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The emergence of locally adaptive institutions: Insights from traditional social structures of East African pastoralists

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ABSTRACT

Humans inhabit the widest range of ecological and social niches of any mammal. Yet each ecological and social environment presents a set of challenges that we must solve in order to successfully inhabit it. We are able to do so by building institutions that can flexibly respond to changing circumstances. Institutions that solve adaptive challenges necessary for human sociality, such as how to resolve conflicts, find mates, and extract and distribute resources, are termed *locally adaptive institutions*. The design of locally adaptive institutions promotes coordination and cooperation among unrelated individuals, reflecting the constraints of the particular ecological and social challenges to which they are responsive. Institutions generally are enabled by a suite of social and psychological mechanisms, including norm compliance, self-interested design, selective imitation, and cultural group selection among others. The development of locally adaptive institutions are likely to be especially shaped by self-interested design in which agents are sensitive to the payoffs from various norms and choose to enforce and follow those which they anticipate to be most beneficial to themselves. Exogenous shocks, including the advent of material and cultural technologies, population pressures, or even group conflict can contribute to the modification of existing social institutions and the development of new social structures. Using several case examples from traditional east African pastoralist societies, I illustrate how ecological and social pressures shape the development of social norms that underlie locally adaptive social institutions and facilitate continued cooperation in the face of change at scales ranging from local to global.

1. Introduction

1.1. Why do human societies need institutions?

The success of human societies everywhere, from small groups of hunter-gatherers living in the Artic and Amazon to large nation-states, depends on solving a common challenge: motivating people to interact with each other in a way that facilitates their continued survival despite having competing and sometimes adversarial interests. For example, how are limited resources managed and wealth transmitted? How are mates located and coalitions and alliances formed? How are decisions made and conflicts resolved? A failure to find effective solutions to any one of these threatens the viability of a society including the persons in it. Indeed, human populations around the globe have faced catastrophic failures and occasional extinctions due to their inability to solve basic coordination and collective action problems (Diamond, 2011; Ostrom, 1990a). At the same time, humans are obligately social and cultural, depending on complex cumulative culture traditions that arise through iterative evolutionary processes (Henrich, 2015). Specifically, for humans to survive and thrive, we must do so through interaction, coordination, and exchange with others (Christakis, 2019).

Many social species are able to solve the problems arising from living together through high levels of genetic relatedness (Boomsma, 2009; Cornwallis et al., 2010). But humans are unusual in that societies everywhere have low-levels of relatedness, exacerbating conflict of interests (Hill et al., 2011). How can humans so successfully solve the challenges of building societies to the extent that we have inhabited every continent—and done so while expanding at an astonishing rate? We do so by building social institutions that solve the particular challenges of sociality through governing the behavior of individuals within them. These challenges include those posed by the environment, such as procuring food and the resources necessary for group living and responding to changes in the environment. Challenges can also stem from other humans; these include dividing and sharing resources that are cooperatively produced, obtaining mates, and resolving conflicts of interest. These dual challenges are often termed “us versus nature” and “us versus them” (Gavrilets, 2015). Institutions solve both types of challenges and are so necessary and ubiquitous that they often recede

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into the backdrop almost unnoticed though they underlie our sociality.

2. Institutions

What are institutions? Humans everywhere adhere to norms, rules, and expectations of behavior that are often implicit and that regulate a vast range of behaviors (Brown, 1991). Norms and rules govern the mundane, such as how to greet strangers and friends, how to properly consume food and drink, and how to comfort those grieving for a lost loved one. They also govern more consequential behaviors, such as how to handle grievances and disputes, when and whom one can marry, how ownership and transference work, and who can have a say in shaping the rules of society. There is hardly a domain of human social life that is ungoverned by a norm or rule (Hechter and Opp, 2001; Reno et al., 1993).

When individuals whose behavior is shaped by norms, rules, and heuristics interact repeatedly, it produces a set of patterned interactions. The patterned interactions resulting from the regular and predictable interactions of individuals adhering to norms and rules are called *institutions* and they include the laws, norms, expectations, and rituals that structure human society (Knight, 1992; North, 1990; Ostrom, 1990a).[1] Institutions alter the payoff structures of interactions allowing persons to coordinate their behavior, either through shared expectations about how others will act such as conventions, or through selective incentives such as sanctioning, and thus can promote cooperation. Common examples of institutions are marriage, systems of economic transactions, religious belief structures, education, and law.

Consider the set of norms and rules defining who one can choose as a reproductive partner. Depending on the society, potential partners may be pre- or proscribed by age, sex, class, or relatedness (Westermarck, 1922). Potential partners may also be determined by a specific relationship to others (such as a patrilateral cross-cousin) or through a previous agreed upon exchange by the parents of the spouses. Together the set of interlocking norms shaping the behavior of individuals in choosing a reproductive partner is called marriage. Because individuals have a similar set of norms and expectations, the transaction costs are substantially reduced, thus facilitating persons finding mates (Bossen, 1988) (See Fig. 1).

Sets of norms, like those surrounding marriage, that produce patterned interactions lead to institutions. These can then produce other emergent phenomena that are difficult to understand without knowing the rules governing the institution. For example, consider the marriage norms in a society based around mobile livestock production where men are polygynous, marrying multiple wives at once, while women can have only one husband. This marriage system typically produces a particular family and demographic structure that itself is an emergent phenomenon but not an institution. In this case, the result is that the ages of marriage are highly skewed with men frequently not marrying until after age 30 when they have amassed sufficient resources (bride-wealth) to be competitive mates while women marry in their mid to late teenage years. One result of this is a glut of young unmarried bachelors who intensely compete for access to resources for future mates (Draper, 1989; Westermarck, 1922). This community structure can then fuel the propensity for intergroup conflict due to competition for mates, patterns of inheritance, and even rates of domestic violence (Macfarlan et al., 2018, 2014; Smuts, 1995).

These examples illustrate three main points. First, while marriage is an institution, not all emergent phenomena (such as the demographic structure of a community resulting from marriage rules) are institutions. Second, while institutions may lower the transaction costs in one domain (finding a reproductive partner), they can have far-ranging effects on other areas of social behavior potentially creating costs or benefits in other domains, such as through intergroup conflict. Finally, institutions produce emergent phenomena (such as the demographic profile of a community, how property is inherited, etc.) that are difficult to understand without consideration of the underlying norms constraining the institution (such as whom to choose as a reproductive partner) (Fig. 1, Panel 3).

