

APPLICATIONS OF EVOLUTIONARY CULTURE THEORY

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INTRODUCTION

Evolutionary culture theory (ECT) is a growing corpus of principles and arguments that attempt to explain the “descent with modification” of human cultural systems. Although it encompasses diverse viewpoints (see comparisons in 24:158-66; 52; 53:Ch. 4), ECT is united by three underlying propositions: (a) that the socially transmitted information systems we call “cultures” provide human populations with an important second source of heritable variation; (b) that these cultural systems are historically interrelated by a branching, hierarchical pattern of descent; and (c) that this “cultural phylogeny” is itself a product of two basic kinds of processes—transformation (that is, sequential change within any given culture) and diversification (the branching of one culture into two or more descendants). It bears emphasizing that evolutionary culture theory differs substantially from earlier views of cultural evolution (such as those of classical evolutionary anthropology, neoevolutionism, and sociobiology; see 52) and that it refers not to any one position or line of argument today, but rather to the diverse collection of efforts to elucidate the patterns and processes of descent with modification in cultures.

In this chapter, I review recent attempts to use evolutionary culture theory to analyze stasis and change in human cultural systems. Among the many reasons why a review of these attempts is useful today, three seem particularly compelling. First, ECT is still to some degree isolated from mainstream concerns in anthropology and related social sciences. One reason for this is simply the field's youth: Its first important theory papers were published only in 1973 (32, 33). Another reason is the notoriety of earlier kinds of cultural inquiry that called themselves "evolutionary"—a notoriety vigorously renewed during the sociobiology debate (e.g. 30, 144). But perhaps a more important reason is that applications, especially thorough empirical analyses of phenomena of wider interest to social scientists, have to date received less attention than theoretical arguments and mathematical models. I hope a review of existing applications will both demonstrate the value of ECT and encourage new and more extensive empirical studies.

Second, evolutionary culture theory does not require an impoverished conceptualization of culture as is often believed. Although early arguments did give that impression (e.g. 35, 50, 51, 106, 171), the problem was one of oversimplification, not incompatibility. A review of applications can make clear that this shortcoming resulted more from the novelty of this line of inquiry than from an inherent weakness in the evolutionary approach. Finally, I believe that ECT has itself evolved without adequate attention to the social structure of human populations. In most formulations, for example, cultural change is modeled as the statistical outcome of simple decision-making by individuals; as one author noted (151:6), this reduces cultural evolution to "the product of choices made in the marketplace of cultural possibilities" (for an explicit case in point, see 106:176). A review of applications illustrates why this is at best a caricature of cultural evolution, and can suggest steps to correct it.

With these goals in mind, I address empirical work bearing on two main areas of ECT, conveniently summarized by Darwin's aphorism: namely, "descent" (i.e. cultural uses of the descent relationship) and "modification" (i.e. studies of the processes causing sequential transformation within cultural systems). I have taken the liberty of including a number of works that were not undertaken as applications of evolutionary theory by their authors, but that do provide useful empirical examples of cultural descent and modification. Because ECT is still a relatively new endeavor, I focus largely on its application to culturally homogeneous societies or "ethnolinguistic populations." This body of theory can make many useful contributions to the study of culture in more complicated, heterogeneous settings, including the modern nation-state; for now, however, the arguments and issues are best illustrated in less complex contexts. For other reviews of ECT, or "dual inheritance theory" as it is often called in comparisons with genetic evolution, see 16, 45, 52, 53:Ch. 4. For recent reviews of other, often complementary, approaches see 6, 26, 158 on evolutionary psychology; 22, 42, 153 on human behavioral ecology; 21, 77 on

human sociobiology; 86, 103, 104 on “biocultural” evolution; and 95, 149 on social evolution.

DESCENT

A principal assumption in ECT is that new cultures generally originate from pre-existing “parental cultures” via a splitting or branching process called “diversification” or “culture birth.” The assumption holds that diversification is normally a process of uniparental fissioning; although the so-called “daughter cultures” produced in this way may certainly go on to acquire many of their features by subsequent diffusion, in most cases they still begin as offshoots from a single parental stock. In principle, of course, new cultures can also originate through a simultaneous “fusion” or merger of different parental cultures, giving rise to descendants that are thoroughly hybrid or “mixed” from the start [as implied, e.g., by Kroeber’s “tree of culture” (93:260–61)]. Surely bi-parental, tri-parental, or even multi-parental culture births are possible; indeed this has sometimes been the goal of attempts in the last few centuries to build synthetic “national cultures” (see 59 for a pertinent example). The implicit assumption of most ECT, however, is that genuine cultural hybrids have been rare, special cases in human history, at least until very recently—much as are the so-called “mixed languages” (pidgins, creoles, and “products of extreme borrowing”; see 84a, 164a) in the universe of human languages [e.g. Ruhlen’s global inventory (142) lists only 37 pidgins and creoles]. Supporting this assumption are the arguments: (a) that there is neither a logical requirement nor a routine mechanism for bi-, tri-, or multi-parental inheritance in culture (in other words, successful culture birth requires the equivalent of neither sex nor syngamy); and (b) that there exist a number of effective barriers to hybridization—ecological, psychological, linguistic, and cultural (see 170)—that act as transmission isolating mechanisms (TRIMs), by analogy to the reproductive isolating mechanisms (RIMs) of speciation theory in biology. Although the strength of these and other barriers surely must vary from context to context, it is revealing that languages of mixed origin—not to mention whole cultures of mixed origin—seem to have formed only rarely, and then only under coercive conditions (see 15:108; also 110, 164a).

The Family-Tree Hypothesis

For these reasons, the “cultural phylogeny” behind most cultures—that is, the pattern of relationships generated by culture birth—is believed to form a systematic hierarchy of successive splits. Let me call this argument the “family-tree hypothesis” after its counterparts in linguistics (see e.g. 82:27–35; 142:Ch. 1) and evolutionary biology (see e.g. 77a, 78, 136, 154 on cladistic classification). Again, I emphasize that the family-tree hypothesis applies only to ties of descent (i.e. to links created by the actual birth of new cultures); it surely does not apply to ties of diffusion, which tend to be more clinal than

tree-like (142:257) and are better described by “wave theory” (see 82:32–33). It will therefore be useful to distinguish between the bona fide phylogenies of cultures related by birth and the phylogeny-like mix of horizontal transfer and descent that may characterize the evolutionary history of any given technology, tradition, or social institution; my focus here is on the former.

