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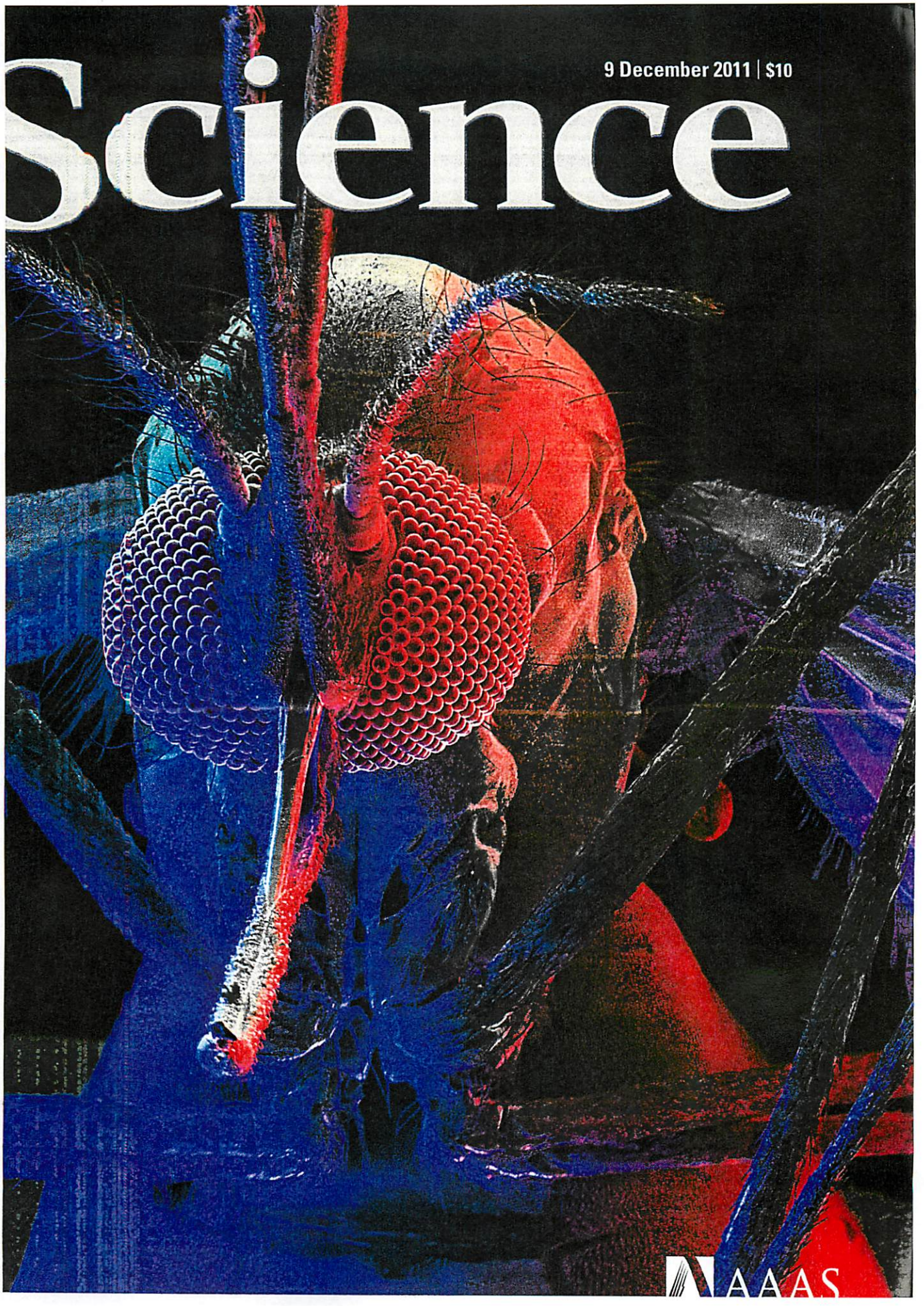

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Context Modularity of Human Altruism

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Whereas altruism drives the evolution of human cooperation, ethno-religious diversity has been considered to obstruct it, leading to poverty, corruption, and war. We argue that current research has failed to properly account for the institutional environment and how it affects the role diversity plays. The emergence of thriving, diverse communities throughout human history suggests that diversity does not always lead to cooperation breakdown. We conducted experiments in Mostar, Bosnia-Herzegovina with Catholic Croats and Muslim Bosniaks at a critical historic moment in the city's postwar history. Using a public goods game, we found that the ability to sanction is key to achieving cooperation in ethno-religiously diverse groups, but that sanctions succeed only in integrated institutional environments and fail in segregated ones. Hence, we show experimentally for the first time in a real-life setting that institutions of integration can unleash human altruism and restore cooperation in the presence of diversity.

