Biological Psychology 92 (2013) 179–184

Contents lists available at SciVerse ScienceDirect

Biological Psychology

journal homepage: www.elsevier.com/locate/biopsycho

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

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ARTICLE INFO

Article history:
Received 22 August 2012
Accepted 17 November 2012
Available online xxx

Keywords:
Oxytocin
Ownership
ERP
Sustained positivity

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.

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1. Introduction

Individuals tend to prefer their own possessions over those they do not own, a bias that has been termed as the *mere ownership effect* (Beggan, 1992). This effect can appear in different guises. For example, sellers typically demand higher prices to relinquish the goods they own than buyers would be willing to pay to acquire those goods that they do not own (i.e., the *endowment effect*, Kahneman et al., 1990). This effect can be observed even when the object of possession is not physically present or even when the "possessions" are abstract arguments and positions (Huang et al., 2009). For instance, individuals tend to evaluate alphabetical letters in one's name, especially the initials, particularly favorably (Nuttin, 1985). This *name letter effect* occurs primarily because individuals feel ownership over their name letters and extend their favorable evaluation of the self to the letters (Hoorens and Nuttin, 1993). Indeed, individuals may have favorable attitudes toward brand names starting with one's name initials (Hodson and Olson, 2005). Gebauer et al. (2012) also demonstrated that individuals prefer the self over their favorite other on the implicit level.

The ownership effect has been linked to the self-enhancement motivation in which individuals overvalue an object owned by or associated with the self in order to improve their self-image (Beggan, 1992). Any opposition or counter-argumentation to one's arguments or possessions could be interpreted as ego-threatening. This self-enhancement motivation is prevalent in various social-cultural contexts and is associated with subjective well-being and resilience against adversity (see Taylor and Brown, 1988 for a review). On the other hand, the self-enhancement may also manifest itself as other-derogation (Fein and Spencer, 1997). For instance, Fein and Spencer (1997) demonstrated that after undergoing an ego-threatening task, participants were more likely to derogate stereotyped targets (e.g., gay) in rating and this derogation mediated the enhancement of self-esteem. A recent study by Huang et al. (2009), using the implicit association test (IAT) paradigm, demonstrated that participants responded faster when self-owned objects were implicitly linked with positive words (e.g., *happiness*, *sunshine*), as opposed to negative words (e.g., *death*, *war*), whereas they responded faster when other-owned objects were implicitly linked to negative words, as opposed to positive words. These results suggested that the self-owned objects, as part of the extended self (Belk, 1988), are closely associated with positive valence in memory, whereas other-owned objects, suffering from other-derogation in specific situations, may be implicitly associated with negative valence.

The role of exogenous oxytocin (OT) in social cognition has been studied extensively in recent years (see Bartz et al., 2011 for a review). A number of studies suggested that intranasal oxytocin promotes various prosocial sentiments, such as trust (Baumgartner

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0301-0511/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.biopsycho.2012.11.011

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 they would have *positive* brain responses to these objects preceded by negative adjectives, as compared with the condition in which these objects were preceded by positive adjectives. The crucial question was whether this effect could be altered by the administration of oxytocin. If oxytocin enhances prosocial motivation, as demonstrated by the previous studies (e.g., Baumgartner et al., 2008; Declerck et al., 2010; Kosfeld et al., 2005; Zak et al., 2007), then the administration of oxytocin could reduce or abolish the tendency of other-derogation. Note that in the present study, we assessed other-derogation via a priming paradigm (see above). If oxytocin could reduce or reverse other-derogation motivation, then the priming effect in the placebo group could be reduced or reversed in the oxytocin group, and this would be evidenced by differences in brain responses to positive- and negative-termed other-owned objects.

2. Methods

2.1. Participants

A total of 46 healthy male students (mean age ± SD, 22.48 ± 1.41 years) from different universities in Beijing participated in the study. Participants with chronic diseases, mental disorders, medication, or those smoked or abused alcohol were excluded from the experiment. Participants abstained from food and drink (other than water) for 2 h before the experiment, and from exercise, caffeine, and alcohol during the 24 h before the test. Participants were informed at the time of recruitment that the experiment evaluated the effects of a hormone on word judgment and there was no side effect associated with the administration of a low dose of this hormone. Written consent to participate in the experiment was obtained from each person. The experiment was performed in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Department of Psychology, Peking University. Each participant was paid 60 Chinese yuan (about US $9.50) for his participation.

