As diversity increases, people paradoxically perceive social groups as more similar

Bai, Xuenzi; Ribeiro Da Silva Taborda Ramos, Miguel Rui; Fiske, Susan

DOI:
10.1073/pnas.2000333117
https://doi.org/10.1073/pnas.2000333117

Document Version
Peer reviewed version

Citation for published version (Harvard):
Bai, X, Ribeiro Da Silva Taborda Ramos, MR & Fiske, S 2020, 'As diversity increases, people paradoxically perceive social groups as more similar', *Proceedings of the National Academy of Sciences*, vol. 117, no. 23, pp. 12741-12749. https://doi.org/10.1073/pnas.2000333117, https://doi.org/10.1073/pnas.2000333117

Classification: SOCIAL SCIENCES (Psychological and Cognitive Sciences; Social Sciences)

Title: As diversity increases, people paradoxically perceive social groups as more similar

Author Line: Xuechunzi Bai [a], Miguel R. Ramos [b,c], Susan T. Fiske [a,1]

Author Affiliation:

[a] Department of Psychology and Woodrow Wilson School of Public and International Affairs, Princeton University, Princeton, NJ 08544, US.

[b] Department of Social Policy, Sociology and Criminology, University of Birmingham, Birmingham, B15 2TT, UK.

[c] Instituto Universitário de Lisboa (ISCTE-IUL), CIS-IUL, Lisbon 1649-026, Portugal.

[1] **To whom correspondence may be addressed:** sfiske@princeton.edu

Keywords: Intergroup relations, Social diversity, Similarity inference, Cognitive process

Author contributions: X.B., M.R.R., and S.T.F. developed the research concept and designed research; X.B. performed research; X.B. and M.R.R. analyzed data; and X.B., M.R.R., and S.T.F. interpreted data and wrote the paper.

Competing interests: The authors declare no competing interests.

Data and materials availability: All data and analytic code can be accessed at https://osf.io/hcg72/?view_only=45a5a582fe2c4ae9af88dc32795c875c. Study 3 preregistered the analysis plan at https://osf.io/be9s5.

Acknowledgments: This research was supported by Princeton University. Part of this research was conducted while M.R.R was a visiting scholar at Princeton University, funded by a Fulbright Grant. All human subjects' participation was approved under Princeton IRB #10027.

Abstract. With globalization and immigration, societal contexts differ in sheer variety of resident social groups. Social diversity challenges individuals to think in new ways about new kinds of people and where their groups all stand, relative to each other. However, psychological science does not yet specify how human minds represent social diversity, in homogeneous or heterogenous contexts. Mental maps of the array of society's groups should differ when individuals inhabit more and less diverse ecologies. Nonetheless, research does not agree on which way they should differ. Confirmation bias suggests more diversity means more stereotype dispersion: With increased exposure, perceivers' mental maps might differentiate more among groups, so their stereotypes would spread out (disperse). In contrast, individuation suggests more diversity means less stereotype dispersion, as perceivers experience within-group variety and between-group overlap. Across three studies using worldwide, statewide, individual, and longitudinal datasets (N=12,011), a diversity paradox emerged: *More* diversity consistently meant *less* stereotype dispersion. Both contextual and perceived ethnic diversity are associated with decreased stereotype dispersion. Countries and U.S. states with higher levels of ethnic diversity (e.g., South Africa and Hawaii, as compared to South Korea and Vermont), online individuals who perceive more ethnic diversity, and students who moved to more ethnically diverse colleges mentally represent ethnic groups as more similar to each other, on warmth and competence stereotype dimensions. Homogeneity shows more differentiated stereotypes. Diversity means less differentiated stereotypes, as in the melting-pot metaphor. Diversity and reduced dispersion also correlate positively with subjective wellbeing, among other implications for society.

Significance. Globalization and immigration expose people to increased diversity, challenging them to think in new ways about new people. Yet, scientists know little about how changing demography affects human mental representations of social groups, relative to each other. How do mental maps of stereotypes differ, with exposure to diversity? At national, state, and individual levels, more diversity is associated with less stereotype dispersion. Paradoxically, people produce more differentiated stereotypes in ethnically homogeneous contexts, but more similar, overlapping stereotypes in diverse contexts. Increased diversity and decreased stereotype dispersion correlate with subjective wellbeing. Perhaps human minds adapt to social diversity, by changing their symbolic maps of the array of social groups, perceiving overlaps, and preparing for positive future intergroup relations. These results explain people's observed ability to adjust to diversity, to study, live, and work together.

To love, to laugh, to live, to work, to fail, to despair, to parent, to cry, to die, to mourn, to hope: These attributes exist whether we are Vietnamese or Mexican or American or any other form of classification. *We share much more in common with one another than we have in difference.* - Viet Thanh Nguyen (*1*).

Nguyen is not alone. Globalization and immigration are exposing people to more diversity than ever. There are 272 *million* immigrants around the world (*2*): 31% reside in Asia, 30% in Europe, 26% in the Americas, 10% in Africa, and 3% in Oceania. These demographic changes transform economies (*3*), cultures (*4*), policy decisions (*5*), and daily interactions (*6*). The increasing social diversity challenges individuals, both those who move to a new country and those who host incomers, to think in new ways about new groups of people. However, our knowledge on this topic is incomplete.

Psychological science tells us individuals prefer homogeneity (*7*). At an interpersonal level, people show homophily, that is, they are attracted to others who are similar to themselves (*8,9*). At the group level, individuals favor ingroup members, over outgroups, even when ingroup similarity has little meaning (*10*). Moreover, people tend to approach dissimilar others (outgroups) with uncertainty and vigilance (*11*). Therefore, people may react negatively toward increasing social diversity. For example, interactions with outgroups produce stress and anxiety (*12*), and people living in ethnically diverse communities have lower levels of trust and social cohesion (*13*). From this perspective, the future of diversity seems bleak.

