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Second-order ethnic diversity: The spatial pattern of diversity, competition and cooperation in Africa

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ABSTRACT

Ethnic diversity has been linked to important social outcomes such as economic underperformance and civil war, yet its study is still hampered by conceptual difficulties and imprecise measurement. In this paper, a modified understanding of ethnic diversity is developed. Ethnic diversity is disaggregated into two components—first- and second-order ethnic diversity—which have opposing consequences for collective outcomes. While first-order ethnic diversity—the diversity of a local community—is theorized to undermine cooperation, second-order ethnic diversity—the ethnic diversity of the *hinterland* of a community—is theorized to induce ethnic competition, thereby reinforcing cooperation. Relating data from over 100,000 individuals interviewed at 2,942 locations in 33 African countries to novel subnational indicators of first- and second-order ethno-linguistic diversity, the theory is tested and its basic tenets confirmed. In a next step, I show that it is indeed ethnic competition that accounts for the positive association between second-order diversity and increased cooperation: second-order ethnic diversity is a much better predictor of cooperation in regions where contemporary or historical factors have exacerbated interethnic tensions. The paper sheds new light on the debate on the consequences of ethnic diversity for cooperation and contributes to our understanding of the origins of the global 'geography of social capital'.

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Introduction

Ethnic diversity has been linked to a wide range of—mostly negative—outcomes, from economic underperformance to patronage politics and civil war (Arriola, 2009; Easterly & Levine, 1997; Sambanis, 2001), and more generally is seen as undermining cooperation and the provision of public goods (Alesina, Baqir, & Easterly, 1999; Habyarimana, Humphreys, Posner, & Weinstein, 2009). While clearly of great importance, the study of the consequences of ethnic diversity is still hampered by conceptual difficulties and imprecise measurement, however. This paper develops a revised understanding of the concept, distinguishing between local, first-order ethnic diversity and second-order ethnic diversity, the diversity of the *hinterland*. First-order ethnic diversity is the diversity of a local community—how many different groups live together and interact in one place. Through various mechanisms, first-order or local ethnic diversity *undermines* community cooperation (Habyarimana et al., 2009). Second-order ethnic diversity is the ethnic diversity of the *hinterland*—how many different groups settle in the surroundings of a given community. In sharp contrast to first-order ethnic diversity, second-order ethnic diversity can *strengthen* community cooperation. This is because second-order diversity induces ethnic competition. Ethnic competition, in turn, has been linked to increased levels of mobilization and cooperation in historical and contemporary cases (Enos, 2016; Olzak, 1992), and is deemed particularly important in the African context (Bates, 1983). The distinction between first- and second-order ethnic diversity thus helps to make sense of the persistent contradictions that have riddled the scholarship on diversity, cooperation and public goods provision. It can also help us to shed light on the intriguing differences in the supply of social capital between and within different regions of the world.

The theory is tested by relating data on social and political engagement from over 100,000 individuals interviewed at 2,942 locations in 33 countries in Africa to novel subnational indicators of first- and second-order ethnic diversity. In line with previous research, I show that first-order ethnic diversity consistently has a negative impact on cooperation. Effect sizes are substantial and comparable to those found by other scholars (Miguel & Gugerty,

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2005). Moving from full homogeneity to full heterogeneity is associated with a 14% drop in cooperation levels. At the same time, local cooperation rises as second-order ethnic diversity increases. Moving from ethnically homogenous surroundings to fully heterogenous surroundings is associated with a 28% upsurge in cooperative behavior. At the aggregate level, the cooperation-inducing effect of second-order ethnic diversity thus overcompensates the negative effects of first-order ethnic diversity, leading to an overall positive relationship between ethnic diversity and cooperation on the African continent. These findings are robust to an extensive set of controls and fixed effects, and an instrumental variable strategy suggests causality.

In a second step, I present evidence showing that it is indeed ethnic competition that accounts for the positive association between second-order ethnic diversity and increased cooperation. Second-order ethnic diversity goes along with higher levels of cooperation where contemporary geographic and political factors identified to raise levels of interethnic competition are present: in urbanised areas, where ethnic and administrative boundaries coincide and where government is dominated by a single group (and thus faces many challengers). Since these factors may suffer from endogeneity bias, in a further step I turn to history to identify factors that are linked to competition but are also plausibly orthogonal to cooperation dynamics. I present three tests. First, inspired by research on the political salience of externally determined borders, I demonstrate that ethnic diversity that is attributable to ethnic groups being separated by colonial borders has a weaker effect on cooperation than 'genuine' ethnic diversity. Second, I examine the legacy of the *trans*-Atlantic slave trade—one of the main causes of intergroup conflict during 400 years of Africa's more recent history—on cooperation (Nunn & Wantchekon, 2011). I show that the link between second-order ethnic diversity and cooperation is stronger in regions historically more severely affected by the slave trade, despite the fact that the overall effect of the legacy of the slave trade is to undermine contemporary trust and cooperation. Finally, I show that second-order ethnic diversity has a stronger effect on cooperation where states had in the past found it hard to establish control, and where societies relied more on indigenous slavery. In tropical Africa, both phenomena are linked to the presence of the tsetse fly, which weakens or kills domesticated animals such as horses and oxen used for transport and the projection of power (Alsan, 2015; Herbst, 2000). I demonstrate that the relationship between second-order diversity and cooperation is stronger in regions hospitable for the tsetse fly.

The paper contributes to two bodies of literature. For one, I add to the literature on ethnic diversity and interethnic relations, directing attention to the effects of ethnic competition, an aspect often overlooked. For another, the paper contributes to an emerging literature that attempts to explain why certain regions tend to be more cooperative than others—the 'geography of social capital'—adding ethnic conflict and competition to the list of explanatory factors.

Diverging effects of ethnic diversity and the geography of social capital

Even a cursory review of studies on ethnic diversity and cooperation from Africa demonstrates that the field is still riddled with contradictions. A range of studies shows that regions that are ethnically heterogenous are economically and politically held back, and have a poor record in the provision and maintenance of collectively owned goods (Arriola, 2009; Easterly & Levine, 1997; Miguel & Gugerty, 2005). Other studies estimate the effect of ethnic diversity as precisely zero (Glennerster, Miguel, & Rothenberg, 2013), however, or even present evidence for a *positive* relationship between ethnic diversity and respondents' willingness to contribute to public goods (Schündeln, 2013). Comprehensive reviews of the literature are inconclusive, too. Overall, only about one-third to one-half of studies are found to demonstrate a negative relationship between ethnic diversity and measures of social cohesion, trust and cooperation (Schaeffer, 2014; Van der Meer & Tolsma, 2014).

In trying to account for the contradicting findings, scholars have pointed out that different studies use different levels of aggregation to assess levels of ethnic diversity—and often with vastly different results. One of the mentioned reviews shows that only ethnic diversity measured at the regional or sub-regional level—but not at the national level—is found by a majority of studies to reduce levels of trust and cooperation (Schaeffer, 2014). While authors have linked this finding to the 'modifiable areal unit problem' widely discussed in geography (Holt, Steel, Tranmer, & Wrigley, 1996; Openshaw & Taylor, 1979)—that the same spatial phenomenon measured at different scales of measurement does not necessarily have the same effect at all scales—it remains unclear *why* ethnic diversity should negatively impact on cooperation in some cases and not in others. The solution proposed in this paper is that ethnic diversity can have two internally consistent effects: ethnic diversity on the local level consistently works to undermine community cooperation, while ethnic diversity in surrounding areas consistently induces cooperation within groups. The net effects of ethnic diversity then depends on which partial effect dominates or whether the two effects cancel each other out.

Several theories account for why first-order or local ethnic diversity, i.e. the number and distribution of different ethnic groups that mix at one place—should undermine cooperation. A first strand of research suggests that people feel intimidated by the presence of ethnic others, they 'hunker down' and are less socially active (Putnam, 2007). Others draw on insights from the extensive research programme on the evolution of cooperation (Axelrod & Hamilton, 1981; Nowak, 2006). Multiethnic neighborhoods go along with fractured, less integrated social networks since friendship and acquaintances tend to be formed along ethnic lines (McPherson, Smith-Lovin, & Cook, 2001). In such multiethnic neighborhoods, the probability of future contact with any inhabitant is thus reduced, making cooperation motivated by future consequences of present behavior less likely than in ethnically homogenous neighborhoods. The lack of traceability through networks also complicates the use of social sanctions to enforce cooperation (Habyarimana et al., 2009). Other scholars have pointed out that ethnic diversity may go along with different groups having conflicting preferences, making it harder to cooperate in the pursuit of common goals (Kimenyi, 2006). Finally, there is some evidence that cooperation is inhibited by a lack of shared cultural 'tools' (Habyarimana et al., 2009). When lacking a common language, for instance, individuals will find it difficult to organize and act collectively.