2.2. Design and procedures

The experiment used a $2 \times 2 \times 2$ mixed design, with the treatment (oxytocin vs. placebo) as a between-participant factor and the ownership of the objects (self vs. other) and the valence of the priming adjectives (positive vs. negative) as two within-participant factors.

Participants were randomly assigned to the OT (24 participants) or placebo (22 participants) group. The oxytocin powder (Prospec, Israel) was dissolved with saline, and participants received 8 sniffs of oxytocin (32 IU in total) intranasally or placebo (saline) 30 min before the start of the main task. Participants read the following two-page scenario on the computer screen:

> *Please visualize the following scenario. There were six products bought from a supermarket: pen, candy, satchel, cup, bread, and bookshelf. Please visualize and remember these products. They will be used in the following experiment.* (Page 1)
> *Of these six products, three were given to you, and the other three were given to another person. You were given the pen, the candy and the satchel. Those given to the third-person were the cup, the bread, and the bookshelf. Please spend some time visualizing and remembering the objects given to you and the objects given to the other person. They will be used in the following experiment.* (Page 2)

In each group of substance administration, half of the participants were shown the aforementioned scenario. The other half read similar instructions except that the products given to the self and the other were swapped. To make sure that the participants had memorized the objects assigned to them and to the others, they were asked to write down on a blank paper the object names before the EEG test.

Each trial began with the presentation of a fixation cross at the center of screen for 500 ms against a black background. Then a positive or negative adjective (white and *Song* font, size 32) that could be used to describe the quality of an object was presented for 800 ms. After a jittered interval of 200 ms, 300 ms, or 400 ms, one of the six memorized objects (e.g., *cup*) was presented for 1000 ms. This was followed by the presentation of two options, "self" and "other" (in words), randomly on the left or right side of the screen. The participants were asked to judge the ownership of the object by pressing a corresponding key as quickly as possible. The next trial began 1000 ms after the button press.

The participant was seated comfortably about 1.5 m in front of a computer screen in a dimly lit and electromagnetically shielded room. The experiment was administered on a Pentium IV computer with a Del 22-in. CRT display, using Presentation software (Neurobehavioral System Inc.) to control the presentation and timing of stimuli. For either the oxytocin or placebo group, each participant received 2 blocks of 144 trials, with each of the four experimental conditions having 48 trials. In addition, there were 48 trials in which the objects were preceded by adjectives unrelated to the quality of the object and 48 trials in which the objects were not preceded by any words. These trials were used as fillers to control for possible response strategies. The 288 trials were randomly sequenced for each participant.

2.3. EEG recording and analysis

EEGs were recorded from 64 scalp sites using tin electrodes mounted in an elastic cap (Brain Products, Munich, Germany) according to the international 10-20 system. The vertical electrooculogram (VEOG) was recorded supra-orbitally from the right eye. The horizontal EOG (HEOG) was recorded from electrodes placed at the outer canthus of left eye. All EEGs and EOGs were referenced online to an external electrode which was placed on the tip of nose and were re-referenced offline to the mean of the left and right mastoids. All electrode impedance was kept below 5 kΩ. The bio-signals were amplified with a band pass from 0.016 to 100 Hz and digitized on-line with a sampling frequency of 500 Hz.

EEG epochs of 1200 ms (with a 200-ms pre-stimulus baseline) were extracted offline for ERPs time-locked to the onset of the object names. Ocular artifacts were corrected with an eye-movement correction algorithm which employs a regression analysis in combination with artifact averaging (Semlitsch et al., 1986). Epochs

