring to the ownership of the objects (self vs. other) and the valence of the priming adjectives (positive vs. negative) preceding the names of the objects. Before the execution of the formal experiment, we asked each participant to image a scenario in which he was assigned three objects while an unspecified other person was assigned another three objects. In the formal experiment, we used positive or negative adjectives (e.g., *clean*, *dirty*) to prime the names of objects owned by the participant or by the other person and asked the participant to judge whether the object belonged to himself or to the other person. Event-related potentials (ERPs) were recorded for the presentation of the object names.

Previous studies showed that in such associative priming, the semantic incongruity between a prime (e.g., *kitchen*) and a stereotyped target (e.g., *man*) would elicit negative-going brain responses (the N400) to the target compared with the congruent pairs (e.g., *gun*–*man*; Wang et al., 2011; White et al., 2009). In the present design, in line with self-enhancement motivation, self-owned objects paired with positive adjectives would result in semantic congruity and therefore be positively valenced, whereas self-owned objects paired with negative adjectives would result in semantic incongruity and therefore be negatively valenced. On the other hand, consistent with other-derogation motivation, other-owned objects paired with negative adjectives would result in semantic congruity and therefore be positively valenced, whereas other-owned objects paired with positive adjectives would result in semantic incongruity and be therefore negatively valenced. We expected to observe negative brain responses to the self-own objects preceded by negative adjectives, as compared with the condition in which these objects were preceded by positive adjectives. It was an empirical question whether this effect could or could not be enhanced by the administration of oxytocin. Given that individuals tended to derogate objects owned by others (Huang et al., 2009) in similar situations, it was possible that

