

## OUR SEXY BRAIN; OUR COMPELLING ENVIRONMENT: INTERACTIONISM IN FEMALE DEVELOPMENT

Doris K. Silverman

The infant female is unique. Her particular qualities include specific genetic, hormonal, and physiological ingredients that help sculpt her development. Parental influences and the wider society and culture have a profound shaping effect on her particular biological components. Whereas male infants have their own inimitable developmental line, this paper's focus is on the female.

Our recent history of knowledge about infant development has been schismatically driven, a rift I briefly address herein. This paper is essentially a theoretical one wherein I offer an integration of our current understanding of the complex interactive role of biology and environment in shaping the trajectory of female development. I detail some of the female infants' distinctive features and their mothers' responses to them.

### THE SCHISM

There is increased appreciation of the contribution of biology to the shaping of personality and gender. We are certainly aware of how biological psychiatry has underscored this focus with an increasing reliance on drugs for a wide variety of disorders. The psychologist Wilson (1998), long an advocate of the significant contribution of genetics, has seen his ideas minimized in the past. However, this is changing, as he is joined by Pinker (1994), Turkheimer, (2000) and a host of others (see the essays presented in Einstein, 2007).

There is an ever expanding list of the contribution of genes to a wide variety of personality features (shyness, criminality, un-

usual sensitivities, irritability, etc.; Diamond, 2009). The involvement of dopamine and serotonin, two neurotransmitters, is hypothesized for a host of personality traits: and Dopamine is associated with possible tendencies toward extraversion, novelty seeking, and impulsivity, and serotonin with resiliency or depression (Bakermans-Kranenburg & van IJzendoorn, 2006). Contemporary research is providing information, for example, about genetic sensitivities to fear and anxiety as well as other specific genetic contributions and about how they can shape children's and adult's reactions to stress or insensitive parenting, and influence the nature of attachments<sup>1</sup> (See lead, summary, chapter in Diamond, 2009). Thus, there is a considerable literature about disorganized attachments that has highlighted the mother's confused communications with her infant (Lyons-Ruth & Jacobvitz, 1999; Lyons Ruth & Zeanah, 2000). An awareness of atypical genetic proclivities that contribute to these confused communications alters the way a clinician may view the interactions between mother and child and between therapist and patient who maintain a disorganized attachment relationship. It might minimize mutual and dyadic frustrations in their joint attempt to mitigate the old attachment alignments. There can be shared recognition of the patient's long-standing, characteristic ways of behaving and anticipating responses from others. Acknowledgment of this multisourced attachment outcome can offer useful understanding for both participants.

Our clinical minds tend toward cause-and-effect, social-psychological considerations. Recognition of the multiple inputs that constitute an individual self opens the possibility for tolerance of ambiguity and complexity in developmental origins. An ultimate goal for such an outlook rests on the exploration of a range of clinical hypotheses as well as the role of change in our therapeutic endeavors.

Genetically inclined researchers like Pinker (2009) maintain, "The human mind is prone to essentialism—the intuition that living things house some hidden substance that gives them their form and determines their powers" (p. 26). Most careful researchers in the field, however, recognize that there is an interaction between neural-biological-genetic contributions and their expression or inhibition as shaped by their environment. While

in the not so distant past, the environment was emphasized in shaping personality with the certain exceptions like schizophrenia and manic depression, currently we see the shift toward underscoring the contributions of biology.

The arena of sex–gender has also seen this tangle between the role of biology and the environment. In the middle 1980s I published a paper on some of the qualities and features of female infants and their development that demonstrated small but significant differences between the sexes which suggested inborn proclivities (Silverman, 1987). However, my views over the following years changed and reflected an increasing shift toward the role of powerful environmental influences that contributed to shaping sex and gender (Long, 2005; Silverman, cited in Harris, 2005). The increasing recognition of the emergent features of each individual as a complex function of psycho-sociocultural experiences both internal and external dominated my thinking.

