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Cultural Evolution of the Structure of Human Groups

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Abstract

Small-scale human societies are a leap in size and complexity from those of our primate ancestors. We propose that the behavioral predispositions which allowed the evolution of small-scale societies were also those that allowed the cultural evolution of large-scale sociality, in the form of multiple transitions to large-scale societies. Although sufficient, the cultural evolutionary processes that acted on these predispositions also needed a unique set of niche parameters, including ecological factors, guiding norms, and technologies of social control and coordination. Identifying the regularities and patterns in these factors will be the empirical challenge for the future.

Introduction

What are the behavioral predispositions that cultural evolution has used, and changed, to facilitate the transition of human societies from small to large scale? Much excellent work has been done on the evolution of complex societies (e.g., Johnson and Earle 2000; Keech McIntosh 2005; Flannery 1972; Turchin 2003; Vaughn et al. 2009; Kristiansen and Larsson 2005). Our contribution in this volume seeks to add to the understanding of the evolution of social complexity, from the perspective of the behavioral predispositions that facilitated the evolution of small-scale human societies, and to stimulate proposals for how these were expanded, elaborated, or repressed by cultural evolution to make the formation of complex large-scale societies possible. A complete answer to this question requires that we (a) specify in detail these behavioral predispositions, (b) explore which are necessary for the evolution

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of small-scale sociality and cooperation, and (c) explore how they can (and have been) exploited by cultural evolutionary processes in the formation of large-scale societies. As Turchin (this volume) points out, what we refer to as small-scale societies in humans are still huge cooperative endeavors, involving many more individuals, compared to the scale of cooperation in other vertebrates. The identification of a minimal set or sets of predispositions necessary for small-scale societies to arise then gives us building blocks necessary for thinking about the cultural evolution of large-scale societies.

In the discussions that led to this chapter, we were informed by the theoretical and definitional perspectives expressed in the four relevant position papers (see Gintis and van Schaik, Turchin, Mathew et al., and Haun and Over, all this volume). Many of the key contributions to our understanding of human sociality and cooperation are discussed therein and need no further review here. We make a distinction between small-scale (groups of hundreds to a few thousands of individuals practicing mostly hunter-gatherer/foraging ways of life) and large-scale (groups of thousands upward to state-level complex societies of millions) sociality on a fuzzy basis. The importance of subsistence type, or complexity of social relations, means that there were and are many border cases in human history; however, our aim in this chapter is not to typologize. Rather, we aim to recognize a broad and (what is possibly the most) salient distinction in the variety of human social structures, and to consider how cultural evolutionary theory can stimulate research toward understanding the puzzle of ultrasociality. We begin with a phylogenetic and developmental perspective.

Mechanisms Enabling Cooperation in Human Small-Scale Societies

From Primate-Scale to Small-Scale Human Groups

Every primate group contains close and more distant relatives as well as nonrelatives, often immigrants. Whereas tolerance and cooperation among relatives is easily explained by kin selection, similar phenomena among nonrelatives require another explanation. In stable, personalized groups, familiarity among nonrelatives serves a basic function: to reduce aggression and create a tolerant context—the foundation of any cooperative exchange (Preuschoft and van Schaik 2000). Familiarity among nonkin could be a very basic extension of the kin recognition mechanism, which reduces aggression and creates tolerance. Likewise, in cooperative groups, individuals preferentially cooperate (i.e., engage in costly acts that will be reciprocated) with others they can trust to engage in mutually beneficial exchanges and interactions. Long-term social bonds among kin as well as nonkin, some possibly recruiting the same psychological mechanisms among human friendships, enable dyadic cooperation in many primate societies (Hruschka 2010; Seyfarth and Cheney 2012).

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Mechanisms Enabling Small-Scale Human Societies

Even the smallest-scale human society is far larger than most primate groups, and it is likely that early hominins engaged in fission-fusion social organization, much like both extant human foragers and chimpanzees. For instance, even the most mobile extant forager societies have a network size (a few hundred to a few thousand) that far exceeds the largest chimpanzee community (Johnson and Earle 2000; Apicella et al. 2012). Most mobile hunter-gatherers live in bands of 15–50 people, but their members interact with kin in some 6–10 nearby bands on a regular basis (Heinz 1979; Lee and DeVore 1968; Wobst 1974; Williams 1974; Peterson 1976). These "maximum bands" gather for infrequent ceremonial occasions, if at all. Personal networks built on marriage ties or exchange ties extend outside of the "maximum band" and tap into a broader surrounding population of up to a few thousand people (Gamble 1999; Wiessner 1986; Yengoyan 1968). Thus at some time during hominin evolution, individuals became more likely to encounter strangers who were the kin or partners of *their* partners, but not directly known to *them*; that is, in-group strangers (Hill et al. 2011). At this point the interaction history with ego could no longer be relied on to estimate the reliability of a partner, and the question is how this problem could be overcome. The reputation of unfamiliar people within spheres of interaction became key for tolerance and cooperation, together with indicators of shared customs, norms, and values.

Preexisting mechanisms may have been pressed into service to solve this problem, and we begin by specifying a candidate list of psychological/behavioral predispositions (mechanisms) that, either in isolation or in combination, can produce the sorts of widespread cooperative social outcomes we see in small-scale human societies (Table 6.1). The candidates in this list may be compared with those in Hill et al. (2009) and Rodseth et al. (1991).

For our purposes we take a working definition of "mechanism" to be (partly) biological processes that shape human behavior in a given situation or environment, including, for example, cognitive capacities, cognitive preferences, and emotional reactivity; it also includes, for example, the ability to digest certain foods or the motoric ability to throw projectile weapons. There is general agreement that these are species-typical (i.e., universal) mechanisms and that they are to some extent (though we do not specify) genetically specified. Conglomerate mechanisms in the traditional anthropological sense which are externalized to cognition (e.g., warfare or religion) may themselves be the result of cultural evolution, but here we focus on *species-typical predispositions and capacities*.

Table 6.1 lists candidate mechanisms and indicates whether they are present in other primate species and/or in the last common ancestor (LCA). This list is not prioritized in order of importance. We either do not agree that such a ranking is possible or, if we do, we disagree internally on what that ranking might be. Instead, Table 6.1 groups together those mechanisms that are shared ancestrally

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Table 6.1 Mechanisms that enable cooperation in small-scale human societies and their presence in other primate species and/or in the last common ancestor (LCA).

Mechanism	Presence
Kin recognition, kin bias, nepotism	Common in other species but recognition of patrilateral kin probably absent in LCA
Respect of territory, property, mates	Found in other species
Structured social interaction (assortativity)	Presumed in LCA
"Reverse dominance hierarchy" (Boehm 1993)	Leveling coalitions in chimpanzees (van Schaik et al. 2004a)
Direct reciprocity: Who did what to me?	Some evidence in apes, such as sex for food or grooming
Coalition formation, socially organized aggression	Common in other species
Multilocal residence: flexibility of male/female dispersal	Residence flexibility in bonobos
Cooperative breeding	Not in LCA, but in other species (Burkart et al. 2009; Hrdy 2009)
Marriage, pair bonding	Pair bonding not in LCA but other species
Multilocal or multilevel ties outside the group	Presumed absent in LCA
Leadership by persuasion, authority, or prosocial leadership	Minimal in other species, not in LCA
Moralistic punishment, moralistic rewards	Presumed absent in LCA
Reputation and gossip	No third-party reputation in other species beyond dominance; only in humans is reputation used for communicating behaviors that are good or bad for the group
Norm psychology: norm adherence, norm internalization, institutions	Not in LCA
Lethal force at a distance	Not in LCA
Cumulative culture, cultural variation, social-learning biases	Social-learning biases in other species, but cumulative culture limited or absent in LCA
Language	Not in LCA
Symbolic behavior: expressive and as ethnic marker	Not in LCA
Predisposition to impose categorical distinctions onto continuous cultural differences, leading to group boundaries and identities	Not in LCA
Predisposition for collective ritual and synchronicity	Not in LCA

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with other primate relatives, and those that are hominin specific (i.e., derived). Some of this may be married up with evidence presented in Shultz et al. (2011), who use comparative primate data and phylogenetic methods to infer some of the appropriate features of social organization for the LCA.

