

Responses to Environmental Novelty: Changes in Men's Marriage Strategies in a Rural Kenyan Community

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Summary. This chapter examines the use of behavioural ecological models as applied to humans in conditions of environmental novelty. On the assumption that individuals pursue behavioural strategies that maximize their fitness, predictions can be made concerning how social and ecological conditions generate a variety of optimal responses. With environmental novelty, the question arises: For how much of human history (or prehistory) can we assume that the environment remained sufficiently unchanged for appropriate behaviour to be elicited and genuine functional outcomes to be observed? Data from rural Kenya show how Kipsigis men vary their allocations to mating effort, as measured through bride-wealth payments, consistent with predictions from an optimality model. The pattern of men paying large bride-wealth payments for women of high reproductive value and high labour value disappeared in the 1980s. This shift may reflect the changing reproductive and economic roles of women, contingent on incipient demographic transition in Kenya and an increasing involvement of men in food production and the cash economy. Despite some problems with the interpretation of data such as these, a generally positive appraisal is made of the appropriateness of using behavioural ecological theory in the study of contemporary human populations, both because it provides an empirical measure of the extent to which adaptive responses are

still generated, and because it focuses attention on variability. These results challenge the view held by some evolutionary social scientists that there is no a priori reason to suppose that any specific modern cultural or behavioural practice is adaptive. At the same time these findings point to a potentially important area of congruence between behavioural ecology and evolutionary psychology, by highlighting the need to investigate decision-making rules that, on account of their sensitivity to new socioecological conditions, might contribute to the generation of cultural change.

INTRODUCTION

Debates within the evolutionary social sciences

WHILE EVOLUTIONARY APPROACHES find increasing acceptance within the social sciences (e.g., Lieberman 1989), there is still much debate over their appropriate uses and interpretation (Borgerhoff Mulder *et al.*, in press). One hotly contested issue is whether studies of *behavioural variability in contemporary populations* tell us anything about how evolution has shaped human decision making processes and human action. On the one hand, human behavioural ecologists are excited by the prospect of using contemporary ethnographic diversity to identify and test models of how humans strategically respond to varying ecological and social challenges (Smith 1992). On the other hand, evolutionary psychologists offer trenchant criticisms of some of the underlying assumptions of such a research agenda (e.g., Tooby & Cosmides 1990).

At the heart of this critique (examined in more detail in Borgerhoff Mulder *et al.*, in press) lies the issue of novel environments. For how much of human history (or prehistory) can we assume that the environment remained sufficiently unchanged for appropriate behaviour to be elicited and genuine functional outcomes to be observed? Scholars have delineated this period of time in various ways: an unspecified and variable age in the evolution of the mammals and primates, termed the 'environment of evolutionary adaptedness' (Symons 1979; Tooby & Cosmides 1990); the Pleistocene, as bounded by the Neolithic Revolution (Symons 1989); all periods up to the present (Caro & Borgerhoff Mulder 1987) or very recent past (Betzig 1989; Turke 1990). For none of these positions is there a clear rationale for specifying what is, or is not, a 'sufficiently unchanged' environment. Caro & Borgerhoff Mulder (1987), however, argue for the most radical position on methodological considerations: there are no grounds for an *a priori* determination of the environments in which either

appropriate responses are unlikely to be elicited or genuine functional outcomes observed *without empirical investigation* (see also Perusse 1992).

This chapter breaks from the somewhat sterile debate that has surrounded the question of environmental novelty, and what it means for evolutionary accounts, by moving towards an empirical test of whether and how humans respond to environmental novelty in adaptive ways; adaptive here is defined as 'likely to be fitness-enhancing in the current environment'. It examines the allocation of male mating effort (in the form of bridewealth payments) in a rapidly changing rural Kenyan community. The full results of this longitudinal study of Kipsigis bridewealth have been published elsewhere (Borgerhoff Mulder 1995), but their significance for theoretical issues within the evolutionary social sciences was not explored in the original (strictly anthropological) treatment. In more general terms, this chapter has two goals. First, it defends a controversial use of evolutionary thinking within the social sciences by demonstrating how behavioural ecology can contribute to an understanding of human behavioural and institutional diversity. Second, it points to a potentially important area of congruence between behavioural ecology and evolutionary psychology, by highlighting the need to investigate decision-making rules that, on account of their sensitivity to features of the social and ecological environment, might shape cultural change (Cosmides & Tooby 1992: 219).

Human behavioural ecology

Human behavioural ecologists explore the function of behaviour in contemporary and past populations by looking at how behaviour is a response to specific ecological and social conditions, insofar as these vary both across societies, within societies, and over time. It has been extensively reviewed in easily available recent sources (Borgerhoff Mulder 1991; Cronk 1991; Smith 1992).

