DOUGLAS R. WHITE
MICHAEL L. BURTON
University of California, Irvine

Causes of Polygyny: Ecology, Economy, Kinship, and Warfare

We discuss and test competing explanations for polygyny based on household economics, male-centered kin groups, warfare, and environmental characteristics. Data consist of codes for 142 societies from the Standard Cross-Cultural Sample, including new codes for polygyny and environmental characteristics. An explanatory model is tested for the worldwide sample using regression analysis, and then replicated with regional samples. We obtain convergent results with two different measures of polygyny, cultural rules for men's marriages and the percentage of women married polygynously. We conclude that the best predictors of polygyny are fraternal interest groups, warfare for capture of women, absence of constraints on expansion into new lands, and environmental quality and homogeneity.

NOTHING COULD BE MORE CENTRAL TO THE ANTHROPOLOGICAL TRADITION than the study of kinship, marriage, and gender. Within this domain, variations in the frequency and form of polygyny play a critical and poorly understood role. We can readily disprove simplistic hypotheses about polygyny, such as the belief that it exists mainly to satisfy male sexual appetites, but developing a comprehensive model of polygyny has proved elusive. In this article we present a model of general polygyny that improves upon existing explanations and replicates across world regions.

General polygyny, our dependent variable, requires access to large numbers of potential wives, something which is difficult to effect through wives' kin networks. Hence, general polygyny tends to be nonsororal. In its most extreme form, general polygyny falls into a pattern where all men aspire to marry polygynously, where most men succeed with age, and where success increases the chance of future success (Spencer 1980). It is associated with separate residences for co-wives, and with a pattern of aloofness between husbands and wives (Whiting and Whiting 1975).

Nineteenth-century evolutionary theorists thought polygyny occurred in the middle stages of societal evolution. For example, Engels posited three evolutionary stages: group marriage, polygynous marriage, and monogamy. He saw monogamy as developing with civilization and social classes (Engels 1972 [1884]:129) and coinciding with a decline in female status. Engels's notion that polygyny occurs mainly in the middle ranges of societal complexity is supported by cross-cultural research (Martin and Voorhies 1975; Blumberg and Winch 1972; Osmond 1965). Although useful for generating hypotheses, these kinds of evolutionary studies do not constitute explanations, since they do not identify the processess that cause polygyny to be most common in middle-level food-producing societies.

Sociobiologists view polygyny as a reproductive strategy by which men maximize the number of their offspring but minimize investment in each child, called the r-strategy (Alexander et al. 1979; Alvard 1986; Chagnon 1979; Hartung 1982). These analyses sug-

DOUGLAS R. WHITE is Professor, School of Social Sciences, University of California, Irvine, CA 92717. MICHAEL L. BURTON is Professor, School of Social Sciences, University of California, Irvine, CA.

gest that polygyny has more reproductive benefits for men than for women, and in so doing direct our attention to social circumstances that favor men in reproductive decision making. The male-centered view is qualified by Hartung (1982), who notes that polygyny allows women to have large numbers of grandchildren, provided they have sons. Hence, mothers will form alliances with their sons to favor the allocation of additional wives to their sons rather than to their husbands (Hartung 1982:5).

While describing the parameters of reproductive decisions within polygynous societies, sociobiologists tell us relatively little about cross-societal variations in the rate of polygyny. For these explanations we must turn to the cross-cultural literature, which emphasizes the roles of economics and warfare.

Economic Explanations for Polygyny

We find two kinds of economic explanations for polygyny, one based on household economics, and a second based on the degree of agricultural intensification. Three studies (Boserup 1970; Goody 1976; Burton and Reitz 1981) link the two explanations.

Explanations for polygyny based on household economics see polygyny as a consequence of rational choices made by household members. Grossbard (1976, 1980, 1984) develops a formal economic model of polygyny based on Becker's (1981) work and tests it with Nigerian data (Cohen 1971; Steckle and Lewanyk 1973). Grossbard's model focuses on the supply and demand for, and trade-offs among, the gender-specific types of household and wage labor. Defining income to include both cash and imputed value, Grossbard posits that married men are able to benefit from female income through family labor, but not from female income through wage labor. Hence, the benefit to men and women from marriage will depend upon the relative quantities of female income from family versus wage labor. Grossbard derives several hypotheses, including:

1. As the value of women's subsistence contributions ("domestic income") increases, polygyny becomes more likely, since the income that men gain from marriage increases.
2. As women's wage opportunities outside the domestic domain increase, polygyny decreases.
3. As inequality among men increases, polygyny increases, since women will choose to marry wealthy men who already have several wives. Further, wealthier men will be more likely to choose polygynous marriages.
4. Homogamy decreases the incidence of polygyny by limiting the possibilities for polygynous marriages.
5. As the sex ratio decreases, polygyny will increase.
6. If there are economies of scale in polygynous households, polygyny is more likely.

Grossbard's first hypothesis appears frequently in the cross-cultural literature. Heath (1958) hypothesizes that polygyny and bride price will both increase with women's economic contributions, and finds modest positive correlations to support his hypotheses. Osmond (1965) obtains a positive correlation between female economic contributions and polygyny only for the societies without plow agriculture, whereas Burton and Rietz (1981) find a positive relationship between polygyny and female contributions to crop tending, when controlling for the presence of plow agriculture. Lee (1979) finds a positive correlation between polygyny and female subsistence contributions for agricultural and gathering societies, and a negative correlation between these two variables for fishing, hunting, or herding societies. Finally, Ember (1984) finds no relationship between total female subsistence contributions and polygyny. These studies paint a mixed picture of the relationship between female subsistence contributions and polygyny, suggesting that it may be valid only for agricultural and gathering societies.

