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TECHNOLOGY, IDEOLOGY, AND SOCIETAL DEVELOPMENT

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ABSTRACT: *To address the question of whether ideology or technology has been the more powerful force shaping societies and their development, log-linear models are used to assess the association of typologies based on religious beliefs and on subsistence technology with indicators of: (1) community size, (2) political complexity, (3) stratification, (4) marital patterns, and (5) premarital sex norms. Using data derived from Murdock's* Ethnographic Atlas, *the analysis suggests that, although ideology is significantly associated with a number of important societal variables, the effects of technology are generally more powerful, more widespread, and more robust.*

INTRODUCTION

Most sociologists would agree that both ideology and technology have had a powerful impact on the conditions of life in human societies. What is not clear, however, is their *relative strength.* Which has been the more powerful, or has their impact been more or less comparable?

When phrased in such general terms, the question obviously cannot be answered. In certain circumstances and under certain conditions, ideology has been the more powerful, while under other circumstances and under other conditions the opposite has been true. There is also good reason to believe that the relative strength of ideology and technology varies with the dependent variable in question and the time frame involved. Thus, if we are to advance our understanding of this important question, we have to be much more specific. We need to specify the circumstances, conditions, dependent variables, and timeframe involved, and we also need to be cautious not to overgeneralize our conclusions.

From the standpoint of macrosociological theory, the most important question that needs to be answered concerns the determinants of the basic features of

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societies—their size, complexity, and major institutional patterns. How important has ideology been in shaping these features? How important technology? And which, if either, has been the more important? Without answers to questions such as these, it is all but impossible to construct meaningful models of human societies and their development, and this, in turn, means that little real progress (i.e., *cumulative* advance in knowledge and understanding) is likely in macrosociological theory.

As early as the eighteenth century, social theorists were divided on the question of the relative importance of technology and ideology and the division has continued down to the present day. From Vico and Comte to Weber and Parsons, many have argued for the dominance of beliefs or ideology. But from Millar to Morgan, Marx, Childe, and Lenski, others have argued for the greater importance of technology. What has been largely lacking in all of this has been any systematic analysis of relevant data. Illustrations and examples aplenty, but very little systematic data.

In this article, we offer just such data. We readily acknowledge at the outset that our data are not flawless, but we believe that they are the best available and that their flaws are not so serious as to render them useless for our purpose. In fact, we would argue that they are every bit as valid and reliable as most of the data obtained from sample surveys and questionnaires that fill our journals today, and that they are far too important for sociological theory to be ignored. We would challenge those who may not like the conclusions we draw from our analysis (see Discussion, pp. 33-34, noting especially the limitations we set on our conclusions) to find better data or better methods of analysis to support their view but not to simply reject our findings out of hand or ignore their critical relevance for theory.

STUDY DESIGN

For our purposes, the best dataset for assessing the effects of ideology and technology on societal size, complexity, and institutional patterns is that contained in the *Ethnographic Atlas* created by George Peter Murdock and refined and expanded in more recent years by others. The great virtue of this atlas is that it, more than any other dataset, reflects the full range of variability and diversity that has been observed in human societies. With respect to size, for example, it contains information on societies varying from some with fewer than fifty members to others with tens of millions. Comparable diversity exists with respect to other fundamental societal attributes.

It is hard to exaggerate the importance of this from the standpoint of theory construction: when building and testing theory, the dataset employed should reflect, as nearly as possible, *the full range of variation in the dependent variables that the theory seeks to explain* (a criterion that is too often ignored in theory construction in sociology today).[1] Failure to take this principle into account can lead to the over generalization of conclusions and, worse yet, to the misreading of causal relationships.

For the purposes of the present study, the *Ethnographic Atlas* is invaluable not only because it provides data on an extremely diverse set of societies with respect to important dependent variables but also because it provides essential data on their ideologies and technologies. In the case of the former, societies are classified in terms of fundamental religious beliefs;[2] in the latter, they are classified in terms of basic subsistence technology (see Appendix). If one is to compare the relative strength of ideology and technology across the broadest possible spectrum of societies, it is hard to conceive of a more suitable pair of variables.[3]