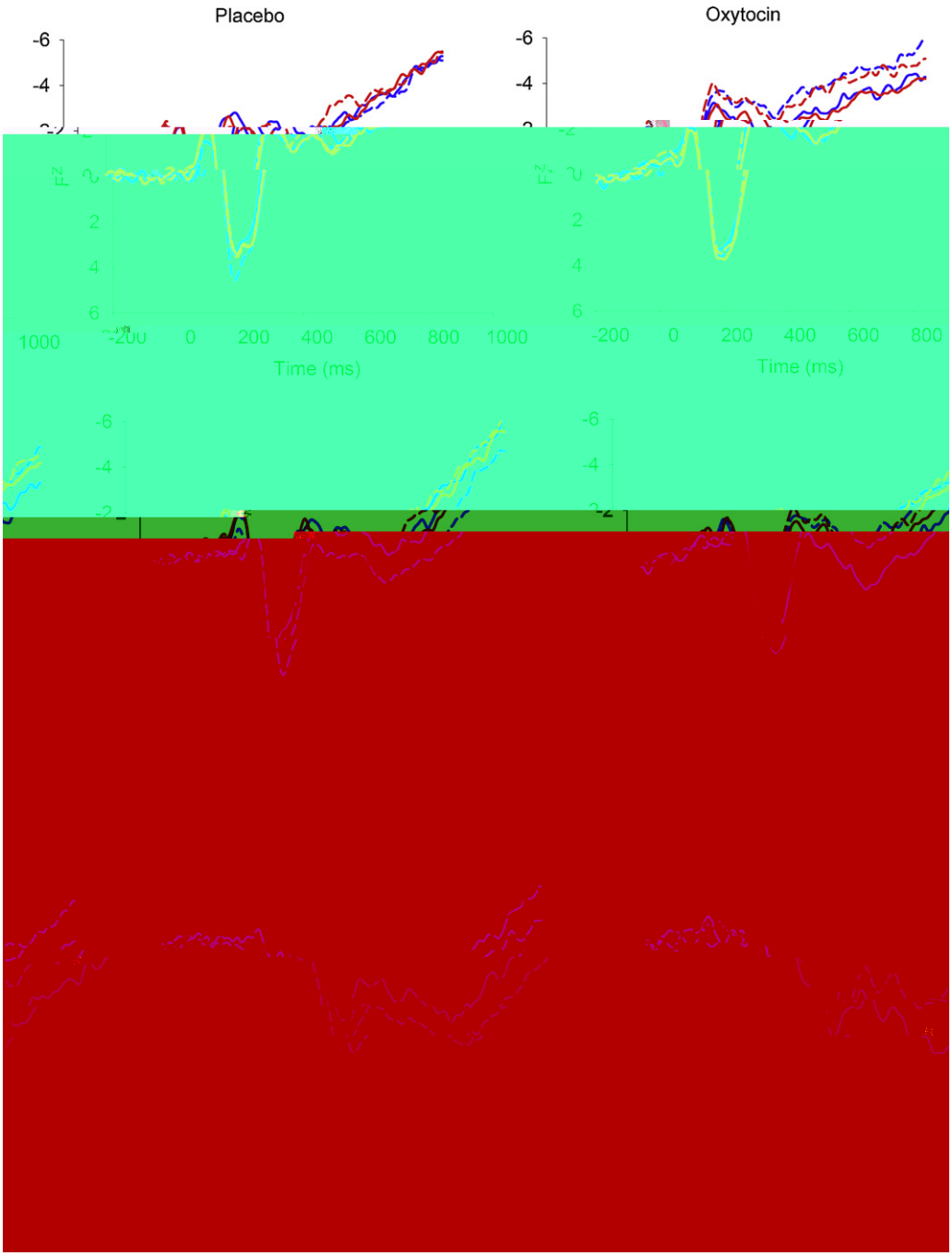

Fig. 1. ERP responses at the midline Fz, Cz and Pz, time-locked to the onset of object nouns in the placebo (left panel) and oxytocin (right panel) group.

were baseline-corrected by subtracting from each sample the average activity of that channel during the baseline period. All trials in which EEG voltages exceeded a threshold of ±80 μV during recording were excluded from further analysis. The EEG data were low-pass filtered below 30 Hz.

Based on visual inspection of the ERP waveforms (Fig. 1), we selected the ERP responses in the 300–1000 ms time window for statistical analysis. The Greenhouse–Geisser correction for violation of the assumption of sphericity was applied where appropriate.

3. Results

3.1. Behavioral results

Trials in which the participants did not respond within 2 s or responded incorrectly, and trials in which the reaction times (RTs) exceeded three standard deviations from the mean in each experimental condition were excluded from data analysis. About 4.21% of the total data points were lost due to these procedures.

A $2 \times 2 \times 2$ mixed ANOVA on the RTs revealed a significant main effect of ownership, $F(1,42) = 20.10$, $p < 0.001$, suggesting that the responses to self-owned objects (mean ± SE, 527 ± 21 ms) were significantly faster than to other-owned objects (548 ± 21 ms). Although the behavioral responses lagged behind the presentation of the stimuli, this finding is consistent with previous studies showing that individuals generally respond faster to self-related items such as one's own names, phone numbers, or face photos (Greenwald and Farnham, 2000; Ma and Han, 2010). No other effects were found in RTs.

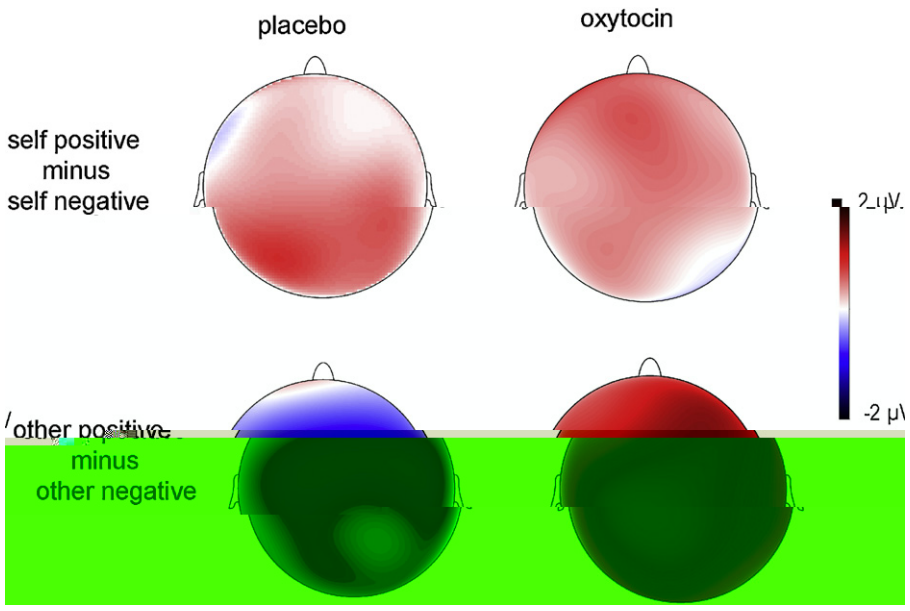

Fig. 2. Topographic maps for the sustained positivity.