Early experimental work on the foundations of human cooperation focused on reciprocal altruism, according to which, individuals reward others as long as they get rewarded in return. Such work sought to explain cooperation through mechanisms based purely on self-interest (*1*); however, a series of more recent experiments has shown that individuals appear to have authentically prosocial preferences that drive cooperation in ways not consistent with rationalist explanations. Fehr and his colleagues found evidence of "strong reciprocity" in economic experiments, which is defined to include a combination of (i) altruistic rewarding as a predisposition to reward others for cooperative, norm-abiding behaviors and (ii) altruistic punishment as a predisposition to impose sanctions on those who violate norms (*2*, *3*). These findings have been strengthened by neurophysiological evidence suggesting that some individuals appear to derive pleasure from the costly prosocial action of sanctioning those who violate norms of cooperation (*4*) and some preliminary evidence that altruistic motivations observed in the laboratory also play a role in real-world economic decisions (*5*).

However, despite the growing evidence on the importance of sanctions and reciprocal altruism in driving cooperation, a key question that remains unresolved is how these mechanisms vary across different environments. In particular, although altruism may drive cooperation (*6*, *7*), ethnoreligious differences may undermine it as poverty, corruption, and war emerge (*8*–*10*). We therefore investigated how different structural contexts affect the expression levels of human altruism and did so by asking: (i) Do contexts of greater ethnoreligious diversity inhibit human altruism? and (ii) Can environments that promote integration or segregation differentially activate human altruism, either in general or by influencing the effect of diversity on the expression of altruism? To answer these questions, we measured the expression of altruism in public goods game experiments with costly punishment.

An innovative combination of experimental and field methods enabled us to make a new contribution to the existing debate. In essence, we brought a controlled experiment to a relevant field setting. The specific historical circumstances of Bosnia-Herzegovina's postconflict state-building experience enabled us to study how the exogenously imposed introduction of real-life institutions interacts with ethnic diversity to affect contribution to public goods. Specifically, reintegration of the ethnically divided city of Mostar offers opportunities to study how the introduction of institutions of integration can affect cooperation in the form of contributing to public goods or the willingness to use costly sanctions against norm-defiers. One aspect of this institutional change has been the partial integration of the secondary school system: Two of the four segregated high schools—one is Catholic Croat, and one is Muslim Bosniak—were integrated, leaving two segregated schools. Because of the assignment mechanism, which determined whether and where integration would occur, there was no possibility of self-selection into either segregated or integrated schools, leaving the allocation of students to an integrated or segregated student environment up to chance. This allowed us to implement a field experiment, bringing an n-person public goods game into a field setting and examining the direct effect of exogenously imposed institutions and the experimentally manipulated availability of sanctions on the willingness to contribute to public goods. Although social scientists give institutions an increasingly explanatory role in a variety of theories, we are not aware of any experimental studies that have been able to test the direct effects of institutions on public goods provision in a real-world context.

In the public goods game, all players (four in each round, in this case) decide simultaneously on the contribution they want to make to the common good. The contribution of a player i to the public good is given by $g_i \in [0, y_i]$, where y_i is the starting endowment of player i and therefore the maximum possible contribution. In each round, the endowment y_i made available to each player is reset to the same level. The contributions of all four players in each round of the game are summed up, the sum increases by 20%, and the public good is equally divided among the four players, regardless of their contribution. The dominant strategy for a purely selfish player is to contribute nothing to the public good. The result is a formal version of the well-known collective action problem of free-riding. In contrast, the aggregate welfare of the group is maximized when each agent contributes their entire endowment. A standard way to measure altruism in these games has been to introduce costly sanctions in the second stage, in which players receive information