It is also important, if the tests are to be as fair and broad-based as possible, that the dependent variables should constitute a reasonable sampling of important societal and cultural dimensions. Clearly. the more representative they are, the more convincing the tests will be. The dependent variables we examine are: (1) mean size of local communities; (2) complexity of political organization (measured two ways); (3) complexity of stratification system; (4) nature of marital patterns; and (5) norms of premarital sexual conduct for girls. They are each individually important, and together they represent a diverse sampling of the organizational and normative features of societies. According to Leslie White (1959:9) culture includes: knowledge and beliefs, social systems, political and economic institutions, rituals and art, attitudes and sentiments, codes of ethics and etiquette, and technology. The first and last categories correspond to our independent variables; the others—our dependent variables—represent three of the five remaining categories. Thus, we have a relatively broad sampling of cultural domains. More detailed information on these variables is provided in the Appendix.

METHODS

By confronting each typology (separately and together) with the same challenge—cross-classifying the *same variables* for the *same cases*—we can see if each does equally well or if one is clearly superior in predicting other important features of societies. Therefore, whatever the pattern of results produced by the analysis, we will know more about the societal impact of these features of culture than we did before.

Log-linear techniques are the most appropriate and powerful for the questions we are asking and the data we have. They are designed for nominal-level measurement, are multivariate, do not assume linearity, and can be used to explicitly test the relative fit of researcher-specified models. With them, we can determine not only if one variable accounts for variation in another but, more importantly, if *adding* a variable significantly improves the fit or explanatory power of a particular model (e.g., Goodman 1972; Duncan and Duncan 1978: Appendix A).

In our analysis, we first establish a baseline or null model and then test whether or not adding technology and ideology significantly improves the fit of the model. As Figure 1 shows, in the baseline model, identified as Model 1 in the tables, the independent variables, ideology and technology, are allowed to be associated with one another but not with the dependent variable.[4]

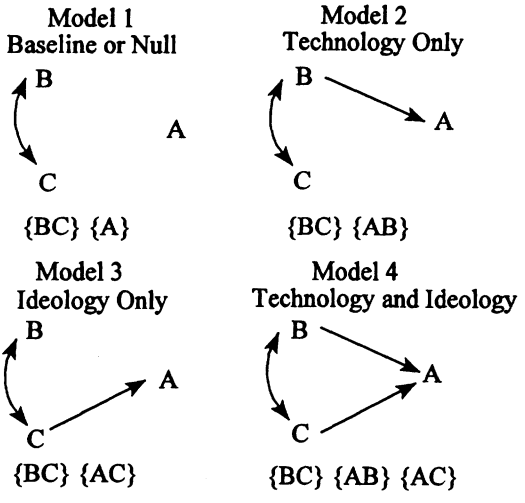

Figure 1
Models Estimated with: (A) Social and Cultural Features of Societies, (B) Technology: Subsistence Technology, (C) Ideology: Structure of Religious Beliefs

Model 2 allows an effect of technology, Model 3 allows an effect of ideology, and Model 4 includes both effects. Since the models are hierarchically nested, comparisons of the technology and ideology models (Models 2 and 3) with the baseline reveals whether or not technology and ideology have significant effects on the dependent variable; comparison of the complete model (Model 4) with the technology and ideology models (Models 2 and 3) respectively, reveals whether the effects of technology and ideology are independent or redundant.

For example, if comparisons of the baseline model with Models 2 and 3 show that each has a significant effect but Model 4 does not fit significantly better than Model 3, this would suggest that the effects of technology are redundant with those of ideology, or that interpretations of technology's association with the dependent variables may be spurious. In correlation/regression terms, therefore, comparisons of Models 2 and 3 with Model 1 provide information on *zero-order* associations, and their respective comparisons with Model 4 provide information on *partial* (first-order) associations (e.g., Davis 1974). We can also compute partial and multiple coefficients of determination (similar to R^2) that assess the relative contributions of the independent variables to the explanation of the dependent variable (Goodman 1972).

It is tempting to use polytomies in this analysis—each independent variable has the same number of categories and is arguably ordinal—but one serious problem posed by the analysis of such tables is the "sparseness" of the data in them. Although some analysts advocate adding a small constant (e.g., 0.5) to all cells of

a sparse table (Knoke and Burke 1980) to overcome the computational problem of dividing by zero, adding a constant can distort the estimates of odds ratios and can bias assessment of the fit of models (Clogg and Eliason 1988).

