Cooperation & Collective Action

Archaeological Perspectives

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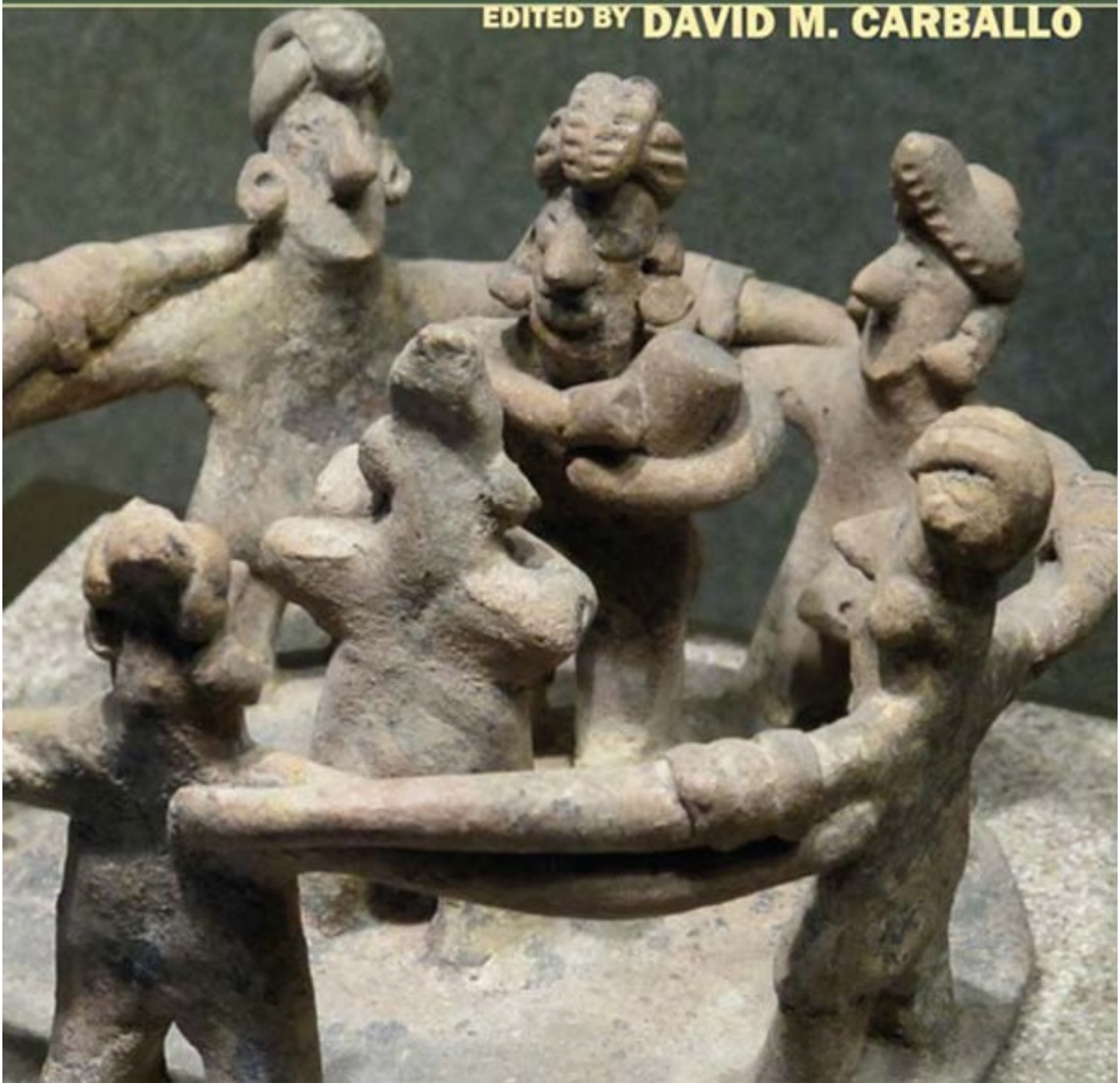

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EDITED BY **DAVID M. CARBALLO**

UNIVERSITY PRESS OF COLORADO
Boulder

Published by University Press of Colorado
5589 Arapahoe Avenue, Suite 206C
Boulder, Colorado 80303

Printed in the United States of America

 The University Press of Colorado is a proud member of the Association of American University Presses.

The University Press of Colorado is a cooperative publishing enterprise supported, in part, by Adams State University, Colorado State University, Fort Lewis College, Metropolitan State University of Denver, Regis University, University of Colorado, University of Northern Colorado, Utah State University, and Western State Colorado University.

 This paper meets the requirements of the ANSI/NISO Z39.48-1992 (Permanence of Paper).

Library of Congress Cataloging-in-Publication Data

Cooperation and collective action : archaeological perspectives / edited by David M. Carballo.
pages cm
Includes bibliographical references and index.
ISBN 978-1-60732-197-2 (hardback) — ISBN 978-1-60732-208-5 (ebook) (print)
1. Commerce, Prehistoric. 2. Commerce, Prehistoric—Cross-cultural studies. 3. Economic anthropology. 4. Economic anthropology—Cross-cultural studies. I. Carballo, David M., editor of compilation.
GN799.C45C67 2012
306.3—dc23

2012038942

Design by Daniel Pratt

22 21 20 19 18 17 16 15 14 13 10 9 8 7 6 5 4 3 2 1

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Cultural and Evolutionary Dynamics of Cooperation in Archaeological Perspective