The Critical Importance of Norm Psychology

Provided with such a list, the immediate question becomes: Which of these mechanisms are *essential* for the evolution of cooperation in small-scale human societies? From a primatological perspective, we can identify the preexisting preference for informational conformity (in chimpanzees, see Haun et al. 2012) that became modified into social conformity and norm psychology. When individuals began to live in larger small-scale societies with a high degree of anonymity, yet needed to associate and cooperate on many occasions, they also needed a reliably correlated proxy measure for familiarity. Similarity in all aspects of the phenotype (morphology and behavior) provides one such measure. Thus, while conformity was previously driven by utilitarian reasons, conformity acted to prevent individuals from being classified as dissimilar. This social conformity[1] is truly normative because individuals benefit from being as similar as possible in all respects to other group members (which brings acceptance), and they benefit from detecting deviations from conformity. Those deviations are then used to estimate reduced similarity, possibly on some threshold of perception below which another individual is classified as belonging to an out group. Thus, behaviors that initially had no normative dimension have now acquired one: from the best way to do things to the way *we* do things (see Haun and Over, this volume). For instance, young children actively extract normative information from actions by adults and reinforce them among peers (Rakoczy et al. 2007). This evolutionary development, we posit, is the origin of norm psychology, which subsequently gave rise to institutions (Chudek and Henrich 2011).

From a developmental perspective, we can posit that observational forms of social learning have moved from the more utilitarian emulation (end copying) in apes toward imitation (means copying) in humans. Imitation will produce fine-grained behavioral similarity. Indeed, humans have a tendency to imitate the details of action that are functionally superfluous but are good indicators of similarity ("overimitation," Lyons et al. 2007). Imitation has been documented rather rarely in nonhuman primates, although many would claim it occurs at least occasionally (Whiten et al. 2009), whereas it is ubiquitous among humans from an early age.

[1] This statement is not intended to erase the ubiquity or importance of role specialization (formal or informal) within any particular society. In many small-scale societies, role diversity between people is overtly appreciated and tolerated. Differences between people can promote a complementarity that holds groups together—one person might be a musician, another a storyteller, another a dancer, another a hunter.

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Cognitively, humans generally have a tendency to categorize continuous variation into usually discrete categories. Thus, continuous variation in similarity can thus become dichotomized into in-group versus out-group, and human in-group–out-group psychology may be based on categorization. Indeed, humans have created dichotomous similarity markers that go beyond morphology and behavior, a truly novel feature that anthropologists call ethnic marking (Efferson et al. 2008a). For ethnic markers to be stable markers of similarity, they must be socially costly (by increasing similarity to one group, one automatically decreases similarity to another), permanent, or both. Indeed, humans show the hallmarks of this process in which even children actively use a variety of similarity markers, as suggested by experiments which removed all possible familiarity-relevant information and showed that even arbitrary markers can serve to guide similarity judgments (see Haun and Over, this volume).

Importantly, humans do not need functional outcomes like chimps do (Haun and Over, this volume) to change their behavior. We are what Gintis and van Schaik refer to as *Homo ludens*; that is, the only species that can make up new games and follow those rules. Because people can be "programmed" with new preferences, the transaction costs of social exchange are reduced. This means that norms can have flexible regularities in their content, and some of these regularities may have become so important as to be independent mechanisms/processes, such as religion or warfare. The task for scholars interested in understanding how norms change is then to draw upon ethnographic and historical data and, using the frameworks of cultural evolution outlined in this volume, to specify the steps in individual cases. Subsequent generalizations can then be addressed at different levels of explanations (Tinbergen 1963; Oyama et al. 2001). For example, experimental and developmental psychologists can add to our understanding of how norms change through mechanism-based approaches.

Niche Parameters

In the course of our discussions, it became apparent that a complete cultural evolutionary explanation could not consist of purely endogenous factors (mechanisms). Thus we identified a set of "niche parameters" for the evolution of human sociality. These contextual features can be said to form the environmental conditions in (and by) which the predispositions identified above are expressed as behaviors or behavioral complexes in human evolution. These niche parameters include a number of elements, and the following is a nonexhaustive list:

1. Fixed locations for sleeping, cooking, and social interaction (e.g., camps and processing sites).
2. Controlled use of fire for defense and/or cooking. (Note that an adaptation to cooked foods may itself be a mechanism or predisposition.)

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3. Hunting and/or scavenging.
4. Resource pooling and communal eating: Wrangham (2009) has argued that humans needed to develop normative systems for the distribution of hunted/gathered food.
5. Savannah living, entailing some necessity for defense against predators.
6. Environmental change (Richerson et al. 2009).

Ethologists would argue that the predispositions evolved to maintain a particular social organization and structure in the context of these niche parameters, which, in turn, were molded by, and further co-constructed the species' lifestyle. Modern evolutionary paradigms, such as niche construction (Laland et al. 2000, 2011; Odling-Smee et al. 2003) and developmental systems theory (Oyama et al. 2001; Fuentes 2009; Gray 2001), may be useful in further elaborating the dynamics of construction and feedback between niche parameters and species characteristics. Sterelny (2012) provides one such example by considering how humans have structured the environments of their conspecifics in such a way as to enable cognitive competence in the face of high informational loads and demanding tasks—in both the social and physical domains.

The importance of considering these niche parameters in combination with mechanisms is demonstrated by a portion of Gintis and van Schaik's account of prosociality (this volume). On this view, our primate ancestors evolved a complex sociopolitical order based on a social dominance hierarchy in multimale/multi-female groups. A niche for hominins in which there was a high return to cooperative hunting or confrontational scavenging (O'Connell et al. 2002) was created by multiple niche parameter factors: the emergence of bipedalism in the hominin line, environmental developments which made a particular diet (of meat from large animals) fitness enhancing, and cultural innovation in the form of fire and cooking (Wrangham 2009; Wrangham and Carmody 2010). The hominin control of fire cannot be accurately dated, but may have been achieved more than 500,000 years ago (Berna et al. 2012) and was probably habitual by 300,000–400,000 years ago (Roebroeks and Villa 2011). This cultural innovation had strong effects on hominin cultural and phylogenetic evolution. Prior to the control of fire, humans almost certainly took to the trees, cliffs, or caves at night like most other primates, as a defense against predators. Because predators have a fear of fire, the control of fire permitted hominins to abandon climbing almost completely. The control of fire may thus have been a prerequisite for the transition to obligate bipedality. Wiessner adds that by controlling fire, hominins could be gathered in one place at night, thus extending social life into the night. The practice of cooking food is a related cultural innovation with broad gene–culture coevolutionary implications. Cooking may involve a central location to which the catch is transported, and the calorie-distribution phenomena typical of food sharing in nonhuman primate species could have given way to food distribution based on agreed-upon fairness norms. Collective hunting in other species does not require a fairness

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ethic because participants in the kill simply eat what they can secure from the carcass. However, the practice of bringing the kill to a central site for cooking is not compatible with uncoordinated sharing and eating. Meat is only one part of the story. Cooking is important in freeing time from the processing of vegetable foods which make up at least two-thirds of most hunter-gatherer diets. Cooking makes vegetables more digestible and decreases chewing time (Wrangham 2009). Importantly, cooking incentivizes the sharing of vegetables like tubers at central cooking sites because of the costs of building a fire for the small caloric return from each vegetable *in situ.* Seen this way, the control of fire and the practice of cooking are thus (some of the) cultural preconditions (niche parameters) for the emergence of morality and social organization based on normative behavior.

Conditions for the Evolution of Cooperation in Small-Scale Societies

We now turn to a discussion of the conditions necessary for the evolution of cooperation in small-scale human societies (i.e., those of up to a few thousands of individuals). The diversity of approaches to the mechanisms promoting cooperation was highlighted by Bshary and Bergmüller (2007), who identified distinct classes of criteria: from ultimate fitness benefits, to ecological and life history conditions, to specific game theoretical structures. However, the term "conditions" and "mechanisms" promoting cooperation can have different meaning, depending on the disciplinary perspective. Our approach reflects the various fields from which we originate (anthropology to evolutionary biology, primatology to economics) and encompasses different levels of description, from social to genetic. We identified three main requirements or necessary conditions which, in combination with the mechanisms described in the previous section, could produce small-scale society cooperation:

1. increasing returns to scale with group size,
2. control of defectors, and
3. cultural group selection/assortativity.

