Tend and Befriend

Biobehavioral Bases of Affiliation Under Stress

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ABSTRACT—*In addition to fight-or-flight, humans demonstrate tending and befriending responses to stress—responses underpinned by the hormone oxytocin, by opioids, and by dopaminergic pathways. A working model of affiliation under stress suggests that oxytocin may be a biomarker of social distress that accompanies gaps or problems with social relationships and that may provide an impetus for affiliation. Oxytocin is implicated in the seeking of affiliative contact in response to stress, and, in conjunction with opioids, it also modulates stress responses. Specifically, in conjunction with positive affiliative contacts, oxytocin attenuates psychological and biological stress responses, but in conjunction with hostile and unsupportive contacts, oxytocin may exacerbate psychological and biological stress responses. Although significant paradoxes remain to be resolved, a mechanism that may underlie oxytocin's relation to the health benefits of social support may be in view.*

KEYWORDS—*oxytocin; opioids; tending; befriending; affiliation*

The dominant conception of biobehavioral responses to stress has been the fight-or-flight response. In response to threat, humans or animals can become aggressive and confront a stressor or flee either literally or metaphorically, as through avoidant coping. Fight-or-flight responses depend on two interacting stress systems, the sympathetic nervous system (SNS) and the hypothalamic-pituitary-adrenocortical (HPA) axis, which mobilize the organism for concerted efforts to combat or escape from threat. In important respects, fight-or-flight provides a good characterization of responses to stress. However, from the standpoint of human beings, this analysis is incomplete. One of the most striking aspects of the human stress response is the tendency to affiliate—that is, to come together in groups to provide and receive joint protection in threatening times (Baumeister & Leary, 1995; Taylor, 2002).

Our laboratory has explored a biobehavioral model that characterizes these affiliative behaviors. From animal studies and our own data, we infer that there is an affiliative neurocircuitry that prompts affiliation, especially in response to stress. We suggest that this system regulates social-approach behavior and does so in much the same way as occurs for other appetitive needs. That is, just as people have basic needs such as hunger, thirst, sexual drives, and other appetites, they also need to maintain an adequate level of protective and rewarding social relationships.

As occurs for these other appetites, we suggest there is a biological signaling system that comes into play if one's affiliations fall below an adequate level (see Fig. 1). Once signaled, the appetitive need is met through purposeful social behavior. If social contacts are hostile or unsupportive, then psychological and biological stress responses are heightened. If social contacts are supportive and comforting, stress responses decline. Positive contacts, in turn, lead to a decline in the need and, in the context of stress, a decline in stress responses. The fact that affiliation may look like other appetitive needs is not coincidental. Because biological neurocircuitries tend to be efficient, the dopamine and opioid systems that are recruited for other reward-based systems may well be recruited for the satisfaction of affiliative needs as well (see Depue & Morrone-Strupinksy, 2005).

In characterizing these social responses to stress we have used the metaphor "tend and befriend" (Taylor, 2002; Taylor et al., 2000). Our position is that under conditions of stress, tending to offspring and affiliating with others ("befriending") are at least as common responses to stress in humans as fight-or-flight. In building our model, we have focused heavily on the hormone oxytocin (see Fig. 1). We maintain that oxytocin is released in response to (at least some) stressors, especially those that may trigger affiliative needs; oxytocin prompts affiliative behavior in response to stress, in conjunction with dopaminergic and opioid systems. This affiliative activity may serve tending needs, including protective responses toward offspring, and/or it may take the form of befriending, namely seeking social contact for one's own protection and solace. Oxytocin, in conjunction with