DAVID M. CARBALLO

Humans are excellent but strategically contingent cooperators. How we cooperate and the boundaries of our cooperative relations are two of the most important organizing principles for social groups. No surprisingly, the cultural and evolutionary dynamics of cooperation represent a fertile topic of research in social and behavioral sciences such as anthropology, economics, political science, psychology, and sociology (Axelrod 1997; Bowles and Gintis 2011; Boyd and Richerson 1992, 2009; Dovido et al. 2006; Fehr and Schmidt 1999; Gintis et al. 2005; Gurven 2006; Hammerstein 2003; Henrich and Henrich 2007; Marshall 2010; Ostrom, Gardner, and Walker 2003; Patton 2009; Willer 2009). From a contemporary biological perspective, much of human uniqueness is said to rest in our abilities to cooperate at larger scales and in qualitatively different ways than all other animals, including nonhuman primates (Bingham 2000; Hill, Barton, and Hurtado 2009; Mitani 2009; Nowak 2006a, 2011; Sussman and Cloninger 2011; Tomasello 2009; Wilson, Timmel, and Miller 2004; cf. Kappeler and van Schaik 2006). Yet we can also be exceedingly competitive. These two sides of humanity are entwined, and may tragically converge in destructive forms of intergroup competition such as wars, which require high levels of intragroup cooperation and coordination. Disentangling the motivations and institutions that foster group cooperation among competitive individuals remains on of the few great conundrums within evolutionary theory. How, researchers ask, does cooperation evolve and thrive among individuals who strategically pursue self-or kin-interests despite all of the potential obstacles those interests present to group-oriented behaviors? What are the costs and benefits to individuals across the socioeconomic spectrum in participating in, or defecting from, cooperative endeavors? What suite of mechanisms for encouraging and maintaining cooperation exis within any particular society, and how does its composition evolve over time as a result of cumulativ goal seeking by individuals and larger-scale environmental processes? Why does cooperation sometimes break down completely?

Archaeologists have been investigating the developmental trajectories of cooperation and competition in past societies for decades, but have tended to emphasize the latter in seeking to explai those processes underlying cultural evolution. As a result, bottom-up possibilities for group cooperation (or "self-organization") have been undertheorized in favor of political models stressing top-down leadership, often invoking compliance through coercion. In the meantime, evidence from a range of disciplines has demonstrated humans effectively sustain cooperative undertakings through a number of social norms and institutions that are applicable to archaeology on multiple analytical scales, including reciprocal exchanges, monitoring the reputation of others, and the retribution or

rewarding of transgression or compliance. This important axis of variability in the dynamics of past human societies has received scant attention in archaeological theory, with notable exceptions discussed later in this chapter.

A focus on the interplay between cooperation and competition in past societies necessitates multiscalar approaches that consider the complete spectrum of human behavior, from the broad evolutionary processes instigated by aggregate individual actions, to the motivations for those action at the level of households or individuals. Such approaches combine many of the strengths of existing theoretical paradigms in archaeology while offering productive means of reconciling entrenched divides between considerations of process and agency (compare Blanton and Fargher 2008; Boyd and Richerson 2008; Cowgill 2000; Feinman, Lightfoot, and Upham 2000; Flannery 1999; Pauketat 2001 Richerson and Boyd 1999; Shennan 2002; Spencer 1993). Contemporary models of cooperation are evolutionary, overlapping comfortably with traditional archaeological interests in elucidating the processes of diachronic social change. But they are also multiactor, envisioning all individuals as pursuing goals that can be simultaneously individualistic/competitive and collective/cooperative in a manner consistent with approaches that emphasize human agency and strategic action. In turn, the diachronic breadth and material focus of archaeology provide a much-needed complement to existing research on cooperation and collective action, which thus far has relied largely on game-theoretic modeling, surveys of college students from affluent countries, brief ethnographic experiments, and limited historic cases. Archaeological perspectives draw on a comparative record of long cultural evolutionary sequences (Marcus 2008), containing the physical correlates of past cooperation and competition, including the particular resources that were utilized through collective action and the symbols people manipulated to define themselves as cooperative or antagonistic.

The contributions to this volume are not unified by a single paradigmatic approach to cooperation and collective action, yet the authors share the conviction that these issues should be foregrounded within contemporary archaeological discourse in order to better understand their dynamics in varied past and present contexts. Examples include non- or less coercive social mechanisms that operated in smaller-scale societies or in factions that primarily operated independently from the political institutions of larger ones, such as labor groups and social castes within early states and empires. Authors are interested in better defining the terms, appropriate units of analysis, and theoretical frameworks necessary for understanding group cooperation. We present diverse case studies with the aim of situating the diachronic and material foci of archaeology within the interdisciplinary dialogue on this issue of broad social concern. In this chapter I highlight some recent insights from research on cooperation across disciplines, use cross-cultural cases to suggest points of intersection with the archaeological record of cultural evolution, and outline the organization of the volume.

COOPERATION: DEFINITIONS AND APPROACHES

People cooperate within multiple, overlapping, and occasionally conflicting scales of social interaction, and they often do so in ways that are inconsistent with canonical models of rationality and self-interest. The structure of cooperative undertakings is segmentary, nested, and fluid, with the result that individuals who cooperate as groups in certain settings may be adversarial in others. This segmentary structure and the tensions inherent in reconciling individual and group interests pose dilemmas for sustaining cooperation, which has been analyzed within domains as diverse as treaties between sovereign nation-states, ethical codes established by enemies engaged in trench warfare, community-managed irrigation systems, and household recycling (e.g., Axelrod 1984: 73–87; Henric

and Henrich 2006; Ostrom 1990: 69–88; Wagner 1983). Individuals act within vastly different interpersonal parameters across the spectrum of potential cooperative undertakings, and cooperation surely motivated and sustained by combinations of mechanisms depending on social context. Accordingly, classification of the types of undertakings that could be deemed cooperative and the sorts of mechanisms that promote them assists in comparative analysis and in evaluating the appropriateness of particular approaches to the archaeological record. Definitions of cooperation usually entail some calculation of cost or risk on the part of an individual so that another individual o group of individuals receives a benefit (e.g., Smith 2010; West, Griffin, and Gardner 2007). Yet authors envision the costs, benefits, and goals of cooperation differently, which is reflected in the approaches reviewed in this section, as well as in the subsequent chapters of this volume.