However, recent evidence suggests the opposite: People adapt to diversity. Time helps. In early stages, diversity tends to lower trust, but with time, mixing with others counteracts that negative affect (*14*). Initial contact with outgroups is stressful, but as contact continues, positive outcomes emerge (*15*). Integration helps. High minority-share areas improve relations between

integrated groups but harm relations between segregated groups (*16*). In diverse communities, it is the residential segregation, not diversity per se, that reduces trust (*17*). Contact helps. Constructive intergroup contact improves intergroup attitudes (*18,19*; but see *20*).

How do individuals transition from a predisposition favoring homogeneity, to embrace positive outcomes of diversity? We offer a social cognitive perspective. Humans' ability to navigate in social environments depends on their mental maps of societal groups (*21*). As thinking organisms (*22,23*), people's attitudes and behavior depend on their constructions of social reality (*24,25*). In prior work, attitudes, affect, and subjective wellbeing demonstrate diversity effects, but leave open the cognitive mechanisms. We know people mentally array racial and social-class groups on economic status (*26,27*), and we know that people map the full array of society's salient groups on two or more dimensions (*21*). But we do not know how human minds represent societal groups under differing degrees of diversity (*4,6*) — that is, how they map more and less heterogenous arrays of group stereotypes.

Stereotypes mentally represent social groups, influenced by immediate contexts (*28-31*). In a homogenous environment, people do not encounter difference, so they can maintain their culturally-given stereotypes of outgroups that they rarely see. Diverse environments, compared to homogeneous ones, are more likely to expose people to variety, so they will encounter stereotype-(in)consistent instances. People may flexibly revise their prior stereotypes if they are motivated (*32,33*) or develop new more encompassing and complex identities (*34*). This view of diversity suggests cognitive adaptation to heterogenous environments. Two potential and distinct pathways could describe how stereotype maps adapt under diversity.

Confirmation bias suggests that people seek, infer, and store stereotype-consistent information (*35*). This suggests stereotype exaggeration, so that socially diverse contexts should

reinforce people's expectations, as they cognitively support their prior stereotypes. Diversity would exaggerate perceived dissimilarity between groups with distinct stereotypes. People do selectively perceive, learn, and recall group attributes that confirm their prior stereotypes (*36*); stereotype exaggeration would result from diversity, at least initially. Mental maps of diverse settings would differentiate social groups because there are more of them.

However, the opposite may also emerge: An individuation perspective (*33,37*) might predict a stereotype inversion. In a socially diverse context, individuals begin to reject categorical thinking, as they realize that each category is heterogeneous, comprising many individuals with different characteristics. Exposure to diversity over time would create overlapping representations of group stereotypes, as within-group variability is acknowledged. The more overlap, then the more groups seem similar. This leads to a stereotype inversion: with social diversity, groups seem similar.

To be sure, the stereotype exaggeration pathway may fit the initial stage of diversity encounters: The few new, personally unfamiliar groups seem—without any information except their presumed fit to cultural stereotypes—to support distinct group differences. Homogeneity should, paradoxically, produce differentiated stereotypes. Exaggerated dissimilarities may increase intergroup anxiety, prevent intergroup contact, decrease social trust, and undermine cohesion; these negative responses may just describe initial responses to diversity (*14*).

In contrast, the stereotype inversion may be more in line with a positive association between social diversity and intergroup relations over time. Acknowledging the variety within each social category should make their overlap — and therefore similarity — more salient. Diversity should, paradoxically, shrink the dispersed stereotype map, as in the melting pot metaphor. Reducing perceived differences between groups should pave the way for some

common ground, easing communication and soothing antagonisms. Subjective wellbeing and more positive responses characterize exposure to diversity (after 4-8 years; *14*).

Given the social cognitive perspective's potential implications for societal diversity, therefore, we document here how social diversity influences people's mental representation of the array of social groups. To further understand the relevance of stereotype dispersion, we tested its association with wellbeing.

Variables.

Key variables are defined and operationalized in the following ways.

First, ethnicity is the exemplar domain, given that changes in ethnic diversity shape the world and have been key in recent events, both political (e.g., the refugee crisis, the rise of populist right-wing parties) and historical (e.g., Nazi persecution and genocide of minority groups). We rely on official records of resident ethnicities.

Next, we approximate contextual diversity with the Herfindhal index (*38*), which measures degrees of group concentration when individuals are classified into groups. Specifically, ethnic diversity (*ED*) is defined as the probability that two randomly selected individuals from a population will belong to different ethnic groups (*39*):

$$ED = 1 - \sum_{i=1}^{n} S_{ij}^2 \qquad [1]$$

where, $S_{ij}$is the share of ethnic group *i* in population entity *j*. It takes into account the relative size distribution of each ethnic group and approaches maximum when a region is occupied by a single ethnicity. Subtracting from 1, then higher scores indicate less concentration of any particular ethnic group, thus higher diversity. Given that contextual diversity is a distal measure of individual's surrounding context, we complement with perceived (proximal) diversity

whenever feasible. Perceived diversity is accessed through a self-report of perceived diversity and estimations of groups' perceived population share.