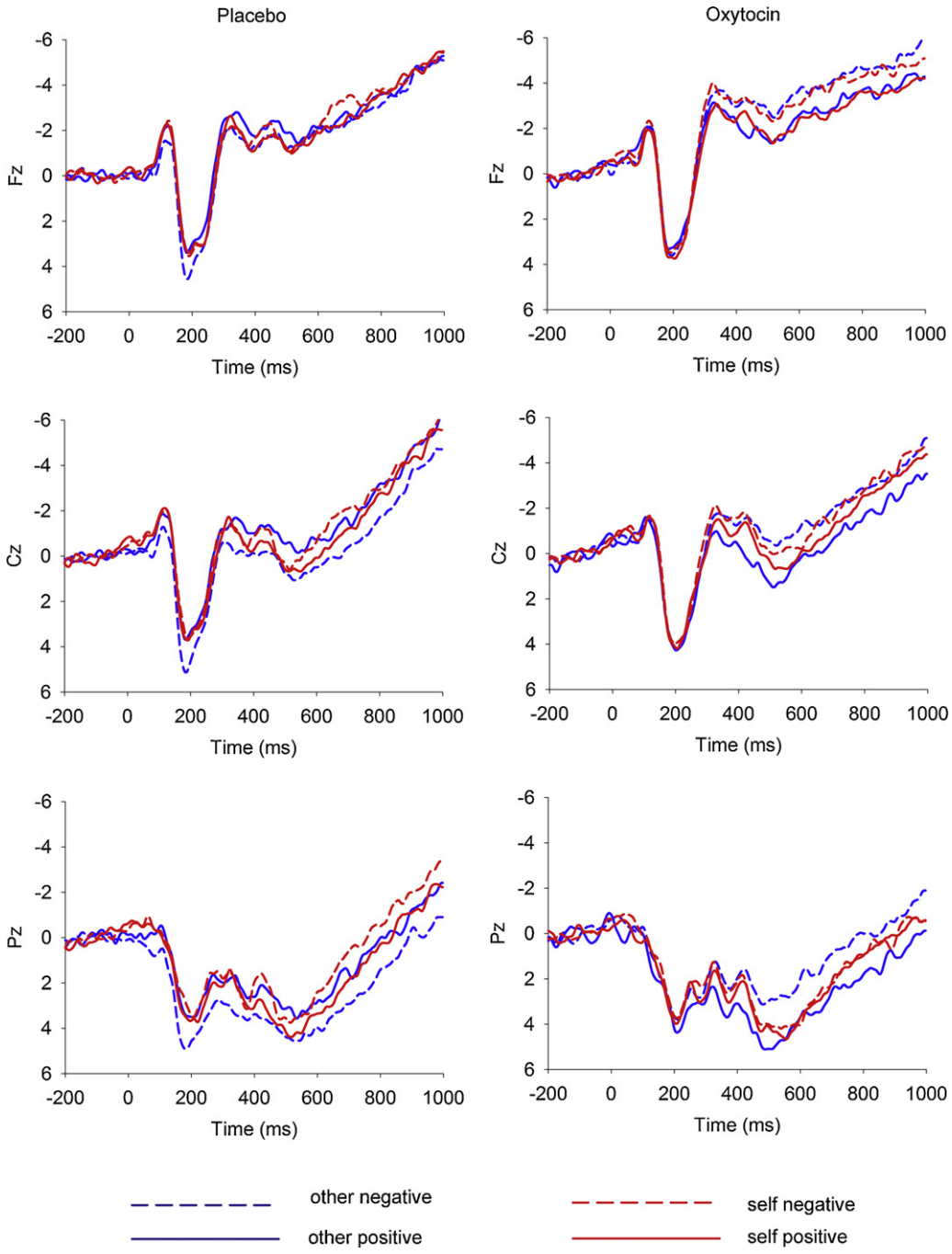

Fig. 1. ERP responses at the midline Fz, Cz and Pz, time-locked to the onset of object nouns in the placebo (left panel) and oxytocin (right panel) group.

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 × 2 × 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.