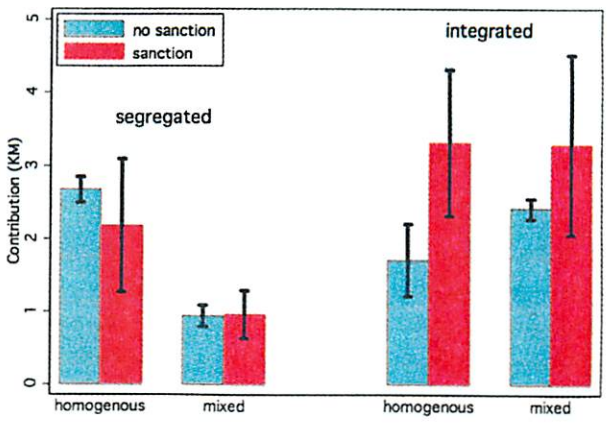

Fig. 1. The effect of institutions of integration, sanctions, and ethnic diversity on contribution to public goods. The experiment exploits prior arbitrary assignment of subjects to two institutional contexts in the divided city of Mostar in Bosnia-Herzegovina. We observed that (i) ethnoreligious diversity damages cooperation among students from segregated schools, but this effect is apparently overcome by institutions of integration; (ii) integration increases contributions, but primarily when sanctions are available; and (iii) the availability of sanctions is effective in generating cooperation, but only under institutions of integration. Displayed are mean contributions by experimental treatment condition, and SEs clustered by session (see SOM text and tables S2 to S4 for further details, including tests of statistical significance).

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on each others' contribution and then decide to impose sanctions on other players. The personal cost undertaken by the punisher ensures that sanctions are credible and helps elicit the extent of the player's altruism: The more of her endowment she spends to encourage group-wide contributions, the higher her altruism as defined and measured by this methodology.

Our experiment was performed over 26 sessions with 8 to 24 students participating in each session. Students were assigned to one and only one session. They played the public goods game described above in anonymously matched groups of four (with the identities of the group members withheld, except for information about ethnicity). They were then randomly rematched into new groups of four to play the game again. The first five rounds were used for practice, followed by 20 rounds during the session. Three manipulations varied between sessions: Players were either in homogenous (mono-ethnic) or mixed groups for all rounds; were permitted to use sanctions or were not permitted to use sanctions for all rounds; and were drawn from either the integrated school or from the two segregated ones. Thus, we performed a 2-by-2-by-2 factorial design, with each session falling into one of eight possible conditions.

Our experimental design allowed us to test the following core hypotheses. First, we predicted that increasing group diversity would reduce cooperation, as measured by the average amount contributed to the public good. We expected this relationship to be stronger in a postconflict society because the literature discussed above suggests that conflict hardens ethnic identity affiliations. Second, when institutions of integration are present, they will increase the participants' propensity to contribute to the public good. To test these hypotheses, we used regression with robust SEs clustered at the session level so as to conservatively account for possible within-subject or within-trial correlations. Also, to reduce SEs and control for any finite-sample differences in background characteristics across treatment conditions (despite the random or as-good-as random assignment of all the treatments) [supporting online material (SOM) text and table S1], we included information about parental income, math test scores, parental worship frequency, and ethnicity in the regressions. None of these variables is likely to be affected by the treatments themselves (SOM text), so their inclusion does not introduce posttreatment bias.

Testing the first hypothesis, we found that heterogeneity has a significant but conditional effect on contributions. Among participants from segregated institutions, group heterogeneity reduces contributions, measured in the local Bosnian currency (KM), by 1.46 KM (SE = 0.43, P = 0.005). Institutions of integration, however, erased this effect: In the integrated subsample, group heterogeneity is associated with a nonsignificant change in contributions (0.46 KM, SE = 0.89, P = 0.62). In short, group heterogeneity among the players interacting in any given round leads to decreased contributions as hypothesized, but only among students from the segregated schools. Institutional integration, in this case at least, overcomes the damaging effects of diversity on cooperation (table S2).

