

**9.14 class #34: Limbic system 3: Hormonal and other influences on development and plasticity.**

*Readings:*

Swaab, D. F. and Hofman, M.A., "Sexual differentiation of the human hypothalamus in relation to gender and sexual orientation", *Trends in Neuroscience*, 1995, 18: 264-270.

Nottebohm, F., "From bird song to neurogenesis", *Scientific American*, Feb 1989, 74-79.

Baum, M.J., "Chapter 47, Psychosexual development", *Fundamental Neuroscience*  
Zigmond et al., New York: Academic Press, 1999, pp. 1229-1244  
Read Box 47.2 and Box 47.3; remainder is recommended but not assigned.

Abstracts of recommended readings (below).

*Also recommended:*

Toran-Allerand, C.D., "Mechanisms of estrogen action during neural development: mediation by interactions with the neurotrophins and their receptors?", *J. Steroid Biochem Mol Biol*, 1997, 56: 169-178.

Toran-Allerand, C.D., "Organotypic culture of the developing cerebral cortex and hypothalamus: relevance to sexual differentiation", *Psychoneuroendocrinology*, 1991, 16: 7-24.

Reisert, I., Han, V. Lieth, E., Toran-Allerand, D., Pilgrim, C. and Lauder, J., "Sex steroids promote neurite growth in mesencephalic tyrosine hydroxylase immunoreactive neurons in vitro", *International Journal of Developmental Neuroscience*, 1987, 5: 91-98.

Johnson, F. and Bottjer, S.W. , "Differential estrogen accumulation among populations of projections neurons in the higher vocal center of male canaries", *J. Neurobiology*, 1995, 26: 87-108.

Brown, S.D. and Bottjer, S.W. , "Testosterone-induced changes in adult canary brain are reversible", *J. Neurobiology*, 1993, 24: 627-640.

Brown, S.D., Johnson, F., and Bottjer, S.W., "Neurogenesis in adult canary telencephalon is independent of gonadal hormone levels", *J. Neuroscience*, 1993, 13: 2024-2032.

Bottjer, S.W. and Dignan, T.P., "Joint hormonal and sensory stimulation modulate neuronal number in adult canary brains", *J. Neurobiology*, 1988, 19: 624-635.

*Questions:*

1. Compare evidence for genetic factors, hormonal influences and social environment in the determination of sexual orientation.
2. Give two examples of neurological or psychiatric disease where there are dramatic sex differences.
3. When are sex differences in gonadal hormone levels at a peak in human development, and when do morphological differences in the hypothalamus appear?
4. Describe one of the technical factors in studying morphological differences in the hypothalamus of postmortem human brains. What is the Swaab and Hofman solution?

5. What is a cell group of the human hypothalamus which differs between the sexes? Is it also different in hetero- and homosexuals?
6. Which nucleus of the hypothalamus may be involved in sexual orientation according to a recent study in rats? How is this cell group different in human males of different sexual orientation?
7. Describe the Nottebohm et al. evidence that the male canary brain changes from season to season. What did he think the change was caused by? How has the work of Sarah Bottjer modified this view?
8. Describe the findings of Toran-Allerand which indicate that sex differences in the brain are probably much more widespread than has been indicated in the studies of cell stained human post-mortem material.