INTRODUCTION: THE ROLE OF MODERN NEUROSCIENCE IN SEXUALITY RESEARCH

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The past decade has witnessed an explosion of neuroscience research on sexuality. This research has been driven by three forces: the quest of drug companies for Viagra and even better successors; technological advances in numerous areas, including functional magnetic resonance imaging (fMRI) technology; and advances in neuroscience techniques in both animal and human postmortem research. The result is that a tremendous amount more is known today about the biological substrates of human sexuality than 10 years ago.

I use the terms neuroscience and biological substrates in their broadest sense here, to include central and peripheral neural pathways, neurotransmitters, the endocrine system, genetic blueprints, and interactions among all these systems. The emphasis on biological substrates is not intended to slight the enormous cultural, interpersonal, and individual life history influences on sexuality, which are well documented elsewhere (e.g., Adkins-Regan, 2002; Frayser, 1985, 1994; Gregersen, 1996; Herdt, 1984, 1997; Wyatt, 1997). I seek only to focus on a specific piece of the puzzle, namely the biological substrates.
This volume is above all integrative. It integrates research on humans and animals; research on males and females; research using vastly different methodologies including twin studies, fMRI, viral tracers to identify neuroanatomy, and experimental pharmacology; and research at multiple levels of analysis from the molecular (McKenna’s chapter on pharmacology) to the familial (Hyde’s chapter on family resemblance for sexual orientation). It integrates a fascinating array of aspects of sexuality, including sexual orientation, orgasm, erectile dysfunction, the sexual functioning of women with spinal cord injury, and compulsive sexual behavior. The authors represent a variety of disciplines, including psychology, physiology, neuroscience, urology, and nursing.

This book will be useful to many sectors of the community of psychologists. Practitioners increasingly need to understand the biological substrates of both male and female sexual functioning and dysfunction; for example, they need to know what sorts of clients might benefit from Viagra. Those who teach human sexuality, behavioral neuroscience, or biopsychology in colleges and universities will find in this volume much-needed information for updating their teaching. And certainly researchers in sexuality and related fields will appreciate the cutting-edge reviews found in the chapters that follow.

This book integrates multiple levels of analysis, ranging from the most basic to the most complex. The book begins with genes, the basic biological blueprints, and Hyde’s chapter on the genetics of sexual orientation. The next chapter moves to the cellular level, focusing on the hypothalamus, a region of the brain that has been implicated particularly in sexual behavior and identity. Swaab’s chapter reviews research on the important regions of the human hypothalamus and their connections to the sex hormone system, also discussing data from animal research. McKenna focuses on the central nervous system, synthesizing research that has identified the pathways in the brain and spinal cord, and the neurotransmitters that are involved in sexual function and dysfunction. Komisaruk and Whipple review their pathbreaking research using fMRI and positron emissions tomography (PET) scans to understand how women with complete spinal cord injury can nonetheless feel genital stimulation and experience orgasm. Finally, we move to the level of clinical applications, with Coleman’s chapter on compulsive sexual behavior and the neural dysregulation that may underlie it.

One overarching theme is prominent across chapters. Sexuality is multifaceted and complex, even in the rat. In the male rat, for example, mounting, intromission with erection, and ejaculation are all distinct processes with somewhat different neural control. In humans, sexual orientation may be defined by behavior, attraction, or identity, and individuals may be discordant from one aspect to another. It is unfortunate that some recent trends in the field ignore these distinctions. For example, some speak of
"female sexual dysfunction" as if it were a single diagnostic category, masking the multiplicity of sexual dysfunctions and dissatisfaction that women can experience. Each of those dysfunctions may have distinct biological substrates and sources of learning through the environment and experience. The chapters that follow give ample recognition to the complexity of sexuality.

In chapter 2, Hyde reviews the evidence on whether there is a genetic basis for sexual orientation. Much of the evidence comes from studies of identical (monozygotic or MZ) twins compared with fraternal (dizygotic or DZ) twins and their concordance for homosexuality—or, more precisely, nonheterosexual orientation, including both homosexuality and bisexuality. Sufficient studies using strong methods now exist to support the conclusion that nonheterosexual orientation is moderately heritable. Other researchers have advanced the hypothesis that homosexuality in some men is influenced by a gene on the X chromosome, called Xq28. The replicability of these findings is somewhat ambiguous. Results of the first genomewide scan for male sexual orientation, published in 2005, are included. Hyde also reviews genomic research with other species such as fruit flies, which has identified specific genes controlling specific aspects of sexual behavior such as the courtship ritual. Finally, Hyde considers the ethical issues that will arise if specific genes influencing homosexual orientation are identified.

