Social Neuroendocrine Approaches to Relationships

SARI M. van ANDERS and PETER B. GRAY

Abstract

Social neuroendocrinology is the study of social behaviors and hormones, using ultimate (evolutionary) and proximate (mechanistic) considerations, alongside social context. In this entry, two scholars from psychology and anthropology focus on social relationships (e.g., parenting, romantic relationships, sexual contacts) and both peptide (e.g., oxytocin, vasopressin) and steroid hormones (e.g., testosterone, estradiol, cortisol). Basic theoretical underpinnings of social neuroendocrinology are discussed, along with classic and cutting edge scholarship alongside newer theories. The challenges and promises of social neuroendocrine approaches to relationships are detailed, with an eye to the future of the discipline.

INTRODUCTION

Social relationships provide meaning and structure to our lives; they are the foundation for our families, friendships, workplace hierarchies, sexual contacts, and loving relationships. They impact our health and well-being, and teach us about the cultures we live in. Human social neuroendocrinology is the study of these types of social relationships, using a hormonal lens. Social neuroendocrinology provides fascinating insights into the ways that hormones influence our social relationships and, in addition, how our social relationships affect our hormones. But, social neuroendocrinology is not just about biology. It also sheds light on cultural processes and pays attention to social experiences. This interactionist lens contributes to an ongoing reshaping of knowledge that incorporates both nature and nurture, biology and culture, evolution and social construction.

We focus specifically on two kinds of social relationships in this article: (i) adult-infant interactions such as those between parents and children and (ii) adult partnering, such as pair bonds or romantic/sexual relationships. Many aspects of our social relationships are unique to humans, whereas some are

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shared with other animals ranging from birds to rodents to nonhuman primates, and more. Those features common across species allow scientists to study the evolved neurobiological systems that may be a common denominator in social relationships, albeit with attention to the uniqueness of each species and taxa.

Social neuroendocrine perspectives on relationships draw on a number of theoretical foundations. One of these was advanced by Niko Tinbergen in the early 1960s. Tinbergen outlined how questions in biology can be answered via four complementary levels of analysis: phylogeny (evolutionary history), function (adaptive explanations), mechanism (physiological causal processes), and ontogeny (development; changes across the lifespan). When we ask *why* an association between hormones and social relationships exists, we are asking an *ultimate* question that is answered via research on phylogeny and function. When we ask *how* this association exists, we are asking a *proximate* question that is answered via research on mechanism and development.

Another important theoretical foundation for social neuroendocrinology is *attachment theory*, associated with John Bowlby and Mary Ainsworth. Here, the notion is that humans are born with the goal of forming social bonds with parental figures, because these are adaptive in promoting child survival. Attachment is thought to drive much of social motivation *and* influences other close social bonds. And, it means that social relationships of various kinds are thought to share common features and even hormonal systems with parent-infant bonds.

A third foundation for social neuroendocrinology is based on scientific and agricultural experimentation with hormones. This is largely understood to have originated in the nineteenth century with Arnold Berthold, who transplanted testes from one species to another. However, recognition that something in the body could influence social relationships has a deep history, with castration of humans and other animals a longstanding practice. Insights into what this "something" might be, however, arrived in the twentieth century with the identification of steroid hormones such as testosterone (secreted mainly from the testes or ovaries). This fostered the development of behavioral neuroendocrinology; the study of hormones and a broad range of behaviors.

Social neuroendocrinologists are largely interested in steroid hormones and peptide hormones, which have *pleiotropic*—or multiple—functions that are not limited to social relationships. Steroids are released from hormonal glands and bind to hormone receptors located throughout the body and brain. Androgens (e.g., testosterone), estrogens (e.g., estradiol), and glucocorticoids (e.g., cortisol) are the steroid hormone groups largely studied in social neuroendocrinology. A mistaken belief is that androgens exist in men

and estrogens in women; in fact, both groups of hormones are functional and present in women and men. Peptides are released from the pituitary gland in the brain, and bind to specific receptors located throughout the body and brain. Oxytocin, prolactin, and vasopressin are important peptide hormones that, within social neuroendocrinology, are largely studied in relation to attachment.

