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Tibetan Fraternal Polyandry: A Test of Sociobiological Theory

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This paper tests sociobiological hypotheses regarding the way practitioners of fraternal polyandry in a Tibetan population in Nepal may enhance their inclusive fitness. Demographic data demonstrate higher mortality and lower survivorship of offspring in fraternal polyandry than monogamy. Moreover, the probability of allele transmission for an ego is lower in fraternal polyandrous unions than in monogamous unions. On the basis of the measured parameters, Tibetan fraternal polyandry does not appear to enhance the fitness of individuals who practice it and, in fact, seems to entail substantial reproductive sacrifice. [sociobiology, fraternal polyandry, inclusive fitness, demography, Tibet]

THE SOCIOBIOLOGICAL THEORY OF KIN SELECTION refines the Darwinian concept of differential individual transmission of genes and adds that the representation of genetic material in the next generation may be either through one's own or one's relatives' reproduction. It hypothesizes that animals maximize their inclusive fitness—their net genetic representation in subsequent generations—and predicts the evolution of altruistic behaviors when

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such behaviors maximize genetic representation in subsequent generations (Barash 1977).

Sociobiologists' contention that all animal behavior, including that of humans, can be explained by a unified evolutionary biological paradigm has produced lively and often acrimonious debate characterized more by conjecture and plausibility than by empiricism. Most observers now agree that the level of this debate must move from theoretical possibilism to the testing of hypotheses with empirical data. But the testing of sociobiological hypotheses and predictions requires demographic and ecological data and until recently, anthropologists rarely collected such data in a systematic fashion. It is, therefore, not surprising that the debate over human social systems has hardly moved beyond the level of plausible explanations.

The present paper addresses this problem by testing hypotheses derived from kin selection theory in a Tibetan-speaking population practicing fraternal polyandry, the mating system in which two or more brothers jointly share one spouse. At first glance, fraternal polyandry presents a serious challenge to sociobiological theory since it appears to reduce rather than maximize the inclusive fitness of the male practitioners.

Male and female differences in parental investment are fundamental to the evolution of mammalian mating systems (Trivers 1972). Female reproductive strategies generally involve the intensive nurture of a few offspring while the male mating strategy involves maximizing the number of matings. Fraternal polyandry seems an exception since each of the several brothers sexually sharing a single wife substantially lowers his number of matings and his chance to fertilize a female and produce offspring. For example, among Tibetans it is not uncommon for one brother in a polyandrous union of four brothers to split off, marry monogamously, and have the same total number of offspring as his three remaining polyandrous brothers.

Polyandry also reduces the probability of one of ego's alleles appearing in any one of ego's wife's offspring (see Table I). Assuming full brothers with equal sexual access to the wife and equal fertility, as the number of males in the marriage increases, the probability of ego's being the biological father of his offspring decreases (column B) while the probability of another male (a brother with only a 0.5 probability of possessing ego's allele and a 0.5 probability of passing it on) being the biological father increases (columns C and D). The effect of additional brothers in the marriage is a decrease in the total probability of ego's allele transfer (column E). (If one or more of the brothers is a half brother, then the values in columns D and E are lower.) This strongly suggests that each individual male in a polyandrous union makes considerable sacrifice of his potential to reproduce his alleles in the offspring generation (compared with monogamy). This potential attains a maximum in the case of a monogamously married male and declines regularly as additional males join the union. The decline occurs in the following manner:

$$\text{Total probability of allele transfer} = .25\left(1 + \frac{1}{n}\right)$$

where n is the number of males in the marriage. The decrement in allele transfer potential is a measure of the "cost" of adding a brother to the marriage indicating again that the selection of the polyandrous alternative seems a case of reproductive restraint of altruism.

Sociobiological theory predicts that altruistic behavior must somehow be rewarding fitness or it would not persist. The existence of fraternal polyandry in Tibetan populations since antiquity thus seems paradoxical. However, a leading sociobiologist (Alexander 1974) has argued that fraternal polyandry is:

commensurate with predictions from kin selection and parental manipulation . . .[p. 372] [it occurs in societies with] low *and* reliable productivity of farms, with the result that additional labor without additional children . . . has come to be the best route to long-term maximization

TABLE I. PROBABILITY OF ALLELE TRANSFER: PROBABILITY OF PASSING A GIVEN ALLELE FROM MALE EGO TO A GIVEN OFFSPRING IN MONOGAMOUS AND FRATERNAL POLYANDROUS MARRIAGES.