Where TRIMs are strong and diversification consistently uniparental, there will be no mixed ancestries in a group of related cultures, and the corresponding family tree will specify a “unique and unambiguous” phylogeny, much as assumed by cladistic classification in biology (136:51). Such “unmixed” trees, or unmixed portions of trees, have a special importance in the study of cultural evolution because they provide a kind of “general reference system” for the group of related cultures (after 78), containing useful information about their historical ties. Where TRIMs are less effective and fusion occasional or intermittent, the resulting “mixed” family tree will still contain useful information and implications about cultural history. However, it will also be more difficult to infer parental relationships and thus to piece together an accurate phylogeny.

In organic evolution, the descent relationship has special importance because it creates what Darwin (44:206) called a “unity of type” among descendants: that “fundamental agreement in structure, which we see in organic beings of the same class, which is quite independent of their habits of life.” In cultural evolution, one can speak of an analogous “unity” consisting of the cultural similarities among societies of a given region and period that are, likewise, independent of current circumstances and ecological exigencies. Any particular instance of such similarity can be called a cultural homology (that is, a similarity by descent) to distinguish it from other kinds of similarity among cultural systems (see 52:191) including: analogy (similarity by convergence or by parallel change), synology (similarity by diffusion or borrowing), “icology” or iconic similarity (similarity by intrinsic association; see example below), and mere coincidence (similarity by chance or accident). The family-tree hypothesis posits a large and generally unappreciated amount of similarity by descent among human cultural systems. Although some homologies are surely universal in their distribution (see discussion in 52:188–89), similarities by descent will generally be more specific, more detectable, and more abundant in instances of relatively recent cultural divergence—within language families or subfamilies, for example (see 1, 2). For convenience, I refer to this generalization as the “descent principle.”

Putting Cultural Descent to Work

The analytical value and utility of the descent relationship among human cultures have been suggested many times by scholars in all four main subfields of anthropology (see e.g. 92, 102, 141, 143, 159, 169). Yet descent has rarely been given its due, in part because of the difficulty of obtaining the necessary data, comparative and/or diachronic, but also because of a prejudice widely

held since Boas (see e.g. 19:211–25; and discussion in 52, 160) that diffusion reliably “swamps” all traces of phylogeny. The advent of evolutionary culture theory, together with studies like those described below, suggests that descent deserves a new hearing.

HISTORICAL LINGUISTICS Since the pioneering arguments of Sir William Jones in 1786 (see 140:134), the descent relationship has played a prominent role in historical and comparative linguistics (5, 27, 82), where it has been used in two related ways. First, descent has served as the basis for the so-called “genetic classification” of languages into a structured taxonomy of phyla, stocks, families, subfamilies, and the like (75, 142, 143). Here the idea is that ties of descent have created a hierarchy of differential similarity among related languages, a hierarchy that can be detected through systematic comparative analysis. One of the more successful, though still controversial, techniques for doing this is Greenberg’s method of “multilateral comparison” (71, 72, 142, 143): the study of basic word lists from an array of languages in an effort to distinguish probable “genetic cognates” from similarities caused by diffusion, sound symbolism (i.e. the iconic similarity between sound and its meaning, as in onomatopoeic words), and chance. A substantial list of suspected cognates is taken as *prima facie* evidence that two or more languages have probably descended with modification from a common ancestor. This follows from the “relatedness hypothesis” (82:17), which holds that descent from common origins is the most likely explanation for systematic similarities of sound and meaning in the basic vocabularies of a group of languages (see also 160). By themselves, of course, suspected cognates do not “prove” a descent relationship, particularly in situations where language contact has occurred (a point emphasized in 164a); still, they are useful for identifying similarities that warrant further study (see 72).

Once this first step is completed, the search continues within the group of hypothetical descendants for “exclusively shared innovations” (142:14), whether lexical, phonological, semantic, or syntactic. The presence of such innovations can both confirm suspected descent relationships and reveal more detailed similarities among certain subgroupings, allowing one to reconstruct a model of phylogenetic relationships. Here, as in Hennigian classification in biology (where the focus is similarly on “shared, derived characters” among related species; see 136:Ch.4), the assumption is that convergent evolution is relatively rare, and thus that exclusively shared innovations will appear only among the descendants of the parental language they first appeared in. This technique has been used intermittently since the time of Sapir (150; see review in 143) but perhaps nowhere more productively than in the major linguistic classifications of Greenberg (70, 71, 73).

The second use of descent within historical linguistics works the other way around. In this instance, homologous aspects of descent-related languages are used to reconstruct basic features of the common ancestor or “protolanguage” of the group (163). Aided by the “regularity hypothesis” (82:17)—that is, the

hypothesis that linguistic evolution produces a characteristic series of sound changes through time within each language family (e.g. “Grimm’s law” for Indo-European languages)—linguists have used sound correspondences among related languages to infer the historical pattern of sound shifts and thereby to reconstruct original words and expressions of the protolanguage. This procedure, too, has been widely applied, generating word lists and associated cultural inferences for many ancestral languages, including Proto-Athapaskan (55, 80), Proto-Indo-European (e.g. 63; see also 107, 128–130), Nostratic (85), Austronesian (12, 17, 18), and Proto-Polynesian (124–126), to name a few. In addition, comparative reconstruction has an important, more general role to play in the study of cultural evolution as described below.

