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Intergroup Contact and Exposure to Information about Immigrants: Experimental Evidence

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Abstract

We examine the relationship between beliefs about and attitudes towards immigrants and intergroup contact between natives and migrants in eastern Germany, a region characterized by anti-immigrant sentiment. Using probability-based survey data, we randomly vary respondents' access to a signal about the true size of the immigrant population in the region. Respondents who receive the signal show more supportive attitudes toward immigration, with effect sizes being more pronounced for attitudes toward high-skilled immigrants. Importantly, estimating conditional average treatment effects shows that respondents who have less contact with immigrants prior to our intervention respond more strongly to the treatment. Additional findings suggest that the level of intergroup contact and biased beliefs about immigrants are complementary targets for information campaigns on immigration.

JEL-Codes: C900, D830, F220, J150.

Keywords: beliefs about immigrants, immigration attitudes, intergroup contact, information campaign.

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1 Introduction

Immigration is a prominent issue topic in the political debate. In the last decade, economic nationalism and public opposition to immigration have increased in Western societies (Colantone and Stanig 2019). In the context of this development, it has been shown that immigration in several European countries is causally related to the observed increase in right-wing voting behavior (Edo et al. 2019; Halla et al. 2017), and that the debate on immigration seems to be a relevant determinant of voting intentions (Barrera et al. 2020).

In recent years, the eastern part of Germany has experienced a particularly strong increase in the vote share of right-wing parties that oppose immigration (Weisskircher 2020). A common motive of right-wing politicians is to foster concerns among natives about potential negative economic consequences of immigration for the host society. Such exclusionary attitudes can also affect firms (Henn and Hannemann 2023). However, there is little research on whether anti-immigration attitudes in the region are based on populist propaganda or factual concerns. Recent findings on natives' beliefs about immigrants consistently point to misperceptions and biases in the host population (see e.g. Dylong and Uebelmesser 2023; Grigorieff et al. 2020; Lergetporer et al. 2021).

The main drivers of these misperceptions remain largely unclear. One possible explanation for biases in beliefs about immigrants and negative attitudes toward immigration is the lack of direct contact between natives and immigrants. This may be particularly relevant in areas where the share of immigrants is relatively low. While intergroup contact, as theorized in the seminal work by Allport (1954), has recently been found to affect attitudes toward immigrants in regional contexts and smaller workplaces (Andersson and Dehdari 2021; Steinmayr 2021), an assessment of the role of contact between natives and immigrants for the relationship between beliefs and attitudes has not yet been examined. However, this evaluation seems to be of high

relevance if policy makers are interested in mitigating anti-immigrant attitudes that are based on misperceptions of the population.

In this study, we use a survey experiment to assess the relationship between biases in beliefs about immigrants, attitudes toward immigration, and intergroup contact between natives and migrants in the regional context of eastern Germany. We find that respondents who receive an information treatment consisting of the share of immigrants in their region develop more supportive attitudes toward immigrants. This effect is strongly moderated by the extent to which respondents have contact with immigrants prior to the treatment, as measured by an index that combines both self-reported and objective indicators of intergroup contact. In particular, respondents with below-average contact relative to the average person in the sample tend to respond more strongly to the information treatment. We find this interaction to be particularly relevant for the effect of information on attitudes toward high skilled immigrants. This highlights important implications for regional policy, suggesting that levels of intergroup contact in the population may inform the design of policies targeting anti-immigrant beliefs and attitudes.

Moreover, we find that the level of intergroup contact and the distribution of beliefs about immigrants are complementary rather than substitutable targets for information campaigns aiming to affect attitudes toward immigrants. Specifically, we find that the correlation between the level of intergroup contact and the prevalence of biases in beliefs about immigrants is rather low. This suggests that biases in beliefs about immigrants may be present regardless of the level of contact that respondents have. As a result, governmental information campaigns can consider both individuals with low levels of contact with immigrants and those with strongly biased beliefs about the immigrant share as targets.

Our paper contributes to two strands of the literature on native attitudes toward immigration. First, our experimental design builds on recent literature examining subjective beliefs about immigration in Western societies. While a stylized finding

is that individuals across societies are often misinformed about immigration to their country, the literature generally reaches mixed conclusions about the effectiveness of information interventions to address such misperceptions.

Grigorieff et al. (2020) find that respondents develop more positive attitudes toward legal immigrants in the U.S. after being informed about a bundle of official statistics related to immigration to the country. In contrast, Hopkins et al. (2019) document that providing individuals only with information about the size of the U.S. immigrant population does not significantly affect natives' attitudes and policy preferences. Dylong and Uebelmesser (2023) show that different types and quantities of information about the immigrant population have heterogeneous effects on economic immigration attitudes and preferences among the German population, and that prior beliefs about immigrants determine the effectiveness of information interventions.

Other studies have concentrated on attitudes toward refugees and asylum seekers. Lergtporer et al. (2021) focus on beliefs about the educational background of refugees in Germany and find sizeable positive effects on general attitudes toward refugees, with countervailing evidence for economic concerns. In contrast, Getmansky et al. (2018) find that information about the economic and social burdens of hosting refugees in Turkey has a negative effect on local attitudes. Relatedly, Hayo and Neumeier (2023) provide evidence that information about the fiscal costs associated with hosting refugees increases individuals' propensity to decrease their support for the right to asylum in Germany. We contribute to this literature by directly evaluating the effectiveness of an information campaign about immigration in a regional context. More specifically, we distinguish between attitudes toward general and high-skilled immigration to the region, as the latter form of immigration represents a group of immigrants that is particularly relevant to economic performance in rural areas, which often face labor and skill shortages.

Second, we contribute to the literature on the importance of intergroup contact between natives and immigrants for attitudes toward immigration. While this literature

consistently reports effects of contact on attitudes toward out-groups such as immigrants (Pettigrew and Tropp 2006), there is conflicting evidence about the direction of the effect. Some studies find that increased contact with immigrants leads natives to develop more positive attitudes toward immigrants and to reduce prejudice (Andersson and Dehdari 2021; Bursztyn et al. 2023; Khalil and Naumann 2021), while other studies report opposite effects of contact, suggesting that natives' prejudices and anti-immigrant attitudes are reinforced by increased exposure to immigrant out-groups (Enos 2014; Hangartner et al. 2019; Harmon 2018).

Recent findings by Steinmayr (2021) further suggest a distinction between mere exposure to immigrants and direct intergroup contact experiences between immigrants and the host population. We contribute to this literature by examining the potential of intergroup contact to moderate the effectiveness of government campaigns aimed at reducing biases about immigrants in the population. Thus, our study addresses the relevance of prior immigrant-native contact for the effectiveness of an information intervention in the context of immigration.

The paper proceeds as follows: The data set and the regional context are introduced in the following section. Section 3 presents the empirical strategy, and section 4 presents the results of our information provision experiment and heterogeneity analysis. Concluding remarks can be found in section 5.

2 Data

This section introduces the dataset used in our analysis and discusses the regional context of our sample.

2.1 Probability-based sample

Our survey experiment was implemented in a tailored population survey in the eastern German State of Thuringia. The sample used in this study consists of data from two

survey waves conducted between September and October 2019 and January and March 2022, respectively. The total sample evaluated in our study is 936 individuals, consisting of 419 individuals from the first and 517 individuals from the second survey wave. The samples were obtained through Computer Assisted Telephone Interviews (CATI) conducted by a professional survey company. The use of CATI allows us to draw a probability-based sample of the general population in a regional context, which would be logistically challenging using alternative survey methods such as quota-based online surveys. In addition, the use of CATI allows for a detailed and reliable regional classification of respondents based on their district of residence within the state. This regional classification is important for evaluating differences in aggregate contact-related measures such as the share of immigrants at the district (NUTS 3) level.

The survey includes questions on the general economic situation, beliefs about immigrants and attitudes towards interculturalism, the economic impact of immigration, immigration policy and general political and social attitudes. The wording of the survey questions is largely based on measures commonly used in the related literature on attitudes toward immigration. Following the literature, we further code variables related to attitudes toward immigrants and immigration policy preferences so that a higher value represents more positive attitudes toward immigrants and more supportive policy preferences, respectively. An overview of the wording of the survey measures used in our analysis is provided in Appendix B.

