

FEMALE PROTO-SYMBOLIC STRATEGIES

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How did humans become the unique symbolic culture-bearing species that we are? One of the most exciting challenges for paleoanthropology is to understand this extraordinary event. Few convincing arguments have been put forward to explain the evolution of symbolic cognition on a Darwinian basis; no theory has ventured predictions which are testable against symbolic data from both the archaeological and the ethnographic records.

Modern paleoanthropology dates from the 1966 “Man the Hunter” conference (Lee and DeVore 1968). Among the hunter-gatherer ethnographers, primatologists, paleontologists and archaeologists present, a consensus emerged that the evolution of humans was the evolution of the hunter-gatherer adaptation. At the time, evidence for the basic elements of the hunter-gatherer lifestyle — centered on food-sharing and a home base — was identified early in the fossil and archaeological record (Isaac 1971). A unilinear, gradualist model developed which proposed co-evolution of increasing amounts of meat in the hominid diet, increasing levels of co-operation between males in the hunt, and the development of cognition, language, and symbolic culture on that basis.

Inspired by the rise of feminist consciousness in the 1970s, women scientists challenged the overt sexism of this account by advancing the parallel model of “Woman the Gatherer” (Tanner 1981). Invaluable for switching attention to female strategies, “Woman the Gatherer” arose at a time when the newly emergent discipline of sociobiology was offering the prospect of a female-centered methodology for evolutionary accounts (cf. Haraway 1989). Among primatologists in particular, selfish-gene thinking focused attention on conflicts between male and female reproductive strategies, thereby highlighting female priorities of foraging and reproduction. Sociobiology discredited so-called “coat-tails” theories of human evolution (cf. Fedigan 1986), according to which traits were predominantly selected for in males, with females hanging on for the ride.

But for clarifying the question of symbolic cultural origins, “Woman the Gatherer” had the same limitations as “Man the Hunter.” Neither model recognized or identified as a problem the uniquely human phenomenon of

symbolic culture. Implicitly, both assumed that symbolic communication such as language was necessarily “better,” and was so obviously an advantage for organizing social life that any sufficiently encephalized hominine (australopithecine and *Homo*) would generate and use it.

However, symbolic speech is not necessarily better than a primate gesture/call system. It has costs as well as benefits, and would be useless to evolving humans lacking other elements of symbolic culture (Knight 1996). In the tradition of Durkheim (1965 [1912]) symbolic anthropologists (cf. Rappaport 1979) have stressed the interdependence of speech and ritual. Symbolic speech is a set of cryptic mutual references to morally authoritative constructs (Knight *et al.* 1995). As they speak, humans trigger acts of identification

	<p>of such constructs. But speech is powerless to implant and replicate those constructs throughout a community of speakers in the first place. A construct such as “God,” for example, must first be emotively experienced — and the only possible medium for this is ritual. Collective ritual action is the source of those shared, morally authoritative symbolic constructs without which speech could have no force.</p> <p>If speech and ritual are so interdependent, then any theory of speech origins must simultaneously account for the emergence of ritual action. Using neo Darwinian methodology, which describes the process of evolution through cost-benefit analyses of short-term fitness payoffs to individuals, how can we explain the ritual domain? What selection pressures would have led individuals to engage with displaced and imaginary constructs, endeavoring to share those constructs with others? What would have been the immediate benefits promoting an interest in illusions?</p> <p>Among the unique attributes of modern humans are symbolic culture manifested in language, ritual and art, and a sexual division of labor, with distribution and exchange underwritten by ritual taboos and myth (Chase 1994). Also unique in its overall combination of features is the human female reproductive cycle. We will advance a Darwinian model which links female reproductive strategies to the emergence of symbolism and the sexual division of labor. Essentially, the hypothesis proposed here is that symbolism emerged as a set of deceptive sexual signals aimed by female kin coalitions at their mates to secure increased male reproductive investment (cf. Krebs and Dawkins 1984; Knight <i>et al.</i> 1995).</p> <p>FEMALE SEXUAL SIGNALS</p> <p>The modern human female reproductive cycle is characterized by concealed ovulation and loss of estrus implying the capacity for sexual receptivity at any point of the cycle. These features have regularly been implicated in accounts of the emergence of monogamy with male provisioning including hunting (e.g Loveoy 1981; Hill 1982; Stoddart 1986). It is worth reviewing some of the scenarios depicting exchange of economic resources for sexual</p>
155	<p>favors. Both Lovejoy and Hill highlighted continuous sexual receptivity as a necessary component. Lovejoy (1981) argued for this in a monogamous context, the male bringing food “home” to his mate and offspring; the more sexually desirable she was, the more he would be motivated to obtain and return with food. This led to selection for such “attractive” characteristics as breasts, buttocks, smooth skin, etc. By contrast with this nuclear family scenario, Hill (1982) modelled a promiscuous and competitive trade of sex for meat. Males would be motivated to bring meat to estrus females. This led to selection on females to extend estrus throughout the cycle — “sham estrus” — leading to the continuous receptivity pattern of humans. Other theorists have noted the problem of female receptivity in relation to hunting behavior (e.g. Lancaster 1975). Stoddart (1986) pointed out that estrus, and particularly olfactory cues of fertility, would have disrupted hunting. Given reliable cues to ovulation, males who stay back at camp rather than go out hunting would have excellent chances of fertile sex. In these circumstances no male would expend energy to hunt. According to Stoddart, this problem necessitated suppression of such olfactory signals.</p> <p>Models such as these linked levels of male energetic investment with female sexual signals. Lovejoy and Stoddart assumed, rather than explained, a male parental instinct and tendency to provision offspring — that is, a level of male investment radically differentiating hominines from extant nonhuman primates. Hill, a sociobiologist premising his model on conflicts of interest between the sexes, did not make that</p>

