DH-01 Human evolutionary trajectory of the sexes

The human evolutionary trajectory regarding the sexes presents one of the most complex, interdisciplinary puzzles in biological anthropology, evolutionary psychology, and comparative primatology. To establish a rigorous foundation for understanding how men and women can best live together—in couples, families, small groups, organisations, and societies—it is essential to trace the selective pressures that shaped human morphology, neurochemistry, reproductive strategies, and social structures. This report synthesizes peer-reviewed primary literature, systematic reviews, and meta-analyses to provide an exhaustive analysis of the human evolutionary trajectory.

To navigate this highly contested field rigorously, this analysis strictly distinguishes between what is known about population averages and what can be said about individuals. Evolutionary pressures act on populations over deep time, generating statistical distributions of traits. For any given behavioural or physiological trait, human male and female distributions frequently overlap. Therefore, while evolutionary biology can explain the origins of average dimorphic differences (e.g., population-level disparities in height, aggression, or upper-body strength), it cannot deterministically predict the phenotype, capability, or behaviour of any specific individual.

Furthermore, this report separates the human evolutionary story into three distinct, interacting layers:

1. **Physiology (measurable):** The hard biological realities shaped by natural and sexual selection, including skeletal dimorphism, neurochemistry, and reproductive anatomy.
2. **Behaviour (statistical, overlapping distributions):** The predispositions, mating strategies, and parenting allocations that emerge from physiological hardware interacting with environmental stimuli.
3. **Culture (variable):** The institutional frameworks, kinship structures, and socially transmitted norms that harness, suppress, or modify physiological and behavioural predispositions.

Layer 1: Physiology - The Fossil Record and the Flesh

The Reduction of Sexual Dimorphism from Australopithecus to Homo

Sexual size dimorphism (SSD) serves as a primary proxy for inferring the mating systems of extinct species. High SSD, such as that seen in extant gorillas where males are approximately twice the mass of females, typically correlates with polygynous mating systems characterized by intense male-male contest competition for harem control. Conversely, low SSD, as seen in modern gibbons, strongly correlates with monogamy and reduced inter-male physical agonism.

The degree of SSD in early hominins, particularly *Australopithecus afarensis* (circa 3.9–2.9 million years ago), remains intensely debated, as it establishes the baseline for the human evolutionary trajectory. Reno et al. (2003, *Proceedings of the National Academy of Sciences*)

and Reno and Lovejoy (2015) applied a Template Method to evaluate multiple skeletal sites simultaneously, arguing that dimorphism in *A. afarensis* was already moderate and human-like[1]. They utilized the famed "Lucy" skeleton (A.L. 288-1) and the large partial skeleton "Kadanuumuu" (KSD-VP-1/1) to suggest that monogamy and pair-bonding emerged very early in the hominin lineage, precluding a history of intense male-male physical competition[1]. However, this interpretation faces profound criticism. Grabowski et al. (2015, *Journal of Human Evolution*), utilizing the Geometric Mean Method and a comprehensive fossil dataset, estimated the male-to-female mass ratio in *A. afarensis* at 1.55 to 1.59—a degree of dimorphism much closer to modern gorillas than to modern humans[2]. Plavcan (1994, *American Journal of Physical Anthropology*) and McHenry (1992, *American Journal of Physical Anthropology*) similarly concluded that early australopithecines were highly dimorphic, rendering a strictly monogamous structure highly unlikely[1]. Further physical evidence from the Laetoli footprints (3.66 million years old) analyzed by Masao et al. (2016) revealed two bipedal individuals (S1 and S2) whose stature estimates greatly exceed previous reconstructions, supporting considerable body size variation and strong sexual dimorphism within a single species[2].

Despite the controversy over *Australopithecus*, there is broad consensus that a significant reduction in SSD occurred with the emergence of the genus *Homo*, particularly by the time of *Homo erectus* (circa 1.9 million years ago). Early African *Homo erectus* footprint assemblages from Ileret, Kenya (1.5 Ma), which capture a snapshot of a population over a single day, indicate that while *H. erectus* was more dimorphic than modern *H. sapiens*, it was significantly less dimorphic than the highly dimorphic apes[4]. The transition to larger-brained *Homo* was accompanied by an increase in female body size relative to males, which is widely attributed to the metabolic and biomechanical demands of birthing and carrying larger-brained, altricial infants through a bipedally-adapted pelvis[5].

