Affiliation, Social Support, and Biobehavioral Responses to Stress

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The term, stress, was once little more than a colloquialism for feelings of pressure or agitation in response to the demands of daily living. As research on responses to stress has progressed, however, it has become clear that chronic and acute stress are implicated in adverse physiological and neuroendocrine changes, health-compromising behavior changes such as substance abuse and homicide, and risk for mortality from a variety of stress-related disorders (Taylor, 1999). As the significance of the health risks of stress have become known, the study of how people cope with stress, especially how they cope with stress successfully, has taken on scientific and clinical urgency. In particular, research efforts have focused on the ways of coping and personal resources that may mute the adverse behavioral, physiological, and neuroendocrine consequences of stress.

One way that people cope with stress is by turning to others. Living in social groups is thought to be an evolutionary adaptation that has survival value for humans (Caporael, 1997; Dunbar, 1996). Groups provide more eyes for the detection of predators, and most predators are reluctant to attack potential prey if they believe there are others who might come to the rescue. Because human beings lack so many of the "weapons" that are beneficial to other species, such as sharp teeth, claws, and substantial size, as well as defensive resources, such as thick skin, thick fur, and speed, group living may be one of the most significant evolutionary strategies by which human beings have survived.

Affiliation with others appears to be especially common under stress. A large literature reveals that people who are going through stressful events turn to others to help

them deal with those events or to provide them with solace (Bachrach & Zautra, 1985; Ferraro, Mutran, & Barresi, 1984). Psychologists refer to this tendency and the benefits it provides as social support. Social support has been defined as information from others that one is loved and cared for, esteemed and valued, and part of a network of communication and mutual obligation (Cobb, 1976). Such support can come from a partner, other relatives, friends, and social or community ties.

Research on social support indicates that turning to others in stressful circumstances provides a variety of benefits, such as appraisal support, tangible assistance, information, and emotional support (e.g., Cohen, 1988; Schwarzer & Leppin, 1991). Appraisal support is help from another person that improves one's understanding of a stressful event and the resources and coping strategies that may be mustered to deal with it. Through the exchange of appraisals, a person facing a stressful event can determine how threatening the stressful event is likely to be and can reduce uncertainty about the nature of the stressor. Tangible assistance involves the provision of material support, such as services, financial assistance, or goods that may ameliorate a stressful event. For example, the gifts of food that often arrive after a death in the family means that bereaved family members will not have to perform certain routine chores at a time when their energy and enthusiasm for such tasks may be low. Other people can provide informational support about stressful events. For example, a person having a problem on the job may get information from coworkers about how best to manage time or delegate tasks appropriately, or about how to approach a supervisor about restructuring the job. During stressful times, people often suffer emotionally and may experience bouts of sadness, depression, anxiety, or loss of self-esteem. Supportive friends, family, and

acquaintances can provide emotional support by reassuring a person under stress that he or she is a valued individual who is cared for and esteemed. The warmth and nurturance provided by other people can enable a person under stress to approach that event with greater assurance. Networks of potentially supportive friends, acquaintances, and relatives are not always supportive, it should be noted (e.g., Dakof & Taylor, 1990; Coyne, Wortman, & Lehman, 1988), but on balance social networks are more likely to ameliorate than exacerbate psychological distress during stressful times.

Potentially, then, there is a broad array of functions that turning to others can provide during times of stress, ranging from increasing the likelihood of survival to ameliorating the distress that may occur in response to stress. What is the evidence that affiliation under stress and the support it provides can be beneficial to human psychological and physical functioning?

The Psychology of Affiliation

In 1959, Stanley Schachter conducted the first experiments on affiliation in response to stress. At the time, it was not his intention to study stress responses, but rather to demonstrate that under anxiety-arousing circumstances, people choose to affiliate with others for the purpose of evaluating their emotional experience. Nonetheless, the paradigm he adopted approximates what is now termed the experimental acute stress paradigm. Schachter recruited undergraduate women to participate in his experiments and scheduled them to arrive at his laboratory in small groups. In what he termed the "high anxiety condition," the women were met by a white-coated scientist who informed them that each woman would receive a series of electric shocks that would hurt and be painful, but that would do no permanent damage. In the "low-anxiety condition,"

the women were told that the shocks would be very mild, resembling a tingle or tickle rather than an unpleasant sensation. All the women were then told that they would need to wait their turn and were asked whether they preferred to wait alone or with others. In a now commonly replicated effect, Schachter found that the women in the high-anxiety condition were significantly more likely to want to wait with other women anticipating the same fate, whereas those in the low-anxiety condition typically indicated that they did not care whether they were together with the other women or alone.