	<p>assumption. But it is not clear how long- term male investment would be generated on the basis of short-term promiscuous exchange.</p> <p>Why link levels of male investment with female reproductive signals at all? We must posit some such link because of the energetic problems posed by encephalization in the hominine line. As the brain became larger in human evolution, mothers bore the escalating reproductive costs of producing large-brained infants. Female reproductive fitness would increasingly depend on securing greater and more reliable reproductive investment from males. Because it is females who primarily bear the costs of reproduction, we must suppose that females drove this process through sexual selection, their reproductive signals functioning as prime mechanisms for gaining greater investment from males. Our major piece of evidence for the evolution of these features is the modern human female reproductive cycle itself.</p> <p>As females came under pressure to meet the costs of encephalization, one logical strategy is to reward more attentive ‘investor’ males, and to punish or undermine would-be philanderers. A philandering male maximizes his reproductive fitness by fertilizing as many females as possible. He achieves this by reducing the time he spends searching for each fertile female, and the time he spends with her to ensure impregnation. The human female appears well designed to waste the time of philanderers by withholding accurate information about her true fertility state.</p>
156	<p>Concealment of ovulation and loss of estrus is a deterrent to a male philandering strategy because it deprives males of any reliable cue by which to judge whether a female is likely to have been impregnated. The longer a male must remain with one female to ensure fertilization in any breeding season, the smaller are his chances of fertilizing another (Dunbar 1988: 160). These features are not unique to humans as against other primates (Hrdy 1981: 158). However, in some species with apparently concealed ovulation, males may be able to track female cycles through olfactory cues (e.g. cotton-top tamarins, Ziegler <i>et al.</i> 1993). Studies of variation in human ejaculates (Baker and Bellis 1993: 880) confirm that men are unable to track women’s peri-ovulatory periods. Ovulation in women is well concealed from male partners.</p> <p>Alexander and Noonan (1979) argued that through concealment of ovulation and continuous receptivity alone, males would have been forced into prolonged consortships. Even in multi-male group contexts, pair-bonds would have been reinforced, and hence males would have had greater confidence in paternity, leading to greater parental investment. Against this, Hrdy (1981) proposed that concealment/continuous receptivity among primates correlates with promiscuity, females needing to deprive males of information about paternity, so reducing risks of infanticide. These hypotheses are not mutually exclusive. While ovulation may initially be concealed to counter infanticide risk, once present this trait could be exapted to serve a female strategy of increasing male investment (see Sillen-Tullberg and Møller 1993).</p> <p>Another key means of thwarting philanderers is reproductive cycle synchrony. Knowlton (1979) formulated a general model of synchrony as a strategy by the sex which invests most in offspring to secure greater parental investment from their mates. If females synchronize their fertile moments, no single male can cope with guarding and impregnating any group of females. He must concentrate his efforts on one female at a time. The evolutionary effect is to bring more males into the breeding system.</p> <p>Synthesizing Alexander and Noonan’s argument on ovulatory concealment with Knowlton’s synchrony model, Turke (1984, 1988) was the first to focus on “ovulatory synchrony” in hominine mating systems. He argued that ovulatory concealment (with continuous receptivity) functioned to draw males into longer</p>

