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# De-Composing Diversity: In-Group Size and Out-Group Entropy and Their Relationship to Neighbourhood Cohesion

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## Abstract[1]

Ethnic diversity is typically measured by the well-known Hirschman-Herfindahl Index. This paper discusses the merits of an alternative approach, which is in our view better suited to tease out why and how ethnic diversity matters. The approach consists of two elements. First, all existing diversity indices are non-relational. From the viewpoint of theoretical accounts that attribute negative diversity effects to in-group favouritism and out-group threat, it should however matter whether, given a certain level of overall diversity, an individual belongs to a minority group or to the dominant majority. We therefore decompose diversity by distinguishing the in-group share from the diversity of ethnic out-groups. Second, we show how generalized entropy measures can be used to test which of diversity's two basic dimensions matters most: the variety of groups, or the unequal distribution (balance) of the population over groups. These measures allow us to test different theoretical explanations against each other, because they imply different expectations regarding the effects of in-group size, out-group variety, and balance. We apply these ideas in an analysis of various social cohesion measures across 55 German localities and show that in-group size matters more for natives, and out-group diversity more for immigrants. In both groups, the variety component of diversity seems to be decisive. These findings provide little support for group threat as an important mechanism behind negative diversity effects, and are most in line with the predictions of theories that emphasize coordination problems, asymmetric preferences, and network closure, which are maximized where there are many small groups.

*Keywords:Ethnic diversity, social cohesion, entropy, in-group favouritism, group threat*

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## Introduction

Over the past decades, social scientists have become increasingly interested in the relation between ethnic diversity and social cohesion. According to the seminal studies of economists Alesina, Baqir and Easterly (1999) and political scientist Putnam (2007), capacities to produce public goods decline along with levels of social trust and civic engagement as ethnic diversity increases. Today, the literature on ethnic diversity and social cohesion provides a rich set of empirical findings, but according to reviews of the field, the overall picture on whether ethnic diversity and social cohesion are negatively associated is inconclusive (Portes & Vickstrom, 2011; Stichnoth & Straeten, 2013). Two recent meta-analytic reviews show that studies focusing on specific measures of social cohesion, rather than abstract notions of generalized trust, as well as small-scale aggregate units, such as neighbourhoods or cities, mostly find confirmatory evidence of a negative association (Schaeffer, 2013a; van der Meer & Tolsma, 2011). In striking contrast to this debate, social science research on organizations has produced similarly lively debate on the economic benefits of ethnically diverse work teams (see Page 2008). Here ethnic diversity is regarded as a driving factor behind innovation and good decision-making. So is ethnic diversity enriching and beneficial or harmful and prohibiting for society? We believe that there is little to gain from charging the potential positive and negative consequences of diversity against one another. Instead, these complex findings highlight the necessity to study in an interdisciplinary way the mechanisms through which ethnic diversity is linked to valued outcomes such as engagement, trust, or innovation.

We focus on the negative consequences of ethnic diversity for trust and social cohesion on the neighbourhood level that have been documented in many studies. Although there are a number of plausible theoretical explanations on offer, most studies provide no evidence for the supremacy of one explanation over others. This is related to the fact that, as we will explain below, in many real-world comparisons of cities, neighbourhoods or other small-scale units such as schools, the mere population share of minorities, diversity, or polarization are empirically indistinguishable with the commonly used diversity indices (Schaeffer, 2013b).

This paper reports about the merits of an alternative approach of decomposing ethnic diversity to tease out why and how it matters. This approach consists of two elements. First, all existing diversity indices are non-relational. That is, they provide one score for a given context that is supposed to exert the same effect across all individuals within that context. From the viewpoint of the dominant

theoretical accounts that state that negative diversity effects are attributable to in-group favouritism and out-group threat, it should however matter whether, given a certain level of overall diversity, an individual belongs to a small minority group and is thus surrounded by one or more ethnic out-groups, or belongs to the dominant majority and is therefore mainly surrounded by co-ethnics. To measure contextual diversity in a relational way, we decompose it by distinguishing in-group share from the diversity of ethnic out-groups. In spite of its intuitive plausibility, conceptualizing diversity in such a way is to our knowledge a novel contribution – not only to the social sciences but also to fields such as ecology (Ricotta, 2005; Stirling, 2007).

Second, we show how generalized entropy indices can be used to test which of diversity's two dimensions matters more in predicting outcomes of interest: the variety of groups, or the unequal distribution (balance) of the population over groups. Explanations that highlight cultural factors such as coordination problems emphasize the variety aspect of diversity in explaining reduced levels of social cohesion, while group threat theory (e.g. Blalock, 1967) focuses on balance. Any evidence that one – balance or variety – matters more than the other would hence point towards certain theoretical explanations.

To empirically illustrate the merits of our decomposition of diversity, we use the German sub-set of the Ethnic Diversity and Collective Action Survey (EDCAS) with its roughly 7,500 respondents, who live in one of 55 theoretically and randomly sampled German cities and regions. As dependent variables, we investigate three indicators of neighbourhood cohesion and an overall neighbourhood cohesion scale.

## On competing theories and diversity indices

Over the last years, several theoretical approaches have been put forward to explain the potentially negative effects of ethnic diversity. The majority of studies refer to theories of biases against out-group members, in particular group threat theory (e.g. Hou & Wu, 2009) or in-group favouritism (e.g. Alesina et al., 1999). In addition to these approaches, collective choice theories suggest that lower levels of public goods provision are due to the asymmetry of preferences in ethnically diverse communities (e.g. Kimenyi, 2006). Other theories emphasize coordination problems due to cultural differences and the associated lack of shared language, meanings and practices (Habyarimana et al., 2007). Finally, there is the largely neglected role of social control, which may suffer from ethnically clus-

tered networks (Miguel & Gugerty, 2005). While these theoretical approaches are all possible explanations of the macro-demographic ethnic diversity effect, little is known about their relative explanatory power.

In this article, we discuss how a de-compositional and relational approach to diversity can be used to test competing theories against one another. Most of the proposed explanations, with the exception of theories of in-group favouritism and group threat, predict truly diverse compositions to be the most problematic. Preference diversity and coordination and social control problems should find their climax in the limit case in which each person in a given context belongs to a different ethnic group with its own unique language, values, and social network. For theories of in-group favouritism, by contrast, the size of the in-group is what matters most, and the relative sizes and number of out-groups matter little. For theories of group threat, finally, the diversity of out-groups does matter, but in precisely the opposite way as for theories that refer to preferences, coordination, and social control: threat should be highest if out-group members are not scattered, but consist of one large competitor. The commonly used Hirschman-Herfindahl index and similar diversity indices do not allow one to test these competing explanations against each other, because they do not incorporate the relational aspect implied in group threat and in-group favouritism theories.

We therefore define diversity as a concept that combines three dimensions, which are emphasized by different theoretical perspectives: the relative size of the in-group, the unequal balance of populations over out-groups, and the variety of out-groups. To capture the latter two elements, we propose, in addition to in-group size, to use measures of generalized entropy, because they allow weighting variety against balance.

## *Conceptual foundations of diversity indices*

While most people will have some intuitive understanding of what diversity is, concrete measures help to clarify the use of a concept. One of the most familiar measures of diversity is the Hirschman-Herfindahl Index (Herfindahl, 1950; Hirschman, 1964), also known as the Blau Index (Blau, 1977) in sociology, or Simpson Index (Simpson, 1949) in biology/ecology:

$$\mathrm{HHI} = 1 - \sum_{i=1}^{k} s_i^2$$

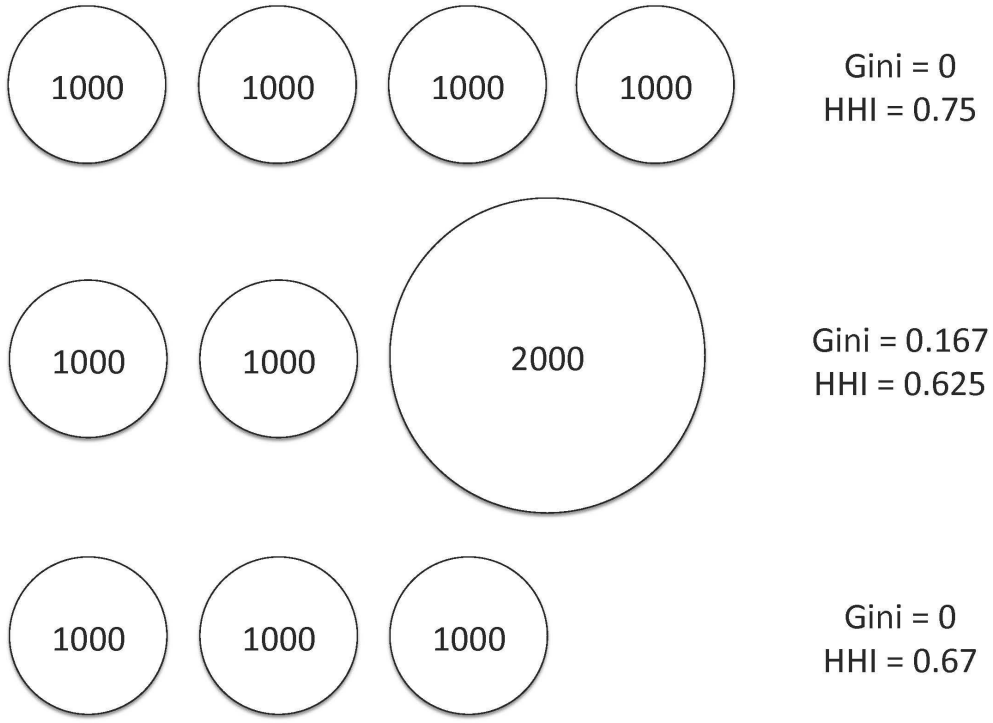
where *s* is the population share of (ethnic) group i and k is the number of groups. The index varies between a minimum of 0 for settings with only one group and a maximum of 1, which is reached when the population is divided into an infinite amount of groups. Many scholars explain the intuition of the index by highlighting that it gives the probability of two randomly drawn individuals belonging to the same group. This appealing interpretation is indeed the property that distinguishes it from other proposed diversity indices. Yet, this property is not what makes the index a diversity index.

What is diversity, conceptually? Stirling emphasizes that diversity is 'an attribute of any system whose elements may be apportioned into categories' (Stirling, 2007: 708). In accordance with this assertion, some researchers distinguish diversity as being concerned with differences across nominal types – such as parties, confessions or scientific disciplines – rather than variation or inequality of continuous attributes such as height, weight or income (e.g. Page, 2010). Many well-known statistical measures exist for the latter, such as standard deviation, coefficient of variation or Gini index.

Why not simply calculate the standard deviation or the Gini index of the population distribution across groups as a measure of diversity? We agree with von der Lippe (2006) that one should conceptualize diversity in a more precise way. To see why, imagine a population that consists of four ethnic groups, each with 1,000 members, as visualized in Figure 1. The number of members is clearly a continuous attribute, while the ethnic groups are categories. All measures of variation or inequality would suggest that there is no variation, since the four groups are of equal size. Thus, variation is not a property of any system whose elements may be apportioned into categories. There is diversity, however, since the population is distributed over four different groups. Now imagine that two of these four groups merge, so that we now have three ethnic groups, of which two have a population of 1000 members each and one has 2000 members. Now there is variation in the number of group members; it has increased from total equality to a considerable difference between the groups, or in terms of the Gini, it has increased from 0 to roughly 0.167. In terms of diversity, however, we have seen a decrease rather than an increase, because there is one group fewer, and because people tend to be more concentrated in one group rather than being equally distributed across the remaining three groups. Now imagine another scenario, in which one of the four ethnic groups is eliminated, leaving only three equally sized groups. From an inequality perspective, nothing has changed. All remaining three groups have an equally

large population of 1000 members; there is no variation. But diversity has obviously declined in comparison to the first scenario, because now the total population is distributed over only three rather than four groups.

Figure 1 Three examples about diversity and variation




What these examples make clear is that variation *relativizes* the number of categories over which the continuous attribute is distributed. For inequality, it does not matter whether we compare the distribution of income over roughly three million inhabitants of Berlin or over roughly eighty million inhabitants of Germany. Inequality is not by definition larger in Germany than in Berlin, because the former consists of more people. Diversity on the other hand recognizes the *absolute* number of categories. It makes a difference whether the population is equally distributed over three or over twenty ethnic groups. Diversity recognizes both the unequal distribution of the continuous attribute – whether it is income, people or body mass – and the absolute number of categories – whether these are ethnic groups, people or political parties. Variation or inequality in contrast only recognizes the former.

These hypothetical examples should help to understand that, according to Stirling (2007) and Page (2010), all conceptualizations of diversity have in common

that they deal with three basic properties: variation, balance and disparity. *Variation* refers to the number of categories or types, which in our case means the number of ethnic groups. *Balance* refers to how (un-)equally a continuous attribute (usually a population) is distributed over the categories – in our case, how similarly sized the population shares of the different ethnic groups are. *Disparity*, finally, refers to what actually distinguishes the categories from one another. It is important to note that there is a simple version of disparity and a complex one. In its simple version, disparity refers to what distinguishes nominal categories from one another; but all categories are seen as similarly different from one another. In most European research on ethnic diversity for example, ethnic categories are distinguished by nationality: Greeks are treated just as distinct from Egyptians, as Poles are from Argentinians. What such categories might be correlated with, but do not measure, is actual cultural diversity in norms, values, preferences, languages and meanings. This is the complex version of disparity, which goes beyond the necessary first step of merely differentiating categories: 'It is the answer to the question: "how different from each other are the types of thing that we have?"' (Stirling, 2007: 709). In the following we will focus on the simple version of disparity – but our de-compositional approach to diversity can easily be extended to take more complex versions of disparity into account.

Given the simple version of disparity, a diversity index is a way of compressing information on the number (variety) and population shares (balance) of ethnic groups in a given setting into a single number. As in any discussion that distinguishes two core dimensions, we can derive four ideal-typical compositions (see Figure 2):

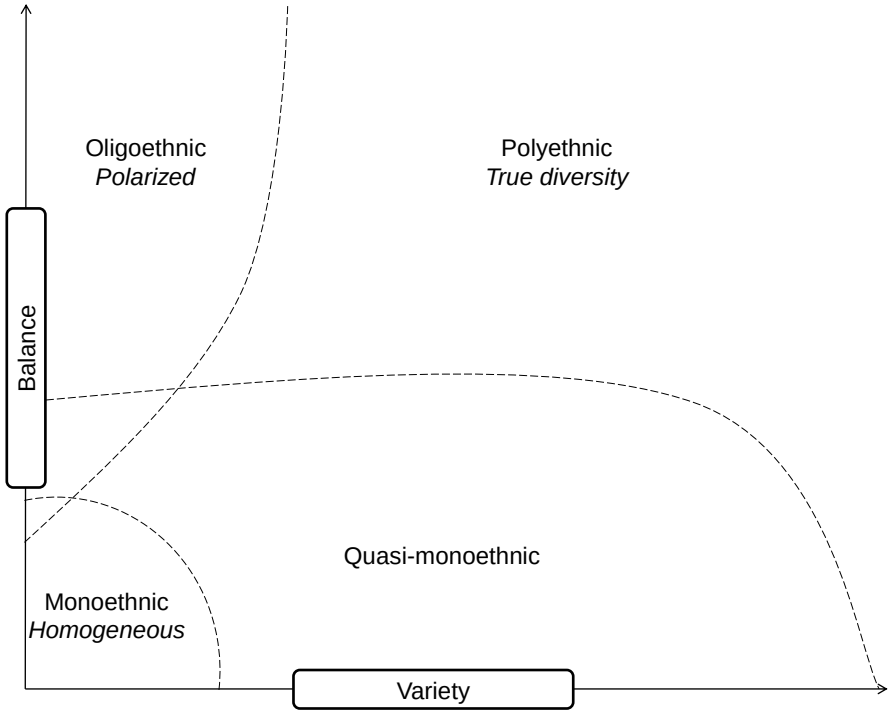
- Mono-ethnic or homogeneous settings are those in which there is, apart from perhaps a few deviant individuals, only one ethnic group. This composition is defined by the virtual absence of variety and extreme imbalance. Iceland before the recent arrival of immigrants could be an example of such a mono-ethnic society.
- Quasi-monoethnic settings are those in which there are non-negligible minority groups, but the sizes of each of these minority groups is dwarfed by that of one strongly dominant majority. The situation in most European immigration countries is generally a quasi-monoethnic one: a clear national majority is accompanied by a number of comparatively small minority immigrant groups. As we will argue below, the commonly used diversity indices are badly suited to capture diversity in such contexts because in

quasi-mono-ethnic situations they mainly pick up the balance dimension and hardly reflect the variety aspect of diversity.