BIOLOGICAL ANTHROPOLOGY Paradoxically, one of the early studies to put the principle of cultural descent to good use was Livingstone’s (102) pioneering work in human genetics. In an attempt to test the “malaria hypothesis” for the distribution of the sickle cell gene (*S*) in West Africa, Livingstone found a striking correlation between the linguistic affiliation of local populations and frequencies of the *S* gene. The comparison allowed him to attribute genetic differences between language groups to salient cultural differences, such as subsistence strategies, settlement patterns, and migration habits, but only because these properties were more or less consistent within language families. The success of the analysis, in other words, both in early tests and in later confirmations (see 53:Ch. 3), depended directly upon cultural similarities produced by descent.

Livingstone’s analysis paved the way for other comparisons between the biological and linguistic phylogenies of human populations. Among other things, these studies add up to a striking confirmation of the validity of the procedures used to infer descent relationships in historical linguistics. One recent study by Greenberg et al (74), for example, compared linguistic, dental, and genetic evidence among broad samples of indigenous New World populations, and found three closely matched subdivisions. The correspondence suggested “that the Americas were settled by three separate population movements whose identity can be most precisely expressed in linguistic terms as Amerind, Na-Dene, and Aleut-Eskimo” (74:477). The finding raised no small controversy (see e.g. 43, 112), but subsequent genetic analysis (see 23, 31) has only strengthened the claim for the three-way split. Meanwhile, other researchers working on more or less analogous comparisons in Africa, Europe, and Oceania have confirmed the first study’s most basic finding: “genetic differentiation clearly parallels the clustering of major linguistic families” (58:151; also 79a, 88, 155). It takes little imagination to predict that the search for other correlated phylogenies will continue to shed new light on the genetic and cultural histories of regional populations.

Meanwhile, the descent principle has reached a kind of ultimate expression for both historical linguistics and biological anthropology in recent compari-

sons of the global phylogenies of gene pools and languages. Consider the linguistic side first: There are new arguments and evidence for the monogenesis of human language—that is, for the existence, long postulated (161, 168; see discussion in 131), of a single common ancestor to all known human languages. Thus Greenberg's recent work with multilateral comparisons suggests that human languages form "what is very likely a single language family," all related by a branching hierarchy of descent (71:337; 73; and J. H. Greenberg, personal communication). To this, Bengtson and Ruhlen have added an impressive, growing list of global cognates and supporting etymologies (13). But the single most convincing piece of evidence comes again from correlated phylogenies—this time on a global scale, as documented by Cavalli-Sforza and colleagues (23, 31, 37, 39). Using, on the one hand, genetic data (from both "classical" protein analysis and nuclear DNA polymorphisms) and, on the other hand, linguistic data [from Ruhlen's (142) impressive world-scale compilation], these researchers find that the genetic family tree of human populations correlates "suprisingly well" with its (still somewhat incomplete) linguistic counterpart (31:76). This analysis, too, has drawn much criticism, some of it inevitable for a project of this scale (see e.g. 9, 120, 121, 173; see also replies in 38, 72). But the fact remains that not even a rough and approximate correlation would be found were the descent relationship important only to the genes, and not the cultures, of human populations.

ARCHEOLOGY The descent relationship has also played a visible role within archeology, although its analytical importance has often been overshadowed by unilinear stage models and "essentialist," typological thinking (47–49, 95, 152). Prominent archeological studies with a "phylogenetic theme" include works by Bellwood (11), Childe (40, 41), Ehret (57), Flannery & Marcus (61), and Linares & Ranere (96). But surely the most comprehensive of such undertakings are recent works on (a) "the puzzle of Indo-European origins" by Renfrew and Mallory (e.g. 107, 128–131) and (b) "the evolution of the Polynesian chiefdoms" by Kirch (89–91) and Kirch & Green (92). In both cases the expanding archeological data base is supplemented by a wealth of independent information from historical linguistics (see sources above) and comparative ethnography. In the interest of brevity, and because the Indo-European case has been thoroughly reviewed elsewhere (see e.g. 107, 129), let me focus on the Polynesian work, which also draws upon the lessons of earlier phylogenetic studies by Goldman (64, 65; reviewed in 164) and Sahlins (145, 146; reviewed in 68). As Kirch has pointed out, Polynesia is almost an ideal setting for this kind of investigation: The more than 40 ethnographically described societies "can be likened to a set of historical, cultural 'experiments', in which the founding ancestor was identical, but where certain variables—ecological, demographic, technologic, and so on—differed from case to case" (90:2–3; see also I la, 67, 162).

Results from Polynesia bode well for the future of cultural descent studies in archeology and anthropology more generally. First, drawing upon compara-

tive archeological data and lexical reconstructions, Kirch (90:Ch. 3) is able to reconstruct significant features of “Ancestral Polynesian Society” (APS), and its internal variability, as these existed between about 500 BC and 300 AD. The characterization includes key aspects of technology, agriculture, animal husbandry, marine exploitation, settlement pattern, kinship, and social relations. Among other things, the reconstruction shows that “Colonizing Polynesians in every case carried with them concepts of pyramidal social structure, of first fruits and tribute as obligatory to the chiefs, of chiefs as earthly representatives of ancestral diets ... [and] of domination by the chiefs over labor and the means of production” (90:281). In all, it adds up to one of the more complete cultural reconstructions available, confirming by example the value of the descent principle for archeology.

From this common base, Kirch argues, the cultural/ideational systems of Polynesia differentiated and transformed, as did the interrelated systems of social relations (a distinction I would emphasize more than Kirch, for reasons outlined in 53), giving rise to the “myriad cultural and social variations” that characterized the region at the time of contact (90:2). By then, variations on the ancestral theme ranged from relatively egalitarian societies, most commonly on atolls, all the way to highly stratified polities, most commonly on high islands, “where the chiefly class claimed descent independent from commoners, ranked themselves internally into seven or eight grades, practiced sibling marriage to maintain those grades, mobilized *corvée* labor and organized production on a grand scale, and most notably, alienated land from ownership by commoners” (90:4).

