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Oxytocin and vulnerable romantic relationships

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ABSTRACT

Oxytocin (OT) has been implicated in the formation and maintenance of various social relationships, including human romantic relationships. Competing models predict, alternatively, positive or negative associations between naturally-occurring OT levels and romantic relationship quality. Empirical tests of these models have been equivocal. We propose a novel hypothesis ('Identify and Invest') that frames OT as an allocator of psychological investment toward valued, vulnerable relationships, and test this proposal in two studies. In one sample of 75 couples, and a second sample of 148 romantically involved individuals, we assess facets of relationships predicting changes in OT across a thought-writing task regarding one's partner. In both studies, participants' OT change across the task corresponded positively with multiple dimensions of high relationship involvement. However, increases in participants' OT also corresponded to their partners reporting *lower* relationship involvement. OT increases, then, reflected *discrepancies* between assessments of self and partner relationship involvement. These findings are robust in a combined analysis of both studies, and do not significantly differ between samples. Collectively, our findings support the 'Identify and Invest' hypothesis in romantic couples, and we argue for its relevance across other types of social bonds.

1. Introduction

Oxytocin (OT) is a neuropeptide hormone involved in diverse aspects of mating and reproduction across mammalian species. Early work emphasized the importance of OT in physiological processes such as uterine contractions and erections (reviewed in Borrow and Cameron, 2012) and milk letdown during nursing (Crowley and Armstrong, 1992). Within psychology, OT's roles in regulating maternal caregiving and infant responsiveness across mammalian species have received extensive attention (e.g., Pedersen and Prange, 1979; Kendrick, 2000; Carter et al., 1992; Fries et al., 2005). A related, more recent literature has emphasized the importance of OT within close social relationships, including mating pair-bonds (van Anders et al., 2011; Carter, 2014). Scholars have found that experimental administration of OT affects pair-bond formation and related processes: e.g., in female prairie voles, the formation of selective partner preferences (Williams et al., 1994); in black-tufted marmosets, huddling with a partner (Smith et al., 2010); in humans, constructive communication between romantic couples during a conflict (Ditzen et al., 2009). These experimental findings are consistent with a perspective in which OT possesses functions for both pair-bond formation *and* maintenance (see Machin and Dunbar, 2011, for an opposing perspective). In multiple lineages, functions that OT plays in maternal-offspring relationships may have been co-opted to regulate pair-bonding (e.g., Crespi, 2015; Numan and Young, 2016).

Administration studies can speak to potential effects of OT. But as scholars explore broad questions regarding OT's function—its "role or manifestation as relevant to social bonds" (van Anders et al., 2011; p. 1267)—an understanding of the circumstances that lead to the *natural production* of OT is also crucial. Environmental contexts prompt hormonal secretion, with certain social ones potent antecedents (Bos et al., 2012). While administration studies provide valuable information, they need not represent ecologically valid scenarios in which individuals naturally produce OT. A complete understanding of function also requires studies of naturally-occurring OT variation.

Recent correlational studies have tested two models of OT's role in human romantic relationships. The first model, "Calm and Connect", predicts positive associations between relationship quality/investment and OT levels, due to the hormone's inhibition of detrimental relationship behaviors (e.g., anxiety, defensiveness) and subsequent stage-setting for warm, nurturing behaviors (e.g., emotional intimacy, physical closeness) (Carter, 1998; Uvnas-Moberg and Petersson, 2005). Several

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findings are consistent with this perspective. For example, Schneiderman et al. (2012) found that 'new lovers' experience high OT levels, which predicts relationship durability months later. Past the initial stages of pair-bond formation, multiple studies also find that circulating levels of OT covary positively with various indices of 'quality' in established bonds (e.g., Light et al., 2005; Grewen et al., 2005; Holt-Lunstad et al., 2008; Holt-Lunstad et al., 2014). Circulating OT within bonded individuals may also be responsive to partners' behaviors: one recent study (Schneiderman et al., 2014) found a positive dyadic association between an individual's OT and his/her partner's reported empathy. The second model, "Tend and Befriend", predicts negative associations between relationship quality and OT. In this model, perceived gaps in romantic relationships (manifesting in stress and/or anxiety) lead to elevated OT, in turn fueling increased 'appetite' or motivation to seek affiliation outside of the threatened relationship (Taylor, 2006; Taylor et al., 2010). Neither model appears to explain the full range of findings. A recent test supported neither model in a large sample of romantic couples (Smith et al., 2013).

We propose a novel way to reconcile conflicting data regarding these past models. Studies that support the Calm and Connect model have tended to ask individuals to report on their own level of relationship involvement (Light et al., 2005; Holt-Lunstad et al., 2014). Research supporting the Tend and Befriend model has asked about the level of relationship involvement or support offered by partners (Taylor et al., 2010). The two sets of findings are not necessarily in conflict.

