
THE PUZZLE OF MONOGAMOUS MARRIAGE

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MATING STRATEGIES

Evolutionary approaches to human mating psychology, and in particular to the differences between male and female mating strategies, focus on the distinct selective pressures faced by males versus females. An essential difference in male and female mating psychology arises from two basic facts about primate (and mammalian) physiology: (1) females invest heavily in the egg compared to the paltry investment that males make in the sperm, and this asymmetric investment only increases as females subsequently must invest in gestation, lactation, and parenting if their offspring is to survive, and (2) females are limited in their lifetime reproductive output (their direct fitness) to the number of babies they themselves can carry to term and rear to adulthood. Meanwhile, males can potentially father thousands of offspring and invest nothing other than sperm. This difference spawns another pattern that will be relevant below: the variance in reproductive success is much lower for females compared to males. Women will have typically at most 18 offspring,¹ a number that was much lower for most of our evolutionary history. For men, offspring production can range from zero to thousands [2-4]. At the top end, some men (e.g., Genghis Khan) had so many reproductively successful offspring that their impact has been argued to be measurable in the human genome [5]. At the bottom end, low-status males have been routinely shut out from successful reproduction.

The same logic predicts a difference in “choosiness” with regard to mates (that is, differences in willingness to have sex). Because females can produce only a limited number of offspring, and each requires substantial investments of time and energy, female mating psychology favours selectively mating with high quality mates based on genetic quality and access to resources (for rearing the offspring). Any sexual encounter could result in two decades of intense investment. Males, who can potentially invest very little, should be less choosy, and focus mostly on the fertility and genetic quality of potential mates. This means, at the low end of reproductive success, almost any female can manage to get pregnant because some males are always willing to make the minimal investment necessary. In contrast, males that are both low-status and low genetic quality could easily end up leaving no offspring since females are choosy about with whom they mate. Empirical evidence from diverse societies broadly supports these differences in mating preferences [4, 6-8].² For our purposes, these data show specifically that women tend to prefer males with more resources and greater social status [10], while men tend to prefer younger, more attractive, women who are capable of successfully rearing healthy and robust offspring.

This approach suggests that males are the “risky” sex, and predicts both psychological and physiological responses to the steepness of the status hierarchy (the intensity of intra-sexual competition). For example, males who finds themselves without prospects for access to females should (1) heavily discount the future and invest achieving higher status now, and (2) be willing to

¹ There are a variety of aberrant cases that dramatically exceed this numerical guideline. The highest recorded number of children born to one woman is 69 (in Russia between 1725 and 1765). This involved 27 pregnancies resulting in 16 pairs of twins, 7 sets of triplets, and 4 sets of quadruplets. Some have questioned the veracity of this claim. The important point is that even this extreme case does not compare to a long list of despotic rulers from across the globe [1].

² There is much important cross-cultural variation in the relative strength of these preferences. Interestingly, consistent with evolutionary predictions, some of the variation in the importance of attractiveness (relative to other attributes) is predicted by the prevalence of pathogens and parasites in the environment. When pathogens and parasites are more dangerous, genetic quality (as indicated by attractiveness) is relatively more important because this predicts a resistance to pathogens and parasites [9].

take substantial risks aimed at increasing opportunities for status/sex (e.g., theft, murder, etc.), lest they get shut-out for certain. Ample empirical evidence indicates that males have a much greater propensity for taking risks of all kinds, especially when status is at stake [2, 3, 11, 12]. This means that social factors that flatten the outcomes of status differences or decrease reproductive competition will shift males away from high-discounting and risk-taking. These psychological and physiological shifts toward long-term investment in response to reduced competition may improve both health and educational outcomes for men.

However, central to understanding human mating and mating psychology is to recognize that humans, like some other primate species, form lasting pair-bonds. Gorillas, for example, form lasting pair-bonds in which males “mate guard” to both prevent other males from gaining sexual access to their partners, and protect their offspring—which they know are “theirs” if they have done a good job of mate guarding previously. However, unlike gorillas, human males in pair-bonds care—to varying degrees—for the offspring of their partners. This has been observed even in the smallest scale human societies, especially among foraging populations [13]. Human males, much more than all other primates, invest in at least some of their offspring for many years.³

Efforts to reconstruct the pre-cultural (pre-marriage norms) mating systems of human ancestors are necessarily speculative. A recent comprehensive effort [14] suggests that the common ancestor to chimpanzees and humans probably had a single-male mating system, like gorillas (who happen to share a common ancestor with humans and chimpanzees). In different ecological conditions males will be limited in the number of females that they can defend access to. If resources are widely scattered and scarce, single-male mating systems can turn into a mixture of groups, some involving monogamous pair-bonds and others involving one male and multiple females. Pair-bonding initially started out as mate guarding but as our lineage’s brains began to expand, paternal contributions to subsistence and cultural transmission became increasingly crucial. This, and a variety of other evolutionary pathways, suggests that men possess psychological mechanisms for both mate guarding (to ensure paternity) and for regulating investment in offspring, while considering both their paternity certainty and the cost of additional mating opportunities [15, 16].

For men this creates two different kinds of reproductive strategies, one based on developing long-term pair-bonds and one based on seeking short-term (often, very short) mating opportunities (extra-pair copulations). The selection pressures for the two strategies are somewhat different. For short-term mating, males should focus principally on females showing cues of fertility (ovulation) and health. For selecting long-term mates, to mother the offspring that the male will invest in, males should desire females who are young, healthy, fertile, emotionally stable, motherly, hard-working, and of suitable and compatible personal characteristics. Since a male’s desire to invest in offspring is strongly related to his beliefs about his paternity, males in long-term pair-bonds should always be concerned with the sexual fidelity of their mates—but they should be most concerned when intra-sexual competition is fierce and some males have limited or no reproductive opportunities. Both strategies can be operative at the same time, although the decision to invest in offspring and in pair-bonding necessarily shifts attention, resources, and affective commitments (including hormonal shifts) away from seeking short-term mates. Substantial evidence from psychological experiments support these predictions [3, 17-20].

³ Note, the term “pair-bond” does not mean monogamy. One male gorilla can pair-bond with multiple females. Each of these is an independent durable relationship that facilitates the safe rearing of offspring.

Human female mating psychology also has two flexible strategies [14, 21], but they are different from males' strategies in crucial ways. Successful reproduction, at least in ancestral human societies, probably required pair-bonding with a male, establishing his beliefs about paternity, and obtaining as much of his investment in her and her offspring as possible.⁴ In long-term mates, females look for a combination of the ability to invest in the form of resources and skills/abilities [10], some willingness to invest, physical size, and genetic quality. Extra-pair copulations do not improve a female's fitness in the same dramatic way they do a male's fitness. As noted, females have a limited number of times they can be pregnant in their lives, and they "want" (from a fitness perspective) to make each one count (get a high quality offspring). Once pair-bonded, it is more important for a female to appear chaste, since hints of sexual infidelity will reduce a male's paternity certainty and his investment in offspring.

Human females' other mating strategy comes into play when extra-pair copulations provide an opportunity to obtain higher quality genetic material (i.e., sperm), or other direct investment, while still retaining investment from their current partner. Much recent evidence supports this by showing how women's mate preferences shift during ovulation. Around the time of ovulation women's relative preferences for high genetic quality increases while their interest in resources decreases; they are also more interested in sex with men besides their long-term partner [23-25].

For males, the fitness maximizing situation is probably to have as many matings as possible, and have other males invest heavily in rearing their offspring (cuckold other males). However, since low-status males of low genetic quality will have limited mating prospects, they should shift toward long-term pair-bonding and parental investment assuming they can get at least one long-term mate. Higher-status males should shift the balance toward parental investment as their mating prospects diminish or become too costly. Social factors that (1) make mates available to low status males (who would otherwise not have them) and (2) increase the costs for higher status males of obtaining additional mates (either long or short-term mates) will increase overall parental investment by males. This suggests that suppressing intra-sexual competition should foster familial investment, savings, and security-seeking in males [2, 3, 12, 26].

PRIMATE MATING SYSTEMS

The interaction of different mating strategies by male and females in different ecologies yields diverse primate mating systems. Table 1 summarizes data on primate mating systems. Under the column "Mating System," males in "Multi-male polygyny" groups defend access to groups of females. Here there are no long-term mating-related associations between males and females (no pair-bonds). Within groups, males still compete for access to females when females become sexually receptive (that is, when they can get pregnant). Females typically signal their entry into this period with changes in colouration, or by presenting their hind quarters. Status competitions and consequent social rankings determine the frequency of mating with receptive females, although within-group males of lower rank are still given some access. A receptive female chimpanzee, for example, may end up mating at least once with most adult males in a group. Such multi-male groups contrasts with "Single-male polygyny," which means that some individual males successfully associate with, and limit access to, groups of females. Other males have no access to these females. Gorillas, for example, live scattered in small groups with one dominant male who defends (or guards) several adult females, and their offspring. Bands of subordinate "bachelors" also roam

⁴ If males lack confidence in their paternity of offspring, they tend to invest less [11, 22].

these forests, occasionally challenging dominant males. Beginning with humans, the first column orders these categories according to their phylogenetic distance from humans. Humans are a type of Great Ape, and most closely related to chimpanzees, then gorillas and orangutans. Gibbons are a type of Lesser Ape, which share a common ancestor with all the Great Apes. All apes are equally distant from Old World Monkeys.