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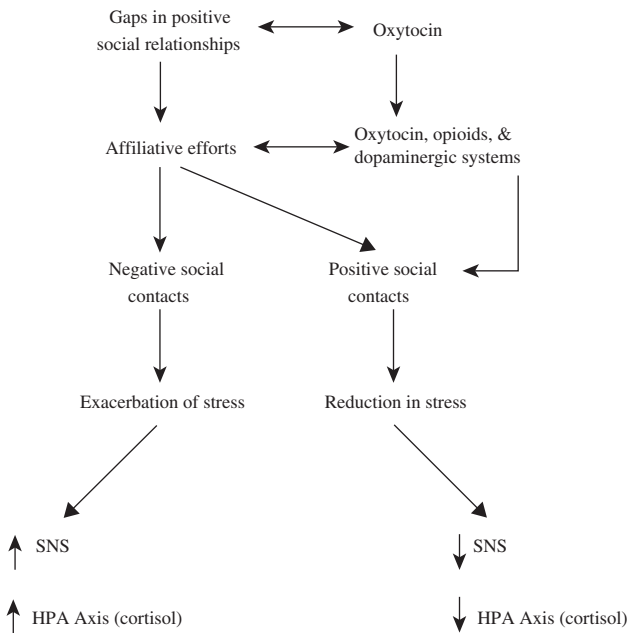

Fig. 1. A model of affiliative responses to stress. Elevations in plasma oxytocin accompany gaps in positive social relationships and are believed to prompt affiliative efforts aimed at restoring positive social contacts; engagement of opioid and dopaminergic systems coupled with oxytocin may lead to a reduction in stress responses, including those of the sympathetic nervous system (SNS) and the hypothalamic-pituitary-adrenocortical (HPA) axis. However, negative social contacts exacerbate stress, leading to an increase in these same biological stress responses.

positive social contacts, attenuates biological stress responses (SNS, HPA axis) that can arise in response to social threats. In the sections that follow, we detail the elements in Figure 1, which is used as an organizational as well as a conceptual device.

It is important to note that oxytocin has been implicated in a broad array of social relationships and social activities, including peer bonding, sexual activity, and affiliative preferences under nonstressful circumstances (Carter, 1998; Insel, 1997). Thus, the model to be characterized in the subsequent sections primarily elucidates social behavior under stress and does not address larger issues concerning how oxytocin may be implicated in social activity in nonstressful times.

RELATIONSHIP GAPS AND SEPARATION DISTRESS

Affiliation is vital to the survival of human beings; accordingly, there are likely to be biobehavioral mechanisms that are sensitive to social threats or loss of social contact. Evidence for such an assertion comes from research on separation distress. When young are separated from their mothers, separation distress in offspring can result, leading to distress vocalizations that may prompt the return of the caregiver. This system appears to be dependent, in part, on oxytocin and brain opioids. Evidence consistent with the existence of such a system includes the facts that brain opioids reduce separation distress and that drugs such as morphine reduce distress vocalizations in animals (Panksepp, 1998).

Adults experience separation distress as well, but until recently the biological underpinnings of adult relationship gaps were not explored. To address this issue, we examined the relation of plasma oxytocin levels to reports of relationship distress in adult women (Taylor et al., 2006). We found that women who were experiencing gaps in their social relationships had elevated levels of oxytocin. Specifically, women with high levels of oxytocin were more likely to report reduced contact with their mothers, their best friends, their pets, and social groups to which they belonged. In addition, those with significant others were more likely to report that their partners were not supportive, did not understand the way they felt about things, and did not care for them. Poor quality of the marital relationship and infrequent display of affection by the partner were also associated with higher levels of plasma oxytocin. Thus, oxytocin appears to signal relationship distress, at least in women.

Plasma oxytocin was not related to general psychological distress, only to gaps or problems in positive relationships; and whereas oxytocin appeared to signal gaps in relationships, levels of the stress hormone cortisol were not similarly elevated. These points suggest that oxytocin may be distinctively related to relationship distress. Similar findings have been reported by Turner, Altemus, Enos, Cooper, and McGuinness (1999), who found that elevated plasma oxytocin was associated with anxiety over relationships, perceived coldness or intrusiveness in relationships, and not being in a primary romantic relationship. Thus, the relation of oxytocin to relationship distress has been confirmed in two independent laboratories.