These may operate in a hierarchical fashion; cultural group selection/assortativity (and the processes therein) can solve the problem of controlling defectors, which in turn allows for increasing returns to scale. Considering a great variety of issues in both general and explicitly evolutionary collective action models (e.g., heterogeneity in resources and/or interests) reveals a range of conditions where issues like the structure of social interaction can be more important than the population size (Marwell and Oliver 1993). However, there was broad agreement with the suggestion that humans can uniquely "change the rules of the games" such that games resulting in more efficient outcomes (returns to scale) may be favored by cultural transmission.

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Increasing Returns to Scale

The basic condition for the evolution of group living is that individuals do better in groups than by themselves. Thus, some kind of fitness or benefit function needs to increase with group size. It might not continue to increase for groups of arbitrary size; in fact, there could be a peak, but there needs to be a region of group sizes for which the benefit function increases.

This is not just a general case of, for example, "why do primates live in groups?" There, fitness benefits are largely derived from reduced risk of predation due to grouping. These benefits gradually level off with group size, and generally do so at fairly small group sizes. Much larger groups than about ten individuals require additional benefits. Similarly, the benefits of cooperative hunting, at least among primates, level off at relatively small group sizes. Thus, the various conventional benefits of grouping in primates or carnivores do not explain why even "small-scale" human societies can contain an order of magnitude more members. To account for this, we need to recognize new functions. Examples include: some types of big-game hunting and/or coordinated defense against predators; risk pooling through extended networks and access to their resources, and economic returns from trade and the movement of labor (Wiessner 1986); warfare and the returns of group size on aggression and defense against aggression (Turchin 2009); and the effect of group size on the sophistication of the culture that can arise and be maintained (Powell et al. 2009; Henrich 2004b; Shennan 2001).

Increasing returns to scale is a prerequisite for large-scale cooperation to evolve, but essentially all this means is that there should be some benefits to cooperation for cooperation to evolve. The hard problem in the evolution of cooperation is not whether this precondition is met or not. In this volume, Mathew et al. discuss why it is plausible to suppose that this precondition is almost always met, in most species, in various domains of activities. The hard problem is how cooperation evolves, given that exploiters will appropriate these benefits causing the cooperation to dissolve.

Control of Defectors: Overcoming the Problem of Collective Action

When groups produce public goods that benefit all group members equally, but individuals must bear the cost of producing the goods privately, the rational strategy is to free ride on the efforts of others. For cooperation to evolve, such defectors must be somehow controlled or eliminated. "Defection" can be controlled within the dyadic context and does not always require sanctioning by the group, but control of those who bully, exploit, or disrupt norms facilitating group cooperation requires responses that are sanctioned by the group. This can be accomplished by means of group selection: groups that have more cooperators will do much better than groups with few cooperators so that, despite cooperators losing to defectors within groups, the frequency of

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cooperators will globally increase. However, such "naked" group selection is very inefficient. Adding mechanisms for the control of defectors, such as moralistic punishment, allows cooperation to evolve under a much broader range of parameters and conditions (Boyd et al. 2003).

Social Norms and Institutions

Researchers have found that long-lasting communities which govern their common resources sustainably are ones that put substantial effort into monitoring and enforcement (e.g., Ellickson 1991; Hechter 1987; Ostrom 1990). To be effective, these norms and rules need to be well understood and accepted. These institutional arrangements start with social norms, learned effectively from infancy (Haun and Over, this volume), and the importance of norms is recurrent throughout this chapter (see also Chudek and Henrich 2011). Norms are essentially statements that apply to the appropriate behaviors for a particular context. Rules are statements with explicit consequences for what happens if the conditions are not met and can therefore be enforced by third parties; for an interdisciplinary perspective, see Hechter and Opp (2001) and Ostrom (2005). Of course, many norms are not oriented toward the control of defectors at all. Norms may be *antisocial* (Kitts 2006), advocating behavior that is harmful to the society in which the group is embedded or even dysfunctional for the very actors who invent and enforce the norm: so-called toxic work cultures provide an informal example. Understanding the content of norms is an important area of research, but here we focus mostly on an important subset of norms that either promote collective action directly or foster social organization of a society that serves as a substrate for collective action.

Human societies are organized by systems of norms and rules that we call institutions. Marriage is an example. In any given society, norms define proper behavior for husbands, wives, children, and other people who interact with the married couple as a married couple. In general, norms differ somewhat for the different roles in the institution. People, of course, do not conform perfectly to the norms attached to roles: spouses may, for example, be unfaithful. People affected by norm violations may directly sanction violators, and typically sanctions are graded (Radcliffe-Brown 1952). A first offense, especially if minor, may provoke only the mildest verbal complaint. If norm violations become habitual or serious, sanctions typically increase in severity in a graded fashion. Third parties frequently become involved at this stage. An extramarital affair may result in the termination of a marriage or even violent retribution by the relatives of the offended spouse. Formal legal institutions may intervene in a complex society. We normally think of norms and rules as making it possible to realize gains from increasing returns at a fairly large scale. Certainly, institutional arrangements (like markets) or organizations (like armies) are used to realize gains at huge scales. Think of the institutional arrangements that make modern international trade possible. However, consistent with sociological

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research on norms and enforcement in families and small groups (e.g., Hechter 1987), Mathew et al. argue (this volume) that we deploy the normative system to increase cooperation at quite small scales. The institutionalization of mating that we call marriage, all but universal in human societies, is an illustration. Rather than depend upon kin selection and reciprocity to manage mating unaided by culture, we engage rather elaborate institutions even in this intimate and personal sphere.

Postmarital residence norms provide an example. Societies have stated norms that concern where couples will reside after marriage. Although adherence to these norms can vary greatly, they provide the basis for certain preferred types of association and cooperation between different sorts of relatives. A few societies allow married couples to practice natolocal residence (both with their own kin group), but most involve the transfer of one or the other spouse to a new place of residence, thus providing a small increase in the returns to scale on, for example, household or reproductive labor. Further norms indicate the types of cooperation that are expected. In otherwise virilocal systems, for example, where a woman will move to live with her husband and his kin group, initial periods of uxorilocal residence with the woman's kin can require a new son-in-law to provide labor to his wife's family. That there are regularities in the evolutionary transitions of norms of residence strongly suggests that these norms have adaptive value (Fortunato and Jordan 2011).

Norm Regulation: Internalization, Rewards, and Punishments

Some members may comply with and support norms because they have internalized those norms through processes of socialization. Norms, however, are also explicitly enforced by both rewards and punishments. Explicit punishments are leveled with care because costs of losing an otherwise highly productive group member are high, as are risks of later direct retaliation by the punished (or allies of the punished), as well as resistance against the norm itself in reaction to punishment. To avoid some of these dysfunctional consequences of explicit punishment, groups may instead reward those who provide exemplary service to the group by giving them esteem, status, or social approval. If groups prefer exemplary contributors as partners in economic exchange, political alliances, or marriage, this creates models of good behavior for other members. Of course, it also implicitly punishes those who are unproductive, stingy, or noncooperative by leaving them without partners or with less desirable partners or terms of exchange. In applying more explicit punishment, groups often attempt to corral the offender back to good behavior, first by gossip, shaming, and withholding assistance (Boehm 2011; Wiessner 2005). In extreme cases, those who engage in serious norm violations may be repeatedly shunned, ostracized, or subjected to violent punishment at greater cost to the group.

It is an open question as to whether the implementation of norm regulation is qualitatively different between (a) small-scale societies in our hominin past

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and present-day societies, and (b) contemporary small- and large-scale societies. For example, with respect to the former, did we evolve a "new" mechanism that could be called "respect for authority"? By what means? With respect to both, what coevolutionary feedback processes have been responsible for new forms (both processes and mechanisms) of norm regulation?