2.2 Regional context

While our data are based on a regional sample that allows for a detailed classification of respondents by district of residence within Thuringia, it is also important to assess whether the demographic characteristics of Thuringia are similar to those of the other federal states in the eastern part of Germany. To assess how our sample compares to these other eastern German states (excluding Berlin), Table 1 presents a descriptive comparison of aggregate demographic statistics. This comparison suggests that

Table 1: Demographic comparison of Thuringia and Eastern and Western German state averages.

	Thuringia	Eastern Germany	Western Germany
GDP per capita (in Euro)	29883	29739	43826
Household net income (average)	1648	1644	1882
Population density (per km ²)	132	123	947
Age (average)	47.2	47.2	44.0
Household size (average)	1.9	1.9	2.0
Unemployment rate	5.3	6.2	5.6
Share of immigrants	5.4	5.3	15.1
Unemployment rate of immigrants	14.9	17.1	14.0

Notes: The demographic statistics presented are based on data from the German Federal Statistical Office and cover years from 2017 to 2019.

Thuringia is suitable as a benchmark for the average characteristics of eastern German states.

In particular, economic performance, household income, the share of immigrants, and the general unemployment rate are highly comparable between Thuringia and the aggregate of eastern Germany, with a slight deviation of about 2 percentage points in the unemployment rate of immigrants. We also compare Thuringia with the aggregate characteristics of western German states. As expected, there are notable differences in terms of demographics between Thuringia and eastern Germany on the one hand and western Germany on the other. We therefore refrain from comparing Thuringia with western Germany in our further discussion. Instead, our comparison suggests that the aggregate characteristics of our sample region are representative of eastern Germany as a whole, while still being narrow enough to make use of a detailed regional classification of respondents.

A demographic characteristic of particular relevance to our study is the share of immigrants at the district level. This local share of immigrants represents an objective aggregation of the potential for contact between natives and immigrants in the area, and thus constitutes a main component of our measure of the degree of intergroup contact. We show the spatial distribution of immigrants across Thuringia in Figure 1. The share of immigrants across districts ranges from 2.3 percent to 8.9 percent and is

concentrated in the state's smaller city districts, which have higher population densities than the larger but also more rural districts.¹

We draw two main conclusions from this descriptive overview of the extent of immigration in Thuringia: (i) In general, the extent of immigration in Thuringia is comparatively low, as a maximum district share of immigrants of 8.9 percent is considerably lower than the share of immigrants in Germany (13 percent), while (ii) there is nevertheless substantial variation in the local share of immigrants and thus in the potential for intergroup contact across districts in Thuringia.

In sum, our unique data set allows us to examine the effectiveness of a survey experiment on attitudes toward immigration in a highly regional context. Given that attitudes toward immigrants are expected to be heterogeneous across local areas, this disaggregated focus allows us to assess whether an information campaign has the potential to overcome biases in the regional population. It also allows us to measure the degree of contact between natives and immigrants at the local level and its relationship to the effectiveness of information provision.

3 Empirical Strategy

In this section, we present our empirical strategy for examining the interplay between intergroup contact, beliefs about immigrants, and immigration policy preferences. Our empirical strategy consists of three steps: In a first step, we induce exogenous variation in beliefs about immigrants via an experimental design that provides a subset of individuals with information about the regional share of immigrants.

In a second step, we construct measures of the degree of intergroup contact between natives and immigrants and of attitudes toward immigrants in the host population. Building on this approach, our third step of analysis assesses whether individuals

¹We show here the data from 2017, which we also use to construct our contact index (see below). Since then, the share of immigrants has increased. In 2022, it ranges from 4.3 percent to 13.3 percent.

respond differently information to exposure depending on their prior contact with immigrants. The three steps of the analysis are described in more detail below.

3.1 Experimental design

Our experimental design consists of four stages and two experimental groups. A graphical overview of our experimental design is shown in Figure 2.

In the first stage of our experiment, we elicit prior beliefs about the share of immigrants in Thuringia for all respondents. This allows us to control for differences respondents' pre-treatment information sets about immigration. In the second stage, we provide a random subset of respondents with true information about the share of immigrants. Specifically, these respondents are informed that the true share of immigrants in Thuringia is about 5 percent.² In addition to the information, our treatment includes conditional feedback on respondents' prior beliefs, reminding respondents whether they correctly estimated the share of immigrants or whether they underestimated or overestimated it. In contrast, respondents in the control group receive neither feedback nor information about the true share of immigrants.

The third stage of our experiment consists of survey questions about respondents' attitudes toward immigrants and their immigration policy preferences.³ Specifically, we examine immigration policy preferences, welfare state concerns, labor market concerns, and an assessment of whether immigrants have contributed positively or negatively to

²Our treatment is based on data from the Statistical Office of Thuringia for the year 2018. To keep our treatment consistent across the 2019 and 2021 survey waves, we do not adjust this information between waves. The share of immigrants increased very slightly by about 1 percentage point during this period. Since we continue to treat respondents' beliefs as correct if their reported prior beliefs are within ± 1 percentage point of the true value, this does not considerably change our treatment between our two surveys.

³It is important to note that when we ask respondents about their attitudes toward immigrants, we also relate the wording of these questions to the case of Thuringia in order to again emphasize the regional context to respondents.

the Thuringian economy in recent years. We choose these measures because (i) they have been widely examined in the empirical literature on attitudes toward immigrants (see e.g. Facchini and Mayda 2009; Haaland and Roth 2020; Hainmueller and Hiscox 2010; Huber and Oberdabernig 2016), and (ii) a combination of these measures captures a comprehensive attitude toward immigrants in a regional context from an economic perspective.

To measure immigration policy preferences, we follow a wording based on questions used in previous work examining immigration policy preferences. The specific wording differs slightly between survey sources, such as the European Social Survey (ESS) used by Card et al. (2012), the National Identity module of the International Social Survey Program (ISSP) studied by Mayda (2006), or the American National Election Studies (ANES) used by Scheve and Slaughter (2001). In essence, however, these questions ask respondents to state their preference for the number of immigrants that should be allowed to immigrate to the host country in a given year.

Welfare state concerns about immigration capture an individuals' concerns that immigration may lead to adverse effects on the fiscal system in their region. In contrast, labor market concerns refer to individuals' fears of increased competition in the regional labor market (Facchini and Mayda 2009). In addition to these questions, we ask respondents to assess the contribution of immigrants to the region of Thuringia over the past ten years.

While we ask these questions first for the general case of immigration to the region, which includes all types of immigrants, we also ask respondents a second time specifically about high-skilled immigrants. The case of high-skilled immigrants is of high relevance for the eastern German states and is prominently discussed in the media and in politics, also against the background of increasing skill shortages in the region.⁴ We

⁴See, for example, the following report by the German Federal Ministry of Economic Affairs and Climate Action on the topic of skill shortages and immigration in German regions: www.bmwk.de/Redaktion/EN/-Dossier/skilled-professionals.

therefore want to examine whether we obtain different empirical results when we ask respondents specifically about this particular group of immigrants. On the one hand, this may change respondents' assessment of their economic concerns about immigrants (i.e., welfare state and labor market concerns). On the other hand, referring specifically to high-skilled immigrants may also change preferences for further (high-skilled) immigration and the assessment of past migrant contributions.

In the fourth and final stage of our survey experiment, we elicit respondents' posterior beliefs about the share of immigrants for those respondents who received the treatment. We conduct this elicitation at the very end of our survey to mitigate concerns about experimenter demand.

3.2 Construction of indices

Our goal is to obtain joint measures of both attitudes toward immigrants and intergroup contact between natives and immigrants to use in the analysis of our experiment. There are two main reasons for doing so: First, both attitudes toward immigrants and native-immigrant contact are complex socioeconomic dimensions that can be surveyed from multiple perspectives. The construction of a standardized index allows us to incorporate different survey questions into a single measure to quantify these concepts in a comprehensive manner. Second, the construction of indices allows us to mitigate concerns about multiple hypothesis testing in the context of our experiment. This is particularly important in our setting because we want to examine the interplay between our treatment, a set of outcome measures, and effect heterogeneity based on a set of variables that capture contact with immigrants.

To compute our indices, we follow the methodology developed by (Anderson 2008) as implemented by (Schwab et al. 2020). This method of index construction is based on a generalized least squares (GLS) weighting scheme that efficiently accounts for correlations between the variables combined in the index (Schwab et al. 2020, p. 954). The resulting index represents a standardized multi-variable summary index that has

Table 2: Summary statistics of variables used for index construction.