RELATION OF OXYTOCIN TO AFFILIATION

If oxytocin is related to social distress, then as an affiliative hormone, oxytocin may provide an impetus for social contact to ameliorate stress. There is manifold evidence that oxytocin, indeed, promotes affiliation, most of which has come from animal studies (e.g., Panksepp, Nelson, & Bekkedal, 1999; see Insel, 1997, for a review). Exogenously administered oxytocin has been related to increases in physical proximity, increased maternal behavior, grooming, and preferences for conspecifics in whose presence elevated oxytocin was experienced (see Panksepp, 1998; Taylor, 2002, for reviews). Oxytocin is also thought to underlie affiliative activities in humans as well, including maternal behavior and social bonding more generally (e.g., Carter, 1998; Carter, Lederhendler, & Kirkpatrick, 1999; Taylor, 2002). Thus, it appears that a fairly broad array of affiliative behaviors may be subserved by oxytocin.

RELATIONSHIP OF OXYTOCIN TO STRESS RESPONSES

The next link in the model relates oxytocin to stress responses. Animal studies have shown that exogenous administration of oxytocin or stimulation of oxytocin secretion decreases sympathetic reactivity, blood pressure, pain sensitivity, and cortico-

steroid levels, among other findings suggestive of a reduced stress response (e.g., Carter, 1998; Insel, 1997). A more modest literature in humans suggests similar effects. For example, among breastfeeding women who have high levels of oxytocin (Light et al., 2000), among women reporting more frequent hugs from partners (Light, Grewen, & Amico, 2005), and among men receiving exogenous oxytocin (Heinrichs, Baumgartner, Kirshbaum, & Ehlert, 2003), psychological and biological stress responses are lower. Overall, the evidence that high levels of or exogenously administrated oxytocin attenuate stress responses is strong in animals and suggestive in human studies.

As our model maintains, however, if affiliative efforts are unrequited or negative, heightened stress responses may occur. In a study consistent with this point (Taylor et al., 2006), women participated in a socially threatening laboratory challenge task and their responses were assessed. Those with low levels of plasma oxytocin showed an increase in cortisol in response to the social threat and a decrease during recovery. By contrast, women with initially high plasma oxytocin levels had significantly higher cortisol levels initially, which decreased early on in the laboratory procedures but then again became elevated during the threat tasks. These findings suggest that women with high levels of oxytocin may be especially attuned to social features of the environment and that their levels of stress may be especially exacerbated by unsupportive social contacts. Thus, quality of social contacts during stressful times may be a pivotal variable for understanding the relation of oxytocin to stress responses.

The fact that high levels of oxytocin can be associated both with relationship distress and with reduced stress responses appears inconsistent. One hypothesis is that bursts of oxytocin, as may occur in response to anticipated or actual social contact or exogenous administration of oxytocin, reduce stress responses but that elevated oxytocin in plasma, which likely represents trace evidence of some preceding process, is associated with relationship distress (Turner et al., 1999; but see Grewen, Girdler, Amico, & Light, 2005). Another possible resolution stems from the fact that most studies documenting the stress-reducing qualities of oxytocin have not disentangled the effects of oxytocin from affiliation itself or its anticipation. Oxytocin increases the sensitivity of brain opioid systems, and at least some of the stress-reducing properties of oxytocin appear to be mediated by an opioid pathway and also, as noted earlier, by dopaminergic pathways. It is possible that a need for social contact that is unrequited does not implicate these downstream stress-reducing effects of oxytocin that appear to occur in the context of actual or anticipated affiliative contact.

BENEFITS OF TENDING UNDER STRESS

Why would humans (and some animals) have a biologically regulated affiliative system? Looking at the affiliative system from the standpoint of evolutionary theory suggests that there would be clear survival benefits of a biobehavioral mechanism that signals gaps in social support and prompts affiliation for beneficial communal responses to stress. Tending to offspring in times of stress would be vital to ensuring the survival of the species. Oxytocin may be at the core of such tending responses in threatening circumstances. Evidence from a broad array of animal studies shows that central administration of oxytocin enhances maternal behavior (see Taylor et al., 2000, for a review; Taylor, 2002). Such tending also has a wide array of immediate benefits—for example, reducing HPA and SNS activity in both mother and offspring.[1]

Evidence concerning the biological bases and consequences of maternal–infant contact in humans is more limited. Oxytocin is believed to be implicated initially in bonding between mother and infant. Oxytocin is at high levels in the mother following giving birth and may promote bonding; however, mother–infant attachment may soon become independent of its hormonal bases, maintained instead by neuromechanisms in the brain that underlie attachment (Taylor, 2002).