As a way to reconcile these findings, we propose that, across domains of social relationships, cues of relationship *vulnerability* combine with *emotional engagement* in the relationship to drive increases in OT. In turn, increased OT functions to orient psychological resources toward the vulnerable relationship. Hence, OT, akin to other hormones such as testosterone, functions within a communication system directing the allocation of an individual's psychological and/or physiological resources to certain classes of activities (e.g., Finch and Rose, 1995). For testosterone, evidence supports its role as an allocator of effort toward acquiring new mates (e.g. Gettler et al., 2011). Oxytocin, as a hormone co-opted to function within multiple types of close social relationships (e.g., Crespi, 2015), might function to maintain important social relationships in the face of threats to their security.

Multiple studies examining participants within vulnerable relationships have reported elevated OT, consistent with this proposal. Young adults in new romantic relationships, which may require special investment and attention to foster their success, have higher baseline OT than singles (Schneiderman et al., 2012). Taylor et al. (2010) report higher OT among women who perceive a lack of investment from their partner. Even the widely-recognized role of OT in the mother-infant relationship could be interpreted within this framework, as infants are both highly valued and vulnerable: maternal OT responses bias psychological (as well as physiological) resources toward this relationship (White-Traut et al., 2009; Feldman et al., 2011).

Our proposal resembles the Tend and Befriend model in that both propose that a gulf in relationship investment leads to increased OT. Nonetheless, the two ideas are distinct. Tend and Befriend conceptualizes OT as a modulator of "appetite" (Taylor, 2006; p. 273) for social affiliation in general. Taylor et al. (2010) explicitly conjecture that OT levels "rise in response to [relationship] distress as a signal to affiliate with others" (p. 6). Our proposal argues the opposite: OT motivates interest in the vulnerable pair-bond relationship, rather than other social bonds. In addition, we note that Taylor et al. (2010) argue that OT serves this function for women but not men, for whom they propose vasopressin serves this function. In its original formulation, the Tend and Befriend model applied to women in particular, not men (Taylor et al., 2000).

To test these predictions, we conducted two studies. In Study 1, we asked both partners in romantically involved couples to report on their level of relationship involvement. In Study 2, we recruited romantically involved individuals without their partners, who then provided both self and partner reports of involvement. In both studies, we predicted that there exists a *positive* relationship between an individual's OT and their relationship involvement, but, with an individual's own relationship involvement controlled, an individual's OT is predicted *negatively* by their partner's relationship involvement. Together, these predictions propose that, in the context of romantic relationships, a *discrepancy* between self and partner relationship investment/involvement—specifically, where a partner's investment lags behind one's own—signals vulnerability that triggers an increase in OT.

As levels of OT sampled in uncontrolled settings may be influenced by many factors, we created a lab procedure designed to selectively elicit OT responses to relationship features. We asked romantically involved individuals to think about the support they receive, or wish they received, from a relationship partner, and measured pre-post change in OT as a function of this task. Our main prediction concerned the OT change, not baseline OT; however, in each study we also examined mean OT levels across two samples collected one week apart.

2. Study 1

2.1. Method

2.1.1. Participants

We recruited 75 heterosexual couples (mean age = 21.27, SD = 5.37) from a psychology student subject pool to participate in the current study, designed to investigate relationships between several physiological biomarkers and aspects of participants' romantic bonds. All participants reported being in an exclusive romantic relationship with their partner lasting at least one month; the mean reported relationship length was 24 months (SD = 23 months). We obtained mean OT levels (containing at least one 'baseline' measurement) on 149 individuals, and OT change during the lab session on 132 individuals. In several instances, a sample was missing because of insufficient saliva collection, errors in substituting a sample of urine (collected for assaying separate biomarkers), or the participants had to leave the session prior to the second saliva collection. 41% of female participants reported use of hormonal contraceptives at the time of the study. Neither mean OT nor OT change significantly differed as a function of contraceptive use, $t(69) = -0.85$, $p > 0.25$, and $t(56) = 1.76$, $p = 0.084$, respectively. Controlling for contraceptive use did not affect results reported below.

Target sample size was initially 100 couples, based on estimated power to detect a correlation of 0.2 with 80% power in a sample of 200 individuals. We stopped data collection midway through the second semester of recruitment, to permit time to complete most hormone assays by end of the semester. Completed sample size yields ~80% power to detect a correlation of 0.25. Data collection was complete at the time assays were performed.

2.1.2. Procedure

Couples arrived at the laboratory session together, but completed study procedures in separate rooms. After providing informed consent, participants were simultaneously given the first of two sets of questionnaires and materials to provide an initial saliva sample. After completion of both the first questionnaire and sample, participants were given 10 min to perform a thought-writing task. Following the task, participants completed the second questionnaire set. Fifteen minutes into the second questionnaire set (hence, 25 min after initiation of the thought-writing task), a second saliva sample was collected. Participants left the laboratory after completion of the second questionnaire, and returned one week later to drop off a third saliva sample, and to fill out a brief follow-up survey.

Though Horvat-Gordon et al. (2005) argued that saliva does not contain detectable levels of OT, use of newer, and perhaps more sensitive, assay kits suggest that saliva is an acceptable medium for the measurement of OT (e.g., Grewen et al., 2010). The manual for the newest OT