Hormones are actually released in response to signals from the brain. The brain's hypothalamus sends releasing signals to hormonal glands based on an integrated mix of incoming messages from the rest of the brain, reflecting the social environment, and actual hormone levels in the body. That's one reason why social neuroendocrinology is interactionist, that is, that hormones respond to internal (in the body) and external (e.g., social) phenomena.

Social neuroendocrinology uses a broad set of methods to assess how hormones and social relationships are associated. For example, some scientists conduct experiments to determine effects of hormone on behavior. Others experimentally examine how social behavior affects hormones. Still others use correlational studies, group differences, or other neuroscience techniques such as genetics or neuroimaging. Research might occur in the laboratory or in the field. At its core, social neuroendocrinology is an interdisciplinary endeavor that draws on perspectives from multiple fields. It provides important insights about hormones and social relationships, and the evolutionary and cultural context in which our social relationships develop.

FOUNDATIONAL RESEARCH

One of the most important insights from social neuroendocrinology is that social relationships can profoundly influence not only whether we feel loved or supported, but also can reshape our very biologies. For example, rat mothers engage in a variety of maternal behaviors, including pup licking, that differ in frequency. As scientists have found, pups who were maternally licked more frequently had different DNA methylation patterns compared to low-licked pups, leading to epigenetic alterations of the glucocorticoid receptor and impacting stress physiology.

Although parents can exert such strong effects on offspring, infants can actually affect their caregivers as well. Studies have shown that attachment behaviors (e.g., close touch, warm support) increase oxytocin and decrease cortisol in both parents and children. This is thought to occur because the physiology of caregiving seems to "borrow" from evolutionary systems that underlie reproductive processes. For example, peptides such as oxytocin and prolactin underlie lactation and birth, but also are implicated in attachment. Estrogens and progesterone are intrinsic to ovulation and pregnancy, and ratios between them seem important to maternal feelings during and after

pregnancy. Of course, pregnancy, birth, breastfeeding, and the postpartum are not merely hormonal or reproductive events themselves; they are also social experiences. However, research on breastfeeding suggests that it has hormonally mediated benefits for *mothers* in addition to nutritional and attachment benefits for children: it increases and/or decreases cortisol and stress responsivity in ways that seem to reduce stress and facilitate bonding.

There has been an explosion of interest into how peptides might mediate attachment between parents and infants. In part, this is based on research with species that, such as humans, develop close social bonds. The most well-known model species is the prairie vole, that forms close parental and pair bonds. In comparison to the closely related montane vole, prairie voles show higher density of peptide receptors that have been experimentally shown to support bonding behavior. Although social bonds do not work in the same way across all species or contexts, and also do not necessarily rely on the same neurobiological substrates, this research on social bonds has been pivotal for human studies. Indeed, Sue Carter published a landmark paper in the field that turned "love" into a respectable topic for neuroscience.

What *does* research with humans show? Prolactin actually increases in response to infant stimuli in pregnant women, even before they have children. After birth, mothers and fathers show bigger oxytocin increases if they had more affectionate or stimulatory contact. And, higher oxytocin seems to be related to more sensitive caregiving in women and men. Indeed, parents with high levels of certain peptides seem to engage with their infants in ways that reflect more *synchrony*, or matching of play styles or affect. Still more research suggests that mothers with higher oxytocin responses to infants are also more sensitive to affective and physical phenomena.

The above research demonstrates how individual differences in peptide levels or responses are associated with differences in attachment-related behaviors. Research has also demonstrated that administration of peptides may have similar effects. Intranasal oxytocin administration to fathers seems to have small effects on paternal behaviors with toddlers, like decreases in hostility. This research is still somewhat controversial, however, as many scientists question whether intranasal peptide administration can actually affect the brain because of the blood brain barrier. What about the infants? Research has suggested that oxytocin administration to *parents* increases a set of behaviors that are known to support parent-infant bonds, and—also—increase oxytocin and engagement in the infants themselves. Conversely, socially-deprived children who were orphaned and subsequently adopted into caring families exhibited alterations in their oxytocin and vasopressin systems.