Assortativity

For cooperation to evolve, cooperators must assort in some ways with other cooperators (Frank 1998; Hamilton 1971; Eshel and Cavalli-Sforza 1982). In other words, cooperators need to interact with other cooperators more frequently than by chance alone. A number of processes potentially lead to assortivity. For example, accurate recognition of cooperators, using tightly linked phenotypic characteristics—the "green beard" effect (Hamilton 1964)—would allow cooperators to interact preferentially with other cooperators, leading directly to assortativity. Limited dispersal of offspring leads to assortativity in space and the evolution of cooperation by kin selection. Kin recognition allows for the same even if offspring disperse broadly. Cultural transmission biases (Richerson and Christiansen, this volume) can do the same. For example, conformism (i.e., adopting the cultural trait possessed by the largest number of individuals) will result in some groups consisting only of cooperators and others of noncooperators.

Relevant Regularities in the Dynamics of Assortativity

Given the crucial role of assortativity, any pervasive features of the dynamics of sorting and mixing in social interaction networks may prove consequential for the evolution of cooperation. Research across many different kinds of networks has revealed that the following two regularities are extremely pervasive:

1. Social interaction partners tend to be disproportionately similar to one another, a pattern called assortative mixing or homophily (Kandel 1978; McPherson et al. 2001).
2. Partners of partners tend also to be partners, a phenomenon called transitivity or triad closure (Holland and Leinhardt 1970; Rapoport 1957). For example, if A and B are allies, and B and C are allies, then A and C tend also to be allies.

These two regularities jointly produce clusters of culturally similar individuals with high local network closure. By network closure, we mean that actors within a cluster interact with each other more than outsiders do; as a consequence, social interaction between any two cluster members is observable to third-party cluster members that are tied to both of the interaction partners. Clustering of culturally similar individuals with high local network closure thus facilitates cooperation directly, as well as development and maintenance

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of norms. For example, assortative mixing and network closure lead to greater agreement and clarity for the development of norms as well as greater visibility which leads to more efficient enforcement of norms by third parties (Hechter 1987; Coleman 1990).

As noted earlier, there is evidence for behavioral dispositions leading to patterns of assortativity and closure, and evidence of preferences for homophily (Haun and Over, this volume). Many researchers have inferred a behavioral predisposition toward network closure from structural balance theory (Cartwright and Harary 1956), which posits that unbalanced triads (where A and B are friends, B and C are friends, but A and C dislike each other) are aversive and thus transient, and so tend to resolve into balanced triads (e.g., where A, B, and C are all friends, or A and B are mutual friends but both enemies to C). This pattern can yield homogeneous clusters as well as division into mutually antagonistic factions.

Although assortative mixing and network closure are pervasive and widely believed to follow from behavioral dispositions, recent research has shown that either homophily or triad closure may be largely a byproduct of the other; both may result from features of the environment (e.g., physical space, event timing) or simply from heterogeneity in the baseline tendency toward sociality (Goodreau et al. 2009). Assortative mixing may also result from social influence among network neighbors. Further research (particularly experiments) is needed to elucidate the underlying social dynamics and how these play out in different social and cultural contexts.

Small-Scale Society Cooperation in Human Evolution: Inspiration from Darwin

Darwin (1871) argued that the evolution of human cooperation evolved in two phases. In the "primordial" stage, some stretch of time in the Pleistocene in modern terms, group selection on tribal-scale variation favored the evolution of "social instincts" such as sympathy and patriotism. Tribes which had such prosocial predispositions to a higher degree would prevail in competition with tribes who had them to a lesser degree. By some time deep in the past, all humans came to have more or less the same prosocial "instincts."

After this primordial time, the prosocial dispositions came to act as forces in cultural evolution. As Darwin put it, the "advance of civilization" (in the Holocene in modern terms) depended not only on ongoing natural selection at tribal or larger scales but on advances in laws and customs guided by sympathy and patriotism favoring superior norms and institutional arrangements. Innovations by moral leaders, and the diffusion of these innovations by other moral leaders, aided by the pressure of public opinion, have become the main motors of contemporary institutional evolution. Darwin was quite aware that patriotism could trump sympathy and lead to the evolution of such institutions as slavery. Richerson and Boyd (2005) and Bowles and Gintis (2011) used

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contemporary gene–culture coevolution models to modernize Darwin's two stage idea, albeit in rather different ways. Selection—either directly on genetic variation (Bowles and Gintis 2011) or indirectly via culturally mediated social selection on genes within groups (Richerson and Boyd 2005)—remodeled ape/hominid social psychology to be much more prosocial during the Pleistocene. In Bowles and Gintis's model, culturally mediated reproductive leveling allows relatively weak group selection for "parochial altruism" to trump within-group selection for selfish behavior. In Richerson and Boyd's "tribal social instincts hypothesis," natural selection acts on cultural rather than genetic variation to favor primitive prosocial norms and institutions (Boyd and Richerson 1985). In both proposals, the initial prosocial norms and institutional arrangements exert social selection which may strengthen genetic predispositions for in-group cooperation and act to guide further institutional innovation and evolution.

From these two models issues arise in considering the necessary conditions for the evolution of cooperation in small-scale societies: the importance of cooperative breeding, and debates about coordination and cooperation.

Cooperation and Coordination

Cooperative breeding has been hypothesized to be foundational for the evolution of small-scale societies and can be seen as one mechanism to increase returns to scale. Human infants are relatively helpless and our juvenile period is long. Our large brains are energy and protein hungry. Burkart, Hrdy and van Schaik (2009) argue that infants cannot be successfully raised by human mothers in the manner of the other apes. Even with less-dependent young, the great apes have very long interbirth intervals and are barely viable demographically (see also Hrdy 2009). In humans, the contributions of pre- and post-reproductive women and adult men to the care and feeding of children can shorten interbirth intervals to an unprecedented extent. Effectively this meant that humans can achieve robust population growth rates, despite having infants that are so costly to nurture that unaided mothers could not raise them alone. Burkart et al. suggest that capturing the increasing returns to scale in infant quality may have been the foundational step in the human cooperative syndrome. Large brains and a long period of juvenile dependence seem to be necessary to support the acquisition of a large, complex cultural repertoire. This repertoire includes both foraging and processing skills and our norms-and-rules social systems and allows us to flexibly exploit myriad activities which exhibit increasing returns to scale. Indeed the creation and maintenance of complex culture itself has increasing returns to scale (Henrich 2004b; Kline and Boyd 2010; Powell et al. 2009; Shennan 2001). Beyond the returns to scale, Hrdy (2009) has argued that through the development of "other-regarding impulses," cooperative breeding set the stage for advanced social learning and cumulative culture, teaching, and language to evolve. Importantly, cooperative child rearing had knock-on effects on the cognitive and emotional development of infants, who

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looked not only to their own parents but also to alloparents to get the costly care they needed. In effect, babies (and the adults those babies grew up to be) were the products of selection pressures that favored social communication, perspective taking and mutual tolerance—even toward others who might not be close kin.

Hrdy's view is that attention to the *novel* conditions of human development could inform our understanding of human sociality. Others, however, have proposed that our unique levels of cooperation may have roots in simple "coordination," as in the "stag-hunt" game (Tennie et al. 2009). This is in contrast to general public goods games that have free-rider problems: we all gain if we all cooperate, but individuals can benefit from defection if others cooperate; therefore, the outcome for selfish rational actors is that nobody cooperates. However, often the interdependency assumption/stag-hunt payoff assumptions do not match real life. If human warfare were actually like that, there would not be a problem of cowardice and desertions on the battlefield. Each person should have sufficient incentives to contribute if their marginal contribution is what ensures victory. Yet, cowards and deserters are a problem in even pre-state raiding, and various forms of sanctions are deployed to motivate warriors to fight (Mathew and Boyd 2011). Moreover, other animals are able to solve various coordination problems like herding, mating, etc., but this has not led to much cooperation. This would be puzzling if being able to engage in games with interdependency-type payoffs was indeed the key factor in making humans cooperative.

At this point we are armed with some idea of the behavioral predispositions that are necessary for the evolution of small-scale sociality and cooperation, as well as some idea of the importance of considering niche parameters. The cultural evolutionary perspective (Richerson and Christiansen, this volume) then allows us to hypothesize how those features can be exploited in the transition from small- to large-scale societies. As emphasized earlier, humans are able to acquire vast amounts of nongenetically encoded behaviors and/or information during their life span. Hence, both genetic and nongenetic change is likely to have affected the emergence of large-scale sociality. Next we discuss the main evolutionary processes or "engines" behind such changes.