The theoretical underpinnings of behavioural ecology lie in evolutionary ecology, the branch of evolutionary theory that analyzes adaptations in ecological context. Studying behaviour in relation to the ecological and social environment flourished in the 1970s, following on the innovative theoretical work of Hamilton (1964), Williams (1966), Maynard Smith (1974) and Trivers (1971, 1972). These advances opened up new ways of looking at an animal's behaviour, particularly social behaviour. In brief, individuals are viewed as facultative opportunists who assess, either consciously or not, on either the behavioural or the evolutionary time scale, a wide array of environmental conditions (both social and ecological) and determine the optimal fitness-maximizing strategy whereby they can out compete conspecifics in terms of the number of genes transmitted to

subsequent generations. As such, behavioural ecology relies on Darwinian theory in a homologous sense, and uses as theoretical tools individual selection, inclusive fitness theory, optimization models and game theory.

Two sets of assumptions are made. First, in order to develop models of optimal behaviour, behavioural ecologists typically ignore the nature of the genetic control of phenotypic design, and adopt a research strategy that has been dubbed 'the phenotypic gambit' (Grafen 1984; Smith 1992). This entails assuming that (a) natural selection can override such conflicting forces as drift, (b) sufficient genetic variation in the past has allowed evolution of the optimal phenotype, and (c) any deviations for simple Mendelian inheritance of phenotypes will not significantly affect the expected evolutionary outcome. Although disregard for the genetic control of adaptations has been criticized (Lewontin 1979), cases where the specifics of inheritance system might make a difference are thought to be rare (Maynard Smith 1982; Grafen 1984). Second, as regards the relationship between genetic differences and phenotypes, behavioural ecologists view behaviour as a flexible phenotype exhibiting reaction norms (Stearns 1989), with behaviour taking different character states in different environments. Hypothetically these different states equilibrate at different local optima, giving rise to the diverse patterns of behaviour that we see both between and within different human populations. Plasticity is a feature of great interest to evolutionists (e.g. Via 1993), and human behaviour can be viewed a prime example of this phenomenon.

The commonest research strategy within behavioural ecology, then, is to rely on the assumption that individuals behave in ways that maximize their fitness, and to develop models of how particular social and ecological configurations impact on an individual's optimal course of action. The goal is not to prove fitness maximization, but rather to use models predicated on this assumption to explain behavioural variability. As in the study of non-humans, predictions for human studies can be imported from general bodies of theory (e.g. Kaplan & Hill 1992), from comparative studies in other species (e.g. Daly & Wilson 1984), or from empirical observations on the determinants of fitness in a given population (e.g. Borgerhoff Mulder 1990).

Studies of humans do, however, raise the problem that most people now live in social and ecological circumstances that are highly altered from their 'traditional' form. While there is much debate over the extent to which any human population ever lived in a state of stability, isolation or equilibrium (Solway & Lee 1990), it is clear that recent social and ecological developments dramatically perturb the vast majority of contemporary human populations. Is it therefore reasonable to expect that men and women do still follow strategies that are fitness maximizing? This is really a double question. Is the environment sufficiently unchanged for appropriate

behavioural decisions to be elicited by particular environmental cues? Second, is the environment sufficiently unchanged for expected fitness outcomes to be commonly observed?

As regards the first question, all evolutionary social scientists (by definition) suspect that there is sufficient continuity between ancient and contemporary environments to render legitimate the assumption that humans should still, by and large, reason and behave in ways that are predictable by fitness optimization models. If this were not the case there would be no value in studying contemporary subjects at all. As regards the second question behavioural ecologists and evolutionary psychologists differ. Only the former, and particularly those working in relatively unmodernized populations, are likely to give a positive response. In other words behavioural ecologists are prepared to examine variability from the standpoint of whether or not any given strategy maximizes fitness in *that particular environment* (contemporary or historical), whilst acknowledging that the psychological apparatus whereby adaptive behavioural responses are produced, such as emotions, basic motivations, learning and decision-making abilities, are products of *past* evolutionary pressures (e.g. Irons 1991). The unstated assumption of the behavioural ecologist, then, is that critical environmental features that both affect the expression of the phenotype *and* mediate its fitness consequences have been relatively stable, and are still present (Turke 1990).