While institutions are made possible through individuals adhering to norms, importantly, institutions do not necessarily align with the preferences of individuals who participate in them (Richerson and Henrich, 2009). For example, a person may participate in the institution of marriage while disagreeing with the norms concerning whom and when one can marry, at what age, whether divorce is allowed, and so on. Norms that have low alignment with individual preferences are maintained through conformity biases and enforced through the threat of sanctions for violations, gossip or ridicule (Hess and Hagen, 2006; Wu et al., 2016), or through other mechanisms (Boyd and Richerson, 1992; Oliver, 1980). Importantly, it is not necessary for individuals to support an institution or to benefit from an institution for an institution to emerge.

Institutions often develop in response to recurrent contexts, but they do not have to lower transaction costs or solve adaptive problems for the individual or group. For example, belief systems such as shamanism (Singh, 2018a; Singh and Henrich, 2019), witchcraft (Singh, 2018b), or beliefs about the causes of misfortune leading to infanticide (Grubb, 1904; Robarchek, 1998) are recurrent features of many human societies and often appear to develop into institutions. However, while they may provide some benefits, they can impose substantial costs while not solving any particular social or environmental problem.

In contrast, some institutions develop as a result of humans solving specific and recurrent problems necessary for human society—such as finding mates, weathering periods of resource scarcity, regulating common pool resources, resolving conflicts, building alliances, obtaining and distributing property, and so on. Such institutions include systems of exchange such as trade or marriage (Korotayev, 2003; Marlowe, 2003), social interactions including rituals or even games (Binde, 2005; Mitchell, 1988), sports (Cohodas, 1975; Fox et al., 1996), or even modes of intergroup conflict (Glowacki, 2018; Wiessner, 2006). Often these solutions appear to be responsive to particular ecological and social constraints in ways that appear to benefit the group or be "group--functional" (Brumfiel and Earle, 1987; Radcliffe-Brown, 1952; Smaldino, 2014).

The set of institutions that are generally thought to benefit the group are often termed *group-functional institutions*, but this framework obscures two important challenges. First, many institutions create asymmetric costs and benefits to subsets of a population or are beneficial only to a small fraction of a population. For example, norms over property inheritance, such as primogeniture inheritance where the oldest son inherits the majority of property, may benefit him and continue the preservation of certain forms of wealth (such as plantations and estates), or levirate marriage where wives stay within a husband's family by marrying the husband's kin upon his death may be "group-functional" for the husband's kin but impose substantial costs on other subsets of the group. A focus on group-functional institutions obscures the fact that while stable equilibria can develop that solve social and environmental challenges, in many cases the outcomes impose strongly asymmetric costs and benefits on subgroups. Relatedly, successful institutions that do solve environmental and social challenges often impose external costs in other domains that harn the group or some subset. The focus on group-functionality ignores that successful solutions in one domain often impose costs in other domains and thus may not actually be "group-functional".

Second, a focus on group-functional institutions treats the group as agentic and the basis of the institution when in fact institutions do not develop to solve the problems of the group. Instead, they arise from the interactions of individuals faced with specific dilemmas (e.g., who to

[1] Note there are other definitions of institutions, the definition often varies by disciplinary specialization. See (Powers, van Schaik, and Lehmann, 2016) for example.

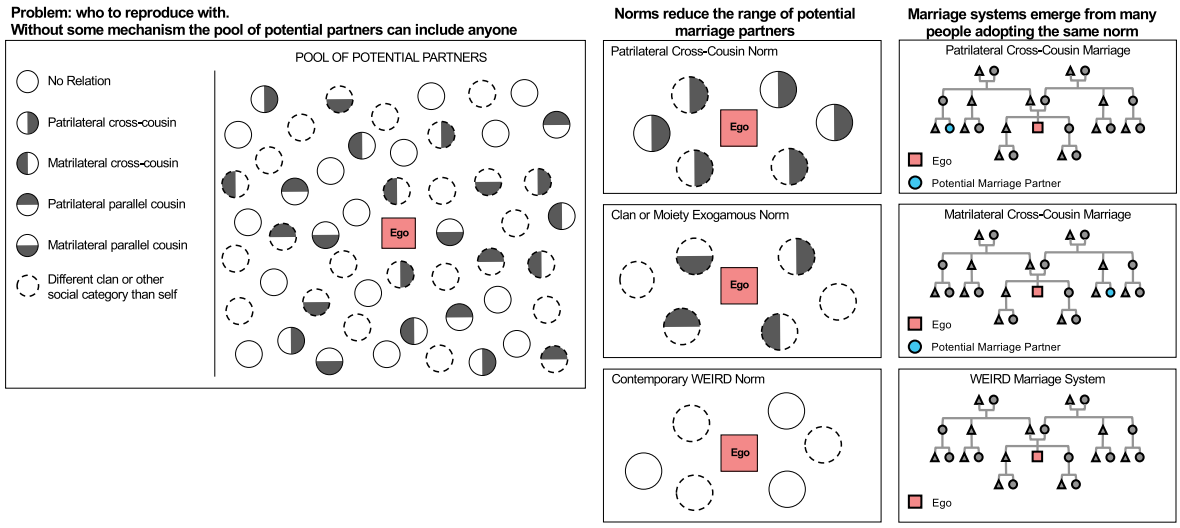

Fig. 1. The emergence of marriage systems.
Caption: *Without norms, potential reproductive partners can include nearly anyone. Norms restrict the pool of potential partners on the basis of categories such as age, current reproductive status, kinship, and other social categories such as clan, caste, or religion. This reduces the transaction costs of finding a mate. The particular norms that develop* often *reflect other social and environmental constraints, such as the type of subsistence or nature of wealth. People are likely to select and enforce norms that benefit them, either directly or through the creation of positive externalities. When many people follow the same norms, a patterned phenomena emerges, in this case a certain type of marriage system.*

marry, where to move, how to share resources) who calibrate their behavior based on what others are doing, likely payoffs to various choices, and anticipation of the behavior of others. When individuals solve similar problems in aggregate and over time, the patterns of their behaviors often result in a set of socially shared norms that are tailored to the nature of the challenges. Thus, marriage rules seem to match the type of subsistence system and distribution of wealth while food sharing norms relate to the amount of variance in daily returns from subsistence, but the institutions arise from individuals solving specific problems such as with whom to reproduce or whether or not to share food. The resulting solutions (institutions) may lower transaction costs and promote cooperation and thus appear to be group functional. Yet these institutions develop not because people select for group-functional norms in their choices but because individuals adopt behaviors and norms that in aggregate produce an institution which appears group functional. So the appropriate focus is on why persons select certain types of norms and when and how these produce institutions (which may or may not lower transaction costs and solve problems for themselves and others). One mechanism this approach will advance is that persons adopt norms that lower transaction costs for themselves and that also lower transaction costs for others when they adopt them as well.