Evolutionary Processes Relevant to Understanding Human Sociality

Types of Learning and "Engines of Change"

Individual learning is a generic term for the cognitive processes that allow individuals to acquire novel behaviors and/or select novel actions among alternatives during their life span in the absence of interactions with conspecifics (Boyd and Richerson 1985; Rogers 1988; Dugatkin 2003). It comprises

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processes such as trial-and-error learning, inference, induction, and deduction, or insight. Individual learning is the generator of novel behaviors. On the other hand, social learning is the generic term for the cognitive processes underlying the acquisition of information when interacting with conspecifics (Boyd and Richerson 1985; Rogers 1988; Dugatkin 2003; Enquist et al. 2007; Cavalli-Sforza and Feldman 1981). Social learning involves processes such as imitation, copying, teaching, and local enhancement. It is the engine of transfer of behavior between individuals in a population.

As individual and social learning tend to occur on a local scale (between individuals within groups), different groups of individuals are likely to innovate and express different combinations of trait values. If different combinations of norms/institutions are associated with differential reproduction and/or payoffs to individuals, beneficial trait combinations may spread in the population. Thus the interaction between individual and social learning causes changes in nongenetically inherited behaviors during an individual's life span, and leads to potential changes in the population-wide distribution of behavior(s). These changes are driven by two factors: cultural group selection and endogenous social change.

Cultural Group Selection

Cultural group selection refers to a competitive advantage for a group as a whole that arises from within-group norms, practices, etc. Cultural group selection can favor group-beneficial outcomes on very large scales, including among thousands of genetically unrelated individuals (Henrich 2004a; Boyd and Richerson 1985). Thus it constitutes a crucial process in understanding how human societies went from relatively egalitarian foraging bands to complex states comprising millions of people. Although many features accompany such a rise, more complex societies generally manage cooperation at a larger scale and/or more efficiently than less complex ones. To account for this, we need an evolutionary process that can favor norms and institutions that increase the scale of cooperation, and which create more efficient outcomes at this new scale. Cultural group selection is such a process.

Selection creates adaptive behavior at any level upon which it operates, and thus group selection can explain group-functional outcomes. Conversely, selection at a lower level does not lead to functional outcomes at a higher level. Genetic group selection cannot explain cooperation observed in large-scale human societies, and most animal and human societies do not have sufficient between-group genetic variation for it to be an important force. However, because humans acquire locally adaptive behavior through social learning, there is a great degree of between-group cultural variation across societies (Bell et al. 2009), thus making cultural group selection a much more plausible mechanism for humans than genetic group selection in humans and other animals.

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Empirical studies also support the view that cultural group selection has played a role in shaping human societies. Soltis, Boyd, and Richerson (1995) show that group functional behaviors were able to spread through cultural group selection on a timescale of a few hundred years in New Guinea. Mathew and Boyd (2011) demonstrate that norms governing warfare among Turkana pastoralists in East Africa generate group-beneficial outcomes at the scale of cultural variation. Turchin (2006) shows that empires emerged at the point where there is maximal between-group cultural variation, such as along the boundaries that separated herders and agriculturalists.

Competition between cultural groups will lead to larger and more complex societies with more efficient social institutions to manage production and warfare. Between-group competition can occur through a number of means. One is through *warfare*, as exemplified in the Nuer expansion into Dinka territory (Kelly 1985), and another is through differential *population growth*, as when agriculturalists outcompete hunter-gatherers in reproduction. Additional means for between-group competition include *immigration* into perceived "successful" societies (e.g., migration into the United States), *adopting the social institutions* of successful groups, as exemplified by Enga bachelor cults that were widely borrowed from innovating clans (Wiessner and Tumu 1998), or the spread of democracy in the modern world.

Endogenous Cultural Change

Cultural change can also arise endogenously, from within-group processes that generate variation. Endogenous change can result from prosocial preferences, such as a regard for equitable, or fair, or parochial outcomes that have resulted from a longer history of cultural group selection. Such preferences—combined with abilities for persuasion, leadership, or deliberation—can allow societies to adopt norms that are consistent with these preferences. Democracies, or jury systems, may be the result of preferences shaped by cultural group selection (like fairness and peer sanctioning, respectively). It is important to note that on longer timescales, these institutions will persist only if they also lead to groups that adopt these social arrangements to fare better than other groups. However, on shorter timescales, some of the change that we see in human societies can be the result of people tinkering with their social institutions in accordance with their preferences and their contexts, rather than due to between-group selection itself. Much social/cultural anthropology is concerned with the diversity of these creative processes and their outcomes in a particular cultural milieu, and it is here that cultural evolution scholars can engage with other anthropologists on topics of agency and innovation in creating behavioral and cultural variation. However, as change comes about endogenously, such processes may produce differentially "channeled" or biased types of innovations so that we may see only a subset of all possible types of cultural behaviors and

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societies (see the "design space" questions in language evolution, Dediu et al. this volume).

Genetic and Cultural Coevolutionary Circuits

Learning rules and/or preferences that support cultural evolution and cultural group selection may themselves evolve and be influenced by genetic evolution. The full coevolutionary feedback between nongenetically inherited phenotypes—including memes, variants, traits, norms, and institutions—and the cognitive machinery which supports them is gene–culture coevolution, or dual inheritance (Cavalli-Sforza and Feldman 1981; Boyd and Richerson 1985). The selection pressure on genes involved in this coevolutionary circuit must be consistent with the principles of natural selection. These can be framed in terms of selection at the individual level by way of inclusive fitness costs and benefits (Frank 1998; Gardner et al. 2011). The equivalence between group- and individual-level selection perspectives is true for any phenotype, regardless of whether the source of variation under study is genetic, cultural, or a combination of both (Frank 1998). As such, any cultural group selection process can also be expressed in terms of selection at the individual level and could be framed in terms of cultural inclusive fitness costs and benefits (André and Morin 2011).

Predictions can arise from considering these different sources and engines of evolutionary change. One implication is that the rates and types of change will differ. For example, we can ask where and when in the historical record we should see large-scale societies arise. With endogenous social change we might expect multiple independent origins of cultural features, each differing somewhat, whereas cultural group selection might be expected to produce spread or diffusion of the same basic phenomena (perhaps with graded differences predictable from, e.g., geography or ecology). With endogenous social change we might see small incremental steps, whereas cultural group selection might produce large changes. To consider how a research program might approach these predictions empirically, we need to have some idea of the "target" state of what can be variously termed social complexity, or (types of) large-scale society. Next we delineate some defining characteristics.

Social Complexity: What Is the "Phenotype" of Large-Scale Societies?

"Social complexity" is a fairly slippery concept with no standard definition and with historically problematic implications for many anthropologists and archaeologists (e.g., Yoffee 1993; Flannery 1999). Demographers, psychologists, historians, and biologists, as well as complexity theorists, may have different phenomena in mind when considering social complexity. The central

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issue is whether social complexity can be represented by a single principal component (plus "noise"), or whether the notion is better served by multidimensional structures, and, if so, what evidence should be considered in such a description. A well-known multidimensional operationalization of social complexity or cultural complexity is the one provided by Murdock and Provost (1973), which is based on the widely used Standard Cross-Cultural Sample (Murdock and White 1969). The most convincing single measure of social complexity is to use the largest settlement size as proposed by Naroll (1956) and repeated by Chick (1997). A new approach, discussed extensively at this Strüngmann Forum, is one advanced by Turchin, François, and Whitehouse, who are developing a dynamic historical database toward this end (for details, see http://www.cam.ox.ac.uk/ritual/). Instead of trying to define a single metric for measuring social complexity, this practical, empirically based approach uses a number of measures that address different aspect of social complexity. By coding these aspects for a variety of past and present societies, the resulting database can be analyzed with multivariate statistical tools, such as principal component analysis. Many of these variables also act as processes which stabilize social complexity. Here we highlight those measureable features that can index social complexity.