- Oligoethnic or polarized compositions are those in which few roughly equally-sized ethnic groups coexist. Polarized settings are therefore defined by low variety and strong balance. In the most polarized composition, two equal-sized groups face each other. The index of (ethnic) polarization (see below) measures diversity along the poles of homogeneity and polarization.
- Polyethnic or truly diverse compositions are those with many more-or-less equally sized groups, which results in both high variety and balance. The Hirschman-Herfindahl Index measures diversity along the poles of homogeneity and true diversity.

Note that the distinction between the four types of ethnic compositions is not analytical – no clear-cut criterion marks the distinction between a quasi-monoethnic and a polarized composition, which is why the boundaries of the four spaces in Figure 2 overlap. Fortunately however, such clear criteria are not necessary, because ethnic diversity is not measured in terms of these types of compositions, but by continuous indices.

Figure 2 Types of ethnic composition



This classification is important for clarifying the ideal-typical diversity situations that different theoretical approaches judge to be harmful or not for social cohesion. Many political scientists and sociologists who work on the consequences of ethnic diversity refer to *group threat or competition* theories (e.g. Blalock, 1967; Olzak, 1992) and argue that ethnic struggles for resources and symbolic representation compromise social cohesion (e.g. Hou & Wu, 2009). Some authors claim that if group threat theory is right, it is not ethnic diversity per se that undermines trust and cooperation. By contrast, the most contentious situations are polarized, meaning that two equal opponents face each other: 'Conflict is less likely in societies in which fractionalization is minimal or maximal' (Dincer, 2011, p. 291; see also Esteban & Ray, 1994; Garcia-Montalvo & Reynal-Querol, 2004). The ideal-typical situation of minimal social cohesion is a polarized situation rather than a truly diverse one. The Hirschman-Herfindahl Index is hence a poor operationalization of this theory, which is better captured by the so-called index of (ethnic) polarization:

$$\mathrm{EP} = 1 - \sum_{i=1}^{k} \left(\frac{0.5 - s_i}{0.5}\right)^2 s_i$$

where $s$ is the population share of (ethnic) group $i$ and $k$ is the number of groups. This index increases if one shifts the population between categories in such a way that categories become equal in size. The index ranges from 0 where either all people belong to one category or are divided across an infinitive amount of categories, to 1 where there are two groups of equal size.

Other authors have referred to cultural differences between ethnic groups to explain problems of inter-ethnic co-existence. If a person's ethnic background is associated with certain preferences, ethnic diversity could stir disagreement about what a shared community should look like, and which public goods should be provided. The potential for such disagreement erodes trust (Kimenyi, 2006; Page, 2008). If so-called *asymmetrically distributed preferences* lie at the heart of negative diversity effects, the most harmful ethnic composition is a truly diverse one, because the more divergent interests there are the more complicated and unlikely compromises on shared goals become. Two polarized groups can come to a compromise on at least a few shared goals more easily than can a large number of groups. We arrive at a similar conclusion, if we conceive of ethno-cultural differences, not as preferences, but as habituated routines of action and ways of doing things, which allow us to interact and communicate with others (Swidler, 1986).

Translation problems increase with the number of languages spoken, which means that *coordination problems*, too, are a function of true diversity rather than of polarization, where only two languages or ways of doing things have to be coordinated. To the degree that ethnic boundaries are also reflected in network compositions, because people tend to associate with co-ethnics, ethnic diversity is also associated with lower *network density*, decreased social control and via this mechanism lower levels of social cohesion. Again a truly diverse situation would be most problematic, because here the network would be maximally clustered. It follows that for these theories, the Hirschman-Herfindhal Index is a suitable operationalization. We can thus test different theories against one another by comparing the explanatory power of the polarization versus the Hirschman-Herfindahl Index.

## *Ethnic disorder – generalized (ethnic) entropy as solution*

Unfortunately, such a comparison is only possible under certain, rather strict, empirical conditions, as Schaeffer (2013b) has shown. Only if a sample of contextual units (such as work groups, cities or countries) entails quasi-monoethnic, polarized and truly diverse contexts, do the two indices measure distinct properties. If however, as in most European cities or neighbourhoods, the native population is always the large majority and if the minority population is highly diverse and not dominated by one or a few single groups, the indices are highly collinear and thus empirically indistinguishable. Moreover, they tend to be extremely highly correlated with the simple percentage of natives – or its complement, the percentage of immigrants, which makes it even more difficult to determine whether any effects that are found are due to diversity or some other correlate of the presence of large numbers of immigrants. In other words, if a sample entails only quasi-monoethnic compositions, the unequal balance dimension dominates the commonly used diversity indices, which fail to discriminate along the variety of groups dimension, even though the recognition of both these dimensions is what characterizes a diversity index in the first place.

We propose generalized entropy as a solution to this problem. In physics, entropy indices measure a system's disorder – the variety of different discrete states molecules can be in and the (un-)equal probabilities of these states (Sethna, 2006, p. 81). If the variety of discrete states is exchanged for ethnic groups and the probabilities of these states for the groups' population shares, we can conceive of

*entropy as indices of ethnic disorder, i.e. diversity*. The generalized entropy index is of particular interest, because it entails a scaling parameter that weights balance against variety and hence allows giving more leverage to the latter dimension. According to Page (2010), a general formula that encompasses most entropy measures as special cases is given by:

$$\mathrm{E}_k^{\alpha} = \left( \sum_{i=1}^{k} s_i^{\alpha} \right)^{\frac{1}{1-\alpha}}$$

Where E is generalized entropy, $s_i$ denotes the share of ethnic group $i$, and $k$ the number of ethnic groups. $\alpha$, on the other hand, is the scaling parameter of interest that defines how much weight is given to variety and how much to balance when we compress or reduce those two aspects into a single number. For $\alpha = 0$, the measure simply captures the number of ethnic groups; all weight is given to the variety dimension. Increasing $\alpha$ means to increase the weight we give to the balance dimension and to decrease the weight of variety. For $\alpha = \infty$, the entropy measure reduces to the inverse of the largest group's population share $\left(\frac{1}{s_{largest}}\right)$, and neglects variety altogether. Among all possible values for the scaling parameter a generally feasible one is $\alpha = 2$, because here each group is weighted by its own population share, or in Page's words 'the measure weights proportions by their proportion' (Page, 2010: 70). To come full circle, the Hirschman-Herfindahl Index is simply the inverse of generalized entropy (so that it varies between 0 and 1) with $\alpha = 2$ and subtracted from unity (so that larger values denote more diversity). But because the proportions of minority groups are rather small in quasi-monoethnic compositions, they also receive little weight. In consequence the HHI neglects the variety dimension in samples that exclusively contain quasi-monoethnic compositions.

Against this background, we propose to compare the explanatory power of generalized entropy indices with different values for the scaling factor $\alpha$, as a strategy to answer whether balance or variety is more important in accounting for diversity effects. At least for samples that are strongly dominated by quasi-monoethnic compositions, focussing on ethnic entropy is a superior alternative to comparing the HHI to the EP index, which are empirically indistinguishable under such circumstances. In particular, we can investigate whether the explanatory power of entropy indices with smaller values for $\alpha$ increases, as theories predict that emphasize the variety of ethnic groups over which the population is spread. If

in contrast feelings of group threat were the main mechanism accounting for ethnic diversity effects, then balance is the single crucial dimension and entropy indices should yield higher explanatory power at higher values of $\alpha$.

## *Relational diversity*

Yet, classical diversity indices and entropy indices share a general problem: they measure a macro state that might have very different implications on the micro level. In immigration contexts in particular, more diversity will most of the time for immigrants also mean more in-group members, because where there are more immigrants there also tend to be more members of each immigrant group. Moreover, in most immigration countries, very high levels of ethnic homogeneity only occur in areas dominated by natives, where there are few immigrants of any ethnic group. Thus, for natives in-group size and diversity are negatively correlated – and often so highly that it becomes practically impossible to distinguish the two in empirical analyses using traditional diversity indices. Conversely, out-group threat is also differently related to diversity for immigrant minorities and the native majority. For natives, out-group size and thus presumably out-group threat increases with diversity, but for immigrant minorities out-group size tends to be inversely related to diversity, as in the limit case of a lone immigrant living in a setting completely dominated by natives. If in-group favouritism and out-group threat are important mechanisms behind diversity effects, diversity should also have different effects for members of different immigrant groups, particularly between larger minority groups, whose members will sometimes live in settings where their own group forms a significant part of the population, and very small ethnic groups, which nowhere attain significant numbers. Yet, common diversity indices as well as more sophisticated entropy measures assume that a given level of diversity affects all persons in a setting in the same way, regardless of whether they belong to the native majority, to a sizeable minority such as Turks in Germany, or to a tiny ethnic group. As such, these measures are inadequate for capturing the predictions of in-group favouritism and group threat accounts of diversity effects.