Theories as to why second-order ethnic diversity—the extent to which the *hinterland* of a community's place of settlement is populated by members of other ethnic groups—should increase cooperation, on the other hand, usually invoke ethnic competition and threat. The idea is that by increasing—or historically having increased—the level of interethnic threat and competition, the presence of other groups nearby can induce local cooperation. This conjecture has been widely discussed in 20th-century sociology and anthropology, and the effects of outgroup presence and competition on ingroup cooperation have triggered a rich research programme in psychology and economics (Abbink, Brandts, Herrmann, & Orzen, 2010; Tajfel, 1982). In politics, a similar concept to that of outgroup competition has been explored under the heading of 'racial threat'. In a classic account, race relations were shown to

drive much of the cohesiveness of politics in the mid-20th-century American South, where White constituencies formed cohesive coalitions to exclude African Americans from politics (Key, 1949). Somewhat surprisingly, these ideas have rarely been brought to bear on the debate on the effects of ethnic diversity, however (cp. Enos, 2014 for an exception).

To see more clearly how the distinction between first- and second-order ethnic diversity may help to analyze the effects of ethnic diversity more precisely, consider the stylized example of three villages, A, B and C, depicted in Fig. 1. Villages A and B are ethnically homogenous, i.e. have a first-order diversity of zero, while village C is ethnically diverse, i.e. has a first-order diversity greater than zero. We also see that village A is surrounded by other villages inhabited by co-ethnics, while villages B and C are surrounded by villages inhabited by members of another ethnic group. For village A, second-order diversity is zero, while for both villages B and C, second-order diversity takes a high positive value.

Now imagine a researcher seeking to explain levels of cooperation with reference to ethnic diversity. Assume that, in line with the theories discussed above, first-order ethnic diversity negatively correlates with levels of cooperation, while second-order ethnic diversity positively correlates with cooperation. Not making the distinction between first- and second-order diversity, the researcher might focus on the ethnic diversity of the villages proper. The researcher could then explain the lower level of cooperation in village C in comparison to villages A and B, but could not explain the higher value in village B in comparison to village A.

Alternatively, the researcher might calculate an index for ethnic diversity at the level of the district that the villages are placed in (here indicated with dashed lines). This index would be zero for the district that village A is located in, and would take high positive values for the districts that villages B and C are located in. In this case, from a comparison between villages A and B the researcher would now have to conclude that ethnic diversity increases levels of cooperation, while a comparison between villages A and C could lead her to the opposite conclusion (assuming that the effects of first-order diversity dominate those of second-order diversity). A complete explanation therefore has to consider both the effect of first-order diversity and, conditional on this, the effect of second-order diversity. This is the approach I take in the empirical section below.

Regional variation in cooperation and social capital

Investigating how the ethnic diversity of the *hinterland* shapes cooperation also holds the potential to make inroads into what Ostrom (1998, 9) referred to as the 'really big puzzle in the social sciences…the development of a consistent theory explaining why cooperation levels vary so much and why specific configurations of situational conditions increase or decrease cooperation in first- or second-level dilemmas.' The phenomenon that communities in different regions of the world differ in their ability to solve collective action problems is well documented. In their comparative study of small-scale societies around the world, Henrich et al. (2004) show that patterns of pro-sociality varied widely between different societies. To account for these different patterns of sociability, Henrich et al. identified religion, settlement size and market exposure, and in a related study, Hruschka and Henrich (2013) link the prevalence of communitarian forms of cooperation to the absence of social security mechanisms beyond the family.

However, stark variations in the degree of cooperation have also been observed in societies showing little variation in any of these factors. The paradigmatic case is the North–South divide in Italy. Italy's northern regions boast a larger number of voluntary associations, blood donations and have a generally greater abundance of 'civic' values (Guiso, Sapienza, & Zingales, 2013; Putnam, Leonardi, & Nanetti, 1994). While these differences have been explained with reference to republican self-government (Guiso et al., 2013) and the subversive force of the Spanish rulers (Pagden, 1988), an explanation based on the experience of ubiquitous threat and conflict is also plausible. In the politically unstable environment that famously inspired Machiavelli's (2005 [1532]) *Prince*, the threat of attack was constant. Bigoni, Bortolotti, Casari, Gambetta, and Pancotto (2013) therefore argue and show that those places that had seen most conflict in the past exhibit the highest levels of cooperation in the present. Turchin (2009) makes a similar argument to explain the rise of empires throughout history. Empires would rise in such regions where extreme external threat induced people to behave cooperatively within large polities. The present study provides further empirical evidence from the African continent identifying conflict and competition as a factor that may have shaped the global 'geography of social capital' (Mohan & Mohan, 2002) similar to the spread of world religions or market exposure.

Measurement, data and model

The following section empirically tests for the impact of first- and second-order ethnic diversity on cooperation in Africa. The African continent is a natural environment for such a study due to its pronounced ethnic diversity. Continent-wide estimates are hard to come by, but especially those countries located along the equator are typically home to several dozen ethnic groups. Africa's most populous country, Nigeria, alone hosts members of over 200 distinct ethnic groups (Sklar, 2004). Cooperation here is understood as the capacity of a community to solve local collective action problems. This notion of cooperation is closely related to the concept of 'social cohesion' employed by Fearon, Humphreys, and Weinstein (2009), and also links with certain understandings of social capital. The ability to solve collective action problems has been placed at the core of concept by scholars such as Putnam (1995) and Ostrom and Ahn (2009) and has been termed

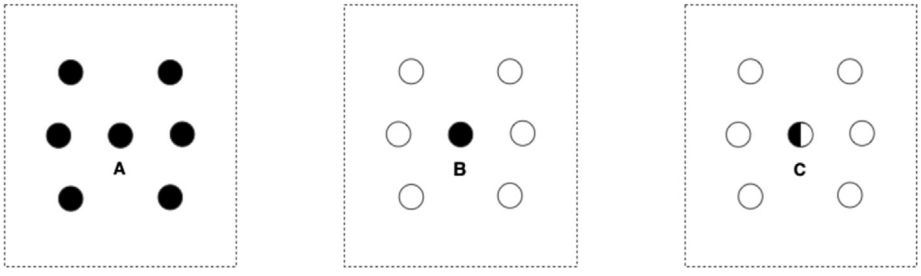


Fig. 1. Stylized comparison of three villages with different levels of first- and second-order local ethnic diversity.

'behavioral social capital' (Carpenter, Daniere, & Takahashi, 2004).

The indicators for cooperation, as well as all other individual-level data, come from the Afrobarometer (afrobarometer.org). The data included in the sample comprises 102,282 observations collected by means of face-to-face interviews in 33 different African countries. For all interviews, the Afrobarometer indicates the region and district of interviewing. I used this information to assign geographic coordinates to each interview location using GIS software. This allowed me to identify 2,942 locations at which interviews took place. The interview locations are shown in Fig. 2.

My main measure of cooperation is the composite score from two Afrobarometer items on community meeting attendance and collective action. Respondents were asked whether, during the last year, they took part in a community meeting, or whether they 'got together with others to raise an issue'. To both questions, they could answer on a five-point scale ranging from 'No, would never do this' to 'Yes, often'. As the indicators are fairly highly correlated ($r = 0.64, p = 0.00$), I combine the answers to both questions to create a nine-point scale ranging from zero for those who show no interest in collective efforts to eight for those eagerly taking part. In further specifications, I also look at political behavior usually associated with collective action: addressing political representatives and protest behavior. The Afrobarometer asks people whether, during the last year, they had 'attended a demonstration or protest march' and whether they had contacted a) their local councillor or b) their national representative 'about some important problem or to give them their views.' To the protest question, respondents could answer on the same five-point scale used to calculate the cooperation score. With regard to contacting representatives, respondents could choose from among the four answers 'Never', 'Only once', 'A few times' and 'Often'.