Today, the schism between biology and the environment continues to fuel the debate about female sex and gender. The current proliferation of information regarding neural-hormonal influences has once again altered the framework of understanding sex and gender development in females. There are current writers who stress these findings suggesting a striking biological contribution to sex and gender formation (Brizendine, 2006; Friedman & Downey, 2008). Researchers describe the dimorphism (two forms—female and male) in the infant's brain and the different circulating hormones that effect brain differentiation and subsequent behavior (Einstein, 2007). Einstein's lengthy anthology, containing both historical and current research, demonstrates the importance of gonadal-hormonal influences on the sexually differentiating brain, producing one or the other phenotype. However, Einstein recognizes as well the complex interrelationship between hormones and environment and the reciprocal influences they demonstrate. Nonetheless, there are analysts who are more inclined toward the sociocultural matrix contributing to the construction of gender (Benjamin, 1996; Dimen, 1991; Goldner, 2003; Harris, 1991, 2000; Gediman, 2005, who cites Rivera, 1989, and Weedon, 1987). The schism remains.

This paper is primarily about the development of the infant female, her attachment relationship, and her early unique quali-

ties, including her initial physiological state system. I bring an integration of the two positions outlined here. The significance of the environment to the attachment relationship is shown by the importance of mother–infant bodily connections as reflected in maternal care. The attachment system is by now sufficiently addressed in our literature that there is no need to focus on it in this paper. At the same time, however, the shape of the attachment relationship is qualified by the mother’s physiological and psychological features as well as by the genetic-hormonal features of the infant; those interacting features cascade and emerge as a unique attachment system for the two, indelibly influenced by the larger sociocultural milieu and its effects (Caspers et al., 2009; Gillath, Shaver, Baek, & Chun, 2008).

Female and male infants differ at birth, leading to differences in their attachment system. Infant females have specific attributes that guide their early and sustaining attachment relationships, and this distinctive bonding affects their subsequent sexual and gender development. Those attributes entrain mothers and increase attachments, and the mothers in turn are more responsive to their female offspring when compared with their male offspring. Certain features of early brain differentiation and maturation are more characteristic of the growing female, these features sculpt her specific social and emotional sensitivities. In addition, specific sex hormones that the mother secretes in birthing stimulate conditions for attachment in her female neonate. The neural hormone oxytocin, expressed in birthing and nursing, kindles bonding and reduces stress in the mother and her offspring. Heightened bonding can occur with a less fretful infant, which is more characteristic of infant females. When offering the relevant supporting data for these ideas, one needs to underscore that whereas there appears to be characteristics features of brain and behavior influences for each of the sexes, their brain-behaviors are on a continuum demonstrating great within-sex differences as well as across-sex differences. Each of the sexes has a unique trajectory of development. Certain features may arise at different stages for each of the sexes (e.g., brain lateralization, to be explained later), leading to differential initial reactions. Hormones and brain differentiation, for example, appear to have different timetables for each of the sexes.

## FINDINGS

I start with the particular significance of infant females' state system. The state system is a cluster of a number of potentially stable constellations, for example, the time spent along the sleep-awake continuum or along the calm-crying continuum. There is a consistent finding demonstrating that female infants have a more stabilized state system. They spend more time in wakeful states, are more alert, are calmer and easier to soothe, and when fussy and irritable are soothed more readily and then return to a state of alertness and quiescence. Their nocturnal behavior shows less disruption, and they sleep for longer periods than male infants. These qualities are consistent with the findings that the female infant demonstrates a faster rate of neurological maturation of development when compared to her male counterpart, who does not achieve it until later (Bauer, Shimojo, Gwiazda, & Held, 1986; Held, Shimojo, & Gwiazda, 1984; Malcolm, McCulloch, & Shepherd, 2002; Moore & Cocas, 2006; Shucard, Shucard, & Cummins, 1981; Tanner, 1978). Thus there is a physiological propensity for increased stability in infant females when compared to males, which can be channeled in a variety of unpredictable ways as they interact with parents and the wider environment.