As a solution to this problem, we suggest decomposing in-group share and diversity into two separate statistics. This can easily be achieved by decomposing any ethnic diversity index into the population share of the own group and the

(ethnic) diversity of the others, the out-group members. For the Hirschman-Herfindahl Index this results in:

$$\text{In-Group Share} = \frac{n_i}{N_k}$$

$$\text{RHHI} = 1 - \sum_{j=1}^{G} \left( \frac{n_j}{N_g} \right)^2$$

where $n$ is the number of members of in-group $i$ or out-group $j$ and $N$ is the overall population. $k$ is the overall number of groups, including the in-group, while $g$ is the number of out-groups. We call this index the Relational Hirschman-Herfindahl Index, because our measure takes the relative position of each group into account, resulting in two times (in-group share and diversity of the others) as many diversity scores as there are groups in a given context. This stands in stark contrast to the existing global indices that estimate a single score for a given context. It means that particular diversity values not only need to be matched to particular contexts, but also to particular groups within particular contexts. Our proposed solution recognizes that the ethnic composition of, say, Berlin is different when seen from the perspective of a Turkish as compared to that of an Irish immigrant. For the former, diversity may be counterbalanced by the fact that Turks constitute in some neighbourhoods a sizeable minority, whereas Irish immigrants in Berlin never live in neighbourhoods where there ethnic in-group is a significant part of the population. We believe with Coleman (1990) that this is a theoretically desirable property. Good macro sociology should not only investigate macro relations, but also specify how macro-demographic structures impact upon individuals and this entails that similar macro structures might have different implications for different individuals. This of course complicates the derivation of macro-predictions because, if we wish to inquire whether social cohesion suffers in more diverse contexts, the answer might differ for different groups, depending on their population shares and the diversity of the groups surrounding them.

## *Relational (out-group) entropy*

Combining our two proposed innovations, we also need to define entropy measures in relational ways by calculating the diversity of out-groups for various levels of the scaling parameter $\alpha$, and adding the separate measure for relative in-group size

$$\text{In-Group Share} = \frac{n_i}{N_k}$$

$$\text{RE}_k^{\alpha} = \left( \sum_{i=1}^{g} \frac{{n_j}^{\alpha}}{N_g} \right)^{\frac{1}{1-\alpha}}$$

where RE is generalized entropy, $n$ is the number of members of in-group $i$ or out-group $j$ and $N$ is the overall population. $k$ is the overall number of groups, including the in-group, while $g$ is the number of out-groups.

Each of the discussed theories would predict the in-group share to be positively related to social cohesion. Most obviously, this is the case for theories of in-group favouritism, which expect trust and cooperation to be highest, the more public goods accrue to in-group members. Because in-group and total out-group size are inversely related, detrimental effects on social cohesion of perceived out-group threat should also be more limited the larger the in-group is. Because from the point of an individual a larger in-group size increases the number of people with whom one shares a language, norms, and preferences, and with whom one maintains close network links, in-group size should also be associated with greater social cohesion according to the other theoretical perspectives. However, in-group size is likely to matter mainly for groups for whom the size of the in-group carries significant weight in determining overall diversity. In the case at hand, this is primarily the case for natives, who make up between 63 and 99 percent of the population in the 55 counties that we compare. For minority groups in Germany, in-group size is a much less important factor in determining overall linguistic, preference or network diversity, as the maximum in-group size for minorities does not exceed eleven percent for any group in any of the counties and is below one percent for the median minority respondent in our sample. This expectation is in line with the finding of Bakker and Dekker (2012), who investigated the importance of in-group share in Amsterdam and found it to be an important predictor of neighbourhood cohesion only among native Dutch, but not among immigrants.

Our relational entropy measure allows for sharper distinctions between the theoretical perspectives. According to group threat theory, a unified out-group is more threatening than a similarly sized out-group population composed of many small groups. Therefore, out-group threat theories predict out-group entropy to matter for social cohesion, but to do so particularly at high values of alpha, which

emphasize the degree of concentration within the out-group population (balance), rather than the number of out-groups (variety). The lower the degree of diversity (entropy) among out-groups, i.e., the more the out-group is dominated by one single group, the more should we expect negative impacts on social cohesion. If on the other hand coordination problems, diverse preferences or network density are the main explanations for lower social cohesion, the fractionalization of out-group members is a crucial factor. Hence these theories would also predict out-group entropy to matter, but to do so especially at lower values of alpha, which emphasize variety rather than balance, and in such a way that higher levels of out-group diversity reduce social cohesion. Finally, if in-group favouritism is the core mechanism, out-group entropy should not matter at all. In this case, only relative comparisons between in-group and out-group members matter, but not the composition of the out-group. Table 1 gives an overview of the expectations that we derive from the different theoretical perspectives:

Table 1 Expected relations between relational (out-group) diversity and social cohesion

| | Predicted effects on social cohesion of: | |
|---|---|---|
| | In-group size | Relational entropy |
| In-group favouritism | Positive | None |
| Out-group threat | Positive | Positive; at high values of $\alpha$ |
| Coordination problems, preference diversity, network closure | Positive; but mainly for large in-groups (i.e. here for natives) | Negative; at low values of $\alpha$ |

## Data and Methods

The analysis relies on the German subset of the Ethnic Diversity and Collective Action Survey (EDCAS), which was conducted between October 2009 and April 2010 (Schaeffer, Koopmans, Veit, Wagner, & Wiedner, 2011). The German part of the survey consists of 7,500 standardized telephone interviews with participants who are at least 18 years of age. The survey has a 26 per cent oversample of persons of immigrant origin, here defined as either being born abroad or having at least one parent born abroad who came to Germany after 1949. There is an additional 14 per cent oversample of persons of Turkish origin. In order to prevent unfeasible screening costs these latter participants were not sampled via random digit dialling but via their last names from telephone books. These participants

also had the possibility to conduct the interview either in German or Turkish. 55 Kreise stratify the sample. Kreise are administrative units with an average population of about 190.000 inhabitants. In each region, 100 respondents were interviewed, except in five of the largest German cities where we conducted 500 interviews.

As dependent variables, we analyse three indicators of social cohesion that are of particular interest, as well as an overall neighbourhood cohesion scale. The first, trust in neighbours, is identical to the measure Putnam (2007) uses in his seminal article.

> *Please indicate on a scale from 0 to 10, how much you trust the people in your neighbourhood.*

The second, collective efficacy, was originally developed by Sampson, Morenoff and Earls (1999) and is designed to measure a community's capacity to collectively solve neighbourhood problems, such as waste lying about or street muggings and harassment. The EDCA-Survey measured collective efficacy with two items that are influenced by Friedrichs and Oberwittler (2007), who adapted the concept to suit the German context.

> *In neighbourhoods there are different problems. Let me give you some examples:*
>
> *On a public green space lies bulky waste. On a scale from zero to ten, how likely is it that people from your neighbourhood would jointly try to find a solution?*
>
> *In a dark alley several people have been mugged. On a scale from zero to ten, how likely is it that people from your neighbourhood would jointly try to find a solution?*

Our third measure, *reported social problems* in the neighbourhood, serves as an indicator of under-provision of neighbourhood public goods. We use a scale of two items, which refer to the same public goods as those used for measuring collective efficacy. We assume that disorderly waste disposal and unsafety are indicative of a failure of informal social control and cooperative norms in the neighbourhood.

> *How often do the following problems occur in your neighbourhood? Never, rarely, sometimes, often or very often?:*
>
> *Waste lying about?*
>
> *Harassment or verbal abuse?*

In addition to these separate indicators, we built a neighbourhood cohesion scale that has a Chronbach's Alpha of 0.69. To measure the degree of ethnic diversity of the cities and regions in which the respondents live, we use data from the Federal Office for Migration and Refugees' central register of foreign nationals, which is the most reliable source of information on the foreign population in Germany. The population shares of people from all 193 fully recognized nations are available. Ethnic categories are thus defined by nationality, which fits the way ethnicity is conceived of in Germany (Schaeffer, 2013c). Using nationality to distinguish ethnic categories has the disadvantage that all people of immigrant origin who have acquired German citizenship are treated as German natives, meaning that diversity is probably underestimated. Therefore, we conducted additional analyses with inflated indices that do not underestimate the overall share of persons of immigrant origin (for more information see Koopmans & Veit, 2013; Schaeffer, 2013b). But since the results do not imply any alternative conclusions, we here only report results based on nationality.