Fortunately, there is another way to overcome the problem of sparse data without distorting the estimates—that is, to collapse the categories of the variable in such a way that zero cells are eliminated. Moreover, if we collapse *all* of the variables into dichotomies, it is possible to estimate a *single* beta-like coefficient (with a standard error) for each of the independent variables. This coefficient depicts how much being in a particular category of the independent variable (e.g., believing in an active supportive high god) raises or lowers the probability (odds) of being in a particular category of the dependent variable (e.g., practicing monogamy).

The binary data also address another possible bias in the analysis of the polytomies: namely, that ideology—a single variable—is (unfairly) forced to compete with technology, which is a set of variables (i.e., presence or absence of plant cultivation, metallurgy, and plows). By construction, the binary variables compare the effects of the presence or absence of the plow with the effects of the presence or absence of an active, supportive, high god.[5]

Therefore, we focus most of our attention on the analysis of the dichotomies and only discuss analysis of the polytomies (tables are available from the authors) to point out similarities and differences. Theoretical considerations suggest that we dichotomize our measure of ideology into societies that believe in an active, supportive, high god versus those who do not; and that technology should be divided into societies practicing (plow) agriculture versus those practicing hunting and gathering or horticulture (i.e., gardening).[6]

The dependent variables must be dichotomized individually on the basis of conceptual breaks in their categories and their marginal frequencies. The object is to get a "meaningful" division with a relatively even distribution of cases across it. By these criteria, we have made the following breaks:

- Jurisdictional hierarchy—no levels versus one or more levels;
- Marital composition—monogamous (codes 1 and 2) versus nonmonogamous;
- Premarital sex norms—activity prohibited or discouraged (codes 1-3) versus allowed;
- Political integration—non-states (codes 1-3) versus states;
- Community size—less than 200 versus 200 or more; and
- Class stratification—absent among freemen (code 1) versus present in some form.

Cross-classification of these data produce tables that are without zero cells.

FINDINGS

Table 1 shows how well the proposed models fit the data. As it shows, ideology (Model 3) provides an acceptable fit ($P > .05$) in one case—norms of premarital

TABLE 1
Social and Cultural Features (A) by Subsistence Technology (B) and Structure of Religious Beliefs (C) for Dichotomized Variables

	Model	L^2	*DF*	*P*
Mean Size of Local Communities ($N = 157$)[a]				
1	{BC} {A}[b]	47.0	3	.000
2	{BC} {AB}	14.3	2	.001
3	{BC} {AC}	12.7	2	.002
4*	{BC} {AB} {AC}	0.7	1	.400
Political Integration ($N = 109$)				
1	{BC} {A}	34.6	3	.000
2*	{BC} {AB}	2.8	2	.252
3	{BC} {AC}	16.2	2	.000
4	{BC} {AB} {AC}	1.3	1	.246
Jurisdictional Hierarchy Beyond Local Communities ($N = 209$)				
1	{BC} {A}	59.4	3	.000
2	{BC} {AB}	6.6	2	.037
3	{BC} {AC}	27.3	2	.000
4*	{BC} {AB} {AC}	0.3	1	>.500
Class Stratification ($N = 210$)				
1	{BC} {A}	44.4	3	.000
2*	{BC} {AB}	3.2	2	.203
3	{BC} {AC}	23.1	2	.000
4	{BC} {AB} {AC}	0.5	1	.499
Marital Composition ($N = 215$)				
1	{BC} {A}	29.5	3	.000
2*	{BC} {AB}	0.3	2	>.500
3	{BC} {AC}	19.4	2	.000
4	{BC} {AB} {AC}	0.1	1	>.500
Norms of Premarital Sex Behavior of Girls ($N = 127$)				
1	{BC} {A}	20.7	3	.000
2	{BC} {AB}	9.1	2	.000
3*	{BC} {AC}	2.9	2	.238
4	{BC} {AB} {AC}	0.1	1	>.500

Notes: [a] Variable descriptions and sources are in the Appendix. An asterisk indicates the preferred model.
[b] Since the models are hierarchical, the {BC} interaction in the baseline model includes {B} and {C}, and the {AC} and {AB} interactions in the more complete models include {A} and {C}, and {A} and {B}, respectively.