Specifically, female newborns, within hours of delivery, are more responsive to auditory stimuli (Rosenthal, 1983), are socially more responsive, and demonstrate gazing and maintain eye contact longer than male newborns (Haviland & Malatesta, 1981; Weinberg, Tronick, Cohn, & Olson, 1999). Female infants continue to show increased attention, focusing, and perceptual sensitivity when compared to males (Else-Quest, Shibley Hyde, Hill Goldsmith, & Van Hulle, 2006). With the male infants' more irritable, fussy state, they show an increased tendency to sleep less, cry more, grimace, show anger, fuss, want to be picked up, kick, and use more motor movements (Michel, Harkins, & Meserve, 1990; Silverman, 1987; Weinberg et al., 1999, p. 16). Male infants appear to have more difficulty self-comforting, and more trouble with states of overarousal and excitement, and, in general, demonstrate greater lability in their emotions and problems regulating their affectivity when com-

pared to females (Weinberg et al., 1999). When there are mismatches in emotional coordination between infants and their mothers, and this is true for all infants, boys more slowly return to a state of social matching and synchrony as compared to girl infants. A meta-analysis of longitudinal studies starting from four months of age reports that infant boys are typically rated as being difficult and intense. (Else-Quest et al., 2006). This intensity refers as well to their typically tolerating more intense pleasure.<sup>2</sup>

Although this paper is about infant females, I depart from this topic and briefly discuss the implications of the more active male and how understanding of the biological-environmental mix can shed light on his different trajectory.

Male infants tend to be less calm and more motorically inclined. This type of activity continues as a temperamental characteristic. In its socially valued and sanctioned form it leads to active, exploratory, even risk-taking behavior, all of which contribute to the agentic form of male autonomy.

Some males have been labeled as possessing an “irritable temperament” (Wiebe et al., 2009). These children show a particular allele that contributes to a higher level of activity. These males have more difficulty with self-regulation, that is, they express decreased modulation in their early state system. When this genetic disposition exists, and it is minimally restrained by his environment, it can interfere with the more typical learning experiences in nursery and elementary school. The diagnosis of hyperactivity, more characteristic of males, might be considered on a continuum of normality. It is a product of a biological process. Attention-deficit labels too often become a pejorative way of dealing with genetically different individuals, instead of an impetus for educators to seek creative teaching solutions for these students. However, this does not address males who are more atypical. Those males who display an avoidant attachment are often aggressive and disliked by other children as well as their teachers (Lyons-Ruth & Jacobvitz, 1999). At the extreme end of the continuum, the possession of genetically increased motoric activity along with substantial trauma in the child’s life tend toward antisocial behavior, more characteristic of males. Here the importance of biology–genetics influences illuminates

the view of the more actively inclined male child, recognizing as well the profound effects the environment may have in potentially facilitating nonadaptive behavior.

The less motorically active female infants can rapidly habituate to familiar stimuli and can pay attention to new and varied informational inputs (Davis, 1999; Else-Quest et al., 2006; Moore & Cocos, 2006; Seidlitz & Diener, 1998). The distinguishing of informational input is seen in the female infant's ability to detect marginal affectively toned information. Infant females show subtle recognition of nonverbal cues, reflecting early nonconscious emotional understanding of the other.

Mothers show affective differences in their handling of infant girls or boys. For example, mothers are more positively expressive toward their infant daughters than toward their infant sons (Fogel, Toda, & Kawai, 1988; Malatesta, Culver, Tesman, & Shepard, 1989). This may be a function of needing to deal with the more fraught and irritable initial states of male infants. There is more containing of the son's emotions. This is in keeping with Brody's (1993) finding that mothers limit their emotional expressions with their sons and express themselves more freely with their daughters. Infant boys do not respond as readily to them, even when the mothers' messages were clear and intense with their sons (Rosen, Adamson, & Bakeman, 1992). Thus the female infant's reading and responding to overt and covert cues and communications assists in her early "knowledge" about emotions in others and what is likely to be permissible in her own emotional expressiveness. Here we can readily appreciate the interweaving of her early proclivities and their flowering or curtailment in her environment.

#### BRAIN DIMORPHISM

There is some understanding of the preceding phenomena based on knowledge of brain differentiation in infants. The mother's face is the most salient interest of the newborn (Johnson, Grossman, & Cohen Kadosh, 2009).

There is preliminary evidence that the part of the brain involved in facial discrimination is more developed in females than males, starting very early in life (McClure, 2000). It is the higher

level of circulating testosterone that appears to slow the maturation of males' temporal cortical areas (McClure, 2000) as well as the slower development of lateralization in males (Geschwind, 1982, cited in Einstein, 2007). In general there appears to be a faster rate of neurological maturation characteristic of the female versus the male brain (Bauer et al., 1986; Held et al., 1984; Malcolm et al., 2002; Moore & Cocas, 2006; Shucard, Shucard, & Cummins, 1981; Tanner, 1978). Females show more rapid bilateral brain development than males (Rossell, Bullmore, Williams, & David, 2002; Shaywitz et al., 1995) and its greater inter-hemispheric connectivity in females (Friedman & Downey, 2008; Halloway, Anderson, Defendini, & Harper, 1993). Relative to brain size, the corpus collosum, connecting the two hemispheres, is significantly larger in females. This suggests that the earlier lateralization in female brain development may foster increased sensitivity to the kinds of emotional scanning, cue discrimination, and communication demonstrated in the very young infant female.