#	Primate	Phylogenetic category	Mating system
0	Humans	Great Ape	see below
1	Common chimpanzee	Great Apes	Multi-male polygyny (no pair-bonds)
2	Gorilla	Great Apes	Single-male polygyny (pair-bonds)
3	Orangutan	Great Apes	Single-male polygyny (pair-bonds)
4	Gibbons	Lesser Apes	Monogamous (pair-bonds)
5	Colobines (from multiple genera)	Old World Monkeys	Single-male polygyny (pair-bonds)
5	Old world monkeys (from multiple genera)	Old World Monkeys	Multi-male (no pair-bonds)
5	Hamadryas and gelada baboons	Old World Monkeys	Single male polygyny (pair-bonds)
6	New world monkeys (from multiple genera)	New World Monkeys	Multi-male polygyny
6	New world monkeys	New World Monkeys	Monogamous (pair-bonds)
6	Marmoset/tamarin	Callitrichidae (New World Monkeys)	Monogamous and sometimes polyandrous (pair-bonds)

Putting the complicated question of humans aside, there are no Great Apes that mate monogamously or polyandrously [14, 27]. Gibbons, a Lesser Ape, do pair-bond monogamously, and together defend territories with their mates. Otherwise, only a few groups of New World Monkeys pair-bond monogamously. Saddleback tamarins are highly variable, and include groups that are monogamous and polyandrous, with some that are even multi-male. While active parental investment by males in offspring is extremely rare in primates, when it does occur it is always closely associated with monogamous mating systems. Monogamous male primate species invest in their offspring, unlike all other primates. Similar patterns hold in birds [28].

MARRIAGE SYSTEMS

Marriage systems are distinct from mating strategies. Humans, unlike other species, are heavily reliant on cultural learning for acquiring all manner of behaviors and practices, including social behavior. Because humans also acquire the standards by which we evaluate others as part of this process, cultural evolution gives rise to social norms [29-31]. Social norms are shared standards of behavior that emerge readily from a reliance on cultural transmission. Failure to meet minimal standards results in reputational damage, loss of status, and both formal and informal sanctions. Some norms also incentivize excess performance by providing reputational benefits for actions that

are above and beyond the normative standard [29]. In some societies having more wives is both a signal and a source of prestige [32] for males, see below. It is only in cases of marriage systems based on normative monogamy that adding wives is viewed negatively. Even in societies with substantial polyandrous marriages, people marrying polygynously are not viewed negatively.

Different societies have culturally evolved a wide range of social norms and institutions that regulate pair-bonds—these are marriage systems. Marriage systems influence peoples long-term pair-bonds based on locally shared behavioral standards that are enforced by the community. Being married comes with economic, social, and sexual expectations, prescriptions, and prohibitions (norms) for both parties (and their families), who are accordingly judged—formally or informally—by the community. Marriage may or may not be sanctioned by formal laws, and marriage certainly existed long before formal laws. Public rituals usually mark the commencement of a marriage. “Cohabitation,” which is empirically distinguished from marriage in the main text (in terms of how marriage impacts crime), does not carry the set of shared expectations, prohibitions, and prescriptions, as judged by *a community*, that marriage does. The key to understanding marriage vs. merely pair-bonding is recognizing the role of a community in defining, sanctioning, and enforcing it. This element of human social life is routinely missed in non-cultural evolutionary and economic approaches to monogamy

Marriage systems represent collections of social norms that harness and extend our evolved psychology for forming long-term pair-bonds. Marriage norms, for example, govern such areas as who (1) a person can marry (e.g., exogamy, incest taboos), (2) pays for the marriage ritual, (3) pays for which spouse (dowry or brideprice⁵), (4) gets the children in the event of the groom’s (or bride’s) death, and (6) is a “legitimate” heir of the couple. For our purposes, marriage norms also specify rules about partner number, and arrangement of partners (e.g., no group marriages). A *marriage system* is the package of marriage-related norms in a society.

Marriage norms are certainly not independent of our mating psychology, nor can they entirely replace or subvert it. They can, however, strongly influence behavioral patterns in two ways. First, humans readily internalize social norms, at least partially. This means that norm adherence is intrinsically rewarding [31]: work in neuroscience has shown how both adhering to local norms and punishing norm violators activates the brain’s reward circuitry [34].

Second, the fact that people acquire and internalize norms means that any norm-violator may be condemned and sanctioned in some way [35]. Thus, independent of any internalization, norms impose real costs on norm violators. Of course, some cultural evolutionary trajectories have generated sets of norms and institutions that suppress our pair-bonding instincts and dramatically reduce or eliminate paternal investment [36], or manage risk by distributing beliefs about paternity among multiple fathers [37].

Type	Ethnographic Atlas N = 1231 societies [33]
Monogamous	15% (186)
Occasional polygyny	37% (453)
Frequent polygyny	48% (588)
Polyandry	0.3% (4)

⁵ A dowry is a payment from the bride’s family to the groom and/or his family. A brideprice is a payment from the groom’s family to the bride’s family. Payments can be in the form of cash, jewellery, animals (e.g., cows, chickens), or other items that have value within the culture.

NATURE AND VARIATION IN NORMS REGARDING SPOUSAL NUMBER

To examine the nature and variation in patterns of human mating, and particularly in marriage patterns, we examine the anthropological record of extant and historically known societies. The most extensive database of such information across diverse human societies is the *Ethnographic Atlas*⁶, which currently includes information on marriage for 1231 societies. These data, summarized in Table 2, show that exclusive monogamy occurs in about 15.1% of the sample, polygyny in 84.6% of these societies, and polyandry in less than 1%.

The problem with using all these data straight from the *Ethnographic Atlas* is that the data points are non-independent. That is, many of these societies are probably historically related and have splintered off over centuries

from older societies. This leads to the worry that certain traits might be common because certain societies happened to spread. To mitigate this problem, cross-cultural researchers use the Standard

Table 3. Marriage Systems in the Standard Cross Cultural Sample⁷	Count (%) N = 176
Polyandry	2 (1.1%)
Monogamy	27 (15%)
Monogamy with occasional polygyny	33 (19%)
Polygyny preferred (but <20% of male engage)	54 (31%)
Polygyny preferred (> 20% of males engage)	60 (34%)

Cross-Cultural Sample [40]. This is a sample of 186 preindustrial societies from across the globe that have been selected both to avoid historical connections (which create non-independence) and because of the rich quality of material available for them. Table 3 shows that using this sub-sample we find monogamy is also limited to about 15% of societies.

For our purposes, one problem with these data is that they represent mostly ethnographic observations about how marriage systems actually operate on the ground. For monogamy, they do not separate *normative or imposed monogamy* from *ecological monogamy* [42-44]. By normative or imposed monogamy we mean groups that possess marriage norms that prescribe monogamous marriage and punish violations in some fashion. For some societies with socially-imposed monogamous marriage, there remain debates about whether they should be categorized as “monogamous” [44] since (1) the nobility often retained the right to marry polygynously, such as in Egypt and Babylon (monogamous marriage was imposed on the commoners), and (2) slave concubines were still permitted for those with the means (inheritance rights for offspring varied).

Ecological monogamy describes situations in which there are no prohibitions against having different marital arrangements, but that the economic or ecological circumstances are such that males are not sufficiently different from one another to attract more than a single wife. Some small-scale societies have strong sharing norms that demand the equitable division of economic surpluses across the group. Such levelling will sometimes reduce polygyny to just monogamy, at least during periods of scarcity.

⁶ The *Ethnographic Atlas* was first published by Yale anthropologist George Peter Murdock in a series of installments beginning in 1962 and ending in 1980 (published as the *Atlas of World Cultures* in 1980). It represents the single largest coded anthropological database of world cultures. The codes were derived from collections of ethnographic and historical materials. In 1998, Gray [33] produced an updated and corrected version. The *Standard Cross Cultural Sample*, developed by both Doug White and Murdock, is a subsample of the best known cultures, selected so as to maximize historical independence.

⁷ Data is drawn from White [38]. This work cross-checks and verifies earlier coding efforts [39-41].

In a detailed study of polygyny, White [38] tried to distinguish the cultural rules of a society from their practices by re-coding the Standard Cross-Cultural Sample looking to distinguish cultural norms from the what happened on the ground. Drawing from White, Table 4 distinguished cases of (1) norm-prescribed monogamy, (2) monogamy preferred but some polygyny, and (3) various degrees of polygyny. The coding for prescribed monogamy is strict in the sense of focusing on the existence of penalties for extra-marital offspring. Monogamy is prescribed in 15% of these societies, and preferred in another 17%. Where monogamy is only “preferred”, polygyny inevitably creeps in. Of the 186 societies in the Standard Cross-Cultural Sample, White was able to find normative statements from ethnographers for 183. Meanwhile, direct behavioral observations of those in Table 3 were only available for 176 societies. Regarding the coding used to generate Table 4, White warns that while descriptions appear normative, it’s not completely clear they are always prescriptive (p. 534). Thus, Table 4 probably sets an upper bound on the amount of prescriptive monogamy.

Polygynous marriage systems are composed of many parts and much variation exists within the category. White’s comprehensive statistical analysis empirically distinguishes two major kinds, or clusters, and one minor category. The major clusters distinguish *sororal polygyny* from *general polygyny*. In sororal polygyny there is substantial normative pressure for a male to marry real or classificatory sisters (who are typically some kind of cousin). This partially solves a major problem with polygynous households: conflict among co-wives over access to the husband and his resources. When co-wives are relatives they can more easily cooperate (humans have an evolved psychology for helping blood relatives), and tend to live in the same house. See Table 5.

Table 4. Cultural Norms	Count (%) N = 183
Monogamy prescribed (offspring of non-wives do not inherit)	27 (15%)
Monogamy preferred but some polygyny	32 (17%)
Polygyny for exceptional males (leadership, skills)	45 (25%)
Polygyny for men of wealth, nobility, etc.	33 (18%)
Polygyny preferred for most men. Most older men should have 2+ wives.	46 (25%)

Under general polygyny (meaning non-sororal polygyny), the other major type, wives are rarely sisters and may be quite different in age. Because of conflict among co-wives, each wife often maintains a separate household, or at least a separate hearth. It is under general polygyny that differences in the numbers of wives for each man can get extreme. Globally, sororal polygyny tends to occur in the New World (the Americas) while general polygyny tends to occur in the Old World, and remains common in Africa.