An initial distinction may be drawn between what could heuristically be termed ultimate and proximate causes of cooperation. Approaches focused on ultimate causes are more common in biology, evolutionary psychology, and human behavioral ecology. They seek to explain cooperation i terms of the evolved predispositions that humans are argued to possess that facilitate working in groups, and often discuss culture-gene coevolution (that human genetic evolution has been structured by life within cultural groups) and multilevel selection (that selective processes can operate at individual and group levels) in examining what evolved psychological mechanisms might be conducive to cooperation (e.g., Bingham 2000; Bowles 2006; Boyd and Richerson 1992, 2009; Fessle and Haley 2003; Fuentes, Wyczalkowski, and MacKinnon 2010; Gurven 2006; Henrich and Henrich 2006, 2007; Richerson, Boyd, and Henrich 2003; Sober and Wilson 1998; Traulsen and Nowak 2006; Wilson and Kniffin 1999; Wilson, Timmel, and Miller 2004). Although evolutionary themes focused on ultimate causality are central to the holistic study of cultural practices, the archaeological and historic cases discussed in this volume deal with the evolution of norms, institutions, and symbols th complex societies of the last ten thousand years created and reconfigured through time. Such cases ar more aligned with developing proximate explanations regarding how particular cultural patterns eith promoted or discouraged cooperation. Theories concerning the biological evolutionary bases of cooperation are incorporated into this volume and introductory chapter, but those relating to cultural evolution—the emergence of norms, institutions, and symbols through archaeological time—are emphasized for this reason.

Further classification of the relevant concepts for understanding cooperation forces us into semantic discussions of occasionally colorful terms, often derived from game-theoretic modeling, such as cheaters, defectors, free-riders, punishers, green beards, altruists, tit-for-tat, mutualism, common-pool resources, and the like. Several concise overviews of terminology have fortunately bee compiled, though variability between and within disciplines is apparent (compare Dovido et al. 2006 21–28; Henrich and Henrich 2006; Kapur and Kim-Chong 2002; Nowak 2006b; Tomasello, Kruger, and Ratner 1993; West, Griffin, and Gardner 2007). West and colleagues (2007: 416) provide an especially succinct glossary from a biological perspective. I draw on these recent works in discussing key terms, but should note that attention to such issues is not new; rather, it extends back centuries to earlier social theorists.

Conceptualizing Cooperation

The Enlightenment revival of classical scholarship saw many Western philosophers ponder why people participate in social groupings when their motivations tend to be selfish (see Baum 2004). For Hobbes (1958 [1651]: 142), a social contract based primarily on collective defense was the means by which self-interested individuals pursue collective goods through the “Leviathan” that is state

governance: “The only way to erect such a common power as may be able to defend them from the invasion of foreigners and the injuries of one another, and thereby to secure them in such sort as that by their own industry and by the fruits of the earth they may nourish themselves and live contentedly is to confer all their power and strength upon one man, or upon one assembly of men that may reduce all their wills, by plurality of voices, unto one will.” Alternatively, in his *Discourse on the Origin and the Foundations of Inequality among Men*, Rousseau (1984 [1755]) considered how cooperation could shape social structure through the analogy of a stag hunt, in which individuals could choose to collectively hunt a larger stag or individually hunt smaller hares. Both scenarios suggest that mutual gains can be achieved through cooperation, but whereas the social backdrop for Hobbes was one of threat and competition, Rousseau’s was one of more voluntary collaboration. The ideas of these two authors still resonate with contemporary social theorists, who have elaborated and refined them by approximating payoff matrices for collective or individual behavior drawing on game-theoretic modeling, human behavioral ecology, and related disciplines (Skyrms 2004). Rather than relying solely on the verbal logic of humanistic philosophy, contemporary behavioral-science approaches to decision making employ mathematical logic involving experimentally estimated costs and benefits, impacting archaeology in cases parallel to Rousseau’s analogy, such as through the application of optimal foraging theory (e.g., Gremillion 2002).

Early anthropologists also took an interest in cooperation. Most notably, Mead’s (1937c) edited volume *Cooperation and Competition among Primitive Peoples* assembled leading scholars of the time who presented ethnographic cases relating to the behavioral dynamics of these opposed tendencies within a number of societies that would be classified as “intermediate” by many contemporary archaeologists, because they are neither egalitarian nor do they possess institutionalized hierarchies. The modern equivalent of Mead’s volume might well be *Foundations of Human Sociality: Economic Experiments and Ethnographic Evidence from Fifteen Small-Scale Societies* (Henrich et al. 2004), and a comparison of the two serves to develop a framework of terms and concepts that are applicable to archaeology. Soon after the Mead volume, Murdock (1945) included cooperative labor as one of the behaviors he deemed to be cultural universals (see also Brown 1991: 137–139). Later generations of anthropologists would object to the way that earlier approaches discussed cultural practices as habits, and their implicit assumptions of immutable group psychologies, as exemplifications of the normative model of culture (e.g., Fox 1991; Geertz 1973: 33–54). Indeed, an emphasis on individual action within anthropology began shortly after these publications (Hays 1958: 394–404). I return to this critique in outlining contemporary approaches to cooperation, which I argue dovetail with current archaeological interests in considering both process and agency in envisioning how individuals within groups strategize, moving us from the normative model to one of negotiated norms. But first I outline a few of the insights from Mead’s volume and their relationship to contemporary models, such as those used in the volume by Henrich and colleagues.

In her introductory chapter, Mead (1937a) discussed cooperation and competition not as a singular axis, but rather as orthogonally balanced by individualistic behaviors (Figure 1.1a). These three terms were then distinguished as (1) competitive: individuals striving to gain what another is simultaneously striving to gain; (2) cooperative: individuals working together to one end; and (3) individualistic: individuals striving toward goals without reference to others (Mead 1937a: 8, 16). In concluding the volume, Mead (1937b: 461) classified the societies discussed along a triangular plot with these three terms as midpoints. Mead’s definitions for competitive and individualistic behaviors are straightforward, while her definition of cooperation deserves some unpacking for our purposes because it implies mutualism (Tomasello 2009: 41) or mutual benefit (West, Griffin, and Gardner 2007: 416), as used by contemporary scholars. In the sense of ultimate causality, Tomasello (2009)

argues that mutualism among early human ancestors was the primary selective pressure affecting the evolution of our faculties promoting cooperation. He defines collaboration for mutual benefits as a phenomenon of cooperation, of which altruism is another.