We estimate a series of different relational entropy measures by varying the scaling factor $\alpha$ between 3 and 0.1 in 0.1 sized steps, i.e., 30 indices overall. We choose the rather low value of 3 as starting point, because, as we have argued above, already for a value of 2, which is equivalent to the classical Hirschman-Herfindahl index, the measure hardly gives any weight to the variety dimension. The 30 indices of course correlate strongly with one another. For this reason we estimate separate models and compare the development of the model fit in terms of $R^2$ rather than test the indices against each other in one model. To measure in-group size, we attribute to each respondent the local population share of his or her ethnic group. This implies that we calculate up to 194 (193 immigrant ethnic groups plus natives) in-group shares, as well as up to 194 distinct relational entropy measures for each of the 55 contextual units.

Importantly, the effects in-group size and relational out-group entropy are empirically distinguishable because the two measures have low inter-correlations among both natives (.24 at $\alpha$=2) and immigrants (.02). Only in the combined sample do the variables correlate highly (.82). This is because out-group diversity tends to be low for immigrants (because of the strong dominance of natives among out-groups) and high for natives (because of the generally high variety of immigrant groups across Germany) while simultaneously in-group size is low for immigrants and high for natives. We deal with this problem by presenting sepa-

rate analyses for the native and immigrant samples, and by controlling for level differences by including immigrant background in the combined regression.

The four dependent variables are regressed on the above-discussed diversity measures, migration background, as well as on the following additional control variables: the number of years someone has lived in the neighbourhood, home ownership, education, gender, dummies indicating the religious confession, being married, and age. On the context level, the analyses control for East/West-German differences, the local unemployment rate, the population per square kilometre, and the total size of the local foreign population. We include the latter control variable because, all other things being equal, there is a greater likelihood that many different ethnic groups are represented in a particular context if the absolute number of foreign residents is large. By including foreign population size as a control, we avoid that entropy measures that strongly emphasize the variety of groups (i.e., with low $\alpha$ values) pick up unwanted scale effects. The descriptive statistics of all dependent and independent variables are shown in Table 2.

## *Modelling strategy*

Since the data is clustered in 55 cities and regions and the analyses include context-level variables, a multi-level modelling strategy is needed. We estimate linear (OLS) regression models with cluster-robust standard errors. Cluster-robust standard errors have the advantage that the standard errors of parameters of context-level regressors are not underestimated (Angrist & Pischke, 2009: 308-323). Moreover, they assume 'no particular kind of within-cluster correlation nor a particular form of heteroscedasticity' (Wooldridge, 2003: 134), meaning they allow for any kind of upper and lower-level heteroscedasticity. Random intercept models, an alternative estimation strategy, assume homoscedastic errors on both the individual and contextual level (e.g. Rabe-Hesketh & Skrondal, 2008). For our analyses, this is an unrealistic assumption given that some contextual units are highly dense and socio-culturally heterogeneous cities like Berlin or Hamburg, while others are sparsely populated, homogeneous rural areas like Oberallgäu. Yet, results of estimations that rely on random intercept models yield similar conclusions.

Table 2 Descriptive statistics

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| *Dependent Variables* | | | | |
| Trust in neighbours | 6.78 | 2.53 | 0.00 | 10.00 |
| Collective efficacy | 6.19 | 2.57 | 0.00 | 10.00 |
| Reported social problems | 0.76 | 0.79 | 0.00 | 4.00 |
| Neighbourhood cohesion scale | 0.00 | 1.00 | -3.97 | 1.66 |
| *Individual Level Variables* | | | | |
| Age (in 10 years) | 4.83 | 1.69 | 1.80 | 9.70 |
| Education, reference: Low | 0.09 | 0.28 | 0.00 | 1.00 |
| Medium | 0.61 | 0.49 | 0.00 | 1.00 |
| High | 0.30 | 0.46 | 0.00 | 1.00 |
| Employed | 0.61 | 0.49 | 0.00 | 1.00 |
| Residence in the neighbourhood (in 10 years) | 1.90 | 1.61 | 0.00 | 9.00 |
| Home owner | 0.45 | 0.50 | 0.00 | 1.00 |
| Female | 0.54 | 0.50 | 0.00 | 1.00 |
| Immigrant origin | 0.43 | 0.49 | 0.00 | 1.00 |
| Married | 0.52 | 0.50 | 0.00 | 1.00 |
| Religion, reference: Atheist | 0.40 | 0.49 | 0.00 | 1.00 |
| Protestant | 0.18 | 0.38 | 0.00 | 1.00 |
| Catholic | 0.19 | 0.39 | 0.00 | 1.00 |
| Muslim | 0.16 | 0.37 | 0.00 | 1.00 |
| Other | 0.07 | 0.25 | 0.00 | 1.00 |
| Immigrant origin | 0.43 | 0.49 | 0.00 | 1.00 |
| *Contextual Level Variables* | | | | |
| East Germany | 0.13 | 0.34 | 0.00 | 1.00 |
| Local unemployment rate | 0.09 | 0.03 | 0.03 | 0.15 |
| Aggregate level | 0.08 | 0.03 | 0.03 | 0.15 |
| Population density | 1.53 | 1.36 | 0.04 | 4.27 |
| Aggregate level | 0.96 | 1.05 | 0.04 | 4.27 |
| Local foreign population (in 1000) | 96.44 | 130.19 | 1.08 | 448.39 |
| Aggregate level | 42.30 | 80.75 | 1.08 | 448.39 |
| *Diversity indices* | | | | |
| Relational (out-group) entropy$^{0.5}$ | 41.75 | 23.46 | 3.43 | 81.88 |
| In-group share | 0.50 | 0.41 | 0.00 | 0.98 |
| Aggregate level | 0.92 | 0.06 | 0.70 | 0.99 |

Unfortunately, only 82% of the native German and 77% of the respondents of immigrant origin answered all questions. This is particularly due to missing values on religious and educational background. We therefore estimate the models with twenty multivariate imputations for missing values – herewith we follow the suggestion of Graham, Olchowski and Gilreath (2007). As proposed by Enders (2010), the imputation model consisted of all variables used in the analyses. The imputation procedure also includes respondents who discontinued the telephone interview, because these were part of the original sampling plan and should thus not be excluded.

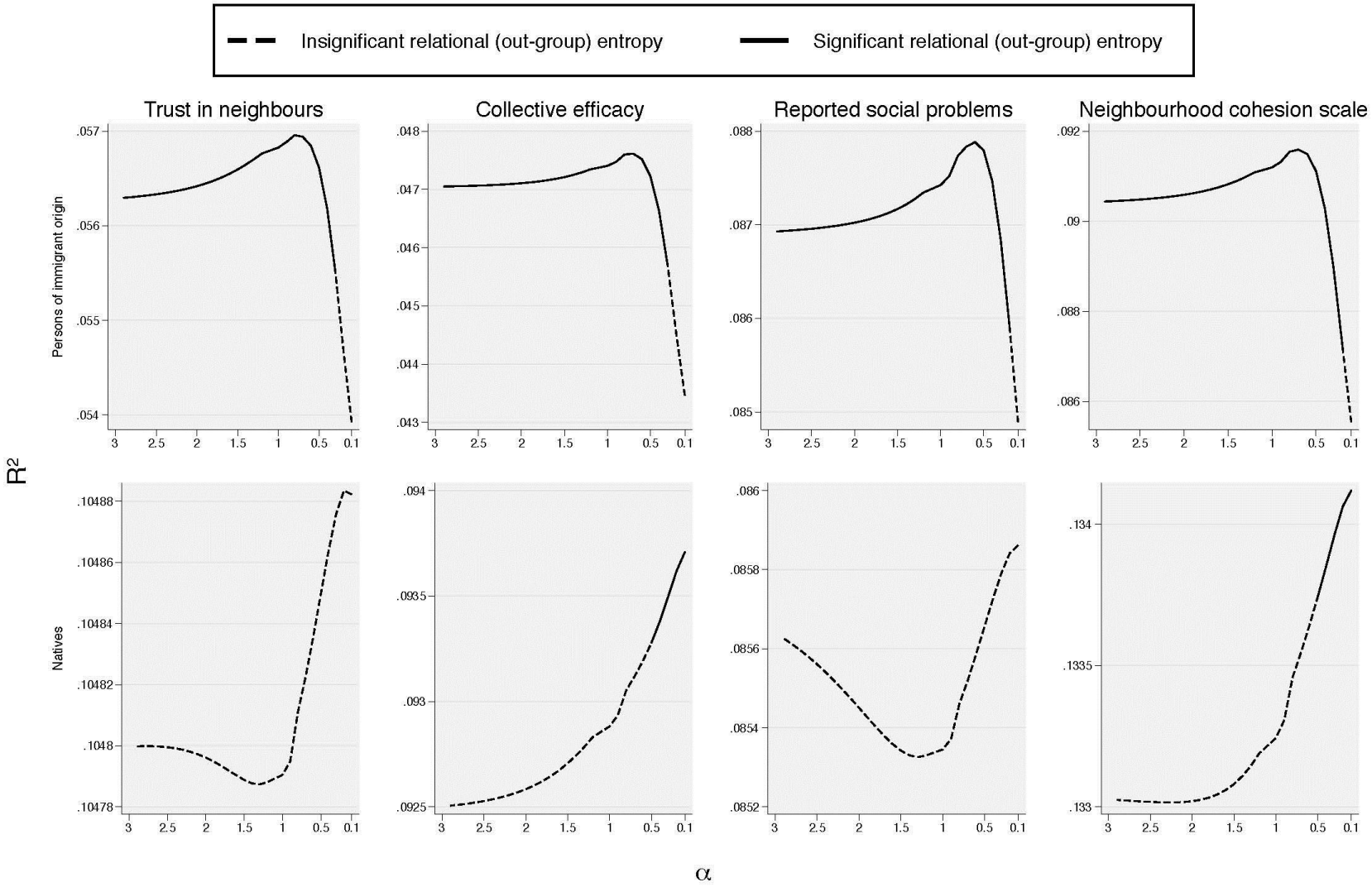
However, comparing fit between the models is not straightforward, because they rely on multiply imputed data. Weakliem (2004) suggests to compare Akaike's Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Unfortunately, it is an open domain of research how to estimate AIC and BIC values for models that rely on multiply imputed data. Instead, we use $R^2$ values that we estimate with Yula Marchenko's mibeta Stata ado-file, which is based on Harel's (2009) suggestions on how to estimate $R^2$ values with multiply imputed data.