Measuring ethnic diversity at the local level

In order to measure first- and second-order ethnic diversity I construct local ethno-linguistic fractionalization (*LEFI*) indices. The calculation of the indices follows a procedure similar to that used by Rohner, Thoenig, and Zilibotti (2013) in their work on Uganda. The indicator is based on the World Language Mapping System, the digital version of the *Ethnologue*, an inventory of the world's languages (GMI, 2004). The *Ethnologue* is regularly updated. Here the 14th edition of 2004 is used. For most countries in the world, the *Ethnologue* lists all living languages and indicates the 'homeland' for each—the area from which the language originates and where it is most widely spoken.

The only other data sources with a comparable breadth are the *Atlas Narodov Mira* (ANM), developed by Soviet Ethnographers in the 1960 (Bruk & Apenchenko, 1964; cp. Weidmann et al., 2010), and the *geoEPR*, which maps the presence of 'politically relevant' ethnic groups in space (Vogt et al., 2015; Wucherpfennig et al., 2011). The *Ethnologue* is preferred here because for Africa it appears to contain the more reliable and up-to-date information than the ANM (which was produced by the Soviet Ethnographic Service in the 1960s and 1970s), and because the *Ethnologue* has a more comprehensive coverage of different groups than the *geoEPR* that allows me to capture inter-group dynamics independent of those groups' relationship with the state.[1]

I use the information of the location of ethnic 'homelands' to construct simple indices of first- and second-order ethnic diversity. An important conceptual question is which ethnic diversity should be counted as first-order diversity, which as second-order diversity, and which is inconsequential to a given situation. Obviously, an answer is not easy to give and should ideally be decided case by case. Since this is hardly possible in a study covering 33 countries, I here address this problem technically by calculating indices for first- and second-order ethnic diversity that cover discrete geographical areas, and by providing alternative measures for both concepts.[2] Concretely, I calculate indices for first- and second-order local ethno-linguistic fractionalization (*LEFI*1 and *LEFI*2). To do so, in a first step I overlay the whole of the African continent with a 10×10 km grid layer. For each grid field, first-order fractionalization is evaluated at the level of that cell's Moore neighborhood, i.e. the area comprising the central grid cell plus its 8 direct neighbors. My indicator of first-order ethno-linguistic fractionalization, *LEFI*1, is thus a moving average of ethno-linguistic fractionalization in 30×30 km (i.e. 900 km^2) areas.[3] Second-order ethnic diversity is evaluated at the level of 20 km corridor surrounding the central Moore neighborhood. The index for second-order fractionalization, *LEFI*2, is thus calculated as a moving average of ethno-linguistic fractionalization in the 40 grid cells surrounding the central Moore neighborhood (a 4000 km^2-large, 'donut'-shaped area formed by a 70×70 km outer square with the central 30×30 km Moore neighborhood cut out).

For both the central Moore neighborhood and the 20 km corridor surrounding it, I record the number of intersecting ethnic homelands and record the size of each intersecting area. The fractionalization indices are then calculated as the size of an ethnic homeland relative to the size of the other ethnic homelands. Formally, the *LEFI* indices are calculated as

$$LEFI = \sum_{j=1}^{k} ethn\_share_j \cdot (1 - ethn\_share_j) \quad (1)$$

whereby $ethn\_share_j$ is the relative size of the area covered by an ethnic group j in the central Moore neighborhood or the 20 km corridor, and k indicates the total number of groups. Fig. 3 illustrates graphically how the indices are calculated, and Fig. S1 in the Supplementary Material visualises second-order fractionalization for a map excerpt of Western Africa. Under the assumption of perfect ethnic homogeneity per ethnic homeland and even population density, the indices would have the familiar interpretation that two people drawn at random were of a different ethnicity. Needless to say, these conditions are typically not matched in reality so that the indices have to be interpreted with due care. For

[1] I used the ethnicity information included in Afrobarometer for an evaluation exercise: I checked to what extent the ethnicity information (self-reported ethnic affiliation and mother tongue), which Afrobarometer respondents supplied about themselves, complied with the 'homeland' designated by either the *Ethnologue* or the *Atlas Narodov Mira* (ANM). While for the ANM this is the case for about 37% of observations, in the case of the *Ethnologue*, 51% of respondents live in their ethnic 'homeland'. By exclusively listing groups that are 'politically relevant', the *geoEPR* has conceptually a different aim from the current paper. Notably, the *geoEPR* limits the scope of the included groups to those politically represented at the level of the central government or being subject to discrimination by the state. While there are 124 'politically relevant' *geoEPR* groups that can be mapped on Afrobarometer data, there are 577 such groups in the *Ethnologue*. This said, both the ANM and the *geoEPR* are used below for further analyses and robustness checks.

[2] Most importantly, in the Supplementary Material I use the distance between an interview location and the nearest inter-ethnic boundary as an alternative measure of second-order ethnic diversity. This continuous measure allows for a robustness check that does not rely on diversity being measured at a particular scale.

[3] The main reason why this approach is preferable to evaluating first-order diversity at the level of the 10×10 km grid cell itself is the imprecision of the available interview data. In most cases the interview location refers to a larger area such as a district or quarter of a bigger city. The actual places where interviews were conducted may thus be scattered out over a wider area, which typically seems larger than one single grid cell but roughly corresponds to the size of the Moore neighborhood. The Moore neighborhood is also used to calculate all secondary and control variables.

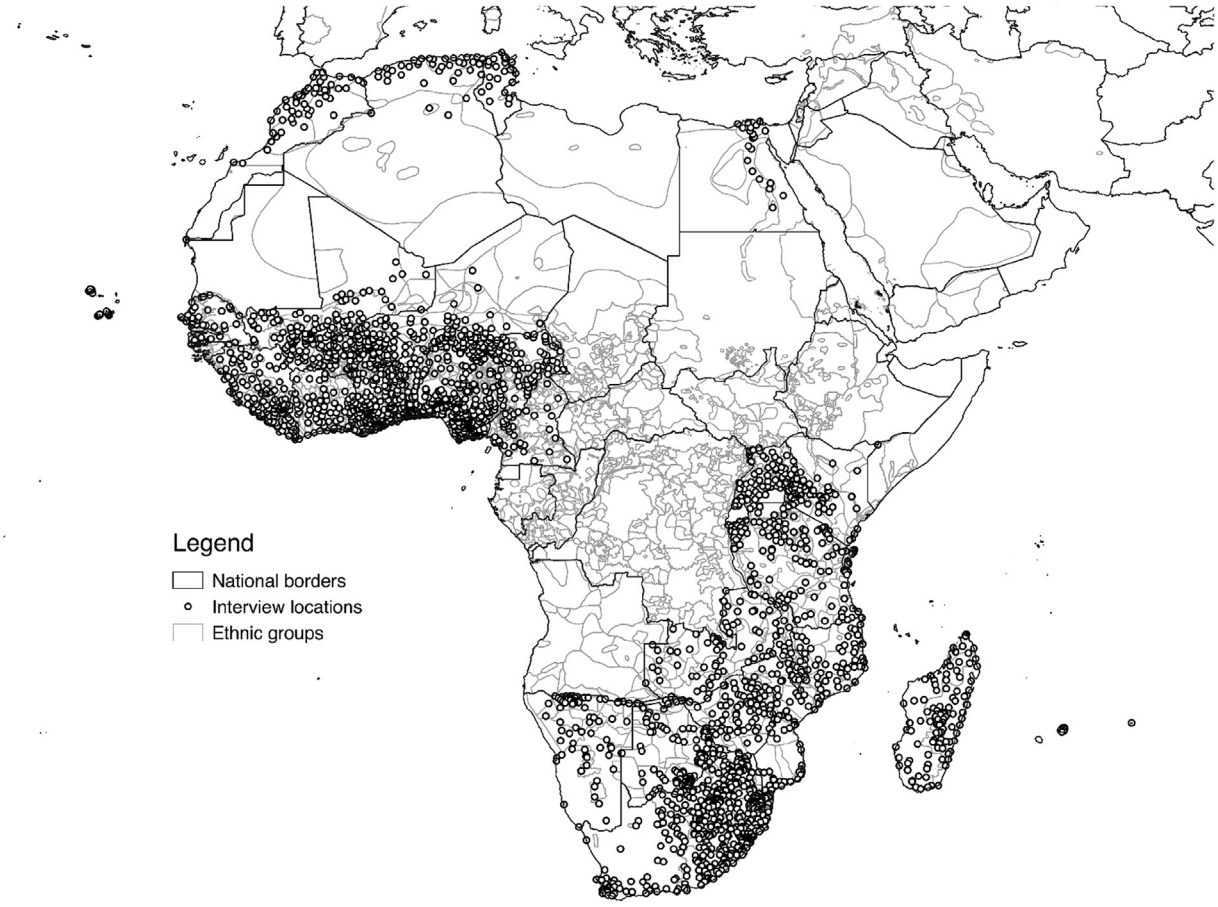


Fig. 2. Interview locations with survey data from the Afrobarometer.

the given sample, the indices range from 0 (*LEFI*1 and *LEFI*2), for Moore neighborhoods inhabited only by a single group or surrounded only by coethnics, to 0.85 in the most ethnically fractionalized Moore neighborhood (*LEFI*1) and 0.94 in the most fractionalized 20 km corridor (*LEFI*2). Table 2 in the Supplementary Material presents correlations of country-average *LEFI* values with fractionalization indices developed by other scholars (that are only available on the country level), demonstrating a close fit with most other indicators.

