



# Oxytocin and social context moderate social support seeking in women during negative memory recall



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## ABSTRACT

**Background:** Oxytocin is theorized to promote social support seeking under stress— an alternate biobehavioural response to challenge known as the *tend-and-befriend* response. These effects may be context dependent, however, and no study has evaluated this effect in the presence and absence of social support. The aim of this study was to evaluate the effects of oxytocin on the experience of recalling emotional autobiographical memories in two contexts—with and without social contact with an experimenter.

**Method:** Sixty-three individuals (32 female) participated in this randomized, double-blind, placebo-controlled, and within-subject study.

**Results:** During recall of negative memories in the absence of social contact, oxytocin decreased perceived emotional support relative to placebo  $F(1,62) = 10.75, p = 0.002$ . In this same context, women who were motivated to affiliate with the experimenter following oxytocin administration showed this effect in greater magnitude  $t(57) = -2.04, p = 0.047$ , but showed the reverse effect (i.e. increased perceived support in response to oxytocin) when social contact with the experimenter was available  $t(57) = 2.78, p = 0.007$ . Male participants did not evidence this pattern.

**Conclusion:** These findings support the role of oxytocin in social support seeking in distressed women, and highlight the negative consequences of increasing oxytocin bioavailability in the absence of social support. Supportive relationships may be necessary to elicit the prosocial effects oxytocin.

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## 1. Introduction

The mammalian hormone oxytocin is known for its role in a myriad of social processes, including pair bonding, social cognition, and stress-regulation (Carter, 2014). Oxytocin is produced in the hypothalamus and acts both as a neuromodulator in the central nervous system and as a hormone in the periphery (Carter, 2014). Because estrous hormones and stages of maternity modulate endogenous oxytocin expression in humans, Taylor et al. (2000) posit that the roles of oxytocin in social affiliation and stress-regulation could be implicated in a sexually differentiated biobehavioural response to stress known as the *tend-and-befriend* theory. Specifically, it is theorized that because women are smaller in stature and provide more care for offspring than men, the traditional fight-or-flight response may be maladaptive under some circumstances in women. When faced with an environmental challenge, tending to offspring could increase their chances for survival and reproduction, and befriending peers in a social group could

serve as protection for women against altercations with physically dominant men. Together, it is posited that increased flexibility in the biobehavioural response to stress (i.e. not just fight-or-flight, but also tend-and-befriend) confers increased evolutionary fitness (Taylor et al., 2000). The role of oxytocin in the tend-and-befriend response, however, has not received a great deal of attention in experimental research on stress to date; women were underrepresented in experimental research on stress when Taylor et al. (2000) developed the tend-and-befriend theory 15 years ago (17% female; Taylor et al., 2000), and women are still underrepresented in experimental research on stress and oxytocin today (32% female; Cardoso et al., 2014b).

Exogenous oxytocin administered using a nasal spray increases its levels in human cerebrospinal fluid (Striepens et al., 2013), and studies have documented increased trust, positive communication behaviours, attention to emotion in faces, and stress regulation following its application (Kosfeld et al., 2005; Ditzen et al., 2009; Cardoso et al., 2013a, 2014a), all of which are potential mechanisms by which oxytocin could promote social support seeking under stress. Correlational evidence suggests that endogenous oxytocin may function to promote support seeking under stressful circumstances: Women in distressed relationships show elevated levels of endogenous oxytocin in plasma (Taylor et al., 2006, 2010), female

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children in distress show increased oxytocin in urine following contact with their a caregiver (Seltzer et al., 2010), and variations in the oxytocin receptor gene predict social support seeking in distressed men and women (Kim et al., 2010). Experimental evidence also suggests that intranasal oxytocin promotes increased trust in others following social rejection, but only in those who experience high levels of distress (Cardoso et al., 2013b), which may indicate that oxytocin increases openness to social support during stressful circumstances. The direct, and sexually differentiated, effect of oxytocin on social support seeking outlined in *tend-and-befriend*, however, has never been demonstrated in experimental research. Further, it is unclear how the promotion of social support seeking in distressed people might influence them in circumstances where social support is withheld or unavailable. Indeed, a number of studies now show context-dependent effects of oxytocin, where the administration of oxytocin in a negative, competitive, or non-social context is associated with null or negative effects (Bartz et al., 2011a; Scheele et al., 2014).