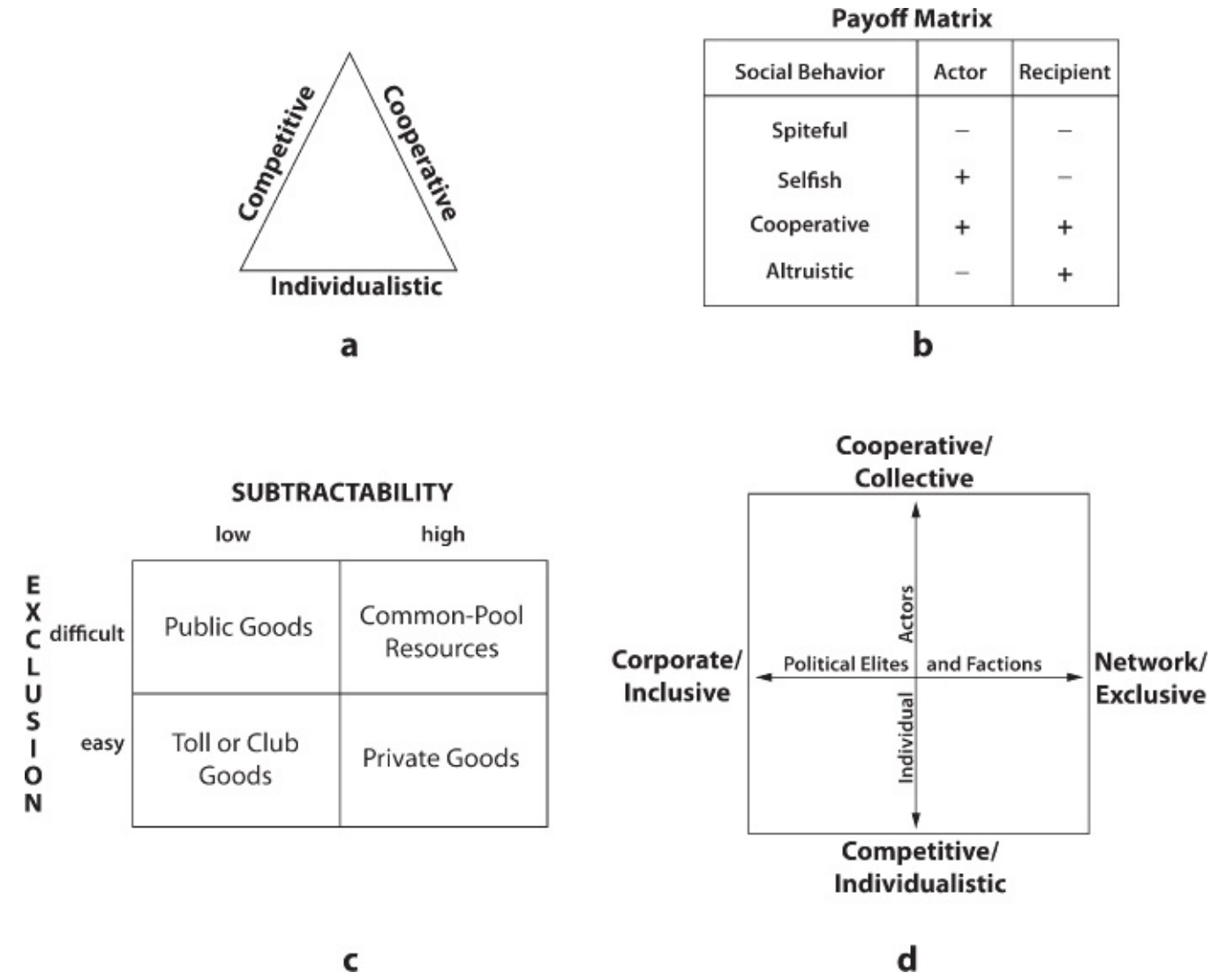

FIGURE 1.1 *Schematic representations of cooperation and other dimensions of group behavior: (a) Margaret Mead's triadic classification of intermediate societies (modified from* Mead 1937b: *461); (b) idealized payoff matrix for social behaviors, which following biological frameworks classify impact in terms of reproductive success (e.g.,* West, Griffin, and Gardner 2007*); (c) classification of types of resource problems by Elinor Ostrom and colleagues (modified from* Ostrom, *Gardner, and Walker* 1994: *Figure 1.1); (d) comparative axes drawing on the work of* Blanton et al. (1996) *and* Feinman, Lightfoot, and Upham (2000: *Figure 1).*

Definitions of cooperation involving mutualism find wide support within many disciplines, but definitions of altruism vary greatly, with some researchers questioning whether "pure" altruism, involving a cost with no payoff, actually exists. West and colleagues (2007: 419–423) outline several uses of the term *altruism* and critique its application to cases when the cost-benefit matrix for an individual actor is anything other than a net decrease in fitness relative to another actor or group of actors, measured over the lifelong effects of that behavior on all parties (Figure 1.1b). For instance, reciprocal altruism has cost-benefit matrices that offset or are mutually beneficial ("a win-win situation"), and is therefore not pure altruism according to these authors. Other behaviors potentially

defined as altruistic may carry more cost than benefit for an individual actor, but those effects could be mediated by genetic relatedness, such as in calculations of inclusive fitness, whereby actions are considered by their impact on the aggregate fitness of all the relatives of that individual who may potentially be impacted, weighted by genetic relatedness (Grafen 1984; Hamilton 1964, 1972; cf. Nowak, Tarnita, and Wilson 2010). This definition of altruism is significantly more restrictive than one from social psychology, in which an act may be considered altruistic if it is performed with no expectation of rewards or benefits to one's self (Dovido et al. 2006: 26). Mead (1937a: 17) also considered the necessity of distinguishing between cooperative behaviors and help. In cooperation, shared goals or mutual benefit keep individuals working in a coordinated manner, while for help the immediate goal only benefits a single individual, but the relationship between helper and helped is shared. Mead's distinction of these terms is similar to the one drawn in contemporary approaches between public goods or common-pool resource problems and forms of direct reciprocity that operat at smaller scales, such as is common for planting or harvesting between households in agrarian societies.

