A youth remembers a time when he was sitting in the family room with his parents watching the original “Star Trek” television series. He reports that he was 10 years old and had not yet developed any of the obvious signs of puberty. When “Captain Kirk” suddenly peeled off his shirt, the boy was titillated. At 10 years of age, this was his first experience of sexual attraction, and he knew intuitively that, according to the norms of his parents and society, he should not be feeling this same-gender attraction. The youth relating this memory is a self-identified gay 18-year-old in Chicago. He also reports that at age 5 he had an absence of sexual attractions of any kind, and that even by age 8 he had not experienced overt awareness of sexual attraction. By age 10, however, a profound transformation had begun, and it was already completed by the time he entered puberty; sexual attraction to the same gender was so familiar to him (Herdt & Boxer, 1993) that it defined his selfhood.

Recent findings from three distinct and significant studies have pointed to the age of 10 as the mean age of first sexual attraction—well before puberty, which is typically defined as the age when the capacity to procreate is attained (Timiras, 1972). These findings are at odds with previous developmental and social science models of behavioral sexual development in Western countries, which suggested that gonadarche (final maturation of the testes or ovaries) is the biological basis for the child’s budding interest in sexual matters. Earlier studies postulated that the profound maturational changes during puberty instigate the transition from preadolescent to adult forms of sexuality that involve sexual attraction, fantasy, and behavior (Money & Ehrhardt, 1972). Thus, adult forms of sexuality were thought to develop only after gonadarche, typically around ages 12 for girls and 14 for boys, with early and late bloomers being regarded as “off time” in development (Boxer, Levinson, & Petersen, 1989). But the new findings, which locate the development of sexual attraction before these ages, are forcing researchers to rethink the role of gonadarche in the development of sexual attraction as well as the conceptualization of puberty as simply the product of complete gonadal maturation.

Many researchers have conflated puberty and gonadarche, thinking that the two are synonymous in development. The new research on sexual orientation has provided data that invalidate the old model of gonadarche as the sole biological cause of adult forms of sexuality. To the extent that sexual attraction is affected by hormones, the new data indicate that there should be another significant hormonal event around age 10. Indeed, there is: the maturation of the adrenal glands during middle childhood, termed adrenarche. (The adrenal glands are the biggest nongonadal source of sex steroids.) This biological process, distinctively different from gonadarche, may underlie the development not only of sexual attraction, but of cognition, emotions, motivations, and social behavior as well. This observation, in turn, leads to a redefinition of prepubertal and pubertal development.
ference in age of gonadarche: 12 for girls and 14 for boys. Neither of these predictions however, has been borne out by recent data.

In three studies attempting to illuminate the sources of sexual orientation, adolescents have been asked to recall their earliest sexual thoughts; their answers are surprising. One study (Herdt & Boxer, 1993) investigated the development of sexual identity and social relations in a group of self-identified gay and lesbian teenagers (ages 14–20, with a mean age of 18) from Chicago. The mean age for first same-sex attraction was around age 10 for both males and females. Moreover, sexual attraction marked the first event in a developmental sequence: same-sex attraction, same-sex fantasy, and finally same-sex behavior (see Table 1).

This evidence provides a key for understanding sexuality as a process of development, rather than thinking of it as a discrete event, which emerges suddenly at a single moment in time. Virtually all models of adolescent sexual development, from Anna Freud and Erik Erikson up to the present, have been based on the gonadarche model (Boxer et al., 1989). It conceptualizes the development of sexuality as a precipitous, singular, psychological event, fueled by intrinsic changes in hormone levels. Gonadarche is seen as a "switch," turning on desire and attraction, and hence triggering the developmental sequelae of adult sexuality.

Instead, the new data suggest a longer series of intertwined erotic and gender formations that differentiate beginning in middle childhood. Indeed, the psychological sequence of attraction, fantasy, and behavior may parallel the well-known Tanner stages, which are routinely used by clinicians to quantify the process of physical development during puberty (Timiras, 1972). For example, in girls, onset of sexual attraction may co-occur with Tanner Stage II (development of breast buds); sexual fantasy may co-occur with Tanner Stage III (enlargement of mammary glands); and sexual behavior may co-occur with Tanner Stage IV (full breast development), with each psychosexual stage reflecting a different stage of hormonal development. If so, then we may begin to look for a biological mechanism for psychosexual development in the physiological basis for these early Tanner stages that occur prior to the final gonadal maturation that enables procreation.