Subsequent studies revealed that the desire to affiliate with others under stress is not as general as had originally been thought. First, the effects were found primarily with female participants; indeed, after some unsuccessful pilot work, Schachter never recruited male participants again. The desire to affiliate was also confined to wanting to be with women anticipating the same fate. When the opportunity was provided to wait with other people anticipating a different experiment, most women preferred to wait alone. The desire to affiliate with others was present only when the women were given the opportunity to talk about the stressful event, and not when they were allowed only to talk about irrelevant topics. Finally, the effect appeared to be considerably stronger for women who were firstborn members of their family than later-born. Despite these qualifications, research on affiliation and social support proliferated in subsequent decades and, increasingly, the beneficial effects of the companionship of others under stress have been clarified.

Benefits of Social Support

Research consistently demonstrates that social support effectively reduces distress during times of stress (Cohen & Wills, 1985; Kessler & McLeod, 1985; Wallston,

Alagna, DeVellis, & DeVellis, 1983). Studies attesting to this important role of social support have ranged from laboratory investigations similar to those conducted by Schachter and his students, to naturalistic studies of neighborhoods coping with a trauma such as the Three-Mile Island nuclear accident (Fleming, Baum, Gisriel, & Gatchel, 1982), soldiers in combat, and individuals coping with personal tragedies, such as bereavement (Dunkel-Schetter & Wortman, 1981) or adverse changes in health (House, Umberson, & Landis, 1988). This last literature on the relation of social support to health has most clearly confirmed the apparent beneficial physiological consequences of social support. That is, in addition to providing psychosocial benefits, social support also appears to lower the likelihood of illness, to speed recovery from illness when it does occur, and to reduce the likelihood of mortality due to serious disease (House et al., 1988; Kulik & Mahler, 1989; Wallston et al., 1983).

An example of the significance of social support for combatting the threat of illness comes from a classic study of adults in Alameda County, California, conducted in 1979 (Berkman & Syme, 1979). Approximately 7,000 people were asked about their social and community ties, and their death rate was tracked over a nine-year period. The study showed that people who had fewer social and community ties were more likely to die during this period than were people with many such ties. Having social contact appeared to give women an average of 2.8 years of longer life, and men, an average of 2.3 years of longer life. These differences could not be explained by socioeconomic status, health differences at the beginning of the study, or the practice of health habits.

Since that time, numerous studies have shown that social support is associated with better health. People with high levels of social support have fewer complications

during pregnancy and childbirth (Collins, Dunkel-Schetter, Lobel, & Scrimshaw, 1993), less susceptibility to herpes attacks (VanderPlate, Aral, & Magder, 1988), and lower rates of myocardial infarction (Bruhn, 1965). Social support promotes better adjustment to and/or faster recovery from coronary artery surgery (King, Reis, Porter, & Norsen, 1993; Kulik & Mahler, 1993), rheumatoid arthritis (Goodenow, Reisine, & Grady, 1990), kidney disease (Dimond, 1979), childhood leukemia (Magni, Silvestro, Tamiello, Zanesco, & Carl, 1988), and stroke (Robertson & Suinn, 1968); it has been tied to a reduced likelihood of mortality from myocardial infarction (Wiklund et al., 1988), better diabetes control (Marteau, Block, & Baum, 1987), and less pain among arthritis patients (DeVellis, DeVellis, Sauter, & Cohen, 1986). This consistent evidence showing the apparent health benefits of social support has increasingly led to a search for physiological and neuroendocrine mechanisms whereby social support may exert these effects.

Physiologic and Neuroendocrine Studies of Acute Stress

Stress is known to produce a variety of short-term and long-term physiological and neuroendocrine responses, and so it is likely that social support exerts its protective effects, in part, by moderating some of these responses. Most research on human stress has focused on the fight-or-flight response, which involves the release of the catecholamines, epinephrine and norepinephrine, and concomitant sympathetic nervous system (SNS) arousal, and/or HPA (hypothalamic-pituitary-adrenocortical) activation, involving the release of corticosteroids, especially cortisol. Although these responses have short-term protective functions under stressful circumstances, with chronic or recurrent activation, they are associated with deleterious long-term effects.