To differentiate the array of social groups, we approximate their mental representation using the stereotype content model (SCM; *21*). Human minds frequently represent various social groups along two central dimensions: warmth and competence. Stereotypes are accidents of history, which result from a group's perceived societal status (competence) and perceived cooperation/competition (warmth), reflecting the niches of both newly arrived immigrant groups and established long-term inhabitants (*40*). For instance, current American societal stereotypes portray Canadians and middle-class Americans as warm and competent; Asians and Jews as competent but cold; some native peoples as warm but incompetent; and LatinX refugees as cold (untrustworthy) and incompetent (*41*). To reflect degrees of stereotype exaggeration (differentiation), we need to measure perceived (dis)similarities among groups (stereotype dispersion). Stereotype dispersion (*SD*) is operationalized as the Euclidean distance in warmth-competence space:

$$SD = \frac{1}{n}\sum_{i=1}^{n}\sqrt{(x_i - \overline{x_j})^2 + (y_i - \overline{y_j})^2} \qquad [2]$$

where x_i is perceived warmth and y_i is perceived competence for each group i; $(\overline{x_j}, \overline{y_j})$ is the centroid, a hypothetical average of warmth and competence, for each population entity j. The Euclidean norm, summing up all Euclidean distances from each group to the centroid and averaging the sum by the number (n) of groups, gives us a dispersion metric. Higher scores indicate larger distances among groups, which means larger stereotype dispersion or more perceived dissimilarities.

Finally, a range of datasets here supports the scope and generalizability of this research. Study 1 focuses on worldwide data, 46 nations on six continents, including 6585 respondents.

Study 2 collects new data from 50 U.S. states, comprising 1502 American online respondents. Both studies examine the diversity and dispersion relation. Study 3 examines changes in perceived diversity and dispersion with a five-year longitudinal study, including 3924 college students enrolled in 28 American universities. These three studies test our hypothesis at multiple levels (i.e., at the country-, state-, and individual-level) and deploy various analysis strategies (i.e., exploratory, confirmatory, multilevel modeling, and difference-in-difference estimation). Consistently, stereotype inversion emerged with social diversity: Increased contextual and perceived ethnic diversity associates with decreased stereotype dispersion, as if social diversity brings together dispersed stereotypes. Moreover, in the last two studies, increased perceived diversity and decreased dispersion correlated with increased subjective wellbeing.

Results.

Study 1. Stereotype dispersion examined worldwide: More ethnic diversity correlates with less stereotype dispersion.

The SCM has been studied in multiple contexts, including a total of 46 countries (*42-45*). We merged and analyzed the stereotype content data in these studies. The final dataset contains 12 Western European countries (Belgium, Denmark, England, Finland, Germany, Greece, Italy, Norway, Portugal, Spain, Sweden, Switzerland), 8 Eastern European post-Soviet countries (Armenia, Georgia, Belarus, Kazakhstan, Russia, Ukraine, Uzbekistan, Kosovo), 9 Middle East countries (Afghanistan, Egypt, Iran, Iraq, Israel, Jordan, Lebanon, Pakistan, Turkey), 6 Asian countries/regions (India, Malaysia, South Korea, Japan, Hong Kong, China), 3 African countries (Kenya, South Africa, Uganda), 2 Southwest Pacific countries (Australia, New Zealand), 2 North American countries besides the US (Canada, Mexico), and 4 South and Central American

countries (Bolivia, Chile, Costa Rica, Peru). This dataset comprised 6585 participants (52% female). The mean age was 27-years-old, and most had a college degree.

In each country, preliminary participants listed up to 20 social groups that they could spontaneously recollect. Other participants rated the most commonly mentioned groups' perceived competence and warmth on 5-point scales. These scores were then combined into a stereotype dispersion measure for each country using Eq [2]. The ethnic diversity data came from (*37*) that uses Eq [1]. The analyses were conducted at the country-level and, given that countries' levels of income inequality and national wealth are correlated with stereotype content (*27*), we controlled for these variables with Gini and GDP indexes provided by the World Bank.

On average, the stereotype dispersion was .772 (*SD* = .212). In our sample, South Africa displayed the smallest dispersion (.391) and Lebanon displayed the largest dispersion (1.433). The average ethnic diversity was .371 (*SD* = .260), with South Korea (.002) representing the least diverse country and Uganda (.930) representing the most diverse country (see *SI Appendix* for a full table of country data).

We first explored the Pearson correlation coefficient between countries' levels of ethnic diversity and social group stereotype dispersion. We observed a negative relationship between ethnic diversity and stereotype dispersion, $r(44) = -.366$, $P = .012$. More ethnically diverse nations showed less stereotype dispersion (Fig. 1). Next, we explored a partial correlation in which Gini and GDP were added as control variables. After adjusting for Gini and GDP, results were in line with our predictions, $r(42) = -.284$, $P = .062$, but marginally statistically significant.

Concentrating on ethnic groups, excluding countries that did not rate multiple ethnic groups, the Pearson correlation again revealed a negative relationship, $r(36) = -.405$, $P = .012$. The magnitude was slightly stronger than the test with all social groups. Partial correlation

controlling for country covariates again suggested a negative relationship, $r(34) = -.317$, $P = .060$, marginally statistically significant.

In sum, worldwide data suggest that the more a country is ethnically diverse, the more participants mentally represent social groups as being close to each other, on warmth and competence dimensions.

Study 2. Stereotype dispersion from 50 states in the US: More state-level and individual perceived ethnic diversity predicts less stereotype dispersion.

Study 1 data, collected for other purposes, spanned a 20-year period and were tailored to each society's particular construction of societal groups, and not just ethnic groups. Limitations thus include generational change from multisite data collection and response heterogeneity from mixed group labels. To address these limitations, we collected data within a single month, from 1502 online Amazon Mechanical Turk participants distributed across the 50 US states. The United States provides a rich context to test our hypothesis, given its long immigration history. To ensure between-state variability, we used stratified sampling with at least 30 participants from each state (except Nebraska 13 participants, North Dakota 20). In this sample, 42% of the participants were female with a mean age of 34 years old. Most of these participants were married (48%) or single (34%), with some college (28%) or bachelor's degree (41%). Most said they were descendants of German (25%), British (14%), Native American (10%), or African American (10%) ancestry.