What forces guided the evolution of such differences? Here again Kirch draws upon the relationship of descent to infer a “synthetic explanation” with varied roles played by many factors (90:283; 92). The main argument can be summarized as follows: (*a*) Culturally sanctioned, politically motivated demands by the chiefs for surplus production, plus (*b*) natural population increases, operating within (*c*) the constraints of technology and varying local environments, propelled (*d*) various forms of expansion and intensification in agriculture and other production systems (90:281–82). Sooner or later (or not at all), depending on local conditions, expansion led to (*e*) competition and warfare between lineages, which (*f*) increased the power and wealth of successful chiefs, allowing them (*g*) to consolidate polities and restructure the social hierarchy, which in turn permitted them (*h*) to impose changes in local culture, including changes in the rules governing landholding, first-fruits ceremonies, and the tribute they were owed, which then (*i*) fueled further demands for surplus, leading back to item *a* above and creating, under suitable circumstances, a positive feedback loop.

The processes are clearly delineated, the causal links plausible, and the overall model reasonably well supported by selected cases (especially Hawai’i; see 90:Ch. 10). Moreover, by basing the APS reconstruction largely upon independent linguistic data, Kirch & Green avoid the potential for circu-

larity in their inferences (as would result, for example, if APS were reconstructed by running the model backward, so to speak). There remain large gaps in the data, however, and many more cases beg to be tested (as in 91a), including atolls; in addition, much would be gained if the analysis were extended into the early post-contact period and explicitly linked up with studies of more recent Polynesian culture history (e.g. 147, 148; see also 164). Nevertheless, the study is a benchmark in the annals of descent research. Indeed, it is almost a paradigm of the historical interplay between cultural evolution and social change. Here one sees particularly clearly how power differentials can, through the mechanism of imposition (see below), give particular direction to cultural change. But one also sees how directional change in culture translates back into further increases in the social asymmetry that allowed the imposition in the first place. The result—a reciprocally interactive “coevolution” of culture and social structure—is certainly not unique to Polynesia, but it does seem especially accessible there to further study.

CULTURAL ANTHROPOLOGY Descent-based analyses have a similar history, if not yet an equivalent apogee, in works of various authors in cultural anthropology (see especially 1, 2; 99:Ch. 21; 113–116, and an early review in 56). At times, the descent relationship even shows up in studies that are self-avowedly anti-evolutionary and/or anti-Darwinian in their approach. A classic example is Hallpike’s argument, on the one hand, that it is “impossible to apply Darwinian principles ... to socio-cultural systems” (76:32) and, on the other hand, that “a number of those basic institutional and ideological forms which we regard as characteristic of Western European [society] ... can be traced to [a common ancestral] Indo-European origin” (76:329ff).

In the interest of brevity, let me offer examples of the use of the decent relationship in cultural anthropology according to the kind of inference that has been made, thus illustrating something of the greater potential for this kind of work. Descent has been used:

1. *To construct phylogenies and branching tree diagrams from comparative ethnographic data for groups of closely related cultures.* A good example is Marshall’s (108) analysis of structural patterns of sibling classification in island Oceania, which generated a new “synopsis of Oceanic prehistory.” The ensuing debate over the ancestral prototype, however (see 108:626–29), underscores an important procedural point: Some technique such as “outgroup comparison” (see 136:60ff) is essential for distinguishing ancestral from derived forms. Although building cultural phylogenies in this way is a perfectly legitimate use of the descent principle, the methodological challenges of assembling a comparative data base (as e.g. in 109) and carrying out multivariate statistics (as e.g. in 84) may limit its appeal; fortunately, in most instances, historical linguistics already provides an independent phylogenetic model—as in Ruhlen’s classification (142; although the fine-grained categories should be approached with caution)—against which more selective ethnographic data

may then be compared (for examples of this more limited application, see 53:520–24; 54).

2. *To establish the relative age of certain traditions, or to make sense of their geographical distributions.* Such was the use of “genetic heritage” among cultures by Driver (46; see also 83), who sought to understand patterns of in-law avoidances among North American Indians; and by Murdock et al (118:459), who sought to comprehend regional patterns in the global distribution of theories of illness. As reviewed by Goodenough (68a:Ch. 4), descent was also “a major interest” to some American anthropologists, notably Wissler and Kroeber, and to German scholars of the *Kulturkreislehre* in the early decades of this century, “as they tried to trace the origin and diffusion of particular traditions” (p. 127). In my own work, I have used the descent relationship to infer the time depth of particular customs—a valuable aid where more direct historical information is lacking (e.g. see 53:474; 54).

3. *To reconstruct key features of ancestral cultural systems.* A prominent example here is Dumézil’s reconstructed “tripartition” of Proto-Indo-European (PIE) society into the classes of priests, warriors, and herder-cultivators (see 98, 100, 101, and reviews in 98a:Chs. 19–21 and 107:Ch. 5). A related example is Lincoln’s reconstruction of the PIE “myth of the first sacrifice” and its correspondences across Indo-European mythologies (97, 98:Ch. 4). The analysis allows Lincoln to infer subtle differences among prehistoric Indo-European cultures, as between the value of cattle to agriculturalists vs pastoralists (97:143), which in turn have shed light on the history of dairying and adult lactose absorption (see 53:269–73, 505–10). Lincoln’s recent self-criticism (98a)—provoked by certain new insights into Dumézil’s political life (explained in Ch. 19)—is a useful reminder that, in order to argue convincingly for cultural homology, one must always rule out convergence and coincidence (see p. xvi). In addition, it is an appropriate call for greater attention “to the multiple competing voices that find expression in differing variants [of myths], and to the struggles they wage in and through mythic discourse” (98a:124).

4. *To infer key processes guiding the differentiation from the common ancestor.* Vogt (169:35–45) uses the descent principle in this way, much as do Kirch & Green in the example discussed above, to formulate a number of hypotheses about the radiation of “the Maya genetic unit” as affected by ecological setting, contacts with other groups, and internal cultural dynamics. Again, it is important to guard against the potential circularity of arguing, from the same data, both up the family tree and back down again. But where that can be avoided, this use of descent helps to show that “societies are not simply bundles of adaptations to the here-and-now ... [but] can inherit certain basic institutional and ideological principles from a remote and primitive antiquity ... [that] are often of vital significance” to their ongoing evolution (76:370).