Specifically, excessive or repeated discharge of epinephrine or norepinephrine is believed to lead to the suppression of cellular immune function, produce hemodynamic changes such as increased blood pressure and heart rate, provoke abnormal heart rhythms such as ventricular arrhythmias, and produce neurochemical imbalances that may relate to the development of psychiatric disorders (McEwen & Stellar, 1993). Enhanced physiological reactivity in the form of intense, rapid, and/or long-lasting sympathetic responses to repeated stress or challenge have been implicated in the development of hypertension and coronary heart disease (see Fredrickson & Matthews, 1990; Krantz & Manuck, 1984).

Corticosteroids have immunosuppressive effects, and increases in cortisol have been related both to decreased lymphocyte responsivity to mitogenic stimulation and to decreased lymphocyte cytotoxicity (e.g., Cunningham, 1981). Such immunosuppressive changes may be associated with increased susceptibility to infectious diseases, among other adverse health outcomes. Prolonged cortisol secretion has been related to the destruction of neurons in the hippocampus, which is believed to underlie problems in memory and concentration, particularly in older age (McEwen & Sapolsky, 1995; Sapolsky, 1996; Seeman & Robbins, 1994). Pronounced HPA activation has also been associated with depression (Sapolsky, 1996). Links between HPA axis activity and sympathetic nervous system activity (SNS) suggest that increased activation of the HPA axis could potentiate overactivation of sympathetic functioning (Chrousos & Gold, 1992). Indeed, the combination of catecholamine and cortisol hypersecretion is thought to increase the likelihood of coronary atherosclerosis and acute coronary events (Krantz & Manuck, 1984; Kvetnansky, 1980). Given this broad range of adverse effects, it comes as

no surprise that researchers have increasingly turned their attention to the ways in which social support may attenuate SNS and HPA stress responses.

Studies of Responses to Acute Stress

The effort to identify the beneficial effects of social support on physiologic and neuroendocrine responses to stress has utilized an experimental paradigm very much like that of the original Schachter affiliation studies. In a typical investigation, participants are brought into the laboratory and asked to engage in a stressful experience either alone or in the presence of a supportive other person. The stressful tasks range from immersing one's hand in ice water for several minutes (the cold pressor test), receiving electric shock, preparing a speech to give to a panel of judges, or performing stressful cognitive tasks, such as difficult memory tasks, arithmetic, counting backwards by threes or sevens, or completing the Stroop color-naming task (in which participants must identify the color of the ink in which the name of a color has been written (e.g., saying "green" in response to the word "purple" written in green ink). Blood pressure and heart rate are typically monitored before, during, and after the stressor, selected neuroendocrine responses are sometimes assessed, and participants complete questionnaires assessing their anxiety and other emotional responses to the stressful task. Because blood pressure and heart rate typically increase during the performance of a stress-inducing task, relative to baseline, this paradigm has been especially used to study cardiovascular reactions to stress.

Consistent with the health studies on social support, a substantial literature suggests that the presence of a supportive person during a stressful task, whether friend or stranger, can reduce cardiovascular and HPA reactivity to stress (Christenfeld et al., 1997; Gerin, Pieper, Levy, & Pickering, 1992; Gerin et al., 1995; Kamarck, Manuck, &

Jennings, 1990; Kors, Linden, & Gerin, 1997; Lepore, Allen, & Evans, 1993; Sheffield & Carroll, 1994). In addition to reducing heart rate, blood pressure, and cortisol, the presence of others also typically reduces feelings of arousal and anxiety in response to stress, although psychological and physiological changes are typically only moderately correlated with each other.