Table 5: Household Arrangements	
Marriage Arrangements	Ethnographic Atlas % (N = 1267)
Independent nuclear, monogamous	14.6% (186)
Independent nuclear, polygyny	35.7% (453)
Preferentially sororal, cowives in same dwelling	5.4% (69)
Preferentially sororal, cowives in separate dwellings	1.4% (18)
Non-sororal, cowives in separate dwellings	27% (344)
Non-sororal, cowives in same dwellings	12.4% (157)
Independent polyandrous families	0.32% (4)
Missing data	2.8% (36)

The minor cluster involves societies with sharp social stratification (classes or castes) in which only members of the high class can marry polygynously (monogamy is enforced in the lower classes by the upper classes). Realize also that ascription or assignment to the nobility or high caste is often by birth and blood, not by wealth. This means that rich traders who are of low birth status are limited to one official wife.

As is clear from these data, polyandrous marriages are quite rare. However, four other patterns are important: polyandry is (1) usually fraternal polyandry, meaning brothers marry the same woman, (2) typically found intermixed with other marriage types in the same society, including both monogamy and polygyny, (3) considered to be somewhat unstable with the youngest husbands leaving the marriage, or taking additional wives themselves (giving rise to polygynandry), and (4) principally confined to the Himalayan and, to a lesser degree, Indian regions of Eurasia, though it has been observed elsewhere, including in the Americas [45]. Many researchers have argued that polyandry emerges when sustaining a household requires the input of multiple males [45]. For example, in some places economic circumstances make it necessary for a man to travel long distances from the household while the presence of bandits requires a man to guard his family—solution: brothers team up.

Besides the broad categories outlined above one sees reports of other forms of marriage in humans, such as group marriage. Many of these reports are of dubious quality. Sometimes they track to the observations of single travelers who noted a particular family arrangement (that is, one family), often with insufficient detail to judge just how well the observer had investigated. Or, non-anthropological observers have confused marriage with the custom of wife sharing or loaning, which was common in both aboriginal North America and Australia. In these societies, which were numerous (and usually polygynous), husbands controlled sexual access to their wives, and it was considered polite and honourable for them to give their wives' "services" to close friends or honoured guests for a night or some period of time. Since these other men were often married as well, it might have appeared to a casual observer as if some kind of complicated marital arrangement existed.

Nevertheless, there may be a few societies that have some degree of group marriage, alongside polyandry [46]. The case of the Todas in India was extensively documented by the psychologist and anthropologist W.H.R Rivers [47]. Here, two brothers (usually) would marry a single woman. When the family's economic prospects improved, a second woman is brought into the marriage, often a sister of the first wife. This suggests that some cases of group marriage exist, but nowhere do they form a stable societal pattern prescribed by social norms. After reviewing the evidence, Murdock [39: 24] claims that group marriage has never been normative in any human society.

One feature of marriage norms is worth highlighting. As noted, marriage norms prescribe and prohibit roles and responsibilities related to economics, subsistence, child rearing, sex, and inheritance. Still, only 23.3% of societies in the Standard Cross-Cultural Sample (including monogamous and polygynous ones) have marriage norms that strongly condemn extra-marital sexual activity by males [48]. Meanwhile 89% of societies condemn all extra-marital sex by wives, though there are interesting exceptions in societies that believe in partible paternity [37].

SUPPLEMENTAL THEORY AND EVIDENCE

With regards to how polygynous marriage creates a pool of low-status unmarried men, two additional points should be mentioned. First, it is possible to avoid creating a pool of unmarried males if population growth rates are particularly high and men marry much younger females. Of course, high population rates are not sustainable. Second, if divorce is permitted, high status males will engage in serial monogamy. Serial monogamy is what otherwise polygynously marrying men are forced into under normative monogamy. Serial monogamy, however, does not expand the pool of unmarried men since men are required to give up one wife before taking another (the size of the pool of single women is unaffected). And, if divorce is costly, more paternal investment can still be extracted. Modern divorce, for example, obliges men to support the divorced wife and their children.

MECHANISMS THROUGH WHICH MARRIAGE INFLUENCE MALE BEHAVIOR

There are several sociological hypotheses about what the causal relationship is between marriage and crime, which we sketch here for the interested reader. These hypotheses are not mutually exclusive and the strength of evidence varies substantially between them.

1. Marriage changes routine activities, especially with regard to deviant peer groups. Unstructured activities with peers increase the frequency of deviant behaviors among those ages 18 to 26. The same person, when married, will spend less time with same-sex peers than when not married (or before marriage). There is supporting empirical evidence for this hypothesis in the finding that the transition to marriage is followed by a decline in time spent with friends and exposure to delinquent peer groups, controlling for age [49]. This idea is related to Waite and Gallagher's [50: 24] argument that marriage restrains people from certain kinds of behavior (i.e., staying up all night drinking beer) that do not pay off in the long run (in health, happiness, or income).
2. Parenting responsibilities can lead to changes in routine activities because more time is spent in family-centred activities than in unstructured time with peers.
3. A change in criminal behavior may occur in response to the attachment or social bond that forms as a result of marriage. Social bonding: the social ties of marriage create

interdependent systems of obligation, mutual support, and restraint that impose significant costs for translating criminal propensities into action [51].

4. For some, getting married connotes “getting serious”; in other words, becoming an adult. Marriage means having someone to care for and having someone to take care of you, and these perceived responsibilities and obligations strengthen when children enter the family. Marriage norms mean being married changes expectations of one’s proper behavior [52].

TESTOSTERONE AS ONE PROXIMATE MECHANISM

Though speculative, testosterone may provide one important proximate mechanism that contributes to regulating male psychology in the manner predicted. Lower testosterone is associated with reduced risk-taking and sex-seeking [53] as well as greater sensitivity to infant cries [54]. Some evidence from normatively monogamous societies suggests that testosterone drops in men both when they marry (in a monogamous society) and again when they become fathers [55-58]. However, marriage and fatherhood do not appear to reduce men’s testosterone in polygynous societies [59], because, of course, married men are still on the mating market— still openly and actively seeking additional long-term mates [though see 60]. This suggests that marrying in a polygynous society, especially if a male is higher status, may not have the same effects on criminal behavior and personal abuses as it does in normatively monogamous societies. Thus, normative monogamy may provide a kind of societal-level testosterone suppression program [61].

CROSS-NATIONAL REGRESSIONS LINKING POLYGNY AND CRIME

These analyses extend analyses already performed by Kanazawa and Still [62, 63]. Kanazawa provided the dataset. More information about this dataset is available in their papers.

To show that increasing polygyny is associated with a higher percentage of unmarried men, we use national-level data from Kanazawa and Still [62, 63], who compiled crime statistics, demographic information and economic data together with a measure degree of polygyny for 157 countries. To create a measure of polygyny, Kanazawa and Still coded all of the cultures in the *Encyclopedia of World Cultures* on a four point scale (from 0 = monogamy is the rule and is widespread, to 3 = polygyny is the rule and is widespread), and then developed a country-level value by aggregating all of the cultures within a country, multiplying the values for each culture by the fraction of the country’s population represented by that culture.

First, we regress the percentage of unmarried men (age 15 and over) in the national population on this measure of polygynous intensity with controls for Economic Development (GDP per capita), Economic Inequality (sectoral Gini coefficients), Population Density, and degree of Democracy in 1980, as well as dummy variables for Africa and Asia [62]. The complete model in Table 6 (Model 6) provides estimates for the coefficients in this regression equation:

$$\begin{aligned} \% \text{ of unmarried men} = & \text{constant} + \beta_1 * \text{Deg. of Polygyny} + \beta_2 * \text{GDP per capita} + \beta_3 * \text{Pop.} \\ & \text{Density} + \beta_4 * \text{Index of Democracy} + \beta_5 * \text{Gini sectoral} + \beta_6 * \text{Africa dummy} + \beta_7 * \text{Asia dummy} \end{aligned}$$

Models 1 to 5 in Table 6 perform this estimation with various terms on the right-hand side dropped from the equation. The coefficients are estimated using standard linear regression techniques (least squares) and are accompanied by robust standard errors (Huber/White sandwich). This was accomplished using Stata IC 10.1.

Table 6. Regressing the percentage of unmarried men on the degree of polygyny

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Deg. Polygyny	3.030***	3.542***	3.489***	2.980***	1.740	1.740*
	(0.952)	(1.059)	(1.072)	(0.765)	(1.183)	(1.028)
GDP per capita		0.000218*	0.000167	-0.000391**	-0.000362*	-0.000295*
		(0.000114)	(0.000121)	(0.000153)	(0.000185)	(0.000160)
Pop. Density			0.000533*	0.000617	0.000536*	0.000495*
			(0.000317)	(0.000398)	(0.000270)	(0.000276)
Index of Demo.				0.165***	0.0944**	0.0985***
				(0.0307)	(0.0378)	(0.0364)
Gini sectoral					-0.0623	-0.150**
					(0.0633)	(0.0690)
AFRICA (1= African)						6.925** (2.992)
ASIA (1= Asian)						-0.0340 (2.128)
Constant	37.21***	35.38***	35.60***	31.20***	37.98***	37.65***
	(0.939)	(1.621)	(1.698)	(1.547)	(3.166)	(3.537)
Observations	128	126	119	116	86	86
R-squared	0.081	0.092	0.099	0.346	0.151	0.243

*p < 0.1 **p< 0.05 ***p<0.01;
Robust errors (Huber/White) are in parentheses below the unstandardized coefficients.