Public Goods and Common-Pool Resource Problems

The vast, multidisciplinary corpus of literature on public goods and common-pool resources is of significant value to archaeology. Some of the central tenets of public goods are encapsulated by the familiar parable of the tragedy of the commons (Hardin 1968, 1998), which stipulates that people fac certain cooperative dilemmas in which it is in everybody's individual interest to pursue one strategy (in this parable, grazing one's animals as much as possible on communally owned pasture) that is at odds with the collective interests of the community as a whole (in this case, to avoid overgrazing).

In his classic work on collective action, Olson (1965: 28) noted that for something to truly be a public good, its benefits must be available to all and cannot be easily excluded (see also Hardin 1982 17–20). Contemporary theorists continue to distinguish between excludable and nonexcludable goods problems (e.g., Boyd and Mathew 2007; Ostrom and Walker 1997). Excludable goods are those in which the benefits of some undertaking can be excluded from a noncontributing segment of the population to a significant degree (Figure 1.1c). Nonexcludable goods confer important benefits on t members of a population irrespective of an individual's or faction's level of participation. This distinction is used to separate private or toll/club goods (where exclusion is easy) from public goods or common-pool resources (where exclusion is difficult), and is of greatest relevance for defining cooperative dilemmas, as individuals can only free-ride if it is difficult to exclude them from benefit (Ostrom, Gardner, and Walker 1994: 6–8). Subtractability presents another important axis of variability in defining the degree to which the exploitation of a resource precludes others from doing the same. Common-pool resources and private goods are by definition unevenly distributed among a population, and have high subtractability, while public and toll/club goods are theoretically available to anyone, but cultural institutions may regulate the means and frequency with which they are exploited (see also Acheson 2011).

As examples, economic collectivities such as guilds, in which individuals cooperate in different aspects of the production and/or distribution of craft items, can easily exclude nonparticipators from the goods or the profits derived from them; the end products are largely private or club goods, depending on the subtractability of the materials involved. However, the building of a palisade aroun a community engaged in violent conflict with neighbors confers a public-goods benefit to all residing within that palisade irrespective of whether they contributed to its construction. Zero-sum resources, which can be overexploited to the point of no or very low regeneration (high subtractability) and

where exclusion is possible, represent classic common-pool resource problems and include illuminating cases of self-organization in undertakings such as forest and fishery maintenance (e.g., Ostrom 1990). Between these more clear-cut examples lie many subtler ones, with culturally or historically contingent dimensions that could result in their being excludable or nonexcludable goods problems. For instance, the benefits derived from the construction and maintenance of an irrigation system may be more excludable if diversionary canals can be managed (i.e., open/closed) or landholding is more private, but they become nonexcludable in situations of low management or mor collective landholding—making irrigated farmland in such cases a common-pool resource. Likewise cooperative craft production is less excludable and becomes more of a public good if the products are intended for a redistributive economic system, in which the households within a community will all receive a share (e.g., Stanish 2004). The resource extraction involved in craft production could also create cooperation problems in cases where scarcity affects net yields for crafters, whereby high subtractability results in a common-pool resource problem (e.g., Ostrom and Gardner 1993: 93).

Nonexcludable goods problems have been of significant interest to theorists who model cooperation because they represent the strongest cases of free-rider dilemmas: where nonparticipator can reap the benefits of collective action. Nevertheless, problems involving relatively more excludable goods characterize a wide array of cultural phenomena that researchers are interested in explaining, including archaeologists. Common-pool resource problems include cases of collective ownership with some possibility of exclusion, while their high degree of subtractability makes overexploitation a possible cause for social crises or outright collapse. Ostrom's work on such problems draws on a number of multigenerational and cross-cultural cases that should be of great interest to archaeologists, including the local management of irrigation systems and other ecological resources (1990, 1992; Ostrom, Gardner, and Walker 1994).

Just as the freerider dilemma affects the expected social dynamics between excludable and nonexcludable goods problems, it may also be used to distinguish between cooperation and coordination. Coordination problems may be defined as those in which an individual's level of participation is a function of how many other individuals participate (Chwe 2001). For example, a critical mass of people must arrive in costume for an event to qualify as a successful "costume party," rather than a party with a few oddballs in costume, and individuals are more likely to dress unconventionally if there are assurances that others will as well (e.g., from previous experience or communication with other partygoers). Within group coordination problems, conformity is usually beneficial to all individuals, while defecting from the norm may even incur greater costs to an individual defector. As an example of the latter, cultures may decide to drive on the right side of the road or the left side of the road, and individuals benefit from conforming to the system around them, whereas they incur costs by driving on the left side in the United States or the right side in the United Kingdom (Henrich and Henrich 2006: 242). Free-riding in such situations is not an issue, therefore, and while the particular dynamics of how groups coordinate their actions remains an essential issue in the social sciences, coordination problems do not pose the same evolutionary conundrum as do cooperation problems in terms of reconciling individual and group interests.

Mechanisms Promoting Cooperation: The Four Rs

Many contemporary evolutionary approaches emphasize the following four mechanisms in promoting cooperation, conveniently all beginning with the letter *r*: (1) reciprocity, (2) reputation, (3) retribution, and (4) rewards (compare Baumard 2010; Boyd and Richerson 1992, 2009; Boyd et al. 2003; Fehr and Gächter 2000; Fehr and Schmidt 1999; Henrich and Henrich 2006, 2007; Milinski,

Semmann, and Krambeck 2002; Nowak 2006b; Ostrom and Walker 1997; Richerson, Boyd, and Henrich 2003). Reciprocity is perhaps the best known within anthropological archaeology, following classic ethnographic cases such as the Trobriand *kula* exchange and Pacific Northwest potlatch, and has already been incorporated into archaeological theory. Game-theoretic models such as tit-for-tat (i.e., "You scratch my back, I scratch yours") center on reciprocity and have been influential in theorizing contemporary international politics (e.g., Axelrod 1997). Tit-for-tat models have many iterations depending on how forgiving actors are considered to be in cases of deviation from reciprocal relations. Some researchers critique these models on the grounds that they only work well when groups are small and there is little restraint in the transmission of information on cooperative intent among actors, which is usually not how humans interact in real-world settings (e.g., Henrich and Henrich 2007: 51). They argue that such mechanisms must be bolstered by other, stronger forms of affiliation such as kinship and ethnic marking as strategies for determining with whom one should reciprocate (e.g., Dawkins 1976: 89; Gil White 2001; Hamilton 1964, 1972).