**Results**

In order to compare entropy at 30 different levels of the scaling parameter, we estimated altogether 120 regressions including the full set of contextual and individual level controls, for each of our four dependent variables and separately for the samples of persons of immigrant origin, natives, and the two pooled. Because we cannot display the full results of so many regression models, we first determine at which level of the $\alpha$ parameter our measure of relational (out-group) entropy has the most explanatory power. Figure 3 shows the results in terms of the significance of the relational (out-group) entropy measures and the overall explained variance for natives and immigrants separately. A similar figure for the pooled sample can be found in the appendix (Figure A.1).

The model fits and significance levels indicate that the variety component of diversity drives responses to diversity for both immigrants and natives. As $\alpha$ decreases, so that the relational (out-group) entropy measure gives more emphasis to the variety of groups rather than to the balance of their population shares, explanatory power increases. For immigrants, out-group entropy is a significant predictor of all four dependent variables and across a wide range of $\alpha$, but reaches its strongest predictive power at $\alpha \approx 0.5$, i.e. a diversity index that gives considerably more weight to the variety dimension than the classical HHI. For even smaller $\alpha$ values, at which the index merely reflects the number of groups without considering their population shares, the explanatory power diminishes again and loses significance. For natives, we see a very similar pattern of increasing explanatory power as $\alpha$ declines, and out-group entropy becomes a significant predictor of collective efficacy and the overall neighbourhood cohesion scale at $\alpha$ levels of 0.5 and lower, where the measure heavily weighs the number rather than the relative sizes of out-groups. For trust in neighbours and reported social problems the

Figure 3 Explanatory power of ethnic entropy with varying α



tendency is similar, but the entropy coefficients do not become significant. Contrary to group threat theory we thus find that, given a certain level of total out-group size, it is the variety of different ethnic out-groups, rather than the presence of one or a few large out-groups (balance) that has the strongest effects for both natives and immigrants. Another noteworthy implication of the results is that with a conventional measure of diversity such as the HHI, which is equivalent to the $\alpha = 2$ level in the figure, we would not have found any significant (outgroup) diversity effect for natives, and would have underestimated (out-group) diversity effects for immigrants. Thus, entropy measures not only allow us to differentiate between theoretical mechanisms that have been proposed for diversity effects, but also to detect diversity effects where we would otherwise have concluded that there are none.

The increases in explanatory power, for both natives and persons of immigrant origin alike, are certainly modest, but should be put into context: the total contribution of the local unemployment rate (the other highly significant contextual level predictor) to the $R^2$ is at best 0.004 and therewith about as important as the increases in the explanatory power of relational (out-group) entropy at smaller $\alpha$. A second concern might be that for small values of $\alpha$ the relational (out-group) entropy merely reflects the size of the foreign population, since the variety of groups is large where many foreign nationals live. But the results presented here are statistically controlled for the local size of the foreign population, which tends not to be related to neighbourhood cohesion in contrast to out-group fractionalization.

We now turn our attention to the direction of diversity effects, and to the role of in-group size. To this end we present in Table 3 regression results using relational entropy at $\alpha = 0.5$, which as Figure 3 showed is the level of $\alpha$ at which it overall predicts our social cohesion measures best. We do not display the results for the control variables, but the full regression tables can be found in the appendix (Tables A.1 to A.3). Results for in-group size in Table 3 are similar to those using entropy at other $\alpha$ levels (results available upon request).

The table shows that in-group share is a strong and significant predictor of neighbourhood cohesion among native respondents, but less so among persons of immigrant origin (see similarly Bakker and Dekker 2012). While the coefficients for majority and minority respondents are quite similar in size – with the exception of trust in neighbours – the standard errors for persons of immigrant origin are too large to draw robust conclusions. Accordingly, in-group share is a strong

Table 3 Relational diversity as predictor of neighbourhood cohesion across 55 German cities and regions

| | Trust in neighbours | Collective efficacy | Reported social problems | Neighborhood cohesion scale |
|---|---|---|---|---|
| **Persons of immigrant origin** | | | | |
| In-group share | -0.017 | 0.512 | -0.233 | 0.400 |
| | (0.270) | (0.340) | (0.455) | (0.356) |
| Relational (outgroup) entropy$^{0.5}$ | -0.368$^{***}$ | -0.418$^{***}$ | 0.449$^{**}$ | -0.539$^{***}$ |
| | (0.100) | (0.103) | (0.131) | (0.112) |
| Control variables | Yes | Yes | Yes | Yes |
| $R^2$ | 0.056 | 0.047 | 0.088 | 0.090 |
| Obs | 3307 | 3307 | 3307 | 3307 |
| ***Native Germans*** | | | | |
| In-group share | 0.234$^{*}$ | 0.348$^{**}$ | -0.524$^{**}$ | 0.496$^{***}$ |
| | (0.096) | (0.125) | (0.158) | (0.132) |
| Relational (outgroup) entropy$^{0.5}$ | -0.021 | -0.080$^{*}$ | 0.050 | -0.075$^{*}$ |
| | (0.026) | (0.038) | (0.036) | (0.035) |
| Control variables | Yes | Yes | Yes | Yes |
| $R^2$ | 0.105 | 0.093 | 0.086 | 0.134 |
| Obs | 4581 | 4581 | 4581 | 4581 |
| ***Persons of immigrant origin and natives pooled*** | | | | |
| In-group share | 0.255$^{**}$ | 0.357$^{***}$ | -0.370$^{**}$ | 0.442$^{***}$ |
| | (0.081) | (0.088) | (0.111) | (0.092) |
| Relational (outgroup) entropy$^{0.5}$ | -0.045 | -0.110$^{**}$ | 0.075 | -0.108$^{**}$ |
| | (0.025) | (0.036) | (0.050) | (0.039) |
| Control variables | Yes | Yes | Yes | Yes |
| $R^2$ | 0.111 | 0.074 | 0.081 | 0.120 |
| Obs | 7888 | 7888 | 7888 | 7888 |

*Note*: Estimates are from OLS regressions with standardized coefficients and cluster-robust standard errors that control for: East/West German differences, the local unemployment rate, the population per square kilometre, and the total size of the local foreign population, age, employment status, gender, education, family status, religious background, home ownership, and where applicable migration background and immigrant generation. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

and significant determinant of neighbourhood cohesion in the pooled sample. Depending on the outcome, a standard deviation increase of the in-group share is associated with an increase of neighbourhood cohesion by a quarter (trust in neighbours) to half a standard deviation (neighbourhood cohesion scale). Overall, this supports the prediction, which all theoretical perspectives on diversity effects share, that in-group size matters. But the fact that in-group size is a significant predictor only for natives particularly only fits the prediction derived from theories emphasizing coordination problems, asymmetric preferences, and social control, namely that in-group size is likely to matter most for groups for whom the size of the in-group carries significant weight in determining overall linguistic, value, and network diversity.