2.1. Locally adaptive institutions

While institutions encompass a wide swath of human cultural life, some institutions enable the success of human societies, including expansion, exploiting new niches, and maintaining resilience in the face of exogenous pressures. Institutions that solve specific and recurrent social or ecological problems necessary for the viability of human societies are termed *locally adaptive institutions*. When societies lose locally adaptive institutions, which can include material culture such as methods of making tools or houses, or social institutions such as belief systems, corporate structure, or mechanisms to resolve conflicts, this loss can threaten the viability of the population, potentially leading them to cultural or physical extinction (Walker et al., 2016, 2012). The structure of some institutions are *resilient*, meaning they can better withstand exogenous stresses thus providing a buffer against periods of hardship and protecting against vulnerability (Adger, 2006; Folke, 2006; Walker et al., 2004).

The challenges human societies face are often conserved, occurring across a range of social systems, such as how to extract resources from an environment (subsistence strategies (Gavin et al., 2018):), how to resolve conflicts between parties (customary dispute resolution institutions (Fry, 2007):), and how to create bonds between individuals connected through shared ancestry and marriage (kinship systems (Chapais, 2014):). However, other institutions may be specific to a particular ecological or social niche—for example, in a highly mobile society with periods of resource scarcity, how do you build alliances with members of other groups? Fictive kinship and ritualized trade are often solutions.

Local adaptive institutions are *adaptive* in that they are solutions to specific problems pertaining to the functioning of society. This would exclude institutions regulating some subset of behaviors not applicable to the viability of society, such as the rules of the game Dungeons and Dragons, certain child rearing practices, or the norms of seating in a classroom, but would include those of institutions that govern the building of alliances necessary for survival, the production and distribution of foods systems, and managing intergroup conflict, property inheritance, or marriage. Indeed, human societies with similar social organizations or subsistence niches often converge on similar institutions including institutionalized egalitarianism (Boehm, 1999; Wiessner, 1998), commons management (Moritz et al., 2018; Ostrom, 1990a), resource management and exploitation (Bird et al., 2020; Crabtree et al., 2017), and sharing norms (Gurven et al., 2004). Although such institutions are adaptive in that they solve certain problems, such solutions are by no means expected to be optimized.

While local adaptive institutions solve problems pertaining to a specific domain, they may impose external costs in other domains. Thus, such institutions are *locally* adaptive in that there are solutions to specific problems (such as how to find a mate), but they can create negative externalities in other domains. For instance, a marriage system that effectively solves the issue of locating mates given a particular subsistence strategy may lead to potential negative externalities such as an imbalance of unmarried men to women, which in turn may fuel within- and between-group conflict as bachelors compete for reproductive opportunities (Fleisher and Holloway, 2004; Glowacki and Wrangham, 2015). As the challenges a particular society faces change, current institutions may no longer be well-suited to solving those challenges or

Table 1
Key Terms Related to the Development of Locally Adaptive Institutions.

Key Terms	Definition	Examples
Context Bias	Any learning bias that uses cues about the social context in which learning occurs rather than the content of the norm being learned.	The preferential adoption of behaviors of high-status individuals, such as particular manners of dress or speech (prestige bias); the preferential adoption of behaviors of persons with particular group membership, such as being from a specific cultural or social group.
Cultural Group Selection	The process by which cultural traits spread at the population-level, either through replacement due to warfare, demographic competition, or horizontal transmission among others.	The spread of numerous norms across the globe such as compulsory education, economic systems, forms of social organization, and monogamous marriage.
Institution	Patterned interactions resulting from multiple individuals adhering to norms and rules. Institutions alter the payoff structures of interactions, allowing persons to coordinate their behavior thus promoting cooperation.	The rules, norms, expectations, and rituals that structure human society. Common examples include marriage, law, education, resources management, religious belief systems, and conflict resolution strategies.
Locally Adaptive Institution	The subset of institutions that solve social or ecological problems necessary for the viability of human societies. They are adaptive in that they are solutions to problems pertaining to the functioning of society. They are local in that while they may solve one kind of problem, they can impose negative externalities in other domains.	Matrilineal descent, polyandrous marriage, corporate groups, age structures, ritualized conflict resolution, initiation rituals, etc.
Norms	The rules and expectations that govern behavior. They may be explicit or implicit and enforced through external incentives and sanctions or internalized.	How one is expected to greet strangers and friends, how to properly consume food and drink, how to handle grievances and disputes, when and whom one can marry, who can own property and who can have a say in shaping the rules of society.
Selective Imitation	Once traits including norms emerge, individuals are selective about which traits to copy. In choosing which traits to copy, they may use different heuristics such as prestige or conformity biases.	Prestige biases where persons copy traits from high-status individuals, or conformity biases where people are attentive to the frequency of a trait in deciding to copy it.
Self-interested Design	The process by which persons choose to follow and enforce norms that benefit them. When people have different interests, this process can result in norms that provide asymmetric payoffs based on the capacity to enforce those norms.	Norms and institutions often benefit persons in power such as marriage norms that allow men to marry multiple wives and religious and sacred taboos that benefit leaders. Many group functional norms may also arise through self-interested design, such as food sharing.
Social Identity	The categories and concepts that are used by people to specify who they are and how they relate to other people and groups.	Nationality, social group membership, cultural background, ethnicity, educational status, religious beliefs, sets of values, and so on.

may even become maladaptive. For example, while strong norms of revenge may be a deterrent to unprovoked aggression (Jackson et al., 2019), tamping down the threat of intergroup violence when other precursors are present, they can lead to spiraling amounts of violence if left unchecked, threatening the viability of the society itself (Beckerman et al., 2009; Boehm, 1987). In these cases, formerly locally adaptive institutions would no longer be adaptive and may become maladaptive.

Although locally adaptive institutions are a subset of institutions, much of the literature on the development of institutions has focused on institutions generally without considering how the nature of the challenges actors face in making decisions can give rise to differing kinds of institutions. There are at least two advantages of an approach considering locally adaptive institutions as a subset of institutions more generally. First, a variety of mechanisms shape the development of institutions, but the nature of the interactions that give rise to the institution are likely to strongly influence both the mechanisms shaping the institution and the payoff structure of the resulting institution. Second, institutions vary enormously across human societies, yet certain patterns emerge with surprising regularity. Focusing on the source of the institution (adaptive) and scale (local) can shed light on the causes of these regularities and potentially be used to better predict the development of future institutions.

3. The development of institutions

For the purposes of this paper, we focus on institutions that are developed through bottom-up interactions of individuals without formal coercive or hierarchical authority and limited global knowledge. We highlight the primary mechanisms involved in the development of these types of institutions, though this is by no means exhaustive (Table 1).