One obvious empirical substantiation of the behavioural ecological position lies in investigating how humans respond to rapid conditions of social change. While this topic has for a long time intrigued social (and socio-cultural) anthropologists (e.g. Firth 1959) it has not, at least until recently (e.g. Cronk 1989), been examined by human behavioural ecologists. Volland *et al.* (in manuscript), for example, are trying to determine the lags with which peasant farmers respond to the changing sex-specific opportunities for their sons and daughters. In this study I investigate whether and how rural African men modify their allocations of mating effort in response to changing economic circumstances.

BACKGROUND TO THE KIPSIGIS STUDY

Social organization

Kipsigis are a Kalenjin-speaking Nilotic group living in south western Kenya. Their social organization is very typical of East Africa. Marriages are commonly polygynous, and households consist of related men, typically an elderly man, his wife (wives), his married sons with their wives, and other

unmarried dependents. Descent is reckoned exclusively through the paternal line, and all heritable wealth (primarily land and livestock) are passed in equal shares to the sons of each of a man's wives.

Study site

The study area comprises two adjacent clusters of sub-locations within Abosi Location (Kericho District) and Moitanik East Location (Narok District), and is commonly referred to as Abosi, after a hill of that name. It includes land from the former Native Reserve and squatter communities settled during the 1930s. Rainfall is somewhat less than 1000 mm. per annum. Soils are primarily black cotton, of medium and marginal agricultural potential (Kericho District Development Plan 1989–93). In the study site there are three Primary Schools. A government Secondary School and a Catholic Mission Health Centre lie adjacent. Within approximately 45 km of Abosi there are three other secondary schools and two hospitals. The study was initiated in 1982, when 20 months were spent in the field, and then followed up in 1991 for a 3 month period.

Economy

In the pre-colonial period Kipsigis were agro-pastoralists, engaged in the subsistence production of eleusine and some sorghum. Animal husbandry (cattle and small stock) predominated over agriculture both economically and culturally (Peristiany 1939; Manners 1967). With the arrival in 1906/7 of the first European settlers in Kericho District, Kipsigis were relocated into densely-populated 'Native Reserves'. Maize was introduced as a subsistence and cash crop, and became increasingly profitable after World War One on account of the new market among labourers on European estates throughout the Kenya Colony (Manners 1962), and the pattern of individualized land ownership (with title deeds held by men) became legally encoded in the Swynnerton Plan of 1954. After 1960, when the ban against African ownership of European 'grade' cattle was lifted, commercial milk production soared, and was paralleled by a boom in the commercial production of maize (Daniels 1980). Concurrently the District population density escalated from an estimated 58–78/km² to 267/km² for 1993 (for references, see Borgerhoff Mulder 1995).

Women's labour has (until very recently, see below) been critical to production systems such as that of the Kipsigis. Traditionally women were almost exclusively responsible for the production of vegetable food (Peristiany 1939). During the colonial period, as maize became a cash commodity, women continued to maintain responsibility for the labour

entailed in its cultivation, even through cash derived from the valuable maize surpluses fell almost exclusively into the hands of men (Sørensen 1990; Davison 1988).

Marriage and marriage payments

Among Kipsigis a single bridewealth payment (from groom's family to bride's family) is made at the time of marriage with no formal expectation of protracted or return payments. The lump sum is constituted of livestock and (since the late 1950s in Abosi) cash. The payments are highly variable, and can be thought of as allocations to mating effort made by men with respect to the kind of wife that they attain. As is common in much of East Africa, first marriages are paid for by the groom's father, and subsequent marriages by the groom himself, although nowadays employed sons contribute some cash to their first marriage payment. The bride's parents are primarily responsible for the negotiation and final acceptance of the bridewealth offer of a potential son-in-law (for details of the negotiation process, see Borgerhoff Mulder 1988).

Bridewealth payments: previous results and new questions

A study of Kipsigis bridewealth payments transferred between 1960 and 1982 showed, amongst other things, that men paid more for women who reached menarche early (Borgerhoff Mulder 1988). Insofar as early maturing Kipsigis women have higher reproductive success than later maturing women, due to their longer reproductive lifespans and higher fertility rates, this result was interpreted as adaptive variation in the exertion of male mating effort, with men paying particularly heavily for women of high reproductive value (Borgerhoff Mulder 1989).

The original study also showed that men paid more heavily for brides who lived outside the small geographically defined local community. In conjunction with the finding that women whose natal homes were distant offered a more reliable source of labour than did women whose natal homes were local (the latter spent disproportionate amounts of time helping out their mother rather than working in their marital home), an adaptive rationale was also placed on this result: high payments for distant brides reflect the tendency for men to make heavy bridewealth payments for women who offered high labour value.