	<p>consortships by depriving would-be philanderers of accurate information about fertility. A pattern of ovulatory synchrony in local populations had the further effect of thwarting male attempts to philander. This drove the ratio of sexually active males to females in groups towards one-to-one. Sustained male/female bonds on a one-to-one basis led to greater paternity confidence, and greater inclination on the part of males to invest in offspring.</p> <p>Equal sex ratios can only be guaranteed by extreme reproductive synchrony, with local females synchronizing all reproductive events — ovulation, conception, gestation, birth, lactational amenorrhea and return to fecund cycling. In these conditions, to maximize fitness, males have no alternative but to invest</p>
157	<p>in current partners. However, such a strategy would be costly to females in populations with high infant mortality, and would be virtually impossible to sustain where females were using sexual receptivity to bond with males (Arthur 1994). But a seasonal form of synchrony, restricting most female fecund cycles to a certain period of the year, would incur minimal costs to synchronizers, and would still function to counter male attempts to philander.</p> <p>Seasonal ovulatory synchrony with continuous receptivity would effectively ensure at least as many males in breeding groups as fecundable females. But it would not prevent males from deserting lactating females in favor of cycling females. Where a degree of synchrony was an important female strategy for undermining male philandering, we would predict minimizing of any signal that divulged information about prospective fertility. If synchrony is not going to be perfect, then the least females can do is not advertise the fact.</p> <p>But one reproductive signal has been amplified in the course of human evolution — menstrual bleeding which is unusually profuse in women (Profet 1993). Signalling is not a primary function of menstruation, which occurs in other primates and a wide range of species. But once ovulation was concealed and estrus was lost in the human lineage, menstruation would have taken on significance as a cue. It is not an accurate indicator of fertility, because it occurs at the non-fertile time of the cycle. But it is a good indicator of impending fertility. Because menstruation would have been the only cue which gave males positive information about female reproductive condition, we would expect that hominine males came under selection pressure to respond to it. Since it is not accurate about timing of fertility, the information is not very useful for philanderers. Menstruation should make a female attractive to males who are prepared to wait around and mate-guard. Given concealment of ovulation, males lack information about when to bring mate-guarding to an end. So the male who responds to menstrual cues must spend plenty of time with the female to increase his chances of paternity.</p> <p>This implies that menstrual bleeding functioned as a mechanism of attracting extra male attention, procuring mating effort. But the signal does not necessarily secure genuine parental effort from males. Once a female was pregnant, she risked losing male attention to other menstruating females in the vicinity. Can the problem of the giveaway menstrual signal be resolved to uphold a synchrony strategy which would secure a level of paternal investment in the offspring?</p> <p>One logical possibility is that, within kin coalitions, non-menstruating females “cheated” by “borrowing” the blood of a menstrual relative. Confusing the information available to males by showing the same reproductive signal at the same time, coalition members could then retain both the attractions of</p>

	<p>menstruation as an indicator of impending fertility, and the advantages of synchrony for maximizing male parental investment.</p> <p>On this basis, we would expect females, within kin coalitions, to manufacture synchrony of signals whenever a member was actually menstruating —</p>
158	<p>a strategy we term “sham menstruation.” We might then expect them to resort to cosmetic means — blood-coloured pigments that could be used in body-painting — to augment their “sham” displays. We expect the earliest instances of such cosmetic elaboration of menstrual signals to have occurred among archaic <i>Homo sapiens</i> as females experienced reproductive stress owing to the increasing costs of encephalization (see below, pp. 162-5).</p> <p>Such coordinated body-painting at menstruation would function as advertising for extra male attention. Provided females maintained solidarity within their menstrual coalitions, even if males were aware of which females were actually menstruating, they would not be able to use the information. If males attempted to fight for access to a particular female, they would encounter resistance from female relatives, and there would be no fitness benefit since the menstrual female would not be immediately fertile. As a result, males would maximize fitness by continuing to invest in current partners rather than by targeting menstrual females.</p> <p>The “sham menstruation” model gives a basis for describing behavioral adaptations that prefigure symbolic and ritual activity. A signal that originally belonged to an individual, and was capable of extracting energy from males on a one-to-one basis, would become collectivized and amplified among a coalition of females, broadcasting information of critical importance which males could not afford to ignore. This means that the female coalition would now have a powerful signal for manipulating males. To the extent that some females who were not imminently fertile pretended to be, the signal would be deceptive. Unlike nonhuman primate tactical deception, which is always on an egocentric and individualistic basis (Byrne and Whiten 1988), in this case the deception would be incipiently sociocentric, maintained by a collective. As such, it represents a vital step towards sustaining an imaginary construct and sharing that construct with others — that is, dealing with symbols.</p> <p>So long as female deceptive displays remained situation-dependent, constrained by the local incidence of biological menstruation, they would not be fully symbolic but tied to here-and-now contexts. Symbolic cultural evolution would take off when cosmetic displays involving use of pigment and body painting were staged as a default, a matter of monthly, habitual performance, irrespective of whether any local female was actually menstruating. Once such regularity had been established, women would effectively have created a communal construct of “Fertility” or “Blood” — no longer dependent on its perceptible counterpart. Ritual body-painting within groups would repeatedly create, sustain, and recreate this morally authoritative construct. Such repeated ritual — which is energetically costly — must be linked to the level, regularity, and kind of male provisioning effort it engenders. We therefore expect that data interpretable as evidence for regular female ritual performance, such as abundant red pigment, will correlate with the onset of a symbolically structured sexual division of labor.</p> <p>Our model rests on the value of menstruation as a signal of impending</p>
159	<p>fertility to attract and retain male support. But, no matter how amplified, the signal would not motivate males to embark on long-distance, logistic hunts or foraging expeditions; on the contrary, it should</p>