Marriage form	A Probability of fertilization by ego	B = A × 1/2 Probability of transfer of a given allele by ego	C = 1 − A Probability of fertilization by brothers	D = C × 1/2 × 1/2 Probability of transfer of a given allele by at least one brother	E = B + D Total probability of allele transfer
Monogamy, 1 male	1	.5	—	—	.5
Fraternal polyandry, 2 males	.5	.25	.5	.125	.375
Fraternal polyandry, 3 males	.33	.165	.67	.167	.332
Fraternal polyandry, 4 males	.25	.125	.75	.187	.312
Fraternal polyandry, 5 males	.20	.10	.80	.20	.300

of reproduction because of the necessity of retaining the minimal acceptable plot of land . . . [p. 317, emphasis in original]. In effect, a parent may dramatically increase the parental care available to its grandchildren by adding parents in the form of nonbreeding offspring [p. 372].

Other authors use similar arguments to analyze human and avian polyandry (Berte 1977; Jenni 1974: van den Berghe 1979, personal communication). To date, however, attempts to relate sociobiological theory and human fraternal polyandry have not been based on demographic and economic data. This paper tests these and other hypotheses regarding the way fraternal polyandry may enhance inclusive fitness using data from a demographic and ecological study of a polyandrous population undertaken by Goldstein in 1974, 1976, and 1977 in Tsang Village in the Limi Valley of northwest Nepal.

Limi is an indigenous (i.e., not recent refugee) Tibetan culture area of about 518 sq. km. located in the northwest corner of Nepal abutting the Tibetan border. It consists of three villages ranging from 3,688 m. to 3,932 m. in elevation and adjacent pastureland ranging from 3,962 m. to over 5,181 m. in elevation. The population of the area is approximately 800 persons and that of Tsang village is 288.[1]

Theoretically, there are several ways in which fraternal polyandry may enhance the individual and/or inclusive fitness of a male. One hypothesis is that fraternal polyandry enhances fitness because of differential survival of offspring in such unions due to the greater parental investment made possible by multiple brothers supporting a wife and her offspring (see Alexander above).

Table II presents the average number of children ever born, percent of children dying, and mean number of surviving children for women of four marital statuses in Tsang. These data describe the entire adult female population of Tsang, not a sample of that population.

The data in Table II indicate that monogamously married females do not experience higher levels of offspring mortality than polyandrously mated females. Vital statistics collected by Goldstein between 1975 and 1977 confirm this by indicating no difference in infant mortality between monogamous and polyandrously married females. Mean offspring survival, moreover, is higher for monogamously mated females in all age categories but one (30-34). The greater parental investment of polyandrous males apparently does not pay off in terms of successful child raising.

Applying the potential allele transfer argument developed in Table I to the Tsang fer-

TABLE II. AVERAGE NUMBER OF CHILDREN EVER BORN, PERCENT OF CHILDREN DYING, AND MEAN NUMBER OF SURVIVING CHILDREN FOR FEMALES OF FOUR MARITAL STATUSES IN TSANG, LIMI.

Age and marital status	N	Mean number children ever born	Mean percent offspring mortality	Mean number surviving children
20-24				
monogamy	0		—	—
polyandry	2	2.0	25	1.5
unmarried	7	0.6	50	0.3
25-29				
monogamy	7	3.3	44	1.9
polyandry	4	3.3	55	1.3
unmarried	4(1)[a]	0.5	50	0.3
30-34				
monogamy	3	4.3	38	2.7
polyandry	2	5.0	40	3.0
unmarried	5(4)	1.2	25	1.0
polygynandry	2	7.0	62	2.5
35-39				
monogamy	3	6.0	41	3.7
polyandry	3	6.0	46	3.3
unmarried	4(1)	0.3	0	0.3
polygynandry	2	6.0	34	4.0
40-44				
monogamy	7	7.0	44	4.1
polyandry	2	7.5	55	3.5
unmarried	2	3.0	20	2.0
45 +				
monogamy	13(12)	7.8	59	4.3
polyandry	4	6.3	69	4.0
unmarried	4(3)	1.8	67	1.0