These results, and more precisely their interpretation, lead me to predict that the covariates of bridewealth are likely to vary between different societies, depending on the specifics of the systems of reproduction and production (Figure 1). Specifically, I suggested that 'in societies where it is

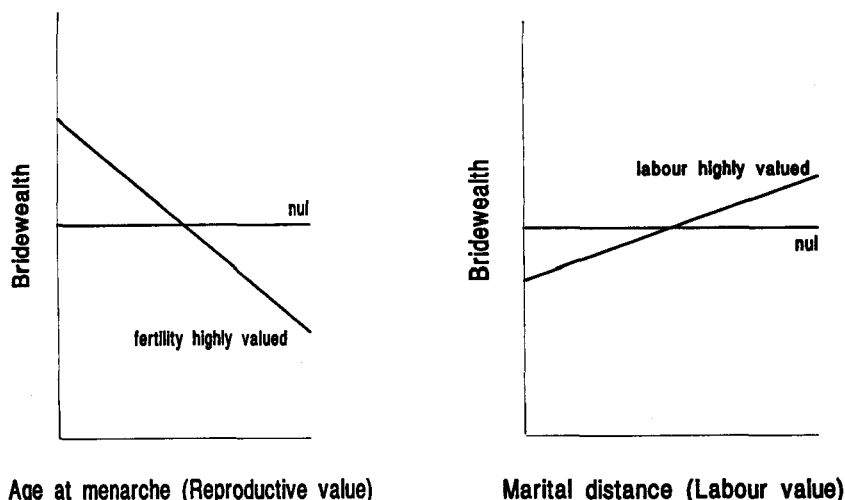


Figure 1. Some hypothetical effects of reproductive value and labour value on bridewealth. (A) Using age of bride at menarche as an indicator of reproductive value the two functions describe how the differential evaluation of reproductive value in different populations might affect negotiated bridewealth outcomes. (B) Using distance between natal and marital home as a measure of the alienation of women's labour services, the two functions describe how differential evaluation of women's labour in different populations might affect negotiated bridewealth; see text for details. (Modified from Borgerhoff Mulder 1988.)

important to produce a large number of children, for example where offspring mortality is high, or where children are not excessively costly to raise, as in labour-intensive systems of production, female reproductive potential will be highly valued' (Borgerhoff Mulder 1988: 78). Alternatively, 'where production of a large family is not feasible, either because children constitute a net cost or because production is limited by capital rather than labour assets, women of high reproductive value may not be more expensive than those of lower reproductive value'.

In similar vein, I predicted that interpopulational differences in the importance of women's economic roles would be associated with the covariates of bridewealth. 'Where women play a critical role in a labour-intensive mode of production, men will pay highly for total control over their wives' labour. Alternatively, where women's labour inputs are less important, differential access to a wife's labour services may not be associated with any variability in bridewealth' (Borgerhoff Mulder 1988: 79).

In the original paper some qualitative supportive evidence was brought from other ethnographic studies to support these propositions. In 1992 I had the opportunity to return to Kenya and test these hypotheses, not across populations as I had originally intended but using longitudinal data

on the Kipsigis. Specifically I designed a study by means of which data on bridewealth payments prior to my previous field study could be compared with similar data for the last decade. By way of introduction to these new results, a summary of some of the pertinent economic and social changes in Abosi during the last decade will be outlined.

LONGITUDINAL ANALYSES

Changed historical conditions

Kenya in the 1980s showed signs of reduced economic expansion, with a slowing in the growth rate of real Gross Domestic Product, weakened investment, a hike in inflation rates, and rising costs of agricultural production. Indeed the only boost in the economy was in employment, particularly the informal sector (Economic Survey 1991). The causes of these changes are complex, but are clearly linked to political instability, the retraction of foreign aid programmes to Kenya and the worldwide economic recession. For rural areas such as Abosi, these developments lead to increasing poverty, greater differentiation in wealth holding, and an emergence of a wealthy strata of landholders with sufficient land on which to support one or more families (for details, see Bergerhoff Mulder 1995, Table 1).

Since the early 1980s, for reasons that are unclear, less maize is being sold to the national marketing board, and for a much lower price. Consequently many families are turning to the profitable sale of milk, and a local cooperative has been formed to deliver morning milk to a dairy processing plant 40 km away. Men, retaining their traditional exclusive rights to morning milk, gain directly from the cash thereby generated. In addition, several younger men have begun raising cash through the sale of chickens, eggs and vegetables, commodities traditionally reserved for trade by women; with bicycles, men can take larger quantities to local markets, thereby out competing women (who walk with produce on their backs or in

Table 1. Changes in percentage of income from the economic activities of men and women.^a

Source of income	1982-83	1991	Sex-specific responsibility
Sale of surplus milk	57	25	Primarily women
Sale of vegetables, etc.	5	12	Men's participation increasing
Sale of surplus milk	21	35	Mainly men
Employment	17	28	Almost exclusively men

^a Data with interviews with household heads and their wives ($n = 98$, $n = 88$, for 1982-83 and 1991 respectively; 1982 and 1983 scores averaged).