On the second hypothesis, we found that integration leads to an increase in individual contributions by a per-round average of 1.21 KM (SE = 0.56, P = 0.04). More interestingly, this average effect is again conditional: It is generated entirely within the subsample of sessions in which sanctions were available. Integration increases individual contributions by an average of 2.25 KM (SE = 0.92) per round when sanctioning is available but has almost no effect when sanctions are not available, increasing contributions nonsignificantly by 0.21 KM (SE = 0.47). That is, for institutions to be effective in reducing the adverse effects of diversity, sanctions must be available (table S3).

We found a corresponding result regarding the effect of sanctions on contributions. The availability of sanctions matters significantly within the integrated group, increasing per-round individual contributions by 1.78 KM (SE = 0.83, P = 0.055). In contrast, there is no significant effect of the availability of sanctions among the segregated group (−0.36 KM, SE = 0.58, P = 0.55). Again, this suggests that the availability of sanctions is key to increasing contributions but is only effective in doing so among integrated groups (table S4).

The main results of institutions on sanctions' effectiveness are illustrated in Fig. 1. Our experiment demonstrates that sanctions have a very different effect depending on the institutions within which they operate. In the presence of institutions of integration, the availability of costly sanctions has a large, substantive effect. However, when our subjects were drawn from an institutional environment of segregation, the availability of sanctions had no substantive effect on contribution to public goods. We also found that institutions are associated with the marginal effects of diversity: Diversity reduces contributions to public goods as expected, but only when students come from segregated institutions. In contrast, when institutions of integration are present, the difference between homogenous and heterogenous groups' contributions to public goods declines, as demonstrated in Fig. 1.

One consequence of our empirical findings is that the observed effect of institutions appears to require the availability of sanctions in order to be effective, suggesting the need for further research in order to better understand the underlying mechanism behind the institutional effect we uncovered. Under segregated institutions, we found that group heterogeneity has a weakly significant (but causally identified) effect of decreasing average sanctions by roughly 0.50 KM (P = 0.076) (table S5). Consistent with recent research on the norms underlying "antisocial punishment" by Herrmann *et al.* (2008) (*11*), we found that the degree of sanctioning is proportional to the discrepancy in contributions made by the player exacting the sanction and the player on the receiving end, but this relationship depends on the institutional environment. Sanctioning is the highest in response to players who contribute less than the punisher but only under institutions of integration in which each KM less that a sanctionee gives relative to a sanctioner is associated with a 0.052-KM-per-round increase in sanction size (P = 0.048) (table S5). This effect of contribution discrepancy is not causally identified here because only the availability of sanctions (and not their actual use) was randomly assigned. Nevertheless, this evidence is consistent with a mechanism in which institutions of integration lead players to sanction those who under-contribute when playing with mixed groups, potentially driving up contributions in the long run.

In all, our results confirm the previously reported evidence that the average effect of the availability of costly sanctions is to increase contribution to public goods and that ethnic diversity lowers public goods contribution. However, our results show that the institutional context plays a key role in three ways: (i) On average, institutions of integration significantly increase contribution to public goods; (ii) the institutional context conditions the role of sanctions—the availability of sanctions within institutions of integration drives up contributions significantly, whereas the availability of sanctions appears to have no such power under institutions of segregation; and (iii) institutions of integration also modify the role of ethnic diversity on contributions—the diversity of groups causes significantly lower contributions only in the case of segregation.

The results reported here can have substantial effects on how we think about cooperation and public goods contribution in modern human societies, which are increasingly diverse and characterized by a multitude of ethnic identities and religions. The question of public goods contribution is currently central to the understanding of development and the quality of governance in divided societies. Recent experiments in the Kampala slum areas of Uganda found that the strength of group networks—which grants co-ethnics the ability to use social sanctions among each other as punishment for failure to contribute to community projects—is a better predictor than primordial understandings of co-ethnic preferences (*12*). Other experiments with indigenous tribes of Papua New Guinea identified that ethnic homogeneity can hurt in-group cooperation because threats of sanctioning are not credible because of an extremely high sense of intra-group kinship (*13*). Observational evidence from Kenyan primary schools suggests that the inability to impose social sanctions across ethnic groups explains low contributions to local public goods provisions, assuming that social sanctions are strong within ethnic groups but very weak across ethnic groups (*14*). Other observational research has found that societies can sort into

ethnically homogenous communities so as to avoid costs resulting from heterogeneity (*15*), and that heterogeneity of preferences among groups can promote lower contributions toward public goods on the level of entire countries (*16*). In addition, differences in returns to public goods can determine the interaction between ethnic diversity and the collective action necessary in order to bring about economic cooperation (*17*).