[a] The bracketed numbers are females with at least one birth. This number is used to calculate mean offspring mortality and survival.

tility data, the average number of copies of an allele a male would produce in the offspring generation if he were married polyandrously or monogamously is calculable. Given the fertility of 7.8 and 6.3 for monogamous and polyandrous females over 45 and

Given the fertility of 7.8 and 6.3 for monogamous and polyandrous females over 45 and utilizing the general formula presented in Table III:

monogamously married: $1[(7.8) \times (1)(.5)(1)] = 3.9$

polyandrously married: $1[(6.3) \times (1)(.5)(.46)] + 1.25[(6.3) \times (.5)(.5)(.46)] = 2.2$

the average number of copies of a gene in the offspring generation is 3.9 for a monogamously married male compared to 2.2 for a polyandrously married male.[2]

Another striking demonstration of the reproductive sacrifice of polyandrously married males is provided by computing the average number of copies of an ego's allele in the offspring generation according to different combinations of marriage types (see Table III).

For example, four brothers could implement seven logically possible combinations of marriage forms, ranging from all four marrying monogamously to all four marrying polyandrously. Using the actual Tsang fertility data and the probability of allele transfer concept (from Table I), inclusive fitness for a male with three brothers is nearly five times greater if all brothers marry monogamously (9.75) than if they all marry polyandrously (1.97). There is considerable reduction in fitness associated with fraternal polyandry, even if only two brothers opt for polyandry (7.43).

Another possibility, derived from the notion of inclusive fitness, is that polyandrously married brothers recoup the loss of some of their reproductive potential through female siblings. Theoretically, the reproductive disadvantage of polyandrously married brothers could be offset if a sufficiently greater proportion of their sisters married and reproduced. The data indicate that this is not the case: about 72 percent of the sisters of both polyandrous and monogamous males marry.

Recent sociobiological theory emphasizes the importance of the environment, including human sociocultural systems, as a selective pressure which must be considered in attempts to explain behavior (Barkow 1978). An understanding of the costs and benefits of alternative strategies lies at the heart of sociobiological research, particularly for humans where sociocultural factors directly affect the opportunity costs of strategic options. This raises the question of why individual brothers initially marry jointly with their brothers and why they remain in these unions. This is not a hypothetical issue, for in Limi

TABLE III. AVERAGE NUMBER OF AN EGO'S HYPOTHETICAL ALLELE REPLICATED IN THE TOTAL OFFSPRING OF FOUR BROTHERS ACCORDING TO THE MARRIAGE FORM OF EGO AND HIS THREE BROTHERS, CALCULATED WITH RESPECT TO THE COMPLETED FERTILITY OF WOMEN MARRIED MONOGAMOUSLY OR POLYANDROUSLY AND THE PROBABILITY OF ALLELE TRANSFER.[a]

A.	Ego, 3 brothers each marry monogamously $1[(7.8) \times (1)(.5)(1)] + 3[(7.8) \times (.5)(.5)(1)] =$	9.75
B.	Ego, 1 brother each marry monogamously, 2 brothers marry polyandrously $1[(7.8) \times (1)(.5)(1)] + 1[(7.8) \times (.5)(.5)(1)] + 2[(6.3) \times (.5)(.5)(.5)] =$	7.43
C.	Ego, 1 brother marry polyandrously, 2 brothers each marry monogamously $1[(6.3) \times (1)(.5)(.5)] + 1[(6.3) \times (.5)(.5)(.5)] + 2[(7.8) \times (.5)(.5)(1)] =$	6.26
D.	Ego marries monogamously, 3 brothers marry polyandrously $1[(7.8) \times (1)(.5)(1)] + 3[(6.3) \times (.5)(.5)(.33)] =$	5.46
E.	Ego, 2 brothers marry polyandrously, 1 marries monogamously $1[(6.3) \times (1)(.5)(.33)] + 2[(6.3) \times (.5)(.5)(.33)] + 1[(7.8) \times (.5)(.5)(1)] =$	4.02