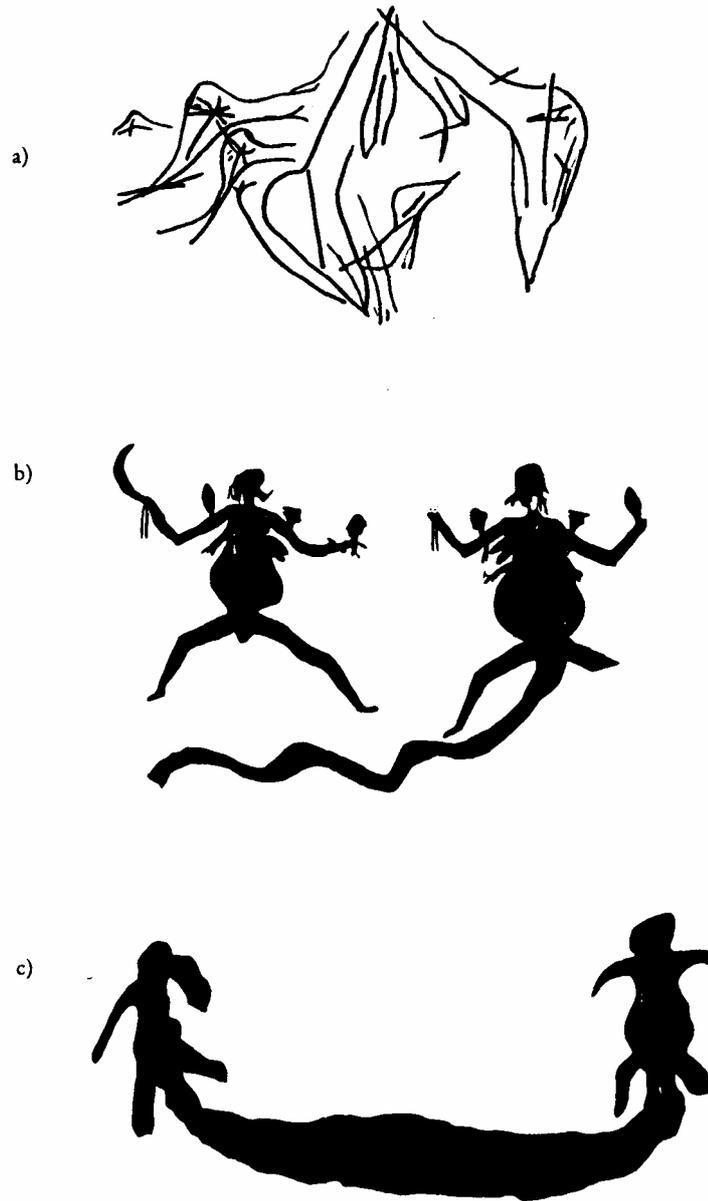
	<p>promote mate-guarding. Sham menstruation would function to mobilize male mating effort in contexts of area-intensive foraging, where there were sufficient gatherable resources in the vicinity. It is consistent with fairly similar foraging strategies between the sexes where females travel with males for hunting of no more than small to medium game. However, for females burdened with increasingly dependent offspring, one of the key means to alleviate reproductive stress would be to reduce activity levels, especially energetic costs of travel (Prentice and Whitehead 1987). In a study of activity levels among Efe hunter-gatherer women of different ages and reproductive status, Peacock found that “pregnant and lactating women curtail the performance of strenuous work activities in comparison with cycling women” by travelling shorter distances and carrying lighter backloads (Peacock 1991: 350-351).</p> <p>The sexual division of labor entails differentiation of roles in food procurement, with logistic hunting of large game by males, co-operation and exchange of products. Our hypothesis is that symbolism arose in this context. To minimize energetic costs of travel, coalitions of women began to invest more heavily in home bases. To secure this strategy, women would have to use their attractive, collective signal of impending fertility in a wholly new way: by signalling refusal of sexual access except to males who returned “home” with provisions. Menstruation — real or artificial — while biologically the wrong time for fertile sex, is psychologically the right moment for focusing men’s minds on imminent hunting, since it offers the prospect of fertile sex in the near future. Once amplified menstrual displays signalled “no” to males, “ritual” and “taboo” in forms known among hunter-gatherers would have been established. Coalitions of women who had already been artificially manipulating information divulged to males, and engaging in a level of collective deception, would have had the preadaptations necessary to construct such a signal of “no sex” or “taboo.”</p> <p>MENSTRUATION IN HUNTER-GATHERER ETHNOGRAPHY</p> <p>Hunter-gatherer ethnography documents a cross-cultural linkage between observance of menstrual taboos, hunting success, lunar periodicity and normative beliefs in menstrual synchrony (see Knight <i>et al.</i> 1995). Behavioral menstrual synchrony is well documented in human groups (McClintock 1971; and see Graham 1991; Weller and Weller 1993). The human female is well designed for widespread cycle synchrony across a population because the average length of her menstrual cycle corresponds to the mean lunar synodic period at 29.5 days (Gunn <i>et al.</i> 1937; McClintock 1971; Vollman 1977; Cutler <i>et al.</i> 1980). The average length of gestation at 266 days is a</p>
160	<p>precise multiple of the lunar synodic period (Menaker and Menaker 1959; and see Martin 1992: 263-264). The model asserts that periodic female inviolability should be discernible as a focus of early ritual traditions. Menstrual taboos satisfy this condition, being sufficiently widespread and invariant to indicate extreme antiquity (Knight 1991: 374ff.). Recurrent among southern African San hunter-gatherer groups are the related beliefs that (a) a man should not hunt while his wife is menstruating (Bieseles 1993: 93); (b) he should not have sex while his wife is menstruating (Shostak 1983: 239); or (c) he should not have sex if he is about to go out hunting large game (Bieseles 1993: 196). This implies that ideally hunting should follow menstruation which initiates periodic sex abstinence. Associated with this are beliefs in women synchronizing their periods (see Shostak 1983: 68), both with each other, and with the moon. The Hadza of Tanzania and the San both link menstruation to dark moon (see Knight <i>et al.</i> 1995). To this day, the</p>