A Multivariate Approach to Social Complexity

We begin with the demographic basics of *scale*. This includes the population size of an independent unit or polity, the territorial extent of the polity, and the population and density of the largest settlement (often, but not necessarily, cities). Populations in large-scale societies have *hierarchy* by which we can identify the jurisdictional levels in administration: the segmentary, modular, or nested structures of organizations. There are within-sector hierarchy structures, such as found in military, bureaucratic, legal, and religious orders, and these involve professional officials, such as military leaders, priests, and judges, whose presence is often used to define a state. *Economic extent* and *specialization* are well developed in large-scale societies; the total number of novel professions extends far beyond the division of labor seen in small-scale societies, which is based on sex, age, and expertise. The degree of specialization and/or exclusivity (i.e., who may practice certain professions) is thus more marked. In addition, there is a greater extent, and often complexity, to the trade networks in large-scale societies. From these three factors emerges *institutional complexity*, composed of both hierarchical (vertical) complexity and the orthogonal feature of horizontal complexity.

Large-scale societies tend to support more and different types of information, especially *cultural information*. Much of this may be "stored" culture in the form of literature, art, and other material information, usually in excess of what can be maintained in a small-scale group. In addition, there is usually *monumental culture* in the form of buildings and architecture, and large

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public spaces (often dedicated and/or built) for ritual, performance, economics or politics. Some forms of *religion* and *religious practices* (discussed in Bulbulia et al., this volume) are roughly identifiable with large-scale societies; in addition, religion and religious beliefs themselves may have been key causative elements in the evolution of large-scale sociality. Niche parameters that are certain to have had massive feedback effects in the evolution of large-scale sociality are what we term *management technologies*: technologies for coercion, coordination, and production. These include systems of tribute and taxation; environmental modifications such as permanent roads, outposts and observational stations; recording technologies such as writing and accounting; and weapons for large-scale violence.

Some further elements constitute the "dark side" of social complexity. In particular, *inequality* is rife in large-scale societies. Inequality can be economic, and therefore measurable in, for example, the ratios of the largest private fortune to the median. It can also be structural and characterized by features such as human sacrifice, slavery, castes, legal distinctions such as aristocracy, and the deification of rulers. *Urbanization* itself is complex and variable with respect to impacts on human well-being, but there is good cause to see cities, particularly those before the nineteenth century, as "death traps": preindustrial cities sucked in populations, acting as a sink, and went through boom or bust extinctions. Why would we willingly live in a sick, smelly crowd of strangers? Finally, it has been argued that *too much social complexity itself* leads to higher costs of maintaining its structure and can lead to collapses (Tainter 1988). Although such a general statement is debatable, some elements of social complexity can challenge the system attributes that maintain the stability of small-scale societies. Increasing scale affects the ability to monitor behavior and derive information to maintain reputations. Complexity may lead to a loss of local stability of equilibria in dynamical systems (Mayr 1970). Increasing interactions are between strangers and incomplete information that may make the system vulnerable to defectors.

The Transition from Small-Scale Societies to Large-Scale Societies

Increasing Returns to Scale

The major evolutionary transition from small-scale to large-scale societies involved an increase in social scale by five or more orders of magnitude (from hundreds to a few thousands, up to hundreds of millions and more; see Turchin this volume). As discussed earlier in this chapter, a necessary condition for enabling such an evolutionary shift is that the increasing returns to scale (IRTS) function must reach a peak at much higher population numbers, or at least need to increase for a region of group sizes that includes tens and hundreds of millions. What processes can account for such an enormous expansion of

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increasing returns to scale? Anthropologists, economists, political scientists, and sociologists have contemplated a range of explanations, roughly divided into: (a) warfare, (b) economic efficiency, (c) information-processing capacity, and (d) demographic diversity. The first of these, *warfare*, is easy to understand. Larger societies can mobilize more resources and field larger armies than smaller societies. An interesting feature of this explanation is that it suggests that there is no maximum in the IRTS curve: it continues to increase without limit (a population of a trillion is better than a hundred billion, but ten trillion is even better). This does not mean that we will see societies of ten trillion people any time soon; other processes limit such runaway growth, most obviously the problems with maintaining fighting forces of massive size.

Economic efficiency invokes a variety of mechanisms. For smaller-scale agrarian (or even hunter-gatherer) societies, it has been proposed that they can greatly benefit from extended social networks that allow buffering against variable environments or access to novel resources (Hruschka 2010). For larger-scale societies, including those with modern economies, economists generally agree that there are substantial returns on the scale, resulting from the division of labor between different regions and groups. This idea dates back at least to Adam Smith, more recently developed by Paul Krugman and others (Fujita et al. 1999; Krugman 1991). An *information-processing* hypothesis suggests that the ability of societies to generate new knowledge is not simply a linear, but an accelerating function of its size. Some models (Henrich 2004b; Powell et al. 2009) suggest that there are nonlinearities, because when the numbers or population density of interacting human groups fall below a threshold, such groups start losing technology, rather than cumulating it. Such models should be augmented by accounting for not just the evolution and effects of endogenously produced behaviors, but the niche-constructive effects of material technologies and learning environments as well (Laland et al. 2011; Powell et al. 2009; Sterelny 2012; Mesoudi et al., this volume). When problem solving acts to structure knowledge (or "chunks" it, in psychological terms), not only does new knowledge increase the information-processing capacity of the group, the structuring itself also affords greater capacity for the cognition of new problems. New problems can lead to new knowledge in which more people will have participated in the creation or processing of knowledge or skills, through, for example, phenomena such as formal teaching or semiformal-structured learning environments (Sterelny 2012). Continued cycling of knowledge aggregation can then have positive feedback effects on information-processing group size.

Sociological research on demographic diversity in networks, groups, and organizations reveals that assortative mixing leads social interaction to transpire within culturally similar relationships, a phenomenon called *sociodemographic clustering* (Goodreau et al. 2009). Increasing the size and diversity of the population (subject to these local mixing dynamics) leads to greater cultural homogeneity at the level of social interaction, even as the overall population

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grows more diverse. In the transition to large-scale societies, for example, this social organization leads exchange and other interaction to occur within dyads that are more culturally similar, while neighborhoods, groups, and formal organizations also become more internally homogeneous in culture. Cultural diversity becomes increasingly compartmentalized as scale increases. If social dilemmas of various kinds (opportunities for individually costly and mutually beneficial cooperation) are faced by people who are more culturally related to each other, this structuring of interaction will enhance cooperation at the level where social interaction typically occurs. Groups are comprised of increasingly compatible members—members who are also *relatively* similar to one another (*vis a vis* neighboring groups). Of course, as increasing scale leads to more culturally homogenous relationships and groups, it also leads to cultural differences between groups. Thus, increased cooperation at a local level may result in tension or conflict at a higher level.

From Small to Large: Which Mechanisms Maintain Large-Scale Sociality?

One way to understand small- to large-scale transitions, of which there have been many in human history, is to ask which of the behavioral mechanisms discussed above, in interaction with the niche parameters and contingent historical facts, were factors in the maintenance of large-scale societies? They may have inhibited (–), were irrelevant (○), facilitated (+) or were crucial (++) in these pathways (see Table 6.2). By asking which are necessary or not, we generate a set of testable hypotheses that can then be compared (in the future!) against the available ethnographic, archaeological, and historical data. One could also consider the transitions from small-scale societies to various types of large-scale societies, such as acephalous tribes, chiefdoms, small states, empires, and modern industrialized states. These pathways will be context specific. For example, in chiefly societies and royalist states, elite marriage alliances may be incredibly important (such as in the case of dynasties), but in modern industrialized societies marriage is less crucial. Among several acephalous pastoral societies of East Africa, age sets crosscut other social groupings of the society and enable large-scale social organization without political centralization (Baxter 1978). It is also revealing to ask what can be removed from large-scale societies today without causing them to collapse; this provides an excellent tool for thinking through case studies. Examples like the Turkana, the Nuer (Kelly 1985), and the Comanche (Kavanagh 1996) illustrate how even quite rudimentary political institutions can allow societies of considerable scale to emerge. These societies were able to coordinate warfare and enforce internal peace among tens to hundreds of thousands of people without hierarchical leadership.

A crucial point in our debate, and for future research, was whether humans need extra (psychological) mechanisms to go from small-scale societies to

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Table 6.2 Mechanisms from Table 6.1, identified as to their role in the maintenance of large-scale societies. Key: inhibited (–), were irrelevant (○), facilitated (+), or were crucial (++).