The household economics model is intriguing, but it cannot address the larger political, economic, or ecological factors that affect polygyny. Even Grossbard's model begs for understanding of the exogenous causes of variations in its independent variables—the sex ratio, homogamy, social inequality among men, and female domestic income. The

literature on agricultural intensification, though limited to agrarian societies, may offer more fruitful hypotheses about cross-societal variations. This literature seeks to explain the very low frequency of polygyny in plow-farming societies. Both Goody (1976) and Burton and Reitz (1981) show that this is not simply due to low female subsistence contributions in plow farming.

Goody (1973) argues against the female contributions hypothesis. He notes Dorjahn's (1959) comparison of East and West Africa, showing higher female agricultural contributions in East Africa and higher polygyny rates in West Africa, especially in the West African savannah, where one finds especially high male agricultural contributions. Goody says, "The reasons behind polygyny are sexual and reproductive rather than economic and productive" (1973:189), arguing that men marry polygynously to maximize their fertility and to obtain large households containing many young dependent males.

In *Production and Reproduction* (1976) Goody hypothesizes that plow agriculture, economic differentiation, and a complex polity act to produce bilateral inheritance and/or dowry, two social institutions that transmit part of a man's property to his daughters, either when he dies or when they marry. Goody claims that this mode of property transmission requires the husband's estate to be matched with the wife's estate, and that it would be difficult for a man to make more than one of these arrangements, so that polygyny will be infrequent. Hence, Goody foreshadows Grossbard's hypothesis about the relationship between homogamy and monogamy. He tests his model cross-culturally, finding empirical support for it with a path analysis.

Boserup (1970) explains the lack of polygyny in plow-farming societies in terms of access to land, saying that polygyny occurs in long-fallow agricultural societies with communal land tenure and land available for expansion, where "an additional wife is an additional economic asset which helps the family to expand its production" (1970:38). This view also appears in Goldschmidt and Kunkel, who say that "polygyny is advantageous where two conditions prevail: (1) the women do the bulk of the farm work and (2) land can be readily obtained for successive wives" (1971:1061).

Both Goody and Boserup focus on the acquisition and transmission of land, with Boserup emphasizing expansion into new lands in polygynous societies, and Goody emphasizing the inheritance of scarce land in monogamous societies. It will prove useful to generalize this thinking beyond agricultural societies by expanding the scope of the theory to include resources other than land.

A weakness of the economic theories of polygyny is their failure to specify demographic mechanisms by which polygynous societies have more wives than husbands. Explanations for polygyny based on warfare suggest some of these mechanisms. Before we discuss warfare it will be useful to discuss in some detail the demographic processes that affect the ratio of wives to husbands.

The Demographic Perspective

Several demographic processes produce larger numbers of married women than married men. These processes may affect the adult sex ratio or the relative proportions of adult males and adult females who are married. Both endogenous and exogenous processes can affect the adult sex ratio. Possible endogenous processes include an effect of polygyny upon the natal sex ratio (Whiting 1977), and higher male mortality from disease, warfare, or dangerous occupations such as hunting, ocean fishing, or male labor migration (Dorjahn 1959). High male mortality may explain in part the increase in polygyny with male contributions to hunting, fishing, and herding (Lee 1979).

Exogenous processes include male labor migration, capturing women, and moving women at marriage with payment of bridewealth. Of these, we think capture of women is an especially important variable; many early ethnographies describe capture of women in warfare, along with marriage of the captives. We assume that there is intraregional variation in polygyny rates, and that this variation may be related to variations in the rate of taking captives (Dow 1983).

The proportions of adults who are married will be affected by the ease of divorce and remarriage, and by the sex difference in age of first marriage. The difference between mean male and female marriage ages can be as much as ten years, and can have a large effect on the ratio of wives to husbands. This variable is emphasized by Dorjahn (1959). Witkowski (1975) and Ember (1984) find significant relationships between polygyny and delayed marriage for males. Delayed marriage for men is often associated with the presence of a class of warriors; hence, this custom is correlated with warfare.

High male mortality from warfare, disease, or dangerous occupations will magnify the effect of differences in marriage age by reducing the cohort of older men relative to the cohort of younger wives. An expanding population also will interact with age differences at marriage, by increasing the cohort of younger wives relative to the cohort of older married men. The interaction of age differences at marriages, differential mortality, and an expanding population can easily produce an average of more than two wives per husband. It is this interaction effect that makes the difference in marriage age an especially powerful mechanism affecting polygyny.

Warfare and Polygyny

Murdock (1949) sees polygyny as based on high female contributions to subsistence, and as part of a complex that includes "movable property in herds, slaves, or other valuables" (1949:205), patrilocal or avunculocal residence, and warfare. Of war, Murdock says that it "enhances men's influence and brings them captive (and hence patrilocal) wives and plunder wherewith to buy other women" (1949:207).

Ember (1947) hypothesizes that polygyny is a consequence of high male mortality in warfare, which reduces the sex ratio. In a second article Ember (1984) tests the hypothesis that polygyny is associated with a delayed age for marriage of males, male mortality in warfare, and internal warfare. In both studies Ember finds empirical support of his hypotheses. Dow (1983), however, finds the demographic evidence on male mortality in warfare in relation to the adult sex ratio to be equivocal.

Dorjahn (1959) says African warfare emphasized taking captives, rather than killing the enemy. Kelly's discussion of Nuer warfare provides an interesting perspective on this phenomenon. In Nuer warfare the main casualties were younger men and older women, with male and female mortality being almost equal. Younger women and children were captured. Female captives were valued because they could be used to generate bridewealth when they were married to other Nuer, whereas captive boys were adopted into the lineage of their captor and would require bridewealth payment when they married. Consequently, few males were taken captive (Kelly 1985:56–57).