most productive form of hunting among these groups is nocturnal ambush hunting over game trails leading to waterholes, practiced in the dry season (Crowell and Hitchcock 1978; Hawkes *et al.* 1992). This is necessarily restricted to the moonlight nights between first quarter and full moon. The major religious ceremony of the Hadza, the *epeme* dance, takes place each dark moon (when women are normatively menstruating) and is held to be vital for hunting luck (Woodburn 1982: 191, and pers. comm.). Among widespread San groups, the distribution indicating considerable antiquity for the practice, a girl's release from her first menstruation ceremony would be timed for the appearance of the new moon (see Knight *et al.* 1995). The picture that emerges from the African ethnography is of a sequence of ritual and taboos associated with menstruation around dark moon, preceding and motivating collective, logistic hunting in the period when maximum nocturnal light is available to hunters, towards full moon.

In Khoisan ethnography, cosmetic application of pigment is found regularly, and is linked both to menstrual ritual and hunting performance. Among the /Xam (the extinct southern San), a girl emerging from menarcheal seclusion would give all the women of her band lumps of hematite (a very bright red ochre) to dress their cloaks and decorate their faces (Hewitt 1986: 284). A Zu/'hoasi maiden has an ochre design painted on her face, and she adorns the young men with ochre to protect them from accidents while hunting (Lewis-Williams 1981: 51). Similar practices involving real blood, red plant pigments or red ochre are reported for most other San groups (see Knight *et al.* 1995).

Worldwide in the rock art of hunter-gatherer cultures, representations of ritual power centered on female reproductive signals — menstruation and menstrual synchrony — appear prominently. Examples of such paintings and engravings (Figure 8.1) are found in the European Upper Paleolithic (Marshack 1975), the southern African Later Stone Age (Solomon 1992; Garlake 1987), and Aboriginal Australia (Wright 1968).

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8.1 Images of women from the rock art of hunter-gatherer communities: (a) European Upper Paleolithic, Lalinde, Middle Magdalenian, redrawn after Marshack (1975); (b) San, Zimbabwe, Later Stone Age, redrawn after Garlake (1987: fig. 78); (c) Pilbara region, Western Australia, redrawn after Wright (1968: fig. 845).