Reputation is directly tied to reciprocity because, aside from kinship or other corporate-group ties individuals should make decisions concerning the choice of partners based on favorable or unfavorable information (Baumard 2010). Indeed, reputation is often referred to as *indirect reciprocity* in the cooperation literature, and negative reputations—which may be justly earned based on previous behavior, or unjustly earned through malicious gossip—could be used by third parties as light form of retribution (Nowak and Sigmund 2005). Reputation effects within communities may ac as strong leveling mechanisms in certain instances or, alternatively, could be effectively manipulated by individuals in order to aggrandize themselves through strategic displays of largesse. The aggrandizing form relates to behavioral ecology models of costly signals within cooperative undertakings—meaning, signals that reliably convey an individual's likelihood of cooperating and ar not worth the cost for a potential freerider to attempt to fake (see Gintis, Smith, and Bowles 2001; Smith 2003; Smith and Bleige Bird 2005). Theorists focused on more proximate explanations for cooperation more frequently refer to mutual monitoring and the generation of common knowledge (e.g., Chwe 2001; Ostrom 1990; Ostrom, Gardner, and Walker 1994; Ostrom and Walker 1997), with the same understanding that individuals who have been witnessed transgressing suffer poor reputations. The process of mutual monitoring is of direct relevance to archaeology due to the spatial component of how actions are monitored by members of communities, and the topic is explored further in the next section.

Retribution may be better known under the more frequently used terms *punishment* or *sanctioning* In either case, it is a central feature of many proposed frameworks for the evolution of cooperation (e.g., Boyd et al. 2003, 2010; Henrich and Boyd 2001; Henrich et al. 2006; O'Gorman, Henrich, and Van Vugt 2009; Ostrom and Walker 1997; Richerson, Boyd, and Henrich 2003). A number of mathematical models suggest that retribution against defectors and free-riders—along with retributio of individuals who do not punish such transgressions (i.e., second-order free-rider problems or third-party sanctions)—can effectively stabilize norms of cooperation within a population. It should be noted that models of the formalization of retribution suggest that it can serve to stabilize virtually an norm within a population (Boyd and Richerson 1992), but those populations that cooperate are hypothesized to possess group-selection advantages over those that do not.

Overcoming the second-order freerider problem through the development of norms of retribution against individuals who do not punish is termed *strong reciprocity*. In terms of ultimate causality, Bowles and Gintis (2004) model how strong reciprocity could proliferate in even heterogeneous populations based on traits that are unique to humans, particularly language and remote punishment. They acknowledge that Hobbes and earlier classical philosophers emphasized social punishment in th

maintenance of cooperative human behavior (Bingham 2000: 49; Bowles and Gintis 2002: 419), yet contemporary approaches have benefited from centuries of historical and ethnographic cases to reflect on, as well as from a range of continually more refined cost-benefit calculations derived from mathematical models and simulated experimental cases. For instance, Bingham (2000) explores ultimate evolutionary explanations in proposing that the selective roots of cooperation through retribution lie in the reduced costs of punishing that developed within our early *Homo* ancestors as a result of their adoption of group-coordinated remote killing using projectile technologies (i.e., throwing rocks or spears). Given the individual and group benefits of cooperation and the reduced costs of enforcement, Bingham outlines a "coalitional enforcement hypothesis" for human uniqueness. Unlike other animals, humans can physically punish individual transgressors collectively, but transgression need not be culturally defined exclusively as cheating in cooperative endeavors—as many rationales for death by stoning make (painfully) clear. In terms of more proximate causality, Dubreuil (2008) notes that any evolved tendencies for strong reciprocity do not explain the scales of cooperation seen in complex human societies, and the cultural evolution of larger social groups required divisions of labor associated with retribution. Further, Baumard (2010) suggests that the ethnographic record of small-scale societies does not support a central role for retribution in group cooperation.

To our list of mechanisms promoting cooperation following these first "three Rs" we could add a fourth based on more recent studies: rewards. Several classic works in sociology list rewards as a natural counterpart to sanctions, or the latter as being defined either positively or negatively (e.g., Giddens 1979; Parsons and Smelser 1956). Contemporary modeling efforts and experimental studies may suggest that rewarding cooperative behaviors, or withholding reciprocity from noncooperators, encourages cooperation more effectively than does retribution (Ohtsuki, Iwasa, and Nowak 2009; Rand et al. 2009; Rand, Ohtsuki, and Nowak 2009). This work is more recent within the evolutionary literature, and is currently supported by fewer models and experiments, but it is certainly a line of investigation worth following as it carries important implications for understanding the dynamics of cooperation.

Cooperation and Collective Action in Cultural Evolution

The diverse disciplines represented above reflect the broad concern for the issues discussed in this volume, and the truly multidisciplinary nature of researching cooperation and collective action. It is only natural that lively debates exist within and between these strands of research, including over terminology and even the very terms *cooperation* and *collective action* themselves. Some tensions relate to differing goals, as with seeking ultimate versus proximate causes; others have to do with scalar issues, such as population size, or differing views on the importance of culture or history (Is an ant colony *really* like a complex human society?); while yet others are methodological debates regarding the relative merits of mathematical modeling, experimental games, ethnographic observation, historical or sociological survey, or other social- and behavioral-science methods that operate at variable levels of abstraction, rigor, and verifiability.

In general, the researchers cited above discussing the "evolution of cooperation" tend to look for more ultimate causes; think in terms of smaller scales (at least for human groups, but not for cells, social insects, and other biota); and draw primarily on game-theoretic modeling of costs and benefits with the understanding, following natural selection, that if some action does not confer a greater benefit than cost, immediately or somewhere down the line of reproductive success, then it should not proliferate in a population. Researchers discussing "collective action" tend to emphasize more proximate, historically contingent causes, rather than cost-benefit matrices; think in terms of large

human groups with marked differences in power, wealth, and hierarchy; and favor the compilation of case-based surveys as an analytical method. These differences are apparent in the contributions to thi volume, but so too are their important points of intersection.