sex behavior, while technology (Model 2) provides an acceptable fit in three cases—political integration, class stratification, and marital composition.[7] Choosing a "preferred model" in log-linear analysis involves a balancing of parsimony (preserving degrees of freedom) and goodness-of-fit (the probability that deviations from the model are due to chance). The objective is to find a parsimonious model

TABLE 2
Chi-square Tests of Improvement in Fit of Models For Dichotomized Variables

Models Compared	L^2	*DF*	*P*	R^2 Change[a]
Mean Size of Local Communities ($N = 157$)				
Model 1 → Model 2	32.7	1	<.001	0.70
Model 1 → Model 3	34.3	1	<.001	0.73
Model 2 → Model 4	13.6	1	<.001	0.95
Model 3 → Model 4	12.0	1	<.001	0.94
Political Integration ($N = 109$)				
Model 1 → Model 2	31.8	1	<.001	0.92
Model 1 → Model 3	18.4	1	<.001	0.53
Model 2 → Model 4	1.5	1	NS[b]	0.54
Model 3 → Model 4	14.9	1	<.001	0.92
Jurisdictional Hierarchy Beyond Local Communities ($N = 209$)				
Model 1 → Model 2	52.8	1	<.001	0.89
Model 1 → Model 3	32.1	1	<.001	0.54
Model 2 → Model 4	6.3	1	<.001	0.95
Model 3 → Model 4	27.0	1	<.001	0.99
Class Stratification ($N = 210$)				
Model 1 → Model 2	41.2	1	<.001	0.93
Model 1 → Model 3	21.3	1	<.001	0.48
Model 2 → Model 4	2.7	1	NS	0.84
Model 3 → Model 4	22.6	1	<.001	0.98
Marital Composition ($N = 215$)				
Model 1 → Model 2	29.2	1	<.001	0.99
Model 1 → Model 3	10.1	1	<.002	0.34
Model 2 → Model 4	0.2	1	NS	0.79
Model 3 → Model 4	19.3	1	<.001	0.99
Norms of Premarital Sex Behavior of Girls ($N = 127$)				
Model 1 → Model 2	11.6	1	<.001	0.56
Model 1 → Model 3	17.8	1	<.001	0.86
Model 2 → Model 4	9.0	1	<.005	0.99
Model 3 → Model 4	2.8	1	NS	0.97

Notes: [a] R^2 Change is the coefficient of partial determination (Goodman 1972) to L^2 Model$_i$ − L^2 Model$_j$ / L^2 Model$_i$ where Model$_i$ and Model$_j$ are hierarchical.
[b] Not significant at .05.

that fits the data reasonably well. By these criteria, Model 2 (technology) is preferred in three cases, Model 3 (ideology) in one, and Model 4 (technology and ideology) in two. Premarital sex norms constitutes the single case where Model 3 is preferred.[8]

Table 2 shows the improvement in fit produced by the addition of the ideology and technology dichotomies to the models. The first and second rows (for each

TABLE 3
Expected Frequencies and Odds on Monogamy for Dichotomized Variables Under Constraints of Model 4

		Marital Composition			
Ideology	*Technology*	*Monogamous*	*Other*	*Odds*[a]	*Log Odds*[b]
High God	Low	68.74	58.26	1.18	0.17
Absent	High	21.26	2.74	7.76	2.05
High God	Low	11.26	7.74	1.46	0.38
Present	High	40.74	4.26	9.56	2.25

Notes: [a] Odds, monogamy:nonmonogamy.
[b] Natural logarithm of odds of monogamy.

dependent variable) show that ideology and technology are both significantly associated with all the dependent variables; each provides a significant improvement in the fit of the baseline (null) model. Nonetheless, in most cases (4 out of 6) technology explains more residual baseline variation than does ideology. For example, whereas technology accounts for 93% of the residual baseline variation in class stratification, ideology accounts for only 48%. Also, comparisons of the third and fourth rows (for each dependent variable) also show that technology generally improves the fit of the ideology model (Model 3) more than ideology improves the fit of the technology model (Model 2). For instance, whereas technology explains 98% of the variation in class stratification unexplained by ideology, ideology accounts for only 84% of that unexplained by technology. These patterns of results indicate that technology not only generally has a greater zero-order relationship with the dependent variables but also has a greater partial association. The exceptions are for premarital sex norms, where ideology clearly does a better job (86 versus 56, and 99 versus 97, respectively), and for mean size of local communities, where they do about equally well (73 versus 70, and 95 versus 94).

