

Oxytocin effects extend to adult maternal behavior, stress reactivity



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What is oxytocin?

Oxytocin is a hormone that in the past was believed to be related to a few well-defined activities related to birth and lactation. However, further research has shown that it has many subtle but profound influences. It clearly has three major effects:

- 1. Stimulation of milk ejection (milk letdown):** Oxytocin stimulates certain muscle cells, causing milk to be ejected into the ducts.
- 2. Stimulation of uterine smooth-muscle contraction at birth:** During labor, oxytocin is released when the fetus stimulates the cervix and vagina and it also enhance the contraction of uterine smooth muscle to help in birth.
- 3. Establishment of maternal behavior:** Successful reproduction in mammals demands that mothers become attached to and nourish their offspring immediately after birth.

The same events that affect the uterus and mammary at birth also affect the brain. During parturition, the concentration of oxytocin in cerebrospinal fluid increases.

Thus, oxytocin plays a major role in establishing maternal behavior. The article on which this *Snapshot* is based focuses primarily on this area.

Summary of findings

Researchers reviewed recent discoveries that showed emerging evidence that oxytocin is involved in transducing nurturing received into adult maternal behavior and stress reactivity.

First line of evidence

Reducing oxytocin decreased the display by nursing rat dams of pup-licking (PL) and arched-back nursing (ABN), but not other components of maternal behavior. This and increased maternal self-grooming suggests that oxytocin may shift the balance of oral grooming by dams away from themselves and toward pups.

Second line of evidence

Oxytocin receptor concentrations in areas in the adult brain where oxytocin stimulates maternal behavior or diminishes anxiety and adrenal axis responses to acute stress were positively related to PL-ABN received during infancy.

(See "Summary of findings" on reverse)

Implications for human psychopathology

Oxytocin activity in the nursing rat dam's brain regulates her frequencies of pup-licking (PL) and arched-back nursing (ABN).

The amount of PL-ABN received by infant female rats determines how many oxytocin receptors they express as adults in brain areas where oxytocin regulates maternal behavior, anxiety and hypothalamic-pituitary-adrenal (HPA) axis activity.

It appears that oxytocin activity in young female rat pups influences their adult PL (and possibly ABN) frequency. PL-ABN shown by dams may regulate oxytocin activity in their pups and thereby affect the maternal behavior later exhibited by their adult female offspring.

The involvement of oxytocin in these processes links neurobiology of parental/affiliative behaviors and early nurturing effects on behavioral and emotional development.

These recent findings provide a new perspective for understanding the origins and characteristics of human behavioral and emotional problems that arise from inadequate nurturing and pathological relationships during childhood.

Neglect, abuse, and deficient emotional attachment and empathic concern tend to be perpetuated within families from one generation to the next.

(See "Implications" on reverse)

This *Snapshot* is based on "Oxytocin Links Mothering Received, Mothering Bestowed and Adult Stress Responses" published in *Stress*, 2002, Vol. 5 (4), pp. 259-2657 and written by Cort A. Pedersen of the University of North Carolina at Chapel Hill Medical School and Maria L. Boccia of the FPG Child Development Institute at UNC-Chapel Hill.

Summary of findings

(continued from front)

Nurturing received in infancy may broadly influence ovarian steroid regulation of central oxytocin receptor expression. Perhaps the degree to which oxytocin contributes to estrogen and progesterone-stimulated female sexual behavior...is determined by early nurturing experience.

Third line of evidence

Oxytocin and oxytocin antagonist treatments of rat pups on postnatal days two to ten, respectively increased and decreased PL by the treated rats when adult and themselves nursing dams.

Findings suggest that maternal contact may stimulate oxytocin release in the pup brain and that a decline in that release during maternal separation may contribute to distress vocalizations. Maternal PL-ABN may be particularly effective in enhancing oxytocin activity in pups.

The widespread central expression of receptors during the first two postnatal weeks suggests that oxytocin may influence early neural development in many brain areas. By regulating central oxytocin release in pups, maternal

PL-ABN could determine the magnitude of these oxytocin effects.

This indicates that oxytocin activity in female rat pups, which may be regulated by PL-ABN received from their mothers, influences their adult levels of PL.

In this way, maternal care received could not only alter the development of oxytocin receptors but perhaps also other neurochemical systems, such as glucocorticoid receptors, corticotropin-releasing hormones and gamma-aminobutyric acid (GABA), that regulate anxiety and HPA axis responses to acute stress.

These three lines of evidence suggest that oxytocin selectively enhances PL-ABN by rat dams, which then increases oxytocin activity in female pups and, thereby, facilitates their expression of central oxytocin receptors (and perhaps other aspects of central oxytocin systems) and, consequently their adult PL-ABN frequencies and acute stress responses.

Implications of findings

(continued from front)

Also, it is not uncommon for children to undergo repeated disruption of attachments during changes in foster care placement.

Such early experience produce persistent difficulties in forming and maintaining relationships and increase vulnerability to depressive, anxiety, addictive and personality disorders.

The research examined in this paper suggests that central oxytocin systems are particularly malleable by nurturing experiences during development and may have lifelong influences on the ability to form close emotional attachments to others especially one's own children.

Abuse, neglect and disruptions during early relationships may exert negative effects on the development of central oxytocin systems resulting in deficits in emotional attachment and excessive stress reactivity that lead to abuse and neglect of the next generation of children.

These studies could lead to new biological strategies to facilitate recovery from pathological early experiences and to protect children who are caught in these terrible circumstances.

If you want to know more

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Francis, D.C., Champagne, F.C. and Meaney, M.J. (2000b) "Variations in maternal behavior are associated with differences in oxytocin receptor levels in the rat", *J. Neuroendocrinol.* 12, 1145-1148.

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