Mechanism	Role in maintenance of large-scale societies
Kin recognition, kin bias, nepotism	+ elites ○ commoners
Respect of territory, property, mates	+
Structured social interaction (assortativity)	++
"Reverse dominance hierarchy"	– or + depending on functional organization of society
Direct reciprocity: Who did what to me?	○
Coalition formation, socially organized aggression	+ for midlevel complexity – can degrade social organization (e.g., revolution, trade unions)
Cooperative breeding	○
Marriage, pair bonding	+ elites ○ commoners
Multilocal residence: flexibility of male/female dispersal	○
Multilocal/multilevel ties outside the group	++
Leadership by persuasion, authority, prosocial leadership, or prestige	++
Moralistic punishment, moralistic rewards	++
Reputation and gossip	+
Norm psychology: norm adherence, norm internalization	++
Lethal force at a distance	++
Cumulative culture, cultural variation, social-learning biases	++
Language	++
Symbolic behavior: expressive, and as ethnic marker	++
Predisposition to impose categorical distinctions onto continuous cultural differences, leading to group boundaries and identities	+
Predisposition for collective ritual and synchronicity	+

large-scale societies. Two proposals on the table are: (a) the religious "bundle," including mechanisms such as agency detection, sacred values, etc. (see Bulbulia et al., this volume), and (b) respect for authority. Although respect for authority might be quite highly heritable in a gene–culture coevolutionary

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sense, there is no evidence that such an "authoritarian mind" is fixated across our species. For example, while hunter-gatherer groups might have respect for age, and/or respect for knowledge, there does not appear to be universal respect for *command*. These require further conversation and detailed proposals for hypothesis testing. Richerson and Boyd (1999) review data that suggest that even in modern mass armies, where this is a highly organized hierarchical chain of command, combat efficiency is highest in those armies that use prestige as a tool for leadership and least in those that depend more heavily on coercion; see also Turchin's (2006:8–9) discussion of the fluctuations of *asabiya* (roughly a society's spirit of common purpose) in agrarian states. On this view, the same counterdominance impulses that resulted in highly egalitarian small-scale societies remain an important check on elite expropriation, which, when unchecked, can destroy a society's *asabiya*. It is unlikely, however, that any faint population-level biases in genes, such as postulated for the learning of tone languages by Dediu and Ladd (2007), would be important here: they would be utterly swamped by the effects of cumulative cultural evolution of population-level differences on developmental environments.

Drivers of Social Complexity

One useful way to review these potential mechanisms, and to develop a comparative perspective on their relative importance, is to conceive of larger complexes in which they sit as drivers of social complexity. The chapters throughout this volume discuss a number of such complexes, such as religion (Slingerland et al. and Bulbulia et al.), technologies (Mesoudi et al. and Boyd et al.), and warfare (Turchin). Here we consider homogenization and incorporation, and the management technologies of large populations.

Homogenization/Incorporation

A key challenge of administering large-scale societies is coordinating their multiple subunits, whether these are provinces, settlements, cities, or tribes. One factor which can facilitate the emergence and spread of large-scale societies is the prior existence of a set of social units that already share a common language, culture, or administrative structure. For example, the relative homogeneity of Greek city-states may have facilitated the higher-level aggregration of Greek leagues and the early expansion of the Macedonian Empire (Malkin 2011). In other cases, such homogenous administrative units must be reproduced to extend a territory, as was the case with the construction of Roman cities during imperial expansion (Boatwright 2000) or European colonial imposition and formalization of tribal chiefs in Africa to serve as points of control for long-distance administration (Leeson 2005).

If the erosion of strict boundaries between units allows the transition between small-scale societies and large-scale societies, what mechanisms are

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co-opted to make boundaries porous; that is, how can this homogenization take place? It could be that any dimension of similarity taps into our preexisting psychology for homophily and ostracism aversion (Haun and Over, this volume). However, some are differentially effective, and some candidates seem to warrant special attention, such as warfare, or a common enemy, and religion, which can expand identity through fictive kinship (e.g., my brothers- and sisters-in-arms). In some cases, religious identity becomes more important than ethnic identity, and this "super-effectiveness" of religion is of note because religions explicitly contain norms and rules, characterize the nature of social bonds, and provide social support.

Furthermore, such explicitness can help homogenize when, as in more complex societies, relationships are increasingly defined by position instead of personal relations. Named positions such as a guard, an accountant, or a chairperson can be derived by appointment, election, or other mechanisms. An institutional structure based on positions requires collective choice mechanisms, such as voting procedures, at different levels with clearly defined positions (Ostrom 2005). In more complex societies, formal rules start to define who has access to the public goods of society (i.e., which groups have access and how group membership is defined). For example, following warfare, will subjugated groups be absorbed into the victorious group? Some rights need to be given to those people to make them active members of society.

An open question is then: What are the consequences of the rights given to the "losers"? Denying them access to public goods may be ineffective for the stability of society. How frequent are situations where there are true conferments of rights, as opposed to situations where subjugated people form coalitions to agitate for rights, or rebel? Many characteristics of large-scale societies (discussed above) are what is in essence population substructure (hierarchy, division of labor, specialization, etc.), and this then begs the question of whether substructure can ever be anything but unequal. We lack space to develop these notions here, but there are empirical implications to this question that are relevant to the evolution of the Axial religions and are explored in detail by Turchin (this volume).

Technologies of Coordination/Coercion and Management of Large Populations

As polities comprise larger populations over ever-wider territories, new technologies play an important role in managing people and resources: Engineered roads facilitate communication, trade, and faster deployment of military power. Strategic administrative settlements and ritual centers permit more direct control of far-flung populations. Improved military technology can inflict lethal force on larger groups. External representations, such as clay tablets in southwest Asia or knotted *khipu* strings in the Inca Empire, permit impersonal accounting for finance and trade (Luttwak 1976; Headrick 1981; Basu

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et al. 2009). Physical infrastructure also plays an important role in storing, protecting, and transferring surplus production. Surplus production has long been suggested by archaeologists to be exceptionally important in the transition from small-scale to large-scale societies (Earle 1991) and is one obvious way in which human niche construction can change the adaptive landscape of cultural evolution. Once a surplus storable energy source arises, payoffs for phenotypes can change, and the forces of cultural evolution are liable to act in different ways. Not all surplus has the effect of increasing the human population directly: some can be used nonnutritionally to "do culture" that can alter the niche in ways that further persist over generations and become selective parts of the environment, for example, to build monuments. A further suggestion is that surplus not only allows large societies to be maintained but allows elites to control them.

At what social and geographical scales do such technologies become necessary for binding polities together? As discussed earlier, human societies on the scale of hundreds of thousands of individuals can organize without much requirement for such physical capital. Niche construction models that incorporate multigenerational investment in roads, fortifications, long-term settlements, storage centers, weaponry stores, and other infrastructures should help us understand the conditions under which long-range feedback between built environments and social organization plays a role in the emergence of large-scale societies.

Case Study: Enga of New Guinea

Using Wiessner's long-term fieldwork with the Enga of New Guinea (see Wiessner and Tumu 1998), we discussed the importance of identifying the "package" of processes/mechanisms that were (and were not) important in the transition from small-scale societies to large-scale societies. Trade, warfare, and ritual were identified and were found to encompass a host of the elements discussed in this chapter. In the Enga, both cultural group selection and endogenous cultural change were engines of change and creative innovation.

The Enga of Papua New Guinea are a highland horticultural population who formerly lived as hunter-gatherers and subsistence horticulturalists with clans of some 500 people. Warfare served to split up groups that had become too large to cooperate, and long-distance trade formed via marriage ties. Some 350 years ago, the South American sweet potato was introduced along local trade routes, releasing constraints on production and allowing the Enga to produce a substantial surplus for the first time in their history in the form of pigs. First contact with Europeans occurred some 70 years ago.

After the arrival of the sweet potato, large-scale wars redistributed the Enga over the landscape as groups sought to take advantage of the new crop.