There are at least two relevant frameworks to understand the development of locally adaptive institutions: *selective imitation* and *self-interested design* (See Table 1). In both cases, institutions depend upon humans coordinating their behavior, which requires we act in recurrent ways and can predict the behavior of others in similar circumstances. We do so through several mechanisms but especially through *norms*, which are rules and expectations telling persons how to act (Knight, 1992; Ostrom, 1990a), and enabling coordination by informing persons how others are likely to act (Cronk and Leech, 2013; Schelling, 1980). Norms are maintained through two mechanisms. First, they alter behavior through shifting incentives, often through negative payoffs for violations, which can include ostracism, gossip, sanctions (Boyd and Richerson, 1992; Krasnow et al., 2012; Wiessner, 2005; Wu et al., 2016), and the costs of miscoordination. Second, norms are frequently internalized such that their adherence is intrinsically motivating and following them is an end itself (Gavrilets and Richerson, 2017; Richerson and Henrich, 2009). Thus when others violate norms that have been internalized, the violation has the capacity to take on an affective or moral valence (Burkart et al., 2018; Haidt, 2007). In this case, external incentives including punishment and reward are less important for norm adherence. As a result, humans generally follow norms when they are internalized or externally enforced and we can reasonably expect others to also follow them when the same enforcement mechanisms are operating. This allows us to have interactions with regular and repeatable features and to predict we will continue to have those in the future under similar circumstances.

3.1. Selective imitation

Selective imitation approaches posit that once behavioral or cultural traits emerge, including norms, individuals selectively observe and copy them. There may be biases to copy from certain types of individuals (such as parents or high-status persons) or transmission can be based on other heuristics such as averaging the behavior of others (Gavrilets and Duwal Shrestha, 2020; Richerson and Henrich, 2009). This approach has been most thoroughly developed by Boyd, Richerson, and Henrich (Boyd and Richerson, 2008; Henrich, 2001; Henrich and McElreath, 2003; Richerson and Boyd, 1998) and is a particularly potent

mechanism for cultural group selection to operate on, leading to the diffusion of norms across populations.

When individuals encounter a trait, such as a behavior or norm, they may use the *context* in which they encounter it in deciding whether or not to copy it rather than the content of the norm. This set of biases are known *context-biases*. In one well-studied approach, individuals are hypothesized to attend to the cultural model through which they encounter a norm in deciding whether or not to adopt a norm (Henrich and McElreath, 2003). For example, they may preferentially copy norms or behaviors from older, more well-known individuals with little attention to the payoff of the norm. There is good evidence that in some circumstances people are more likely to copy prestigious individuals, a tendency termed the *prestige bias* (Chudek and Henrich, 2011; Garfield and Hagen, 2020; Henrich and Gil-White, 2001), though there are important exceptions (Jiménez and Mesoudi, 2019). People may also use indicators of relatedness, dress, or other cultural identifiers when deciding whether to adopt a norm (McElreath et al., 2003).

Another important type of context bias are *conformity biases* in which persons aggregate information from multiple models in deciding which behavior to adopt, paying attention to the frequency of the trait in deciding whether to copy it (Henrich and McElreath, 2003). In doing this, they attend to features beyond the cultural model, such as whether most other people are doing it or by adopting the average of a particular group of people, such as high-status persons. Individuals and groups vary in their reliance both on particular biases and their use of social information more generally (Garfield et al., 2016; Glowacki and Molleman, 2017; Mesoudi et al., 2006; Molleman and Gächter, 2018). Through these two mechanisms, some cultural variants come to be adopted while others may eventually disappear, driving the spread of norms through populations. As a result, patterns of behavior and shared norms are likely to emerge.

3.2. Self-interested design

An alternative set of approaches focuses on the capacity of individuals within a society to shape institutions to serve their personal interests (Cofnas, 2018; Gavrilets and Duwal Shrestha, 2020; Singh et al., 2017, 2016). The key difference between selective imitation and self-interested design is that under models of self-interested design, persons choose to copy norms that best serve their interests or selectively enforce the norms others follow through incentives or sanctions. This results in norms that often benefit the people who follow and enforce them. Given that individuals differ in their capacity to enforce their preferences (i.e., their power), these approaches consider the distribution of power in a society to be a critical factor in the design of institutions. Recent work has incorporated the fact that humans can often anticipate future situations, their payoffs, and the behavior of others through "foresight" and this is a key aspect in choosing which norms to follow and enforce (Perry et al., 2018; Perry and Gavrilets, 2020).

In choosing how to act and which norms to enforce, individuals are sensitive to the potential payoffs in the short term but also downstream benefits. Persons are likely to follow norms when doing so is perceived to be in their self-interest either directly from the norm itself or when the norm will lead to positive externalities. They should enforce self-beneficial norms and neglect to enforce norms that do not benefit them (Singh et al., 2017). When persons have overlapping interests and are able to coordinate to enforce their preferences on others, the result is asymmetric payoffs that favor their subgroup (Cofnas, 2018). When enforcers have overlapping interests with members of other sub-groups, such as through blood or marriage, the resulting norms are less likely to be asymmetric and may benefit the larger population. Social institutions often promote shared interests through the development of social categories that mimic those of kinship, thus resulting in norms and institutions that provide benefits to groups of unrelated persons (Smaldino, 2019).

One corollary of this framework is that while group-functional institutions develop from this process, institutions will typically reflect the distribution of power in society such that parties who wield more power are more likely to be benefited by particular institutions. For example, while marriage solves the problem of persons finding mates, the design of marriage institutions often reflects the interests of people in power. This may be one reason why norms often permit men to marry more than one woman at a time while restricting women to only one husband at a time (polygyny), though other marriage systems often emerge in response to demographic and ecological features (Starkweather and Hames, 2012). Leaders or other prominent persons also have more influence in shaping norms, through choosing which norms to follow and anticipating that others may copy their behavior, and through deciding what norms to enforce. Thus, leadership can be a powerful driver of the development of institutions ranging from shamanism to war (Garfield et al., 2020, 2019; Glowacki et al., 2016). Norms are predicted to benefit the individuals or subgroup that can best enforce them and are predicted to be population beneficial when the interests of the enforcing parties overlap with the interests of the population or larger group.

3.3. Cultural group selection

When different groups converge on differing institutions, competition between groups can favor the spread of one variant over another in a process known as *cultural group selection* (Richerson et al., 2016). Cultural group selection can result from several processes including warfare, demographic competition, or even copying between groups, and indeed there is ample evidence that cultural group selection explains the expansion of many prosocial traits (Handley and Mathew, 2020; Turchin et al., 2013). While cultural group selection is posited to be particularly important with the spread of institutions developed through selective imitation as people adopt the norms of more successful groups, it may also contribute to the diffusion of institutions developing through self-interested design. The extent to which cultural group selection is an important force in the distribution of norms continues to be a source of empirical and theoretical debate.