Clearly then, technology appears to have more powerful and more robust effects than ideology on a set of sociologically important variables; it generally accounts for more variation, and it is more likely to be significantly associated with the dependent variables net of the effects of ideology. But before we draw our final conclusions, we should consider what an alternative analysis of the odds-ratios, and the beta-like coefficients constructed from them, can tell us about these relationships.

A detailed examination of one of these eight-celled tables will help to explain what the beta-like coefficients are and how they should be interpreted. Table 3 shows the expected frequencies for the cross-classification of marital composition, technology, and ideology. The first two columns show the (best-fitting) expected cell frequencies for the dichotomized variables under the constraints of Model 4. The third column shows the odds on monogamy, and the fourth column shows the (natural) log of these odds. Associations can be detected and expressed in terms of these odds.

For example, the frequencies in the first and second rows show that when belief in an active, supportive, high god is absent, the odds that monogamy is the norm are 1.18 to 1 (68.74/58.26) in societies that are low on technology, and they are 7.76 to 1 (21.26/2.74) in societies that are high on technology. A simple way to express how much ranking high on technology affects the odds on monogamy is to calculate the *ratio* of these odds: 6.58 (7.76/1.18). This (odds) ratio indicates that (net of ideology), the odds on monogamy are 6.6 times higher in high technology societies than they are in low technology societies.[9] If technology did not have any effect on the likelihood of monogamy, the ratio would have been 1, indicating that having different technologies did *not* affect the likelihood of monogamy.

Similar comparisons reveal the effects of ideology. The first and third rows show that when technology is low, the odds on monogamy are 1.18 to 1 (68.74/58.26) for societies that do not believe in an active supportive high god, and 1.45 to 1 (11.26/7.74) for those that do. The ratio of these odds, 1.23 (1.45/1.18), indicates that (net of technology) societies which have a belief in an active, supportive, high god are 1.2 times more likely to prefer monogamy as those who do not.[10]

We can also calculate the odds ratios for our independent variables from these frequencies. They show that a society with an active supportive high god is 11.7 times more likely to practice agriculture than is a society that does not have an active, supportive, high god (40.74/11.26) / (21.26/68.74) or (4.26/7.74) / (2.74/58.26) and looking at it from the other side, societies that practice agriculture are 11.7 times more likely to believe in an active, supportive, high god than are societies that practice hunting and gathering or horticulture (40.74/21.26) / (11.26/68.74) or (4.26/2.74) / (7.74/58.26).

To simplify this procedure, if we substitute dummy variables for the ideology and technology dichotomies—$X_1 1$ = belief in an active supportive high god present, 0 = absent; $X_2 1$ = high technology (agriculture), 0 = low technology (hunting-gathering or horticulture)—we can express their effects on the dependent variable with the following equation, where Y' is the log odds on a value of the dependent variable and B_1 and B_2 are the (logarithm of the) odds ratios:

$$Y' = A + B_1X_1 + B_2X_2$$

Table 4 displays these parameter estimates for each of dependent variables under the constraints of Model 4. As it shows, the parameter estimates for marital composition are:[11]

$$Y' = 0.165 + 0.209(\text{active supportive high god}) + 1.883(\text{agriculture})$$

Entering the appropriate values of the dummy variables into the equation should produce the log odds in Table 3 and, taking their antilogs, the odds ratios. For example, the odds on monogamy for societies that have low technology and do not believe in an active, supportive, high god are 1.18 (the antilog of 0.165), and they are 7.75 (the antilog of 0.165 + 1.883) for societies that have high technology

TABLE 4
Parameter Estimates and Standard Errors For Model 4

A	B_1	B_2	*Adjusted* R^2
Mean Size of Local Communities			
Predicting Log Odds:	*200 or more to less than 200*		
-.636*	1.841*	1.511*	0.950
(.222)	(.544)	(.452)	
Political Integration			
Predicting Log Odds:	*State to non-state*		
-.649*	0.937	2.441*	0.883
(.245)	(.794)	(.728)	
Jurisdictional Hierarchy Beyond Local Communities			
Predicting Log Odds:	*One or more levels to none*		
-0.315	1.230*	2.434*	0.984
(.178)	(.512)	(.567)	
Class Stratification			
Predicting Log Odds:	*Stratification present to absent*		
-0.060	0.765	2.158*	0.969
(.177)	(.471)	(.528)	
Marital Composition			
Predicting Log Odds:	*Monogamy to nonmonogamy*		
0.165	0.209	1.883*	0.994
(.175)	(.427)	(.480)	
Norms of Premarital Sex Behavior of Girls			
Predicting Log Odds:	*Not accepted to accepted*		
-0.094	1.806*	0.813	0.986
(.226)	(.680)	(.496)	