	Obs.	Mean	SD	Min	Max
Panel A: attitudes toward general immigration:					
Immigration policy preferences	914	2.759	0.996	1	5
Welfare state concerns	895	3.483	2.566	0	10
Labor market concerns	916	6.291	2.327	0	10
Assessment of immigrants' contribution	919	5.324	2.441	0	10
Panel B: attitudes toward skilled immigration:					
Immigration policy preferences	919	3.649	0.962	1	5
Welfare state concerns	899	6.216	2.529	0	10
Labor market concerns	921	6.821	2.292	0	10
Assessment of immigrants' contribution	923	7.15	2.115	0	10
Panel C: contact between natives and immigrants:					
Contact with immigrants among family and friends	936	1.675	1.033	0	4
Contact with immigrants in neighborhood	936	1.252	1.096	0	4
Share of immigrants in district	936	4.638	2.091	2.3	8.9
Residence in urban district	936	0.348	0.477	0	1
Migration background	936	0.094	0.292	0	1

Notes: Attitudes toward immigrants are measured in such a way that a higher value indicates more positive attitudes or more supportive preferences. The data on the district-level share of immigrants and the indicator for urban districts come from official government statistics. Note that the method of index construction allows for the inclusion of observations that are missing for some of the included variables (Schwab et al. 2020).

a mean of zero and a standard deviation of one (when the full sample is used as the reference group), thus avoiding potential problems arising from different scaling, different variances and differences in the direction of the variables.

We construct three summary indices: an index of attitudes toward general immigration, an index of attitudes toward high-skilled immigration, and an index of intergroup contact between natives and immigrants. To construct the indices for attitudes toward immigrants, we aggregate the four variables that capture different concerns about immigration and policy preferences described in the previous section: immigration policy preferences, welfare state concerns, labor market concerns, and assessment of immigrants' past contributions. For skilled immigration, we use the respective versions of the variables that refer specifically to high-skilled immigrants.⁵

⁵Note that these summary indices of our outcome variables are standardized using the mean and standard deviation of the control group (Anderson 2008).

Panels *A* and *B* of Table 2 present summary statistics of the variables that make up the immigration attitude indices for the cases of general and skilled immigration. We observe that attitudes towards skilled immigrants tend to be more positive when compared to attitudes towards immigration in general, especially for the welfare state channel and the assessment of immigrants' past contribution to the region. Nevertheless, for both cases of immigration, attitudes and preferences vary considerably within the population, as indicated by the standard deviations and the minimum and maximum values of the respective variables.⁶

To construct our contact index, we combine the following variables: self-assessed contact with immigrants among family and friends, self-assessed contact with immigrants in the neighborhood, the local share of immigrants at the district level, an indicator of whether the district of residence is classified as an urban district by government institutions, and an indicator of whether an individual or his or her parents were born outside of Germany.⁷

Panel *C* of Table 2 shows summary statistics of the variables used to construct the contact index. We use these variables to construct our index of intergroup contact because they include both self-assessed and objective measures of contact. This allows us to capture both the personal circumstances and background of an individual as well as the local characteristics of his or her socioeconomic environment: On the one hand, the first two variables capture respondents' self-assessment of the frequency of contact with immigrants in their personal environment and in their neighborhood. These variables thus include the subjective perception of contact as assessed by individuals,

⁶Figures A1 and A2 in the appendix show the spatial distribution of our indices of attitudes toward immigration for general and skilled immigration, respectively. This visual overview supports the interpretation that attitudes toward immigrants vary considerably, also across different regions of Thuringia.

⁷Note that we do not include a self-assessed measure of contact at work, as this would exclude respondents from the index construction who are not part of the labor force, notably retirees and respondents currently in education.

which is difficult to measure with more objective variables alone. On the other hand, the share of immigrants at the district level and the indicator for residence in an urban district provide more objective measures of the potential for contact between natives and immigrants in the local area. Finally, the indicator for migration background captures respondents' personal experience of migration or indirect experience of migration through their parents.

Figure 3 visualizes the spatial distribution of our contact index across districts in Thuringia. We observe that above-average contact (i.e., values above zero) is concentrated in the state's urban areas, while the larger less densely populated districts also show lower levels of intergroup contact based on our index measures. Thus, similar to our indices of attitudes toward immigration, we observe considerable variation in intergroup contact between natives and immigrants in our sample, as measured by our index. This allows us to assess potential heterogeneity in the effect sizes of our information treatment based on the level of contact as discussed in the next section.

3.3 Assessing heterogeneity based on contact

The third step in our analysis is to assess the interplay between our information treatment, its effect on attitudes in the context of immigration, and intergroup contact between natives and immigrants. This poses a challenge for standard econometric tools, as it is difficult to assess such heterogeneity in treatment effects across our population of interest without first making assumptions about which variables to include in the heterogeneity analysis. Therefore, to obtain a comprehensive picture of the degree and direction of treatment effect heterogeneity in our case, we use a recently developed machine learning approach called causal forests, which is designed to directly estimate effect heterogeneity in a systematic and data-driven manner (Athey and Imbens 2016; Athey et al. 2019; Wager and Athey 2018).

This algorithm takes a recursive approach to detecting heterogeneity in treatment effects by sequentially partitioning the data into subgroups based on the conditional

average treatment effect (CATE). Since the CATE cannot be directly observed for an individual who is either in the treatment or control group, but never in both at the same time, the CATE is estimated instead. Estimation is achieved by recursively comparing the values of the outcome variables for respondents who were randomly assigned to either the treatment or the control group, but who share many common characteristics in terms of their observable covariates (Lechner 2023). The result is a causal tree represented by a flow diagram, showing the partitioning of covariates based on the estimated CATE for a given subgroup. The causal forest algorithm then creates an ensemble of many causal trees to estimate the CATE for each respondent in the sample and across experimental groups. The result is an estimated distribution of effect sizes instead of a single point estimate of the average treatment effect (ATE).

In our analysis, we incorporate a number of socio-demographic characteristics and attitudinal measures into the algorithm in addition to our index of intergroup contact. This allows us to specifically assess which covariates are relevant to treatment effect heterogeneity and whether immigrant contact is particularly important relative other sociodemographic measures. We analyze the relevance of covariates for effect heterogeneity by regressing the estimated effect sizes on the covariates themselves in a standard regression framework. The estimated coefficients of this regression thus represent associations between the covariates and heterogeneity in the estimated effect sizes, indicating which variables are particularly important for the effectiveness of our information treatment.⁸

⁸Note that these are associations between the covariates and the estimated effect sizes for each respondent, as it is possible that variables correlated with heterogeneity are omitted from the regression. However, the estimation of the effect sizes themselves is based on the causal effect of the treatment on outcomes.

Table 3: Tests for experimental balance between treatment and control group.

	Control	Treatment	p-value
Contact with immigrants	-0.047	0.047	0.151
Belief about share of immigrants	13.084	13.936	0.374
Concerns about immigration (pre-treatment baseline)	4.108	4.412	0.156
Concerns about the state of the economy	4.895	5.134	0.176
Disagreement with cultural diversity	4.901	5.038	0.514
Assessment of intercultural coexistence	2.510	2.427	0.050
Social trust	5.381	5.123	0.124
Age group	3.785	3.722	0.437
Female	0.501	0.561	0.069
Education	2.320	2.308	0.778
Employed	0.520	0.571	0.120
Survey wave	0.559	0.546	0.678

Notes: The table shows the mean values of the covariates for the control and treatment groups and the p-values for a between-subject t-test for experimental balance per covariate.

4 Results

In the following section, we present and discuss our empirical results. First, we check for the balance in covariates between the treatment and control groups. Second, we examine which factors are associated with a bias in prior beliefs about the share of immigrants and above-average contact with immigrants. We then estimate the average treatment effect of providing information about the share of immigrants on our indices of immigration attitudes. In the final step of our analysis, we examine treatment effect heterogeneity as well as the relationship between intergroup contact and the effect size of our treatment intervention on attitudes toward immigrants.

4.1 Experimental balance

To assess the balance between experimental groups, Table 3 shows between-subject t-tests for experimental balance in terms of observable characteristics. The experimental groups are well balanced, and we only observe very little marginal imbalance.⁹ We are

⁹We additionally control for all covariates used in the balance tests in our further specifications.

therefore confident in interpreting the estimates of treatment effects as causal effects on the outcome variables.