Nevertheless, the stronger test among theories is the association between neighbourhood cohesion and relational (out-group) entropy. Table 3 shows that among persons of immigrant origin the diversity of others is strongly negatively related to neighbourhood cohesion, with a standard deviation increase predicting a reduction of between 37% (trust in neighbours) to 54% (neighbourhood cohesion scale) of a standard deviation in neighbourhood cohesion. This strong negative relation holds significantly for all four dependent variables and thereby contradicts group threat theory, which had predicted a positive relationship between out-group diversity and cohesion, because a homogeneous out-group is supposedly more threatening than a fractionalized one. Among natives the results are less striking, but nevertheless refute group threat theory. The coefficients are all in the same direction as for persons of immigrant origin, but they are much smaller and significant only for collective efficacy and the neighbourhood cohesion scale. Among natives, a standard deviation increase in out-group diversity is associated with an 8% decline in neighbourhood cohesion.

Overall then, these findings speak against the majority of the sociological and political science literature that treats feelings of group threat as the key explanatory mechanism accounting for negative ethnic diversity effects. Group threat theory is essentially a theory about population shares of out-groups and thus about balance. Contrary to this perspective, the more we emphasize fractionalization rather than balance, the better our prediction of neighbourhood cohesion becomes. At least among natives, the pattern does not necessarily speak against in-group favouritism, but cannot be fully explained from its viewpoint either, since the diversity of out-groups should not have been relevant from this theoretical perspective. The pattern among immigrants deviates even more from the predictions of

in-group favouritism, since we find no significant in-group size effects and strong out-group diversity effects. Only theories about increased collective choice, action and coordination problems in settings with a large variety of groups can account for all three findings: in-group share as a strong and robust predictor of neighbourhood cohesion only among the majority, out-group diversity as a negative predictor of neighbourhood cohesion, and the latter particularly so if it emphasizes variety of groups rather than balance.

## Conclusion

Diversity consists of two defining properties: variety and balance. But in most settings, the well-established diversity indices do not properly account for the crucial variety dimension of diversity. This reflects the relative theoretical neglect of cultural and network explanations and the dominant view that negative ethnic diversity effects are rooted in feelings of out-group threat and in-group favouritism. Moreover, taking in-group favouritism and group threat theory seriously, the own group's share matters so that the same ethnic composition may have divergent implications for people of different ethnic backgrounds, especially for the contrasting cases of majority and minority members. In this paper, we have proposed two innovative ways to de-compose diversity indices in order to compare the predictions of competing explanations of why ethnic diversity matters. First, we distinguishing in-group share from the diversity of ethnic out-groups. Second, we show how generalized entropy measures can be used to test which of diversity's two basic dimensions matters most: the variety of groups, or the balance of their population shares. This de-composition allows for straightforward tests of competing theories. In-group favouritism and group threat theories emphasize the relative sizes of in-group and out-groups (i.e., balance aspects of diversity), whereas theories about coordination problems, preference diversity, and network closure predict trust and cooperation problems to increase with the number of different groups (i.e., the variety aspect of diversity). An additional advantage of our approach is that it can be applied to samples of contextual units that are strongly dominated by what we have called 'quasi-monoethnic' settings, i.e. contextual units that are dominated by one large majority. In such contexts, which are the rule rather than the exception in most immigration countries, conventional diversity and polarization indices are indistinguishable from each other as well as from the mere percentage shares of natives or immigrants. Lacking a measurement instrument that is sensitive to theoretically relevant features of ethnic composition,

the findings of research on the impact of immigration on social cohesion have, in spite of the large number of studies that have been conducted, remained theoretically inconclusive. We view our de-compositional and relational approach to diversity as a promising way to draw theoretically more meaningful conclusions.

The results of our application of these ideas in an analysis of social cohesion across 55 German localities speak against the majority of the sociological and political science literatures, which treat in-group favouritism and feelings of group threat as the key explanatory mechanism accounting for negative ethnic diversity effects. While all proposed explanations predict in-group shares to matter, cultural and network explanations best account for our finding that the in-group share is most important for determining neighbourhood cohesion among native majority members. For minorities in-group size is a much less important factor in determining overall linguistic, preference or network diversity and concomitantly in-group share does not attain statistical significance as a predictor of social cohesion for minorities, although the coefficients point in the same direction as for natives. Furthermore, we find out-group diversity to be negatively related to neighbourhood cohesion, which directly contradicts group threat theory which predicts a homogeneous out-group (i.e., low out-group diversity) to be the most threatening. The finding does not necessarily speak against in-group favouritism, but cannot be accounted for by it either because from the in-group favouritism perspective the composition of out-groups should matter little. Finally, we showed, using a range of entropy measures with different scaling parameters, that the predictive power of out-group diversity increases as the entropy measure emphasizes the variety of out-groups over the balance of their population shares. Only theories about increased coordination problems, diversity of preferences and network closure can account for all three findings, i.e. the importance of in-group share among the majority but not minority members, out-group diversity as a negative predictor of neighbourhood cohesion, and the latter particularly so if it emphasizes out-group fractionalization rather than balance.

We hope to inspire other researchers to move away, where possible, from conventional diversity measures such as the Hirschman-Herfindahl index, and to take seriously that from a theoretical perspective, diversity is neither a one-dimensional phenomenon, nor is it plausible to expect that the same aggregate ethnic composition affects all members of a population in the same way, regardless of their own group membership. Diversity is about balance *and* variety, and different theoretical perspectives emphasize the one or the other of these dimen-

sions. All available theoretical approaches moreover imply that in-group size should matter, but nevertheless, for any particular context, conventional diversity indices attribute the same diversity value to a member of a dominant group member who lives surrounded by co-ethnics, as to a member of a tiny minority, who has no in-group members around him. This makes no theoretical sense and may be one reason why past research findings have sometimes been contradictory. In addition, the use of entropy measures of diversity allows us to detect diversity effects where conventional measures would have led us to conclude that there are none. Tying our measurement instruments, along the lines we have proposed, more closely to relevant theoretical approaches may help move ahead a research field that is currently characterized more by repetition than theoretical advancement.

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## Appendix

Figure A.1

Table A.1: Relational diversity as predictor of neighbourhood cohesion across 55 German cities and regions among persons of immigrant origin

| | Trust in neighbours | Collective efficacy | Reported social problems | Neighborhood cohesion scale |
|---|---|---|---|---|
| In-group share | -0.017 | 0.512 | -0.233 | 0.400 |
| | (0.270) | (0.340) | (0.455) | (0.356) |
| Relational (outgroup) entropy$^{0.5}$ | -0.368$^{***}$ | -0.418$^{***}$ | 0.449$^{**}$ | -0.539$^{***}$ |
| | (0.100) | (0.103) | (0.131) | (0.112) |
| Local unemployment rate | -0.073$^{**}$ | -0.083$^{**}$ | 0.146$^{***}$ | -0.130$^{***}$ |
| | (0.022) | (0.024) | (0.028) | (0.027) |
| Population density | 0.074 | 0.036 | -0.069 | 0.069 |
| | (0.043) | (0.042) | (0.057) | (0.047) |
| Local foreign population | 0.019 | 0.028 | 0.022 | 0.015 |
| | (0.037) | (0.029) | (0.030) | (0.034) |
| Age (in 10 years) | 0.070$^{***}$ | -0.004 | -0.066$^{***}$ | 0.045$^{*}$ |
| | (0.017) | (0.018) | (0.013) | (0.017) |
| Medium | 0.010 | 0.046 | -0.024 | 0.044 |
| | (0.057) | (0.060) | (0.069) | (0.058) |
| High | 0.141$^{*}$ | 0.056 | -0.063 | 0.106 |
| | (0.068) | (0.069) | (0.084) | (0.072) |
| Employed | 0.013 | 0.005 | -0.055 | 0.031 |
| | (0.045) | (0.033) | (0.037) | (0.036) |
| Residence in the neighborhood (in 10 years) | 0.057$^{**}$ | 0.029 | 0.063$^{***}$ | 0.011 |
| | (0.018) | (0.018) | (0.017) | (0.017) |
| Home owner | 0.227$^{***}$ | 0.280$^{***}$ | -0.360$^{***}$ | 0.381$^{***}$ |
| | (0.037) | (0.040) | (0.037) | (0.038) |
| Female | 0.049 | 0.067$^{*}$ | -0.161$^{***}$ | 0.125$^{***}$ |
| | (0.035) | (0.028) | (0.039) | (0.031) |
| East Germany | -0.065 | 0.010 | 0.035 | -0.028 |
| | (0.090) | (0.086) | (0.086) | (0.093) |
| Married | 0.180$^{***}$ | 0.136$^{**}$ | -0.062 | 0.163$^{**}$ |
| | (0.037) | (0.047) | (0.046) | (0.049) |
| Protestant | 0.164$^{*}$ | 0.089 | -0.026 | 0.115 |
| | (0.063) | (0.062) | (0.076) | (0.060) |
| Catholic | 0.031 | 0.003 | 0.045 | -0.005 |
| | (0.062) | (0.058) | (0.072) | (0.063) |
| Muslim | -0.004 | -0.041 | -0.110 | 0.018 |
| | (0.059) | (0.053) | (0.077) | (0.058) |
| Other | 0.028 | 0.005 | 0.035 | -0.003 |
| | (0.069) | (0.077) | (0.071) | (0.080) |
| 2. Generation | 0.072 | -0.042 | 0.140$^{**}$ | -0.058 |
| | (0.045) | (0.039) | (0.048) | (0.039) |
| Constant | -1.298$^{***}$ | -0.191 | 0.722 | -0.804 |
| | (0.350) | (0.396) | (0.528) | (0.412) |
| $R^2$ | 0.056 | 0.047 | 0.088 | 0.090 |
| Obs | 3307 | 3307 | 3307 | 3307 |