3.4. Why adaptive design?

Locally adaptive institutions are adaptive in that they solve certain problems imposed by group-living, but how do they come to do this? More so, institutions across the globe in societies only remotely connected if at all share many deep similarities such that there appear to be regular patterns across societies in the form and structure of many institutions, especially those related to adaptive challenges (Benedict, 1934; Radcliff-Brown, 1968). Selective imitation and self-interested design differ in how they explain the similarities of institutions across disparate societies.

Selective-bias approaches emphasize the biases people have in choosing which norms to adopt from others. Model-based biases, such as prestige-biases, posit the primary role in the adoption of norms as arising from cues exhibited by persons one observes modeling a behavior. For example, a person may choose to copy a trait based on the stature or group membership of those they observe. Or, in the case of multiple people exhibiting varied behavior (multiple cultural models), people employ heuristics to integrate varied models, such as "adopt the mean of behaviors" or "copy the most common thing people are doing". Societies can converge on a set of norms that can then be maintained through selective incentives (punishment and rewards), and theoretical work shows that selective incentives can stabilize any norm whether group beneficial or not (Boyd and Richerson, 1992; Oliver, 1984). However, a challenge of this framework is that it is difficult to account for the prevalence of institutions that are adaptive to specific social problems without invoking additional machinery. Thus, many proponents of selective imitation hypothesize a large role in cultural group selection in the spread of norms, especially those that are group beneficial and

adaptive. In this framework, it is cultural group selection rather than selective imitation that has a primary role for sharpening a set of varied norms into those that are locally adaptive.

In contrast, self-interested design predicts that many locally adaptive norms arise through individuals choosing to adopt and enforce norms that they predict will benefit them. Because people often have real or perceived overlapping interests with their group, to the extent they do, norms will be group beneficial. Where interests and enforcement diverge, norms should favor those individuals or sub-groups with additional enforcement capacity or power, thus institutions often favor elders and men at the expense of youth and women. Accordingly, much of the convergence between institutions separated by time and space is not due to cultural group selection, but rather the fact that humans everywhere confront similar ecological and social environments which shape payoffs reliably. Humans then choose between alternative choices (such as competing norms) favoring the choice with higher payoffs. Because the challenges within socio-cultural systems are similar in similar ecological and social niches across the globe and the heuristics humans use in choosing which norms to adopt are also similar, the institutions humans develop are responsive to those challenges (adaptive) and are likely to share much in common across populations.

Thus, in disparate societies, similar institutions develop because persons sculpt culture through choosing which norms to follow and enforce that reflect their interests. For example, nomadic hunter-gatherers around the globe often have an egalitarian complex, bride service, wide-spread food sharing with non-kin, and a specific pattern of sexual division of labor despite often having little cultural contact with each other and varied cultural evolutionary histories (Kelly, 1995; Service, 1966). These institutions reflect the decisions of persons who choose to follow and enforce norms that are more likely to benefit themselves in these types of social environments and subsistence niches. As the constraints in a society change, say, due to a change in the social environment (such as decreasing mobility or increasing inequality) or the ecological environment (such as a lack or loss of high variance resources), hunter-gatherer institutions may change resulting in new locally adaptive institutions, such as potlatch, bridewealth, institutionalized inequality, etc.

Although self-interested design posits that humans can develop locally adaptive institutions through attention to payoffs coupled with foresight, it leaves open the door for cultural group selection to operate on the resulting norms and institutions. Just as with selective imitation, competition between groups, demographic replacement, or copying can result in more successful institutions spreading within and between groups.

4. Case studies of locally adaptive institutions

We have reviewed the mechanisms that contribute to locally adaptive institutions, in particular that they develop in response to social and environmental challenges and are often common across a range of human societies. Because social and environmental challenges are frequently similar in human societies with similar material technology and subsistence strategies and humans share common underlying psychological biases, the institutions that develop to solve these problems are often similar (Boyer and Petersen, 2012). Here I draw on long-term fieldwork with East African pastoralists to review several types of locally adaptive institutions that commonly develop to recurrent social and environmental challenges.

4.1. How to resolve internal conflicts and motivate collective action?

All human societies need mechanisms to resolve conflicts and facilitate collective action, including group defense. The inability to do this can affect the viability of society itself (Boehm et al., 1996; Wiessner, 2006). The ranges of institutions we develop to solve these challenges are enormously varied, ranging from court systems (both formal and customary), ritualized battles and fights, initiation rituals, social and civic entities, to forms of age organization (Glowacki and Gönc, 2013; Hoebel, 2009; Ostrom, 1990b; Wiessner, 2019).

I outline one common locally adaptive institution many pastoralist groups develop to both to adjudicate within-group conflicts and mobilize persons for collective action, especially group defense. Pastoralists in east Africa face unique challenges: they are often acephalous and decentralized, lacking formal leadership structures, written and fixed laws, and explicit mechanisms to resolve disputes; yet they possess wealth in the form of herds of livestock which form the basis of many economic and social exchanges including marriage (Dyson-Hudson, 1966; Leslie and Little, 1999). Thus, the conditions are ripe for conflicts and disputes within the group. At the same time, due to possessing mobile wealth in the forms of herds, intergroup conflict in the form of violent cattle raids is common (Bollig, 1993; McCabe, 2010; Wild et al., 2018). The persistent threat of raids gives rise to the need to defend against them by being able to mobilize defenders and create a credible threat of deterrence through counter-attack.

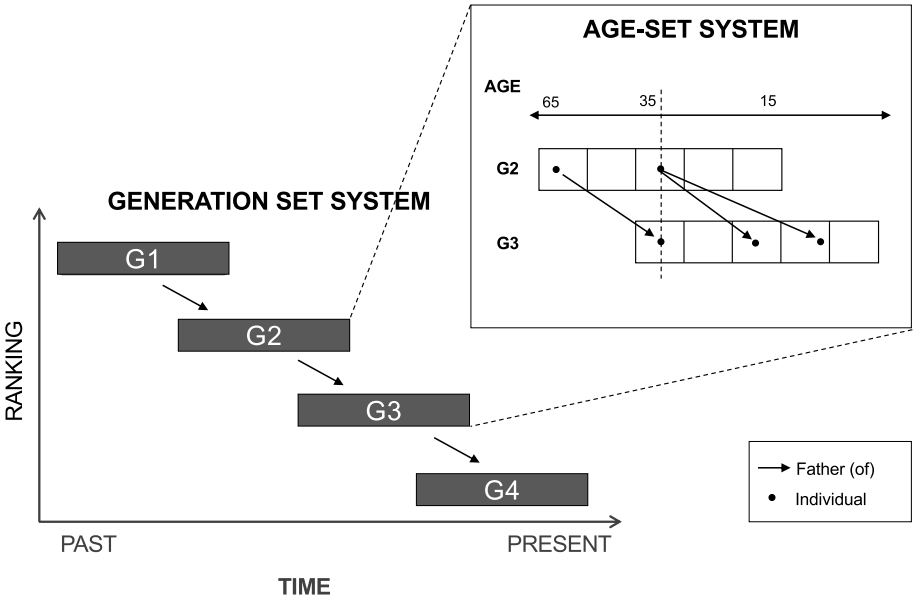

Fig. 2. Model of traditional age system for Nyangatom pastoralists.
Caption: All men belong to the generation following their father's generation. They also belong to an age set composed of members of the same generation, which is nested within a generation and determined by one's age. Age set membership is usually accompanied by an initiation and may occur every 7–20 years on average depending on the society. Women also frequently participate in their own age set system but these are one of the most understudied aspects of pastoralist cultural systems.