Variable descriptions:

- % of unmarried men = the percentage of men (over age 15) who were unmarried in each country in 1990.
- Deg. of Polygyny = the degree of polygyny within a country based on data between 1991 and 1995. This varies from 0 (no polygyny) to 3 (widespread polygyny). Because the Degree of Polygyny variable was constructed based on information gathered between 1991 and 1995, most of the other control variables were collected from this period as well. The precise year used depended on the availability of information.
- GDP per capita = Gross Domestic Product Per Capita for a country.
- Pop. Density = persons per square mile in the country.
- Index of Democracy in 1980 = an index for the strength of democracy in a country. This index varies from 0 (completely authoritarian) to 100 (most democratic). It comes from Bollen's [64] detailed analysis and comparison of such measures.
- Gini sectoral = the sectoral gini coefficient for a country. One concern with this sectoral gini data is that it comes from 1980. Sectoral Gini is used in lieu of standard Gini coefficients because it is available for a larger number of societies. Note that it is possible to find Gini coefficients for many of the countries listed as "missing" in the K&S dataset, and Kanazawa and Still [62] use four measures of inequality in their analyses. The problem with regular Gini coefficients from the early 1990s is that they are derived from different sources. Sometimes those sources (1) use male income only, (2) calculate the inequality of households instead of persons, (3) involve only people in urban areas, and (4) use gross taxable income instead of other definitions of income or consumption. K&S drew their Gini coefficients from a single source to deal with this problem, but this limits the available data.

- Africa dummy = 1 when the country is in Africa and 0 otherwise.
- Asia dummy = 1 when the country is in Asia and 0 otherwise.

Across the six models in Table 6, the higher the Degree of Polygyny, the higher the percentage of unmarried men in a country. While the coefficient on the Degree of Polygyny in Model 5 misses conventional significance ($p = 0.15$), the size of the coefficient is identical to that in Model 6. Going from a negligible degree of polygyny (polygyny = 0 nationwide) to widespread polygyny (polygyny = 3 everywhere) increases the size of the pool of unmarried men by between 13% and 27%. A comparison of AIC for each model shows that Model 6 is the best.

Countries drop out of the regressions when additional predictor variables are added because of a lack of data on those variables. This occurs most seriously when the sectoral Gini coefficients are added. We suspected that including sectoral Gini might bias results toward less polygynous societies. This, however, is not the case. Removing the societies without sectoral Gini data does not appreciably alter the distribution of our Degree of Polygynous variable.

Making the second link, Table 7 shows that the greater the percentage of unmarried men in the national population the greater the rates of rape, murder, assault, theft and fraud, controlling for the same variables as above. To deal with the highly skewed distributions of crime rates we've taken the natural logarithms of these rates. The percentage of unmarried men is a highly significant predictor of all these crime rates, except assaults where it is only marginally significant. The regression equations estimated in Table 7 is:

$$\text{Ln(Crime Rate)} = \text{constant} + \beta_1 * \% \text{ of unmarried men} + \beta_2 * \text{GDP per capita} + \beta_3 * \text{Pop. Density} + \beta_4 * \text{Index of Democracy} + \beta_5 * \text{Gini sectoral} + \beta_6 * \text{Africa dummy} + \beta_7 * \text{Asia dummy}$$

The dependent variable Ln(Crime Rate) is natural logarithm of five different crime rates: rape, murder, assault, theft and fraud (see columns of Table 7). These are measured in incidences per 100,000. These data were also gathered from the early 1990s.

The percentage of unmarried men is the only predictor that is consistently important across all five felonies. For rape and murder, adding the percentage of unmarried men to a regression with all the other variables increases the variance explained from 33% to 45% and from 12% to 24% respectively. For Assault, Theft, and Fraud, the variance explained increases by about 5% when our theoretical variable is added.

Natural logs of→	Rape	Murder	Assault	Theft	Fraud
% unmarried men	0.0510***	0.0225***	0.0337*	0.0324**	0.0500***
(age 15+)	(0.0128)	(0.00815)	(0.0196)	(0.0153)	(0.0136)
GDP per capita	2.89e-05	-4.53e-05**	6.84e-05**	0.000140***	0.000142***
	(2.00e-05)	(1.80e-05)	(2.97e-05)	(2.20e-05)	(2.20e-05)
Pop. Density	-7.54e-05*	-2.91e-05	-6.96e-05	3.16e-06	-9.16e-05
	(3.94e-05)	(3.19e-05)	(8.24e-05)	(6.54e-05)	(6.04e-05)
Index of Demo.	0.0108**	0.0111***	0.00841	0.0173***	0.00251
	(0.00467)	(0.00309)	(0.00653)	(0.00494)	(0.00528)
Gini sector	0.00815	0.000776	0.00453	0.00465	-0.00279

	(0.00723)	(0.00711)	(0.0128)	(0.0113)	(0.0106)
AFRICA	-0.0389	0.0286	0.338	-0.184	-0.401
	(0.339)	(0.226)	(0.422)	(0.384)	(0.311)
ASIA	-0.241	0.0106	-0.0961	-1.120***	-0.515
	(0.371)	(0.394)	(0.625)	(0.262)	(0.620)
Constant	-1.400***	0.336	1.025	2.676***	0.550
	(0.527)	(0.465)	(1.000)	(0.804)	(0.718)
Observations	75	86	84	86	83
R-squared	0.449	0.240	0.220	0.682	0.559
*p < 0.1 **p < 0.05 ***p < 0.01; Robust errors (Huber/White) are in parentheses below the unstandardized coefficients predicting the natural logarithm of each crime rate.					

CRIME AND SEX RATIO

In China, as presented in the main text, sex ratios (males to females) rose markedly from 1.053 to 1.095 between 1988 and 2004, nearly doubling the unmarried or “surplus” men [65]. At the same time, crime rates nearly doubled—90% of which were committed by men. The increase in sex ratio was created by the gradual implementation of China’s one-child policy. Different provinces implemented the policy at different times for reasons unrelated to crime rates providing an opportunity for analyses of the impacts of the policy and the alterations in sex ratio it created. The date of implementation provides an exogenous variable that can be used to establish directions of causality.

The authors of the study argue that this setup is also ideal for examining how the surplus males affect crime rates for two reasons. First, limiting child number through potent family planning strengthened preferences for male children. Highly valued male children will benefit from heavier parental investment, and should—if anything—be less likely to commit crimes than the boys of previous generations. Second, limiting family size causes the population to shrink, which opens up opportunities in the labour market and ought to decrease people’s likelihood of committing crimes (there are lots of jobs). So it is significant that, despite these pressures, crime actually went up over this period. While not entirely persuasive, these arguments provide an important point of departure.

To challenge the hypothesis that the increase in crime was driven by an increase in the surplus of low-status, unmarried men, the authors also examine crimes usually committed by white-collar (high status) criminals. Since high status men are still marriageable they are insulated from the hypothesized effect (they wouldn’t be as insulated in a polygynous society, since additional wives could be added). These analyses show that sex ratio does not impact white-collar crime. Thus, the increase in crime driven by a surplus of unmarried men is only found in property (larceny) and violent crimes.

It is also worth noting (contrary to expectations) that increases in rape do not appear to be an important component of this increase in violent crimes, although rates of rape may have been offset by a dramatic increase in prostitution during the same period (from 25,000 to between four and six million prostitutes). Analyses from several studies support the linkage between higher prostitution

rates and a greater excess of males. Below, we review a longitudinal study of rape that shows how it's influenced by fluctuations in brideprice (the cost of obtaining a wife).

In India's case, besides showing that sex ratio differences across districts are strongly associated with murder rates, Dreze and Khera [66] broke the sex ratio down into effects created by differences in sex ratio at birth and the effects created by migration of males in, or out. Both had significant effects, as expected. Their analyses also indicate that literacy is an important independent negative predictor of murder rates across districts, though poverty and urbanization are not. The authors used murder rates because they worried about under- or biased reporting of other crimes—but deaths are hard to avoid reporting.

There is one cross-national study [67] showing that sex ratio is *negatively* (not positively) related to crime (murder, rapes, and assaults). Overall, there are two reasons not to worry about conclusions drawn by this study. First, these are cross-national analyses, which mean many different factors vary across nations (unlike the within-country analyses above) that might be causing these effects. That is, truly causal variables not included in the analyses may correlate with the few variables included in the analyses to create these effects. Normally, econometricians would include many control variables to address this (see main text), but Barber's study controlled only for infant mortality. Second, the sex ratios in many of these nations are very far from 1.05 (the birth value), which means that most of the sex ratio differences are driven by migration, or death of males due to organized violence. What these findings might be telling us is that males leave unstable and violent countries with more crime to move to peaceful and stable countries with less crime. Or, societies with more crime may tend also to have more war and organized violence, which disproportionately remove males (they get killed). This could be sorted out with the analysis of longitudinal (time series) data, such as was used for China above, but this analysis has not been done. As an interesting aside, note that this study does find that *polygyny* is associated with more assaults and murders, independent of sex ratio.

POLYGYNY, SEX RATIO, RAPE AND SEXUAL EXPLOITATION

Within a society, evidence for a positive relationship between degree of polygyny in a society and rape rates comes from the Gusii of Kenya [68]. This polygynous society has a bride price that is paid from the groom's father to the bride's father in the form of cattle. Historically, the size of the brideprice continually escalated until the government periodically intervened and forced the price to be lowered. The lowered rates held temporarily and then the escalations began again. The size of the brideprice impacted how many males were able to get wives because many males were unable to afford the brideprice, especially if they did not have a sister who had gotten married (because the cattle the family receives for the sister can be used to pay the brideprice for her brother). Many fathers tried to arrange marriages for their daughters with older, wealthy men to get brideprices, so more males were excluded from marriage. In 1936-1937, brideprices were at their highest levels in nearly 50 years and many young men who could not afford brides turned to cattle raiding and rape. As brideprice increased rape rates also increased. In one reported incident, a group of young men captured a group of females at the market and raped them, precipitating a decrease in brideprice. The lower rates held until 1950, during which time rape rates were lower. When brideprices began to escalate again in 1950, outbreaks of rape and the existence of rape gangs again occurred.