Model specification

To accommodate the data structure, I estimate a multilevel regression model allowing the intercepts of the model to vary between interview locations. This model specification is especially useful in a situation where observations per grouping unit vary greatly (Steenbergen & Jones, 2002). This is the case for the Afrobarometer data, where observations per interview location vary from 4 to 920, with a mean of 126 and a median of 64. The distribution is thus highly skewed towards the right, i.e. towards interview locations with few observations, which implies that in individual-level OLS, interview locations with many observations dominate the estimates of average effects. The mixed model represents a compromise between an individual-level analysis, where all observations are given equal weight, and the group-level analysis using group-level averages. The model can be written as

$$y_{ji} = \alpha + \boldsymbol{X}_{ji}\boldsymbol{\beta} + \boldsymbol{\mu}_j + \varepsilon_{ji} \quad (2)$$

where j stands for the interview location and i for individual observations. The model includes a set of covariates (X) that contains the independent variables *LEFI*1 and *LEFI*2, controls and, in later models, dummies for countries and group affiliation. The difference between this and a normal OLS model is that the intercept is estimated separately for each interview location (j), which results in the additional error term μ. ε is the individual error term, which is assumed to be uncorrelated with μ. α is the overall intercept. The effect size is hence calculated as the weighted mean of the effects in each location rather than the mean of all individual observations (as in an individual-level OLS) or the unweighted mean of means (as when working with interview location averages). All models include a dummy variable indicating the Afrobarometer round. Generalized least squares are used to fit the models, and standard errors are clustered at the level of the interview location throughout.

Results

Table 1 reports the effect of first- and second-order fractionalization on cooperation, given different model specifications. Panel 1 reports the overall relationship between the two ethno-linguistic fractionalization measures and cooperation. We can see that the variance due to the group variable (the interview location) is 20%, meaning that the hierarchical model is clearly preferable to the individual-level analysis.

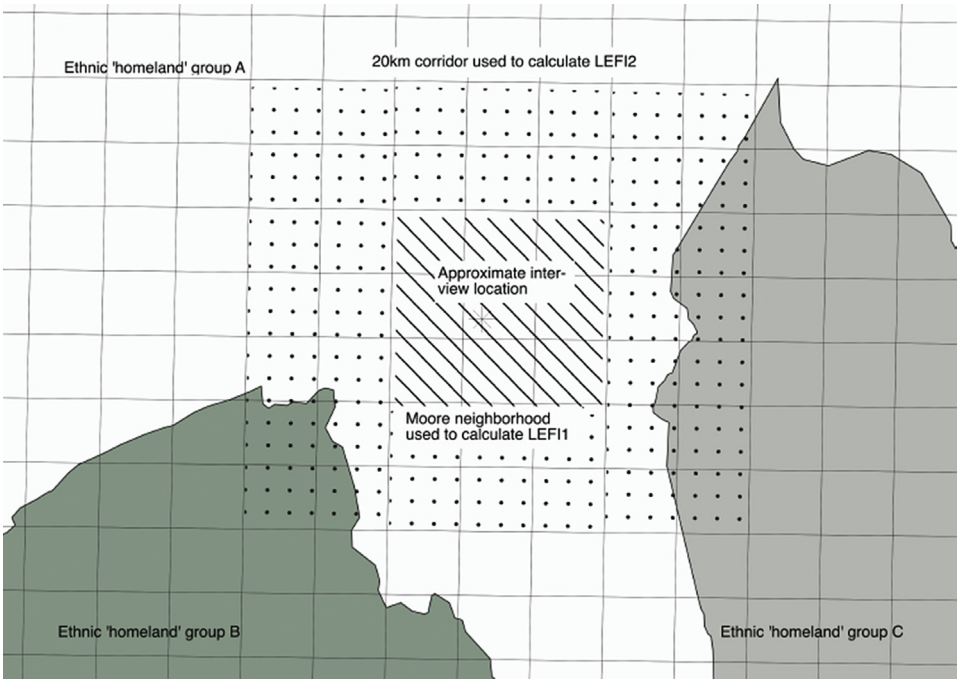


Fig. 3. Calculation of the Local Ethno-linguistic Fractionalization Indices, *LEFI*1 and *LEFI*2.
The figure shows an Afrobarometer interview location in the ethnic context as visualized by the Ethnologue. LEFI1 is calculated at the level of the Moore neighborhood. As the central Moore neighborhood covers the ethnic 'homeland' of ethnic group A only, LEFI1 is equal to zero. In contrast, roughly 8% of the 20 km corridor is covered by the ethnic 'homeland' of ethnic group B, and roughly 15% by the ethnic 'homeland' of group C. LEFI2 therefore equals 0.38.

As expected, first-order ethnic diversity has a negative effect on cooperation. Moving from a completely ethnically homogenous local community to one marked by complete heterogeneity is associated with a drop of the cooperation score by 0.6, or 14%, of the average score of 4.05—an effect size roughly two-third of that reported by Miguel and Gugerty (2005, 2352). In contrast, second-order ethnic diversity is associated with an *increase* in cooperation. Moving from an interview location where second-order diversity is zero (i.e. the wider area belongs to a single ethnic 'homeland') to a location where the surroundings are populated entirely by members of different other ethnic groups results in an increase in the cooperation score by 1.12 points, or approximately 28% of the average cooperation score. The effect of first-order diversity is hence overcompensated by that of second-order diversity.

Columns 6–8 show that these basic correlations also hold for forms of collective (or collectively-beneficial) political engagement such as protest behavior and addressing political representatives. An increase in second-order ethnic fractionalization from zero to one is associated with a 22% increase in the protest measure, and 33% and 51% increased scores for contacting one's local councillor and MP, respectively.[4] Robustness checks are included in Table 3 in the Supplementary Material, which shows that comparable results can be obtained when using analogously constructed fractionalization measures based on the *Atlas Narodov Mira*, the *geoEPR*, when using ethnic polarization indices instead of fractionalization indices, with sample-based measures of ethnic diversity, and with distance to the closest interethnic border as a measure for second-order ethnic diversity. Table 3 also shows that the basic correlations hold when using membership in volunteer or religious associations as alternative measures of local cooperation.

Threats to inference, controls and alternative formulations

Out of the two classic threats to causal inference, reverse causality and spuriousness, spuriousness seems to be more problematic for the current study, not least due to the heterogeneity of the sample. The positive relationship between second-order ethnic diversity and cooperation may be caused by third factors that positively co-vary with both. To control for possible confounding effects, I therefore include a range of control variables in my model. To check for the influence of state institutions and other invariable country-level characteristics, in Panel 2 of Table 1 I include dummy variables for each of the 33 countries included in my sample. The reduced coefficients indicate that part of the association between second-order fractionalization and cooperation is explained by the fact that countries with high ethnic diversity on average also show higher levels of cooperation. However, even when relying solely on within-country variation, the effect of second-order fractionalization remains substantially positive and precisely estimated.

Another possibility is that the factors that cause ethnic diversity also cause communities to cooperate more. This idea is particularly relevant to the climatic and geographic factors which could plausibly also have a direct influence on cooperation. In particular, previous research has shown that regions more diverse in terrain and suitability for agriculture produce a larger number of ethnic groups (Michalopoulos, 2012). Adverse weather conditions in the mountains may force people to cooperate more, or more fertile and productive grounds may encourage more cooperative forms of agriculture, which in turn may raise a community's level of cooperation in other areas as well.

