Chapter 11: Affiliative and Reproductive Strategies

# Brain Scene Investigation: The experimental wedding

What happens to levels of hormones during a wedding? Bride/groom and relatives showed more of an increase in oxytocin than others during the ceremony. Cortisol was high in the bride throughout the day, but decreased for the groom after the ceremony. Groom showed increased testosterone during the ceremony, but decreased vasopressin. These data are correlational, and hormone levels did not always match predictions/self-reported emotions.

# Hormones and behavior

## The endocrine system

Historical background of behavioral endocrinology. Early work in chickens showed that replacing hormones in a castrated chick can restore typical sexual maturation.

Primary endocrine glands and hormones. Hormones are released by specialized endocrine glands (or neurons) located in several places in the body.

Chemical classes of hormones. Hormones are categorized based on their chemical structure: **steroid** (derived from cholesterol, fat soluble), **amine** (derived from amino acid tyrosine), **peptide** (consists of chains of amino acids), or **protein** (also consist of chains of amino acids). Only steroid hormones easily cross cell membranes, other hormones require specific receptors.

Functional relationships between the hypothalamus and the pituitary gland. Hypothalamic releasing hormones travel through the pituitary blood vessels to stimulate the release of *anterior* pituitary hormones, whereas axons from the hypothalamus extend to the *posterior* pituitary, where they release the posterior pituitary hormones. The portal system is a specialized blood system connecting the hypothalamus and pituitary gland.

Organizational and activational effects of hormones during development. Some developmental changes require hormones to be delivered during a sensitive period. Changing the hormones available during gestation leads to dramatic effects on physiology and behavior. In general, prenatal hormone delivery impacts brain *organization*, whereas delivery after maturation leads to brain *activation*. Early hormone therapy and surgery have been used to alter intersex physiology.

# The neurobiology of relationships

## Romantic elixirs

Oxytocin and vasopressin are associated with strong social/romantic bonds. By studying species that have similar environments and genetics but show different mate bonding behavior, the role of hormones can be assessed. Prairie voles (monogamous) show more oxytocin/vasopressin receptors in the nucleus accumbens/ventral pallidum than montane voles (non-monogamous). Genetically-engineered montane voles with more vasopressin receptors in the ventral pallidum show increased partner preference.

## Oxytocin: The social trust molecule?

Oxytocin has been suggested to increase prosocial behavior in laboratory experiments and in commercial products. Clinical trials are underway, but ethical problems exist with marketing a product that (in theory) increases the likelihood of someone complying with your demands. Some evidence suggests that higher levels of oxytocin may actual increase social anxiety.

## The pet factor

Spending time with pets can increase oxytocin levels in a similar manner to spending time with friends.

# Sexual behavior and characteristics

Rodent model: Male and female sexual behavior.

Rat sexual behavior is largely determined by the female’s 4-day estrous cycle: **proestrus** (increasing interest in copulation), **estrus** (high estrogen, fertile period), **metestrus**, and **diestrus**. The amygdala and hippocampus are involved in processing pheromonal signals information detected by the VNO. The Coolidge effect describes the rodent behavior of heightened motivation to mate with new females after previously reaching sexual satiety with another female. Female rodents are more selective in mate preferences than males.

## Sex differences and the brain

Stress leads to increased dendritic in male rodents but a decrease for females. Stress leads to enhanced associative learning in males vs. impaired associative learning in females (rodents and humans). The amygdala in males tends to be larger (correcting for total brain volume). Women tend to show more activation left amygdala, men more in the right amygdala.

## Sexual orientation and transsexualism

There is controversy over whether and how sexual orientation is determined by neurobiology. Some research indicates prenatal environment may decrease heterosexual behavior in rodents. In humans, many regions have been identified as having size differences in homosexual vs. heterosexual individuals, but there is not a strong consensus, and individual differences make group-average comparisons difficult. Serotonin deficiencies have also been suggested as a neurochemical basis for lack of heterosexual interest. Less work has been done with transsexual populations, and although some studies suggest white matter connection differences, there is no consensus and individual variability is high.

# The neurobiology of parental behavior

## The maternal brain

Many brain changes occur during the course of pregnancy, giving birth, and lactation. Critical hormones include estrogen, progesterone, prolactin, and oxytocin; endorphins play a role in preparation for delivery. The hypothalamus and thalamus-cingulate connections are critical for maternal behaviors. Parents show stronger amygdala responses to their infants crying; non-parents show strong responses to infants laughing. There is mixed data on increased smarts after pregnancy, depends on the test (memory test, brain volume, maze learning) and maybe the species.

## The paternal brain

In species that show paternal parenting, brain changes are visible in fathers (relative to non-paternal parenting species): increased oxytocin/vasopressin levels, decreased fear and amygdala response to offspring, and hippocampal cell proliferation. In humans, we also see higher prolactin/cortisol prior to birth and decreased testosterone after birth. In biparental species, removing a parent can lead to dramatic neural development deficits in the offspring that persist into adulthood. In humans, children raised without a father are 4x more likely to have emotional/behavioral/cognitive problems including poor academic performance, drug abuse, and criminal behavior. Paternal parenting roles show large variability across both humans and nonhuman animals.

## Alloparenting

Sharing the task of raising the children across an extended group (including non-near relatives) has clear benefits. Females in species that exhibit cooperative breeding and alloparenting tend to have shorter lactation periods and have offspring more frequently.

# Context matters: An old bird learns a new trick

Terminal investment hypothesis*:* an animal near the end of its reproductive stage of life will invest all available effort to ensure offspring survival. Evidence from blue-footed booby birds show that when ill, older fathers showed increased care to their offspring (relative to healthy older fathers); younger fathers showed no increased care when ill (relative to healthy younger fathers).

# Laboratory exploration: Manipulating hormone levels in laboratory animals with implantable delivery pumps

Scientists can study the role of hormones in behavior by implanting pumps that release precise amount of hormones over an extended period of time. After recovering from implant surgery, the animals no longer require repeated injections or handling that might interact with the hormones delivered. Extensions to humans would allow for precise delivery of drug for extended durations, rather than frequently taking pills or getting shots.