In this study, participants rated 20 relevant immigrant groups (see Methods) according to their perceived competence and warmth, on a 5-point scale, and we constructed a stereotype dispersion score for each individual using Eq [2]. State-level diversity was calculated using the population proportion of 20 immigrant groups from the Census data via Eq [1]. Participants also

provided their perceived diversity of the state, on a 5-point scale (1 *almost nobody is of a different race or ethnic group* to 5 *many people are of a different race or ethnic group*). To reduce omitted variable bias on the state level, we included covariates of Gini and GDP; on the individual level, we included covariates of age, gender, social class (i.e., education, income, social ladder), type of area of residence (i.e., rural or urban), frequency of contact with other ethnic groups, as well as group identity. As a wellbeing measure, we asked current life satisfaction, on a 5-point scale (1 *extremely dissatisfied* to 5 *extremely satisfied*).

Among 50 states (see *SI Appendix* for a full table of state data), the average stereotype dispersion was .871 (*SD* = .107), with Wyoming showing the largest dispersion (1.079) and Alaska showing the smallest (.569). On an individual level, the average stereotype dispersion was .869 (*SD* = .383), with some showing dispersion as large as 2.449 and some showing 0 dispersion (2.7% of the sample). The average state-level diversity was .309 (*SD* = .141). Vermont was the least diverse state (.085), and Hawaii was the most diverse (.760). At the individual level, the average perceived diversity was 3.461 (*SD* = 1.096) on the 5-point scale.

First, our analyses started by replicating the Study 1 analysis. We tested Pearson correlations between state-level ethnic diversity and state-level ethnic stereotype dispersion. Results confirmed the negative relationship, more diversity less dispersion, $r(48) = -.384$, $P = .006$ (Fig. 2). The effect holds after removing an outlier state (i.e., Hawaii), $r(47) = -.305$, $P = .033$, or adjusting for state-level Gini and GDP, $r(46) = -.382$, $P = .007$.

Second, we looked at whether state-level diversity is associated with individual-level stereotype dispersion. We used a multilevel model with errors clustered at the state level. State diversity is the predictor, individual stereotype dispersion is the outcome, and state covariates are controlled. Results showed that state-level diversity predicts individual-level stereotype

dispersion (b = -.282, 95% *CI* [-.478, -.086], P = .008): For those living in states with the same levels of inequality and wealth, one unit increase in contextual diversity associates with a .282 unit decrease in participants' stereotype dispersion.

Third, we examined whether individual-level perceived diversity is associated with individual-level stereotype dispersion. We used a multilevel model with errors clustered at state level, individual perceived diversity as the predictor, individual stereotype dispersion as the outcome, adjusting for individual covariates. Individual-level perceived diversity predicts individual-level stereotype dispersion (b = -.032, 95% *CI* [-.052, -.012], P = .002): Those who perceived more diversity showed less stereotype dispersion; a one-unit increase in perceived diversity corresponds to .032 decrease in stereotype dispersion (Fig. 3, see full model details and robustness checks in *SI Appendix*).

Next, we explored the mechanisms—that is, how contextual diversity associates with perceived diversity and stereotype dispersion—using mediation analysis (*46,* see causal mediation in *SI Appendix*). Living in diverse states should influence individuals' perceptions of surrounding diversity, which in turn should influence their stereotype dispersion. As expected, the effect of state diversity on stereotype dispersion was fully mediated via perceived diversity: Individuals in diverse states have a tendency to report less stereotype dispersion (b = -.287, 95% *CI* [-.484, -.089], P = .007), but this association was reduced after accounting for perceived diversity (b = -.164, 95% *CI* [-.367, .037], P = .117). The indirect effect through perceived diversity was a significant mediator (indirect effect b = -0.123, 95% *CI* [-.183, -.064], P < .001). This is in line with previous work showing that the psychological effects of perceived diversity tend to be stronger than those of objective measures of diversity (*47*).

Finally, to understand the impact of stereotype dispersion, we looked at the association between stereotype dispersion and wellbeing. Using a multilevel model with errors clustered at state level, stereotype dispersion as the predictor and life satisfaction as the outcome variable, we found an inverse relation (b = -.147, 95% *CI* [-.283, -.012], P = .034). In other words, with a one-unit decrease in stereotype dispersion, participants self-reported life satisfaction increased by .147. In two separate models, we found that life satisfaction was positively correlated with perceived diversity (b = .110, 95% *CI* [.062, .159], P < .001), but not with state diversity (b = .188, 95% *CI* [-.235, .613], P = .389).

In sum, using a hypothesis-driven controlled survey in 50 states in the US, we confirmed the inverse relationship between social diversity and stereotype dispersion among 20 top immigrant groups. Contextual diversity at the state-level and perceived diversity at the individual-level were both associated with decreased stereotype dispersion, with the proximal, perceived indicator being more pronounced, indicating that people mentally represent ethnic groups as being similar on warmth and competence dimensions under diversity. In line with our expectations, less stereotype dispersion is positively associated with subjective wellbeing.

Study 3. Stereotype dispersion from a five-year longitudinal study among American universities: Increased campus diversity is associated with decreased stereotype dispersion.

The analyses so far revealed that individuals who perceive more ethnic diversity are less likely to mentally differentiate ethnic groups using stereotype content. These analyses were based on cross-sectional data in which the baseline stereotype dispersion can already be different among different individuals. We address this problem in this study with a difference-in-difference analysis (*48*) on a longitudinal dataset examining changes within the same individuals.