F. Ego, 1 brother marry polyandrously, 2 brothers marry polyandrously
$1[(6.3) \times (1)(.5)(.5)] + 1[(6.3) \times (.5)(.5)(.5)] + 2[(6.3) \times (.5)(.5)(.5)] =$ 3.94

G. Ego, 3 brothers marry polyandrously
$1[(6.3) \times (1)(.5)(.25)] + 3[(6.3) \times (.5)(.5)(.25)] =$ 1.97

[a] Calculated according to the general formula:

Completed female fertility (monogamous or polyandrous)	X	Probability of possessing ego's allele	X	Probability of passing on ego's allele	X	Probability of fertilizing wife

and Tibet multiple brothers do not always form polyandrous unions and some polyandrous unions fission when one or more of the siblings split off and establish monogamous nuclear families (Goldstein 1978). However, while monogamy clearly appears the better evolutionary strategy for an individual male to pursue, if brothers face celibacy, not monogamy, when they split off from polyandrous unions (van den Berghe, personal communication), polyandry would enhance rather than reduce fitness.

The Limi data demonstrate that monogamy rather than celibacy is, in fact, the real alternative to fraternal polyandry. There is no female infanticide and no male surplus as has been reported for parts of the Indian Himalayas (Majumdar 1955a, b; Parmar 1975). In fact, there is a large group of unmarried females in Tsang comprising 31 percent of the women over 20 years of age (Goldstein 1976). Rather than a shortage of females (or an excess of males) generating polyandry, fraternal polyandry produces a surplus of unmarried females.

Another concern is whether polyandrously married brothers desirous of fission can economically afford to marry and establish monogamous households. A common explanation of polyandry dating back at least to the Jesuit priest Desideri (DeFillippi 1937) who lived in Lhasa in the early 18th century argues that the "odious" custom of brothers sharing a wife was a necessity in Tibet because of the difficulty of eking out a subsistence existence in the harsh and infertile Tibetan plateau. If fraternal polyandry was (is) in fact a social adaptation to poverty and a last resort to preclude "beggary" as Desideri and others have speculated, it should be more characteristic of the poor in Tibet than of the wealthy. Brothers in wealthier families with abundant resources in land and animals would be able to split from their natal unit, marry monogamously, and set up and sustain neolocal independent households. Thus, one could hypothesize that the higher status/wealthier social strata (including aristocrats and various types of peasant serfs) in Tibet are more likely to opt for monogamy (maximizing individual and inclusive fitness) (Berte 1977; Alexander 1974). In fact, fraternal polyandry in Tsang is more characteristic of the wealthier/high status peasant families where 56 percent opted for polyandry[3] compared with 33 percent of the lower/poorer stratum (when two or more brothers were present in a given generation). Moreover, all brothers who fissioned from their siblings and parents were able to marry, set up independent households and raise families. There are only two unmarried adult males in Tsang; one of these is an old Tibetan refugee celibate monk and the other a middle-aged man who recently split off from his brother.[4]

The political, social, and economic factors underlying the decision to marry polyandrously or monogamously are discussed in Goldstein (1971, 1978) and are only briefly reviewed here. The Tibetans' explanation of fraternal polyandry is highly materialistic. They choose fraternal polyandry to preserve and increase the productive resources (the "estate") of their family corporation across generations. Fraternal polyandry is perceived and consciously selected as a means of concentrating labor and of precluding the division of a family's land and animals among its male coparceners. By virtue of this it is seen as a mechanism for maintaining or improving the wealth, power, and social status of the family. The motivation underlying the selection of fraternal polyandry is economic in nature but is concerned with wealth and social status, not subsistence survival.