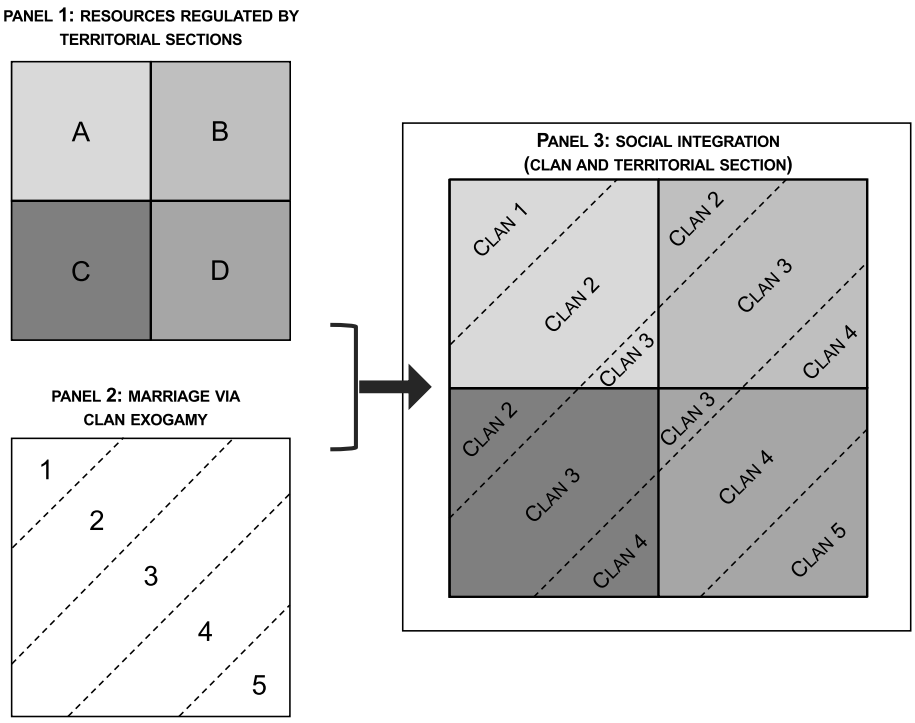

Fig. 3. Social integration via cross-cutting ties for a pastoralist group.
Caption: This is a simplistic model of how many east African pastoralist groups achieve social integration, where individual have access to resources based on membership in any of multiple territorial sections (Panel 1). Individuals often also belong to a clan and marriage is usually outside the clan (Panel 2). In Nyangatom there are at least 7 territorial sections and 20 clans creating many potential combinations for social integration (Panel 3).

Many pastoralist societies have solved these dual problems with age institutions known as generation and age sets or age grades (Foner and Kertzer, 1978; Kurimoto and Simonse, 1998; Müller-Dempf, 1989). While these are most elaborately developed among East African pastoralists, many societies globally have less developed age-based or gerontocratic institutions with important roles in conflict resolution (Bernardi, 1985). I discuss one specific example of among the Nyangatom of southwest Ethiopia but the structure is similar to many groups across Kenya, South Sudan, and Ethiopia (Kurimoto and Simonse, 1998).

All Nyangatom men belong to one of several chronologically rank ordered generations (Tornay, 1998, 1981) (See Fig. 2). The generation a person belongs to is not determined by their age but rather they belong to the generation following their father. Thus, generations consist of individuals with a wide range of ages and can sometimes span 150 years. At any time, one of the senior generations is known as "Fathers of the Country". This generation is recognized as having broad advisory authority of matters that affect society as a whole, including the group's response to intergroup conflict or internal disputes resulting from theft or adultery. This generation is also involved in resolving disputes that threaten the viability of the society (Glowacki and von Rueden, 2015). The following generation is known as "Sons of the Country". This generation wields political and military might in carrying out collective defense and offense after consultation with the Fathers of the Country.

Generations are further subdivided into ranked and ordered age sets (sometimes known as age grades). Ages sets are composed of members of the same generation around the same age and usually span around 7 years though this range can vary enormously between societies. Members of the older age sets command greater respect and authority than members of a younger age set within the same generation. Particular age sets may be tasked with carrying out aspects of ritual and ceremonies, but importantly all age sets are tasked with the collective regulation of the behavior of other members of their age set. Thus, many norms are regulated by the age set and violations sanctioned by one's peers of the same age set (Mathew and Boyd, 2011).

Thus this type of age organization forms an interlocking set of institutions along two axes, one based on age and another on the status of a person's father both conferring certain rights and responsibilities (See Fig. 2). Together they solve two important dual challenges every society much solve: resolving internal conflicts and mobilizing persons for collective action. There is reliable evidence that similar age systems proliferated across east Africa through cultural group selection in which groups copied the traits of other groups either through observation or through incorporation during warfare (Lamphear, 1993, 1988; Müller-Dempf, 2009), although cultural group selection is unlikely to be able to account for the development of similarly structured age organization in diverse regions across the globe including east Africa and North and South America.

4.2. *Social integration: managing resources and finding mates*

Human societies everywhere face the challenge of managing limited resources to ensure access in the present and future. We also have the challenge of achieving social integration through developing ties through persons we may be distantly or unrelated to. Many societies solve both these problems through the development of social classes that dictate behavior based on belonging to one of several social categories (often termed *corporate groups*). The development of social categories does two things: First it can prescribe and proscribe certain behaviors on the basis of membership in a given category. For example, in the contemporary United States, consider the social category of being a resident of the District of Columbia. Those residents with income above a certain threshold are required to pay income taxes; thus their behavior is prescribed by membership in this social category. At the same time, they are prohibited from voting in congressional elections; thus their behavior proscribed by membership in this social category.