Swaab has conducted a long and distinguished program of research on the hypothalamus and endocrine system and reports on this and related research in chapter 3. Patterns of sex differences and control of sexual behavior have been identified in certain regions of the hypothalamus. For example, the sexually dimorphic nucleus of the preoptic area (SDN-POA, also known as the interstitial nucleus of the anterior hypothalamus, or INAH-1 in humans) shows marked anatomical differences between males and females across numerous species. Lesions of the preoptic area eliminate mounting, intromission, and ejaculation in male rats. This region also contains an abundance of both androgen receptors and estrogen receptors and contributes to the regulation of circulating levels of these sex hormones throughout the body. Swaab's discussion ranges over questions of sexual orientation and transsexualism and the possible involvement of the hypothalamus in these patterns of behavior and identity. A glossary beginning on p. 73 makes this technical chapter more accessible. Clearly the hypothalamus is one of the brain's real hot spots for sexual functioning.

In chapter 4, McKenna considers the role of the central nervous system—brain and spinal cord—and neurotransmitters, focusing particularly on mechanisms influencing erection in males. McKenna has been a major contributor to the basic science that supported the development of prescription drugs to treat erectile dysfunction. Viagra acts peripherally, facilitating vasocongestion in the penis. Strategies for successor drugs are capitalizing on central mechanisms as well. McKenna reviews new discoveries about
the neuroanatomy of sexual response, focusing on sites such as reflex centers in the spinal cord, and the inhibitory role of the brainstem (medulla and pons). In his consideration of the pharmacology of sexual response, McKenna focuses particularly on the neurotransmitter serotonin, which generally has an inhibitory effect on sexual functioning. This leads to the unfortunate result that many drugs prescribed for the treatment of depression and designed to raise serotonin levels—particularly the selective serotonin reuptake inhibitors (SSRIs)—have marked sexual dysfunctions as side effects. McKenna considers several other neurotransmitters as well, including dopamine, noradrenaline, oxytocin, and nitric oxide.

Given that brain and spinal cord mechanisms of sexual response (as reviewed by McKenna) are well established, Komisaruk and Whipple begin chapter 5 with a paradox: How could women with complete spinal cord injury feel genital stimulation and experience orgasm? For genital sensations to be consciously perceived, they must travel from sensory neurons in the genitals, to neurons in the spinal cord, and then to an ascending pathway through the spinal cord that eventually registers in the cortex. How could women whose spinal cords have been completely severed at a level above the point where the sensory neurons join the spinal cord feel genital sensation when the ascending pathway has been severed? Komisaruk and Whipple’s path-breaking research began by taking the reports of these women seriously rather than dismissing them as “phantom” sensations. Through a remarkable series of laboratory studies of these women, using fMRI and PET technologies, they have demonstrated an alternative sensory pathway involving the Vagus nerve, which completely bypasses the spinal cord and projects directly to the brain. Their imaging studies have also identified a region of the hypothalamus that is activated during orgasm. Their findings have profound implications for practitioners who may mistakenly tell their clients with spinal cord injury that sex is a thing of the past for them. Komisaruk and Whipple show how and why sexual response may still be possible in many cases of spinal cord injury.

In chapter 6, Coleman addresses the issue of compulsive sexual behavior (CSB, also called sexual addiction by some) and its substrates in neuroanatomy, hormones, and neurotransmitters. Coleman is arguably the nation’s expert on CSB and its treatment. He finds that the limbic system of the brain is particularly implicated. Although findings regarding elevated levels of testosterone in individuals with CSB are equivocal, there is substantial evidence that antiandrogen treatments are effective. Posttraumatic stress disorder and the associated neural consequences may be implicated in some cases of people with CSB who were victims of childhood sexual abuse. SSRIs and other antidepressants are effective in treating many cases of CSB.

In the final chapter, Hyde and Whipple synthesize the findings reported in the previous chapters and identify five overarching themes: Biological
substrates are developmental; sexuality is complex and multifaceted; certain regions of the brain, particularly the hypothalamus, are clearly linked to sexuality; the spinal cord plays a key role as well; and the biological substrates consist of multiple, interlocking systems, including genes, the brain, and the endocrine system. They conclude with suggestions about future directions for research on the biological substrates of human sexuality.

The array of research displayed in these chapters is dazzling. It testifies to the possibility of rapid scientific progress in understanding crucial areas of human behavior such as sexuality. This research has flourished despite societal taboos regarding sex research and opposition of some in the federal government. We hope that readers will gain much from reading these chapters.

REFERENCES