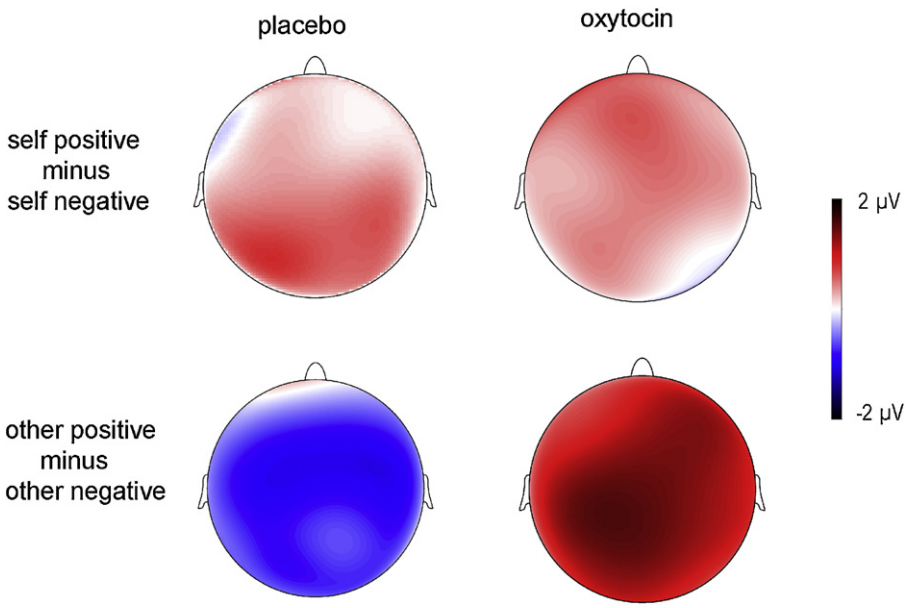

Fig. 2. Topographic maps for the sustained positivity.

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 addressed in further studies. First, we used a between-participant design regarding oxytocin/placebo administration and did not directly measure individuals' self-enhancement and other-derogation motivations before the administration. One might wonder whether our findings concerning the effects of oxytocin/placebo administration on brain responses to the self-own and other-owned objects could have somehow been contaminated by the initial differences between participant groups. We argue that this worry may not be warranted due to our random assignment of participants to the participant groups; this random assignment should have reduced the probability of initial baseline difference. Indeed, we asked the participants to complete the Self-Construal Scale (Singelis, 1994) before oxytocin or placebo administration and observed no difference between the groups. As self-construal refers to the extent to which individuals view themselves as socially embedded entities with strong or weak connections with others (Markus and Kitayama, 1991) and the endowment effect, which is closely related to the ownership effect, is modulated by self-construal (Maddux et al., 2010), the absence of group difference in self-construal might be taken as indirect evidence that the oxytocin and placebo groups had no baseline differences regarding their self-enhancement and other-derogation motivations. Moreover, previous research has shown that the ownership effect is a strong and robust bias and this effect has been replicated using different objects and in different age groups (Carmon and Ariely, 2000; Harbaugh et al., 2001; van Dijk and van Knippenberg, 1998); it is not clear how the initial difference between participant groups, if existed, could lead to opposite patterns of brain responses to the self-owned and other-owned objects in one group but to the same pattern of brain responses in another group. Nevertheless, it is useful for future studies to replicate the present study using a within-participant design and/or including a baseline measure of the ownership effect (e.g., via implicit association test; Huang et al., 2009).

The second limitation of the present study could be that we tested the impact of oxytocin on the ownership effect only on the Chinese participants. However, cultural psychology has demonstrated that individuals in East Asian and Western cultures differ in their tendencies of self-enhancement. In particular, self-enhancement is more prominent in the Western culture than in the East Asian culture (Heine and Hamamura, 2007; Kitayama and Markus, 1997), making Westerners more highly valuing their own possessions more than East Asians (Maddux et al., 2010). Moreover, Kim et al. (2010) found that the effect of oxytocin receptor polymorphism on social cognition was modulated by culture contexts. Taken together, future research is needed to investigate the impact of intranasal oxytocin on self-enhancement and other-derogation in different culture groups.

The third limitation of the present study is that we asked participants to image a scenario in which they owned three objects while the unspecified others owned the other three objects. The effects observed here were induced by imaged ownership rather than actual ownership. Although previous research has shown the ownership effect elicited via imagined scenarios is robust and stable (Huang et al., 2009), future studies could investigate how the current findings can be generalized to actual ownership.

To conclude, by asking participants to judge the ownership of objects framed in either positive or negative terms, the present study found that self-owned objects preceded by positive adjectives elicited more positive-going positivity than the same objects preceded by negative adjectives. The administration of oxytocin had no influence on this effect. In contrast, positively described

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

This study was supported by National Basic Research Program (973 Program: 2010CB833904), National Science and Technology Pillar Program (2009BAI77B04) of China and by grants from the Natural Science Foundation of China (30110972 and 91232708) to Xiaolin Zhou and by CSC-Cambridge International Scholarship to YW. We thank Dr. Wen Zhou, Ms. Jue Xie, Ms. Yue Wu and Ms. Jinting Liu for their help in preparation for the experiment and Dr. Yunhui Huang and two anonymous reviewers for their insightful comments on an earlier version of the manuscript. Electronic mail concerning this study should be addressed to Prof. Xiaolin Zhou, xz104@pku.edu.cn.

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