The generality of these psychological findings is substantiated by two other recent studies that also reported the age of first sexual attraction to be around 10 (see Fig. 1). Pattatucci and Hamer (1995) and Hamer, Hu, Magnonson, Hu, and Pattatucci (1993) asked similar retrospective questions of two distinctive samples of gay- and lesbian-identified adults in the United States. Unlike the Chicago study (Herdt & Boxer, 1993), these studies gathered information from subjects throughout the United States and interviewed adults who were mostly in their mid-30s (range from 18 to 55). They also used different surveys and interview methodologies. Nevertheless, all three studies pinpointed 10 to 10.5 as the mean age of first sexual attraction. Admittedly, none of the studies was ideal for assessing early development of sexuality; the age of first recalled sexual attraction may not be the actual age. Nonetheless, this work is an essential part of the systematic investigation of same-gender attractions in children.

The question then arises whether there is a similar developmental pattern among heterosexuals. We know of no reason to assume that heterosexuals and homosexuals would have different mechanisms for the activation of sexual attraction and desire. Fortunately, we could test this hypothesis because both Pattatucci’s and Hamer’s samples had comparison groups of heterosexuals. Indeed, the reported age of first attraction was the same for heterosexuals as for homosexually identified adults (only the attraction was toward the opposite sex). Thus, regardless of sexual orientation or gender, the age of initial sexual attraction hovered just over age 10. In sum, the switch mechanism responsible for “turning on” sexual attraction seems to be operating at the same time both for boys and for girls, and regardless of whether their sexual orientation is toward the same or opposite gender.

Thus, we surmise that the maturation of the gonads cannot explain the data found independently by these three studies in different samples and geographic areas. There is no known mechanism that would enable the gonads to supply sufficient levels of hormones at that age to cause sexual attraction, because they are not fully developed. The mean age of sexual attraction is the same in both genders and in both struc-

<table>
<thead>
<tr>
<th>Developmental event</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
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<tr>
<td>First same-sex attraction</td>
<td>9.6</td>
<td>3.6</td>
<td>146</td>
<td>10.1</td>
<td>3.7</td>
<td>55</td>
</tr>
<tr>
<td>First same-sex fantasy</td>
<td>11.2</td>
<td>3.5</td>
<td>144</td>
<td>11.9</td>
<td>2.9</td>
<td>54</td>
</tr>
<tr>
<td>First same-sex activity</td>
<td>13.1</td>
<td>4.3</td>
<td>136</td>
<td>15.2</td>
<td>3.1</td>
<td>49</td>
</tr>
</tbody>
</table>

Table 1. Ages (years) at which males and females recall having their first same-sex attraction, fantasy, and activity (from Herdt & Boxer, 1993)
tural forms of sexual orientation; therefore, the biological counterpart in both genders and in both structural forms of sexual orientation of sexual attraction is probably the same. These constraints effectively eliminate gonadarche as a candidate to explain the observed findings.

ADRENARCHE IN MIDDLE CHILDHOOD

In the pediatric literature, it is well recognized that children between the ages of 6 and 11 are experiencing a rise in sex steroids. These hormones come from the maturing adrenal glands. Adrenarche is clinically recognized primarily by the onset of pubic hair, but it also includes a growth spurt, increased oil on the skin, changes in the external genitalia, and the development of body odor (New, Levine, & Pang, 1981; Parker, 1991). Nonetheless, both the psychological literature and the institutions of our culture regard this period of middle childhood as hormonally quiescent. Freud’s (1905/1965) classic notion of a “latency” period between ages 4 to 6 and puberty perhaps best distills the cultural prejudices. In contrast, we have hypothesized that the rise in adrenal steroid production is critical for understanding interpersonal and intrapsychic development in middle childhood.

Both male and female infants have adult levels of sex steroids during the first days of life, and their adrenal androgens also approach the adult range (see Fig. 2). After a few months, the sex hormone levels begin to fall to a very low level and then remain low until the maturation of the adrenal glands and gonads. When children are between 6 and 8 years of age, their adrenal glands begin to mature. Specifically, the adrenal cortex begins to secrete low levels of androgens, primarily dehydroepiandrosterone (DHEA; see Fig. 2) (Parker, 1991). The metabolism of DHEA leads to both testosterone and estradiol, the primary sex steroids in men and women.