4.2 Determinants of prior beliefs and contact with immigrants

As a preliminary step in our analysis, we examine which factors are associated with respondents' prior beliefs about the share of immigrants and their contact with immigrants. For the following specification, we therefore transform our data on prior beliefs and the contact with immigrants index into binary indicators that serve as outcome variables. Specifically, we code respondents who overestimate the share of immigrants prior to treatment as 1 (550 respondents), while respondents with estimates below the true value or correct estimates are coded as 0 (386 respondents). Similarly, respondents with above-average contact with immigrants (i.e., a positive value of our standardized contact index) are coded as 1 (417 respondents), while all other respondents are coded as 0 (519 respondents). We then estimate the following equation as linear probability models:

$$y_i = \alpha_0 + \alpha^T X_i + \varepsilon_i, \quad (1)$$

where y_i represents the outcome variables, i.e., our indicators of overestimation and above-average contact, X_i contains the covariates used in the balance tests, and ε_i is the error term.

The results are presented in Table 4. As the results show, pre-treatment concerns about immigration are strongly positively associated with biases in beliefs about the share of immigrants. This shows that respondents who are more concerned about immigration before treatment are also more likely to overestimate the share of immigrants in the region. Similarly, disagreement with cultural diversity is positively associated with overestimating the share of immigrants. Interestingly, a positive assessment of cul-

Table 4: Predictors of upward bias in beliefs about immigrants and above-average contact with immigrants.

	Overestimation of share of immigrants	Above-average contact with immigrants
Contact with immigrants	0.005 (0.015)	
Belief about share of immigrants		-0.000 (0.017)
Concerns about immigration	0.078*** (0.019)	-0.034* (0.020)
Concerns about the state of the economy	0.026 (0.017)	-0.006 (0.018)
Disagreement with cultural diversity	0.036** (0.016)	-0.025 (0.017)
Assessment of intercultural coexistence	0.031** (0.016)	-0.000 (0.017)
Social trust	-0.065*** (0.016)	0.015 (0.018)
Age group	-0.049*** (0.019)	-0.005 (0.020)
Female	0.077*** (0.016)	0.011 (0.017)
Education	-0.011 (0.016)	0.034** (0.017)
Employed	-0.039** (0.019)	0.015 (0.020)
Adj. R ²	0.137	0.017
Observations	936	936

Notes: The outcome variables are binary indicators of whether a respondent has an upward bias in beliefs about the share of immigrants (i.e., overestimation) or above-average contact with immigrants. Covariates are standardized in terms of their mean and standard deviation. Estimations are based on linear probability models, robust standard errors are shown in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications also include an indicator for survey waves. Concerns about immigration refer to a pre-treatment baseline measure of attitudes toward immigrants.

tural coexistence is also positively associated with an upward bias in beliefs, although to a lesser extent when compared to concerns about immigration.

This suggests that while those parts of the population that are more concerned about immigration ex ante show stronger biases, those parts of the population that report more positive attitudes toward immigrants prior to treatment also overestimate the share of immigrants. The additional covariates show that respondents with more trust in others, older respondents, and respondents who are employed tend to have smaller biases in beliefs about the share of immigrants, while female respondents are more likely to overestimate compared to male respondents. With respect to contact

with immigrants, we observe that greater concerns about immigration are associated with below-average contact with immigrants. This suggests that respondents who are more concerned about immigration tend to have less contact with immigrants. In contrast, being more educated is positively associated with above-average contact with immigrants.

It is interesting to note that beliefs about the share of immigrants and contact with immigrants are not significantly related. This suggests that biases about the share of immigrants may depend more on personal attitudes and other types of beliefs about the socioeconomic environment than on individual levels of contact with immigrant groups per se. An alternative explanation for the lack of correlation is that more contact with immigrants may make it more likely that the share of immigrants is overestimated – if respondents extrapolate from their personal experiences to the total population. At the same time, these respondents may be more interested in and more informed about immigration statistics. Putting these two lines of reasoning together may hence explain the insignificant relationship between contact and beliefs. We discuss this finding further in the context of our experiment and heterogeneity analysis in Section 4.4.

4.3 Effects of information about the share of immigrants

We now turn to evaluating the causal effect of our information treatment on attitudes toward immigrants. Our goal is to assess whether providing respondents with factual information about the regional share of immigrants shifts their set of attitudes toward immigrants, as measured by our indices of attitudes toward general and skilled immigration. Specifically, we estimate the average treatment effect (ATE) using the following equation:

$$y_i = \beta_0 + \beta_1 T_i + \theta^T X_i + \varepsilon_i, \quad (2)$$

where y_i is the index of attitudes toward general immigration and skilled immigration, T_i is the treatment indicator for receiving information about the regional share of

Table 5: Effects of signal on attitudes toward general and skilled immigration.

	General Immigration	Skilled Immigration
Treatment: signal about immigrants	0.122** (0.047)	0.153*** (0.057)
Contact with immigrants	0.057** (0.025)	0.055* (0.029)
Belief about share of immigrants	-0.024 (0.034)	-0.135*** (0.039)
Concerns about immigration	-0.472*** (0.033)	-0.287*** (0.039)
Concerns about the state of the economy	-0.002 (0.029)	0.011 (0.035)
Disagreement with cultural diversity	-0.149*** (0.028)	-0.098*** (0.035)
Assessment of intercultural coexistence	0.091*** (0.030)	0.036 (0.034)
Social trust	0.167*** (0.032)	0.143*** (0.036)
Sociodemographic controls	Yes	Yes
Adj. R ²	0.474	0.242
Observations	936	936

Notes: The outcome indices are coded so that a higher value indicates more positive attitudes toward immigration and are standardized in terms of the mean and standard deviation of the control group. Covariates have been standardized in terms of their mean and standard deviation. Robust standard errors are shown in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The sociodemographic controls include age group, gender, education and employment status. All specifications also include an indicator for survey waves.

immigrants, X_i contains the covariates used in our balance tests, and ε_i is the error term.

Table 5 shows the estimation results for both types of attitudes toward immigrants. We find that our treatment has a positive and statistically significant effect on attitudes toward both general and skilled immigration. The estimated effect size of providing respondents with information about the regional share of immigrants is about 12 percent of a standard deviation of our index for attitudes toward general immigration. For skilled immigration, the effect size is slightly larger, at about 15 percent of a standard deviation.

These results suggest that respondents who receive information about the share of immigrants in the region have more positive attitudes toward immigrants after the

treatment. This result holds for both attitudes toward general immigration as well as attitudes toward high-skilled immigration. We also find that respondents who receive the treatment significantly update their posterior beliefs, with an average reduction in beliefs about the share of immigrants of about 4 percentage points (not shown in the table).¹⁰ Consequently, the results suggest that respondents who receive our treatment update their beliefs to be more in line with the true share of immigrants in the region and, in the process, form more positive attitudes toward immigrants, on average.

While we find sizeable causal effect sizes for our information treatment, it is also interesting to evaluate the correlations between our covariates and our outcome indices. This allows us to further understand the sociodemographic factors that are associated with attitudes toward immigrants. First, we observe that having more contact with immigrants is positively associated with attitudes toward immigrants. This is in line with recent evidence on intergroup contact theory, which suggests that direct contact between natives and immigrants has the potential to reduce anti-immigrant sentiment (Andersson and Dehdari 2021; Steinmayr 2021). Prior beliefs about the share of immigrants are statistically significantly associated with less positive attitudes toward high-skilled immigrants, but not toward general immigration. Pre-treatment concerns about immigration and disagreement with cultural diversity are strongly associated with more negative attitudes toward immigrants. In contrast, a positive assessment of intercultural coexistence and more social trust are positively associated with attitudes toward immigrants.

In terms of treatment effects of information on our outcome variables, we do not find large differences between attitudes toward general and skilled immigration. However, it may be the case that while the patterns appear similar in the aggregate, there are

¹⁰We assess this by conducting within-subject t-tests for differences between the prior and posterior beliefs of respondents who receive the information treatment. This difference is significant at the 1 percent level.

differences in terms of effect heterogeneity between the two types of immigration attitudes. This potential heterogeneity is analyzed in the following section.

4.4 Contact with immigrants and effect heterogeneity

In the previous sections, we examined the factors relevant to biases in beliefs about immigrants and contact with immigrant groups, and found sizeable effects of our information treatment on attitudes toward immigrants. The aim of this section is to investigate which covariates account for the heterogeneity in the treatment effects. In particular, we are interested in whether contact with immigrants is a relevant driver of the effect sizes of our information treatment. In addition, this heterogeneity helps us to further distinguish the relevance of general vs. skilled immigration attitudes.