Nevertheless, the role of an early adverse environment affects the female child's brain structure in seriously detrimental ways (Moulson, Fox, Zeanah, & Nelson, 2009). As early as five months of age, institutionalized females who have shown no indication of neurological deficits eventually exhibit serious deficiencies in their ability to read facial emotional expressions. Limited environmental inputs, as experienced by these infant females in Romanian institutions, lead to "atypical processing of social stimuli such as emotional faces" (p. 18). It should also be noted that when children were removed from these institutions and placed in high-quality foster care there was some mitigation in neural deficits. However, they did not perform as well as noninstitutionalized children as demonstrated at almost four years of age, the time experimental testing was terminated.

#### SOME PSYCHOLOGICAL IMPLICATIONS

The reading of emotions has both positive and negative valences for the developing female. Responding to the needs and feelings of others, while an important consideration in child rearing, can also subvert the female child's independence. She can too readily become subservient to the other. The reading of moth-



er's anxiety, agitation, or depression, for example, often leads to following mother in her symptom picture. Thus, dysregulation of mood is a primary problem for females (Dedovic, Wadiwalla, Engert, & Pruessner, 2009) abetted by the intergenerational transmission of depression in females (Besser & Priel, 2005).

This increased reliance on the other for cues that shape one's responses leads to a lack of autonomous self-regulation in some females. In order to feel stable and modulated they rely more exclusively on interactive regulation. Therapists are familiar with those who carefully monitor their facial and bodily posture. Subtle, nonverbal communications may be understood as behavioral guides toward pleasing the therapist. (See Silverman, 2001, for an exposition of the role of self and interactive regulation between patients and therapists.)

Aloneness, loneliness, and, at times, desperation and panic in those patients dominate separations. Signs of potential interpersonal rejection stir anxiety in females and not in males, who are more likely made anxious by performance, achievement, and dominance goals that may not be met (Dedovic et al., 2009; Stroud, Salovey, & Epel, 2002). Insecurely and avoidantly attached females show increased anxiety in social conflict, and the latter group demonstrates the greatest amount of anxiety.

A hypervigilant style of interacting can develop as the child attempts to mitigate the mother's various moods. It can lead to a reversal of caregiving as the child mothers and attempts to stabilize the other. This can occur within the therapeutic relationship as well.

Studies of stress in men and women suggest that their different hormones produce different kinds of stressors, influenced, of course, by the nature of their attachments. Clinicians need to be mindful of these multiple contributors.

## NEURAL HORMONES

The neural hormone oxytocin typically interacts in complex ways with other female hormones. It has been implicated in the development of social bonds in both animals and humans.

One significant study with infant female rat pups has demonstrated a transgenerational effect on the brain and behavior

of the female infant rat pup (Champagne & Meaney, 2007; Pedersen, 2002). If there is a sufficient amount of oxytocin in the adult female dam's brain, she shows increased pup-licking of her babies and demonstrates arched-back nursing. This in turn has an impact on her female offspring by stirring the oxytocin levels in their brain receptors. Their increased oxytocin levels go on to affect their later adult nursing of their own pups. When there is less of this hormone available in the adult female animal brain, or it is absent, opposite behavioral responses occur. Those adult animals who are pretreated with chemicals that preclude the release of oxytocin produce infant pups who do not develop a preference for their mothers (Carter, 1998). In addition, there is reduced expression of maternal behaviors (Febo, Numan, & Ferris, 2005).

Pups removed from their less affectionate mothers and given to more affectionate ones will engage in more caregiving (licking and grooming) of their own pups when compared to their original sister siblings (Champagne & Meaney, 2007). Mother-reared monkeys (as compared to nursery-reared controls) demonstrate higher levels of oxytocin in brain receptors and engage in more cooperative and companionable behaviors, as do their offspring as well. Parental responses demonstrate the plasticity of genetic-biological dispositions. If we can extend this to humans we can see how alterations in attachment behavior can potentially program changes in brain biology. The clinical implications of such findings are apparent.