The evidence from the Gusii suggests that men rape when they are unable to access females in socially legitimate ways and refrain from rape when women are available to them. Consequently,

polygynous societies may face an increased risk of rape as access to females is denied to a subset of males in the population.

As noted above, in addition to rape, the sexual needs of an increasing pool of unmarried men are met by expanding sex industries. In San Francisco's Chinatown in the mid-1800s, a time and place with a low female to male ratio, the 1850 census indicates that 71% of the area's females were prostitutes [69] and when Australia was populated by male European convicts but few European women, prostitution was widespread [70]. Other times and places include the American frontier, urban Africa, and medieval Europe [71, 72]. Using cross-national data, McDermott [73] reports a positive relationship between polygyny and sex trafficking, controlling for GDP.

MONOGAMOUS MARRIAGE, ECONOMIC PRODUCTION, AND FERTILITY

With regard to Table 1 in the main text, Tertilt [74] asserts that you obtain the same pattern if you create your comparable sample of monogamous countries by matching on GDP instead of latitude. She did not do this because, as we discuss in the main text, her model shows that when males cannot invest in obtaining more wives (because of imposed monogamy) they invest and save in ways that generate both reduced population growth and more rapid economic expansion (increasing GDP per capita). Thus, she suggests that the nearly threefold increase in GDP per capita between Comparable Monogamous Countries and Highly Polygynous Countries is partially caused by legally imposed monogamy.

MICRO-LEVEL CASE STUDIES OF AGE OF FIRST MARRIAGE AND AGE GAP

It is important to realize that our theoretical approach is focused principally on how polygyny will create differences *among societies* in factors like the age gap between husbands and wives and the power of women in society. However, if men recognize early in their reproductive careers that they are likely to be either monogamously married (at best) or polygynous, we may be able to detect individual-level differences (as opposed to societal-level differences) based on the strategies men deploy going into marriage. Men who are either highly polygynous or on the road to high levels of polygyny might prefer very young wives, perhaps because they are easier to control. The higher status of polygynous men, or of men likely to be polygynous in the future, should permit them to more effectively get what they want. Yet, in societies in which men are more equal or upwardly mobile, strategic shifts in preferences for younger wives might not emerge early enough to create observable within society differences. Thus, it will be impressive if we find any differences in the predicted directions.

This case material suggests two findings. First, a future-polygamous man will marry a younger first wife than a future-monogamous man (although the difference in age is not always statistically significant, it is always in the predicted direction). Second, the age difference between husbands and first wives is greater in polygynous marriages than in monogamous marriages. To illustrate these patterns, we provide data from four disparate societies in Africa, the Middle East, and Australia.

A study of Bedouin Arab women living in Israel's Negev [75] found that the average age of marriage for polygynous women and monogamous women was 19.2 and 19.5 respectively. These are not statistically significantly different, but do go in the predicted direction. Polygynous men tend to be

older at marriage than their monogamous counterparts (27 vs. 23, respectively; $p < 0.001$). This difference in men's age at marriage creates a greater age gap between husbands and wives in polygynous marriages (7.83 years) compared to monogamous marriages (3.49 years). See Table 8. All of the Bedouins are Muslim and 50% live in villages recognized by the state of Israel and the other 50% live in unrecognized villages. Culturally, they are characterized by their shared attributes of patriarchy, collectivism, and authoritarianism [75].

	Women		Men	
Variable	Monogamous	Polygynous	Monogamous	Polygynous
Avg. age at 1 st marriage	19.46	19.16	22.95	26.99*
Avg. # of years younger than husband	3.49	7.83*	--	--
* $p < 0.001$				

Polygyny is illegal in Turkey. Nonetheless, polygyny is common in rural villages in south-eastern Turkey and it is estimated that 2% of all marriages in Turkey are polygynous. Senior wives are the first women to whom a man married. A junior wife is the most recent wife joining the marriage. Senior wives are higher status than junior wives, and junior wives have no legal rights on the husband's heritable wealth. Prior to 2004, children of junior wives were registered as belonging to senior wives; this practice changed when laws were passed to recognize the legitimacy of children born in extramarital affairs [76]. The percentage of girls marrying under age 15 is significantly different across marriage types—see Table 9. Thirty percent of polygynous senior wives marry under age 15 versus only 10% of monogamous wives [76]. The average age of first marriage for senior polygynous wives is 15, compared to 17 years of age for monogamously married wives. This difference is not statistically significant, though it does go in the predicted direction.

	Monogamous wives	Polygynous-senior wives	Polygynous-junior wives	Statistical significance
Avg. age at 1 st marriage	17	15	18	Not significantly different
% of married women under age 15	10	30	13	$p < 0.01$

The Arsi Oromo of southern Ethiopia are agro-pastoralists. A third of women are in polygynous marriages, and approximately 29% of men have two wives and 11% have three or more wives. It often takes many years for a man to accrue enough wealth to take an additional wife and the average number of years between marriages is 12.6. Among the Arsi Oromo, the average age of marriage for senior wives in polygynous marriages is 15.3 compared to 17.3 for wives in monogamous marriages. Average age at first marriage for junior wives is older than that of monogamous wives. The difference in age of first marriage is statistically significant between each group of women [77]. See Table 10.

	Polygynous wives*			
	Monogamous wives*	Senior wives	Second wives	Third and higher wives
Avg. age at first marriage	17.25	15.32	18.73	20.1

*All ages are statistically significantly ($p < 0.05$) different from each other

The Aboriginal community in south-east Arnhem Land, Australia was traditionally polygynous foragers. In the 1950s, the community was established as a mission settlement and polygyny was prohibited. Although polygynous marriages continued over the next 30 years, the number of new polygynous marriages declined and by the late 1980s they were almost entirely eliminated. However, women who had previously been married in polygynous unions continued to live in the community. As of 1981, 65% of the women in the community were currently, or at some point had been, in a polygynous marriage. Based on record reviews, census data, and interviews, a reproductive history of women from the community was created [78]. The findings reveal that there was a large age difference between husbands and wives in polygynous marriages; a gap that was much greater than that in monogamous marriages (see Table 11). Women in polygynous marriages were younger at the birth of their first child than monogamously married women, although this difference is not statistically significant. Reflecting the age difference between spouses, men in polygynous marriages were significantly older at the birth of their first child compared to men in monogamous marriages.

Variables	Monogamous marriages	Polygynous marriages	Statistical significance
Avg. age difference between husbands and wives	7	17.1	$p < 0.001$
Avg. mother's age at 1 st birth	19.32	19.19	$p > 0.05$
Avg. father's age at 1 st birth	28.71	36.27	$p = 0.004$

Overall, the findings from these case studies converge with the cross-country evidence reviewed in the main text. These intracultural studies on marriage age also are interesting because they *suggest* that, in addition to driving down marriage age for females across the board (that is, in both monogamous and polygamous unions), there is a further effect specific to polygynous marriages: that is, polygynously marrying men seem to select younger girls as wives (even as first wives) compared to monogamists, both in absolute but especially in relative terms. One plausible explanation for this is that selection of a younger (and especially a relatively younger) bride increases a man's ability to exert control over her. An alternative evolutionary hypothesis, that men are selecting adolescent females because of higher fertility, does not hold since fertility declines as one moves down in age below around 17.

POLYGYNOUS MARRIAGE AND FEMALE EQUALITY

The available cross-country evidence also supports the idea that permitting polygyny increases males' motivations to control women, an effect created by competition among males for access to women. Table 12 partitions the Highly Polygynous Countries (HPC) from the Comparable Monogamous Countries (CMC). The UNDP's Gender Empowerment Measure aggregates a variety of measures of female empowerment into a single index (ranging from 0 to 1). It includes male-female income ratios and female representation in high status jobs. In 2009, Canada was ranked 4th in the world on this, with a score of 0.83 (Norway is currently 1st at 0.91). The HPC mean is 0.22, while CMC score at 0.50. The ratio of adult female to male literacy tells the same story [79].

Cross-national regressions converge with Table 12. Using her own five categories of polygynous intensity across nations, McDermott

[73] shows positive statistical relationships between the degree of polygyny and (1) rates of primary and secondary education of female children, (2) domestic violence, (3) maternal mortality, (4) sex trafficking,

(5) female genital mutilation, and (6) inequality of females (vs. males) before the law. These results all hold controlling for GDP. However, while broadly supportive of our theoretical proposal, more analysis is needed, such as including additional control variables (economic inequality, population density, continental dummy variables, and democracy) and replacing GDP with GDP per capita.

Variable	HPCs	CMCs
Gender Empowerment Measure (GEM), 2003	0.22	0.50
Ratio of adult female to male literacy rates, 2005	0.66	0.95

SEX RATIO AS A PROXY FOR THE EFFECTS OF POLYGyny ON WOMEN

While highly polygynous marriage systems are confined primarily to Africa, sex ratios vary much more widely across the globe. Here we assume that sex ratios favouring males will create effects that mirror those of polygynous marriage by increasing the competition among men for access to women. If true, sex ratio ought to have the same effects on female power and well-being that greater polygyny has, *for the same reasons*. Men will tighten their control over wives, sisters and daughters. This may appear counterintuitive, as one might expect women to gain power given that they are the "limiting resource." However, empirical evidence indicates that this is not the case. As women become scarce they tend to be viewed as commodities and, along with the greater control exerted over them, fertility rates increase and divorce rates decline [80].⁸

To examine the relationship between sex ratio, age of first marriage, and female inequity, South and Trent [80] performed a battery of cross-national analyses using data from 117 countries. Their sample included countries from across the full spectrum of development, but with a bias towards more developed countries (as the lesser developed countries were less likely to have the requisite data available). The sex ratios for each country were based on data available for the number of

⁸ Both fertility rates and divorce rates are considered reliable proxies of women's empowerment by those who study human development [80]. When women have more power in the household and more education they have fewer children and divorce more frequently. Additional children are generally a greater cost for women compared to men. Each additional child costs women in terms of labour, health, and ability to attract additional mates. For divorce rates, suppose that 10% of the time only the husband wants a divorce, 10% of the time only the wife wants a divorce, and 10% of the time both want a divorce. If women have no power, the divorce rate is 20%. If women have power, it's 30%.

males and females between the ages of 15 and 49 from any year between 1973 and 1982. Variability in the sex ratio could be due to differences in the sex ratio at birth, migration, or mortality. The authors speculate that in countries with high mortality rates, such as in East Africa, mortality accounts for most of the skewing of the sex ratio (with mortality impacting males between ages 15-49 more than females). Differential mortality by sex could also skew the sex ratio. Analyses controlled for the reliability of the sex ratio data for each country, as well as the socioeconomic development of each country (an indicator composed of variables including GDP, infant mortality, percentage of population living in urban areas, and life expectancy).