It is possible that male and female mortality in warfare are highly correlated and that both are associated with the taking of captives. If so, then Ember's relationship between male mortality and the sex ratio may be spurious, with the stronger relationship being that between mortality in warfare and the taking of captives. We will test these alternative hypotheses in the study that forms the core of this article.

Warfare may include plunder of resources rather than capture of women; in many cases, plunder may be transformed into the means of bridewealth payment. A community that is richer than its neighbors can easily take more wives than it gives and if it is a militarily dominant community, it may be able to steal the means of bride price payment, hence indirectly obtaining surplus wives from its neighbors, in addition to directly capturing wives. Hence, the position of a society in a local political network may have a strong effect on its adult sex ratio.

Polygyny and the Environment

With high rates of general polygyny, it becomes important for men to have access to the resources needed for support of large polygynous families. The need for access to resources will be even greater if there is rapid population growth. Polygyny will be con-

strained by any factor that constrains access to resources, including dependence upon a single plot of farm land (Boserup 1970), or dependence upon a single lagoon or river for fishing. Expansion into new territory through success in war, or through migration to unoccupied lands, will increase access to resources, and facilitate polygyny.

Ease of acquisition of new lands will be affected by environmental characteristics. A high-quality environment will provide more resources. A homogeneous environment will make movement to new territories easier, first because it poses fewer physical barriers to migration, and second because it will be easier to adapt to an environment similar to the previous environment.

Verdon (1983) compares two Ewe communities, a forest zone community with lower rates of polygyny and a savannah community with higher rates of polygyny. Verdon argues that higher levels of polygyny in the savannah community are associated with fissioning and migration to new communities. In the forest community, there is no level of sovereignty higher than the village, whereas the savannah communities are integrated at a regional level; hence, forest zone migrants lose their clan memberships and political rights, whereas savannah zone migrants maintain those rights. Verdon postulates general differences between forest and savannah adaptations in rates of polygyny, saying "Savannah environments may then be intrinsically more conducive to polygyny" (1983:20). This conjecture is supported by White, Burton, and Dow's (1981) study, which finds the highest levels of African polygyny occurring in the savannah region. We think the high rates of polygyny in the African savannah are due to the facilitating effect of this homogeneous, high-quality environment.

A Multivariate Model of General Polygyny

Following the reasoning above, we hypothesize that the incidence of general polygyny will be a function of variables that (1) affect the flow of women across community boundaries, (2) facilitate societal expansion, or (3) constrain societal expansion.

1. The flow of women across community boundaries, in turn, is affected by at least three factors:

a. *Male-centered residence with bridewealth*, sometimes called fraternal interest groups. Residence patterns (patrilocal, virilocal, or avunculocal) that aggregate related males within the same community make it easier to import women from other communities. Bride price provides a motive for the movement of women at marriage, and also allows men to transform wealth into wives or, at the class level, wealth inequality into marriage inequality. Furthermore, bride price provides a motive for marrying women early, so as to collect bride price early, and for delaying the age of marriage of men, so as to delay the bride price payment, thereby increasing the difference in marriage ages (Boserup 1970:44). Hence, we hypothesize that fraternal interest groups will have a positive effect upon polygyny.

b. *Warfare with plunder or marriage of captive women.* Capture of women reduces the adult sex ratio, making higher rates of polygyny possible; plunder of such resources as cattle provides an exchangeable resource for marriage transactions. Further, warfare with plunder will increase wealth differentiation among men. Given Grossbard's prediction that social differentiation among men will be associated with higher levels of polygyny, plunder should cause increasing polygyny even in the absence of the capture of wives. Since the capture of wives may decrease social differentiation by allowing younger warriors to obtain wives without paying bridewealth, the two variables may have different effects on polygyny.

Cross-culturally it appears that marriage of captives is usually accompanied by warfare for plunder. It is possible, however, to have marriage of captives without plunder. An example is the Tallensi. Fortes (1967 [1945]:239), describing Tallensi warfare, says that it was prohibited to kill enemy women or children, or to "carry off any of the enemy's possessions." In a second account Fortes (1949:83) says that "it is permissible, nay, com-

mendable, to abduct the wife of a member of a distant, unrelated clan," and describes this kind of wife-stealing as a cause of warfare.[1]

c. *A small population.* A smaller total population allows external warfare with capture of wives to have greater proportional effects on the rates of polygyny. We hypothesize an interaction between population size and marriage of captives, so that a small population enhances the effect of marrying captives upon polygyny.

2. As discussed above, we hypothesize that environmental quality and homogeneity will facilitate societal expansion. High-quality environments will provide more resources for the support of large polygynous families; homogeneous environments facilitate migration and adaptation to new territories. The quality of an environment tends to decrease with cold or aridity, so that dry polar regions are lowest on environmental quality, and moist tropical regions highest. Grasslands are among the most homogeneous environments; mountains and rain forests among the most heterogeneous.

We see environmental quality as interacting with environmental homogeneity to generate the optimal conditions for general polygyny. We hypothesize that tropical savannah—a homogeneous and high-quality environment—will have a positive effect on polygyny. We further hypothesize that three low-quality or heterogeneous environments—highlands, desert, and polar environments—will have negative effects on polygyny.

In theory, high female subsistence contributions may facilitate expansion by making it easier for the polygynous household to support itself. However, the empirical studies suggest that the relationship between female subsistence contributions and polygyny is valid mainly for agricultural societies. Accordingly, we hypothesize a positive effect of female agricultural contributions upon polygyny.