Species / Genus	**Estimated Dimorphism Ratio (Male:Female Mass)**	**Dominant Consensus / Mating Inference**
Gorilla gorilla (Extant)	~2.00	Intense polygyny, male-male contest competition
Australopithecus afarensis	1.55 - 1.59 (Grabowski et al., 2015)	Debated: Likely polygynous, high dimorphism[2]
Australopithecus afarensis	~1.15 (Reno et al., 2003)	Debated: Human-like, early monogamy[1]
Homo erectus (Ileret	Moderate (Intermediate)	Transitional, reduction in

footprints)		male-male competition[4]
Homo sapiens (Extant)	~1.16	Pair-bonding, social monogamy, overlapping variance[6]

Modern Human Dimorphism: Stature, Muscle, and Adiposity

While modern humans (*Homo sapiens*) exhibit relatively low SSD in overall body mass (males are on average ~16% heavier) and stature (males are ~7% taller), disruptive natural selection has produced striking, highly replicated dimorphism in body composition[6]. It is often assumed that all sexually dimorphic traits reflect sexual selection (competition for mates), but natural selection frequently builds different phenotypes in males and females due to differing reproductive and ecological burdens[6].

Lassek and Gaulin (2009, *Evolution and Human Behavior*) demonstrated that human males possess, on average, 61% more total muscle mass and 75% to 90% more arm muscle mass than females[6]. The effect size for human sexual dimorphism in arm muscle volume is exceptionally large ($d = 2.50$), surpassing the effect sizes for stature ($d = 1.63$ across 53 nations) and vocal fundamental frequency ($d = 2.38$)[9]. This extreme dimorphism in upper-body strength and power is comparable to that seen in highly polygynous primates.

Carrier (2011) and Morris et al. (2020, *Journal of Experimental Biology*) argue that this architecture is a result of intense sexual selection on males for improved performance during male-male contest competition (specifically striking and fighting) throughout Pleistocene evolution[8]. Furthermore, Lidborg et al. (meta-analysis) demonstrated that strength and muscularity are the only consistent predictors of both mating success and actual reproductive success (number of surviving offspring) in non-industrialized human populations[10].

Conversely, human females exhibit a reversed dimorphic pattern regarding adiposity. Across 260 separate population samples from non-industrial countries and a dataset of $n = 6,421$ individuals across 29 countries (Pontzer et al., 2021), females consistently possess approximately 1.6 times more body fat than males, distributed primarily in the gluteofemoral region[6]. Lassek and Gaulin (2009) argue that this unique adipose distribution did not arise primarily from sexual selection, but via natural selection to accumulate vital neurodevelopmental resources[6]. The human infant brain is exceptionally large and requires massive amounts of long-chain polyunsaturated fatty acids (like DHA) for myelinization and development. Female gluteofemoral fat acts as a specialized physiological bank for these specific lipids, which are mobilized during the third trimester of pregnancy and during lactation.

The Obstetrical Dilemma vs. The Metabolic Hypothesis

The physiological constraints of human reproduction profoundly influence social organization. The traditional "Obstetrical Dilemma" (OD) hypothesis, popularized by Washburn (1960), posits that the human female pelvis represents an evolutionary compromise between two

antagonistic selective pressures: the requirement for a narrow pelvis for biomechanically efficient bipedal locomotion, and the requirement for a wide pelvis to birth large-brained neonates. To solve this dilemma, human infants are born highly altricial (neurologically immature, with brains less than 30% of adult size) compared to other primates, effectively truncating gestation to allow the infant's head to pass through the pelvic canal[13]. The high incidence of obstructed labor due to cephalopelvic disproportion in humans (historically 3% to 6% worldwide) has long been cited as evidence of this tight evolutionary compromise[16]. To analyze this, data extracted from the 2013 US natality database ($n = 3,550,445$ live births) confirm a strong relationship between maternal stature, pelvic dimensions, and the risk of emergency C-sections[6].