Regularization of the relevant concepts is useful for drawing comparisons across disciplines and culture regions. Applying the terminology outlined above to describe something familiar, such as contemporary recycling practices, serves as an illustration. The goals of recycling programs (minimizing pollution and the unnecessary exploitation of nonrenewable resources) represent nonexcludable goods problems (public goods or common-pool resources) involving costs and benefit that may be assessed at the level of individuals, communities, or the entire planet. Most recycling programs are voluntary, and the reputation impacts of compliance vary greatly by community and th context and visibility of associated actions; for instance, there are relatively high reputation impacts on many college campuses. However, some municipalities have begun to levy fines on individuals fo not recycling, employing retribution, punishment, or negative sanctioning for compliance. The payof matrices for these cases are thereby different. In states with redemption values for cans or bottles, organized groups of individuals (often households) collect them for mutual gains that are excludable from other individuals who are not participating in the enterprise, making it classifiable as a toll goo Taken together, we see that a single issue involves a range of potential cultural dynamics that implicate differing forms of cooperation.

Some readers may question the utility of reductive logic such as mathematical modeling and experimental games, used by researchers who favor *both* the terms *cooperation* and *collective action* to characterize what they study (e.g., Henrich et al. 2004; Ostrom, Gardner, and Walker 1994, 2003). A critique might be that simplified exercises cannot account for the complex webs of action and meaning that all humans perpetuate and act within, studied by more traditionally allied social-scienc disciplines, like in the works of Mead, Giddens, and Parsons cited above. Yet the simplification of models and experiments does not purport to capture all of the intricacies of cultural interaction; rather, they provide the opportunity to reduce the spectrum of potential variables in order to examine whether certain premises are logically sound (Maynard Smith 1982; McElreath and Boyd 2007). These premises need to then be evaluated with data, which might include ethnographic observation, sociological or historical survey, archaeological materials analysis, or other methods of cataloging and quantifying human behavior (see Gurven and Winking 2008). Modeling assists in developing multiscalar perspectives on cultural evolution that simultaneously consider broad processes, group action, and individual decision making (e.g., Kohler and Gumerman 2000; Kohler and van der Leeuw 2007).

Research on cooperation and collective action may be evaluated in light of the archaeological record of cultural evolution, including issues such as why humans formed larger and more internally differentiated groups through time, and the importance of material symbols to group identification and affiliation. The above literature makes two important points regarding the application of these concepts to archaeology: (1) helping and altruism are behavioral phenomena that are best understood at the level of the individual, while cooperation is best understood at the level of the group (Dovido e al. 2006: 269); and (2) cooperation should be viewed as a process that can be mediated by any numbe of social institutions, rather than as a discrete event (Boyd and Richerson 2008; Ostrom 1990; Ostrom and Walker 1997). These points relate to archaeology in that, while archaeologists should be aware o work in other disciplines on individual motivations and interactions, archaeological data are usually better suited to understanding cooperation within and among groups: households, corporate factions, communities. Further, the unique archaeological perspective on the processes by which institutions originate and develop through time is well suited to addressing cooperative dilemmas and adding a

more diachronic perspective on how human groups looked to solve them. The approaches reviewed in the rest of this chapter are among those that are examining and refining the logic of models and experiments through the study of diachronic change in material culture that defines archaeology.

DEVELOPING ARCHAEOLOGICAL PERSPECTIVES ON COOPERATION

The archaeology of complex societies has progressed significantly beyond the identification of indices of complexity (asking: *Is* a society complex?) toward a better appreciation of the manner in which myriad possibilities for complex human action intersect with one another to create, sustain, and dissolve social institutions (asking: *How* are societies complex?). The behavioral axis of cooperation and competition is a major determinant of how groups organize themselves, and is therefore fundamental to archaeological explanations that consider the broadest possible array of social institutions. Institutions may be defined as "sets of working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, what information must or must not be provided and what payoffs will be assigned to individuals dependent on their actions" (Ostrom 1990: 51). We know that some level of cooperation takes place in all societies, but how do individuals and groups cooperate in particular cases, and how do these relations define the organization and stability of their institutions?

Archaeological investigations drawing on cooperation and collective action theory have increased over the last two decades, but in many cases scholars attempt to reinvent the wheel by ignoring the large multidisciplinary dialogue on these issues. In this section I highlight three ways in which that literature is relevant to archaeology: (1) the consideration of public goods or common-pool resource problems within the natural and social environments of past peoples; (2) greater attention to self-organization in the emergence of institutions, differential political strategies on the part of actors and factions among and within institutions, and bottom-up collective action as checks on, and resistance to, top-down power; and (3) clearer elucidation of the material correlates of mutual monitoring, signaling of affiliation, and social obligations associated with community membership. Any single archaeological approach may incorporate many of these dimensions, but the discussion is divided thematically in order to differentiate the possible conflicts of interest people faced, the institutions they developed to deal with them, and the symbols and built environments that served to mediate such behavioral dynamics.

Resource Problems

Public goods and common-pool resource problems have long been incorporated into archaeological perspectives on the organization of human societies, with many of these problems proposed in earlier literature as "prime movers" that catalyzed, sustained, or diverged particular cultural evolutionary trajectories. Far fewer investigations have incorporated the logic of cooperation or collective action theory. We will begin by considering land and water, those essential elements for human subsistence, and how they may be conceptualized in terms of their associated resource problems for groups of conditionally cooperative actors. Next we consider resource problems involving warfare and economic specialization.