These analyses were complemented with robustness checks and statistical methods to assess and address potential selection bias in the data.

The analysis rests on a unique panel dataset (*49*), which contains comparable measures of perceived ethnic diversity and stereotype content when participants graduated from high school in 1999 and then again at the end of their college senior year in 2003. The survey consists of face-to-face interviews in the first wave and telephone interview in the following four waves. The final sample of 3924 students contains equally-sized racial groups (959 Asian, 998 White, 1051 African American, and 916 Latino) from 28 higher education institutions, who have lived in a total of 50 different states. In the sample, 58% were female students, and the median household income was $50,000 to $74,999.

The dataset provides measures that are essential to our research question. It includes questions about campus diversity and stereotype content for Whites, Blacks, Hispanics, and Asians. Campus diversity is measured by asking the perceived ethnic and racial composition of participants' high-school and college, on a scale from 0 to 100%. We used their responses to calculate perceived diversity via Eq [1]. Stereotype dispersion is measured by perceived competence and warmth of each group. The available items on competence asked: *perceived laziness, intelligence, giving up easily*. Warmth was assessed with: *hard to get along with* and *honest*, on a scale from 1 to 7 (reverse-scoring the negative items). We used these responses to calculate stereotype dispersion via Eq [2]. Note that these questions were only asked in wave 1 (pre-enrollment) and wave 5 (college senior). As such, we obtained perceived ethnic diversity and stereotype dispersion at these two time points, which were separated by a 4-year time period (see preregistration). The survey also asked participants' life satisfaction (see Methods), which we used as a wellbeing measure to assess the impact of stereotype dispersion.

The average stereotype dispersion in high school (M = .593, SE = .008) was higher than in college (M = .562, SE = .012), d = -.031, 95% CI [-.054, -.008], P = .009. The average perceived diversity in high school (M = .446, SE = .003) was higher than in college (M = .410, SE = .005), d = -.037, 95% CI [-.046, -.027], P < .001. In high school, perceived diversity did not predict stereotype dispersion (b = -.001, 95% CI [-.067, .066], P = .985), whereas in college, higher perceived diversity predicted less stereotype dispersion (b = -.147, 95% CI [-.246, -.048], P = .004).

To formally model the effect of perceived diversity on stereotype dispersion, we employed a mixed-effects difference-in-difference estimator using the following model:

$$Y_{i,t} = \alpha + \beta_1 T_t + \beta_2 d_i + \delta(T_t\, d_i) + \beta_3 X_{i,t} + \varepsilon_{i,t} \quad [3]$$

where, $Y_{i,t}$ is the outcome of stereotype dispersion for each individual i at time t. T_t is a dummy time variable that equals 1 for college, and 0 for high school. d_i is the continuous treatment variable representing intensity of diversity perceived by each individual i. We interacted T_t and d_i to produce the coefficient δ which is the average treatment effect of the perceived diversity on stereotype dispersion over time. It measures whether individuals with higher perceived diversity in college experienced a greater decrease in stereotype dispersion from high school to college. $X_{i,t}$ is a vector of pre-treatment variables including race, gender, and income. The error term $\varepsilon_{i,t}$ is clustered at individual-level and high school state-level.

We found that the interaction between time and perceived diversity was negative and statistically significant (b = -.155, 95% CI [-.260, -.050], P = .004). It indicates a large and significant decrease in stereotype dispersion between high school and college in individuals who perceived more campus diversity. The point estimate implies that one-unit increase in perceived diversity translated into a .155 decrease in stereotype dispersion between high school and college

(Fig. 4). To control for pretreatment individual characteristics, we added gender, household income, and participant's own ethnicity into the model. These controls reduced the perceived diversity coefficient only slightly (b = -.116, 95% *CI* [-.223, -.009], P = .033).

Next, we check the robustness of this result. First, campus diversity did not predict placebo outcomes (attitudes toward future, b = -.014, 95% *CI* [-.242, .267], P = .916, life as failure, b = -.038, 95% *CI* [-.210, .135], P = .664). Second, campus diversity in elementary school, middle school, and neighborhood were associated with group perceptions similarly as in high school (at 13-year-old, b = -.110, 95% *CI* [-.212, -.007], P = .037; three-block radius at 13, b = -.111, 95% *CI* [-.213, -.009], P = .033; at first grade, b = -.102, 95% *CI* [-.203, -.000], P = .049; less so three-block radius at 6, b = -.090, 95% *CI* [-.192, .013], P = .087). Third, we observed different motivations to move to diverse colleges. Logistic regression suggests that students who thought having enough ingroup members was unimportant were more likely to go to diverse colleges (b = -.023, 95% *CI* [-.043, -.004], P = .020). To address this issue, we performed an additional analysis examining the subsample of students who were more open to diversity and moved into a more diverse college. Results were consistent with our previous findings and showed that diversity was negatively associated with stereotype dispersion even among motivated students (b = -.109, 95% *CI* [-.196, -.021], P = .015). See *SI Appendix* for full model details and missing data adjustments.

As in Study 2, we found on aggregate level, less stereotype dispersion was related to more life satisfaction (high school: b = -.067, 95% *CI* [-.128, -.006], P = .031; college: b = -.080, 95% *CI* [-.133, -.026], P = .003; but there were no individual level effects, interaction term b = -.044, 95% *CI* [-.124, .035], P = .272). Perceived diversity indeed showed individual level effects: within the same individual, increases in perceived campus diversity associated with

increases in life satisfaction, interaction term b = .228, 95% *CI* [.033, .423], P = .022. In addition, less stereotype dispersion was correlated with other variables, such as, positive attitudes toward friends of different races and professors. See *SI Appendix* for a full list of these variables and regression results.