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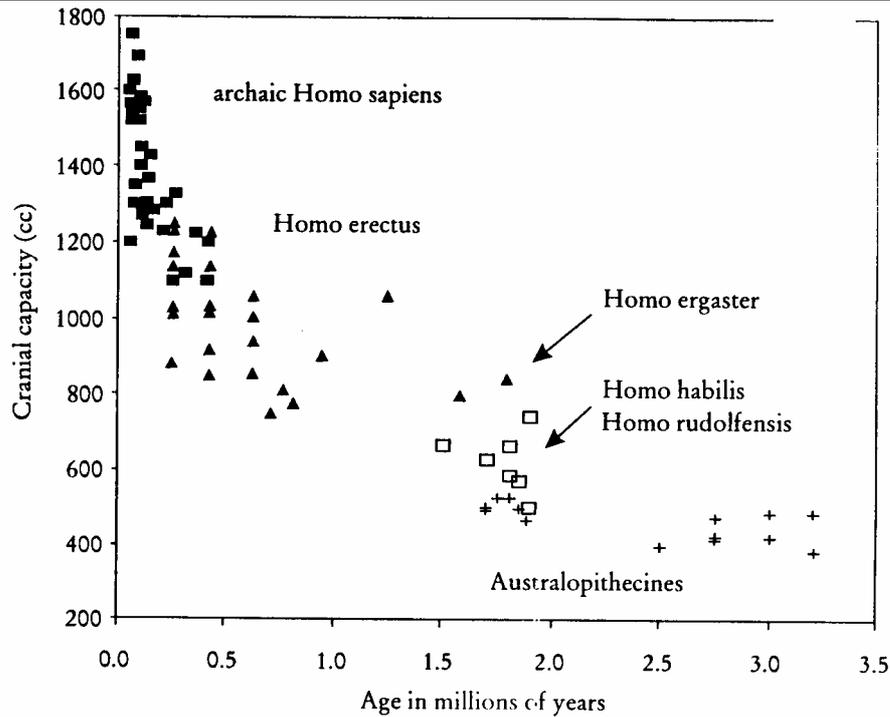
This model argues that human symbolism and cognition emerged as a consequence of the increased costs of reproduction borne by the female resulting directly from the energetic costs of encephalization. But what evidence of these major changes in female reproductive strategy is there in the fossil record for human evolution? Behavioral and cognitive evolution leaves little tangible evidence of the stages through which the model takes us. But one feature available in the fossil record enables us to infer when females would be expected to have come under pressure to alter their reproductive strategies. This is the pattern of brain size increase over the course of human prehistory. Measurements of cranial capacity allow us to estimate the increased costs of reproduction resulting from encephalization, and hence when females

would have required increased paternal investment. At that stage, we expect females to resort to cosmetic manipulation of signals — sham menstruation — to artificially maintain synchrony. The establishment of a fully symbolic sham menstruation strategy, involving regular ritual, should be evidenced by abundant utilization of red pigment in the archaeological record. This should be associated with evidence for a sexual division of labor, with heavier investment in home bases.

When brain size for the available hominine fossils is plotted against time (Figure 8.2) it is immediately apparent that there are two periods of rapid increase in absolute brain size in the fossil record. The first of these marks the evolution of early *Homo*, and particularly *Homo ergaster*, while the second is an exponential increase which gets under way with the appearance of archaic *Homo sapiens*. Between the time of *Homo habilis* and about 300,000 years ago there is little significant increase in brain size (Rightmire 1981; but see Leigh 1992).

A large brain size itself would be expected to have placed little increased metabolic demand on adult individuals. Even though brain tissue is metabolically very expensive and humans brains are just over 1 kilogram larger than would be expected for an average placental mammal of our body weight, our basal metabolic rates are no greater than would be expected. Intestinal tissue is also metabolically very expensive, and humans compensate for their relatively large brain sizes by having correspondingly small guts (Aiello and Wheeler 1995). Although the evolution of the large brain in the hominines did not necessarily put the adults under an increased energetic strain to maintain this large brain size, it did require them to adopt a higher quality diet. Only a high quality, easy to digest diet is compatible with relatively small (and energetically cheap) digestive systems. High quality diets do, however, have their own energy costs. They require larger foraging areas (Clutton Brock and Harvey 1977; Milton and May 1976) and correspondingly increased levels of total energy expenditure in foraging (Leonard and Robertson 1992).

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8.2 The relationship between brain size (in cubic centimeters) and time. Archaic *Homo sapiens* includes anatomically modern humans, and Neandertals as well as other archaic *H. sapiens* such as Kabwe and Petralona (data from Aiello and Dean 1990).

Supporting a larger brain, then, required a more costly foraging strategy. For females, this greater energetic stress would have been compounded by the increased reproductive costs involved in the production of larger-brained infants. Smith (1989, 1991) has pointed out very clearly that adult brain size is highly correlated with the age of eruption of the first permanent molar tooth (M1). The larger the adult brain size, the more delayed is the eruption of M1 and the longer is the period of infancy and childhood. In humans the eruption of the M1 takes just about twice as long as it does in the chimpanzee (Aiello and Dean 1990) and the period of dependency on the mother would be correspondingly lengthened. Added to this is the fact that the human infant is born in a more altricial, or less developed, state than is the chimpanzee infant and would be correspondingly more dependent on the mother for a longer period of time (Martin 1990). Furthermore, Foley and Lee (1991) have argued that up until the age of 18 months a human infant is on average about 8.7 per cent more energetically costly than a chimpanzee infant and this is

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due solely to the high costs of the growth and maintenance of the unusually large human brain. This is reflected in the higher mass specific metabolic rates of human infants in comparison to human adults and gives an indication of the increased energetic demand a human infant would make on its mother during its early years of life.

These analyses compare modern humans and chimpanzees. Earlier hominines with smaller brain sizes than are found in modern humans would have been expected to be under less reproductive stress. Foley and Lee (1991) have estimated that early *Homo* females, living during the long period of apparent stasis in the evolution of brain size (see Figure 8.2), would have been under reproductive stress particularly during the first year after parturition and would have been forced to begin to alter their reproductive strategies (see also Leonard and Robertson 1992).