However, Dunsworth, Warrener, Deacon, Ellison, and Pontzer (2012, *Proceedings of the National Academy of Sciences*) challenged the OD with the "Energetics of Gestation and Growth" (EGG) hypothesis on metabolic and biomechanical grounds. Their kinematic analyses indicated that broadening the female pelvis does not, in fact, significantly reduce the efficiency or increase the metabolic cost of bipedal locomotion[13]. Instead, Dunsworth et al. (2012) argue that human gestation length is capped by the mother's metabolic capacity. By the ninth month of pregnancy, the metabolic demands of the growing fetal brain approach the maximum sustained metabolic rate (approximately 2.0 to 2.5 times the Basal Metabolic Rate) that the human female body can endure[15]. Birth occurs when the mother can no longer metabolically sustain the fetus internally. Whether constrained by the bony pelvis or by absolute metabolic ceilings, the physiological reality remains identical: human females are biologically forced to give birth to highly dependent, energetically expensive infants that require immense postnatal caloric and protective investments, forcing an evolutionary shift in human social structure.

The Neurochemistry of Sociality

The transition to extreme social interdependence required a rewiring of the primate brain. Raghanti et al. (2018, *Proceedings of the National Academy of Sciences*) proposed a neurochemical hypothesis for the origin of hominins, analyzing the striatum—a basal ganglia structure central to reward processing, motor control, and social behaviour.

Raghanti et al. (2018) discovered that humans possess a unique neurochemical profile compared to all other extant primates (apes and monkeys). The human striatum exhibits highly elevated levels of dopamine (DA), serotonin (5HT), and neuropeptide Y (NPY), coupled with significantly lowered acetylcholine (ACh)[17]. Dopaminergic innervation in the human medial caudate nucleus heavily rewards social interaction and affiliative behaviour. High striatal serotonin promotes cognitive control, which buffers the emotional friction of dense group living, inhibits impulsive reactive aggression, and facilitates the cognitive flexibility necessary for strategic social bonding[19]. Furthermore, decreased ACh shifts the behavioural balance away from internally motivated aggression toward externally guided, prosocial behavior[19].

Raghanti et al. (2018) argue this specific neurochemical signature amplifies sensitivity to social cues, encourages social conformity, and promotes empathy and altruism[17]. This physiological adaptation in the basal ganglia likely preceded or accompanied the adoption of obligate bipedalism and the elimination of the sectorial canine, providing the neurochemical hardware

necessary for the subsequent evolution of pair-bonding, cooperative breeding, cumulative culture, and language[17].

Layer 2: Behaviour - Mating, Provisioning, and the Pair-Bond

The transition from physiological hardware to behavioural strategies involves statistical predispositions toward specific mating and parenting configurations.

The Evolution of Pair-Bonding and Male Provisioning

C. Owen Lovejoy (1981, *Science*) published "The Origin of Man," proposing what became known as the cooperative pair-bonding or provisioning model. Lovejoy argued that the defining human traits—bipedalism, concealed ovulation, and reduction of male canines—evolved in tandem as a cohesive reproductive strategy during the Miocene or early Pliocene[21]. In this model, early hominin females offered continuous sexual receptivity to specific males in exchange for exclusive provisioning. Bipedalism evolved precisely to allow males to carry food (provisioning) over long distances back to a pair-bonded female and her altricial offspring[22].

Lovejoy's model relies heavily on the evolution of concealed ovulation (the loss of visible estrus swellings, which are common in chimpanzees and bonobos). Alexander and Noonan (1979, *The American Naturalist*), Strassmann (1981), and Daniels (1983) posited that concealed ovulation evolved to force males into long-term pair-bonds[24]. Because a male could not tell exactly when a female was fertile, he was forced to guard her and mate with her continuously throughout the cycle to ensure paternity. This mechanism precluded him from abandoning her to maintain a large harem of multiple females, thereby incentivizing him to invest his resources into her and her offspring as a form of parenting effort[24].