3.2. ERP results

Mean amplitudes for the ERPs in the 300–1000 ms window were computed for the 8 experimental conditions, with each condition having on average 42–44 trials (ranging from 28 to 48 trials for each participant). It is clear from Figs. 1 and 2 that while oxytocin dramatically altered the differential effect between ERP responses in the 300–1000 ms time window to negatively vs. positively described other-owned objects; the oxytocin administration had no significant impacts upon the difference between brain responses to the negatively vs. positively described self-owned objects. Detailed statistical analyses confirmed this observation.

ANOVA with treatment (oxytocin vs. placebo), ownership of the objects (self vs. other), valence of the priming adjectives (negative vs. positive), electrode row (Fz row, FCz row, Cz row, CPz row, Pz row) and laterality (midline and two electrode positions further away from the midline, i.e., 3, 1, z, 2, 4) yielded a significant three-way interaction between treatment, ownership of the objects and valence of the priming adjectives, $F(1,44) = 10.20$, $p < 0.01$. Separate analyses were therefore conducted for the brain responses to the self-owned and other-owned objects.

For the self-owned objects, 2 (treatment) × 2 (valence of priming adjectives) × 5 (electrode row) × 5 (electrode laterality) mixed ANOVA showed that the main effect of valence of primes approached significance, $F(1,44) = 3.24$, $p = 0.07$, indicating that the positively framed self-owned objects (−0.64 μV) elicited more positive-going responses than negatively framed self-owned objects (−1.04 μV). Neither the main effect of treatment nor the interaction between treatment and valence of primes reached statistical significance, both $F(1,44) < 1$. The topological factors (row and laterality) did not interact with any experimental variables.

Importantly, for the other-owned objects, ANOVA revealed a significant two-way interaction between treatment and valence, $F(1,44) = 28.62$, $p < 0.001$, indicating that the pattern of brain responses to positively vs. negatively framed other-owned objects was modulated by substance administration. Simple tests were therefore conducted for each treatment. For the placebo group, negatively framed other-owned objects (−0.18 μV) evoked more positive-going responses than positively framed other-owned objects (−0.97 μV), $F(1,21) = 7.05$, $p = 0.01$. For the oxytocin group, this pattern was reversed, with the positively framed other-owned objects (−0.10 μV) eliciting more positive-going brain responses than negatively framed other-owned objects (−1.33 μV), $F(1,23) = 26.61$, $p < 0.001$.

4. Discussion

This study demonstrates that brain responses to self-owned vs. other-owned objects can be modulated by the neuropeptide oxytocin. Self-owned objects framed by positive adjectives evoked more positive, sustained responses than those framed by negative adjectives and this effect appeared to be unaffected by oxytocin administration. In the placebo group, other-owned objects described by negative adjectives elicited more positive-going sustained positivity than those described by positive adjectives. However, with the administration of oxytocin, positively framed other-owned objects elicited more positive-going responses than negative-framed other-owned objects, a pattern similar to the effect for the self-owned objects.

The increased sustained positivity for the self-owned objects described by positive, as opposed to the same objects described by negative adjectives, is consistent with the finding of increased P300 to the self-owned objects, as opposed to the other-owned objects (Turk et al., 2011). These effects suggest that the participants devoted more processing resources when evaluating positively valenced (or self-owned) objects than negatively valenced (or other-owned) objects. Although the sustained positivity and the P300 may differ in temporal dynamics and scalp distribution, a number of studies indicated that they share similar functions in social evaluation and attitude categorization (see Hajcak et al., 2010 for a review). The P300 is generally believed to be related to processes of attentional allocation (Gray et al., 2004; Linden, 2005) and/or to high-level motivational/affective evaluation (Yeung and Sanfey, 2004; Nieuwenhuis et al., 2005). Similarly, the sustained positivity has been implicated in the process of social evaluation, with enhanced positive amplitudes reflecting increased motivated attention (van Hooff et al., 2010). For instance, the late positive potentials (LPPs) have been found to be the largest for stimuli that are motivationally relevant, that receive the highest reports of affective experience, and that prompt the highest levels of autonomic arousal (Schupp et al., 2004; Briggs and Martin, 2009; Leng and Zhou, 2010). In the present study,