To systematically analyze treatment effect heterogeneity, we estimate conditional average treatment effects (CATE) using the causal forest methodology described in Section 3.3. Figure 4 visualizes the estimated CATE by plotting the estimated effect sizes for each individual, separately for general and skilled immigration indices, on the horizontal and vertical axes, respectively. A striking observation is that the two types of attitudes toward immigrants are linearly related in terms of the effect sizes of our information intervention. We can use the averages of the two CATE distributions, as indicated by the horizontal and vertical black dashed lines, to construct four quadrants that relate the plotted effect sizes for general immigration attitudes to the effect sizes for skilled immigration attitudes.

Using this visual decomposition, we observe that most combinations of effect sizes for general and skilled immigration attitudes are in the lower left and upper right quadrants. This suggests that for the majority of estimated CATE, the effect sizes for general vs. skilled immigration indices are either both below average or above average. Consequently, there are only a few cases where either the effect sizes for the general case are above average and the effect sizes for the skilled case are below average (bottom right quadrant), or vice versa (top left quadrant). However, we also observe that, in

Table 6: Treatment effect heterogeneity: predictors of above-average CATE.

	General Immigration	Skilled Immigration
Contact with immigrants	-0.190*** (0.014)	-0.240*** (0.012)
Belief about share of immigrants	0.133*** (0.016)	0.152*** (0.014)
Concerns about immigration	0.046*** (0.015)	0.051*** (0.015)
Concerns about the state of the economy	-0.031** (0.015)	0.100*** (0.014)
Disagreement with cultural diversity	0.022 (0.015)	0.047*** (0.012)
Assessment of cultural coexistence	-0.007 (0.015)	-0.015 (0.012)
Social trust	-0.053*** (0.015)	0.032*** (0.012)
Age group	0.071*** (0.016)	0.025* (0.014)
Female	0.007 (0.014)	0.024** (0.012)
Education	-0.004 (0.014)	-0.018 (0.012)
Employed	0.018 (0.016)	0.037*** (0.014)
Adj. R ²	0.344	0.515
Observations	936	936

Notes: The outcome variables are binary indicators of whether a respondent has an above-average estimated CATE for the general and skilled immigration indices, respectively. The coefficients thus represent the marginal probability that a respondent responds more strongly to the treatment due to a change in the respective covariate when compared to the below-average estimated treatment response in the sample. The covariates have been standardized in terms of their mean and standard deviation. Estimates are based on linear probability models, robust standard errors are shown in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications also include an indicator for survey waves.

general, the effect sizes for the skilled immigration case tend to be (slightly) larger compared to the general case, as indicated by the 45 degree line (see the dotted black line). This observation is in line with the estimated average treatment effects in the previous section.

We are now interested in which covariates explain the estimated heterogeneity in effect sizes. To do this, we regress an indicator of above-average CATE (i.e. more pronounced effect sizes compared to the average treatment effect) on the covariates

used to train the causal forest on the estimated CATE. This allows us to infer which covariates correlate with treatment effect heterogeneity.¹¹ The results are presented in Table 6.

We find that having more contact with immigrants is strongly negatively associated with above-average effect sizes for both general and skilled immigration. More specifically, scoring one standard deviation above the mean on our contact index is associated with a lower probability of showing above-average effect sizes of the information treatment of about 19 percent (24 percent) for the general (skilled) immigration case. On the contrary, having larger (i.e. more biased) beliefs about the share of immigrants in the region is strongly associated with a higher probability of having above-average effect sizes of about 13 percent (15 percent) for general (skilled) immigration. This suggests that both contact with immigrants and biases in beliefs about immigrants are relevant drivers of effect heterogeneity, but with opposite signs.

In addition to the contact and belief variables, we observe that stronger pre-treatment concerns about immigration are associated with stronger effect sizes for both types of attitudes toward immigrants. We also find differences in the relevance of covariates between attitudes toward general and skilled immigration. While age is associated with above-average effect sizes in both cases, disagreement with cultural diversity, being female, and being employed are only significantly associated with above-average effect sizes for attitudes toward high-skilled immigration. In addition, we find discrepancies for the relevance of social trust and concerns about the state of the economy. While these variables are associated with below-average effect sizes for general immigration attitudes, they show positive correlations with effect sizes in the case of skilled immigration.

¹¹It is important to note again the distinction between the causal effect of our information treatment on our outcome indices and the association between the covariates and estimated treatment effect heterogeneity. Thus, the estimated correlations between covariates and CATE are not necessarily causal in themselves, but they do provide a comprehensive overview of the degree to which the covariates explain heterogeneity, *ceteris paribus*.

Since we find contact with immigrants to be a particularly relevant driver of effect heterogeneity of our information treatment, we visually examine the relationship between intergroup contact and CATE in Figure 5 for the case of general immigration and Figure 6 for the case of high-skilled immigration. The figures are visually separated by combinations of degree of contact and effect size based on below-average and above-average contact. The visual representation supports our results from Table 6, as they show a negative correlation between contact with immigrants and effect size. In addition to this linear slope, we also display estimates based on locally estimated scatterplot smoothing (LOESS) for the association between the degree of contact and effect sizes.

It is striking that effect sizes tend to be considerably larger when the degree of contact with immigrants is below average. This suggests that our information treatment is particularly effective when respondents have lower level of contact with immigrants prior to treatment. As the degree of contact increases, the size of the estimated CATE approaches zero, as indicated by the linear and LOESS slopes. This relationship is even more pronounced in the case of attitudes toward skilled immigration. In this case, we observe that positive effect sizes are strongly clustered in the area of below-average contact, while in the case of above-average contact, the estimated CATE are very close to zero.

In sum, our analysis suggests that intergroup contact between natives and immigrants is a strong moderator of the effectiveness of information campaigns in the context of immigration. In particular, individuals with below-average levels of contact prior to our information intervention tend to exert above-average effect sizes of the information treatment relative to the ATE, especially for attitudes toward high-skilled immigrants. Combined with the observation that higher levels of contact are associated with more positive attitudes toward immigrants (see Table 5), but not with less biased beliefs about immigrants (see Table 4), this suggests that information campaigns may target both those with low levels of contact with immigrants and those with strongly biased

beliefs about the immigrant share. In other words, our heterogeneity analysis shows that the level of intergroup contact and the distribution of beliefs about immigrants are complementary rather than substitutable targets for information campaigns aiming to affect attitudes toward immigrants.

5 Conclusion

In this paper, we examine the relationship between biases in beliefs about immigrants, attitudes toward immigration, and intergroup contact between natives and immigrants in eastern Germany, a region characterized by strong anti-immigrant sentiment. We find that respondents who receive a signal about the share of immigrants in the region develop more supportive attitudes toward immigrants after receiving the information. We further document that this effect is strongly moderated by the level of intergroup contact between natives and immigrants prior to the treatment, and is more pronounced for attitudes toward high-skilled immigrants. More specifically, respondents with below-average contact with immigrants relative to the average person in the sample prior to our intervention tend to respond more strongly to the information treatment.

Our results suggest that (i) a low level of contact between natives and immigrants is an important driver of the effectiveness of information campaigns on immigration in a regional context, and that (ii) attitudes toward high-skilled immigrants are even more elastic in the context of information provision than attitudes toward immigration in general, depending on the level of contact. In addition, we document that contact with immigrants is a complementary target rather than a substitute for targeting biased beliefs about immigrants when designing information campaigns on immigration. This has important implications for regional policies aimed at reducing biases against immigrants in the population, suggesting that existing levels of intergroup contact as well as the prevalence of biases in beliefs may inform the design of such policies to be particularly effective. Future research may thus shed more light on the relative

importance of intergroup contact and beliefs about immigrants for the effectiveness of government information campaigns.