[4] The respective negative values for first-order ethnic diversity are 0%, −25% and −28%. Note that the coefficients for second-order ethnic diversity are statistically different from zero even when applying Bonferroni correction, i.e. dividing the target p-value by the number of comparisons made. In this case, there are 4 different dependent variables. Given a conventional threshold for significance at 5%, the Bonferroni-corrected target p-value is now 1.25%, which is met by all 4 coefficients.

Table 1
Effect of first- and second-order fractionalization on cooperation and measures of political engagement.

	(1) Coop	(2) Coop	(3) Coop	(4) Coop	(5) Coop, IV est	(6) Protest	(7) Cntct counc	(8) Cntct MP
LEFI 1	−0.58***	−0.27**	−0.25*	−0.28**	−1.21*	0.00	−0.12***	−0.06**
	(0.14)	(0.11)	(0.13)	(0.11)	(0.68)	(0.04)	(0.04)	(0.02)
LEFI 2	1.12***	0.54***	0.57***	0.67***	1.65**	0.13***	0.16***	0.10***
	(0.12)	(0.09)	(0.11)	(0.10)	(0.76)	(0.03)	(0.03)	(0.02)
Suit for agrcltr, Michalopoulos, 2012			0.66***		0.55***			
			(0.09)		(0.12)			
SD suit agrcltr, Michalopoulos, 2012			0.38		0.30			
			(0.31)		(0.30)			
Av altitude in 1000 m			0.72***		0.63***			
			(0.06)		(0.08)			
SD av altitude			−0.01		−0.01			
			(0.01)		(0.01)			
Abs dev from monthl rainf 1980-00			−0.02**		−0.02**			
			(0.01)		(0.01)			
Av temp, 1950-00			0.09***		0.07***			
			(0.01)		(0.02)			
Av intensity stbl nightlights 2000			−0.05***		−0.05***			
			(0.00)		(0.00)			
Gini coeff of nightl intensity			−0.29***		−0.26***			
			(0.06)		(0.06)			
Intercept	3.63***	2.03***	1.34***	5.59***	1.69***	0.66***	0.47***	0.17***
	(0.05)	(0.11)	(0.27)	(0.09)	(0.35)	(0.01)	(0.02)	(0.01)
Round indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country indicators	No	Yes	No	No	No	No	No	No
Ethnic group indicators	No	No	No	Yes	No	No	No	No
Observations	102282	102282	101401	100862	101401	96298	98130	100436
Random part:								
No. groups	2942	2942	2938	2937	2938	2838	2919	2912
sd(residual)	1.09	0.76	0.97	0.75	0.93	0.30	0.25	0.15
sd(intercept)	2.16	2.16	2.16	2.15	2.16	0.85	0.86	0.59
Rho/ICC	0.20	0.11	0.17	0.11	0.16	0.11	0.08	0.06

Notes: Multilevel linear regression of indices for cooperation and collective action on first- and second-order ethnic fractionalization. Intercepts are allowed to vary by interview location. Estimated using generalized least squares. Standard errors in parentheses; $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$.

For each Moore neighborhood I hence calculate the average values for suitability for agriculture and its variability (using an indicator provided by Michalopoulos (2012)), mean temperature, variability in rainfall, average altitude and variation of altitude for inclusion in my model. As Panel 3 demonstrates, while the effects of first- and second-order fractionalization on cooperation are slightly reduced in size when simultaneously controlling for these factors predicting ethnic diversity, they remain substantial and statistically significant.[5] Finally, my data allows me to include indicator variables for the 770 self-reported ethnicities included in the data. In many cases, members of the same self-reported ethnic group are present at several interview locations, often located in different countries, making it possible to check for effects among the members of the same ethnic group by including ethnic-group level fixed effects. As Panel 4 shows, even among members of the same group who likely share many of the same cultural attributes, second-order ethnic diversity positively correlates with cooperation.

Reverse causality may be considered less of an issue for the present analysis, as ethnic diversity is often considered exogenous (cp. Miguel & Gugerty, 2005). This said, there is a possibility that cooperation has shaped ethnic settlement patterns in space, as particularly cooperative communities may have found it easier to keep other groups out of 'their' areas of settlement. However, the resultant correlation would be negative: more cooperative regions should be less ethnically diverse. If there was a parallel causal relationship running from cooperation to ethnic diversity, it would thus likely make it harder, not easier, to detect the positive relationship reported here. For additional confidence with regard to the direction of the causal arrow, I propose to instrument ethnic diversity with two of its ultimate predictors. Previous research has shown the distance from the equator as a major predictor of ethnic diversity, and has also identified migratory distance from mankind's cradle in present-day Ethiopia as reducing both genetic and, as a consequence, ethnic diversity (Ahlerup & Olsson, 2012; Ashraf & Galor, 2013; Mace & Pagel, 1995).

Following this scholarship, I propose to use absolute latitude and the distance to Addis Ababa as instruments for second-order ethno-linguistic fractionalization. As demonstrated in the first-stage regression (see Table 9 in the Supplementary Material), both variables strongly predict ethnic diversity. One problem is that both absolute latitude and distance to Addis Ababa also correlate with climatic and geographic factors identified above as potential confounders. However, conditioning on the measures for climatic conditions and geographic factors already included in the model, the exclusion restriction that the instrument should impact the dependent variable only through its influence on the independent variable, should be met. Panel 5 reports the estimates for the coefficient of second-order diversity instrumented by distance to Addis Ababa and absolute latitude. The coefficient is positive, about 1.5 times the size of the coefficient of the naïve estimate and

[5] Several authors (e.g. Portes & Vickstrom, 2011) have pointed out that the effects of ethnic diversity are due to socioeconomic factors such as absolute levels of wealth and inequality. Although I agree with Schaeffer (2014) that these might be considered channels through which ethnic diversity can influence cooperation levels rather than confounders, I also include as controls a measure of wealth of the locality—measured in terms of nightlight intensity—and of local inequality—the Gini coefficient capturing differences in nightlight intensity within the Moore neighborhood that an interview location is placed in. Although rather strong predictors of local cooperation in and by themselves, wealth and inequality do not strongly moderate the effect of ethnic diversity.

statistically significant.[6] The IV results hence confirm the intuition that second-order ethnic diversity induces cooperation (and not the other way round) and that the estimates from the previous regressions likely constitute lower bounds of this effect.

Ethnic competition as the connecting link

Having established the relationship between second-order ethnic diversity and cooperation, the next section demonstrates that it is indeed ethnic competition that forms the connecting link between the two. This analysis is informed by the voluminous literature analyzing under which conditions ethnic identities become salient, ethnic groups mobilize and enter into conflict (Brubaker & Laitin, 1998; Hale, 2004). The paper so far has treated ethnicity and ethnic diversity as a static characteristic following ethno-linguistic dividing lines. In reality, ethnic identity is often more varied and more fluid, and can be understood as an 'ascribed status which is situationally activated' (Nagel & Olzak, 1982, p. 129). Ethnic groups typically mobilize and enter into competition only under certain circumstances. The literature typically explains the activation of ethnic identities in terms of their usefulness for competing in the political arena (Chandra, 2007; Wilkinson, 2004), securing resources (Bates, 1983; Fearon, 1999), or prevailing in territorial conflicts (Horowitz, 1985).

The demonstration starts with the identification of factors that reinforce or weaken ethnic competition and can be measured empirically, and then interacts these factors with the measure for second-order diversity. Interaction terms that show the hypothesized direction are interpreted as supporting evidence for the idea that competition and conflict are at the root of the link between the ethnic diversity of the *hinterland* and cooperation.

Contemporary factors reinforcing ethnic competition

In his classic theory of ethnic competition in Africa, Bates (1983) argues that competition between ethnic groups is mainly about the spoils of modernization, with ethnic groups being particularly well-suited vehicles to compete over these spoils. This is because scarce resources such as modern sector jobs that promise higher incomes and status—and the educational opportunities to obtain these jobs—are clustered in space in or near cities. Since members of the same ethno-linguistic group tend to settle in geographically compact areas, ethnic groups are ideally placed to compete over such spatially-bound resources. Leaders hence mobilize the populace along ethnic lines and foster cooperation in areas where such resources are available. Bates further argues that this effect was reinforced by colonial authorities who tended to assign discrete territories to specific groups. After independence, the local administrative divisions of the newly formed states would often follow these boundaries, reinforcing intergroup tensions—a point mirrored by Horowitz (1985) who argues that territorial boundaries shape which group identity emerges as most salient (cp. Cunningham & Weidmann, 2010).