	<p>During this long period of stasis there is nothing in the archaeological record that would suggest sham menstruation or any human-like symbolic or cognitive ability, or for that matter significantly greater paternal investment in the offspring to help lighten the energetic load on the female. Even the reduction in sexual dimorphism that is characteristic of <i>Homo</i> in relation to the australopithecines need not imply a move away from inter-male competition for mates towards a more human-like mating strategy (Aiello 1996; McHenry 1994, 1996). Reduction in sexual dimorphism does not need to be explained solely, or even primarily, by a decrease in male body size, as would be implied by these changes in male mating strategy; rather it could be explained by an increase in female size. Such an increase in size would confer on her an essential thermoregulatory advantage in the more open savanna habitat occupied by these hominines (Wheeler 1992). It could also have helped to offset some of the reproductive costs of larger brains by helping her to move more efficiently over larger foraging ranges and also to reduce the cost of carrying dependent offspring. It may have had a further distinct reproductive advantage since the cost of lactation tends to be relatively lower in a larger-bodied animal than in a smaller-bodied one (Martin 1984). We suggest that the increased energetic costs of the first phase of brain expansion that culminated in the appearance of <i>Homo ergaster</i> and <i>Homo erectus</i> were met at least in part by the increase in female body size. Another feature that may also have been important at this stage was development of the considerable fat stores that are characteristic of human females, one of the primary functions of which would be to subsidize the energetic costs of lactation, particularly during periods of relative food shortage (Prentice and Whitehead 1987). We would expect that females came under pressure to conceal ovulation and extend receptivity during this period, both to gain greater attention and more food-sharing from males, and to reduce risks of infanticide by males (cf. Hrdy 1981).</p> <p>This period could be termed the pre-symbolic stage of hominid evolution. it is important to realize that it also would have been characterized by</p>
165	<p>pre-adaptations to the later development of human cognition that would not have been present in other primates. Of particular importance here are the pre-adaptations to human vocal communication. Dunbar (1992, 1993; Aiello and Dunbar 1993) has proposed that language is a direct result of selection for large group size, a factor that he also implicates in the evolution of brain size. He views language as a means of facilitating social bonding which would allow an individual to reduce its social time budget by simultaneously servicing multiple social relationships. In larger groups this would be a distinct advantage over one-to-one grooming behavior in that vocally based social bonding would free a greater proportion of time for other essential activities, such as foraging and feeding. In the earlier stages of this transition as envisaged for early <i>Homo</i>, and particularly <i>Homo ergaster</i> and <i>Homo erectus</i>, this enhanced vocal “grooming” need not have had a symbolic content. Rather, it may simply have resembled the group chattering found today in gelada baboons (Richman 1976, 1978, 1987; Dunbar 1993) which would express mutual interest and commitment and also instill a sense of social cohesion and well being.</p> <p>Therefore, during this intermediate period in human evolution, our ancestors would have lived a life with no parallel among either extant humans or nonhuman primates. They would have walked on two legs, lived in larger groups in more open environments, incorporated more high quality foods, and particularly animal-derived food, in their diets, had reduced sexual dimorphism, and relied more on vocal communication (Aiello 1996). It is also possible, although there is no direct evidence, that concealed</p>