Our experimental findings thus replicate previous findings on the importance of the ability to sanction as a strong determinant of levels of public goods contribution. Our results enhance these previous findings by highlighting the need to focus on institutional contexts and by underlining the way that institutions condition both the role of ethnic diversity and the role of sanctions in public goods contribution. Although in the real world diversity is often associated with the danger of conflict, making economic and social cooperation difficult to achieve, our work suggests that institutions may play an important role in creating environments in which diversity can be bridged and sanctions can be implemented in order to promote well-ordered societies and better-functioning markets.

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Supporting Online Material

www.sciencemag.org/cgi/content/full/334/6061/1392/DC1
SOM Text
Fig. S1
Tables S1 to S5
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Capacity Building Helps Pastoral Women Transform Impoverished Communities in Ethiopia

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Poverty, drought, and hunger devastate people on Africa's rangelands. We used an action-oriented approach from 2000 to 2004 to build capacity among thousands of pastoralists to diversify livelihoods, improve living standards, and enhance livestock marketing. The process included collective action, microfinance, and participatory education. Poor women previously burdened by domestic chores became leaders and rapidly changed their communities. Drought occurred from 2005 to 2008. We assessed intervention effects on household drought resilience with a quasiexperimental format that incorporated survey-based comparisons of treatment groups with ex post controls. Interventions led to major improvements in trends for quality of life, wealth accumulation, hunger reduction, and risk management. Human capacity building can be a driver for change, generating hope and aspirations that set the stage for the use of new information and technology.

Historically, African pastoral societies had low densities of people, large livestock herds, and access to vast grazing lands. This allowed for subsistence food production (e.g., milk and meat), accumulation of animal wealth, and sustainable use of natural resources. Unfortunately, this situation has changed (*1*, *2*). Pastoralists today are often poverty stricken and beset by hunger. Efforts to "develop" pastoralism have had little success (*3*–*5*). Human population growth, overgrazing, annexation of key resources by outside entities, physical insecurity, and underinvestment in pastoral areas contribute to declining per capita food production, reduced vegetation cover, increased soil erosion, loss of herd mobility, and more marginalized people. Multiyear droughts pose grave threats to pastoralists because crop failures and massive death losses of animals escalate into crises for food availability, income generation, and asset preservation. Technical options to increase food production or lessen pressure on natural resources remain elusive, largely because of environmental and social constraints. Alternatively, nontechnical options focused on human capacity building could have positive effects through livelihood diversification that improve risk management (*2*). Diversification could emphasize more involvement in commercial livestock production and nonlivestock microenterprises to balance traditional livestock production. This could help communities become more resilient when coping with drought (*6*).

Once considered a prime example of sustainable pastoralism in eastern Africa, the Borana pastoral system of semiarid southern Ethiopia (Fig. 1) exemplifies the changes noted above. The people have become poorer and more vulnerable due to population growth and lack of development investment, a trend exacerbated by impacts from multiyear droughts in 1983–1985, 1991–1993, 1998–1999, and 2005–2008. Each drought resulted in the deaths of about half of all livestock, losses having a cumulative value in the hundreds of millions of U.S. dollars (*7*). More details concerning the people and system dynamics are given in (*8*) (study area). The main objective of this research was to determine whether pastoral livelihoods on the Borana Plateau could indeed be diversified in a sustainable fashion to lessen or reverse the downward spiral at the household level.

Starting in 2000, we used an action-oriented, participatory approach to engage the pastoral community to refine problem diagnosis, chart pathways for change, and identify and implement interventions. This integrated the ideas, skills, and resources of numerous partners (i.e., pastoralists, researchers, development practitioners, educators, and donors). The process is described in (*8*) (treatment background). In short, the acute need for livelihood diversification was confirmed, a problem that required capacity building. Stepwise capacity-building interventions were undertaken (Fig. 2), including: (i) inspiring the Ethiopians to improve their circumstances by exposure to problem-solving methods and linking them to forward-thinking, successful peers in northern

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