The degree to which ethnic identities are mobilized is also crucially influenced by groups' relationship with the central state. This has been the focus of the *Minorities at Risk* (Gurr, 1993), and has more recently been taken up in the *Ethnic Powers Relations* project (Vogt et al., 2015). A central finding of this research program is that groups are more likely to rebel if they are discriminated against or excluded from state power. As Lacina (2015, 693) writes, rebellions 'do *not* typically arise from ethnic groups that have *better* access to the central executive compared to their neighbors in the periphery' (cp. Cederman & Girardin, 2007; Cederman, Wimmer, & Min, 2010). This also implies that dominant groups face higher levels of competition from peripheral groups competing for the spoils of the central state (Cooper, 2002), and should therefore react especially sensitively to the presence of competitors in the *hinterland*.[7]

I thus test whether the effect of second-order diversity is stronger in more urbanised areas, in regions where administrative divisions fall together with interethnic boundaries, and among members of groups that concentrate more power in their hands. I measure the level of urbanisation of a Moore neighborhood as the share of that neighborhood covered by remotely sensed 'urban extents' around the year 2002, based on data from Schneider, Friedl, McIver, and Woodcock (2003). I also calculate an indicator that records how many local administrative regions a particular Moore neighborhood is divided into, using information on district level administrative boundaries from the Global Administrative Unit Layer published by the Food and Agriculture Organisation of the United Nations (FAO, 2008). Assuming that ethnic competition is particularly severe where cultural and administrative boundaries fall together, ethnic diversity should also more strongly affect cooperation here.

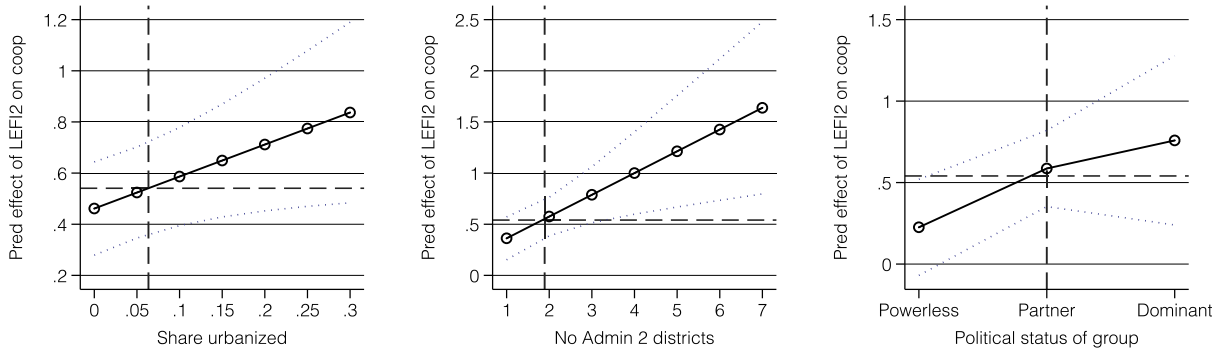
To test for the idea that politically dominant groups should react with higher rates of cooperation given ethnic diversity in their surroundings, I use the threefold categorization by Cederman, Weidmann, and Gleditsch (2011), who distinguish between groups that a) enjoy a dominant position in the executive branch, b) have a share in power, or c) are largely powerless or discriminated against. Within the Afrobarometer sample, I identify individuals that belong to these categories of groups. The more powerful a group, the more second-order ethnic diversity should be associated with higher levels of cooperation.

The results are presented in Fig. 4(a) (see Table 5 in the Supplementary Material for regression results). In line with the predictions of the theory, second-order ethnic diversity is more strongly correlated with cooperation in urbanised regions than it is in rural regions, and the presence of administrative boundaries positively and strongly mediates the effect of second-order diversity on cooperation. Finally, more politically dominant groups—that have more to lose—react more strongly to second-order diversity in their surroundings than weaker ones.

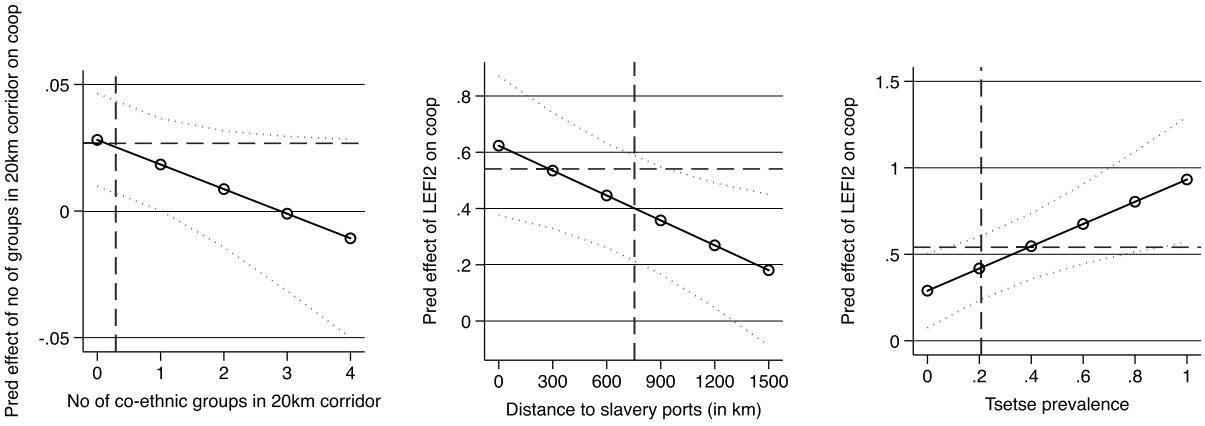
While providing preliminary evidence that ethnic competition links second-order ethnic diversity and cooperation, the tests are not entirely conclusive. The urbanisation and the political status measures are rather noisy, and the administrative boundary measure potentially suffers from endogeneity bias: more cooperative communities may have found it easier to have the boundaries of their ethnic territories demarcated by administrative borders. I therefore turn to history to identify factors that are linked to competition, but are plausibly orthogonal to cooperation dynamics. My aim is to show that second-order diversity has a stronger effect on cooperation in regions where historic, discontinued processes increased levels of conflict than in regions were intergroup conflict was less pronounced. These tests are based on the assumption that historic processes can shape contemporary attitudes and behavior through cultural transmission (Boyd & Richerson 1988;

[6] Variations of the IV regressions using each instrument individually are explored in Table 9 in the Supplementary Material, which also reports the first-stage results for the regression in Table 1, Panel 5.

[7] Note that the primary effect of being in a dominant position on cooperation is negative, i.e. more dominant groups have lower cooperation levels. Arguably, this is because access to state resources can serve as a substitute for group-level self-organisation (Chazan, 1994). For example, a member of a group that is protected by a state's army or police has less need to organize their own protection than one not protected or even threatened by a state's institution.



(a) Contemporary factors



(b) Historical factors

Fig. 4. Effect of second-order ethno-linguistic fractionalization conditional on contemporary and historical factors hypothesized to reinforce ethnic competition.
Solid lines show the effect of LEFI2 on cooperation, conditional on the interacted variables. Dashed lines show the average effect of LEFI2/the variable mean of the interacted variable. 95% confidence intervals are indicated as dotted lines.

Cavalli–Sforza & Feldman, 1981; Guiso et al., 2013).

