



Changes in social functioning and circulating oxytocin and vasopressin following the migration to a new country



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HIGHLIGHTS

- Initial plasma oxytocin levels predicted changes in social functioning over time.
- Changes in social functioning did not impact plasma oxytocin levels.
- Increases in social integration were related to elevations in plasma vasopressin.

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ABSTRACT

Prior studies have reported associations between plasma oxytocin and vasopressin and markers of social functioning. However, because most human studies have used cross-sectional designs, it is unclear whether plasma oxytocin and vasopressin influences social functioning or whether social functioning modulates the production and peripheral release of these peptides. In order to address this question, we followed individuals who experienced major changes in social functioning subsequent to the migration to a new country. In this study, 59 new international students were recruited shortly after arrival in the host country and reassessed 2 and 5 months later. At each assessment participants provided information on their current social functioning and blood samples for oxytocin and vasopressin analysis. Results indicated that changes in social functioning were not related to changes in plasma oxytocin. Instead, baseline oxytocin predicted changes in social relationship satisfaction, social support, and loneliness over time. In contrast, plasma vasopressin changed as a function of social integration. Baseline vasopressin was not related to changes in social functioning over time. These results emphasize the different roles of plasma oxytocin and vasopressin in responses to changes in social functioning in humans.

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1. Background

Oxytocin (OT) and arginine vasopressin (AVP) are two closely related nonapeptides that have been implicated in species-specific social behaviors [63,64]. In animal studies, OT and AVP have been associated with social memory, parental behaviors, social bonding, and certain forms of aggression [26,33,34,59]. While both peptides have been implicated in various aspects of social cognition and behavior, the effects of OT and AVP are sometimes sexually dimorphic [8].

In humans and other primates, the manipulation of OT levels, via intra-nasal administration, impacts social cognition and behaviors. For example, intra-nasal OT administration improved social perception

and memory and influenced social behaviors such as trust, generosity, positive communication behavior, and desire for future interaction [1, 12,13,20,24,61]. However, intra-nasal OT does not always promote prosocial behaviors and can also lead to increased feelings of envy, mistrust, and out-group derogation depending on the person and on the context [3,11,45]. While much less studied, intra-nasal AVP administration also alter aspects of social cognitions and behaviors such as recognition of negative emotions, perception of friendliness, sensitivity to social threat, reciprocated cooperation, and social contact with partners [22,37,44,52].

Despite the fact that circulating OT and AVP levels do not always correspond to central levels of the peptides [27], several studies have reported associations between endogenous plasma OT and AVP and social functioning. However, the directionality of these associations has been inconsistent, with greater OT and AVP being sometimes associated with better social functioning and other times being related to more social stress. For example, among partnered individuals, better marital

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quality, more frequent partner's massages and hugs, and greater social support were related to higher OT levels [19,28,29]. Larger social networks, fewer negative marital interactions, less attachment avoidance, and more attachment security were related to greater endogenous AVP levels [18]. Furthermore, both higher plasma OT and AVP were related to more positive and less negative communication behaviors during a marital interaction task [17]. Among single individuals, women with greater attachment to their friends, more extraverted individuals, and individuals who engaged in more trust behaviors in an experimental economics game had higher plasma OT [2,53,60].

In contrast, other studies have reported that elevations in OT were associated with more social stress. Higher OT levels have been associated with greater intrusiveness in social relationships, fewer contacts with one's main social group, greater self-reported interpersonal dysfunction, and relationship distress in single and partnered women [49,50,54,55]. Higher AVP levels were associated with distressed relationships in males but not in females [50]. To explain these discrepant findings, Taylor [48] proposes that OT increases in situations of social stress and serves as an impetus to seek relationships, especially among women.

Thus far, studies examining the relationship between plasma OT and AVP and social functioning have relied on cross-sectional designs. These studies cannot tease apart the directionality of the relationship between the circulating peptides and the social functioning. Longitudinal studies with repeated assessments of both the peptides and social functioning provide better information regarding the directionality of this peptide-behavior relationship. Another challenge in deciphering this relationship is that social functioning tends to be fairly stable over time.

In the present study, we sought to circumvent these issues by studying individuals migrating to a new country, a situation that represents a naturally occurring opportunity to examine the impact of changes in relationship functioning in a relatively short amount of time. New international students were recruited shortly after their arrival in the host country and were followed for 5 months with repeated assessment of social functioning and circulating OT and AVP levels. We hypothesized that changes in social functioning would predict changes in OT and AVP. Alternatively, we considered the hypothesis that initial OT and AVP levels measured soon after migration might predict changes in social functioning over time. Given that sex differences have been observed in animal studies and some human studies, sex differences in the association of OT and AVP and social functioning were also considered, using approximately equal numbers of male and female subjects.