MODIFICATION

So given the premises (a) that existing cultural systems are all related by descent, but (b) that homologies are most apparent where divergence is relatively recent, it becomes important to ask about transformation. What are the main processes that have guided the cumulative, sequential change of diverging cultures? Here the goals of ECT coincide nicely with recent efforts to “historicize anthropology” (e.g. 122, 123).

On the subject of transformation, ECT proposes a general “selective retention” framework (after 28, 29) within which different authors or schools of thought argue for different versions. The basic idea is that transformation is caused by changes through time in the social distribution of alternative cultural forms or “variants” within a given population or subpopulation. The focus is on “who believes what” (or at least who seems to) and “why” within a given group of people, and on how the answers to these questions change through time. The problem is obviously complicated by social structure, and particularly by differences in the social distribution of options, consequences, and power within a given population. To a considerable extent, social structure can be accommodated by identifying relatively homogeneous “reference groups” within the whole, and then by analyzing cultural dynamics within and between them (see also 53:210–11); however, this area of ECT deserves far more work and attention than it has thus far received.

Nevertheless, the basic idea of selective retention models is that the culture of a given reference group evolves as some variants gain in frequency among its members and others lose. ECT now hosts a whole range of propositions about how this happens. To date, the most promising involve “conveyance forces,” that is, processes (“forces” in a metaphorical sense) causing differential rates of social transmission among the existing variants (see 52). Moreover, all such propositions assume that conveyance forces have a cumulative “recursive nature”; that is, the forces discussed below are viewed as acting repeatedly, over and over with the passage of time, such that trends (or stasis, as the case may be) emerge as a cumulative product of sequential, incremental change. Much in the way that individual frames relate to a movie, the forces at play in one “time step” relate to the eventual outcome of the cultural evolutionary process. In mathematical models of cultural change, this relationship is represented by so-called “recursion equations” or “recursion systems” (see e.g. 24, 35).

Transmission Forces

The first of three kinds of conveyance force can be called transmission forces. These arise from patterns of transmission—that is, from regularities in the social setting of the conveyance process. There are two central arguments here: One, from contextual studies, holds that the social organization and “style” of transmission have profound, cumulative effects on the aggregate

properties of knowledge and culture; the second, from formal models, proposes that regularities in the simple structure of transmission greatly influence the direction and rates of cultural change (or stasis).

Consider the formal models first, particularly those developed by Cavalli-Sforza and Feldman (see especially 35). These investigators have identified 10 "major modes" of cultural transmission (e.g. from parent to child, among age peers, from teacher to pupil, from social leader to follower, etc), each with distinctive kinetic properties and different effects on the evolutionary persistence of variants (34). These 10 modes have been further distilled to four "major mechanisms" of cultural transmission: 1. one-to-one "vertical" transmission (i.e. parent-to-child); 2. one-to-one transmission between nonrelatives, either "horizontal" (between two members of the same generation) or "oblique" (between a member of one generation and a nonrelated member of the next); 3. "one-to-many" transmission (one sender to many receivers), and 4. "many-to-one" transmission (or "concordant pressure" from many senders). The general evolutionary implications of each mode have been worked out using recursion mathematics. In the case of one-to-many transmission, for example, "cultural change is expected to be rapid and within-population variation low"; in the case of many-to-one, on the other hand, transmission will be conservative and evolution slow, as fits intuitive expectations (36:20).

These predictions have been tested in a number of quantitative assessments. One study examined "trait similarity" (e.g. religious and political affiliation, sports preferences, miscellaneous personal habits and beliefs) between students at Stanford University, considered "recipients," and their parents and friends, considered "transmitters" (36). The average correlation coefficients for vertical transmission ($r = 0.22$) were almost double those for horizontal transmission ($r = 0.13$) and were especially high for political and religious affiliation. Another study examined key contributors to the social transmission of subsistence, maintenance, and child-care skills among a sample of Aka pygmies of the Central African Republic (79). If anything, vertical transmission was even stronger in this context, with parents being significant teachers/models for 80.7% of all skills examined. In contrast, one-to-many transmission "seems very rarely if ever found" among the Aka, suggesting that "the high similarity of pygmy cultural traits across a vast area in central Africa" is, in part, "a consequence of the prevalent transmission mechanisms" that tend to favor conservation of cultural forms (p. 933). In short, the models have solid heuristic value and generate testable, if not always surprising, predictions. Already drawing inspiration from epidemiology, the models could surely be improved by heeding Sperber's advice and striving more explicitly for "an epidemiology of representations ... rooted in cognitive psychology" (156:73; 157).

The second, more contextual argument about transmission forces comes from recent work by Barth. His argument, nicely summarized in a 1990 paper (8:640), is that "Differences between traditions of knowledge are illuminated

by comparing the transactions in knowledge by which they are reproduced.” For example, Barth compares the role of “the Conjuror” in Melanesian initiation rites (especially those of the Mountain Ok of western Papua New Guinea)—in which the transmission of knowledge to initiates is actually less important than a brief, “spell-binding performance” of mysterious procedures and secret rites—with the role of the Guru of Southeast Asia (e.g. a Balinese Muslim teacher), where the pressures are not for secrecy and performance but for the clarity, elaboration, and duration of instruction. Barth argues that the differences in these modes of transmission “generate deep differences in the form, scale and distribution of knowledge . . . with profound historic effects on their cultures, even where similar substantive ideas are embraced” (p. 640). The arguments are a logical, comparative extension of the theme of an earlier monograph (7), which showed how “processes of codification, transmission, and creativity in Ok cosmology generate the [impressive] pattern of variation” manifest among different Ok groups today. In both works, Barth takes his cue from Darwin (see 7:Ch. 4), attempting to identify a specific mechanism of cumulative, incremental change within the “informational economy” of communities and regions. And in both cases, the argument provides a reasonably convincing account for observed variation, whether within or between traditions. Now it would be useful for the formal and contextual treatments of transmission to meet each other halfway and thus to generate models and simulations of the long-term, aggregate effects on culture of different “modes of managing knowledge” (8).