the more positive responses for positively framed self-owned objects than for negatively framed self-owned objects are congruent with the self-enhancement motivation implicated in object evaluation.

The intriguing finding was that oxytocin had no obvious effect upon the brain responses in evaluating self-owned objects. This finding appeared to be different from De Dreu et al. (2010, 2011) in which the effect of oxytocin on intergroup (racial) bias was mainly driven by the enhancement of in-group favoritism rather than out-group derogation. However, it should be noted that in De Dreu et al. (2010, 2011) there were clear differentiations between groups that engaged in rivalry activities; moreover, there were (potential) social interactions between the group members. Given the finding that oxytocin promotes prosocial behavior (Baumgartner et al., 2008; Declerck et al., 2010; Kosfeld et al., 2005; Zak et al., 2007), it is understandable that De Dreu et al. (2010, 2011) observed enhancement of in-group favoritism by the administration of oxytocin. In contrast, in the present study, although participants could engage some kind of social comparison (see below) between the self-owned and other-owned objects, they should nevertheless be more occupied by the valence of the priming words preceding the objects. Here there were no obvious social interactions when evaluating self-owned objects and hence oxytocin had no obvious effects. Further studies are needed to verify this finding.

As pointed out in Section 1, individuals may engage in self-enhancement by derogating others, particularly rival groups or objects of social comparison (Fein and Spencer, 1997; Huang et al., 2009). In the present study, we found that, for the placebo group, other-owned objects framed with positive adjectives elicited more negative-going ERP responses, as compared with the objects framed with positive adjectives, in sharp contrast with the more positive ERP responses for the self-owned objects framed with positive adjectives. We suggest that this opposite pattern of ERP effect for the other-owned objects reflected the functioning of other-derogation processes. Although other-owned objects does not necessarily elicit negative motivational or brain responses, by presenting these objects together with positive (and negative) adjectives and by presenting these objects together with self-owned objects framed with negative (and positive) adjectives, implicit social comparison could be induced and participants could attempt to enhance the self by derogating others.

The most important finding, however, was that participants in the oxytocin group and those in the placebo group showed opposite patterns of brain responses to positive- and negative-framed other-owned objects. That is, participants in the oxytocin group responded to the other-owned objects in a similar way as those in the placebo group responding to the self-owned objects. This might indicate that oxytocin administration increases individuals' affilliative and approach motivations by abolishing the other-derogating motivation observed in the placebo group. To put in another way, oxytocin administration may allow individuals to take the others' perspective when evaluating objects. The enhanced ability of perspective taking (theory of mind) with oxytocin has been reported in previous studies on either normal or autistic participants (Domes et al., 2007; Pedersen et al., 2011). For instance, intranasal oxytocin improved the ability to infer the mental state of others from social cues in the eye region (Domes et al., 2007). On the other hand, Todd et al. (2011) demonstrated that training in perspective taking can combat negative attitudes toward out-group members. Therefore, it is possible that the enhanced perspective-taking ability instantiated via intranasal oxytocin in this study might mediate the positive attitude toward other-owned objects and the more positive ERP responses to these objects framed by positive adjectives, as compared with the objects framed by negative adjectives. Further studies are needed to directly measure the effect of oxytocin on perspective taking and to examine its relationship with attitudes toward others.

The current experiment may have some limitations that can be be be

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other-owned objects evoked more negative-going responses than negatively described other-owned objects, but the opposite pattern was found with intranasal oxytocin. These findings suggest that oxytocin abolishes other-derogation but does not affect self-enhancement in object evaluation, consistent with previous studies showing that oxytocin enhances affilliative and approach motivations during social interaction.

Acknowledgments

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