Cortisol is better known as a *stress* hormone, but its function is actually more broad, relating to activation and arousal in general. Interestingly, peptides

seem to dampen cortisol release. Cortisol is related to intimacy in interesting ways. For example, high cortisol has been linked to lower engagement in attachment behaviors. But, *high cortisol* early in the postpartum is actually associated with more attentive maternal behavior. This makes sense: it would be adaptive, on hearing an infant shriek, to feel a sense of activation rather than relaxation (at least for the infant!). Accordingly, whether cortisol's association with caregiving is more or less valuable may depend on the given caregiving culture and situation.

Although infant interactions affect parental hormones, parents also seem to differ hormonally from nonparents in a variety of ways. For example, some evidence shows that fathers and mothers have lower testosterone than nonparents. This is largely interpreted via the "challenge hypothesis," which predicts that high testosterone should be linked with challenge and mating, while low testosterone should be linked to parenting. Although developed with birds, it has been extended to a number of species, including humans. Fathers also differ hormonally from nonfathers in a variety of ways. In several other nonhuman mammals, such as common marmosets, fathers have been found to have higher prolactin levels. A study of Filipino men found that fathers had higher prolactin levels than nonfathers, the first time that had been shown in humans.

The challenge hypothesis is also used to make sense of the ways in which testosterone is linked to adult social bonds, like romantic/sexual relationships. Research from a number of labs has demonstrated that single, heterosexual men and women have higher testosterone than their partnered counterparts. This partnering can be marriage, cohabitation, or even long-term relationships, and classic research first demonstrated the phenomenon using participants from the army or air force, including a transient increase around divorce in men. There is also evidence that cortisol levels are high in couples newly in love, highlighting further that "stress" reflects perturbations of homeostasis even in positive situations.

Hormones are often fingered as the cause of lust, love, and other related phenomena. It would be an exaggeration to claim a large role for them in humans, but scientists have demonstrated fascinating if modest associations between hormones and the phenomena that underlie romantic and sexual relationships. Research links peptides with phenomena like trust or closeness that underlie pair bonds. Because many of the same phenomena underlie pair bonds and parent-infant bonds, scientists have been excited about findings that demonstrate overlapping neural substrates involved in both. For example, viewing pictures of a beloved partner and a loved infant results in neural activation in divergent areas but also some overlapping ones that are known to be dense in oxytocin and vasopressin receptors. Thus, hormonal systems related to reproduction seem to have been

"borrowed" for parent-infant bonds, and *also* for pair bonds. As examples, a number of studies identify links between the oxytocin system and aspects of pair bonds. Women and men reporting higher marital quality had higher blood oxytocin levels than individuals reporting lower marital quality, and oxytocin increased with warm partner contact. Oxytocin levels are higher in new lovers relative to singles. And, showing causal links between oxytocin and pair bonds, the administration of intranasal oxytocin positively impacted partner interactions during a standardized marital discussion. Of course, pair bonds are characterized by more than just bonding—sexuality plays an important role too.

Orgasm and sexual behavior also increases oxytocin and other peptides. Perhaps this relates to oxytocin's role in mediating muscular contractions in parity-related events, like uterine contractions for birth and milk ejection in breastfeeding. Other hormones are also implicated. Estradiol, an estrogen, seems to be correlated with affiliative phenomena, like sexuality.

Testosterone is another hormone that is often linked with sexuality. Indeed, it does increase following exposure to sexual stimuli, engagement in sexual activity, and even sexual thoughts. In fact, testosterone seems to *respond* to sexuality more strongly than it *influences* sexuality in humans. For example, researchers found that heterosexual men engaged in flirtatious behavior with women had an increase in testosterone.