Notes: B_1 Coefficient for ideology dummy variable, high god: 1 = present, 0 = absent.
B_2 Coefficient for technology dummy variable, technology: 1 = high, 0 = low.
* Coefficient is more than twice its standard error.

and do not believe in an active, supportive, high god. The coefficients also show how much having an active, supportive high god religion or having a more highly developed technology raises (or lowers) the odds on monogamy. Belief in a high god raises the odds of monogamy by a factor of 1.23 (the antilog of 0.209), and having a highly developed technology raises the odds of monogamy by a factor of 6.57 (the antilog of 1.883). These are the same (within rounding error) as those we computed from the expected frequencies in Table 3.

Notice too that, since the betas are *logarithms* of odds ratios, their signs and magnitudes have direct interpretations. For instance, a beta of 0 indicates an odds ratio of 1 (no relationship)—the odds are unchanged. A negative beta indicates an odds ratio of less than 1 (a negative relationship)—the odds are lowered. And

a positive beta indicates an odds ratio of greater than one (a positive relationship)—the odds are raised. Furthermore, the magnitudes of the coefficients are an exponential of the odds ratios—a beta of 1.4 would indicate an odds ratio of about 4, but a beta two times larger, 2.8, would indicate an odds ratio four times as great—16.

These coefficients, like regression coefficients, therefore, show not only the direction of the association, but the magnitude of the impact the independent variables have on the distributions of the dependent variables. It is also possible to perform Z-tests of significance on them using their estimated standard errors. For example, the parameter estimate of B_1 is 0.209 and it has a standard error of 0.427. Its Z-score is 0.489 and it is nonsignificant. In contrast, the technology coefficient, B_2, is 1.883, has a standard error of 0.480, and is highly significant ($Z = 3.92$).[12]

As Table 4 shows, the coefficient for technology is generally larger than for ideology (four out of six cases), and in half the cases, the coefficient for ideology is not statistically significant. In two cases, however, the coefficient for ideology is larger. It is substantially larger for premarital sex norms; having an active supportive high god religion raises the odds on prohibiting the premarital sexual activity of girls by a factor of 6.1 (the antilog of 1.806), whereas being high on technology only raises those odds by a factor of 2.25 (the antilog of 0.813). In addition, the ideology coefficient is somewhat larger for community size; having an active supportive high god raises the odds on the community being large (200 or more people) by a factor of 6.3 (the antilog of 1.841), whereas being high on technology (practicing some form of cultivation) only raises them by a factor of 4.5 (the antilog of 1.511).

The ideology typology we have used—based on belief in a high god religion—therefore, has clearly shown itself not to be a "strawman;" ideology is significantly and substantially associated with a variety of important societal characteristics. It was chosen for its potentially great explanatory value, and it has done a credible job, especially in the analysis of the binary data. Nevertheless, it has clearly placed second in the direct comparison with technology.

DISCUSSION

Taken together, the evidence provided by the analysis of *Ethnographic Atlas* data strongly suggests that subsistence technology has had a more powerful and more pervasive impact on societies and their overall development (i.e., from the smallest and simplest to the largest and most complex) than has ideology. For only *two* of the six dependent variables was the relationship with ideology as strong, or stronger, than that with technology.

The fact that ideology was more strongly associated with the measure of premarital sex norms does suggest that had more measures of societal norms been available the pattern of results would have been different. Yet, even if we grant this possibility, as seems reasonable, it does not gainsay the finding that technology

has had a more powerful impact on the *material* and *organizational* features of societies.