Not only does our membership in social categories allow rules and behaviors to be prescribed or proscribed on the basis of that membership, membership in and of itself can be efficacious and motivating. Our capacity to belong to social categories and derive shared meaning from them is a unique human experience termed *social identity* (Drury and Reicher, 2000; Ellemers et al., 2002; Smaldino, 2019). Although the mechanism is unclear, empirical evidence demonstrates that shared social identity leads to great cooperation, possibly through hijacking biases towards treating others as kin (Alnabulsi et al., 2018; Drury and Reicher, 2000; Smaldino, 2019). Not surprisingly then, many societies develop institutions that both regulate access to resources and create

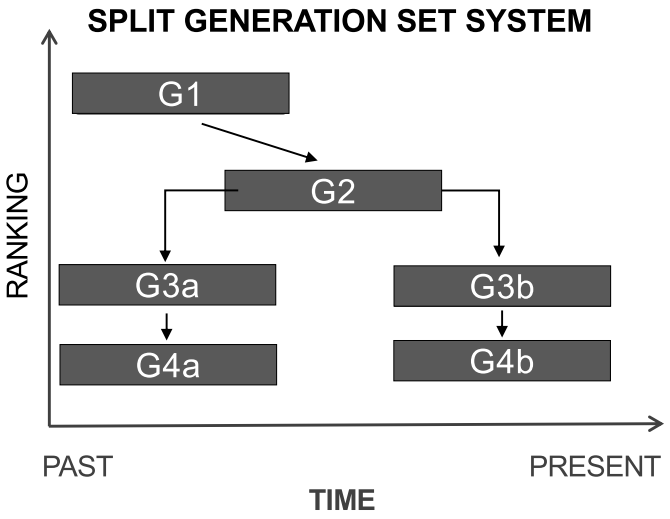

Fig. 4. Model of a split generation system.
Caption: Sometimes generations come into conflict with each other and may split into competing lines. In such cases, the rights and responsibilities of each generation may be curtailed due to power sharing. The Toposa of South Sudan are a well-known instance of generational splitting.

social integration (sense of shared identity) through "cross-cutting" social categories (Voorhees et al., 2020). Such categories are not hierarchal but rather section societies into groups creating social integration among persons that may not be related to each other or seldom interact. For example, in the contemporary United States, state residence (e.g., Connecticut, Maryland Massachusetts) cuts across the larger nation and membership of the United States through cross-cutting and non-hierarchical divisions (no state is ranked above any other state). Most human societies form social categories that cut across their society and form the basis for many social exchanges.

Like all human societies including hunter-gatherers, pastoralists need mechanisms to regulate access to resources (Dyson-Hudson and Smith, 1978; Guenther, 1981; Renom et al., 2020; Thomas et al., 2015). In some cases they are able to do so through simple heuristics such as those governing movement (Moritz et al., 2015, 2013) but in other cases institutions regulating access are required (Moritz et al., 2018; Riches, 1995). Often these institutions rely on membership in social categories and among East African pastoralists these frequently take the form of *territorial sections*, which are categories one belongs to by birth or residence. For example, among the Nyangatom of Ethiopia, persons belong to one of 7 sections. Each section confers nominal rights of access to resources in a particular area, including access to water, horticultural and grazing land (See Fig. 3, Panel 1) (Glowacki and von Rueden, 2015; Tornay, 1981, p. 198). Persons inherit the territorial section of their fathers, though they can move to an area in another territorial section if they have sufficient need through discussions with current residents. If they do move to another section, they themselves do not take on the identity of the new section despite living in it, but any children who are born there become members of that territorial section. Although persons may access the resources of another section, in times of extreme shortage, priority of access is granted to members and residents of that section. Thus, generally territorial sections serve as nominal social categories serving to create social integration more than regulating access to resources. It is only when resources are stressed do they fulfill their ostensible social function—restricting access to resources to members of that section.

Many human societies have social categories not based on residence or resources but shared descent. *Clans* are groups based on common descent from a supposed biological or spiritual ancestor such as a special plant or animal. Descent is often nominal as in many cases persons are not able to identify specific genealogical relationships between other clan members but rather clans often function to group several lineages (Miller, 2013). Clans cut across society so that all members of a society belong to a clan and it is frequently a defining feature of group membership (See Fig. 3, Panel 2). Clan membership is often a key consideration in marriage with many societies restricting potential marriage partners to those with a differing clan membership.

Among the Nyangatom, all persons belong to one of 20 clans inherited from their father and marriage is typically outside of their clan (Glowacki, 2015; Tornay, 1981). In some east African societies such as the Turkana, clans are the most important social institution regulating laws, customs and norms for a broad swath of behavior (Barrett, 1997). For the Nyagnatom, women's dress indicates their clan membership while men will often mark their livestock through brands indicating their clan such that the term for clan and brand are sometimes used interchangeably.

Thus, clans, just as territorial sections, create ties between distantly and unrelated people through membership in socially defined category. It is membership in these social categories (territorial section and clan) that defines one as Nyangatom giving one a recognized social identity and integrating society. For Nyangatom with 20 clans and 7 territorial sections there are 140 possible social categories one can belong to on the bases of these alone creating an enormous opportunity for social integration (see Fig. 3, Panel 3).

4.3. Institutional change

But in neither of these examples are institutions static. Age grades evolve as generational pressures increase, sometimes splitting into competing generation sets or corporate age sets developing into localized age groups. While at the same time, clans go extinct, or new clans emerge as groups are incorporated into society just as new states or countries may come into existence.

Institutions change over time, especially in response to exogenous pressures and they are sometimes discarded. The mechanisms that give rise to institutions—selective imitation, self-interested design, cultural group selection—also affect the nature of the change. Change usually operates on the structures and norms already in place through incremental modification, adopting new behaviors and discarding those no longer useful (or at least those that are not sustained with selective enforcement). Locally adaptive institutions may be particular resilient and persistent through their role in solving challenges necessary for sociality (Folke, 2006). When existing institutions are no longer able to meet the challenges they are designed for, they may be discarded and replaced with new structures that do meet these needs.

Consider the age organization structures described above with an alternating series of ranked and ordered generations subdivided into nested ranked and ordered age sets. This structure confers wide-spread decision-making authority on one generation at a time—the Fathers of the Country. The norms of the institution dictate that at some point as the number of members in the Fathers of the Country generation diminishes, they cede authority to the Sons of the Country, who then become Fathers. But what happens if the Fathers do not cede their position resulting in a tension with the Sons who want to assume authority? In such cases, the generation of Sons may breakaway and assert power for themselves giving rise to dual lines of generations with modified rights or circumscribed authority as happened with the Toposa of South Sudan. Thus the centrality of the structure is intact but the form is different with dual generational lines with modified rights reflecting this internal dispute (see Figure 4) (Müller-Dempf, 2017, 1989) .[2]

As a population increases in size, it may become difficult to form and

[2] Among some groups, there are some groups with more than two generational within a single system. For example, according to Müller-Dempf (2017) the Daasanach have three generational lines and Oromo has five but whether these developed from within-group conflicts is unknown.