Despite the converging evidence from these studies, some ambiguities remain. First, the paradigm in acute stress studies departs in an important way from that initially developed by Schachter. Schachter's original investigations manipulated the presence of potentially supportive others during the waiting period, but not during the stressful event itself. Indeed, Schachter's participants never went through an actual stressful event; they anticipated but did not actually experience electric shock. Subsequent studies have typically had the supportive stranger or friend present before the stressor, during the stressful event, and afterwards. As noted, in most studies, the presence of a supportive stranger or friend is typically stress-reducing, lowering cardiovascular responses to stress during the stressor itself (Christenfeld et al., 1997; Edens, Larkin, & Abel, 1992; Gerin et al., 1992; Kamarck, Annunziato, & Amateau, 1995), but sometimes the presence of a friend or stranger can actually increase sympathetic reactivity (Allen, Blascovich, Tomaka, & Kelsey, 1991; Mullen, Bryant, & Driskell, 1997). For example, Allen et al. (1991) found that, relative to a control condition in which they remained alone, women who completed a stress task in the presence of a female friend showed higher physiological reactivity and poorer performance. Kirschbaum, Klauer, Filipp, and Hellhammer (1995) and Smith, Gallo, Goble, Ngu, and Stark (1998) found that women,

but not men, showed enhanced physiological reactivity to a stressful task performed in the presence of the partner, as opposed to when they completed the stressful task alone.

Research has yet to systematically sort out the effects of affiliation and support at these different times. It is possible that affiliation is more consistently helpful before and after a stressful event than it is during a stressful event. Indeed, the original Schachter paradigm may more properly reflect the kind of social support that people typically receive from others during times of stress. Under many stressful circumstances (such as going through noxious medical procedures or taking tests), people typically receive support from family and friends before they go through the stressful event, or after it has occurred, but not necessarily during the event itself. Indeed, when others are present during the stressful event, often they are experiencing the same stressor. More research will be needed to identify those factors that influence when affiliation during a stressful event is stress-reducing or not.

A second ambiguity concerns what constitutes support in a situation of acute stress. When other people are physically present during a stressful event but do not offer any support, electrodermal responses in particular and, in some cases, cardiovascular responses, may actually increase rather than decrease (Mullen et al., 1997). In addition, when support is provided by a confederate or a friend during a stressful event, friends appear to reduce cardiovascular reactions to stress better than do supportive strangers (e.g., Christenfeld et al., 1997; Edens et al., 1992; Kamarck et al., 1995; Kamarck et al., 1990). The studies showing the beneficial effects of friends involve disproportionately female participants, however, which may represent a qualification to these findings.

Gender, Affiliation, and Stress Responses

An additional unresolved issue concerns who seeks and who benefits from social support under stress: men or women, or both. Perhaps because the emphasis of acute stress studies has been on cardiovascular responses to stress, males have been overrepresented in these studies, relative to females (men are vulnerable to cardiovascular disease at earlier ages than are women). Of 196 experimental investigations of responses to stress over a 15-year period from 1984 to 1998 involving 14,131 participants, 65.8% of the participants were male, and only 34.2% were female (Gruenewald, Taylor, Klein, & Seeman, 1998). However, as was true in Schachter's studies, when the acute stress paradigm has been used to study the effects of affiliation in response to stress, females are overrepresented. Five of 31 acute stress studies during the 1984-1998 time period involving all female participants examined affiliative reactions to stress, whereas none of 96 all-male investigations examined affiliation. Unhappily, this overrepresentation of women in studies of affiliative responses to stress renders gender comparisons difficult. Nonetheless, women's greater preference to affiliate under stress is well-established in the non-experimental literature.

Reviews of the stress literature consistently reveal evidence of women's higher investment in the creation and maintenance of social networks relative to men's (e.g., Belle, 1987). This is one of the most robust gender differences in adult human behavior, and it is the primary gender difference in adult human behavioral responses to stress (Belle, 1987; Luckow, Reifman, & McIntosh, 1998). Across the entire life cycle, girls and women are more likely to mobilize social support, especially from other females, in times of stress. They seek it out more, they receive more, and they are more satisfied with the support that they receive (Belle, 1987; Copeland & Hess, 1995; McDonald &

Korabik, 1991; Ogus, Greenglass, & Burke, 1990; Ptacek, Smith, & Zanas, 1992; Wethington, McLeod, & Kesser, 1987). In a survey study, Veroff, Kulka, and Douvan (1981) found that women were 30% more likely than men to have provided some type of social support in response to a stressor in their social network. Thus, for example, women are much more likely to provide transportation, food, child care, or even just a willing ear to friends and relatives going through stressful events, including job loss, divorce, bereavement, and natural disasters. Moreover, these findings have substantial cross-cultural generalizability. In a study of six cultures, Whiting and Whiting (1975) found that women and girls sought more help and gave more help to others than males in stressful times, and Edwards (1993) found similar sex differences across 12 additional cultures.