Cluster-robust standard errors in parentheses, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table A.2: Relational diversity as predictor of neighbourhood cohesion across 55 German cities and regions among native Germans

| | Trust in neighbours | Collective efficacy | Reported social problems | Neighborhood cohesion scale |
|---|---|---|---|---|
| In-group share | 0.234* | 0.348** | -0.524** | 0.496*** |
| | (0.096) | (0.125) | (0.158) | (0.132) |
| Relational (outgroup) entropy$^{0.5}$ | -0.021 | -0.080* | 0.050 | -0.075* |
| | (0.026) | (0.038) | (0.036) | (0.035) |
| Local unemployment rate | -0.032* | -0.055* | 0.072** | -0.071** |
| | (0.014) | (0.022) | (0.023) | (0.023) |
| Population density | -0.041 | -0.032 | -0.045 | -0.011 |
| | (0.036) | (0.050) | (0.063) | (0.057) |
| Local foreign population | 0.037 | 0.018 | 0.116*** | -0.026 |
| | (0.025) | (0.030) | (0.032) | (0.031) |
| Age (in 10 years) | 0.058*** | -0.002 | -0.070*** | 0.045*** |
| | (0.011) | (0.012) | (0.011) | (0.012) |
| Medium | 0.144 | 0.029 | -0.033 | 0.076 |
| | (0.074) | (0.071) | (0.073) | (0.069) |
| High | 0.218** | 0.058 | -0.011 | 0.107 |
| | (0.075) | (0.078) | (0.077) | (0.074) |
| Employed | 0.019 | 0.105*** | -0.007 | 0.072* |
| | (0.032) | (0.028) | (0.038) | (0.032) |
| Residence in the neighborhood (in 10 years) | 0.047*** | 0.007 | 0.018* | 0.011 |
| | (0.007) | (0.009) | (0.008) | (0.008) |
| Home owner | 0.220*** | 0.347*** | -0.223*** | 0.364*** |
| | (0.026) | (0.037) | (0.039) | (0.034) |
| Female | 0.069* | 0.093*** | -0.114*** | 0.124*** |
| | (0.027) | (0.025) | (0.026) | (0.025) |
| East Germany | 0.089 | 0.102 | 0.006 | 0.088 |
| | (0.051) | (0.056) | (0.058) | (0.055) |
| Married | 0.150*** | 0.125*** | 0.007 | 0.120*** |
| | (0.030) | (0.023) | (0.023) | (0.022) |
| Protestant | 0.176*** | 0.165*** | 0.051 | 0.134*** |
| | (0.031) | (0.039) | (0.032) | (0.036) |
| Catholic | 0.130** | 0.096** | -0.032 | 0.111** |
| | (0.038) | (0.034) | (0.033) | (0.032) |
| Muslim | 0.313 | -0.402 | 1.303*** | -0.718* |
| | (0.260) | (0.241) | (0.310) | (0.281) |
| Other | -0.022 | -0.074 | 0.035 | -0.065 |
| | (0.072) | (0.072) | (0.064) | (0.065) |
| Constant | -0.939*** | -0.665*** | 0.914*** | -1.067*** |
| | (0.122) | (0.129) | (0.164) | (0.135) |
| $R^2$ | 0.105 | 0.093 | 0.086 | 0.134 |
| Obs | 4581 | 4581 | 4581 | 4581 |

Cluster-robust standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: Relational diversity as predictor of neighbourhood cohesion across 55 German cities and regions among persons of immigrant origin and native Germans

| | Trust in neighbours | Collective efficacy | Reported social problems | Neighborhood cohesion scale |
|---|---|---|---|---|
| In-group share | 0.255** | 0.357*** | -0.370** | 0.442*** |
| | (0.081) | (0.088) | (0.111) | (0.092) |
| Relational (outgroup) entropy$^{0.5}$ | -0.045 | -0.110** | 0.075 | -0.108** |
| | (0.025) | (0.036) | (0.050) | (0.039) |
| Local unemployment rate | -0.044*** | -0.057** | 0.093*** | -0.085*** |
| | (0.012) | (0.018) | (0.026) | (0.023) |
| Population density | -0.035 | -0.044 | 0.021 | -0.046 |
| | (0.024) | (0.035) | (0.052) | (0.045) |
| Local foreign population | 0.040 | 0.034 | 0.047 | 0.014 |
| | (0.020) | (0.021) | (0.025) | (0.025) |
| Age (in 10 years) | 0.063*** | -0.005 | -0.073*** | 0.046*** |
| | (0.010) | (0.009) | (0.007) | (0.008) |
| Medium | 0.055 | 0.038 | -0.034 | 0.057 |
| | (0.041) | (0.045) | (0.058) | (0.045) |
| High | 0.151** | 0.064 | -0.032 | 0.100* |
| | (0.045) | (0.051) | (0.065) | (0.049) |
| Employed | 0.023 | 0.063** | -0.026 | 0.056* |
| | (0.025) | (0.020) | (0.026) | (0.022) |
| Residence in the neighborhood (in 10 years) | 0.048*** | 0.012 | 0.030*** | 0.010 |
| | (0.007) | (0.008) | (0.007) | (0.006) |
| Home owner | 0.223*** | 0.317*** | -0.281*** | 0.371*** |
| | (0.020) | (0.030) | (0.026) | (0.028) |
| Female | 0.058* | 0.083*** | -0.132*** | 0.123*** |
| | (0.022) | (0.021) | (0.025) | (0.023) |
| East Germany | 0.074 | 0.088 | -0.067 | 0.104 |
| | (0.046) | (0.047) | (0.055) | (0.057) |
| Married | 0.160*** | 0.135*** | -0.014 | 0.138*** |
| | (0.021) | (0.022) | (0.025) | (0.023) |
| Protestant | 0.161*** | 0.142*** | 0.045 | 0.118*** |
| | (0.029) | (0.035) | (0.031) | (0.031) |
| Catholic | 0.087* | 0.061* | -0.002 | 0.065* |
| | (0.034) | (0.026) | (0.030) | (0.028) |
| Muslim | 0.006 | 0.005 | -0.100 | 0.045 |
| | (0.046) | (0.042) | (0.064) | (0.049) |
| Other | 0.003 | -0.033 | 0.033 | -0.032 |
| | (0.059) | (0.064) | (0.041) | (0.058) |
| Immigrant origin | 0.251 | 0.508* | -0.692*** | 0.663*** |
| | (0.188) | (0.195) | (0.191) | (0.190) |
| 2. Generation | 0.048 | -0.047 | 0.157** | -0.074* |
| | (0.041) | (0.034) | (0.046) | (0.036) |
| Constant | -0.881*** | -0.596*** | 0.834*** | -0.975*** |
| | (0.100) | (0.102) | (0.094) | (0.090) |
| $R^2$ | 0.111 | 0.074 | 0.081 | 0.120 |
| Obs | 7888 | 7888 | 7888 | 7888 |

Cluster-robust standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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