Natural Selection

The second of the three kinds of conveyance force is simply Darwinian natural selection acting on cultural variation, whether at the level of individuals, reference groups, or entire societies. In its most general form, natural selection may be said to occur whenever heritable variants, cultural or otherwise, differ in “fitness”—that is, whenever they differ in ways that affect the number of copies of each in the next generation. As Braun (25:79) puts it, “Natural selection for Darwin referred to the multiplicity of processes that together blindly shape the transmission of heritable characteristics in natural populations without artificial interference.”

On this reading of Darwin, the natural selection of a variant refers to the preservation of that variant in a population by virtue of any replication advantage it has over alternative variants. This meaning of natural selection has been championed by Boyd and Richerson in an important series of publications (24, 133–135). They argue that natural selection on cultural variation can produce both cultural adaptations (as judged by the standard biological criterion of reproductive success) and cultural maladaptations, depending upon whether cultural transmission is “symmetric” to that of the genes, and thus directed from parents to offspring, or “asymmetric,” and thus includes input from persons other than parents. The symmetric case is straightforward and rela-

tively intuitive. As Richerson & Boyd note (135), a pronatalist religion will spread through a population by natural selection at the expense of an “abstemious” one whenever parents both adhere to one creed or the other and successfully pass it on to their children. Another example might be natural selection for fava bean consumption in malaria prone regions (see 24:178; 86, 87).

The asymmetric case is both more provocative and potentially more important. As Boyd & Richerson note (24:178), “Selection will act on asymmetrically transmitted cultural variation if (1) there is competition to occupy the roles that are effective in such transmission and (2) individuals characterized by some cultural variants are more often winners in this competition than individuals characterized by other variants.” This argument is applied, albeit in a preliminary way (24:200; also 133), “to explain the demographic transition [People] like teachers and managers are disproportionately important in horizontal and oblique transmission in modernizing societies. In these circumstances, natural selection should act to increase the frequency of norms and values that stress the importance and value of these roles. Conflict with [reproductive] fitness will occur if one’s success . . . in professional roles is negatively correlated with family size. This is plausible since individuals with small families will have more time, money, and other resources to devote to the attainment of these social roles.”

The argument is logical, consistent with findings from numerous demographic studies, and loaded with implications; clearly a detailed longitudinal study is warranted. The same logic has been applied to the evolution of unilineal kinship systems (see 132) where, again, careful empirical analysis is sorely needed; and to the evolution of celibate religious traditions where, “by avoiding the costs of bearing or supporting children, celibates could devote more time and resources to spreading their beliefs horizontally” (24:202). The latter case underscores the importance of empirical substantiation: Despite its plausibility, the argument runs up against fairly convincing alternative explanations for at least a few of the world’s major celibacy traditions (see 69:77–81 and 20 on Christian religious celibacy; 66:69–70 on celibacy in Tibet). These alternative explanations all entail another force—imposition—which brings us to the third and final category of conveyance force.

Cultural Selection

My own reading of Darwin convinces me that he normally used “natural selection” in the more specific sense of preservation by survival and reproduction advantage (i.e. preservation by actual biological propagation). To avoid confusion, I find it helpful (a) to think of Boyd & Richerson’s “asymmetric” kind of selection as a transmission force (the first kind of conveyance force, discussed above), and thus (b) to distinguish it from both natural selection (kind 2) and a third kind, the differential social transmission of cultural variants as a function of human decision-making (see 53). Generally called “cultural selection” (after 4, 35, 50, 53, 138, 139, and others; called “biased

transmission" in 24), this force arises from the value-guided preferences of culture carriers, whether exerted while they are adopting, sustaining, or conveying an aspect of a cultural system. The term is a deliberate parallel to "natural selection," but it refers to preservation by *preference advantage*, not survival and reproduction advantage.

Although there are as many forms of cultural selection as there are kinds of decision-making (individual and collective, formal and informal, conscious and unconscious, etc), I find it conceptually and analytically useful to distinguish two pairs of intergraded categories. First, following Pugh (127), decisions can be subdivided according to the types of value most influential to the outcome. Primary value selection thus refers to decisions in which 'primary' or 'developmental' values hold sway (these are the values that develop within each individual out of his or her own experience and the interplay of 'nature and nurture'; by definition they contain no significant, decision-altering information from social transmission). Such decisions form a continuum with those resulting from secondary value selection, that is, with decisions in which secondary values play the governing role ("secondary" refers to their derived character, not their importance; a value is secondary if it includes significant socially transmitted information). By these definitions, a decision can be influenced simultaneously by both primary and secondary values; the value that predominates in a given case specifies the form of selection. A decision qualifies as secondary value selection whenever the outcome is governed by socially transmitted information, either because the decision is different from what it would have been according to primary values (the clearest and strongest case) or because what makes it convincing to the deciders is socially transmitted information (an example is given below; compare with 172:643–46). In these terms, the decision-making procedures called "direct bias," "frequency dependent bias," and "indirect bias" by Boyd & Richerson (24) are particular forms of cultural selection; the latter two qualify as important, special cases of secondary value selection.

Another useful pair of intergraded categories ranges from choice to imposition, or more precisely, from autonomous election (autonomous within the constraints of technology, worldview, and actually existing variation) through to total compliance with the decisions of others. In instances of relatively unrestrained choice, the "carriers" of a given cultural variant are also its "selectors:" They decide whether to sustain one variant rather than another. Where choice predominates, the variants kept alive, so to speak, in a given cultural system reflect the local, endogenous preferences of the carriers. Such variants are likely to have the stable and enduring qualities often associated with "cultural tradition."

In imposition, on the other hand, the selectors and carriers are different groups of people. The selectors decide according to their own value systems and then find ways to induce compliance among the carriers. This compliance can be achieved by limiting the number and/or kinds of options, by changing

or threatening to change the perceived consequences of options, or indeed by influencing the secondary values that will be used by the carriers. Either way, the variants kept “alive” by imposition will reflect the endogenous preferences of the selectors, not those of the carriers. To be sure, imposition is a decision process; however, the social locus of decision-making in imposition is different from that in choice, and implementation is here achieved through the exercise of power. Indeed, the very fact that power is generally required for effective imposition (see e.g. 105) suggests that the human “decision system” may well have been designed during its organic evolution to detect and resist such efforts. If so, then impositions are likely to be inherently unstable: Their persistence should then vary as a function of power asymmetries, the degree of imposed hardship, and awareness of potential options, among other things.