In sum, using a quasi-experimental design with longitudinal data among American students, we found that changes in campus diversity were associated with students' mental representations of ethnic groups. Students who moved to and lived in a more diverse campus perceived more similarities among ethnic groups on warmth and competence stereotype dimensions. Less stereotype dispersion was related to better wellbeing.

Discussion.

This research documents mental maps of social groups under diversity, describing the role of social cognition in diversity. Throughout three studies with world-wide, state-wide, individual-level, and longitudinal tracking data, we consistently found an inverse relation: more diversity, less stereotype dispersion. Participants in diverse contexts, especially those who report more diversity, evaluated ethnic groups as being more similar on warmth and competence stereotype dimensions. Diversity, paradoxically, reduces perceived group differences. Reduced group differences also correlate with greater subjective wellbeing.

From homophily to adaptation. The changes in mental representations of social groups provide one cognitive condition for the previously mixed findings of responses under diversity. For example, anticipating diversity (*6*), people initially expect group differences, that is, differentiated stereotypes that elicit threat and negativity toward outgroups. However, as actual diversity increases (*6*), with more exposure and experience, people may tone down previously exaggerated stereotypes, and start to realize latent and deep commonalities across groups, which

eventually buffer against threat and yield more positive group relations over time. Such common ground—reduced stereotype dispersion—is the condition that the contact hypothesis hopes to achieve: the perception of common humanity (*18*, p. 281). It is also the condition that Nguyen realized: we share much more in common with one another than we have differences (*1*).

The current studies provide evidence that diversity is associated with less stereotype dispersion, but do not specify psychological mechanisms, which should be explored in the future.

Positivity. In cross-country and cross-state diversity but not longitudinal diversity, the less dispersed maps tend to cluster groups in the high competence and high warmth quadrant (see *SI Appendix* for statistics). Groups in diverse contexts are not only perceived as more similar, but also are perceived as more positive than neutral. It is an open question then, why the single, less-dispersed cluster did not sit in middle-middle position. One possibility suggests norms (*50*). Diverse environments endorse tolerant norms that lead to more positive outgroup ratings. Another possibility is repeated exposure inducing attraction (*51*). The higher the exposure to outgroups, the more individuals attach positive affect to these groups, resulting in positive impressions. A third possibility is person positivity (*52*): Increased familiarity makes outgroups seem more personal and human, which in turn should produce more positive evaluations. A fourth possibility is similarity asymmetry (*53*). The societal ingroup (high-competence/high-warmth quadrant) is the reference group, so outgroup members are perceived to be similar to the societal ingroup, instead of the societal ingroup being similar to outgroups. Future work needs to test these mechanisms.

Process. Mental maps of social groups' economic positions differ, especially among individuals who experience different information from local networks (*27*) and who endorse different motivations (*26*). Likewise, stereotype inversion under diversity will differ by

experience and motivation. Experience-updating models (*54*) would suggest that warmth and competence are abstract knowledge that people learn from initially sparse data and update based on new evidence. New data with low feature variability (as found in a homogeneous society) strengthens prior knowledge, such as stereotype exaggeration. New data with high feature variability (as found in a diverse society) weakens or adjusts it, which may lead to inference inversion. Intergroup research suggests that people perceive ingroups as more heterogeneous (*55*), and as less extreme (*56*) than outgroups. Our result extends the scope by suggesting that extreme evaluations may come from differentiated stereotypes engrained in homogeneous environments, whereas less extreme evaluations may come from overlapping cognitive representations in diverse environments. Besides experience, motivation-based models (*33*) would suggest that people who live in diverse contexts want to get along with different others. This orientation toward outgroups, in turn, promotes more thoughtful, deliberate processes. People living in homogeneous contexts do not have such motivations and therefore use relatively automatic stereotypes (a dual-process model: *32*). Future work needs to disentangle the mechanisms and specify exactly how diversity reduces stereotype dispersion.

Generality. Several directions would expand the scope. (a) Stereotype dimensions other than warmth and competence. Recent studies suggest ideological beliefs (*57*), and other unforeseen spontaneous contents (*58*) can be critical in impression formation. (b) Diversity other than ethnicity. Sexual orientation, ideological and religious beliefs are also important socially defined categories. (c) Factors other than diversity. Demographic changes by themselves may influence mental representation of social groups, but randomized experiments need to substantiate. According to our reasoning, changes in group perception should be adjusted by continuous exposure (i.e., over a period of time) with large variations (i.e., larger scale), so this

process poses challenges on any single-time or single-site manipulation. (d) Cognition and behaviors. More research needs to test how changing mental representation in human minds influence consequential decision-making and action (*27*,*59*).

Overall, individuals adapt to increasing diversity in ways that are consonant with the coexistence of multiple groups. Reducing perceived differences between groups facilitates finding common ground, sharing social identity, and aids meaningful intergroup interactions. However, make no mistake: Diverse societies are not free of challenges that hamper the adaptive processes uncovered by our work. Among the most significant are barriers to intergroup contact, such as segregation (*16*,*17*,*49*), ethnic conflict (*13*,*39*), or sharp inequalities between ethnic groups (*26*,*27*).

Our work provides evidence of a possible pathway by which individual cognitions adapt to demographic changes in their social ecologies. The core finding—individuals have in them the potential of embracing diversity—should encourage societies to intervene against potential barriers to a peaceful coexistence. One positive characteristic of social diversity is broadening people's horizons. Ironically, stereotype content maps of relevant groups show the opposite movement (i.e., groups represented in mental maps tend be become compressed together). However, perhaps broadening horizons means realizing that societal groups do not differ as much as individuals may initially imagine. Exposure to diversity teaches that fact.

Measures.