2. Methods

2.1. Participants

Participants were new international students recruited during mandatory New Student Orientation and Health Insurance Information sessions for new international students at Concordia University, Montreal, Canada. To create a homogeneous group in terms of initial social functioning, exclusion criteria included the following: (1) arrived in the host city more than 3 weeks prior to the beginning of the semester, (2) currently being involved in a romantic relationship, (3) having friends or relatives in the city prior to migrating to the host country, (4) migrating with some family members, (5) being an exchange student who will stay in host country for less than two years, and (6) having a Test of English as Foreign Language (TOEFL) score of less than 600. To recruit a healthy sample, participants with any chronic health problems or taking prescribed medications on a regular basis also were excluded.

The sample included 59 participants with a mean age of 23.81 (SD = 3.50). There was a near-equivalent proportion of males ($n = 31$; 52.5%) and females ($n = 28$; 47.5%). About 27.1% were undergraduate students, 52.5% were master's students, and 20.3% were doctoral students. In terms of ethnicity, 20.3% were Caucasians, 32.2% were Asians, 20.3%

were South Asians, 11.9% were Middle Easterners, 8.5% were Latinos, and 6.8% were Blacks. About 75% of participants reported that at least one of their parents had an undergraduate degree. Participants completed their baseline assessment on average 22 days (SD = 9.4) after arriving in the host country. Because of missed appointments and difficulties with or refusal of the blood draw, 10 participants did not have OT and AVP data at the 2-month follow-up assessment and 7 participants did not have OT and AVP data at the 5-month follow-up. However, only 3 participants did not provide OT and AVP data at both the 2- and 5-month follow-up assessments.

2.2. Protocol

At each assessment visit, participants provided blood samples for OT and AVP analysis and completed self-report questionnaires on their current social functioning. Each study visit occurred between 9:30 AM and 12:30 PM to minimize the possible impact of diurnal variations in OT [32]. Participants were asked to refrain from eating or drinking caffeinated beverages in the 2 h prior to the study visit [23]. Participants were paid \$20 for the first visit, \$25 for the second visit, and \$30 for the third visit. The Institutional Review Board approved the research protocol. All participants signed written consents prior to beginning the study.

2.3. Psychosocial assessment of social functioning

Social integration was assessed using questions adapted from the Social Network Index [10]. Participants indicated how many individuals they saw or talked to in the past week. Given that interaction with individuals from the host country has been associated with better psychosocial adjustment among international students [21], social integration was evaluated with regard to 3 different cultural groups: members of their own cultural group, other international students not part of their cultural group, and local individuals from the host country, but not part of their cultural group. Responses from the 3 cultural groups were summed to create a composite social integration score at each visit. Higher scores reflected greater social integration.

Social relationship satisfaction was assessed in conjunction with the social integration measure using questions adapted from Sarason et al. [42]. As above, participants indicated how satisfied they were regarding their relationships with (a) members of the their own cultural group, (b) other international students not part of their cultural group, and (c) local individuals from the host country, but not part of their cultural group. Respondents rated their satisfaction using 5-point Likert scale ranging from not at all satisfied to very satisfied. Responses regarding the 3 cultural groups were summed to create a composite relationship satisfaction score at each visit. Greater scores reflected higher social relationship satisfaction.

Loneliness was assessed using the revised UCLA Loneliness scale [41]. This 20-item scale assessed subjective feelings of loneliness on a 4-point Likert scale ranging from 1 = never to 4 = often. The total score is computed by calculating the mean of all items. Greater scores represent higher perceived loneliness. The Cronbach's α for the scale was 0.91 at baseline, 0.88 at the 2-month follow-up, and 0.91 at the 5-month follow-up.

The Multidimensional Scale of Perceived Social Support [62] is a 12-item questionnaire assessing perceived social support from family members, friends, and a special person in the respondent's life. The scale uses a 4-point Likert scale ranging from disagree to agree. In the current study, only the subscales regarding support from friends and the special person were used given that, by definition, the respondent's family was living in another country. Higher scores represent greater social support. The Cronbach's α for the scale was 0.83 for at baseline, 0.90 at the 2-month follow-up, and 0.85 at the 5-month follow-up.

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