South and Trent found that in countries with a high ratio of males to females, females married younger, controlling for the aforementioned factors. This converges with other evidence. Currently, the declining sex ratio in China has caused rich families to acquire infant girls to guarantee their sons have wives [61]. Similarly, in some regions of India (the world's largest democracy) more than half of females in some regions are married before age 15 [81]. As well, in the American frontier where females were in short supply, brides were reported as young as 12 and 13 [71]. This converges with findings reported in the main text, indicating that competition for scarce females drives the age of first marriage down.

These analyses also show that higher sex ratios (i.e., more males than females) predict lower participation of women in the labour force, lower illegitimacy rates, and lower divorce rates (all illustrating male control). In more developed countries, they found that the sex ratio had a *greater* effect on indicators of women's roles than in less developed countries, with the exception of participation in the labour force. In more developed countries, higher sex ratios predict a lower age at first marriage (for females), higher fertility rates, and lower literacy rates.⁹

Some of South and Trent's analyses suggest that living in a society with a highly skewed sex ratio may contribute to diminished well-being for women, as evinced by the high female suicide rate relative to that of males in countries with a high sex ratio. However, data on female and male suicide rates were only available for 51 countries and were not considered highly reliable. These findings, while weak on their own, are consistent with suicide rates in China [World Health Organization (WHO)82], which has the world's highest female suicide rate (14.8 per 100,000). As a point of comparison, Canada's female suicide rate is 5.1 per 100,000. China does not have a high suicide rate for males (13 per 100,000 compared to Canada's male suicide rate of 19.5 per 100,000) (WHO, 2003), indicating that the high female suicide rate is not a reflection of a generalized sense of diminished well-being in China but rather a problem specifically affecting females. The trend of increased female suicide rates in low sex ratio countries suggests that something about being a woman in a country with a relative scarcity of females creates an environment that is deleterious to the well-being of women.¹⁰

Overall, while it's possible that the causal pathways for some of these effects are different from, and specific only to sex ratio, the convergence with both our macro-level comparisons of countries with

⁹ These cross-national analyses could suffer problems similar to those discussed for Barber (2000) above. However, two reasons suggest these issues might be less pertinent in this case. First, South and Trent used an accepted measure of socioeconomic development as a control (instead of only infant mortality), a larger sample, and also included a control for data quality (which Barber did not). The use of the socioeconomic index of development as a control is crucial for their findings. Second, it is more difficult in this case to see how biased migration patterns could have skewed these results.

¹⁰ However, a country's socioeconomic development has a greater effect on the female suicide rate than the sex ratio [80].

differing degrees of polygyny and our micro-level case studies of monogamous and polygynous marriages in the same societies is striking. Increased competition for females, whether due to polygyny or to unbalanced sex ratios, seems to depress the age of marriage for females, increase the spousal age gap, and increase male efforts to control females. This appears to apply in developed societies as well as underdeveloped and developing societies.

NORMATIVE MONOGAMY, PATERNAL INVESTMENT, AND INTRA-HOUSEHOLD CONFLICT

As background, it is important to realize just how discriminating people are regarding kin-relatedness. For example, evolutionary theory predicts that people ought to behave more altruistically—as if they were more closely related—to those who are related through a matriline (e.g., mother’s sister’s son) compared to those related through a patriline (e.g., father’s, brother’s son). This is because every linkage through a male brings some paternity uncertainty (was he really the genitor?). Several empirical studies in different countries now demonstrate that people make this subtle distinction in the predicted manner [3]. This is important in the case of polygynous families because many of the siblings are actually (or supposed to be) genetic half siblings through the paternal line. Because it is through the paternal line, theory predicts more conflict than with equivalent half siblings related through the mother.

MORE ON CONFLICT AMONG CO-WIVES

Here we provide some additional material on conflict among cowives in polygynous households.

Unrelated women within a polygynous household compete directly for household resources. The outcome of these conflicts may directly impact the future welfare of their genetic progeny. This is a zero-sum game among non-relatives without common genetic interests (that is, no common offspring). In a typical monogamous nuclear family all pairs of individuals are close genetic relatives, or share a common genetic interest (spouses are unrelated but linked genetically through shared offspring). Under such circumstances, our approach predicts that serious conflicts will likely arise among the unrelated women in the household.

In-depth ethnographic work in polygynous communities supports this view. Straussman [83] highlights the conflict among both cowives and half-sibling sons. Mothers both reported and widely feared that their cowives would try to poison their sons—so the poisoner’s son could inherit the father’s land instead. Straussman also shows that children of polygynous marriage have a statistically increased chance of dying (relative to monogamous marriages), and she argues that this increases the stress experienced by children. This converges with both ethnographic accounts in which competing cowives suspect and accuse each other of engaging in witchcraft, and with an econometric analysis of data from the Ivory Coast showing that the children of first wives in polygynous marriages receive extra education, probably because of the relative power of the first wife [84].

MORE ON VIOLENCE AMONG UNRELATED FAMILY MEMBERS

Genetic relatedness between individuals within households impacts the chances of violence, including homicide and child abuse. While much violence occurs among household members, most

of this violence occurs among the non-relatives within households [11, 85]. This suggests that—*ceteris paribus*—lower relatedness and more unrelated dyads will increase violence and homicide within households.

Even before considering “blended families” arising as a consequence of divorce and remarriage, non-sororal polygynous households have—by definition—more unrelated members. Husbands are unrelated to all their wives. The wives are typically unrelated or only distantly related to each other, and thus unrelated or even less related to the children of all the other wives. For comparison, contrast a monogamous nuclear family with two parents and four children. In this household there is one unrelated pairing (assuming no marital infidelity): the spouses. Now consider a polygynous household with two wives, each with two children. This quite small polygynous family has 7 unrelated pairings (3 adult pairs + 4 wives-to-others’-children). That is, for similarly-sized families with four children each, the polygynous household has *seven times* the number of unrelated pairs. The ratio of the number of unrelated pairs for polygynous to monogamous households increases with square of the number of wives in the polygynous household.¹¹

When the implications of divorce and remarriage are considered, the effect is further exacerbated. Divorce and remarriage under polygyny not only puts children in a household with an unrelated adult male (just as with monogamous re-marriages), but it adds to the mix one or more stepmothers. To see this, suppose an aspiring polygynous man’s first wife has two children and he marries a second wife who already also has two children. This places the incoming children in a household with two unrelated adults, and places the husband’s genetic children in a household with one unrelated adult (the new wife).

Of course, it might be argued that this effect would be offset if divorce and remarriage were less common in polygynous households than monogamous ones. It is sometimes argued, for instance, that polygyny may be preferable alternative to “serial monogamy”, in the sense that it is better to keep a man’s families together than to encourage him to leave one to start the next. However, the available information indicates that divorce in polygynous marriages is at least as prevalent as in monogamous marriages.¹²

¹¹ Assume that w = the number of wives, and that k is the number of children each wife has (for simplicity assume each wife has the same number of children). The number of unrelated pairs is $N_p = w(1+(w-1)(0.5+k))$. Assume the number of wives in a monogamous family is always 1, the number of children is irrelevant, and $N_{pm} = 1$. Thus, the ratio of unrelated pair in polygynous vs. monogamous is merely N_p . If $w = 3$, $N_p = 18$.

¹² Due to the underground nature of polygynous marriages in North America we know little about divorce rates in North American polygynous communities, though Jankowiak (2008) reports that more than 40% of the women in the FLDS polygynous communities of Colorado City and Centennial Park will divorce during their lives. The comparable statistic for the U.S. in general is 34%, and the number for other religious groups who condemn divorce such as Catholics is much lower (it’s also much lower for atheists). More systematic and controlled analyses from polygynous societies generally show higher divorce rates for polygynous vs. monogamous marriages in the same society [86, 87]. Even these analyses, however, are not entirely persuasive, due to small, localized, samples and sometimes a lack of statistical controls. A more detailed investigation from Nigeria, which controlled for differences in religion, education, urban living, childlessness, and several other variables, shows that while polygynous marriages with 3 or more wives are highly unstable, polygynous marriages with *only* two wives were more stable than monogamous marriages. Relative to monogamous families, polygynous families with more than two wives are five times more likely to divorce. Meanwhile, 2-wife polygynous families divorce half as often as monogamous households. This applies to both Christian and Muslim marriages. Using the numbers from this study we calculated that permitting polygyny

An important concern with the analysis of genetic relatedness above, which suggests that violence and abuse may be higher polygynous households, is that much of the existing research has focused on men as the perpetrators of the additional abuse and filicide. If stepfathers are the only concern, maybe there will be no difference between the polygamous and monogamous households (since they include no stepfathers). That is to say, if stepfathers are the problem, then the children of three women are no worse off sharing one father than having one husband per mother.