Ethnic diversity. In Study 1, ethnic diversity data came from (*39*) dataset. The authors used the Encyclopedia Britannica and Atlas Narodov Mira to get the proportion of different ethnic groups per country, and calculated an index of ethnic diversity using the Herfindahl index (*38*). In Study 2, we used estimates of the proportion of different ethnic groups per state in the

U.S. We used the U.S. Census (2010) data, the most recent census available. In Study 2, this measure was paired with a subjective ethnic diversity measure in which participants responded in a 5-point scale whether in the state where they live from "1 almost nobody is of a different race or ethnic group" to 5 "many people are of a different race or ethnic group". In Study 3, we used estimates of the proportion of different ethnic groups per student per wave, by a perceived ethnic diversity measure available in the survey. In wave 1 (high school) and wave 2 (college), participants responded to the question "What was the ethnic and racial composition of your last high school?" and "Think back to the very first class you attended at college, roughly what percentage of the students were…". Participants responded to both questions on a scale from 0 to 100 for African Americans, Hispanics or Latinos, Asians, and Whites. A higher score in these measures indicates more ethnic diversity (Eq[1] in main text).

Stereotype dispersion. We calculated stereotype dispersion by assessing how different groups were perceived in terms of warmth and competence. In Study 1, respondents read in their native language, "We intend to investigate the way societal groups are viewed by the [country] society. Thus, we are not interested in your personal beliefs, but in how you think they are viewed by others". These groups were provided by a subset of participants from each country. These groups were different for each country, but commonly mentioned groups were age, gender, socio-economic status, race/ethnicity, and religious groups. For each of these social groups, they read "To what extent do most [country citizen] view members of [that group] as [trait]?" The dimension of warmth was assessed with the following traits: "warm", "well-intentioned", "friendly", "sincere", and "moral". Competence was assessed with "competent", "capable", and "skilled". All responses were recorded on a scale from 1 "not at all" to 5 "extremely". In Study 2, we presented participants with the same question as in Study 1, but this

time we selected the groups that were assessed by including the 20 largest immigrant groups in the U.S. according to the 2016 Yearbook of Immigration Statistics. With this criterion we included the following groups: Mexicans, Germans, British, Italians, Canadians, Irish, Russians, Filipinos, Chinese, Austrians, Indians (from India), Hungarians, Cubans, Dominican Republican, Swedish, Koreans, Vietnamese, Polish, African Americans, and Native Americans. Participants evaluated each group with the traits "warm" and "trustworthy" to assess warmth and the traits "competent" and "assertive" to assess competence. In Study 3, respondents read "Where would you rate [ethnic group] on this scale, where 1 means tends to be [adjective] to 7 means tends to be [adjective]". The groups in the survey were: Asian, White, African American, and Latino. All groups were assessed with the available traits diagnostic of warmth ("hard to get along with" and "honest") and competence ("hardworking", "intelligent", and "stick with it"). Exploratory factor analysis confirmed that items loaded on expected dimensions. Factor loadings were .38 for hard to get along with and .51 for honesty, while factor loadings were .71 for hardworking, .64 for intelligent, and .59 for stick with it. The survey included other traits, but none of them were diagnostic of either competence or warmth thus were not included in our measure (see preregistration). These warmth and competence scores were used to calculate our stereotype dispersion measure. Stereotype dispersion was defined as the Euclidean norm among social groups on a two-dimensional warmth and competence space (Eq[2] in main text).

Wellbeing. Study 1 does not have wellbeing measures. Study 2 participants responded to the question "All things considered, how satisfied are you with your life as a whole nowadays?" (1. Extremely dissatisfied, 2. Moderately dissatisfied, 3. Slightly satisfied, 4. Moderately satisfied, 5. Extremely satisfied). Study 3 wave 1 included the question "On the whole, I am satisfied with myself." (1. Strongly agree, 2, Agree, 3. Neither agree or disagree, 4. Disagree).

Wave 5 had the question "You enjoyed life". (0. Never, 1. Rarely, 2. Sometimes, 3. Often, 4. All the time). Responses were reverse-coded and rescaled to align the two waves to be comparable.

Covariates. We controlled for variables influencing warmth and competence at both the contextual- (Studies 1 and 2) and individual-level (Studies 2 and 3). In Study 1, we were restricted to the use of aggregated data and could not include individual-level variables. We controlled for income inequalities measured with the Gini and GDP index, provided by the World Bank. We matched these data with each country and year the data was collected. When Gini data was not available for the exact year, we used the nearest available year. In Study 2, we controlled Gini and GDP at the state level using Bureau of Economic Analysis (BEA) data. At the individual-level, the following covariates were included: age (continuous, centered), gender (binary, factored), education level (from elementary to J.D./M.D./Ph.D., continuous, centered), annual household income (from less than $10,000 to $150,000 or more, continuous, centered) and social status (1. Bottom of the ladder to 9. Top, continuous, centered). To account for characteristics of the different locations we controlled for type of living area with the following question: "Which of the following best describes the area you live in? (1. Big city, 2. Suburbs or outskirts of a big city, 3. Town or small city, 4. Village, 5. Farm or home in countryside, continuous, centered; robust check with discrete)". To see if self-report frequency of contact contributes to stereotype dispersion, we controlled: "How often do you have any contact with people who are of a different race or ethnic group when you are out and about? This could be on public transport, in the street, in stores or in the neighborhood. (1. Never, 2. Once a month or less, 3. Several times a month, 4. Several times a week, 5. Everyday, continuous, centered). Study 3 was restricted to individual-level data. We controlled for demographic features in the

survey: gender (binary, factored), race (categorical, factored), and household income (1. Under $3,000 to 14. $75,000 or more, continuous, centered).

References.