It is noteworthy that both girls and boys experience a rise in androgens, although androgens are typically misidentified as male hormones. Moreover, there is no sex difference in the age at which these androgens begin to rise or the rate at which they do so. After adrenarche, an individual’s level of androgens plateau until around 12 years of age in girls and 14 years of age in boys, whereupon gonadarche triggers a second hormonal rise into the adult range (Parker, 1991).

In adults, the androgens that are produced by the adrenal cortex and their metabolites are known to have psychological effects in a variety of developmental areas relating to aggression, cognition, perception, attention, emotions, and sexuality. Although adult levels of DHEA are not reached until after gonadarche, levels of this hormone do increase significantly around age 10 (see Fig. 2; De Peretti & Forest, 1976), when they become 10 times the levels experienced by children between 1 and 4 years of age. It is plausible that this marked increase in androgen levels alters the brain, and thus behavior, either by modifying neural function or by permanently altering cellular structure.

![Fig. 1. Mean age (±SEM) of first sexual attraction reported by males and females, both homosexual and heterosexual. The data are reported in three studies: Herdt and Boxer (1993), Pattatucci and Hamer (1995), and Hamer, Hu, Magnuson, Hu, and Pattatucci (1993).](image)
We considered the hypothesis that the age of first sexual attraction is similar for boys and girls, both homosexual and heterosexual, because there is some marked change in environmental stimuli, socialization, or cognitive abilities around the age of 10. If so, then the 10-fold rise in DHEA would be only correlated with the emergence of sexuality and should not be considered its direct cause.

A major weakness of the idea that environmental stimuli lead to the emergence of sexual attraction at age 10 is the fact that, in the United States, there is no marked cultural prompt for sexuality in a 10-year-old. Children this age are typically in fourth grade. To our knowledge, there is no overt change in social expectations between Grades 3 and 4, or between Grades 4 and 5, that might account for the developmental emergence of sexual attraction at age 10. In U.S. culture, the typical ages for the so-called rites of passage are 12 to 13, when the adolescent becomes a "teenager," or around 15 to 16, when the driver's license is issued. Perhaps between Grades 5 and 6 (or, depending on the school system, between Grades 6 and 7), we might identify a critical change during the transition from elementary to middle school. Yet all of these culturally more prominent transitions occur later than age 10. Other subtle changes, such as girls wearing ornate earrings or boys forming preteenage groups, may occur around age 10, but these social factors seem too weak to adequately explain the sudden emergence of sexual attraction before anatomical changes are noteworthy in the child.

We also considered the possibility that although the social environment does not change at age 10, sexual attraction arises at this age because of an increase in the child's cognitive capability to perceive and understand the sexual and social environment. When the child becomes cognitively capable of understanding sexual interactions among adults, the child is capable also of imitating and putting into action the behaviors he or she has observed. This may be a plausible explanation for development of an awareness of sexual attraction in heterosexuals, and no doubt plays a role in the development of sexuality (after all, people typically do not develop sexuality in a vacuum). But does the explanation hold for children who are sexually attracted to the same gender?
The simple social-learning hypothesis predicts that as soon as children become aware of a strong cultural taboo on the expression of homosexual feelings, they should inhibit or even extinguish these desires in subsequent sexual development. We would therefore expect to find that homosexuals would reveal same-sex attraction significantly later than the age when heterosexuals reveal opposite-sex attraction. But this is not the case.

If 10-year-old children are simply mimicking the sexual behavior most commonly seen in adults (and the biological ability to actually carry out the behavior will arise only with gonadarche), then, given the predominant culture, all 10-year-old boys should demonstrate sexual attraction toward females, and all 10-year-old girls should show sexual attraction toward males. However, this also is not the case.

Other criticisms of simple learning theory hypotheses regarding sexual development are well known and need not be repeated here (Abramson & Pinkerton, 1995). However, the Sambia of Papua New Guinea (Herd, 1981) provide particularly compelling counterevidence to a simple learning theory model. The Sambia provide powerful reinforcement for same-gender relations by institutionalizing the practice of men inseminating boys over a period of many years, beginning at age 7 to 10. The goal of the men is to masculinize and “grow” the youths into competent reproductive adult men. This intensive training and reinforcement of sexual relationships between males does not result in exclusive homosexuality in adulthood. Instead, adult Sambia men reveal marked bifurcation of their sexual interest; they generally stop all same-gender relations after marriage and enjoy sexual relations with women.