3. Circumstances that inhibit migration will also inhibit polygyny. *Plow agriculture* ties a household to a particular piece of land and makes acquisition of new land expensive. *Fishing* has a similar effect to the extent that it is dependent upon controlling access to particular rivers, lakes, or lagoons. Finally, residence on a *small island* limits the land available for cultivation, and makes migration difficult. We hypothesize that these will all have negative effects upon polygyny.

Definition of Variables

We test our hypotheses on data coded for the Standard Cross-Cultural Sample (Murdock and White 1969), using multiple regression analysis. Following are definitions of our variables, with their abbreviations.

Polygyny

We use three measures of the incidence of polygyny. The first is a new code that measures the cultural rules for men's marriages (White 1988). It has five categories, ordered in terms of increasing involvement of larger classes of men with polygynous marriage:

Cultural Rule of Polygyny

1 = Monogamy prescribed
2 = Monogamy preferred, but exceptional cases of polygyny
3 = Polygyny for leaders or achievers (e.g., hunters, shamans)
4 = Polygyny limited to a general social class of men, and generally not attainable by others
5 = Polygyny preferred by most men, and attained by most men of sufficient years or wealth

Our other two measures of polygyny pertain to behaviors rather than cultural rules: to the percentages of males and females who are married polygynously. These are based on codes developed by John Whiting, who coded 60 Standard Sample societies for these two variables. These have been cross-checked for reliabilities, and extended to an additional 88 societies (White 1988). Together, the three measures are intended to provide conver-

gent measures of polygyny. The correlation between the two frequency measures is .97, and the correlations of the cultural rules measure with the male and female frequency measures are .76 and .81, respectively. Hence, the three measures appear to be measuring the same construct. We use the logs of the frequency variables in our statistical analyses.

Fraternal Interest Groups

We define fraternal interest groups as the interaction of male-centered residence with bridewealth payments (Paige and Paige 1981). Both codes are from the *Ethnographic Atlas* (Murdock 1967):

Degree of Male-Centered Residence
3 = Patrilocal
2 = Virilocal or avunculocal
1 = Matrilocal, neolocal, or bilocal

Bridewealth
3 = Bridewealth
2 = Token bride price, brideservice, gift exchange, sister exchange, or no exchange
1 = Dowry

The scale is computed by multiplying the residence score by the bridewealth score.

Warfare

The variable measuring warfare for plunder or for captives is taken from Wheeler's (1974) cross-cultural study of warfare. This and the following variable, following Otterbein (1970) and Ember (1974), code for warfare within 50 years of the focal date of ethnographic observation.

War for Plunder or Captives
2 = Present
1 = Absent

A second variable measures the marriage of captive women, and is a new code (White 1988). Marriage of captive women includes concubinage, in cases where the children of the union are legitimate, and adoption of captive females if they later become wives of the society's men. In many cases the captive has slave status; usually she or her children attain freedom as a consequence of the marriage (Patterson 1982:228–230).

Marriage of Captive Women
2 = Present
1 = Absent

From these two variables we compute a third variable to measure plunder in the absence of marriage of captive women:

Plunder Without Marriage of Captives
2 = Present
1 = Absent

Smallness of Population

This variable has eight categories that are inversely proportional to the log of population size. This variable will appear in our model in an interaction with marriage of captives, following the reasoning above to the effect that a small population magnifies the effect of marriage of captives upon the adult sex ratio.

Environmental Characteristics

Climate zone is coded by White, Whiting, and Burton (1986) from Goode's *World Atlas* (Espenshade 1986), and is cross-checked against Whiting, Sodergren, and Stigler's

(1982) data on temperature and rainfall. Six major zones are distinguished and recoded into three categories, according to our notions of environmental homogeneity and quality.

Climate Zone
3 = Tropical savannah
2 = Tropical rain forest or humid temperate
1 = Tropical highlands, desert, or polar

Small Island

This variable is coded by the authors, and is 1 for residence on an island smaller than 2,500 km^2; zero otherwise.

Subsistence Variables

Codes for the presence of the plow are from the *Ethnographic Atlas* (Murdock 1967):

Plow
1 = Plow present
0 = Plow absent

Codes for the contribution of fishing to subsistence are computed by averaging a nine-point scale from the *Ethnographic Atlas* and a five-point scale from Murdock and Morrow (1970).

Female Contribution to Subsistence is measured by three sets of raters: Murdock and Wilson (1972), Barry and Schlegel (1982), and Whyte (1978). We found correlations ranging from .51 to .64 among these three scales, and computed an aggregate index from them.

Female Contributions to Agriculture is coded zero for societies that lack agriculture, and coded on a five-point scale from the *Ethnographic Atlas* for societies that have agriculture.

Zero-Order Relationships

Correlations among the major variables used in our model are shown in Table 1. The strongest zero-order correlates of polygyny are fraternal interest groups, marriage of captives, the presence of the plow, and female subsistence contributions.

Table 2 is a cross-tabulation of climate zone with the five-point polygyny scale. Here we see that the three forms of polygyny have different distributions. While general polygyny is most frequently found in the tropical savannah, class-based polygyny is most frequently found in the temperate or rain forest zones, and polygyny for leaders is found most frequently in zones other than the tropical savannah.

Regression Analyses: Tests of the Hypotheses

The regression analyses involve two measures of the dependent variable (cultural basis of men's marriages and percentage of female polygyny), and replication within three regions: Western Old World (Europe and Africa), Eastern Old World (Asia and Oceania), and the Americas. The purpose of the regional replication is to test for the presence of unique historical events or processes not accounted for by our model (White, Burton, and Dow 1981; Burton and White 1984). The regressions for the regional replications involve a relatively small ratio of cases to variables; hence, they have less statistical stability than the overall model, and we cannot expect every variable to replicate perfectly. Rather, we look for an overall consistency in the pattern of results.