Table 2. Interview responses of women concerning family limitation.

	Date of interview	
	1982-91	1991
<i>Desired family size—modal value</i>		
Women aged:		
20-24 (n = 18)	8	7
25-29 (n = 16)	8	6
<i>Use of non-traditional birth control methods</i>		
All women (n = 114)	0	2

baskets). Kipsigis of Abosi see this intensification and diversification in cash-producing activities as resulting from increased land shortages. The key social effects of these changes in the Abosi economy over the last decade are that (a) less of the family income depends on women's work in maize production, and (b) men are responsible for a greater proportion of the household's cash income. The data in Table 1 confirm this conclusion: in the 1990s, earnings from maize appear to contribute less income to the household than do earnings from local marketing of other produce and from off-farm employment, both activities pursued almost exclusively by men.

Finally, with respect to demographic patterns, fertility limitation is finally in evidence in rural Kenya. Land already seen as in short supply in the early 1980s is now the focus of intense inter-ethnic conflicts in many parts of Kenya, including Kericho District. Family limitation, not commonly discussed in the early 1980s, is increasingly seen as a necessary response to the daunting challenge of feeding families of seven or more surviving children on farms often averaging little more than 2 or 3 hectares. Though I have no detailed analyses of changes in fertility in the Abosi sample, desired family size has declined (Table 2). More generally, total fertility declined from 8.2 (1973-77) to 6.7 (1984-88), with Kericho District showing a typical 22% decline (Brass & Jolly 1993). In addition it seems as if the rate of decrease accelerated in the late 1980s. The general interpretation of this finding is that Kenyans are producing fewer live births and investing more heavily in the survival and education of those that they do produce, in response to reduced land availability and the increased costs of (and payoffs to) education. Government programmes in health and education, as well as private family planning organizations, have clearly facilitated this transition.

Sample and methods

Data on 248 marriages are divided into four time blocks (1952-61, 1962-71, 1972-81 and 1982-91). Payments for marriages in which the bride was

reported pregnant, had already produced a child, or was being married by another woman were excluded ($n = 19$), since these are typically characterized by low bridewealth and constrained negotiation (e.g. Borgerhoff Mulder 1988). From the remaining cases, those for which the full array of independent variables are not available are dropped, leaving a resulting sample of 200 marriage payments, and a reduced sample for those with data on menarcheal age (see below).

Marriages in which the bride was the first, second or subsequent wife are all analyzed together since bridewealth values do not vary according to marital status in either this or the earlier study. Payments for secondary wives are highly variable: some are very expensive on account of the wealth of the suitor; some are very cheap, on account of the higher incidence of pregnant women or unmarried mothers falling into this category (see similarly for the Sebei, Goldschmidt 1974); controlling for these factors shows no overall influence of marital status *per se*.

Statistics were calculated using SPSSpc, with 2-tailed significance values reported. Analyses of variance were conducted, with coefficients of linearity, main effects and interaction effects reported in the figure legends. All main and interaction effects reported are independent of other significant factors affecting bridewealth at the appropriate period in this population; the multivariate analyses showing the independence of these effects are reported elsewhere (Borgerhoff Mulder 1995, Appendix).

Reproductive value

In the original study, menarche was dated to the year preceding clitoridectomy, according to the Kipsigis custom of sending girls for their initiation in the December following first menses. There are increasing difficulties in dating menarche to the year preceding clitoridectomy because of the tendency of young women pursuing education to defer their initiation ceremony until they finish primary school. Thus only girls who failed to proceed beyond Standard 5 were used for this analysis; the typical pattern among these girls was for them to leave school at between 12 and 14 years of age, and then undergo clitoridectomy. In this sub-sample then we can be reasonably certain that age at clitoridectomy provides a good indicator of age at menarche. Furthermore in 33% of this sub-sample I was able to confirm *without exception* that clitoridectomy had been precipitated by first menses (as reported by the subject or her mother) within the preceding 11 months.