To directly examine whether the effect of oxytocin on social support seeking is moderated by sex, distress, and the availability of social contact, men and women recalled positive, neutral, and negative autobiographical memories in the laboratory under two contexts: with and without social contact with an experimenter. We also examined whether participants' perceptions of the experimenter further moderated this effect. Participants received intranasal oxytocin (24IU) or a placebo on two occasions one week apart in a double-blind, placebo-controlled, randomized, and within-subject experiment. Three hypotheses were put forth. First, consistent with past studies, oxytocin administration was predicted to have context-dependent effects on behavior (Bartz et al., 2011b; Cardoso et al., 2013b). In response to oxytocin and relative to the placebo, we expected participants to experience increased emotional support when recalling negative autobiographical memories with an experimenter, and decreased emotional support when recalling such memories in social isolation. Second, we predicted that oxytocin would have the strongest effects in those persons most sensitive to the manipulation of social context (Bartz et al., 2011b; Huffmeijer et al., 2013). In response to oxytocin and relative to the placebo, we predicted that increased rapport and motivation to affiliate with the experimenter would amplify the magnitude of the effects outlined in the first hypothesis (i.e. a stronger relationship with the experimenter would increase individual receptiveness to social support). Finally, these effects would be greater in magnitude in women, relative to men, consistent with the *tend-and-befriend* theory and recent intranasal administration studies comparing male and female participants (Taylor et al., 2000; Titzen et al., 2013; Fischer-Shofty et al., 2013; Yao et al., 2014).

Additional analyses were conducted to demonstrate the validity of the experimental manipulation of affect and support using autobiographical memory recall, as well as the manipulation of social context. We predicted that recalling negative autobiographical memories would induce negative mood in participants, relative to recalling positive and neutral memories. Relative to autobiographical memory recall with an experimenter, we also predicted that participants would feel less emotionally supported when recalling negative memories via a computer, without contact with the experimenter.

## 2. Method

### 2.1. Participants

Sixty-three participants (32 female) between the ages of 18 and 35 ( $M = 24.6$ ,  $SD = 4.22$ ) were recruited to participate in this study through online advertisements (e.g. Craigslist). Exclusion criteria

included current use of tobacco, current use of any prescription drugs, current or past use of illicit drugs (excluding cannabis, which required one year abstinence), severe medical conditions, history of consultation with psychiatric or psychological services, and suspected pregnancy in women. Only participants who were fluent in English were included in the study. Of the 25 females not taking the oral contraceptive pill, 6 were in the follicular menstrual phase and 19 were in the luteal phase across all test sessions. The Human Research Ethics Committee at Concordia University (Montréal, Canada) provided ethical approval of the study.

### 2.2. Modified autobiographical memory test

The modified autobiographical memory test was used in a previous study (Cardoso et al., 2014c), but with no manipulation of social context, and is based on the well-established procedures reported by Williams and Broadbent (1986). Participants were asked to recall specific episodic memories that occurred within a 24-h period in response to positive, negative, and neutral cue words. In the *social* condition, cue words were verbally presented by a same-sexed experimenter in-person. In the *non-social* condition, cue words were presented visually on a computer to the participant, who was alone in a room that was being monitored remotely. Participants recalled memories in response to 30 unique cue words in each condition that alternated between positive, negative, and neutral valence. One hundred and twenty cue words were randomized into four word lists that were counterbalanced across both conditions (social, non-social) and across two test sessions (placebo, oxytocin). Examples of positive cue words included "happy," "proud," and "brave." Examples of neutral cue words included "radio," "river," and "chair." Finally, examples of negative cue words included "lonely," "angry," and "afraid."

Participants rated their experience of recalling of each memory on the following dimensions: (1) how positive they felt, (2) how negative they felt, (3) how comfortable they felt, and (4) how emotionally supported they felt. Each dimension was rated on a scale from 1 (*not at all*) to 7 (*extremely*). These ratings were completed immediately after recalling each memory. The test-retest reliability of these ratings across sessions (oxytocin, placebo) ranged from 0.58 (affect) to 0.89 (comfort, support).

### 2.3. Experimenter perception questionnaire (EPQ)

The EPQ is an 8-item questionnaire that was developed in-house to measure participants' assessment of the experimenters' social competence and desirability (see Table 1 for the list of questions). Each question was rated on a scale from 1 (*not at all*) to 7 (*extremely or absolutely*). Principal axis factoring revealed two factors: the first factor consisted of items related to *rapport* with the experimenter (placebo: Eigenvalue = 5.01,  $R^2 = 46\%$ ; oxytocin: Eigenvalue = 4.69,  $R^2 = 40\%$ ), and the second factor consisted of items relating to *motivation to affiliate* with the experimenter (placebo: Eigenvalue = 1.53,  $R^2 = 30\%$ ; oxytocin: Eigenvalue = 1.59,  $R^2 = 32\%$ ). Factor loadings are presented in Table 1. The test-retest reliability of ratings for the *rapport* and *motivation to affiliate* factors across sessions (oxytocin, placebo) was 0.80 and 0.81 respectively.

### 2.4. Procedure

Eligible participants were scheduled for two laboratory visits one week apart, keeping the time of day consistent across test sessions. Female participants were scheduled for both sessions on days that they were taking the active oral contraceptive pill to control for variations in estrous hormones. Females not taking the oral contraceptive pill were scheduled for both test sessions within 0–11 or 17–25 days of the first day of menstruation.

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