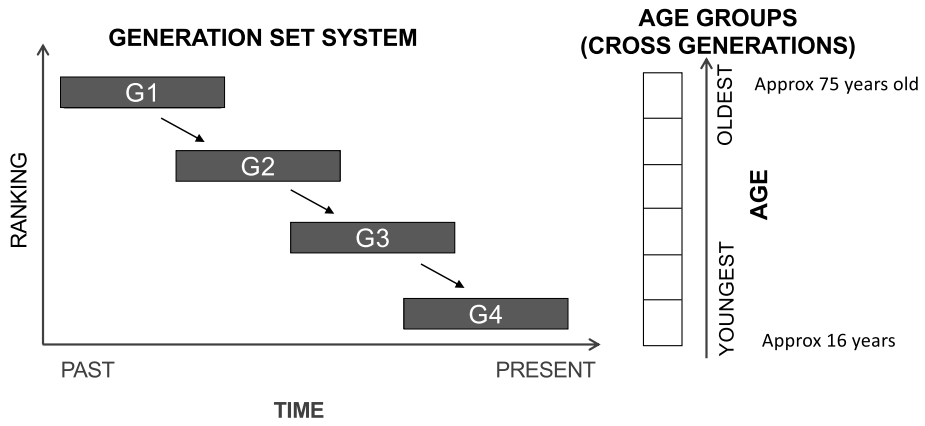

Fig. 5. Developing age system for Nyangatom.
Caption: The rapid population expansion of Nyangatom has created difficulties maintaining society wide (corporate) age-sets. Thus, Nyangatom are presently abandoning age-sets. The importance of age groups, which are based locally and cross-generations is increasing coming to slowly replace age sets among the youth.

maintain the cohesive ties and integration necessary for sodalities such as age-sets which are tasked with managing the behavior of its members, enforcing norms, and certain ritual functions. This has been the case in Nyangatom which has had a five-fold population increase in the past fifty years from approximately 5000 persons (Tornay, 1981) to more than 25,000 (Wild et al., 2019) creating challenges of maintaining cohesive age structure. Nyangatom age organization has responded by slowly abandoning rank ordered age sets *nested within* generation sets and replacing them with local age groups that are orthogonal to generation sets (Fig. 5). Many of the younger Nyangatom today, recognize themselves as being members of a generation set and a local age-group that can include members from multiple generations and not members of an age set. Age-groups are *trans*-generational including persons of similar ages but from multiple generations and are primarily based on local residence and social relationships and thus not pan-ethnic (applying across the entire group) unlike age-sets.

The point with these examples is to illustrate that institutions are not static but respond to changing pressures through the same processes that gave rise to them. When they are no longer functional and not maintained through enforcement, they are likely to be discarded and replaced with alternative institutions. However, little is known about the process by which institutions come to be replaced by alternative or novel institutions (Mccabe et al., 2020).

5. Discussion

Local adaptive institutions around the world are remarkably similar, reflecting their development in response to similiar challenges with similar design processes. Yet in contemporary industrial societies there has been a dramatic replacement of decentralized, bottom-up institutions with top-down engineered institutions reflecting not only local solutions to adaptive challenges but social and moral agendas. For example, the importance of kinship institutions once arguably the most important institution for human societies has been slowly degraded and replaced with religious and then civic and state institutions (Henrich, 2020; Schulz et al., 2019). The 21st century is likely to see the loss of decentralized kin and physical community-based institutions continue.

Self-interested design and selective imitation coupled with cultural group selection provides a framework to predict future locally adaptive institutional design. Future institutions, just as for past and present institutions, will continue to be shaped by many factors, including persons selecting behaviors and norms on the basis of their anticipated outcomes. This process will continue to give rise to adaptive institutions. However, the nature of human interactions in the 21st century and going forward is likely to be different than those that have characterized most human societies thus far yielding several considerations.

Much of our social lives are now spent online in networks with repeated interactions organized around a single theme, such as a vocation or an interest. These online communities resemble the shared-living spaces of smaller human communities in some important features but without being constrained by the geographic or demographic similarity of their members. Thus, these are opportunities for new institutions to develop through the processes that give rise to real-world institutions, such as selective imitation and self-interested design. Many of these institutions will likely possess features that are useful to regulating any human society coopting similar design features such as peer monitoring and sanctioning, structures to moderate conflicts or content, or explicit institutions to prevent hierarchical structures from developing (as in a virtual egalitarian complex), and reputational mechanisms. However, the nature of the online forum whether one-shot, iterated, transactional or other type of social interactions, will likely alter the resulting institutional structure. The spread of prohibitions against anonymous and pseudonymous online accounts such as Facebooks' requiring of real names is an example norms aimed at promoting prosocial behavior, at least in part through reputational mechanisms. Similarly, in the physical world, the automated monitoring and of social behavior through social credit systems are expanding, most notoriously through China's adoption of a state-level social credit system (Kostka, 2019). However, the nature of the online form whether oriented towards one-shot, iterated, transactional or social interactions, likely will alter the resulting institutional structure.

At the same time, telecommunications enable the rapid dissemination of information about institutions, fueling the possibility of sudden shifts in behavior through cultural evolutionary processes. Norms may be adopted for their efficacy in achieving some selected outcomes but also transmission may be biased due to context biases (such as the perceived status, prestige, or some other marker of the cultural model). For example, the methods used early in the Arab Spring protests were copied both throughout Arab countries that experienced protests but later were used in part in other protests movements such as Occupy Wall Street and the Hong Kong protests of 2020. The rapid dissemination of information enables cultural transmission of institutional norms at unprecedented rates bypassing much of the trial and error approach that has historically been involved institutional development.

Although kinship institutions are of little importance in contemporary industrial societies and civic institutions continuing to decline (Putnam, 2000), urban communities are demonstrating renewed interest in creating structures mimicking aspects of traditional social institutions in creating forums for social integration although they may be oriented around commercial elements. In particular, many urban development projects are constructed around creating opportunities to achieve social mixing through shared use of a common space. This

includes now common forums such as local farmers markets and food truck plazas, which are arguably about more than commercial transactions. But it also includes pop up stands, flash mobs, as well as open and accessible public spaces such as libraries, pedestrian plazas, and green-spaces. While these are not institutions per se, they appear designed to fulfill some aspects of locally adaptive institutions—namely mechanisms to connect individuals by developing a sense of community.

The structure of the institutions we develop in the future may vary from those historically found in many traditional societies, but they will solve the same essential functions in helping us deal with challenges caused by the ecological and social environment. Yet their rate of change may be unprecedented due to the speed at which information can travel allowing for rapid adoption and discarding as circumstances and needs change.

Conflicts of interest

I have no conflicts of interests pertaining to publication of this paper.

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