The effects of menarcheal age on bridewealth transferred at marriages that occurred between 1952 and 1981 is confirmed in this sub-sample. Prior to 1982 high bridewealth was paid for women who reached menarche at a relatively young age; these women enjoy longer reproductive life spans and

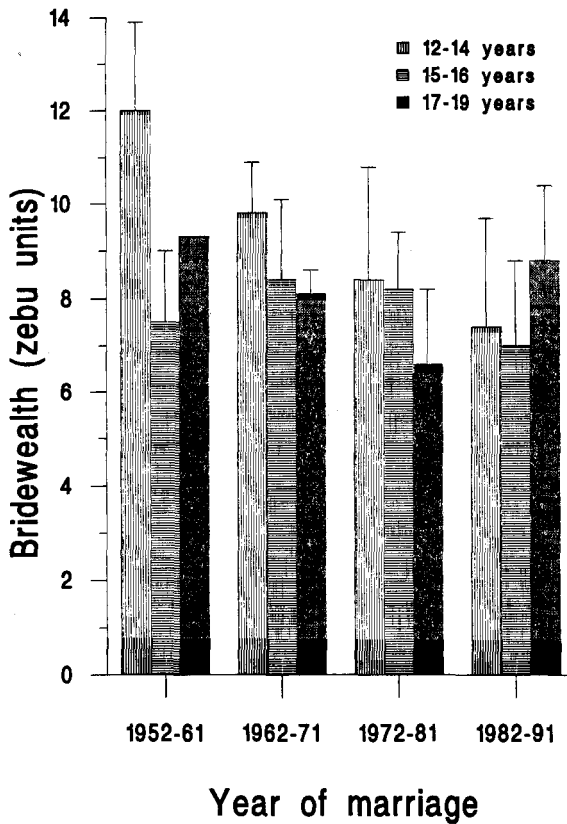


Figure 2. Bridewealth and bride's age at menarche ($n = 101$). Age at menarche classified as 12–14 years, 15–16 years, and 17–19 years. Analysis of variance shows a main effect of age at menarche ($F_{2,95} = 5.83$, $P = 0.004$) and an interaction with time block categorized as 1952–81 and 1982–91 ($F_{2,95} = 4.28$, $P = 0.017$). For explanation for reduced sample size, see text. (From Borgerhoff Mulder 1995.)

higher fertility than do later maturers. The relationship however disappears in the last decade (Figure 2). Grooms are no longer willing to offer large payments for early maturing women.

Labour value

A very similar effect is seen when we consider marital distance. Prior to 1982 higher payments were made for women whose natal homes lay outside of the local community than for women who came from nearby; brides from distant marital homes offer a more reliable labour service to their husband and his kin than do women whose natal homes are close by. In recent times, however, the pattern appears to be changing (Figure 3). Men are no longer

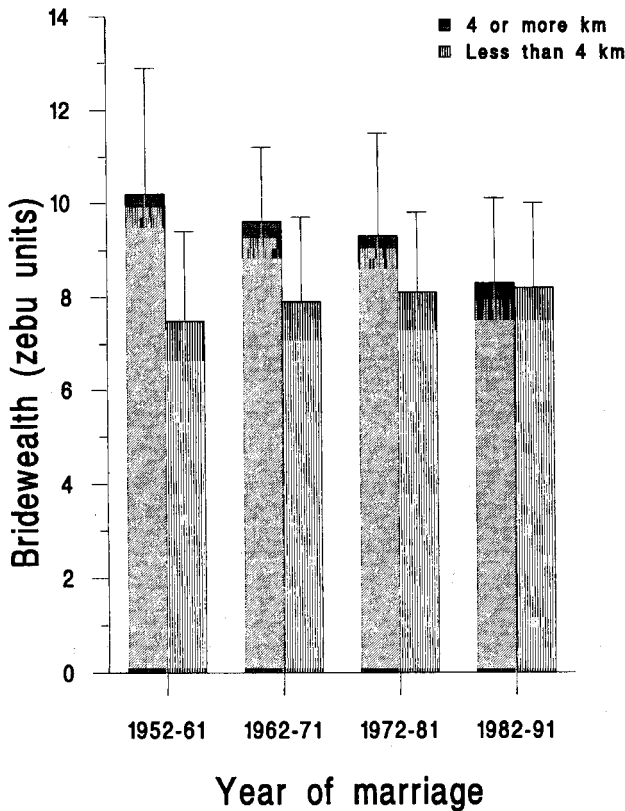


Figure 3. Bridewealth and distance between natal and marital homes ($n = 200$). Marital distance classified as less than 4 km or 4 km or more. Analysis of variance shows a main effect of marital distance ($F_{1,196} = 12.081$, $P < 0.001$) and an interaction with time block categorized as 1952-81 and 1982-91 ($F_{1,196} = 7.75$, $P < 0.006$). (From Borgerhoff Mulder 1995.)

willing to offer large payments for women who are particularly likely to make a reliable labour contribution.