Despite the fact that women seek social support under stress more than men, they do not seem to profit from it more. Both men and women show psychological and health benefits in response to stress (e.g., Berkman & Syme, 1979; Unger, McAvay, Bruce, Berkman, & Seeman, 1998), but men sem to show somewhat greater benefits (Barer, 1994; House, Robbins, & Matzner, 1982; Seeman, Berkman, Blazer, & Rowe, 1994; Umberson, Wortman, & Kessler, 1992; but see Tower & Kasl, 1996). All the reasons for this gender difference are not yet known, and the difference may be more apparent than real. For example, many of these studies use mortality as an endpoint, and because women die at later ages than men, the beneficial effects of social support may be less evident for women, given little variance in the outcome (i.e., fewer women die). Paradoxically, then, social relationships may lengthen women's lives, but appear less effective precisely because they help to lower mortality. Alternatively, the gender

difference in social support favoring men may be real. Men most often report receiving their social support from women (especially their mothers and wives) who are more likely to provide support than men (Wethington et al., 1987). Women find their husbands' efforts to provide support to be less supportive than men find their wives' efforts to be (Gurung, Seeman, & Taylor, 2001), and so the quality of support received by men may be somewhat higher than that received by women. In addition, women appear to be more vulnerable than men to negative events in their social networks which may erase some of the benefits that social ties would otherwise provide (Schuster, Kessler, & Aseltine, 1990). For example, women are more likely than men to be the caregivers for elderly or infirmed relatives and are more likely to provide housekeeping services or child care during acutely stressful events, efforts which may tax their time and emotional and physical resources.

In summary, women seek and give more social support under stress, men may get more and better social support under stress, but both genders are psychologically and physically benefitted by higher levels of social support under stress. How are we to understand this unusual pattern? Turning to the biology of stress responses and sex differences in those biological responses may provide some answers.

Gender, Affiliation, and Neuroendocrine Responses

Recent experimental evidence from animal studies yields a model that may provide a biobehavioral account of sex differences in the likelihood of and the effects of affiliation under stress. This model, which remains somewhat speculative with respect to humans, implicates oxytocin in the modulation of sympathetic and HPA responses to stress, in emotional responses to stress, and in affiliative behavior under stress.

Both sexes experience a cascade of hormonal responses to stress that mobilizes the organism to respond to threat, the so-called "fight-or-flight" response. Yet within this neuroendocrine response may be the basis of a counterregulatory response that reduces the arousal and anxiety that typically accompanies stress, instead helping to promote relaxation and affiliation.

A substantial animal literature reveals that oxytocin downregulates sympathetic and HPA activity. McCarthy (1995) has suggested that, among animals in the natural environment who face a constant barrage of stress, oxytocin is associated with parasympathetic (vagal) functioning that plays a counterregulatory role in fear responses to stress (Dreifuss, Duois-Dauphin, Widmer, & Raggenbass, 1992; Sawchenko & Swanson, 1982; Swanson & Sawchenko, 1980). Oxytocin is known to be released early on in the neuroendocrine stress response (Sapolsky, 1992). In experimental studies, oxytocin has been found to enhance sedation and relaxation, reduce anxiety, and decrease sympathetic activity (Altemus, Deuster, Galliven, Carter, & Gold, 1995; Uvnas-Moberg, 1997). The exogenous administration of oxytocin in rats results in decreases in blood pressure, pain sensitivity, and corticosteroid levels, among other findings indicative of a reduced stress response (Uvnas-Moberg, 1997). Oxytocin appears to inhibit the secretion of adrenocorticotrophin hormone (ACTH) and cortisol in humans (Chiodera & Legros, 1981; Legros, Chiodera, & Demy-Ponsart, 1985). The relation of oxytocin to reduced anxiety under stressful conditions is thought to be one reason why female rats reliably show indications of reduced fear in stressful circumstances (such as less freezing and more exploration in open-field tests) than is true of male rats (see McCarthy, 1995). Thus, oxytocin-mediated reductions in anxiety under stress may have beneficial effects on

an organism, especially one that is repeatedly exposed to stressful circumstances, by muting sympathetic and HPA responses to stress.