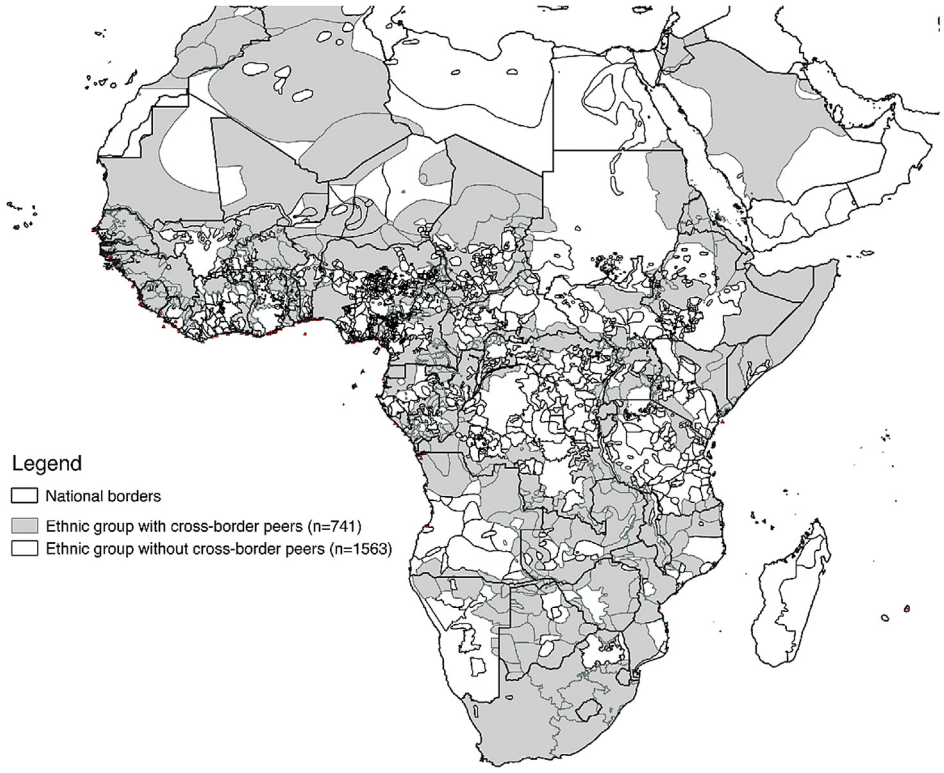
Arbitrary borders and 'artificial' ethnic diversity

Most national borders in Africa were drawn by colonial powers with little attention to social realities on the ground. As a consequence, members of the same ethnic groups often ended up distributed over several countries. As Africa has seen remarkably few border changes in the period after independence, across the continent this situation persists until this day (Asiwaju, 1985; McCauley & Posner, 2015). In contrast to the local administrative borders referred to above, it is therefore unlikely that the drawing of national borders is affected by endogeneity bias.

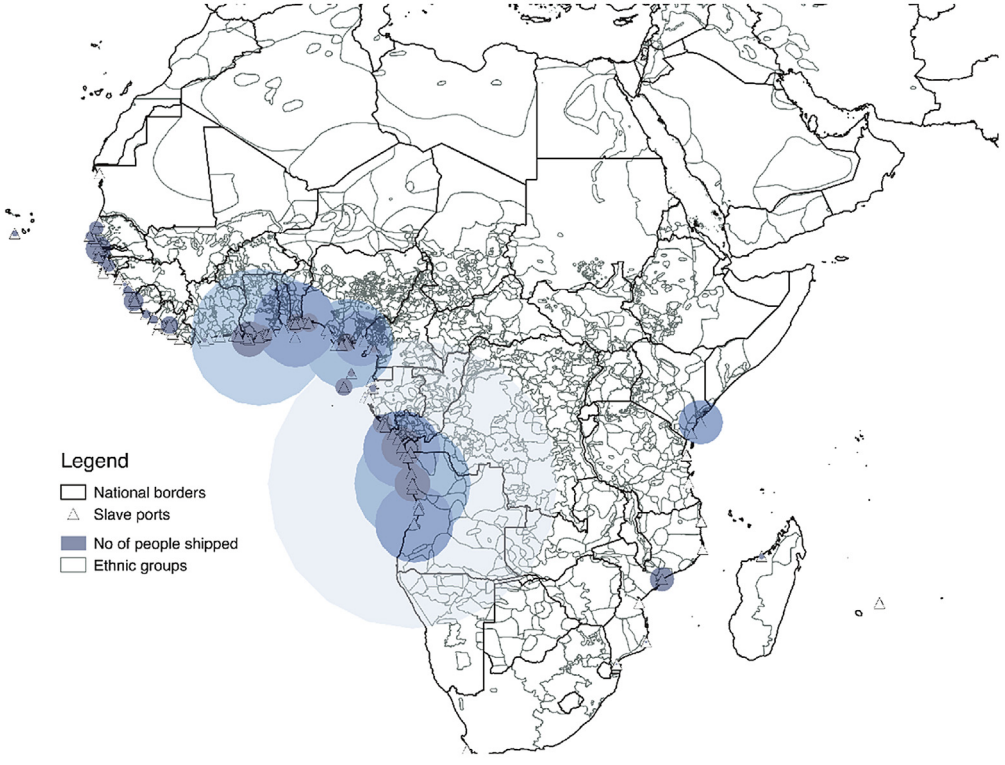
The *Ethnologue* assigns several 'homelands' to the same ethnic group if that group is divided by a national boundaries. For instance, the Tumbuka in Zambia are assigned an ethnic homeland, and so are the Tumbuka of Malawi. This may be justified since the same ethnic identity may play fundamentally different roles, depending on the national political context (Posner, 2004). Nevertheless, we may assume that competition should be less pronounced between culturally highly similar groups than between more distant groups (see Fig. 5(a) below for a graphical representation of groups spanning several national borders). Second-order diversity should therefore induce less cooperation in a context where some of the diversity is simply due to co-ethnics living in neighboring countries. To test this hypothesis, I identify the number of co-ethnic groups of different nationalities among all neighboring groups in the 20 km corridor surrounding the central Moore neighborhood. I then interact this measure with the total number of groups—an alternative measure for ethnic diversity—and regress the cooperation measure on the interaction term. As shown in Fig. 4(b), as hypothesized, the interaction results in a negative slope. Although this effect is statistically weak, communities in contexts where some of the ethnic diversity in the surroundings is made up of co-ethnics indeed appear to be less cooperative than communities where second-order ethnic diversity is made up of culturally distinct groups.

The legacy of the transatlantic slave trade

A historic process that made a deep impact on interethnic relations was the slave trade and the interethnic raids and feuds associated with it. Numerically by far the largest slave trade (in comparison to the Indian Ocean and Arab slave trades) was the transatlantic slave trade. Between the beginning of the 16th and the end the 19th century, an estimated 12.5 million Africans were captured, sold to European traders and shipped across the Atlantic (Richardson, 2011, p. 463). While the demand from Europeans was driving the trade, the capture of slaves was typically carried out by rivalling African states, chiefdoms and communities. During these four centuries of Africa's more recent history, the slave trade hence constituted a major cause of ethnic conflict and competition,

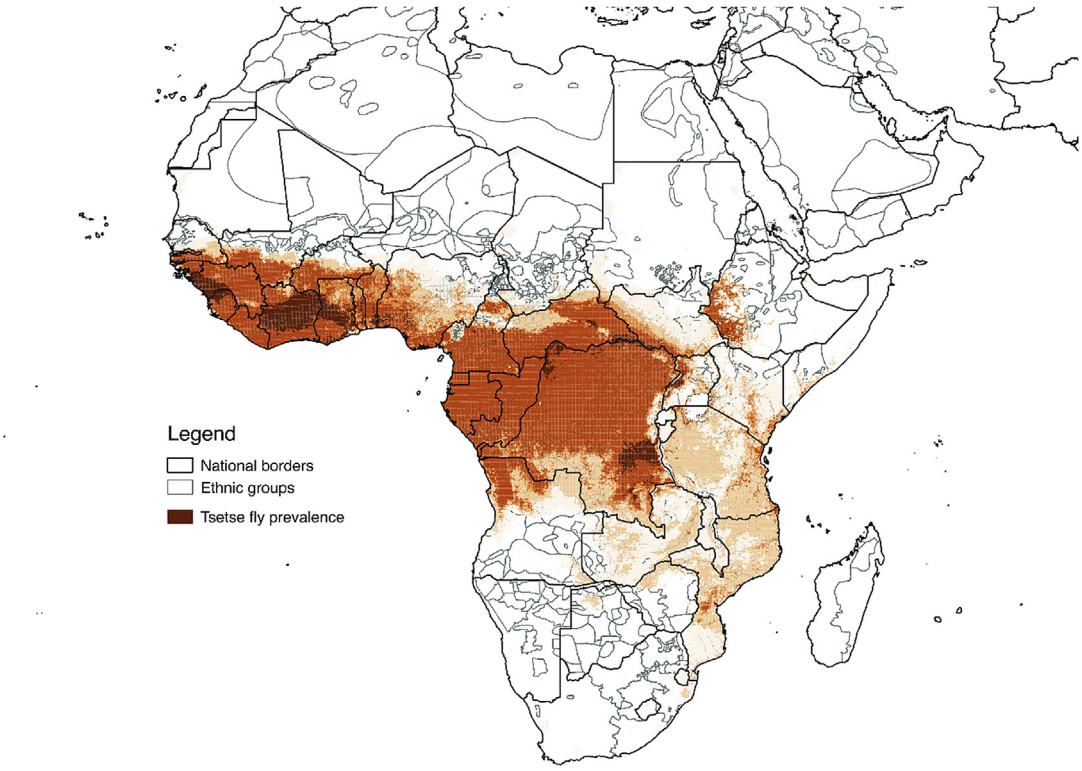


(a) Ethnic groups spanning national borders, creating 'virtual' ethnic diversity



(b) Regional affectedness by the transatlantic slave trade

Fig. 5. Factors associated with lower or higher ethnic competition.