Tibetans do not consider fraternal polyandry a highly valued end in and of itself, e.g., something to be encouraged because of a fundamental belief in the value of sibling solidarity. They can articulate quite clearly the negative aspects inherent in it as well as what, for them, are its overriding advantages. Fraternal polyandry, therefore, is not seen to be without problems. Because authority is customarily exercised by the eldest brother, younger male siblings have to subordinate themselves with little hope of changing their status. When these younger brothers are aggressive and individualistic, intersibling ten-

sions and difficulties often occur. Similarly, tension in polyandrous families may derive from the relationship between the wife and her husbands or from the brothers' relationship concerning access to the wife. While the cultural ideal in Tibet calls for equal treatment in terms of affection and sexual access, deviations from this ideal occur and generate intrafamilial tensions, if not outright conflict. Such deviations are particularly common when there is a sizeable difference in age between the partners in the marriage. Thus, while polyandry provides an answer to one type of culturally perceived problem (albeit one which the subjects see as critical), it does generate other types of problems, and the choice facing all younger male siblings is whether to trade personal freedom (monogamy) for real or potential economic security, affluence, and social prestige (fraternal polyandry). Siblings with some reservations about marrying polyandrously must assess their potential for attaining satisfactory income and social status within some reasonable period. While monogamy is clearly an alternative to polyandry, a brother must examine the opportunity cost of fraternal polyandry vis-à-vis fission.

Another dimension to examine is the timing of fission among male siblings. Brothers in Tsang and Tibet do not marry polyandrously with the hope of accumulating sufficient wealth to fission the family later and marry monogamously. Fission normally occurs when younger brothers first reach their early 20s, i.e., the normal marriage age, and fraternal polyandry is clearly not a temporary phase or strategy in a family developmental sequence.

Lastly, the possibility exists that recent environmental changes such as the introduction of modern medicine or new crops have occurred in Limi and made fraternal polyandry appear to decrease fitness whereas under traditional circumstances it actually enhanced reproductive success. However, changes such as these have not occurred. Limi is one of the most inaccessible areas in already remote Nepal. Until 1976, the nearest airstrip (actually a flat pasture area) was a 14-day trek over rugged terrain including two passes over 4,267 m. and one pass over 4,876 m. At the time Goldstein first arrived in Limi (1974), only three Westerners had ever visited the area and since that time only a few have gone for at most several days. No modern medicine is available in Limi and the nearest for at most several days. No modern medicine is available in Limi and the nearest allopathic physician is a 14-day trek on foot. The Limis, moreover, follow traditional Tibetan cultural patterns in food, dress, language, and social organization. As in traditional Tibet, cultivation of barley and herding of yak and sheep are the economic mainstays. Limi, in fact, was chosen by Goldstein as a research site precisely because it represented one of the last and purest manifestations of traditional Tibetan ecology and society (including contemporary Tibet itself).

In conclusion, this paper presents empirical data testing hypotheses derived from kin selection and parental investment theory for the Tibetan fraternal polyandrous mating system. It presents a number of arguments that could resolve the paradox of polyandrously married individuals reducing their individual fitness by hypothesizing gains they could obtain through inclusive fitness. However, considering the parameters measured, this analysis demonstrates that Tibetan fraternal polyandry does not appear to enhance the fitness of the individuals who practice it and in fact seems to entail substantial reproductive sacrifice. Its perpetuation, therefore, strongly suggests that sociocultural, economic, and political factors can perpetuate mating systems that entail significant reproductive sacrifice, i.e., can perpetuate mating systems that decrease the individual and inclusive fitness of the individuals who practice them.

NOTES

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[1] For a more detailed description of this group see, Goldstein (1974).

[2] Values of the probability of fertilization by ego (.46) and the coefficient of the term expressing the number of alleles ego's brothers may pass (1.25) are weighted averages obtained from Tsang females. Seventy-five percent of the women over 45 in polyandrous marriages have two husbands and 25 percent have three.

[3] Two low-hereditary status but exceptionally wealthy families are included in this figure.

[4] Note should also be taken that there is no norm of primogeniture in Tibetan society and all males theoretically have equal demand rights to land. Alexander (1974:371) misreads Goldstein (1971) when he cites this article as the source of his polyandry correlate that older brothers have first rights over land and wives.

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