As noted elsewhere (52:199–200; 53:202), these two pairs of intergraded categories—choice to imposition, and primary to secondary value selection—can be viewed as the orthogonal axes of a Cartesian reference system for describing different forms of cultural selection. It should be emphasized that both axes represent continua rather than dichotomous categories, and thus that “choice” and “imposition” indicate relative, not absolute, positions on a spectrum. Nevertheless, I consider the contrast between them to be crucial with respect to both theory and empirical applications. The following sections illustrate this point while documenting the evolutionary efficacy of cultural selection in a fitting context: the cultural evolution of incest taboos. For other examples of the role of decision-making processes in cultural evolution, see 60, 62, 111, 137.

SELECTION BY CHOICE A striking example of cultural selection by choice is offered in the recent analysis of “changing concepts of incest” among the Eastern Nuer by Hutchinson (81). As a by-product of social and economic change, the eastern Nuer today are questioning the limits of *rual* (incest) in their traditional incest prohibition, using a method that Hutchinson terms “pragmatic ‘fecundity testing’” (p. 637). Locally called “feuding,” the method entails the elopement of a young couple whose relationship has been declared *rual* by local courts. “If the union then proves fruitful and the child thrives, the couple can later return to their families confident that some sort of marriage arrangement will be made. If not, the lovers usually separate voluntarily It is the fortune or misfortune of such couples, closely watched and commented upon by all, that is later cited as evidence for or against the validity of a particular [incest] prohibition” (81:630). The reason this process is so effective, continues Hutchinson, is that the Nuer believe that any union that bears healthy children is “divinely blessed” and is thus free of *rual*. In contrast, “‘incest children’ are expected to reveal their dangerous [divinely disapproved] origins through illness, abnormality, and early death” (p. 630). Hutchinson notes that because feuding reveals the limits of “divine tolerance” in this way it is “more powerful” than official court decrees in shaping local beliefs.

In this example, the Nuer conception of incest is evolving by choice. No external elite or political authority defines *rual* and imposes it upon the Nuer, and not even the local courts can effectively stem the tide of public opinion. Instead, the limits of *rual* are a matter of open discussion and autonomous election: Selected variants reflect the endogenous preferences of the carriers. (For a second, equally clear example, see 119:58–64.) An important exception in Nuerland tests the rule: the prohibition of incest between a man and his father's sister's daughter (FZD), which is considered worse than incest with his own daughter or sister (p. 625). Hutchinson shows that this one facet of the Eastern taboo reflects an enduring, internal power asymmetry between older men and their own sons (pp. 635–38). As befits imposition rather than choice, this facet is not subject to fecundity testing but is instead set aside, “insulated from the public rethinking and questioning of *rual* limits” (p. 639).

Note that the whole process, including both choice and imposition, also exemplifies secondary value selection. As a result of feuding, decisions among alternative definitions of incest are governed by an explicit value—that unions producing healthy children are divinely blessed—which itself requires social transmission. In addition, socially transmitted cultural notions of “shared blood,” “shared cattle,” and sacrifice (pp. 630–32) come into play; for example, “the ritual splitting of an ox by a Nuer earth priest is believed effective in tempering, if not neutralizing, the misfortunes” of some forms of incest (p. 626). Secondary values are also crucial in the case of imposition. Says Hutchinson, Eastern Nuer share “the conviction that no sacrifice is powerful enough to counter the negative effects of FZD incest” (p. 637).

SELECTION BY IMPOSITION A contrasting example of cultural selection by imposition is provided by Goody's analysis (69:Ch. 3) of historical change in the marriage prohibitions of Western Europe. Beginning with the “Letter of [Pope] Gregory” in the 6th century AD, which forbade the marriage of first cousins, the prohibition of marriage between close kin in Europe became a matter of “prime significance” for the Church and its missionaries (p. 56). In subsequent centuries, the Church extended the ban first to second cousins, then third cousins, and eventually, by the 11th century, to sixth cousins. Reports Goody, “Not only were these enormously extended prohibitions attached to blood or consanguineal ties, but they were assigned to affinal and spiritual kinship as well,” including the levirate and sororate (p. 56). Moreover, they were joined by new prohibitions against adoption, concubinage, and divorce, all of which were imposed by the Church. “Why,” Goody then asks, “should the Christian Church institute a whole set of new [rules] in the sphere of kinship and marriage, when these ran contrary to the customs of the inhabitants they had come to convert, contrary to the Roman heritage upon which they drew, and contrary to the teaching of their [own] sacred texts” (p. 42.)?

The answer, says Goody, lies in the economic interests of the Church. “By setting itself against [pre-existing local] ‘strategies of heirship’ that would

assist a family line to continue—namely adoption, cousin marriage, [and so on] ... the Church brought about the [rapid] alienation of family holdings” (p. 123) and became, in short order, the single largest landowner in most European countries. As Goody notes, the view of the Church as an “accumulator of property” does not deny or contradict its other roles and functions (for example, as guardian of the poor), “for property it had to have in order to look after the faithful and provide a home [for the priesthood]” (p. 46). Yet its cultural impositions in the realm of marriage and the family bore the unmistakable signature of the selectors’ own values and priorities, not those of the affected populations. That there was “continual resistance” from below, even before the Reformation, matches the expectation, mentioned above, about the instability of imposed decisions (see 69:Chs. 7, 8).

CROSS CULTURAL TESTS As convincing as the Nuer and European examples may be, the question remains, Do these processes generalize? Has cultural selection played a major role in the descent with modification of incest taboos in other human societies? If so, what have been the relative roles of choice and imposition? Under what circumstances has choice been more influential, and under what circumstances imposition?