THE RELATIONSHIP BETWEEN ADRENARCHE AND SEXUALITY: CAUSE OR CORRELATION?

Does the inability of the hypotheses of gonadarche and social learning to explain the data imply that adrenarche is the key to the emergence of sexual attraction at age 10? That question cannot yet be answered conclusively. It is entirely possible that the sequential changes in attraction, fantasy, and behavior result from major structural changes in the brain that have their etiology in sources other than sex steroids. However, there has been no documented evidence for such neural structures as of yet. Moreover, if structural changes in the brain do prove to be the cause of the emergence of sexual attraction, modification of all current sexual developmental models and theories will still be needed because they assume that adult desires and behaviors develop from gonadarche.

A change in the nervous system that results from hormones released at adrenarche does look like the most likely developmental mechanism for several reasons. First, girls and boys experience their first sexual attraction, but not gonadarche, at the same age. Second, DHEA, the primary androgen released by the adrenal, is intimately linked with testosterone and estradiol, the major adult sex hormones. Their dynamic relationship is based on the fact that they share many of the fundamental features of steroid function: metabolic pathways that produce the steroids, binding proteins in the blood that carry them to their target tissue, and receptors that enable the cells in the target tissue, including the brain, to change their function in response to the hormonal information. Third, these androgens are known to affect the sexual fantasies and behavior of adolescents and adults, and it is plausible that the same hormones would have similar effects at an earlier age.

RETHINKING PUBERTY: IMPLICATIONS FOR MANY DOMAINS

Given the strong possibility that the currently popular model of puberty is limited, if not incorrect, researchers need to rethink puberty and test the new models in a wide range of psychological disciplines. Adrenarche clearly raises androgens to significant levels, and if these hormones are responsible for the effects seen in sexual attraction, then they are likely to affect a wide range of other behaviors: aggression, cognition, perception, attention, arousal, emotions, and, of course, sexual identity, fantasy, and behavior.

Even if it turns out that hormones released from the adrenal glands are not responsible for the onset of sexual attraction, the behavioral data themselves demonstrate that the concept of puberty must be greatly elaborated and its various stages unpacked. Indeed, Freud’s idea of a latency period is seriously flawed. The current behavioral work reinforces the well-established clinical understanding that puberty is composed of at least two separate maturational processes: adrenarche and gonadarche. Any psychosocial research that uses puberty as a stage in development needs to break down the relevant developmental and social behaviors into these two different stages. Researchers need to take into account the hormonal fact that the start of puberty in normal individuals is around ages 6 to 8 and the end of
puberty is not until around ages 15 to 17.

The idea of sexuality developing in stages is nothing new to social scientists. But the idea that sexuality is a continuous process that begins from the inside, well before gonadarche, and extends into adulthood is a conceptual advance. These new data from sexual orientation research force a reevaluation of the social and health models of sexual development. No longer can the brain at puberty be treated as a black box, which is suddenly able to process sexual stimuli de novo at the time of gonadal change.

Although adrenarche may not be the answer to all the riddles of sexual development, the new data from the developmental and social study of sexual identity have triggered a major conceptual advance in the understanding of both puberty and sexual development as psychobiological phenomena.

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Notes
1. Address correspondence to Martha K. McClintock, 5730 Woodlawn Ave., Chicago, IL 60637; e-mail: mkm1@midway.uchicago.edu.
2. The adrenal glands are small, pyramidal glands located above the kidneys. They produce hormones that affect metabolism, salt regulation, response to stress, and reproductive function, in part by binding in the brain and altering neural function.

References


Marital Violence Among Alchoholics

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Despite a substantial body of experimental studies showing that alcohol can increase human aggression (Bushman & Cooper, 1990), some researchers and many clinicians who study and treat domestic violence believe that although alcohol is a convenient excuse for battering, the consumption of alcohol, per se, does not cause battering (e.g., Gelles, 1993). Although it is possible that alcohol is simply an excuse for violence, this question must be decided on a scientific basis. The sentiment that alcohol is merely an excuse has, over time, been elevated to the status of fact, constraining efforts to develop a coherent theoretical understanding of the co-occurrence of alcoholism and domestic violence.

There is a serious need for such a theory, as empirical evidence demonstrates a strong association between alcoholism and domestic violence. One large-scale survey of the U.S. population revealed that people with higher alcohol consumption were more likely to engage in physical aggression in their heterosexual marital and co-
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