Critics of the provisioning model, most notably Kristen Hawkes (1991, 1993), argued that ethnographic data from modern hunter-gatherers do not consistently support the narrative of male provisioning of specific nuclear families. Utilizing the tolerated theft model, Hawkes proposed the "show-off" signaling hypothesis, which suggests that male hunting of unpredictable large game was primarily a form of mating effort—signaling genetic quality, physical prowess, and generosity to the wider group to secure extramarital mating opportunities—rather than dedicated parenting effort designed to calorically provision a specific mate[22]. Gurven and Hill (2009) challenged the signaling model, demonstrating through empirical foraging data that the cooperative pair-bonding model better explains the reliable caloric transfers required to sustain human offspring[22].

Cross-cultural analyses confirm that while humans are not strictly genetically monogamous (extra-pair paternity exists), *social monogamy* (the pair-bond) is a ubiquitous and foundational feature of human mating systems. Even in the approximately 85% of anthropological societies that socially sanction polygyny, the vast majority of individuals within those societies form and live within monogamous pair-bonds[28].

The Drivers of Primate Monogamy: Infanticide vs. Dispersion

The evolutionary driver that initially forced the primate lineage into pair-bonding remains fiercely contested. Opie, Atkinson, Dunbar, and Shultz (2013, *Proceedings of the National*

Academy of Sciences) utilized phylogenetic reconstructions to argue that the threat of male infanticide was the primary evolutionary driver of social monogamy in primates. Because human and ancestral hominin infants are highly altricial and require long lactation periods, females experience lactational amenorrhea, delaying their return to fertility. This made them highly vulnerable to infanticidal males, who could kill the infant to return the female to ovulation. The pair-bond evolved as a protective strategy, where a male defended his offspring against rival males[29].

Conversely, Lukas and Clutton-Brock (2013, *Science*) analyzed a broader dataset of non-human mammals and found that social monogamy consistently evolved in species where females became spatially dispersed (often due to dietary constraints or resource scarcity), making it physically impossible for a single male to monopolize and defend a multi-female harem. In Lukas and Clutton-Brock's model, paternal care, provisioning, and protection against infanticide are secondary evolutionary consequences that occurred *after* the adoption of monogamy, not the primary drivers[29].

Hypothesis for Monogamy	**Proponent(s) / Journal**	**Proposed Primary Driver**	**Proposed Secondary Consequence**
Infanticide Avoidance	Opie et al. (2013) *PNAS*	Threat of male infanticide due to long lactation	Pair-bonding for physical protection
Female Spatial Dispersion	Lukas & Clutton-Brock (2013) *Science*	Ecological dispersion of females	Biparental care and provisioning
Provisioning Model	Lovejoy (1981) *Science*	Need for extra calories for altricial young	Bipedalism and concealed ovulation

The Ovulatory Shift Hypothesis: A Crisis of Replication

If concealed ovulation evolved to secure steady male investment, do women retain subconscious physiological mechanisms that track their own peak fertility? The "Ovulatory Shift Hypothesis" (OSH), pioneered by Gangestad and Thornhill (1998), posited a dual-mating strategy: during the brief fertile window of the menstrual cycle, women experience an adaptive psychological shift, becoming more attracted to markers of high genetic quality (masculinity, facial symmetry, deep voices, behavioral dominance) for potential short-term sexual encounters, while maintaining pair-bonds with lower-testosterone, provisioning males for long-term investment[30].

The OSH sparked one of the most intense methodological controversies in evolutionary psychology. In 2014, two competing meta-analyses were published simultaneously with strikingly divergent conclusions. Gildersleeve, Haselton, and Fales (2014, *Psychological Bulletin*) analyzed 134 effects from 38 published and 12 unpublished studies, concluding there was robust empirical support for the OSH, showing significant shifts in female preference for genetic cues specifically during the fertile window when evaluating men for short-term relationships[30]. Simultaneously, Wood, Kressel, Joshi, and Louie (2014, *Emotion Review*) analyzed a similar literature base and concluded that the effect was statistically indistinguishable from zero, asserting that the positive findings in the literature were false positives driven by publication bias, small sample sizes, and p-hacking (analytical flexibility)[30]. Subsequent large-scale, pre-registered, longitudinal within-subject studies have largely failed to replicate the mate-preference shifts predicted by the OSH. For example, Jünger et al. (2020, *Hormones and Behavior*) tracked a diverse sample ($n = 78$) using validated salivary hormone measures and linear mixed models, finding no compelling robust evidence for mate preference shifts across the cycle[34]. While women may experience a generalized increase in sexual desire and improved body image during the fertile window (driven by peaking estradiol), the targeted shift toward "good genes" (masculinity/symmetry) for extra-pair copulations has not robustly replicated[35]. This lack of replication implies that human female continuous receptivity and concealed ovulation are deeply stabilized traits, heavily prioritizing the maintenance of the pair-bond and cooperative parenting over opportunistic genetic bet-hedging.