Similar behavioral responses occur in humans. Just as with monkeys, an increase of oxytocin is associated with increased bonding and less stress in both mothers and babies (Coyne & Downey, 1991; Greenwood, Muir, Packham, & Madeley, 1996; Turner Altemus, Enos, Cooper, & McGuinness, 1999; Vilhjalmsson, 1993).

Increased levels of oxytocin occur especially during nursing, and mothers report an augmented sense of well-being, which has a calming effect on both participants. They show increased maternal behavior and are less stressed than nonlactating mothers. Elevated levels of oxytocin are associated with more effective tolerance of negative interpersonal experiences (Uvnas-Moberg, 1998). Oxytocin reduces fear, decreases blood pressure, de-

creases pain sensitivity, and decreases cortisol levels, which are all characteristic of stress (Dedovic et al., 2009). Oxytocin is linked to estrogen production, so it is found more frequently in female animals and in human adult females. It appears to be quite powerful because its effects can be long-lasting. However, whereas animal research can be compelling, it is invariably more complex for humans. According to researchers, there is a significant biological, discriminant preference for infants in females beginning in puberty (Bell & Harper, 1977). Infants' appearance, helplessness, activity, and then reactivity induce connectedness (Bell & Harper, 1977; for a more detailed description of this behavior see Silverman, 1991). Bottle-fed infants as well as adopted ones entice mothers to respond, and mothers in turn have a strong propensity for intense connections with babies.

A contented nursing couple, more likely to consist of an infant female and her mother given the more typical state system found in females, can induce both to readily take advantage of intersubjective cues and signals, thereby facilitating a more rapid affective connection. This is an effective precursor for the sharing of mental states (Hobson, 2002). It sets the stage for the power and force of female empathy and of course, connectedness.

Some women have described the sexually stimulating aspects of nursing. Blaffer Hrdy (1999), the well-known anthropologist, in a personal anecdote has described the sexually stimulating aspect of her nursing experience. Other mothers also specifically report sexual stimulation when their baby is nursing: Contratto (1980) notes that those mothers who chose to nurse their babies (in contrast to non-nursing mothers) experienced "sexual stimulation induced by suckling their infants" (p. 237). However, many women do not report experiencing sexual stimulation during nursing. Chivers, as reported by Bergner (2009), may help us understand something about this experiential difference. According to Chivers, there is a gap between women's sexual arousal and their subjective experience of it as measured by their genital arousal (plethysmographs readings from their vaginas). They often reported consciously less excitement than their genitals reported. If there is sexual stimulation for some women during nursing, it may well be a mixture of the various hormonal

influences that are stirred. Because estrogen and oxytocin are linked, nursing may entwine sex and attachment. It might be interesting to speculate how this coupling phenomenon plays out with their infants. A woman's toleration of implicit and/or explicit sexual sensations associated with oxytocin, dopamine, and estrogen may offer the beginning of sexual, even lustful, pleasures in their offspring. Alternatively, the coupling of the attachment system and sexuality may have negative consequences. A mother who cannot allow for a safe and secure attachment relationship may psychologically withdraw from her infant, minimizing the infant's capacity for social engagement and potential intimacy. Such a removal of tender, caring sensitivity can override hormonal influences (as we have seen with animals) and may produce a subsequent compromise of the child's libidinal investment. A female infant, as has been noted, is more likely than her brother to pick up withdrawal cues. The sensitive reading of cues appears close to Laplanche's (1977) view about the mother's transmission of enigmatic, mysterious, and confounding messages of unconscious sexual desire to her offspring, thereby initiating the child's unconscious in the form of conflicted sexuality.

#### DATA LIMITATIONS

There are a number of cautions that need to be advanced about the data presented. The empirical information about infant daughters, their development, and their mothers' responsiveness is correlational. The mother's receptivity to the female infant's unique qualities contributes to her attachments, nurture, and care of her young. Intergenerational effects exist, facilitating her daughter's capacity for attachment to her young. It certainly has evolutionary benefit. Nonetheless, correlation is not causation.