Table 3 shows the regressions using cultural rules for men's marriages as the dependent variable. All predictions are confirmed except for the effect of residence on a small island. Using stepwise regression we find the strongest predictors of polygyny to be marriage of captives, fraternal interest groups, and the plow, in that order, with these three variables accounting for 42% of the variance in polygyny. Consistent with previous research, the female agricultural contributions variable has a statistically significant effect upon poly-

Table 1
Pearson correlation matrix.

	Cultural rules scale	% female polygyny	% male polygyny	Fraternal interest groups	Marry captives
% Female polygyny	0.885	1.000			
% Male polygyny	0.880	0.983	1.000		
Frat. int. grp.	0.361	0.251	0.263	1.000	
Marry captives	0.503	0.373	0.381	0.244	1.000
War for plunder	0.023	0.015	0.048	−0.024	−0.510
War mortality	0.287	0.140	0.129	0.198	0.347
Plow	−0.355	−0.342	−0.352	0.128	−0.290
Fishing	−0.150	−0.224	−0.208	−0.254	0.011
Small island	−0.101	−0.228	−0.199	−0.085	−0.016
Climate zone	0.281	0.266	0.246	0.017	0.163
Fem. subs. cont.	0.294	0.301	0.307	0.111	0.135
Fem. ag. cont.	0.238	0.174	0.171	0.026	0.156
Small population	0.109	0.200	0.220	−0.262	−0.022

	War for plunder	War mortality	Plow	Fishing	Small island
War mortality	0.026	1.000			
Plow	−0.006	−0.024	1.000		
Fishing	0.089	0.036	−0.261	1.000	
Small island	−0.017	−0.007	−0.168	0.424	1.000
Climate zone	−0.144	−0.128	−0.142	−0.039	0.018
Fem. subs. cont.	−0.106	−0.229	−0.258	−0.081	0.059
Fem. ag. cont.	−0.051	−0.106	−0.038	−0.118	0.066
Small population	0.101	−0.073	−0.586	0.366	0.178

	Climate zone	Fem. subs. cont.	Fem. ag. cont.	Small pop.
Fem. subs. cont.	0.207	1.000		
Fem. ag. cont.	0.313	0.490	1.000	
Small population	−0.099	0.041	−0.154	1.000

Table 2
Cross-tabulation of polygyny with climate zone.

	Polar or desert highlands	Temperate or tropical rainforest	Tropical savannah
Monogamous	9	15	1
Mainly monogamous	10	18	7
Polygyny for leaders	18	20	7
Class-based polygyny	7	19	4
General polygyny	7	15	23

Chi-squared = 31.6, d.f. = 8, $p < .001$

Table 3
Predictors of cultural rules for polygyny scale.[2]

	World		Western Old World		Eastern Old World		Americas	
	Beta	*p*	Beta	*p*	Beta	*p*	Beta	*p*
Fraternal interest groups	.166	.001	.184	.004	.163	.003	.259	.026
Marriage of captives × small population	.264	.001	.278	.075	.279	.002	.231	.003
War for plunder	.794	.001	1.099	.025	.685	.047	.687	.069
Plow	−1.282	.001	−.907	.018	−.983	.009	−2.053	.029
Fishing	−.213	.002	−.358	.050	−.283	.033	−.183	.087
Small island	−.362	n.s.	—	—	.084	n.s.	—	—
Climate zone	.388	.001	.674	.002	.316	.188	.246	n.s.
Female contributions to agriculture	.118	.029	.112	n.s.	.202	.055	.115	n.s.
	R^2 = .59 N = 142		R^2 = .75 N = 45		R^2 = .59 N = 46		R^2 = .38 N = 51	

gyny, and accounts for as much variance in polygyny as the more global female contributions scale.

The model replicates on each variable at the .10 level with two exceptions: the climate zone variable replicates only within the West and the female agricultural contributions variable replicates only within the East. All regression coefficients are in the predicted direction. Overall, the extent to which this model replicates across regions is impressive, given the marked differences between these regions in the relative frequencies of polygyny and the independent variables. For example, general polygyny, fraternal interest groups, and tropical savannah are much more common in the West; in the East, small islands are present and general polygyny is underrepresented; and in the Americas the plow and fraternal interest groups are rare, but high dependence on fishing is much more common than in the other regions.

A further test of the replication of this model is provided by using as the dependent variable the two measures of the percentage of polygyny. Regression results for these two measures are very similar, so we present results in Table 4 for only one of these variables: percentage of females polygynously married. These regressions are similar to the first set. However, we find that residence on a small island has a strong negative effect on the frequency of polygyny, even though it did not affect men's marriage rules. A second difference from the prior analysis is the weaker replication of the two warfare variables.

The two sets of regression equations give remarkably convergent results, with the highest replication across regions and measures for the effects of fraternal interest groups, the plow, and dependence on fishing. The effects of the warfare variables, climate zone, and female contributions to agriculture show weaker replication.[3]

The two kinds of measures of polygyny provide a contrast between cultural rules and frequencies of behavior. It seems plausible to hypothesize that social structural variables, which measure cultural institutions, would play a larger role in explaining the cultural rules scale, and that economic and ecological variables, which measure material processes and constraints, would play a larger role in accounting for the frequencies measures. We tested this hypothesis by comparing the variance accounted for solely by the social structure variables (warfare for plunder, marriage of captives, and fraternal interest groups) with variance accounted for solely by the ecological and economic variables (plow, dependence on fishing, small island, climate zone, and female contribution to agriculture). The social structural variables account for 35% of the variance in the cultural rules scale, whereas ecological and economic variables account for 26% of the variance in that scale. Hence, social structural variables are a better predictor of the cultural rules than are the economic and ecological variables. By way of contrast, the social structural variables account for only 19% of the variance in the frequencies of women's polygynous marriages, whereas the economic and ecological variables account for 27% of the variance in that measure. Hence, men's marriage rules are determined primarily by fraternal interest groups and warfare; frequency of polygyny is determined primarily by economy and ecology.