A separate line of research examines attraction to potential partners across the menstrual cycle. The idea is that during fertile times of the menstrual cycle, when estrogen and androgen levels rise, women may exhibit changes in the characteristics they seek in a partner. In one review, women showed increased attention to masculine faces and voices during their fertile menstrual phase. Other studies suggest that women's sociosexual behavior can also shift during fertile phases. The observation of these kinds of cycle-related effects suggests they are subtle, and studies employ variable methodological rigor (e.g., definition of cycle phases, whether hormones are measured or not).

There are a number of important findings from social neuroendocrinology on relationships, ranging from romantic contacts to parent-infant bonds. These have led to novel insights about the role of hormones in human social connections. However, as researchers delve more deeply into these newly discovered phenomena, sometimes well-accepted findings are turned on their head even as others are more decisively confirmed.

CUTTING EDGE RESEARCH

Do fathers have lower testosterone than nonfathers? Does oxytocin promote love? Do singles have higher testosterone than married folks? Do menstrual

shifts in psychology occur? Cutting edge research in social neuroendocrinology addresses the nitty-gritty details and truth-value of these claims. For example, peptides are largely thought of as "prosocial," meaning that they are always "good" in relation to social bonds. But, researchers are finding that empirical evidence is actually more complicated than the initial story suggested. Thus, even though oxytocin is thought to promote social bonds, it also seems to reflect a need for social bonds: women with self-reported poorer relationship functioning have higher oxytocin than women who are satisfied with their relationships. Evidence suggests that oxytocin may amplify social affect. In this case, one could easily imagine how oxytocin administration might amplify undesirable aspects of social bonds. Moreover, context is increasingly understood to matter. For example, oxytocin administration lessens an overharsh grip strength in response to hearing infant cries, but only among women who were not harshly disciplined themselves as children.

Of course, context is not just background or mood states. It can also be physiological, and behavioral genetics work in social neuroendocrinology has demonstrated just this. For example, though oxytocin administration can increase preference for infant faces, it does so only in individuals with a specific polymorphism on the gene that codes for oxytocin receptors. Differences in the vasopressin 1a receptor have been associated with partner bonding behaviors. However, those associations were only true of men.

Even hormones can be a context for each other, and scientists are increasingly attending to interactions between hormones and their implications for social relationships. In one such framework, the steroid/peptide theory of social bonds (S/P theory), peptides are related to social bonding phenomena, including even negative behaviors that might be related. In contrast, testosterone is negatively associated with nurturant social bond phenomena, and positively associated with competitive behaviors that are aimed at *acquiring* or *defending* resources (that may include social or sexual bonds themselves!). Another integrative theory—the Dual Hormone Hypothesis, has been used around competition and is less used around social relationships, though is promising. It predicts that testosterone is linked to social behaviors in ways that are mediated by cortisol levels.

One perplexing finding in social neuroendocrinology has been that infant cries increase testosterone and that testosterone can upregulate neural areas involved in parental care, in contrast to most theoretical predictions. More recent research has demonstrated that *nurturant* behaviors while hearing infant cries does decrease testosterone, as predicted by the S/P theory. Scientists are increasingly attending to the specificities of the behavior under investigation, in ways that shed light on their associations with hormones. For example, though parents sometimes have lower testosterone than

nonparents, they sometimes have *higher* testosterone. This may be because some parenting involves nurturance and direct care, while some involves competitive behaviors and indirect care. Research does suggest that parents of younger children who are more involved in nurturant care are the ones with lower testosterone.

Relationships, too, are linked to testosterone in more nuanced ways. Marriage is likely a proxy at best for the underlying constructs related to testosterone. Cross-cultural research has highlighted that partnering is not the same world over, and sometimes even pair bonds involve the possibility of new partners. In this way, research has shown that, whether in a relationship or not, interest in new or more partners is associated with higher testosterone in men, whereas presence of more partners or more sexual behavior is associated with higher testosterone in women. Indeed, one interesting outcome of this research has been the suggestion that testosterone is linked to relationship status in women, but relationship *orientation* in men. This body of research shows that relationships are diverse and can involve commitment and/or extra-pair sexuality and that it is these nuances that seem to clarify how specific kinds of relationships are linked to hormones.