A growing literature suggests that oxytocin increases affiliative behavior as well. Social contact is enhanced and aggression is diminished following central oxytocin treatment in estrogen-treated prairie voles (Witt, Carter, & Walton, 1990), and experimental studies with female rats have found that the administration of oxytocin causes an increase in social contact and in grooming (Argiolas & Gessa, 1991; Carter, DeVries, & Getz, 1995; Witt, Winslow, & Insell, 1992). It is important to note that this relationship appears to be bidirectional; that is, oxytocin enhances affiliation, and affiliation, particularly of an affectionate nature, enhances the flow of oxytocin which, in turn, downregulates neuroendocrine stress responses. Because social groups are protective against certain forms of stress (such as attack by predators), and because such protection may be especially helpful to females nurturing young infants, oxytocin-facilitated affiliative responses to stress are thought to represent an adaptive response to stressful circumstances (Drago, Pederson, Caldwell, & Prange, 1986; Fahrbach, Morrell, & Pfaff, 1985; McCarthy, 1995). In summary, animal data suggest that oxytocin induces a state of mild sedation and relaxation, reduces anxiety, decreases sympathetic and HPA activity, and promotes affiliative and prosocial behavior under stressful conditions, which may, in turn, enhance the secretion of oxytocin, downregulating stress responses.

The effects of oxytocin on anxiety and social behavior in response to stress appear to be different for males and females. The effects of oxytocin are believed to be particularly important for females, because they may enhance the affiliative and protective behaviors essential for the care of offspring (McCarthy, 1995). For example,

oxytocin is known to promote maternal and other forms of affiliative behavior in rats (McCarthy, 1995), and it is believed to be a neurochemical underpinning of mother-infant bonding (Keverne, Nevison, & Martel, 1997; Mendoza & Mason, 1997). In rodents, the effects of oxytocin in reducing anxiety, decreasing sympathetic activity, and enhancing social activity are greater for females than for males, first, because oxytocin release in response to stress appears to be greater in females than in males (Jezova, Jurankova, Mosnarova, Kriska, & Skultetyova, 1996); second, because androgens appear to inhibit oxytocin release under conditions of stress (Jezova et al., 1996); and, third, because the effects of oxytocin are strongly enhanced by estrogen (McCarthy, 1995). Thus, there is a robust sex difference in affiliative responses to stress in rodents, such that females seek more such contact.

Carter (1998) reviewed evidence that oxytocin may be at the core of many forms of human social attachment, including caregiver-infant attachments, adult pair bonds, and other forms of affiliative behavior (Carter & Altemus, 1997). For example, Uvnas-Moberg (1996) found that women who were breastfeeding (and therefore very high in plasma oxytocin concentration) perceived themselves to be calmer and rated themselves as more social on personality inventories than age-matched women who were not breastfeeding or pregnant. Moreover, the level of plasma oxytocin in these women correlated strongly with the level of calm reported, and oxytocin pulsatility was significantly correlated with self-reported sociability (Uvnas-Moberg, 1996). Virden (1988) found that breastfeeding mothers one month post-partum were less anxious than bottle feeding mothers, and women who used both feeding methods reported less anxiety, less depression, and less stress after breastfeeding than after bottle feeding (Modahl &

Newton, 1979; Heck & deCastro, 1993), presumably because breastfeeding is a potent elicitor of oxytocin release. Breastfeeding also has been found to suppress cortisol responses in women (Amico, Johnston, & Vagnucci, 1994). Oxytocin may be related either to enhanced perceptions of one's sociability and the positivity of one's social relationships or to behavioral tendencies that lead to more prosocial activity or both.