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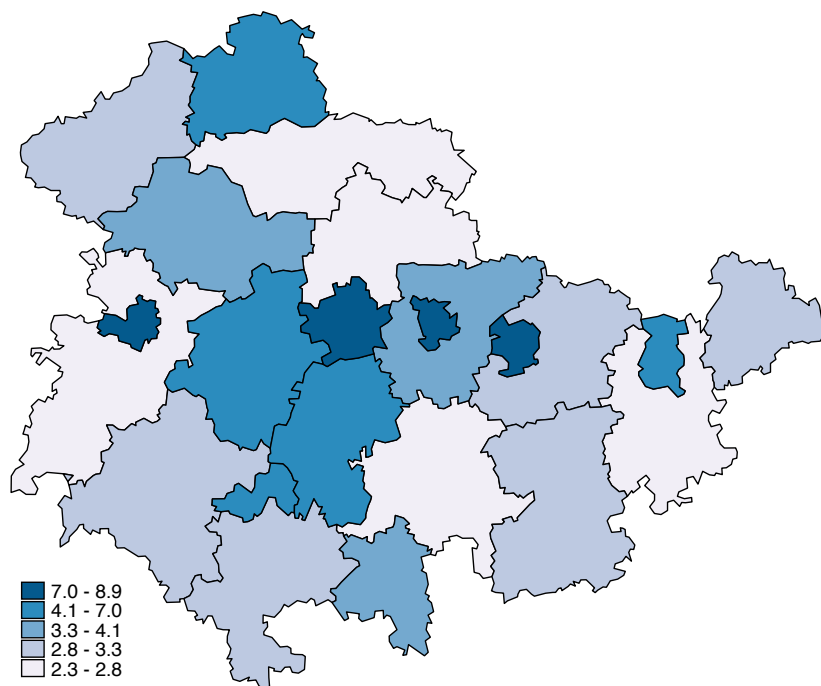
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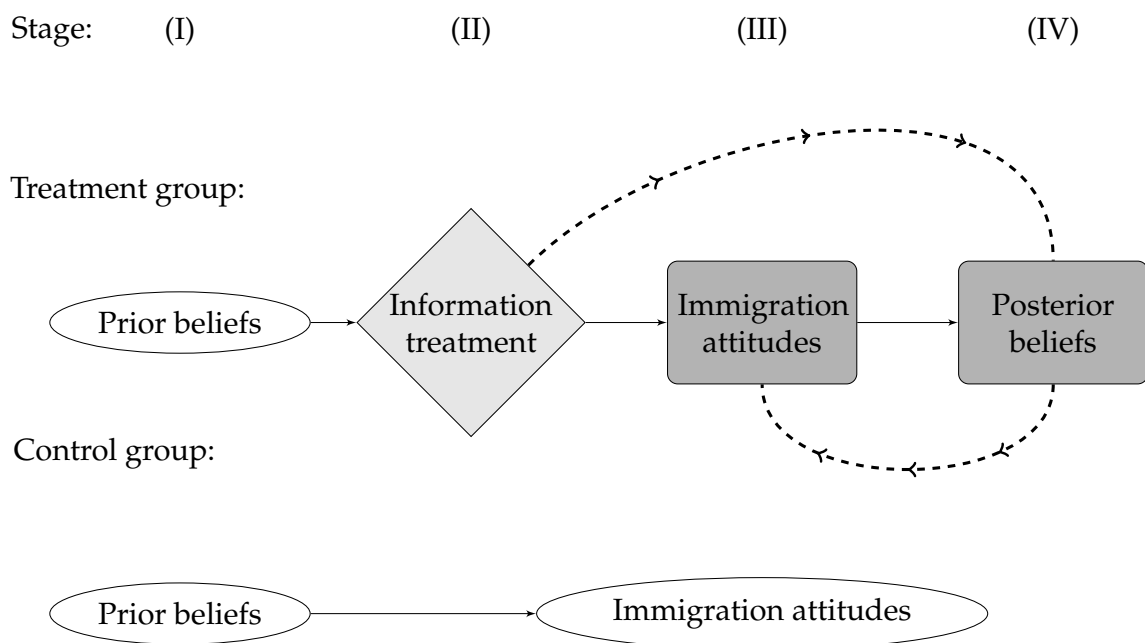
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Figure 1: Spatial distribution of immigrants across districts of Thuringia.



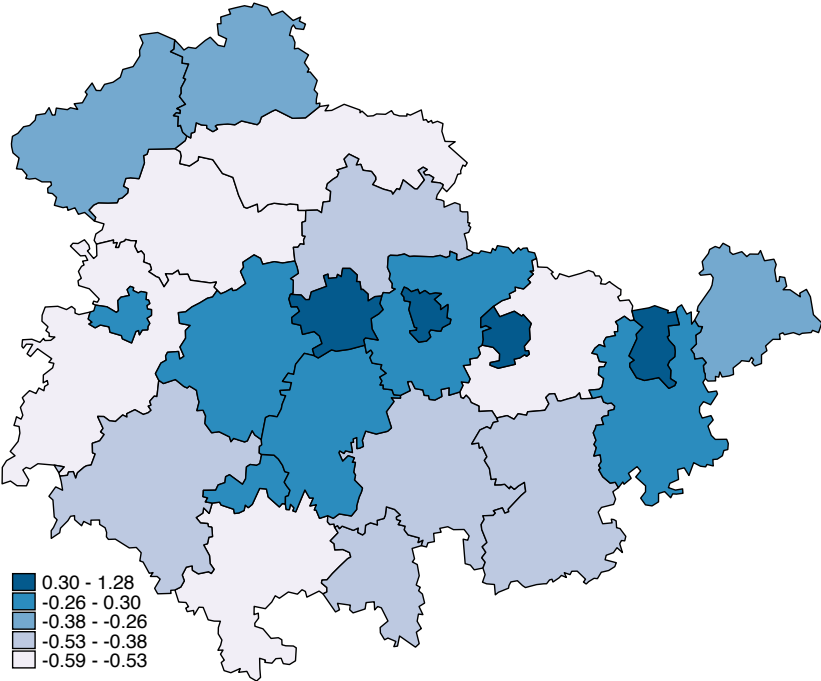
Notes: The figure shows the distribution of the share of immigrants across Thuringian districts based on data from the Thuringian Statistical Office for the year 2017. The share of immigrants is given in percent.

Figure 2: Experimental design: graphical representation of the survey flow.



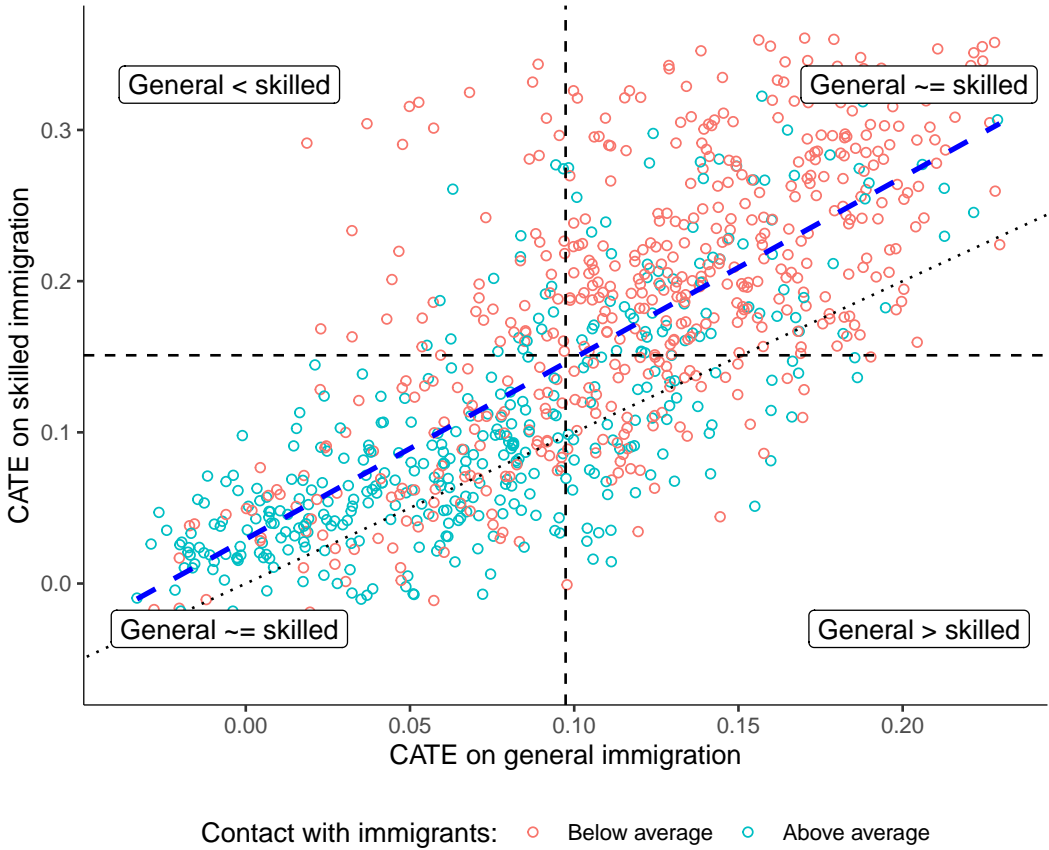
Notes: The figure shows a graphical representation of the survey flow for respondents assigned to either the treatment or control group. Note that the elicitation of posterior beliefs is conducted at the end of the experiment to reduce concerns about experimenter demand. The dashed line instead shows the hypothesized path of transmission of treatment information.