The potential for past systems of land tenure to have created resource problems consistent with th tragedy of the commons has been explored by Kohler (1992), who combines ethnohistoric informatio on Puebloan collective land holding and use rights with archaeological indices of population increase and resource competition in explaining the appearance of architectural units designated as field hous in the American Southwest. Kohler argues that families attempted to establish more private claims to agricultural plots by building field houses following the overexploitation of land in a system that was previously more loosely regulated. Bayman and Sullivan (2008) build on Kohler's logic in examining two other regions of the Southwest. They argue that agricultural terraces in the Trincheras region and public mounds in the Hohokam region may be indicative of shifts from systems in which land was treated as a common-pool resource to ones in which it became more privatized. Both of these studies succeed in demonstrating how common-pool resource theory might be applied to archaeological case They also make judicious use of ethnohistoric data in proposing what social norms and institutions may have regulated one of the more elusive dimensions of past economies lacking textual evidence (land tenure), and the possible archaeological indices of the operation or absence of those norms and institutions.

Eerkens (1999) has explored similar issues but among forager populations in arid portions of Southeastern California. He draws on the work of Ostrom (1990) and ethnographic data from neighboring regions to suggest that foraging territories were managed as common-pool resources, with disputes having been resolved by face-to-face interaction and symbolic signaling of affiliation during the first to mid second millennium. Eerkens (2004) documents a shift approximately six hundred years ago to more intensive seed collecting, which he attributes to increased privatization of resources and decreased norms of food sharing with a rise in regional population. Eerkens builds on his earlier work in chapter 7. Kohler and van West's (1996) study of households in the Mesa Verde region focuses on food sharing as well. These authors argue that the cooperative pooling of food coincides with village nucleation creating social circumscription, integrative rituals within kivas, and relatively high agricultural yields, rather than the low population and low yield assumptions for when food pooling might serve as a buffer against risk.

The control and management of water resources has been debated as factor in the development of complex societies for decades, particularly associated with the works of Steward (1955) and Wittfoge (1957). Debates include whether sophisticated irrigation systems preceded or followed complex socia intuitions, and how these systems could be developed and maintained without centralized organizatio such as state governance or temple ritual (Hunt 1988; Mitchell 1973). Scarborough (2003) provides a recent overview in which he proposes that past societies differed in whether they addressed water systems through greater division of labor, more advanced technologies, or more diversified and decentralized strategies (see also Janusek and Kolata 2004). Contemporary water systems and historically documented cases that span centuries, such as those that Ostrom (1990, 1992) has discussed, are directly relevant to archaeological models. In analyzing these cases as common-pool resource problems, Ostrom (1990: 27) emphasizes the importance of solving problems of individual commitment and the threats posed by free-riding through mutual monitoring and the maintenance of legitimate institutions with clearly defined rules. As her definition cited at the beginning of this section makes clear, institutions may be more centralized or more decentralized within archaeologica cases like those reviewed by Scarborough. Chabot-Hanowell and Lucero bring a new perspective to these issues in chapter 10 (see also Lucero and Fash 2006).

Spencer's (1993) model for the evolution of institutionalized leadership features common-pool resources and public goods prominently, though not explicitly using these terms, and suggests a relationship between such issues and the development of formal, heritable leadership through a

process that Boyd and Richerson (1985) termed *indirect bias* in cultural transmission, but now is mo descriptively termed *prestige bias* (Henrich and Henrich 2006). One of the common-pool resources Spencer (1993: 48–58) discusses is the irrigation system built in Mexico's arid Tehuacán Valley during the first millennium BC. He argues that the coordination and monitoring of participation in th construction of a large dam and in the maintenance of canals may have permitted a leader with achieved status, within a more egalitarian setting, to persuade community members to accept a "leadership package" that included rank differences, or ascribed status, for members of their family. Early institutionalized leadership may therefore have evolved in certain cases through cooperation dilemmas that were confronted by communities through accepting institutionalized retribution coordinated by a single or limited number of individuals (O'Gorman, Henrich, and Van Vugt 2009; Richerson and Boyd 1999, 2001; Van Vugt, Hogan, and Kaiser 2008). These models demonstrate hov cost-benefit considerations may be assessed at the level of individuals and the group, or among agent and their aggregate actions that create communities and drive cultural change. They suggest that an important avenue by which individuals or groups gain power in intermediate societies is success in coordinating and sustaining large-scale cooperation that benefits a community or a large segment of one.

The model developed by Spencer is also applicable to raised fields and warfare in the context of competing villages in western Venezuela during the first millennium AD (Spencer 1993: 58–69). While raised fields may have constituted another common-pool resource system (Spencer, Redmond and Rinaldi 1994), defensive works, like those of the largest town Spencer discusses, may be considered a public good because the benefits of attacks from raiding neighbors cannot be excluded from individuals residing within the defensive structure. In this case, safety and/or group coercive abilities are considered a resource and, just like with land tenure or water systems, social hierarchy may have resulted as an unintended consequence of groups attempting to mediate free-riding dilemmas. Roscoe (2009) discusses similar dynamics relating to warfare within the ethnographic and historic record of New Guinea. He suggests that social signaling in small-scale societies is an institutional response that addresses conflicts of interest in cooperation through rewarding individual who contribute more to group viability in violent conflict, serving to catalyze incipient hierarchies in the process (see also Shennan 2002: 239–261; Turchin and Gavrilets 2009). Roscoe (chapter 3) and Spencer (chapter 9) elaborate on many of these points in their contributions to this volume.

A final set of resource problems revolve around economic goods such as crafts. Evolutionary models suggest that economies of scale change the potential payoffs associated with cooperative dilemmas (Boyd and Mathew 2007; Kaplan, Hooper, and Gurven 2009; Matheau and Boyd 2009). As discussed above, the division of labor involved in creating economies of scale is generally an excludable goods issue, unless those goods are intended for a redistributive system. The fact that members of some societies relinquished their productive autonomy for the Faustian bargain of greate efficiency combined with greater social inequality is one of the central topics in the cultural evolutio of complex societies (Henrich and Boyd 2008). Stanish (2004; Stanish and Haley 2005) has explored this issue by drawing on contemporary cooperation theory and develops his arguments in chapter 4 (see also Shennan 2002: 165–168).

Some of the potential resource problems just noted are environmentally specific (such as irrigatio networks or fisheries), while others are widespread (such as forest or soil maintenance), or have the potential to be present anywhere there are people (exchange networks or warfare/defense). Studies of cultural evolution should consider the relevance of any number of problems to a particular study region and assess what social institutions and strategies mediated such problems.