Oxytocin has also been related to lower neuroendocrine responses to stress. Light and her colleagues (2000) examined the relation of oxytocin responsivity to blood pressure changes in women in response to a stress task. The women, who were either breast-feeding or bottle-feeding their newborns, completed the task on two successive days, once with their baby and once without. Greater oxytocin responsivity was seen among women who were breast feeders and during baby contact days. Those women who showed oxytocin increases in response to stress had lower blood pressure responses. Heinrichs (2000) enrolled lactating mothers in a stress study, half of whom breast-fed their infants just before the task, the other half of whom merely held their infants. Those who had breast-fed their infants, and who presumably had higher levels of oxytocin as a result, had significantly lower plasma cortisol levels at all points during the stress task. Altemus and colleagues (1995) compared the stress responses of breast-feeding and non-breast -feeding women in response to an exercise stressor and found similar effects.

Although we have argued that the effects of oxytocin on men may be less than is the case with women (either because they may produce less oxytocin in response to stress or because its effects may be antagonized by androgens), there is, nonetheless, intriguing evidence to suggest an impact of oxytocin in men similar to that in women, when it is administered exogenously. Pitman, Orr, and Lasko, (1993) administered an internasal

solution of either oxytocin, vasopressin, or a placebo and observed effects on heart rate, skin conductance, and EMG responses of 43 male Vietnam veterans with PTSD. Those receiving OT showed the lowest activation on these measures.

To summarize, consistent evidence from animal studies and suggestive data from humans leads to the hypotheses that oxytocin may be associated with enhanced affiliative behavior, reduced anxiety, and reduced neuroendocrine and physiological responses to stress. These effects may be more pronounced in females than in males, although the requisite comparative studies have not yet been done.

Taken together, evidence from studies of affiliation, social support, and neuroendocrine studies of stress responses in rats and humans suggest the following testable model of human affiliative behavior under stress. In response to the perception of stress or threat, neuroendocrine hormones are secreted that prepare the body for fight-or-flight. Simultaneously, however, oxytocin is secreted, which may lead to a desire to affiliate, especially among females, because estrogen is believed to enhance the behavioral effects of oxytocin, especially its effects on affiliation and/on relaxation. This biobehavioral response may damp down adverse physiological and behavioral reactions to at least some types of stress by reducing anxiety and arousal and increasing prosocial tendencies, especially in females.

There may be long-term benefits of these responses to stress as well. To the extent that this is a reliable response that occurs to a broad array of chronic and recurring acute stressors, females may suffer fewer of the cumulative adverse effects of stress. For example, women are less vulnerable to cardiovascular disorders and to behavioral effects of stress that may be anxiety-related, such as aggression and substance abuse. Sex

differences in affiliative and neuroendocrine responses to stress may provide a partial explanation for these patterns.

Whether oxytocin confers behavioral and neuroendocrine protection in human females as it seems to do in female rodents remains to be seen. The fact that human females show more preference for affiliation under conditions of stress than men and the fact that their stress responses appear to be downregulated as a result is tantalizingly consistent with the above-described animal model. Nonetheless, these links remain speculative, requiring more evidence from studies with humans.

Conclusion

The preference to be with other people appears to be a robust characteristic of human beings (Baumeister & Leary, 1995). Although both men and women appear to benefit psychologically and physiologically from social support, the desire for social support under conditions of stress and the provision of social support to others appear to be more characteristic of women than men. These findings may have relevance to understanding sex differences in health and health-related behavior. Women live longer than men in all developed nations. Women show fewer behavioral disruptions in response to stress than men, in the form of fewer health-compromising behaviors (such as smoking or drinking to excess) and aggression and its behavioral concomitants (such as fighting, homicide, and suicide) (Verbrugge, 1989a, 1989b; Waldron & Johnston, 1976; Wingard, 1982). Neuroendocrine reactions to stress may be implicated in some of these gender patterns. As we have noted, animal data and modest data from humans suggest that oxytocin may downregulate sympathetic and hypothalamic-pituitary-adrenocortical (HPA) responses to stress by leading to a preference to affiliate, by lowering anxiety and

arousal in response to stress, and by reducing the likelihood of stress-related behavior indicative of arousal or anxiety.

In closing, we point out the advantages of an approach to affiliation and social support in response to stress that draws on contributions from social psychology, from health psychology, and from studies of neuroendocrine responses to stress. This area is well-suited to such an integrative analysis. Although the oxytocin-based model proposed here remains speculative and warrants continued examination, especially in humans, it nonetheless provides a potentially viable biobehavioral account of the affiliative processes for coping with stress uncovered by Stanley Schachter more than 40 years ago.

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