What about relational dynamics themselves? A variety of studies have investigated links between cortisol and partner quality. Some studies test whether patterns of cortisol concentrations across the day are related to partnership factors; more partner intimacy was associated with lower cortisol profiles in a naturalistic study. Other studies led by Kiecolt-Glaser and Glaser at The Ohio State University have entailed younger and older couples reporting to a lab to engage in a standardized marital conflict discussion session, testing effects of partner discussions on cortisol profiles. As an example, the marital satisfaction reported by wives was inversely related to their cortisol change across a marital discussion, with more satisfied wives showing more rapid cortisol declines. In addition, a study noted above observed that intranasal oxytocin decreased cortisol levels during marital discussions, showing the relationships between oxytocin and stress hormone reduction.

Though sexual desire is largely assumed to be clearly related to testosterone, research actually shows that desire itself is more complicated. For example, studies have found that solitary sexual desire, or desire to masturbate, is positively correlated with testosterone in women, but not men, whereas dyadic sexual desire, or desire to be sexual with another person, is *negatively* correlated in women but not men. Social neuroendocrinology helps to highlight what desire is actually about, as desire may reflect interest in intimacy, closeness, orgasm, sleep, and so on. It may be that desire for intimacy maps onto lower testosterone, and desire for erotic pleasure maps

onto higher testosterone. Interestingly, these results hold only for women. Research on sexual desire and testosterone in healthy men shows *no* significant correlation between testosterone and desire in healthy men despite longstanding assumptions to the contrary.

The postpartum is often a time for parent-infant bonding, but this still occurs—for many people—within the context of an adult relationship like marriage. Indeed, changes in relationships are a hallmark of the postpartum for most parents. There is some belief that decreases in partnered sexual behavior or sexual desire may map onto the hormonal processes associated with parity. There is also evidence that *social* changes associated with the new parenting roles, relationship structures, and having a new baby are related to postpartum sexuality in both mothers and coparents. And, though researchers have generally focused on low sexual desire and infrequent sexual activity during this time, evidence suggests that many birth mothers are actually engaging in a variety of sexual behaviors at this time. What might be most interesting about postpartum sexuality, however, is how similarly birth mothers and their coparents experience it. This suggests that hormones, if involved, may be reacting to the social changes around birth rather than the birth-specific reproductive events themselves.

Recent cutting edge research in social neuroendocrinology had tended to add more "grey" to early "black-and-white" findings, adding nuance and contextual considerations. In addition, this body of literature is attending more closely to the details of the social phenomena under study to get to the core of what it is about relationships, desire, or parenting, as some examples, that is reliably linked to hormones. Finally, the most up-to-date research takes a more skeptical stance, not undermining that hormones and social behaviors are meaningfully and interestingly connected, but attending to a fuller realm of possible links including null associations, moderation, and counter-expected associations.

KEY ISSUES FOR FUTURE RESEARCH

Social neuroendocrine approaches to relationships are so new that a number of key issues have only recently been identified. For example, the focus on a limited set of social relationships (like marriage, parent–child bonds, etc.) limits our understanding of all social relationships. Attending to relationships like friendships, grandparenting, adoptive- and step-parenting, nonparental childcare, sibling care, mentoring, and even human-pet interactions will likely be informative. And, though research has often focused on hormonal mediation of the positives of human social relationships, like love, intimacy, and attachment, there are a number of "negatives" that merit investigation too. For example, how might social neuroendocrinology

help us understand child neglect, partner abuse, rape, or intrafamilial aggression? Moreover, participants in social neuroendocrinology tend to be adults, or a focus on adult–infant bonds. It remains to be seen whether the same hormonal processes are tied to caregiving of older children, much less teenagers or adult offspring.