BENEFITS OF BEFRIENDING UNDER STRESS

A large social-support literature documents that "befriending" leads to substantial mental and physical health benefits in times of stress. Social isolation is tied to a significantly enhanced risk of mortality, whereas social support is tied to a broad array of beneficial health outcomes, including reduced risk of mortality (see Taylor, 2007, for a current review). Whether oxytocin is implicated in these processes has been unknown. However, in one study (Detillion, Craft, Glasper, Prendergast, & DeVries, 2004), Siberian hamsters received a skin wound and were then exposed to immobilization stress. The stressor increased cortisol concentrations and impaired wound healing, but only in socially isolated animals and not in socially housed ones. Thus, social housing acted as a stress buffer. Removing cortisol via adrenalectomy (removal of the adrenal glands) eliminated the impact of the stressor on wound healing, thereby implicating the HPA axis in the healing process. Of particular relevance to the current arguments, treating the isolated hamsters with oxytocin eliminated the stress-induced increases in cortisol and facilitated wound healing; treating socially housed hamsters with an oxytocin antagonist delayed wound healing. These data strongly imply that social contacts can protect against the adverse effects of stress through a mechanism that implicates oxytocin-induced suppression of the HPA axis. Thus, there appear to be discernible clinical consequences of oxytocin suppression of the HPA axis.

GENDER DIFFERENCES IN THE RELATION OF OXYTOCIN TO TENDING AND BEFRIENDING

The effects of oxytocin on social behavior have been heavily studied in estrogen-treated female animals and in women. The

[1]All the animal data are based on responses of mothers, not those of fathers.

evidence that oxytocin plays an important role in male social relationships is less plentiful. Heinrichs et al. (2003) found that oxytocin had anti-stress effects in men. However, their paradigm used exogenous administration of oxytocin and therefore showed that oxytocin can have such effects in men, but not necessarily that it typically does.

There are several reasons to believe that oxytocin may play a more important role in influencing women's social behavior than men's, especially under stress. At the time when human stress responses evolved, work was largely sex segregated, with women more responsible for childcare. Thus, selection pressures for responses to threat that benefit both self and offspring may have been greater for females than for males—favoring social responses to stress in women especially (Taylor, 2002). Women's consistently stronger affiliative responses to stress compared to those of men (Tamres, Janicki, & Helgeson, 2002; Taylor, 2002) is consistent with this point. Estrogen strongly enhances the effects of oxytocin, which is also consistent with a greater role for oxytocin in women's behavior than in men's. At present, there appears to be a stronger basis for making inferences about the relation of oxytocin to social behavior in females than in males.

CONCLUSIONS

A large animal literature and a small human literature have tied oxytocin to separation distress, maternal tending, befriending responses to stress, and reduced psychological and biological stress responses. Exactly how oxytocin is implicated in these processes and how this may differ for males and females is not yet clear. Moreover, significant paradoxes remain, most especially the relation of oxytocin to both relationship distress and to reduced stress responses. Despite these gaps in knowledge, the mechanisms underlying oxytocin's relation to the reduction of stress and the beneficial effects of social responses to stress on health appears to be in view.

Clarifying the role of oxytocin in relationship processes—those implicated in both stressful and nonstressful times—will be valuable for scientific yield regarding the biological underpinnings of social bonds. Such knowledge will also help to clarify oxytocin's potential role in social dysfunction and disease processes. For example, the centrality of social deficits to mental disorders such as depression and autism suggests that with greater understanding of the oxytocin system, these disorders might become better understood as well.

Basic research issues for the future include resolution of significant methodological issues regarding oxytocin-based underpinnings of social relationships, especially the differences between experimental findings manipulating oxytocin and findings relating plasma oxytocin and social processes. More broadly, whether affiliation is best characterized as an appetitive need with dynamics approximating those in Figure 1 remains to be seen. The model proposed here hopefully provides a heuristic for further examination of these processes.

Recommended Reading

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