(c) Contemporary distribution of the tsetse fly

Fig. 5. (*continued*).

leading one contemporary observer and abolitionist to call the slave trade 'the chief cause of wars in Africa' (Wilberforce, 1789, 9).

The effect of the slave raids were devastating, especially in regions close to the coast. Some regions were affected so badly that populations stagnated or shrank (Vansina, 1992). Frequent slave trading and kidnapping disrupted the 'economic and social systems of communities…villages were destroyed or dispersed, farms were abandoned and people lived in terror' (Alagoa, 1992, p. 452). Slave raiding also set off population movements, as it caused people to migrate inland in search of safer refuges. This process led to knock-on effects with migrating communities coming in conflict with others (Vansina, 1992).

While the transatlantic slave trade therefore poisoned inter-ethnic relations and undermined trust (Nunn & Wantchekon, 2011), within communities, protection from slavery necessitated cooperation. In response to frequent slave raiding, communities would relocate to harder to access, easier to defend or easier to survey locations, or would built fortifications—a classic collective action problem (Bah, 2003). Under the intense pressure of slave raiding, arguably only particularly cooperative communities could sustain themselves, as only they could muster the effort to pursue collective defence strategies. Slave raiding also affected settlement patterns, inducing people to move closer together and to adopt more cooperative methods of agriculture (Udo, 1965). Ethnographic accounts hence lend plausibility to the argument that more cooperative communities fared better in the violent environment created by the transatlantic slave trade, as less cooperative communities would be defeated or disintegrate.

As a proxy for historic exposure to slavery, I use the average distance between an interview location and the 5 closest ports from where slaves were shipped to the Americas.[8] As shown by the negative interaction effect, the relationship between second-order ethnic diversity and local cooperation is stronger in regions historically more heavily affected by the transatlantic slave trade. The force of this test stems from the fact that the slave trade affected Africa in ways that are plausibly orthogonal to other factors potentially influencing present-day levels of cooperation. First, the transatlantic slave trade stopped during the 19th century—more than a century before the data for this study was collected. Second, the slave trade followed its own regularities unlikely related to previously existing levels of cooperation in the societies that slaves hailed from. For instance, communities at the West coast of Africa were far more strongly affected by the transatlantic slave trade than those on the East coast, for the obvious reason that the main 'markets' for slaves were in the Americas and the journey from the West coast shorter (see Fig. 5(b)). Third, if anything, slave raiding might have been more common where cooperation levels were lower, as societies were less able to fend off the raiders. Selection should therefore bias against finding higher levels of cooperation where slave raiding was more common.

The presence of the tsetse fly

As a last test, I show that second-order ethnic diversity has a stronger effect on cooperation where the tsetse fly is endemic. The current spread of the tsetse fly, illustrated in Fig. 5(c), serves as a proxy for its historical spread, which in turn proxies historically decreased political centralisation and increase demand for

[8] The number of slaves shipped and the locations of the ports come from Harvard's *Africamap*, which in turn uses figures from slavevoyages.org. Jerome Chang kindly made the data available to me.

indigenous slaves—both factors arguably linked with inter-community competition and conflict. The tsetse is the main transmitter for *trypanosomes*, parasites that cause sleeping sickness in humans and *Nagana* in many animals. Nagana weakens and kills domesticated animals such as oxen and horses. The tsetse fly thus limits both agricultural productivity and the projection of power via cavalry. Both factors have been linked to the weakness of states (Diamond, 1999; Law, 1976), and one paper directly links the presence of the tsetse fly to lowered state centralisation (Alsan, 2015).

Decreased state capacity, in turn, meant that communities could rely less on a centralised power to keep the peace, implying a more important role for self-organisation in military affairs. What is more, the non-availability of transport animals also increased the demand for human carriers—a role typically burdened on indigenous slaves—and by implication may have increased tensions between local communities in a way similar to the *trans*-Atlantic slave trade (Glasgow, 1963). I proxy the historic occurrence of tsetse flies with their current prevalence level using GIS-readable data produced by Wint and Rogers (2000) for FAO. As shown in Fig. 4(b), the ethnic diversity of a community's *hinterland* is more strongly associated with cooperation where the tsetse fly is currently—and presumably was historically—more common. Taken together, the evidence from these tests therefore suggests that the link from second-order diversity to cooperation runs through ethnic competition.

Conclusion

This paper introduces the concept of second-order ethnic diversity—the ethnic diversity of the *hinterland*. In contrast to first-order ethnic diversity—the diversity of the local community, which tends to undermine local cooperation—second-order diversity increases cooperation through ethnic competition. Two novel indices, the local ethno-linguistic fractionalization indices *LEFI*1 and *LEFI*2, are used to measure first- and second-order ethnic diversity on the sub-national level. The empirical analysis shows that in contemporary Africa, in line with theoretical considerations, first-order ethnic diversity is typically associated with lower levels of cooperation, while second-order ethnic diversity is consistently associated with higher levels of cooperation. The cooperation-inducing effect of second-order ethnic diversity is particularly pronounced where contemporary and historical factors predict increased interethnic tensions. Several of these factors, such as the drawing of colonial borders, the geographic pattern of the transatlantic slave trade, and the distribution of the tsetse fly are plausibly exogenous to current-day social dynamics, suggesting a causal link running from ethnic competition to increased cooperation.

From the idea of second-order diversity, a new synthetic understanding of the effects of ethnic diversity could be developed. The study of cooperation so far has mainly looked at how ethnic diversity undermines cooperation when members of different groups interact locally. This paper joins the more limited literature arguing that what matters is not only the ethnic composition at the place of interaction, but also the ethnic profile of neighboring communities. In addition, the paper contributes to the debate on the origins of the global 'geography of social capital'. Outgroup threat may join market exposure, settlement size and monotheistic religion as a factor explaining why cooperation levels vary between different communities and regions.

Due to the geographic scope of the study (covering a whole continent) and the limits on data availability, some of the concepts used in this paper could only be measured somewhat imprecisely. As long as measurement error is random, this is not problematic *per se*, as it simply makes it harder to detect any effect. Nevertheless, further studies using more precise measurements, likely at a more micro level, would clearly be warranted. Such work should also probe for interaction effects. For instance, communities historically often reacted to outgroup threat with an increase in the size and density of settlements (Dincecco & Gaetano Onorato, 2016; Udo, 1965)—which suggests that outgroup threat and the size of settlements may interact. Other interaction effects—for example with the spread and adoption of monotheistic religions—are also possible.

A further task would be to draw out the implications of the link between second-order ethnic diversity and cooperation for politics and the state more broadly. As a first step, this would require qualifying the nature of the cooperation induced. It is likely that rather than reflecting virtuous citizenship, the type of cooperation associated with ethnic competition must be qualified as cliquish, 'dark', 'bonding' social capital undermining the development of a liberal society (Satyanath, Voigtlaender, & Voth, 2013). However, the fact that higher cooperation levels might only be the *legacy* of a violent and competitive past allows for a more positive view. It could be that the behavioral pattern observed is no longer motivated by the reasons that originally triggered it. Although contemporary high levels of cooperation may have had their roots in historic conflicts between communities, communities nowadays may use the habits and norms prescribing cooperation for purposes favorable to the wider society. The data presented in this paper leave room for both interpretations. Distinguishing between them would be fertile ground for further research.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.polgeo.2017.01.006.

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