Summary and interpretation

There has been a marked change in how both age at menarche and marital distance are associated with bridewealth. While grooms used to pay highly for brides of who reached menarche early and for brides whose natal home was distant, this pattern disappears in the 1980s. This shift in the covariates of bridewealth may mirror the changing economic and reproductive roles of women. Specifically, the loss of the menarche effect may be associated with a devaluation in the value of women's fertility, indicated by the overall decline

in large families at both the national and district level. In similar vein the loss of the marital distance effect may result from a devaluation of women's productive work, reflecting larger structural changes, in particular the drop in the price of maize, the new market orientation in dairying, increased agricultural intensification (particularly by men), and the fact that it is increasingly land and not labour that limits production.

DISCUSSION

Support for the optimality model

The simplest interpretation of these findings is that men modify their mating effort in response to changing circumstances, such as new norms pertaining to fertility and alterations in the division of labour between men and women. These modifications are at least qualitatively consistent with an optimality model. In other words, although such features as birth control technology, a crash in the national maize market, and worldwide economic recession are clearly twentieth century phenomena, the *impact* of these developments on the marriage payments of rural Kenyans are somewhat as one would predict from simple optimality reasoning, predicated on the assumption of fitness maximization. These results therefore challenge the view held by some evolutionary psychologists that there is no a priori reason to suppose that any specific modern cultural or behavioural practice is adaptive (fitness maximizing). From the perspective of behavioural ecology, such a view precludes empirical investigation of interesting, and as yet unanswered questions about the range of human norms of reaction.

Problems of interpretation

Clearly there are many shortcomings to an analysis and interpretation such as this, problems which only far more detailed longitudinal data can remedy. First, the causes of the change in male mating effort allocation are attributed entirely on the basis of correlations between broader socio-economic developments and the changing covariates of bridewealth. Furthermore, there is in effect only a sample size of two periods (1952–1981, and 1982–1991). Conceivably then the decline in bridewealth paid for early maturers may bear no relationship whatsoever with the current demographic transition in Kenya, or with the hypothesized decline in the value of women's fertility. As with all naturalistic studies, we have to rely on inference (and all its inherent shortcomings), rather than experiment. However in the absence of any other obvious explanation for why Kipsigis

men should no longer place such high value on early maturing women (see below), consistency with a deductively derived model should lend some credence to the interpretation.

Second, this study does not show whether by modifying their mating effort allocations in this way, Kipsigis men are in fact increasing their fitness (conventionally measured as number of descendants). This raises the much broader question, quite beyond the empirical scope of this paper, of whether or not parents can increase their fitness by decreasing the number of their births. While this is an obvious prediction from Lack's (1968) work on optimal clutch size, and has commonly been adduced as a rationale for demographic transition in human societies (Turke 1989), there is as yet no clear evidence that reductions in the F1 generation serve to enhance overall numbers of descendants, at least as determined from longitudinal studies in western populations (Kaplan *et al.* 1995; no such long term data are available for rural Kenyans, since fertility limitation is only in its very early stages). It is clear, however, that in many rural communities in the developing world, particularly those in which resources are already severely stretched, an offspring's chances in life are negatively affected by large family size (for Kipsigis, unpublished results). Therefore placing value on, for example, a woman's education (see Borgerhoff Mulder 1995) rather than her reproductive value may in the long term prove to be fitness-enhancing; but clearly this is unsubstantiated at present.

Alternative explanations

To what extent can we rule out alternative explanations for the disappearance of the marital distance and age at menarche effects reported here? First, it is possible that the declining wealth of the people of Abosi (Borgerhoff Mulder 1995) leads to a reduction in the *variability* in bride-wealth payments, and hence to the likelihood of a correlation being observed. This is not the case: although there has been an overall decline in the size of payments in the last decade (*ibid.*), the variability has remained stable. This therefore seems an inadequate explanation.