There are a number of additional axes along which differences can and likely will matter. For example, the majority of social neuroendocrinology, especially about hormones and parent-infant bonds, has been conducted with "WEIRD" populations. But individuals who are ***w****hite,* ***e****ducated, indus-*
trialized, ***r****ich, and* ***d****emocratic* make up a very narrow slice of human diversity. Basic research that presumes "good" or "bad" aspects of social bonding will need to reconcile these notions with parenting across cultures (and within Western nations) that have different norms. But, relatedly, research that more explicitly addresses the applied implications of social neuroendocrine studies of social relationships will also be important. This will require acknowledging that social neuroendocrinology has sometimes erred on the side of focusing on universal generalities rather than local specificities, because applications are potential solutions to particular problems that are generally culture-bound. Addressing both cultural diversity and cultural specificity will thus be an important next step in both exploring the basic social neuroendocrinology of relationships and its exciting applied potential.

Both basic and applied research require attending to cause and effect. Currently, perhaps because of the scientism inherent in incorporating hormonal and biological measures into research, scientists are largely studying how hormones might influence social bonds or using that arguable biologically deterministic perspective. This lens is but one approach, however, because biology need not be biologically deterministic or unidirectional. Other exciting cutting-edge biological approaches include epigenetics (how experiences modify genetic processes), social determinants of health, and phenotypic plasticity (e.g., how experience shapes the brain and body). For social neuroendocrinology, attending to these perspectives include addressing how social bonding processes affect hormones, and interactionist questions of how social relationships and hormones mutually influence each other. Moreover, hormone administration studies have been conducted with a generally narrow frame. For example, work on intranasal oxytocin or vasopressin sprays is interesting, but it is still far from clear whether they have central actions. And, because scientists largely focus on only their prosocial effects, "side" effects and undesirable outcomes remain largely unstudied despite concerning research pointing to them.

The focus on WEIRD populations has not been as prevalent in research on testosterone and partnering, perhaps because this field includes researchers from biological anthropology as well as psychology and neuroscience. This

body of research demonstrates the importance and value of attention to culturally diverse forms of partnering. In addition, by incorporating individuals who are lesbian, gay, bisexual, polyamorous, and in open relationships, it highlights how *sexual* diversity, in addition to cultural diversity, is illuminating. Even WEIRD populations are not only single or married, and relational approaches may be diverse. In fact, one could amend the term to WHEIRD, with "H" signifying heterosexual. The majority of research focuses on one specific kind of gendered pair bonds, but sexualities are broader than this. Attention to bisexuality, same-sex sexuality, and even sexual fluidity will be important. A growing movement of individuals to define an asexual identity highlights diverse relational and sexual bonds, which will be important for social neuroendocrinology to include. For example, demi-sexuals are individuals who experience sexual attraction to a person only after romantic connections. How might this map onto social neuroendocrine systems for social and/or sexual connections? A key challenge for social neuroendocrinology will be to attend to *diversity* rather than *difference*. For example, instead of asking whether gay and straight men show similar neural responses to loved ones, the field might ask how gendered sexuality is implicated among other variables, and alongside socialization factors, in hormone-behavior associations. Indeed, socialization and social constructs remain understudied but powerful lenses for social neuroendocrinology.

For those interested in understanding developmental trajectories, what is strongly needed is a life course or life history perspective. For example, *do* early parent-infant bonds have effects on hormonal systems in ways that influence adult social bonds? Puberty is also increasingly recognized as a period of hormonal plasticity, but remains understudied in human social neuroendocrinology. Indeed, cause and effect remains to be hammered out in a number of contexts. Longitudinal studies tend to be designed to answer other questions, and often end up answering part but not all of this question. Accordingly, life course studies would be informative.