Alternative Warfare Explanations

Earlier we described Ember's competing hypothesis to the effect that polygyny is due to male mortality in warfare. We can test this hypothesis using Ember's codes. Doing so reduces the sample size for the regression to 58 cases. In a model without the captives or plunder variables, but with the male mortality variable and other significant independent variables, male mortality shows a significant positive effect on polygyny. However, the R-squared for this model is much lower (.35) than the R-squared for our model, and controlling for marriage of captives causes male mortality to drop out of the model. Other warfare variables, such as internal war and external war, are also deleted from the model when warfare for plunder and marriage of captives are controlled.

Effects of Data Quality

Several of our variables have been coded in two or more studies, allowing for computation of reliabilities. These reliabilities are plow (.89), dependence on fish (.86), female contributions to subsistence (.57), polygyny (.85), residence (.80), and bridewealth (.54). When bridewealth is multiplied by residence, the resulting variable, fraternal interest groups, has a reliability of .78. For the economic or subsistence variables (plow, fish, female labor contributions, agriculture) we have used averaged or combined ratings from the several coders. For social structural variables (polygyny, residence, bridewealth) we have used the more authoritative sources.

No reliabilities are as yet available on the entire sample for the warfare or climate codes. Our independent ratings of 20 cases of marriage of women captives showed an agreement of $r = .92$. We can get some idea of the convergence of Wheeler's code and our code for marriage of captives by cross-tabulating the two. There are 131 cases where the two codes are consistent with each other, and only seven discrepant cases, in each of which we have coded marriage of captives as present while Wheeler (1974) codes warfare for plunder or captives as absent.

The higher the reliability of the data, especially for the independent variable, the more variance we might expect to explain with our model. Given reliabilities that are in the range of .85, the ability of the model to account for nearly 60% of the variance in polygyny is impressive.

A second source of potential error is bias in the judgments of informants, ethnographers, or coders (Naroll 1962). We tested 14 data quality variables from Rohner, Berg, and Rohner (1982) and Whyte (1985). Three variables proved significant—high language fluency, length of fieldwork, and non-American nationality—but they account for little variance. Of these, non-American nationality has the strongest effect. Since lower rates of polygyny are more typical of the North American and Oceanic areas in which American ethnographers have tended to work, the finding may indicate a regional effect rather than a source of systematic bias.

Implications for Comparative Research

This project offers two important guidelines for conducting cross-cultural research. The first is the importance of doing a detailed analysis of intrasocietal processes before engaging in cross-cultural hypotheses testing. In this case, that analysis involved a careful look at the demographic processes involved in polygyny. That analysis pointed the way toward possible variables to test cross-culturally. The second guideline concerns the importance of viewing social institutions in a regional context. Societies that engage in plunder of resources or capture of women take people or resources away from others. A given society's high polygyny rate thus would entail lower polygyny rates for less militarily dominant neighbors. Our model predicts high and low polygyny patterns at respective ends of the scale of military dominance, but it also predicts that regions would tend to be heterogeneous in this regard, with the more successful societies expanding at the expense of the weaker.

Implications for Theories of Polygyny

Our analysis provides strong support for four interrelated views of polygyny: that polygyny is an expansionist strategy, favored by homogeneous and high-quality environment; that polygyny is associated with warfare for plunder and/or female captives; that polygyny is associated with the presence of fraternal interest groups; and that polygyny is constrained by the presence of the plow or by high dependence upon fishing. We find weaker support for two other variables: female contributions to agriculture and residence on small islands.

Use of two different kinds of measures of polygyny has allowed us to distinguish between predictors of two different kinds of measures of polygyny: rules for men's marriages

Table 4
Predictors of percent of women in polygynous marriages.

	World		Western Old World		Eastern Old World		Americas	
	Beta	*p*	Beta	*p*	Beta	*p*	Beta	*p*
Fraternal interest groups	.120	.002	.141	.029	.180	.006	.300	.041
Marriage of captives × small population	.151	.015	−.128	n.s.	.070	.508	.188	.061
War for plunder	.533	.039	1.080	.027	.415	n.s.	.433	n.s.
Plow	−1.424	.001	−1.712	.001	−1.165	.016	−2.748	.019
Fishing	−.250	.005	−.721	.001	−.321	.045	−.143	.325
Small island	−.933	.013	—	—	−.460	n.s.	—	—
Climate zone	.415	.007	.885	.001	.268	n.s.	.251	n.s.
Female contributions to agriculture	.108	.114	.334	.018	.054	n.s.	.109	n.s.
	R^2 = .47 N = 123		R^2 = .77 N = 38		R^2 = .46 N = 43		R^2 = .32 N = 42	

and frequencies. The social structural variables (warfare and fraternal interest groups) are better predictors of the rules for polygynous marriages, whereas the economic and ecological variables are better predictors of the frequencies of polygyny. Despite these differences in the strength of relationships, both kinds of predictors have statistically significant effects on either measure of polygyny.

A multivariate model allows one to assess the relative importance of competing explanatory hypotheses. In formulating our explanatory model, we tested several alternative hypotheses that we have not reported here because they were eliminated in competition with the model we have presented. Internal warfare was included in our model at one point, but was later dropped because warfare for plunder or captives was a more powerful and correlated predictor. We also tested several measures of social stratification, including slavery and presence of the state, which were dropped when we controlled for warfare.