Although no single study yet focuses precisely on these questions, preliminary answers are available from a reasonably “matched” pair of analyses, one by Thornhill (165–167), which focuses on the effects of imposition, and one by myself (53:Ch. 6), which focuses largely on choice. Consider the Thornhill study first, which uses data from 129 of the societies in the Standard Cross Cultural Sample (SCCS) (117) to analyze variation not in “incest rules” per se but rather in rules of exogamy—that is, in “rules that regulate the mating and marriage of less closely related consanguineal kin and of affinal kin (kin by marriage)” (165:15). Several interrelated hypotheses are included in the full analysis (see 167), one of which is particularly germane here: “that rules of mating and marriage are made in order to prevent families from concentrating wealth and/or power within lineages by intermarriage because such concentration may [threaten] the social status of leaders in society” (165:15).

On the assumption (from 3) that “powerful men” generally make the rules of mating and marriage, Thornhill tests three specific predictions that follow from this hypothesis. She finds, first, that “in highly stratified societies the rules of mating and marriage [are] more extensive ... than in societies with little stratification” (165:15). The association is particularly striking in the case of “maximally extensive” rules (i.e. those applying to all patrilineal and matrilineal relatives), which are found only in societies with three or more hierarchical classes. Second, she finds that “highly stratified societies [have] harsher punishment for infraction of mating and marriage rules than societies with little stratification” (165:16), a finding consonant with Betzig’s earlier analysis of despotism (14). Finally, Thornhill also finds that “as stratification increases, rules [tend to be] less equitably applied” (165:17), such that “rulers

in stratified societies are rarely expected to observe the marriage rules and frequently marry their own relatives" (167:253).

Thornhill's analysis leaves little doubt that imposition has been a major force in the cultural evolution of marriage rules. By the same token, Thornhill's definition of "mating and marriage rules"—which explicitly requires "the behavior ruled against [to have an effect] on the evolved interests of those who make the rules" (167:249)—builds in a certain guarantee of such results. Moreover, this definition must surely explain why "only 44%" of the sample had nuclear family incest rules—a finding contrary to almost every published report since Murdock's (114)—and thus why it seems "that people (rulers in particular) are much more concerned about ... the mating and marriage of distant relatives and nonrelatives than they are about incest" (167:252).

My own, independent analysis (53:Ch. 6) uses the smaller "Sixty Cultures" world probability sample (see 94) to investigate variation in incest taboos per se—that is, variation in the breadth of prohibitions against sexual activity between kin. First, for each population in the sample, I define the breadth or extension of the taboo to refer to the most distant consanguineous relative, *not including* those covered by rules of exogamy, with whom ego is forbidden to have sexual relations (and therefore to marry; for details, see 53:352–53, 511–15). By excluding the strictures of exogamy, this procedure effectively factors out much of the influence of imposition documented by Thornhill. Second, I then propose a model, based on Bateson's "optimal outbreeding theory" (10), for the cultural evolution by choice of incest taboos. The model predicts that the incest taboos of local populations will evolve toward extensions that minimize the total average "costs" of inbreeding and outbreeding. (Here "costs" include all adverse consequences—genetic, social, and psychological—of sexual relations with a given category of relative.) More specifically, the model predicts that incest taboos will be more extensive in the case of large communities that also promote geographical out-marriage, compared to small communities that also promote local in-marriage—a prediction directly opposite to that expected by the well-known Westermarck hypothesis (53:345–46). My prediction is based on the argument that, other things being equal, the costs of outbreeding will tend to be higher in small, endogamous communities, and inbreeding costs may be lower there as well.

The test of these predictions against data from the "Sixty Cultures" sample produced a statistically significant association between the extension of incest prohibitions and the degree of community exogamy: generally speaking, a greater range of kin are prohibited as sex partners within exogamous communities, as compared with agamous and endogamous ones. Moreover, the association is stronger in the subset of societies ($N = 30$) with a small average community size (i.e. fewer than 400 members). In short, the test favors the optimal outbreeding theory and suggests that selection by choice has played an important, general role in the cultural evolution of existing incest taboos. On the other hand, the associations, though statistically significant, are not par-

ticularly strong (nonparametric Kendall's tau was 0.37 for the full sample and 0.48 for a subsample with small community size). And the study does not control for differences in social structure and hierarchy among the sample societies. It therefore seems likely that much of the unexplained variation reflects the evolutionary influence of imposition; further work on this topic is certainly called for.

CONCLUSION

In this chapter, I have reviewed recent efforts to apply tools of evolutionary analysis to the study of cultural change. From studies of "descent" and studies of "modification" the following lessons, among others, can be drawn:

1. The hypothesis that existing cultural systems are all historically related in a branching hierarchical pattern of descent is worthy of more attention in anthropology and other social sciences than it has received to date.

2. Although some consequences of shared descent may well be visible in broad cross-cultural comparisons, cultural homologies are best seen and appreciated in closely related (or recently diverged) groups of cultures, such as those of the same language family or subfamily.

3. Cultural homologies and ties of descent have been explored in specific studies from all main subfields of anthropology; however, they have not yet been integrated by methods or conclusions into a unified, general approach.

4. Historical and comparative linguistics already provide an important general reference system for many of the cultures and societies known to anthropology; comparisons between linguistic and genetic family trees may soon provide a global phylogenetic model of the descent relationships among human populations.

5. The study of descent relations among human cultures would benefit from further empirical and theoretical work, particularly in regard to appropriate methodology and the perennial problem of disentangling diffusion from descent.

6. New headway is also being made in the study of "transformation," or sequential change within a given cultural system, particularly in regard to major processes or "forces" of change. "Diversification," or the branching of one culture into two or more descendants, warrants much more attention than it now receives.

7. Transmission forces, the natural selection of cultural variation, and various forms of cultural selection have all yielded provocative results in specific individual studies. New applications of evolutionary culture theory, and new and better refinements of the theory, are bound to be insightful and productive.

8. Also needed are new and stronger links between evolutionary culture theory and other kinds of culture theory (interpretive, political economic, etc) on the one hand, and among evolutionary culture theory, evolutionary psychology, and human behavioral ecology on the other hand.

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