Fatherhood and Testosterone Modulation

If pair-bonding and male investment are natural human behaviours, there must be physiological mechanisms facilitating male care and reducing male-male competition. Gettler, McDade, Feranil, and Kuzawa (2011, *Proceedings of the National Academy of Sciences*) provided landmark longitudinal evidence for this mechanism. Tracking a large, community-based sample ($n = 624$) of men in the Philippines over a 4.5-year period, the researchers found that single men with higher baseline testosterone were more likely to successfully partner and become fathers. However, upon transitioning to active fatherhood, these men experienced massive, statistically significant declines in daytime testosterone compared to peers who remained single and childless[36].

This effect size was substantial and has successfully replicated across multiple demographic samples[40]. Edelstein et al. (2014) and subsequent meta-analyses (Grebe et al., 2019) confirm that involved fatherhood downregulates testosterone, likely operating as an evolved mechanism to reduce mating effort (seeking new partners and engaging in male-male competition) and facilitate parenting effort (nurturing offspring and maintaining the pair-bond)[40]. This biological feedback loop indicates that human males are hormonally primed for cooperative parenting.

Layer 3: Culture - Kinship, Grandmothers, and Social

Units

While physiology provides the hardware and behaviour the statistical predispositions, human culture generates variable but bounded institutional structures to ensure the survival of metabolically expensive offspring.

Cooperative Breeding and Extended Childhood

Even with a provisioning pair-bonded father, the caloric demands of human infants are too high for an isolated nuclear family to manage alone. Sarah Blaffer Hrdy (2005, 2009) advanced the Cooperative Breeding Hypothesis, noting that humans belong to the roughly 3% of mammalian species classified as cooperative breeders. In human societies, "allomothers" (non-maternal caregivers, including fathers, older siblings, aunts, and grandmothers) are absolutely essential for offspring survival[42].

Hewlett (1991, 1992) extensively documented paternal care among the Aka foragers of the Central African Republic, noting that Aka fathers hold or are within arm's reach of their infants up to 47% of the day—the highest rate of paternal direct care recorded in any human society[46]. However, Hewlett also notes that this extreme paternal care is an outlier. Cross-culturally, fathers tend to interact with children only 25% to 35% as much as mothers do[46]. The massive caloric and caregiving deficit is made up by the broader social network. Hrdy argues that this absolute requirement for allocare acted as a powerful Darwinian selection pressure on human infants, favoring those who could read intentions, engage in eye contact, and employ psychological dimensions of *Kindchenschema* (cuteness) to socially charm caregivers and secure investment[20].

The Grandmother Hypothesis

Kristen Hawkes, O'Connell, Blurton Jones, Alvarez, and Charnov (1998, *Proceedings of the National Academy of Sciences*) offered a powerful explanation for the uniquely human traits of menopause and extended post-reproductive longevity. The "Grandmother Hypothesis" notes that in all other great apes, female fertility and somatic frailty decline in tandem, culminating in maximum lifespans of roughly 50 years[48]. Human females, however, universally cease reproduction around age 45-50 but can live healthily for decades afterward, presenting an evolutionary puzzle regarding why natural selection would favor a post-reproductive lifespan[48].