The field would also benefit from increased comparative attention. At present, there is already a large influence of nonhuman animal research on human research. This makes sense, because there are a number of questions that can only be answered with animal models. However, a comparative approach requires attending to species-specificities. Accordingly, research from one species can only inform understandings of another—it cannot be immediately generalized. Already, there is clear evidence that the hormonal and neurobiological substrates of social bonding are not the same across species. For example, oxytocin and vasopressin receptor density underlie differences between monogamous and multisexual voles, but not birds or even other rodents. If the same hormonal processes do not underlie social bonds among different rodents, it is obviously difficult to translate them

to humans. At the same time, understandings from other species may help shed light on underlying processes, and are sometimes absent when they could be helpful. For example, work with nonhuman primates shows both similarities and differences in the hormonal mechanisms associated with paternal care compared with humans.

Also missing is neural work that is conducted alongside hormonal studies. Research on neural imaging has largely relied on imaging those areas already known to be implicated in social bonds—in other species. But, given that these areas may not translate even to other rodents, there may be a host of neural structures relevant in humans that current science is missing. Future research will need to incorporate multiple methods into the same studies, for example examining hormonal and neural changes to social bond stimuli alongside each other. Coupled with a life course approach, this could be very powerful. For example, how might neural and hormonal responses to infant stimuli differ after extensive caretaking experience or social bonding, compared to controls?

Methodological issues abound in social neuroendocrinology, and need attention for the field to move forward in rigorous ways. For example, cortisol and testosterone exhibit large diurnal variation but it is unclear how dynamic other socially relevant hormones might be. There are also sampling issues, including how closely tied measures from fluids like saliva, blood, urine, or cerebrospinal fluid might be and how well each represents central (i.e., brain) activity. Some methodological reviews have addressed these concerns but are constrained by what limited methodological research exists. Thus, a key task for social neuroendocrinologists will be to incorporate methodological questions and sophistication into their research.

The future of social neuroendocrinology is bright. As more researchers from a variety of disciplines and sub-disciplines understand the value and ease of incorporating hormone measures into their work, social neuroendocrine work on relationships will continue to grow and become integrated into other fields. Work is becoming increasingly sophisticated and nuanced, leading to insights about hormones themselves, social relationships, evolutionary considerations, proximate mechanisms, and potential applications to real-world problems.

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SARI M. van ANDERS SHORT BIOGRAPHY

Sari M. van Anders, PhD, is an Assistant Professor of Psychology and Women's Studies at the University of Michigan, and affiliated with UM's programs in Neuroscience, Reproductive Sciences, Science, Technology, and Society, and the Biosocial Methods Collaborative. In the Social Neuroendocrinology Lab, Dr. van Anders studies hormones and social behaviors in social context, paying special attention to sexuality, intimacy, and nurturance. Dr. van Anders' PhD is in behavioral neuroscience, earned at Simon Fraser University in Canada, in 2007. With over 50 publications in social neuroendocrinology, health, gender/sex, and sexual diversity, Dr. van Anders focuses on feminist and inclusive research practices. Dr. van Anders is the Editor-Elect of the Annual Review of Sex Research and, in 2013, Dr. van Anders received the Janet Taylor Spence Award for Transformative Early Career Contributions from the Association for Psychological Science.

PETER B. GRAY SHORT BIOGRAPHY

Peter B. Gray, PhD, takes an integrative evolutionary perspective of human reproduction. This means drawing on comparative nonhuman findings, cross-cultural research, neuroendocrine mechanisms, and life history theory to make sense of our behavior. He most thinks about how an evolutionary perspective makes sense of human sexuality, fatherhood, and even pet-keeping. He earned BA degrees in Anthropology and Geography/Environmental Studies at UCLA and a PhD in Biological Anthropology in 2003 from Harvard University, also undertaking postdoctoral research in Clinical Endocrinology. He has coedited (2009) "Endocrinology of Social Relationships," and coauthored "Fatherhood: Evolution and Human Paternal Behavior" and "Evolution and Human Sexual Behavior," all with Harvard University Press.

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