	<p>ovulation with accentuated menstrual bleeding may have functioned to secure greater mating effort from males. What is important to realize, however, is that hominines at this stage of evolution were highly successful and that all evidence indicates that this lifestyle lasted for well over 1 million years.</p> <p>We believe that the appearance of human cognition is associated with the second phase of brain expansion which would have placed mothers under increasing reproductive stress from about 300,000 years ago. It is at this period that our model predicts the beginnings of sham menstruation. In the early stage of the process, sham menstruation would be situation-dependent, triggered by local incidence of real menstruation. At the later stage, correlating with the onset of a sexual division of labor, sham menstruation would form the basis of a fully symbolic ritual tradition of dance and body-painting comparable with modern ethnographic examples and designed to construct elaborate taboos. The first stage would involve a lesser degree of planning; female coalitions may have relied more on biodegradable materials such as animal blood and plant pigment for cosmetic use. Hence, we would predict only occasional traces of utilized ochre. By contrast, the fully cultural strategy implies greater regularity of performance and foresight in planning and organizing rituals. In this context, we expect regular and abundant ochre use.</p> <p>The archaeological record suggests that archaic <i>Homo sapiens</i> was the first</p>
166	<p>hominine to use iron oxides. There are fewer than a dozen known instances of ochre usage predating the Upper Pleistocene and the majority of these occur in the Late Acheulian and early Middle Stone Age (MSA) in sub Saharan Africa (see Power and Watts 1996). Beginning with the African MSA2a (possibly from as early as 140,000 BP, the height of the Penultimate Glacial), there is evidence of regular and widespread ochre use, while in MSA2b cave and rockshelter assemblages (from c.110,000 BP), ochre has become ubiquitous. The scale of ochre use in southern Africa from the MSA2 onwards is unparalleled elsewhere until the Eurasian Upper Paleolithic. Strong reds occur earliest and massively predominate; black pigments are used very rarely, despite their availability (Knight <i>et al.</i> 1995). Functional uses for ochre (e.g. in treatment of hides) were then, and remain today, subordinate to ritual and symbolic uses (Watts n.d.; Knight <i>et al.</i> 1995). The use of red ochre in Africa contrasts markedly with the picture in Europe before the Upper Paleolithic. The amount of pigment found in French Middle Paleolithic sites is considerably less, and black manganese predominates (Couraud 1991). It seems that most Neandertal pigment use occurred during the late Mousterian (60-34,000 BP). Only during the Chatelperronian, when Neandertals are believed to have been in contact with modern humans, is there a significant increase in amounts of red ochre.</p> <p>Archaeological evidence for the sexual division of labor during this period remains inconclusive. Stringer and Gamble (1993) argue for the foundation of a “modern” behavioral repertoire, including sexual division of labor, by anatomically modern humans in the phase 60-40,000 BP. Their evidence for this is primarily the greater structuring of “campsites.” But southern African MSA cave and rockshelter sites already show structuring similar to that found in the Holocene (since the end of the Pleistocene) (Deacon 1992; Henderson 1992). Grindstones, a processing facility indicative of planning depth, are also found in MSA sites (see Knight <i>et al.</i> 1995).</p> <p>There are no grounds for inferring differences of technological or hunting ability between Neandertals and early anatomically modern humans. Both were equally capable of hunting prime age adults of medium, and sometimes larger, body size (Klein 1989; Stiner 1993). But the point at issue is not hunting ability as</p>

	<p>such. Rather it is the distribution of the product which matters. Trinkaus (1993) interprets the morphology of Neandertals and early anatomically modern humans to suggest that there may have been greater division of labor by age and possibly sex among Levantine early moderns compared with Neandertals. There is also a high level of stress and trauma in Neandertal skeletons (Trinkaus 1992) and an apparently unusually high level of young adult mortality (Trinkaus 1995).</p> <p>Therefore, the evidence as it stands is not inconsistent with an incipient symbolic organization of the sexual division of labor, associated with regular ritual use of red pigment, at the period of the emergence of anatomically modern humans. Archaic <i>Homo sapiens</i> outside Africa may have utilized</p>
167	<p>context-dependent sham menstruation. But it appears to be in Africa that this strategy was raised to the level of habitual performance (cf. Soffer 1992), establishing the first ritual and symbolic tradition. Reproductive success is strongly correlated with female survivorship, particularly in the young adult years. It is possible that, faced with the escalating energetic stress associated with large brain size, Neandertal females did not alter their reproductive strategies in the same way that early anatomically modern females did. As a result, they may have experienced greater reproductive stress, higher levels of morbidity, and lower infant survivorship. We feel that the novel strategies suggested here would have relieved reproductive stress on young, fertile females. Furthermore, this could have been a significant factor in the rapid population increase at the transition to the Upper Paleolithic (and Later Stone Age) that has been postulated on the basis of both genetic and craniometric data (Harpending <i>et al.</i> 1993; Relethford and Harpending 1994). We propose that by this stage anatomically modern females had consummated a strategy of using sham menstrual ritual to secure systematic provisioning from males.</p> <p>CONCLUSION</p> <p>We have advanced a sociobiological model for the evolution of symbolism and cognition, premised on the observation that encephalization would have placed hominine females under considerable reproductive stress. Modern human female reproductive characteristics, such as concealed ovulation, the tendency to ovulatory synchrony, and accentuated menstruation acting as a “flag” of imminent fertility would have functioned in ancestral populations as mechanisms for raising levels of male investment. A female coalitionary strategy of cosmetic manipulation of menstrual (imminent fertility) signals — sham menstruation, or artificial synchrony — would effectively form a pre adaptation to ritual. Collective, deceptive sexual signalling by females exercised a proto-symbolic capacity for sustaining and referring to shared imaginary constructs. A fully symbolic strategy was consummated when women constructed taboos on menstrual signals to motivate male logistic hunting, thereby establishing the sexual division of labor. Modern hunter-gatherer ethnography, and the fossil and archaeological records for human evolution, are compatible with this model.</p> <p>ACKNOWLEDGEMENTS</p> <p>The authors would like to thank Lori Hager for inviting us to contribute to this volume. Robin Dunbar, Chris Knight, and Paul Turke have been very helpful with comment and criticism on early drafts for this chapter. We also thank Catherine Arthur for discussions on her modelling of female reproductive synchrony, Ian Watts for extensive discussions concerning his analysis</p>

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