Hawkes (1998) and Kim, Coxworth, and Hawkes (2012, *Proceedings of the Royal Society B*) applied Charnov's dimensionless assembly rules for mammalian life histories and developed mathematical models based on ethnographic data from the Hadza hunter-gatherers of Tanzania[51]. They demonstrated that when ancient African climates shifted and forests receded into open savannas, newly weaned infants could no longer forage for soft fruits themselves. Mothers faced a severe energetic bottleneck. Older, post-menopausal women stepped in to forage for deeply buried tubers and other difficult-to-extract resources, subsidizing the caloric needs of their weaned grandchildren[48].

This allocare allowed their daughters to return to fertility and have their next baby sooner. Because grandmothers who lived longer provisioned more grandchildren, they massively increased their inclusive fitness. Through mutation-selection balance and antagonistic pleiotropy, selection against senescence shifted, dragging the entire species' lifespan upward.

In this model, human longevity, late maturity, and early weaning (compared to other apes) are the direct evolutionary consequences of grandmothering[49].

Primeval Kinship and Exogamy

Bernard Chapais (2008), in his seminal work *Primeval Kinship*, synthesized primatology and social anthropology to explain how the pair-bond scaled up into human societies. In chimpanzee societies, males remain in their natal group, while females transfer out (exogamy). Because chimpanzees are promiscuous and do not form pair-bonds, paternity is entirely obscured. Males only recognize their matrilineal kin (mothers and maternal brothers), leading to intense, lethal intergroup violence[54].

Chapais argued that the evolutionary innovation of the stable pair-bond (as suggested by Lovejoy) had a profound, unintended cultural consequence: it rendered fatherhood visible. Once males could recognize their offspring, and offspring could recognize their fathers and paternal siblings, *bilateral kinship* emerged. Humans could trace lineage through both the male and female lines[54].

When females transferred to neighboring groups for marriage (the fundamental equation of the exogamy configuration), the recognizable father-daughter and brother-sister bonds were not broken. Males in competing groups recognized each other as fathers-in-law and brothers-in-law. This institutionalized kinship suppressed male-male lethal intergroup violence, paving the way for hostile bands to affiliate into larger, cooperative tribes. Thus, the pair-bond was the fundamental unit that "gave birth to human society"[55].

Self-Domestication

Richard Wrangham (2019) proposed the "Self-Domestication Hypothesis," arguing that humans have undergone an evolutionary process similar to domesticated animals (e.g., dogs or domestic foxes), characterized by a reduction in neural crest cell migration, resulting in prolonged juvenile traits and reduced facial robustness[42]. The primary driver of this self-domestication was the execution of hyper-aggressive, dominant bullies by coalitions of subordinate males, made highly effective by the invention of projectile weapons. By systematically removing individuals prone to *reactive aggression* (impulsive violence), early humans heavily selected for docility, increased empathy, and the ability to conform to group norms[42]. This cultural practice of egalitarian leveling altered human biology, lowering testosterone reactivity and permitting the intense cooperation required for large-scale societies.

Synthesizing the Competing Models

The debate regarding the primary driver of human social evolution often pits these models against one another, but they describe different nodes of a highly interdependent evolutionary web. Lovejoy and Hawkes are often viewed as opposites (father provisioning versus grandmother provisioning). However, human infant caloric requirements are so extreme that both mechanisms likely operated concurrently. Hrdy's cooperative breeding framework effortlessly absorbs both: humans are adapted to a social environment where mothers, fathers, grandmothers, and siblings all contribute to a pooled energy budget. Chapais demonstrates how the pair-bond scales up into macro-societal kinship structures, while Wrangham explains

the reduction of reactive aggression required to live in those dense structures. Raghanti's neurochemical model provides the striatal hardware that makes the empathy and bonding required by all these behavioral models physically possible.