Our analysis contrasts two alternative views of polygyny that have quite different implications for thinking about gender. The economic model of polygyny views it as having benign effects on the status of women. In that view, polygyny exists in societies where women make high subsistence contributions, particularly to agriculture. They choose polygynous marriages because it is to their own economic advantage to do so. Polygyny can be seen as part of a complex of social institutions that includes high rates of participation in marketing and even politics, as was the case in some West African societies. Our findings provide some support for this model, but give stronger support to a model wherein polygyny is seen as associated with the expansion of male-oriented kin groups through favorable environments, facilitated by capture of women or bridewealth via warfare. Following this analysis, it is difficult to see polygyny as having benign effects upon the lives of all women. Rather, polygyny produces benefits for senior wives, who have sons and can mobilize the labor of junior wives and children (Hartung 1982); it has negative effects on women who become slaves, captives, or junior wives, or who do not have sons. While women as well as men may seek greater advantage from polygyny, its main effect is to stratify women as well as men.

We conclude by mentioning two limitations of the current analysis. The first limitation is the absence of measures of social processes that are affected by the world system. Most notable of these would be male labor migration. High levels of male labor migration skew the sex ratio in a society, and may provide continued support for polygyny in the absence of our predictor variables. This phenomenon may explain the maintenance of polygyny in many societies after warfare ceased.

The second limitation is that the model has greater predictive power for the Old World than for the New World. We think New World polygyny often takes a different form from the pattern of general polygyny described herein. With general polygyny co-wives tend not to be related to each other and to live in separate houses. Much of New World polygyny appears to be of a different pattern, in which wives tend to be related to each other and to live in the same house. Explaining this kind of polygyny would require a different model (Whiting 1986).

Notes

Acknowledgments. Research for this article was supported by BNS grants 8023904, 8304782, and 8507685 from the National Science Foundation and from the UCI Committee on Research. We acknowledge the comments of Duran Bell, Ronald Cohen, Elizabeth Colson, James Dow, Dwight Read, Karl Reitz, and Beatrice Whiting, and the assistance of Candice Bradley and Carmella Moore. We are especially indebted to John Whiting for numerous discussions about polygyny.

[1]The Tallensi are coded by Wheeler as lacking warfare for captives or plunder (although they lack plunder only); we code them as marrying captives but lacking warfare for plunder.

[2]The second variable is an interaction term, marriage of captives multiplied by smallness of population. Using marriage of captives alone produces a similar but weaker relationship. In all regressions we use unstandardized regression coefficients so as to be able to compare regression coefficients across regions.

[3]We computed the regression models with network autocorrelation analysis (Dow et al. 1984) as a test for Galton's problem, and found no residual autocorrelation. We are grateful to Karl Reitz for assistance with this analysis. Since our dependent variable is ordinal, we replicated the model with a logit analysis, finding no differences from the ordinary least squares analysis. All models were tested for multicollinearity. Only the equations for the Western Old World show enough multicollinearity to be of concern; these equations are less stable than the others.

References Cited

Alexander, R. D., J. Hoogland, R. Howard, K. Noonan, and P. Sherman
1979 Sexual Dimorphisms and Breedings Systems in Pinnipeds, Ungulates, Primates and Humans. *In* Evolutionary Biology and Human Social Behavior: An Anthropological Perspective. N. Chagnon and W. Irons, eds. Pp. 402–435. North Scituate, MA: Duxbury Press.

Alvard, Michael S.
1986 Polygyny as a Human Female Reproductive Strategy. Haliksa'i: UNM Contributions to Anthropology 5:42–56.

Barry, Herbert, and Alice Schlegel
1982 Cross-Cultural Codes on Contributions by Women to Subsistence. Ethnology 21:165–188.

Becker, Gary
1981 A Treatise on the Family. Cambridge, MA: Harvard University Press.

Blumberg, Rae L., and Robert F. Winch
1972 Societal Complexity and Familial Complexity: Evidence for the Curvilinear Hypothesis. American Journal of Sociology 77:898–920.

Boserup, Ester
1970 Woman's Role in Economic Development. New York: St. Martin's Press.

Burton, Michael L., and Karl P. Reitz
1981 The Plow, Female Contribution to Agricultural Subsistence, and Polygyny. Behavior Science Research 16:275–305.

Burton, Michael L., and Douglas R. White
1984 Sexual Division of Labor in Agriculture. American Anthropologist 86:568–583.

Chagnon, N.
1979 Is Reproductive Success Equal in Egalitarian Society? *In* Evolutionary Biology and Human Social Behaviors: An Anthropological Perspective. N. Chagnon and W. Irons, eds. Pp. 374–401. North Scituate, MA: Duxbury Press.

Cohen, R.
1971 Dominance and Defiance. Washington: American Anthropological Association.

Dorjahn, Vernon R.
1959 The Factor of Polygyny in African Demography. *In* Continuity and Change in African Cultures. William R. Bascom and Melville J. Herskovits, eds. Pp. 87–112. Chicago: University of Chicago Press.

Dow, James
1983 Woman Capture as a Motivation for Warfare. *In* Rethinking Human Adaptation: Biological and Cultural Models. R. Dyson-Hudson and M. A. Little, eds. Pp. 97–115. Boulder: Westview.

Dow, Malcolm M., M. L. Burton, D. R. White, and K. P. Reitz
1984 Galton's Problem as Network Autocorrelation. American Ethnologist 11:754–770.