In their analysis of an FBI database, Weekes-Shackelford and Shackelford [85] were able to calculate and compare the rates of filicide by stepfathers and stepmothers, as compared to their genetically related counterparts. In this data, while a stepfather is 8.5 times more likely to kill his child (stepchild) compared to genetic fathers, stepmothers are still 2.4 times more likely to commit filicide. Comparing stepfathers and stepmothers, stepmothers have a rate that is roughly 1/3 that of stepfathers. Three unrelated mothers equal one unrelated father in terms of mortal danger to the child.

Beyond homicide per se, the data also demonstrates that a lack of genetic relatedness puts children at higher comparative levels of risk. Studies show, for instance, that investments of money, time and effort by mothers are generally lower for step or adopted children *when* those children compete with the mother's own genetic children [88, 89].¹³ For example, adopted and stepchildren do not wear seatbelts or go to the dentist as often as genetic children. Data from Australia indicates that children living with genetically unrelated parents are much more likely to be "accidentally" killed, compared to both children living with two genetic parents *and even* children living with a single genetic parent. While children living with a single genetic parent are only 1.29 times more likely to die accidentally, children living with an unrelated parent are between 15 and 77 times more likely to die accidentally (children living with no biological parents are between 37 and 102 times more likely).

Besides conflict among unrelated cowives and between cowives and their unrelated children, there is also potential for conflict among brothers and sisters, since many of these individuals are actually only half-sibs and may be dramatically different in age. Even siblings have conflict, since they compete for the same resources from the parents. This sibling rivalry is mitigated by the altruism that comes with being closely related. Half-siblings, however, are only half as related as full siblings and face at least as much competition, and this matters, as noted above [90]. Some evidence also indicates that polygynous households are sensitive to degrees of relatedness, just as are monogamous households. Jankowiak and Diderich [90] compared the solidarity, affect, association and altruism between full and half siblings in polygynous Mormon families. The data reveal much greater association, affect, solidarity, and altruism toward full siblings compared to half-siblings. This finding is interesting because it runs directly contrary to official ideological preaching in this community. Norms may have real effects, but that does not mean that they can completely over-ride ancient evolved impulses.

THE ROLE OF SEXUAL JEALOUSY, AGE DISPARITY, AND SPOUSAL CONFLICT

will increase the divorce rate unless the number of 2-wife marriages is at least triple the number of all other polygynous families combined. Note that this study has some shortcomings in that it was not able to control directly for income (using education as a proxy), or the ages of the husband and wife at first marriage.

¹³ Adopted children, however, do just as well as genetic children as long as they are not directly competing with a sibling who is the genetic progeny of the parents.

Violence driven by sexual jealousy within pair-bonds may be at least as high, and probably higher, in polygynous societies as compared to monogamous societies. There are three reasons why it should be worse (more violent) in polygynous societies, and this applies to first wives as well as to (in more extreme fashion) subsequent wives. First, the larger age gap is a risk factor for spousal violence and homicide. Testing the evolutionary idea that sexual jealousy should increase as the age gap between husband and wives increases, Breitman and Shackelford [91] show that in Chicago, controlling for a wide range of other factors, the age gap between husbands and wives is strongly related to homicide rates. The larger the age gap, the more likely it is that a husband will kill his wife, and vice-versa (the young wife murders her husband). Notably, however, the effect is highly non-linear: in moving from spouses being the same age to husbands being between 13 and 15 years older, the rate increases from 5 per 100,000 to 8 per 100,000. After that, it spikes to almost five times the same-age rate. This suggests that polygyny is relatively (potentially) much more dangerous than monogamous relations because age gaps of 16 years are not uncommon when accumulating young wives (Jankowiak 2008).

A second application of these ideas to polygynous households involves paternity uncertainty. If a man has multiple wives he may have an increasingly difficult time keeping track of where they all are at any one time (“mate-guarding” is more costly), especially since they often maintain separate residences to manage co-wife conflict. Since polygynous husbands typically circulate among their wives residences or rooms on different nights, there may be many nights in which the husband has little idea about what his other wives were doing. This may lead to greater paternity uncertainty and potentially to more use of violence as a form of coercive control.

Finally, polygyny creates greater competition in the mating and marriage markets because all married men are still “on the market” (to add wives) and must compete with the pool of unmarried men created by polygyny. This will elevate competition for women and cause men to use more violent and suppressive measures to sustain paternity certainty, and retain their wives. As shown above, greater polygyny is associated with less gender empowerment and lower rates of female literacy.

POLYGYNOUS MARRIAGE AND CHILDHOOD OUTCOMES

Here we expand on the material covered in the main text.

Using data from 22 sub-Saharan African countries, Omariba and Boyle [92] found that children in polygynous families were 24.4% more likely to die compared to children in monogamous families. The degree to which polygyny elevated mortality risk varied by the GDP of the child’s country, with polygyny posing a smaller risk to mortality in wealthier countries. Family characteristics (maternal education, socioeconomic status, and urban versus rural residency) also reduced the effect of polygyny on child mortality by approximately a third. Similarly, a study of six West African countries found that infants in polygynous families had a 50% greater risk of dying compared to children in monogamous families [93]. Note, however, that while qualitatively convergent with much other work, we have less confidence in the details of this particular analysis because of a lack of controls for wealth and no effects in the purely bivariate analysis.

Detailed ethnographic studies in Tanzania and Chad found that children in polygynous households had poorer nutritional status than their counterparts in monogamous households, as indicated by the children’s height and weight measurements [94-96]. In Hadley’s [95] Tanzanian study, the

women had freedom of mate choice and a general abundance of food with little seasonal food insecurity. Despite these favourable conditions, the children of polygynously married mothers were more likely to be underweight, and were relatively shorter and gained less weight and height during the duration of the study than children of monogamously married mothers. These differences are more pronounced during periods of scarcity. The study started in the dry season, when food is more abundant, and at that time no significant differences in weight were detected between children in monogamous and polygynous households. At the second measurement period, during the wet season when food is scarcer, 24% of children in polygynous households were underweight compared to 8% in monogamous households. No differences were detected in wealth scores between monogamously and polygynously married women and yet monogamously married mothers reported running out of food early during the wet season more often than polygynously married mothers. Wealth differentials do not appear to explain the difference in nutritional status. The analyses controlled for children's age and sex, and household wealth.

In Sellen's [96] Tanzanian study, children of polygynous mothers had lower weight for age scores and height for age scores than children of monogamous mothers. Children's growth and fatness were correlated with both mothers' marital status and household wealth, with wealth having a greater effect than marital status. There was no significant interaction between marital status and household wealth. The analyses controlled for wealth and child and maternal characteristics. Similar findings are numerous [e.g., see 83, 97].

Finally, in looking at the 19th century Mormon data from Health and Hadley reported in the main text, realize that both rich and poor men could be behaving in a manner consistent with maximizing their reproductive success. Rich men produced many more total surviving offspring (past age 15) than poor men; it is merely that their survival rates were lower. Having additional wives more than compensated, reproductively speaking, for the lower survival rates. Poor men could not add wives without decreasing the survival rates of their children: adding wives for poor men decreased child survival, but for rich men this had no impact.

INTERPERSONAL AND PSYCHO-SOCIAL IMPACTS ON WIVES IN POLYGYNOUS MARRIAGES

Women in polygynous marriages may experience both benefits and costs associated with their marital arrangement. The identified benefits stem from the relationship with co-wives, who may provide assistance in household work, childcare, and companionship. Women in polygynous marriages may experience greater autonomy than women in monogamous marriages because the assistance from co-wives makes time available to pursue other endeavours [98]. Moreover, as is the case in households of Bedouin-Arabs, when relationships among co-wives improve, the benefits ripple through the family to improve other relationships, including those among siblings, between wives and husbands, and between children and fathers [99].

Despite the potential advantages stemming from harmonious or helpful co-wife relationships, there are studies indicating detrimental consequences associated with being a woman in a polygynous marriage *in some societies* (but not all, see below). Studies among Arabs in Israel [75] and Turkey [76] found significantly higher rates of psychological distress and disorders among polygynously married women compared to their monogamously married counterparts. Among the disorders/distress experienced at significantly elevated rates by polygynously married women in the Arabic sample are depression, obsession-compulsion, hostility, anxiety, phobia, psychoticism, and paranoid ideation [75]. Women in polygynous marriages also reported significantly more

problems in family functioning and marital relationships and less satisfaction in life than monogamously married women in their societies [75]. In the sample from Turkey, the increased likelihood of having a psychological disorder among senior wives compared to monogamous wives was 1.6 times for conversion disorder and 2.4 times for somatization disorder. The other disorders were not significantly different in prevalence between monogamous and polygamous wives.

The rates of the aforementioned problems vary with the women's co-wife ranking (based on when they married in). However, the impact of wife-order differs cross-culturally. In some societies, senior wives experience higher rates of emotional and psychological distress, presumably because the wives perceive that they are being supplanted by younger wives, or because they believe they have failed to meet the standards of a "good wife" [75]--thus leading their husbands to add another wife. In other societies, the junior wives experience greater rates of emotional and psychological distress because they are subordinate to the senior wives, and/or their husbands favour the senior wife.

Contrary to the findings on emotional and psychological well-being among the Arabs and Turks, a study among East Africans did not find any difference in rates of anxiety or depression between women in polygynous versus monogamous marriages [100]. However, the authors suggest that this may be due to the fact that the study was conducted during the dry season when food is generally abundant and workloads are low. Emotional distress may be more likely to manifest itself during 'hunger seasons.' Alternatively, the authors raise the possibility that the psychological measures were culturally inappropriate. Of course, it may also be that negative consequences associated with polygyny do not emerge in all cultural contexts (such as that in East Africa), or that there may also be benefits that offset the costs—thus, women do not experience a net decrease in emotional/psychological well-being from polygynous marriages. Since women in East Africa are economically productive, households with multiple wives could be generally wealthier than monogamous households, which could offset the downsides of polygyny. Although Patil and Hadley did not control for wealth, they did control for food insecurity in the three months preceding the study (which could be a proxy for wealth) and found this to be a consistent correlate of psychological distress. This suggests that there could be an offsetting wealth effect occurring.