Conclusion

10-Line Summary of Robust Findings

1. The human evolutionary lineage experienced a marked reduction in sexual size dimorphism regarding overall body mass starting with the genus *Homo*, indicating a departure from intense harem-polygyny.
2. Modern humans retain extreme, highly replicated sexual dimorphism in body composition, with males possessing significantly more muscle mass ($d = 2.50$) and females possessing more gluteofemoral body fat for infant neurodevelopment.
3. The human neurochemical profile (elevated dopamine, serotonin, NPY; lowered acetylcholine in the striatum) is highly specialized for prosociality, empathy, and social conformity.
4. Human infants are exceptionally metabolically costly and neurologically altricial, demanding caloric care beyond the physical capacity of a single mother.
5. Humans are obligate cooperative breeders; offspring survival ancestrally required extensive allocare from fathers, grandmothers, and extended kin networks.
6. Fatherhood triggers a biologically robust, replicated decrease in daytime testosterone in human males, shifting physiological priorities from mating effort to parenting effort.
7. Post-menopausal longevity is a derived human trait, and grandmother provisioning significantly increases inclusive fitness, driving human longevity and allowing earlier weaning.
8. The pair-bond (social monogamy) is a universal foundational unit of human social organization, representing the dominant marriage-type even in cultures that sanction polygyny.
9. Recognizable fatherhood, facilitated by the pair-bond, enabled the emergence of bilateral kinship, exogamy, and peaceful between-group alliances.
10. Reactive aggression has been heavily selected against in human evolution via coalitional execution, allowing for hyper-cooperative societal scaling (self-domestication).

Contested or Open Questions

- **The degree of dimorphism in *Australopithecus*:** Researchers remain sharply divided on whether early hominins exhibited gorilla-like dimorphism (implying intense male competition) or human-like dimorphism (implying early monogamy).
- **The Ovulatory Shift Hypothesis:** While deeply embedded in popular evolutionary psychology, evidence for female mate-preference shifts toward markers of genetic quality during peak fertility is currently mired in a severe replication crisis.
- **The ultimate origin of primate monogamy:** It remains fiercely debated whether primate monogamy originally evolved to prevent male infanticide or as a response to the ecological spatial dispersion of females.
- **The limits of gestation:** Does the bony structure of the maternal pelvis dictate birth

timing (Obstetrical Dilemma), or does maternal metabolic capacity (EGG hypothesis) act as the primary ceiling on gestation length?

Most Important Sources to Read in Full

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Implications for Living Together

When translating these findings into models for how men and women can best live together, one must strictly avoid the naturalistic fallacy—the assumption that because a behaviour or structure is biologically "natural" or evolved, it is morally "good," legally acceptable, or socially optimal for the modern world. Evolution optimizes purely for genetic proliferation in ancestral environments, not for human happiness, self-actualization, or modern economic productivity. However, recognizing the deep physiological and behavioural architecture of the species allows couples, families, and societies to design institutions that work with, rather than against, human hardware.

For Couples and Families:

The evolutionary data unequivocally demonstrate that humans are not adapted to raise children in isolated nuclear pairs, let alone as isolated single parents. The metabolic and neurological demands of the human infant evolved in a cooperative breeding matrix. Families function best when they aggressively construct "allomothering" networks—incorporating grandparents, extended kin, and trusted community members. The active involvement of fathers is biologically supported and hormonally reinforced (as evidenced by testosterone modulation upon entering fatherhood), but placing the entire physical and psychological burden of child-rearing exclusively on one or two parents is a historical anomaly that predictably leads to severe parental burnout.

For Organisations and Societies:

The evolutionary record shows that human neurochemistry (the dopaminergic and

serotonergic profiles of the striatum) is intensely wired for social conformity, fairness, and reciprocal altruism, but it is also wired to heavily favor the in-group. Furthermore, the extreme physical dimorphism in male upper-body strength and the evolutionary history of male-male competition suggest that male physical agonism is a latent potential that requires strict cultural channeling.

Organisations and societies function best when they recognize the reality of the pair-bond as the foundational unit of broader social trust (Chapais' bilateral kinship). Policies that destabilize pair-bonds or financially penalize extended family networks (such as economic structures forcing geographic separation from grandparents for employment) actively fight against the evolutionary mechanisms that make human societies viable and psychologically stable. A society aligned with its evolutionary trajectory will prioritize structural support for cooperative breeding, facilitate the integration of elders into daily childcare to mimic grandmothering effects, and create socially productive avenues for competition. By doing so, it satisfies the ancient hardware of the human animal while safely pursuing modern ethical goals.

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