While a single limited study cannot definitively answer the broad theoretical question we have asked, there are several important points that should be emphasized. First, the dataset we have used is more than a sample of societies; it is, in effect, *the universe* of preindustrial societies for which reliably coded data are available. Moreover, it is a dataset that contains an extraordinarily broad range of variation with respect to sociologically important variables. Second, it should also be noted that our results make good theoretical sense: they are consistent with expectations of materialist theories, notably, cultural materialism (Harris 1974, 1977, 1979) and ecological-evolutionary theory (Lenski, Lenski, and Nolan 1991), and they support the conclusions of earlier empirical studies (e.g., Heise, Lenski, and Wardwell 1976; Leavitt 1986). It is possible, of course, that some (other) measure of ideology can be found (or developed) that is more closely related to variations in basic societal attributes, such as size and organizational complexity, than is subsistence technology. At this point, however, that is merely a possibility to be considered and a challenge to be met, not something that has been demonstrated empirically.

A much more likely challenge to our conclusion can be expected from analyses based on more temporally limited datasets. For example, if one looks only at comparisons of subsistence technology and ideology in recent decades, it may seem that ideology is the more powerful force. The new environmentalist ideology of the green movement and its efforts to influence the direction of technological change in Western industrial societies is a case in point.[13]

It should be noted, however, that it is hard to imagine such an ideology having much of an impact anywhere except in highly affluent societies, and such societies are obviously products of countless advances in subsistence technology. Thus, from the standpoint of a comprehensive theory of societal development (i.e., a theory that is concerned with the full sweep of human history, not simply some small portion of it), ideology is probably best thought of as a sometimes important *intervening* variable standing between subsistence technology and the basic structural attributes of human societies. More specifically, it appears to be an intervening variable whose importance increases greatly as the technological resources of societies increase. Thus, we cannot ignore or minimize the influence of ideology on societies and their development; that influence has been real and sometimes, especially in highly affluent societies, it can be substantial. This, however, should be seen as essentially a qualification to the even more fundamental principle that, for the course of human history as a whole, subsistence technology appears to have been the more powerful force shaping the basic structural parameters of human societies. For macrosociological theory and theorists to ignore this is to impoverish the discipline.

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APPENDIX
Variables, Codes, and Sources

Data are from George Peter Murdock's *Ethnographic Atlas*, originally reported in *Ethnology* (1962-1971). Robert Textor transcribed data for the first 400 societies to an alphabetic punched card deck; Herbert Barry, III, transcribed the data for all 1267 societies to a numerical punched card deck. Douglas R. White's floppy disc *World Cultures* version was used here. The variable numbers are given in parenthesis below.

Subsistence technology is an ordered set of categories denoting the principal means by which a society obtains its foods and fibers: (1) hunting and gathering, (2) simple horticulture, (3) advanced horticulture, and (4) agriculture.

	Plant Cultivation	*Metals*	*Plow*
1. Hunting and Gathering	0	0	0
2. Simple Horticulture	+	0	0
3. Advanced Horticulture	+	+	0
4. Agriculture	+	+	+

Notes: 0 = absent; + = present.

Although the subsistence technology codes are based on data from the *Atlas* (V1-V5, V28, V39, and V40), they are not in the *World Cultures* data set. Detailed information on the coding can be found in Lenski, Lenski, and Nolan 1991: 441-442.

Ideology, the structure of religious beliefs, (V34) is an ordered set of categories based on belief in a high god (see Swanson 1960:chapter 2): (1) absent or not reported; (2) present but not active; (3) present, active, but not supportive of human morality; and (4) present, active and supportive of human morality.

Mean size of local communities (V31): (1) fewer than 50; (2) 50-99; (3) 100-199; (4) 200-399; (5) 400-1,000; (6) 1,000 without any town of more than 5,000; (7) towns of 5,000-50,000 (one or more); (8) cities of more than 50,000 (one or more).

Political integration (WES column 15, V89): (1) absent, even at local level; (2) autonomous local communities (not > 1,500); (3) peace groups transcending local community; (4) minimal states (1,500-10,000); (5) little states (10,000-100,000); (6) states (at least 100,000).

Jurisdictional hierarchy beyond local community (V33): (1) no levels (no political authority beyond community); (2) one level (e.g., petty chiefdoms); (3) two levels (e.g., larger chiefdoms); (4) three levels (e.g., states); (5) four levels (e.g., large states).

Class stratification (V65): (1) absence among freemen; (2) wealth distinctions; (3) elite (based on control of land or other resources); (4) dual (hereditary aristocracy); (5) complex (social classes).