Second, it may be that young couples in the 1990s have more autonomy with respect to their marital choices than they did in the past. Under such circumstances, they may have a greater role in the negotiation of their bridewealth transaction, with personal (and perhaps idiosyncratic or unquantifiable) qualities counting for more than, for example, marital distance and age at menarche. While there is some qualitative indication that younger couples do take more initiative in their choice of spouse than formerly, my suspicion is that this freedom is still strongly limited by, in the

case of sons, the threat of disinheritance, and in the case of daughters, their almost complete dependence on their mothers and fathers; no unmarried women in the study site had any significant source of independent income. Furthermore, the details of the bridewealth negotiation remain, almost entirely, within the ambit of the senior generation, following many of the same procedures and traditions described over 50 years ago by Peristiany (1939). In addition, the fact that bridewealth payments covary with socio-economic characteristics of the bride and groom (education, and wealth and education respectively) in ways entirely compatible with the explicit strategies of parents-in-law (Borgerhoff Mulder 1995), indicates that it is still primarily the senior generation that is responsible for negotiated bridewealth outcomes. In short, young couples may have more autonomy these days, but the politics surrounding bridewealth are still primarily the province of parents and elders.

Understanding of mechanism

Even the original finding, that men pay more for women who reach menarche early, raised problems in terms of the *mechanisms* underlying such a decision rule. First, Kipsigis were not aware of the fact that they made higher payments for early maturing girls. Second, even if they had been aware of this tendency, they were rarely cognizant of the exact age of one another; indeed I spent much time ageing women, establishing the dates of their birth and clitoridectomy by means of age ranking, cross-comparisons, and cross-referencing to externally verifiable events. To what mechanisms can the correlation between menarcheal age and bridewealth be attributed, if most people are unaware of exact age?

Detailed analysis of bridewealth payments that were under negotiation while I was in the field (1982–83) showed that other more directly observed phenotypic traits affected the size of the payment. Brides classified as 'skinny' were significantly cheaper than those classified as 'plump' (Borgerhoff Mulder 1988). Since there is some association, if not direct, between fat deposition and early menarche, I suggested that a woman's shape and body form might act as a cue whereby menarcheal age, and subsequent reproductive success, could be assessed. This could lead to a rule of thumb: pay more for fatter than thinner brides (for detailed support of this argument, see Borgerhoff Mulder 1988).

But what mechanisms might underlie the *changing* covariates in bridewealth payments? Can we really expect that men should be motivated to pay heavily for women classified as fat rather than thin in one decade, and not in the following decade, (and similarly with respect to marital distance)? Even though the empirical findings suggest this is the case (and theory

predicts such a response), the mechanistic underpinnings of this behaviour remain totally obscure. This would seem to be a prime example of how studies of function can and should inform studies of mechanism, as recognized by Cosmides & Tooby (1992:218). The challenge now is to conduct a far more detailed study of mate preferences, or perhaps daughter-in-law preferences, using the methods developed by evolutionary psychologists within the framework of functionally-inspired behavioural ecological anthropology.

The contribution of human behavioural ecology

Evolutionary social sciences consist of three separate though ideally complementary fields: cultural inheritance theory, evolutionary ecology and human behavioural ecology. Each has a distinct and powerful contribution to make towards an understanding of the forces that have shaped human evolution and diversity (Blurton Jones 1990). The particular strength of human behavioural ecology, as argued in this paper, is to explore diversity and change within the paradigm of an optimality approach. On the somewhat onerous assumption that individuals, even in contemporary populations, behave in ways that maximize their fitness, predictions can be made regarding how environment and conspecifics shape different individuals' courses of action in different ways. Under perfect field conditions this methodology allows an empirical determination of the limits of adaptation—how far can the environment be varied before appropriate adaptive responses producing true functions are no longer observed? Under normal (and rather less perfect) fieldwork conditions, such as those reported here, this methodology reveals novel findings that stimulate further questions about fitness and mechanism, questions that probe the validity of the onerous assumption noted above. If this assumption, so widely appropriate for all other life forms on earth, is to be modified, it seems greatly preferable to do so on the basis of *empirical data*, rather than on the basis of some idiosyncratic judgment, as for example denoting the Neolithic revolution as a critical threshold beyond which human behaviour can no longer be explained in terms of its likely fitness consequences. More generally, and with many more studies such as this, we can start to build a more complete picture of how and why humans do, and do not, respond to novel conditions in adaptive ways.

A second important contribution from behavioural ecology is that it challenges the somewhat stereotypic characterizations of, for example, mating strategies that have dominated much recent work in evolutionary psychology. Researchers in this area tend to look for the kinds of sex

differences that are typical of mammalian patterns of reproduction and parental care (Trivers 1972), and therefore expect men to be particularly concerned with beauty and health, and women with wealth and ambition. In fact there is plenty of evidence that sex specific preferences and strategies are highly variable, both across cultures and over historical periods. The data presented here show subtle variability over only a very short time scale, at least in terms of what men are willing to pay for in women. Exploring this variability remains the principal challenge of human behavioural ecology, and will hopefully become more central to the design of research within evolutionary psychology.

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