Normative women's distinctive neural hormones appear to provide for the beneficial features of nurturance, care, soothing, and bonding, a salient feature for child rearing and efficacious in sustained adult relationships. Hormonal levels and their interactive effects work in complex ways not yet fully understood.

The power of environmental features for female development must not be minimized. Approximately fifty years of re-

search have documented the prevailing influences of the rearing environment on social interactions. The nature of one's environment, for some individuals, can be a far more instrumental feature than genetic or biological predispositions (Rutter et al., 1999). Whereas this paper suggests the likelihood that certain initial propensities in females are based in brain differentiation and neural-hormonal contributions, it is not offering the idea that there is a greater role to our genetic and biological dispositions than our experiences in our environment. Both work in tandem, each reciprocally influencing the other. As we know, small effects can have major influences, and sometimes we are able to deal with what may be large environmental occurrences with minimal negative consequences.

I do not wish to suggest that these specific female qualities develop ineluctably in facilitating and adaptive ways for females. When development goes awry, we recognize fierce, fraught, maladaptive attachments that females establish both in their adult relationships and with their offspring. Whereas there is current research data on biological dispositions contributing to disorganized attachments, there is also a significant body of information that relies primarily on negative environmental influences. There are cultural and reality issues that can strain or facilitate this brew. (see Shibley Hyde, 2005, for the impact of culture, life span, and context for changes in female functioning). In contrast to the more benign maternal instinct approach of de Marneffe (2004), other writers have described the mixed emotions stirred by mothering (see Rich, 1986, and feminist writers mentioned in DiQuinzio, 1999). The dark, destructive, even infanticidal, wishes, in normal but stressful mothering experiences need to be acknowledged (Cusk, 2007).

## CONCLUSION

Dimorphism does exist, a situation established by contemporary research. One needs only to read the close to one thousand pages of Einstein's (2007) research collection of diverse studies in *Sex and the Brain*, which attests to this. Some researchers have speculated that the length and helplessness of the human infant has led to evolutionary specialization in behavior between the

sexes and may have contributed to the differential development of brain and hormone function (Halloway et al., 1993). Female infants are behaviorally different at birth, and have different brain organizations and hormonal features that contribute to scaffolding their development. Also, a considerable body of evidence demonstrates that psychological and social pressures “are the most powerful in triggering metabolic changes” (Dedovic et al., 2009, p. 51) The brain is not a stagnant system, but an evolving one that can, given a variety of positive environmental occurrences, change and enhance adaptation.

Thus, biological features cascade with environmental experiences, which lead to a unique emergent outcome for the female. Development occurs in nonlinear ways, and is always interactive. Genes interact with other genes and the environment, all of which contribute to the sculpting of development. Such involved complexity results in further flow of this admixture, with new and different gene–environmental participation producing multifaceted results for each of us. On the one hand, the outcome indicates a plasticity in brain development. On the other, our culture has powerful shaping tendencies, often implicitly insisting on different behavioral feelings, reactions, expressiveness, performance, manners, and sexual conduct in boys and girls and men and women.

Certain genetic features may cause the unusual and atypical-appearing child to experience the world differently, and at the same time cause others to treat the child differently as well. What is being discovered now is how dynamically interactive development is, with the intersection of biology, genetics, and environmental influences mutually affecting each other. Clinicians’ recognition of atypical development can help patients deal with what might be their shame-filled experiences associated with their atypical features. Patients often insist upon the idea that their problems are inborn or were initiated so early in life that change is impossible. They maintain a version of genetic determinism. Knowledge of the dynamic fluidity addressed in this paper can help patients deal with their rigidity of beliefs.

An integration of both biology and the environment contributes to our understanding and use of psychoanalytic theory. If we are to build a consistent, coherent, fact-based psychoana-

lytic theory, it can not fly in the face of the combined knowledge derived from biological-psychological sources. This paper is a preliminary attempt to merge these sources.

#### NOTES

1. Research on the disorganized attachment system demonstrates some genetic atypical specificity in the mother that lends itself to disruptive affect communications in those infants who also possess specific atypical genes. This research is in its early stages and needs replication (Caspers et al., 2008).
2. Theorists have speculated that such intensity may well be a precursor to the adult male's greater readiness for excitement seeking (Else-Quest et al., 2006).

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