Marital composition, monogamy and polygamy, (V9): (1) independent nuclear, monogamous; (2) independent nuclear, occasional polygyny; (3) preferentially sororal, cowives in same dwelling; (4) preferentially sororal, cowives separate dwellings; (5) non-sororal, cowives in separate dwellings; (6) non-sororal, cowives in same dwelling; (7) independent polyandrous families.

Norms of premarital sex behavior of girls: (1) early marriage of females (at or before puberty); (2) insistence on virginity; (3) prohibited but weakly censured and not infrequent; (4) allowed, censured only if pregnancy results (5) trial marriage, promiscuous relations prohibited; (6) freely permitted, even if pregnancy results.

NOTES

1. Many contemporary theorists ignore completely the experience of preindustrial societies, and more especially that of preliterate societies.
2. Using the structure of religious beliefs as a means of categorizing ideology might seem odd at first, but it is difficult to think of an equally important feature of basic beliefs/ideology that is coded with comparable reliability for such a diverse set of societies.
3. We thank Wout Ultee of the University of Nijmegen for prompting us to develop a typology of ideology and to compare its predictive power with that of subsistence technology.
4. Given previous theoretical arguments and findings (e.g., Leavitt 1986:543; Lenski, Lenski, and Nolan 1991:81; Simpson 1979:304-305), it is not surprising that we find that the two independent variables are indeed positively related (gamma = 0.46, asymptotic standard error = 0.074 where subsistence technology is ranked 1 to 4 from hunting and gathering through agriculture, and high god is ranked 1 to 4 from absent to present, active, and supportive) and that for each of the dependent variables, entering their association significantly reduces the likelihood-ratio chi-square, L^2, from that of independence.
5. This also renders moot the argument that the categories of subsistence technology clearly order societies in terms of increasing levels of harnessed energy (e.g., Schwartz 1975), whereas, categories of high god belief are ordered, perhaps, *only* from the perspective of a particular belief system: monotheism.
6. An alternative set of dichotomies—absence of a high god versus a high god in any form, and hunting and gathering or simple horticulture versus advanced horticulture or agriculture—produced much weaker results. The R^2 was substantially smaller for five dependent variables, and it was only marginally higher for the sixth, jurisdictional hierarchy: 0.997 versus 0.984). The results were also grossly inconsistent with those produced by the polytomies. For instance, the R^2 was only 0.47 for premarital sex norms using the alternative dichotomies, (versus 0.986) and, more importantly, in this poorly fitting model, *neither* ideology nor technology had significant effects. The dichotomies we have used, thus, preserve the one set of findings that most favors ideology over

technology, premarital sex norms for girls, and improves the performance of ideology in one additional case—community size. Given the theoretical motivation of these dichotomies, the consistency of their results with those of the polytomies, and the stronger support they give for effects of ideology—making the test of technology's effects more conservative—we use and report results from them, rather than the alternatives.

7. Models were estimated, and the significance of chi-square changes was calculated, with the log-linear module of Steve Borgatti's (1992) *Anthropac 4.0*.
8. For the polytomies, Model 2 was preferred in four instances, and Models 3 and 4 in one. The key difference in the results, therefore, is that Model 4 is preferred over Model 2 in one more instance for the dichotomies—size of local communities. This additional preference for the model with *both* ideology and technology in it, over that with technology alone, provides slightly stronger support for ideology than did the analysis of the polytomies.
9. Note that, given the constraints of this model, the same ratio is obtained for societies that *do* believe in a high god—$9.56/1.46 = 6.55$.
10. Again, given the constraints of this model, the same ratio is obtained for societies with high technology—$9.56/7.76 = 1.23$.
11. Parameter estimates were computed with the Freq module of Scott Eliason's CDAS program.
12. These Z-tests will generally produce the same results as the chi-square difference tests between nested hierarchical models (Goodman 1972). For instance, Table 2 indicates that Model 4 significantly improves the fit of Model 3 (the partial effects of technology are significant), but not of Model 2 (the partial effects of ideology are not significant). The corresponding Z-scores are 3.92 ($P < .001$) and 0.489 (NS).
13. Many environmentalists, however, would argue that this is far too optimistic an assessment and that those who adopt it are confusing what they believe ought to be true with what is actually true.

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