HISTORICAL SKETCH OF THE EMERGENCE OF MODERN MONOGAMY

Historians and anthropologists trace the origins of modern monogamy,¹⁴ which spread across the world with the global expansion of Europe after 1500, back through Rome to the Greek city states (e.g., Athens and Sparta), and possibly back to the root of the Indo-European expansion [43, 44, 101, 102]. Under European, and at times specifically Christian missionary influence, monogamy spread throughout the Americas, Australia, and Oceania, and eventually into Asia. Legal monogamy was adopted rather recently in many places: 1880 in Japan, 1955 in India (partially), 1963 in Nepal, and 1953 in China [44].

Greek city states first legally instituted monogamy as part of many different reforms, including elements of democratic governance, which were meant to build egalitarian social solidarity among

¹⁴ Here we use "modern monogamy" to refer specifically to the cultural evolutionary trajectory that produced the Western notion of monogamy that all readers will be familiar with.

their citizenries. Prior to this, all accounts suggest polygyny was common, at least among the nobility, and monogamy was a strange “Greek idea” (instituted legally in the early sixth century BCE in Athens). While Greek monogamy limited each male citizen to a single wife, it was considered acceptable to import sex slaves, which wealthy men did. This approach is interesting because it addresses one of the fundamental social dilemmas posed by polygynous marriage systems: it keeps local women available to poor men for marriage (avoiding the problems created by poor unmarried males), while at the same time allowing rich men broad sexual access to “imported” women.

It is not entirely clear, but the Romans likely inherited and further developed the monogamy of the Greeks (as they did with many Greek ideas), though Etruscan marriage norms. Relative sexual equality likely had some influence as well. Rome outlawed polygamy and regulated this with laws about sexual behavior, birth legitimacy, and inheritance. Bigamists could be prosecuted for adultery, and married women had to be accompanied in public [43, 103].

Later, Augustus felt Roman morality was declining and weakening his empire, so he instituted a series of reforms in an effort to get every man from age 25 to 60 to be married. Augustus evidently believed that making sure most men were monogamously married would strengthen Rome. Legal changes included: (a) restricting married men from having extra-marital sexual relationships with women who were not registered prostitutes, (b) limiting the size of the inheritance that unmarried men could receive, (c) making divorce a formal legal process (to discourage serial monogamy), and (d) eliminating concubinage for married men and making the offspring of concubines unable to inherit wealth. A series of Roman emperors after Augustus, including Tiberius, Claudius, Hadrian and Severii, continued to reinforce these legal principles and adapt the law.¹⁵ The evolution of this aspect of the Roman legal system is intimately intertwined with the emergence of greater sexual equality under the law [44, 101, 103].

Early Christian ideas about monogamy and sexual purity are a combination of the evolving Roman ideals and notions drawn from Greek stoicism. Christian ideals solidified and eventually spread throughout Europe, which was highly polygynous in the pre-Christian era and during the early days of Christianity. These ideas do not come unambiguously from Judaism (which permitted polygynous marriage until at least the 11th century), nor from the Christian Gospels. At best, the New Testament offers some vague recommendations for monogamy among church leaders in the Pastoral Letters [44]. In the Old Testament, the prophets and kings are all polygynous. There are, however, references to husband and wife being of “one flesh”, which may imply monogamy as an ideal.

European aristocracies, which derived from clan-based tribal societies, were highly polygynous in the 5th century. However, all sought alliances with the Catholic Church, which worked vigorously to impose monogamous marriage on the aristocracy. As European kings gradually converted to Christianity, sometimes out of true belief and sometimes for political expediency, the Church increasingly controlled their marriages, and thus their legitimate heirs (that is, they controlled who had rights to political power). Since the lower strata of these societies, who were rapidly adopting Christianity, were economically limited to monogamous marriage anyway, the main line of resistance came from the nobility. Once the nobility began to accept monogamous marriage (without the harems of their peers elsewhere in the world), general monogamy and associated laws

¹⁵ While supporting laws strengthening monogamous marriage (believing it was for the good of the Empire), most Roman Emperors (not all) voraciously pursued immense sexual variety in their personal lives [104]. They were monogamously married, but mated polygynously in extravagant fashion.

followed [43]. The medieval Church continued to adjust and spread the doctrines that reinforced monogamous marriage.

Historians have argued that this was one of the great social achievements of the Middle Ages [103], to put the peasants and the nobility on the same footing with regard to marriage, and it may have been a key step in the development of modern notions of equality—both of the equality among men, and of male-female equality. Realize that norms prescribing monogamous marriage temporally preceded all of the West’s eventual development of democracy, equality, human rights, women’s liberation, etc.

As noted above, modern monogamy likely spread out from Europe because these societies were so successful, militarily, economically, and politically [43, 44, 101, 103]. Monogamy has even now been made law in some Islamic countries [44], including Turkey (1926) and Tunisia (1956). The possibility that normative (often imposed) monogamous marriage was causal in the successful global expansion of European (and European-descent) societies is something that becomes increasingly plausible when we examine the societal-level effects of monogamy.

ALTERNATIVE HYPOTHESES

Other economic and evolutionary approaches to the spread of monogamous marriage posit that it arises from some form of fitness [105] or utility maximizing decision under particular circumstances [106]. Such models are useful if they help us understand how cultural evolution, driven by cultural group selection, could shape sets of interrelated social norms and formal institutions in such a way as to generate success in inter-group competition. There’s little doubt that social norms about spousal number coevolve with norms regarding inheritance, transfer payments, and female sexual fidelity. Both of these approaches suggest how certain social or economic conditions might reduce the incentives for males to marry additional wives.

However, such approaches miss important aspects of marriage and culture. First, they fail to grasp that marriage is not merely pair-bonding, or a contract among those in the marriage. There is a community in which this pair-bonding occurs, and members of these communities often have strong opinions regarding what constitutes proper behavior for married persons. Failure to meet these shared expectations has downstream implications for a person’s reputation and those of their children [29, 31]. In other words, most societies have one or a few normative marriage contracts, rather than leaving the matter up to private negotiation. Decision-makers, be they inclusive fitness or utility maximizers, have to consider how their behaviors will be judged by others. That is, norms exist, shape behavior, and influence both cultural and genetic evolution [30, 107].

Second, these approaches fail to address the expansion of monogamous marriage across Europe, and then across the globe. This spread began long before the industrial revolution (so it cannot be caused by modern economic development, as Gould et. al. suggest), and diffused into places with immensely different inheritance practices, norms of sexual fidelity, and marriage transfer payments (see historical sketch above).

Moreover, immigrants from polygynous to monogamous countries (or vice-versa) do not recalculate their inclusive fitness or utility upon arrival in their new home, as such approaches suggest. Unlike North America, French laws had permitted polygynously marrying African immigrants to settle in France. This led to a massive explosion of polygynous households there

(200,000), and to the predictable array of social problems. France subsequently changed its law in 1993 to halt such immigration. If people were fitness maximizers as Fortunato and Archetti [105] argue, immigrants should switch to prefer monogamous marriage upon arrival in France (no need for laws or “crack-downs”). They don’t. In fact, press accounts suggest immigrant men use their relative wealth advantage—compared to their home country—to obtain even more wives [108]. Also see <http://www.dw-world.de/dw/article/0,1664241,00.html>.

Fourth, none of these models explain why the richest men in the world do not marry polygynously. In Gould et. al.’s model, men trade additional wives off against obtaining a high quality wife in order to raise high quality offspring. Wealthy men could still marry polygynously by hiring a team of experts to compensate any shortcomings in their wives. In Fortunato and Archetti’s model, men trade polygyny (and a divided inheritance) for a wife’s willingness to increase his paternity certainty. The model doesn’t deal with male inequality, however. Billionaires could trade hundreds of millions of dollars in an offspring’s inheritance to each of several wives in exchange for increased paternity certainty (or hire a paternity certainty security force, as emperors did). By any inclusive fitness accounting, being the third or fourth wife of a billionaire will beat the monogamous deals offered by other men.

Fifth, putting aside immigrants, monogamously marrying countries have to continually suppress the outbreak and spread of polygynous communities—which is hard to explain if people are marrying monogamously based on fitness or utility calculations (they should “want” monogamy). Not only did high status Mormon males start marrying polygynously long before arriving in Utah (while living among monogamously marrying Americans), but the U.S. government spent decades working to suppress polygyny, using immense civil, military, and financial resources. Even in the modern world, estimates suggest that nearly 100,000 Americans currently live in polygynous households—despite facing the same environment in terms of human capital, inheritance laws, and marriage transfer customs as other non-polygynous Americans. Polygynous marriage is also spreading in the Islamic communities of Africans and African Americans in Philadelphia and New York. See NPR pieces on this: <http://www.npr.org/templates/story/story.php?storyId=90886407> and <http://www.npr.org/templates/story/story.php?storyId=90857818>.

Finally, non-cultural theories cannot address why marriage prescriptions and prohibitions are so tied up with certain religions, and the desires of supernatural agents. From our perspective, religions with incentivizing supernatural agents are a form of cultural technology favoured by cultural group selection to galvanize group-beneficial social norms [109, 110]. Using supernatural sanction to sustain monogamous marriage may be a particularly instructive case since monogamous marriage runs directly counter to the interests of the most powerful men in any society. Without appealing to a higher power, and making monogamous marriages sacred, persuading kings and aristocrats to give up polygynous marriage may have been impossible.

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