Figure 3: Spatial distribution of the index of contact between natives and immigrants across districts of Thuringia.



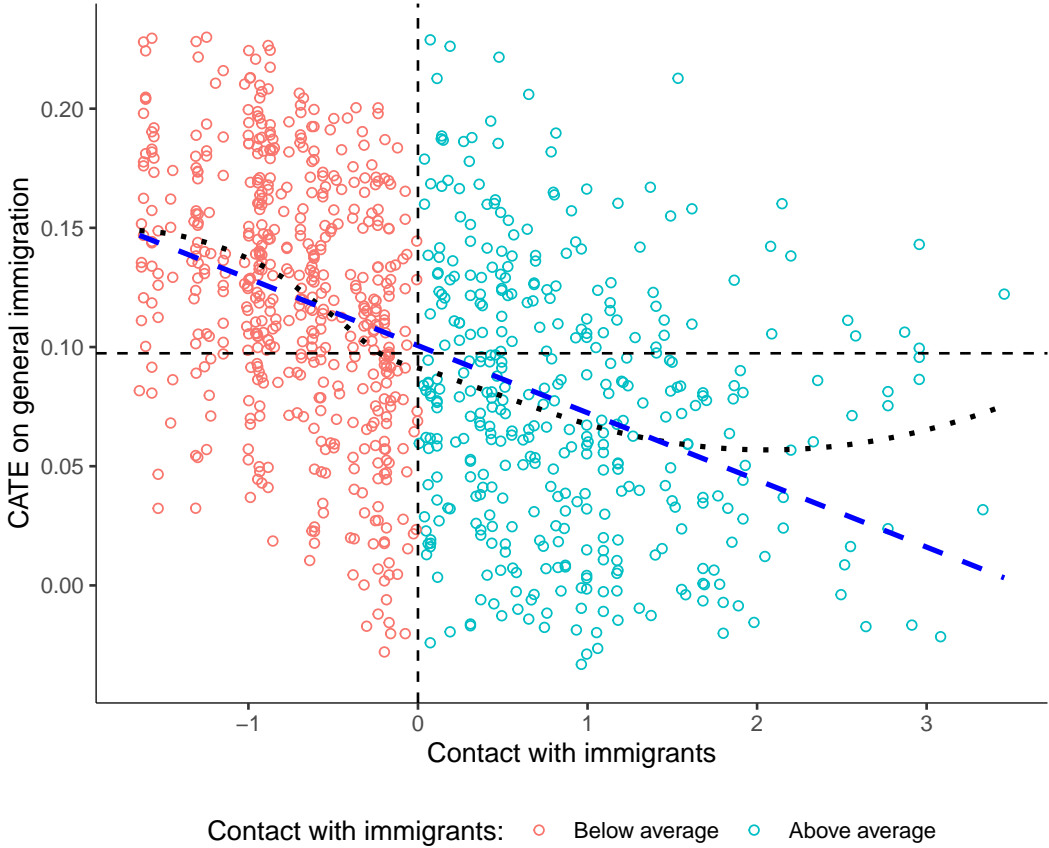
Notes: The figure shows the distribution of our contact index across districts in Thuringia. The index is standardized to have a mean of zero and a standard deviation of one. Values above zero thus indicate above-average contact between natives and immigrants, while values below zero indicate below-average contact.

Figure 4: Treatment effect heterogeneity: CATE on attitudes toward general vs. skilled immigration.



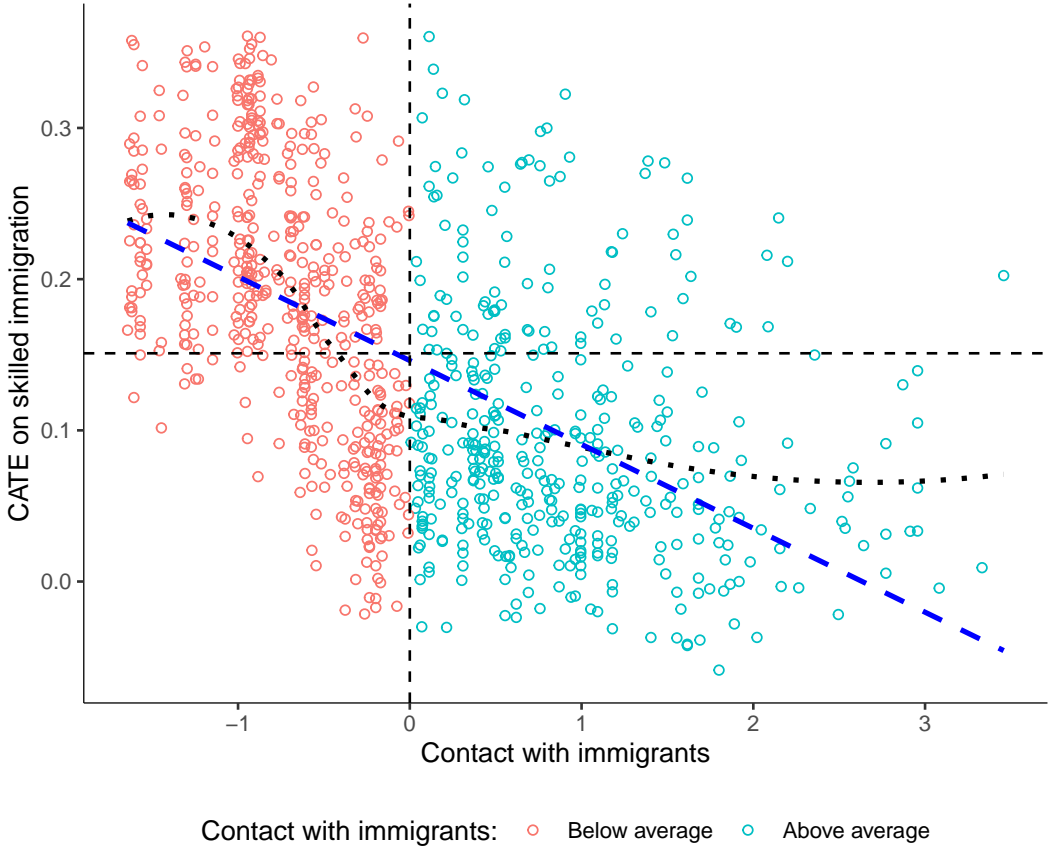
Notes: The figure shows the estimated conditional average treatment effects (CATE) on attitudes toward general and skilled immigration, respectively. The black dashed lines represent the average effect size of the estimated CATE in the sample for both outcomes. The blue dashed line is the estimated slope of the correlation between both types of CATE, and the dotted line is the 45 degree line. The four quadrants reflect areas of combinations of CATE for both outcomes relative to the means of the estimated effect size distributions. For example, the lower right quadrant is the area in which the estimated CATE for general immigration is above average, while the estimated CATE for skilled immigration is below average.

Figure 5: Treatment effect heterogeneity: CATE on attitudes toward general immigration vs. contact with immigrants.



Notes: The figure shows the estimated CATE on attitudes toward general immigration, regressed on the contact with immigrants index. The horizontal black dashed line represents the average effect size of the estimated CATE in the sample. The blue dashed line is the estimated slope of the correlation between CATE and contact with immigrants. The dotted line shows the locally estimated scatterplot smoothing (LOESS) estimates for the association between CATE and contact with immigrants. The vertical black dashed line represents the separation into below-average and above-average levels of contact relative to the mean zero of the contact with immigrants index.