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Postwar population movements greatly disrupted the flow of trade, cooperation, and exchange; the Enga sought to bring order to chaos through the development of large ceremonial exchange systems. By first contact, one of these systems had grown to incorporate some 40,000 people and the exchange of over 100,000 pigs per four-year ritual cycle. To engineer these large systems of ceremonial exchange, Big Men initiated or imported bachelor cults to create uniformity in the norms and values regulating courtship and marriage, so that networks could expand by intermarriage between clans. Similarly, they manipulated ancestral cults to elicit the cooperation of several tribes and provide a forum for planning cycles of ceremonial exchange. Feasting was a key component of all events. Warfare followed by peacemaking served to recreate balance of power in the face of insult or injury so that exchange could flow between clans. Big Men who managed the large cults and ceremonial exchange systems gained great prestige; the public looked to sons of Big Men to replace their fathers so that ceremonial events, which provided benefits to most, would not be disrupted. Big Men drew status from the management of wealth, enjoyed the privilege of polygyny, and controlled the information necessary to arrange ceremonial exchange, but they did not accumulate wealth.

How, then, do norms actually change? For example, when a Big Man coopts a "successful cult" specialist from another group, the norms of the first group are altered by within-group processes, and then acted on by cultural group selection. Other examples are apparent in Enga "dehumanizing" and peacemaking sessions. It appears that homogenizing the preexisting networks in the Enga allowed for subsequent expansion and the development of hierarchy. The Enga case also requires us to consider an historically contingent catalyst of a change to large-scale networks, if we consider the introduction of the sweet potato as an exogenous factor that drove the evolution of the system. Thus there can be multiple and contingent layers of causality for each case where small-scale societies have transformed into larger polities. Careful comparative work based on detailed ethnohistorical description can begin to disentangle these questions.

Cultural Mesoevolution: Bridging Individuals, Populations, and Regions

Empirical Studies Will Drive the Field Forward

In the field of cultural evolution, we are not short on theory, but the anthropological and historical literature is a vastly underutilized resource awaiting our renewed attention. What we need is serious coordinated efforts to connect theory and data that neither do damage to ethnographic detail nor become

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sterile abstractions for beautiful models. What can we learn from cases like the Enga, from those reported by Turchin and Mathew et al. (both this volume), and from the key works on the evolution of societies worldwide (e.g., Keech McIntosh 2005; Vansina 1990; Kirch 1984)? Case studies allow our investigations to become concrete and stimulate potential focus areas for future research, and a positive outcome of this Forum was the suggested set of elements (see Tables 6.1 and 6.2) to formalize both case-study and comparative research. From there, the challenge will be to generalize patterns to the "broad sweep of history." For example, how general is it to have a large network before a hierarchy? Do we need extra mechanisms, or is it just the "old" small-scale society mechanisms in new contexts and combinations that allow the transition to large-scale societies?

Regularities in Process

How regular are the processes that take us from small-scale societies to large-scale societies? Are the same mechanisms acting or do we need new ones? Do we get emergent properties when old mechanisms interact together, or with new facts such as surplus, increased population size, or warfare? Are there regularities of change? The model of the changing adaptive landscape may be extremely useful here, and there may also be parallels between complexification in social change and the other major transitions in evolution (Maynard Smith and Szathmáry 1995), such as the integration and co-opting of preexisting (functional) entities into larger ones, as in the evolution of multicellularity. These questions have empirical answers and can be addressed in a number of ways (e.g., using the social complexity database mentioned earlier).

Thus far cultural evolution research has spanned two broad areas. Cultural microevolution in the main has adapted theory and modeling approaches from population genetics to uncover the dynamics of cultural transmission between individuals within populations; these dynamics are then increasingly tested empirically using frameworks to study individual behavior from within psychology and cognitive science (for a review, see Mesoudi 2011a). Cultural macroevolution has focused on the population level to explain why norms differ between groups, using the analogy of testing species differences from biology. In this paradigm, predictions are tested using comparative phylogenetic methods that control for the effects of shared ancestry (Galton's Problem) on ethnographic, linguistic, ecological, and archaeological data. A recent relevant example is work by Currie et al. (2010a), which showed regularities in the sequence of political complexity in Austronesian societies. Implemented worldwide or on a region-by-region basis, these approaches can be informative about any regular tendencies in the processes of change, and have been successfully employed to answer questions in the domain of language (see Gray as well as Dediu et al., both this volume), technological change (see papers

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in Lipo et al. 2006) as well as aspects of social structure such as marriage, residence, and wealth transfers (Fortunato et al. 2006; Holden and Mace 2003; Jordan et al. 2009).

The desirability of bridging these two levels has become apparent in recent years. Not only do both micro and macro approaches suffer from a degree of abstraction that (while necessary) renders them unpalatable to social/cultural anthropologists working in the field, but for a solid and unique theory of cultural evolution to emerge, it is necessary to have mutually reinforcing research programs across the biological, social, historical, and behavioral sciences. A unified approach to social complexity across disciplinary boundaries will be difficult, but "cultural mesoevolution" should consist of work that brings together different fields to carry out in-depth case studies in, for example, language families or cultural regions where the emic status of phenomena permits systematic and quanitative cross-cultural comparisons. The emergence, maintenance, and transmission of norms and their contents would be the target of study, at levels ranging from long-term historical and ecological factors, to the population-level interactions of groups that emerge through cultural group selection, to the behavior of individuals and groups within populations and the endogenous mechanisms of change therein, as well as their development in children (for the latter, see also discussions in Lieven et al., this volume). In addition, there is scope for gene–culture coevolutionary approaches in this mesoevolutionary perspective, for example, where there are subtle population-level genetic biases (Dediu and Ladd 2007). To return to our example of "respect for authority," it is probably true that basic norm psychology mechanisms have produced a human-wide behavioral predisposition toward respect for those in positions of command, with some cultural variation in content but remarkably consistent outcomes. However, enough time may have passed for the Baldwin effect to be acting on any small underlying genetic differences that strengthen any advantage to these behaviors, perhaps at alleles with putative cognitive and behavioral effects such as the D4 dopamine receptors (Chen 1999; Ding et al. 2002). Finally, as Laland et al. (2011) point out, depending on the level and viewpoint at which we conduct our research program, mechanisms at one point may have been outcomes or processes at another point, and debates about the ultimate/proximate dichotomy can become sterile when we speak at cross purposes. Working at a data-rich but still comparative mesoevolutionary level may help us be clearer in this respect. Ideally we would like to extract and generate patterns for ethnographic analysis from the bottom up, rather than impose external categories on ethnographic data. Thus, we need to develop ways to synthesize across individual and demographic data from, for example, psychology, sociology, and behavioral ecology to arrive at norm abstractions needed to model cultural evolution on the macro scale.

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A Wish List for Future Research

Throughout this chapter we have discussed a number of specific questions regarding the transitions between small- and large-scale *societies*, and what that can tell us about the transition from small- to large-scale *sociality*. Beyond this central concern, we have identified a wish list of high-level questions about the cultural evolution of human social structure, which we think are ripe for the taking by the scientific community.

- Archaeologists! Why didn't complex societies arise in the last interglacial (ca. 125–85 KYA) among populations of anatomically, and debatably, behaviorally modern humans?
- Ethnologists! What norms are "universal" in *content* at different scales (e.g., small-scale, chiefdom, modern industrial state)? Does scale explain the similarities and differences? Is it the most important context?
- Sociologists! Why hasn't religion or ethnicity disappeared? Why is there increasingly less homogeneity in the age of globalization (the "indigenization of modernity")?
- Anthropologists! Does the ethnographic analogy have legs? Is the notion that modern-day small-scale societies can act as proxies for small-scale societies in prehistory still viable? Pleistocene small-scale societies seem to have been different in their scale (i.e., bigger) and style diversity (i.e., reduced) than ethnographically known populations, but is this just an artifact of the decimated record of durable artifacts? Were there more competition and more pronounced leadership, wider trade networks, and heterarchy in the past? How can we answer these questions?
- Psychologists (especially you developmentalists)! How does norm psychology evolve and develop, as Haun and Over (this volume) have been asking? Does cooperative breeding hold the key to our other-regarding cognition?
- *Everyone!* What should we fund? What data is missing? Do we need more and targeted archaeology? Will massive efforts be required to understand within-population behavioral variation? Is a resurvey of extant ethnography necessary to add longitudinal facts? What is it that is really stopping us from understanding this most basic question of human uniqueness?

These questions are aimed, tongue-in-cheek, at different disciplines, but only a cross-disciplinary effort will properly suffice to further understanding. We look forward to the results.

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