Ember, Melvin
1974 Warfare, Sex Ratio, and Polygyny. Ethnology 13:197–206.
1984 Alternative Predictors of Polygyny. Behavior Science Research 19:1–23.

Engels, Frederick
1972 [1884] The Origin of the Family, Private Property and the State. Eleanor B. Leacock, ed. New York: International Publishers.

Espenshade, Edwin B., Jr., ed.
1986 Goode's World Atlas. 17th edition. Chicago: Rand McNally.

Fortes, Meyer
1949 The Web of Kinship among the Tallensi. London: Oxford University Press.
1967 [1945] The Dynamics of Clanship among the Tallensi. Oosterhout, The Netherlands: Anthropological Publications. (Originally published by Oxford University Press).

Goldschmidt, Walter, and Evalyn J. Kunkel
1971 The Structure of the Peasant Family. American Anthropologist 73:1058–1076.
Goody, Jack
1973 Polygyny, Economy and the Role of Women. *In* The Character of Kinship. Jack Goody, ed. Pp. 175–190. London: Cambridge University Press.
1976 Production and Reproduction. London: Cambridge University Press.
Grossbard, Amyra S.
1976 An Economic Analysis of Polygyny: The Case of Maiduguri. Current Anthropology 17:701–707.
1980 The Economics of Polygamy. *In* Research in Population Economics, Vol. 2. J. L. Simon and J. DaVanzo, eds. Pp. 321–350. Greenwich, CT: JAI Press.
1984 A Theory of Allocation of Time in Markets for Labour and Marriage. The Economic Journal 94:863–882.
Hartung, J.
1982 Polygyny and the Inheritance of Wealth. Current Anthropology 23:1–12.
Heath, Dwight B.
1958 Sexual Division of Labor and Cross-Cultural Research. Social Forces 37:77–79.
Kelly, Raymond C.
1985 The Nuer Conquest: The Structure and Development of an Expansionist System. Ann Arbor: University of Michigan Press.
Lee, Gary R.
1979 Marital Structure and Economic Systems. Journal of Marriage and the Family 41:701–713.
Martin, M. Kay, and Barbara Voorhies
1975 Female of the Species. New York: Columbia University Press.
Murdock, George P.
1949 Social Structure. New York; Macmillan.
1967 Ethnographic Atlas. Ethnology 9:122–225.
Murdock, George P., and Diana O. Morrow
1970 Subsistence Economy and Supportive Practices: Cross-Cultural Codes 1. Ethnology 9:302–330.
Murdock, George P., and Douglas R. White
1969 Standard Cross-Cultural Sample. Ethnology 8:329–369.
Murdock, George P., and Suzanne F. Wilson
1972 Settlement Patterns and Community Organization: Cross-Cultural Codes 3. Ethnology 11:254–295.
Naroll, Raoul
1962 Data Quality Control. New York: Free Press.
Osmond, Marie W.
1965 Toward Monogamy: A Cross-Cultural Study of Correlates of Type of Marriage. Social Forces 44:6–16.
Otterbein, Keith
1970 The Evolution of War. Pittsburgh: University of Pittsburgh Press.
Paige, K. E., and J. M. Paige
1981 The Politics of Reproductive Ritual. Berkeley: University of California Press.
Patterson, Orlando
1982 Slavery and Social Death: A Comparative Study. Cambridge: Harvard University Press.
Rohner, Ronald P., D. Scott Berg, and Evelyn C. Rohner
1982 Data Quality Control in the Standard Cross-Cultural Sample: Cross-Cultural Codes. Ethnology 21:359–369.
Spencer, Paul
1980 Polygyny as a Measure of Social Differentiation in Africa. *In* Numerical Techniques in Social Anthropology. J. Clyde Mitchell, ed. Philadelphia: ISHI Press.
Steckle, J., and L. Ewanyk
1973 A Consumer Preference Study in Grain Utilization. Preliminary report, Ministry of National Resources, North Eastern State, Nigeria.
Verdon, Michel
1983 Polygyny, Descent, and Local Fission: A Comparative Hypothesis. Journal of Comparative Family Studies 14:1–22.

Wheeler, Valerie
1974 Drums and Guns: A Cross-Cultural Study of the Nature of War. Ph.D. dissertation, Department of Anthropology, University of Oregon.
White, Douglas, R.
1988 Rethinking Polygyny: Co-Wives, Codes, and Cultural Systems. Current Anthropology 29:529–572.
White, Douglas R., Michael L. Burton, and Malcolm M. Dow
1981 Sexual Division of Labor in African Agriculture. American Anthropologist 83: 824–849.
White, Douglas R., John W. M. Whiting, and Michael L. Burton
1986 Climate and Subsistence Codes. World Cultures 2(2).
Whiting, J. W. M.
1977 Paper presented at meetings of Society for Cross-Cultural Research, East Lansing, Michigan.
1986 Play it Again Sam: A New Paradigm for Cross-Cultural Research. Paper presented at meetings of Society for Cross-Cultural Research, San Diego, California.
Whiting, John W. M., John A. Sodergren, and Stephen M. Stigler
1982 Winter Temperature as a Constraint to the Migration of Preindustrial Peoples. American Anthropologist 84:279–298.
Whiting, John W. M., and Beatrice B. Whiting
1975 Aloofness and Intimacy of Husbands and Wives: A Cross-Cultural Study. Ethos 6:183–207.
Whyte, M.
1978 Cross-Cultural Codes Dealing with the Relative Status of Women. Ethnology 17:211–237.
1985 Independent Variables for Testing Hypotheses on the Status of Women. World Cultures 1(4).
Witkowski, S.
1975 Polygyny, Age of Marriage, and Female Status. Paper presented at meetings of American Anthropological Association, San Francisco, CA.