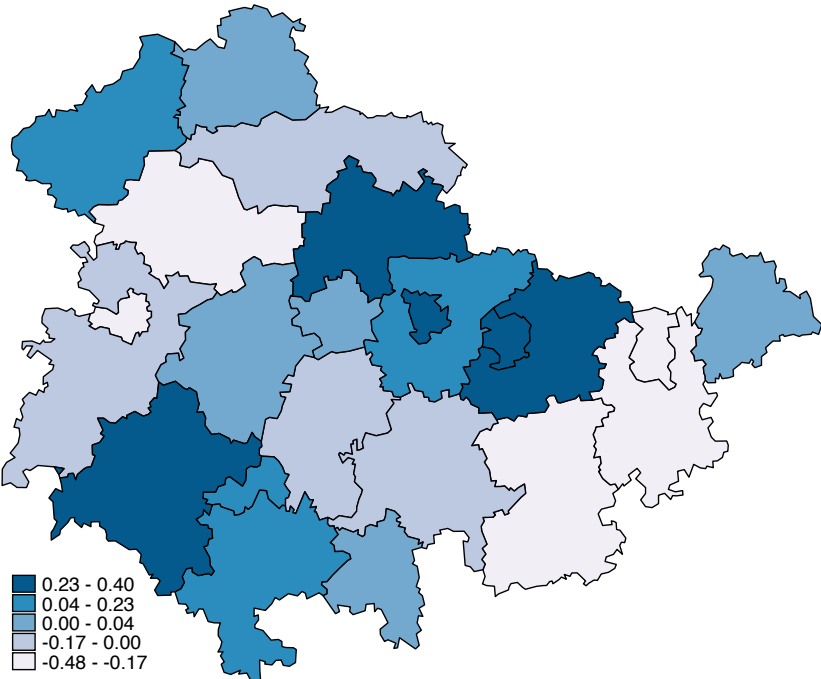
Figure 6: Treatment effect heterogeneity: CATE on attitudes toward skilled immigration vs. contact with immigrants.



Notes: The figure shows the estimated CATE on attitudes toward skilled immigration, regressed on the contact with immigrants index. The horizontal black dashed line represents the average effect size of the estimated CATE on skilled immigration in the sample. The blue dashed line is the estimated slope of the correlation between CATE and contact with immigrants. The dotted line shows the locally estimated scatterplot smoothing (LOESS) estimates for the association between CATE and contact with immigrants. The vertical black dashed line represents the separation into below-average and above-average levels of contact relative to the mean zero of the contact with immigrants index.

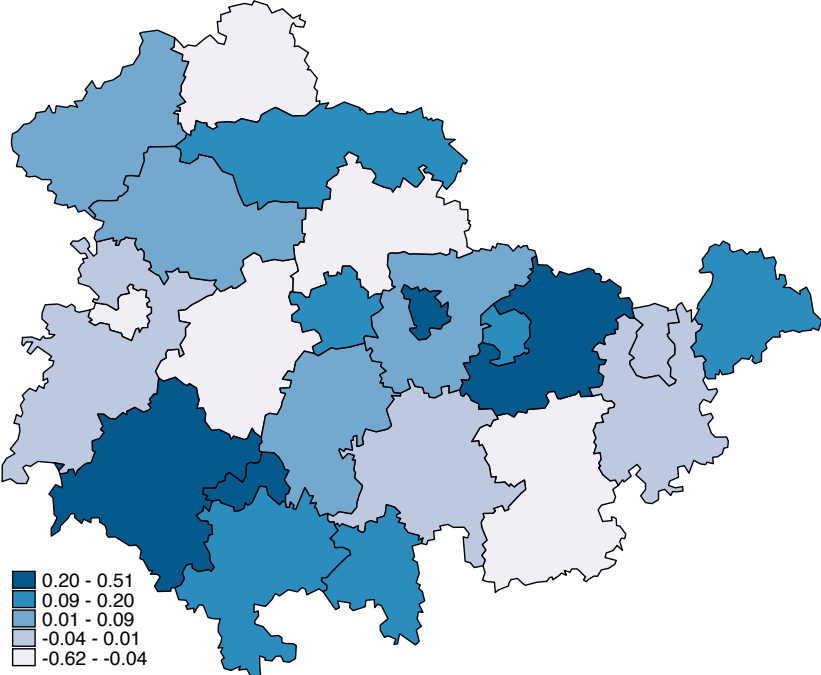
Appendix A: Additional Figures

Figure A1: Spatial distribution of the index of attitudes toward general immigration.



Notes: The figure shows the distribution of our calculated index of attitudes toward general immigration across Thuringian districts. The index is standardized to have mean zero and a standard deviation of one relative to the control group. Values above zero thus indicate above-average attitudes toward general immigration, while values below zero represent below-average attitudes.

Figure A2: Spatial distribution of the index of attitudes toward skilled immigration.



Notes: The figure shows the distribution of our calculated index of attitudes toward skilled immigration across Thuringian districts. The index is standardized to have mean zero and a standard deviation of one relative to the control group. Values above zero thus indicate above-average attitudes toward skilled immigration, while values below zero represent below-average attitudes.

Appendix B: Overview of Survey Variables

Variable name	Type	Description
Attitudes and policy preferences		
Immigration policy preferences	Numerical (1–5)	Respondent’s immigration policy preferences as measured by the following survey question: <i>“Do you think that the number of immigrants coming to Thuringia each year should be: decreased a lot / decreased slightly / stay the same / increased slightly / increased a lot?”</i> .
Welfare state concerns	Numerical (0–10)	Respondent’s welfare state concerns as measured by the following question (based on ESS): <i>“Immigrants pay taxes and receive social benefits from the health care and social insurance systems. On balance, do you think that immigrants in Thuringia receive more social benefits than they pay taxes, or that they pay more taxes than they receive social benefits?”</i> . Answers range from 0 for “Receive more social benefits” to 10 for “Pay more taxes”.
Labor market concerns	Numerical (0–10)	Respondent’s labor state concerns as measured by the following question (based on ESS): <i>“Do you think that immigrants rather take away jobs from workers in Thuringia, or that they rather help to create new jobs?”</i> . Answers range from 0 for “Take jobs away” to 10 for “Create new jobs”.
Assessment of immigrants’ contribution	Numerical (0–10)	Respondent’s assessment of the contribution of immigrants to the region in the past as measured by the following question: <i>“Do you think that immigrants have created more disadvantages or more advantages for Thuringia in the last 10 years?”</i> . Answers range from 0 for “Created more disadvantages” to 10 for “Created more advantages”.

Variable name	Type	Description
Prior beliefs		
Prior beliefs: share of immigrants	Numerical	Respondent's prior beliefs about the share of immigrants in Thuringia (true value 5%) based on the question: "Now it is about the share of immigrants in Thuringia. What do you think: What percentage of people living in Thuringia do not have German citizenship?".
Contact variables		
Contact with immigrants among family and friends	Numerical (0–4)	Measures a respondent's self-assessed contact with immigrants in their family and friends circle on a 5-point scale from 0 for "Never" to 4 for "Very frequent".
Contact with immigrants in the neighborhood	Numerical (0–4)	Measures a respondent's self-assessed contact with immigrants in their neighborhood on a 5-point scale from 0 for "Never" to 4 for "Very frequent".
Share of immigrants in district	Numerical	Represents the share of immigrants in the district of residence of a respondent based on data from the Statistical Office of Thuringia for the year 2017.
Residence in urban district	Binary	Indicates whether a respondent lives in a district classified as an urban area by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development.
Migration background	Binary	Indicates whether a respondent or one of their parents were born outside of Germany.
Further variables		
Concerns about immigration	Numerical (0–10)	Measures a respondent's concerns about immigration pre-treatment (based on SOEP) on an 11-point scale from 0 for "Not at all concerned" to 10 for "Very concerned".

Variable name	Type	Description
Concerns about the state of the economy	Numerical (0–10)	Measures a respondent's concerns about economic development in Thuringia pre-treatment on an 11-point scale from 0 for "Not at all concerned" to 10 for "Very concerned".
Disagreement with cultural diversity	Numerical (0–10)	Measures a respondent's disagreement with cultural diversity pre-treatment (based on ESS) using the following statement: "It is better for a country when everyone shares the same customs and traditions." on an 11-point scale from 0 for "Disagree strongly" to 10 for "Agree strongly".
Assessment of intercultural coexistence	Numerical (1–4)	Measures a respondent's assessment of the coexistence of different cultures in Thuringia pre-treatment on a 4-point scale from 1 for "Very bad" to 4 for "Very good".
Social trust	Numerical (0–10)	Measures a respondent's trust in others (based on ESS) on an 11-point scale from 0 for "You cannot be too careful" to 10 for "Most people can be trusted".
Age group	Numerical (1–5)	A respondent's age group: <i>16 to 29, 30 to 39, 40 to 49, 50 to 64, 65 and older.</i>
Female	Binary	Indicates a respondent's gender.
Education	Numerical (1–3)	A respondent's education based on highest school-leaving certificate according to the ranges: <i>low, medium, high.</i>
Employed	Binary	Indicates whether a respondent is in employment.