1. Nguyen, V. T. (2019, November 19) The people we fear are just like us. *New York Times* Op-Docs. Retrieved from https://www.nytimes.com/interactive/2019/11/19/opinion/opdocs-immigration.html.

2. United Nations. (2019). The International Migrant Stock. Retrieved from https://www.un.org/en/development/desa/population/migration/data/estimates2/estimates19.asp.

3. Milanovic, B. (2016). *Global inequality: A new approach for the age of globalization*. Harvard University Press.

4. Crisp, R. J., & Meleady, R. (2012). Adapting to a multicultural future. *Science*, *336*(6083), 853-855.

5. Bansak, K., Ferwerda, J., Hainmueller, J., Dillon, A., Hangartner, D., Lawrence, D., & Weinstein, J. (2018). Improving refugee integration through data-driven algorithmic assignment. *Science*, *359*(6373), 325-329.

6. Craig, M. A., Rucker, J. M., & Richeson, J. A. (2018). The pitfalls and promise of increasing racial diversity: Threat, contact, and race relations in the 21st century. *Current Directions in Psychological Science*, *27*(3), 188-193.

7. Caporael, L. R. (1997). The evolution of truly social cognition: The core configurations model. *Personality and Social Psychology Review*, *1*(4), 276-298.

8. Byrne, D. (1961). Interpersonal attraction and attitude similarity. *The Journal of Abnormal and Social Psychology, 62*(3), 713.

9. McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, *27*(1), 415-444.

10. Tajfel, H., & Turner, J. C. (1979). An integrative theory of inter-group conflict. In W. G. Austin & S. Worchel (Eds.), *The social psychology of inter-group relations* (pp. 33–47). Monterey, CA: Brooks/Cole.

11. Stephan, W. S., & Stephan, C. W. (2013). An integrated threat theory of prejudice. In *Reducing prejudice and discrimination* (pp. 33-56). Psychology Press.

12. Toosi, N. R., Babbitt, L. G., Ambady, N., & Sommers, S. R. (2012). Dyadic interracial interactions: a meta-analysis. *Psychological bulletin*, *138*(1), 1.

13. Putnam RD (2007) E Pluribus Unum: Diversity and community in the twenty-first century: The 2006 Johan Skytte Prize lecture. *Scan Polit Stud* 30(2):137-174.

14. Ramos, M. R., Bennett, M. R., Massey, D. S., & Hewstone, M. (2019). Humans adapt to social diversity over time. *Proceedings of the National Academy of Sciences*, *116*(25), 12244-12249.

15. MacInnis, C. C., & Page-Gould, E. (2015). How can intergroup interaction be bad if intergroup contact is good? Exploring and reconciling an apparent paradox in the science of intergroup relations. *Perspectives on Psychological Science*, *10*(3), 307-327.

16. Laurence, J., Schmid, K., Rae, J. R., & Hewstone, M. (2018). Prejudice, contact, and threat at the diversity-segregation nexus: a cross-sectional and longitudinal analysis of how ethnic out-group size and segregation interrelate for inter-group relations. *Social Forces*, *97*(3), 1029-1066.

17. Uslaner, E. M. (2012). *Segregation and mistrust: Diversity, isolation, and social cohesion*. Cambridge University Press.

18. Allport GW (1954) *The Nature of Prejudice* (Addison-Wesley, Cambridge, MA).

19. Pettigrew, T. F., & Tropp, L. R. (2006). A meta-analytic test of intergroup contact theory. *Journal of personality and social psychology*, *90*(5), 751.

20. Paluck, E. L., Green, S. A., & Green, D. P. (2018). The contact hypothesis re-evaluated. *Behavioural Public Policy*, 1-30.

21. Fiske, S. T., Cuddy, A. J. C., Glick, P., & Xu, J. (2002). A model of (often mixed) stereotype content: Competence and warmth respectively follow from perceived status and competition. *Journal of Personality and Social Psychology*. 82 (6): 878–902.21.

22. Fiske, S. T. (1992). Thinking is for doing: portraits of social cognition from daguerreotype to laserphoto. *Journal of personality and social psychology*, *63*(6), 877.

23. Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: a social psychological perspective on mental health. *Psychological bulletin*, *103*(2), 193.

24. Lippmann, W. (1965). Public Opinion. 1922.

25. Murphy, G. L., & Medin, D. L. (1985). The role of theories in conceptual coherence. *Psychological review*, *92*(3), 289.

26. Kraus, M. W., Rucker, J. M., & Richeson, J. A. (2017). Americans misperceive racial economic equality. *Proceedings of the National Academy of Sciences*, *114*(39), 10324-10331.

27. Hauser, O. P., & Norton, M. I. (2017). (Mis) perceptions of inequality. *Current opinion in psychology*, *18*, 21-25.

28. Durante, F., Fiske, S. T., Kervyn, N., Cuddy, A. J. C., Akande, A., Adetoun, B. E., et al. (2013). Nations' income inequality predicts ambivalence in stereotype content: How societies mind the gap. *British Journal of Social Psychology, 52*, 726–746.

29. Durante, F., Fiske, S. T., Gelfand, M. J., Crippa, F., Suttora, C., Stillwell, A., ... & Björklund, F. (2017). Ambivalent stereotypes link to peace, conflict, and inequality across 38 nations. *Proceedings of the National Academy of Sciences*, *114*(4), 669-674.

30. Fiedler, K. (2000). Beware of samples! A cognitive-ecological sampling approach to judgment biases. *Psychological review*, *107*(4), 659.

31. Hogarth, R. M., Lejarraga, T., & Soyer, E. (2015). The two settings of kind and wicked learning environments. *Current Directions in Psychological Science*, *24*(5), 379-385.

32. Crisp, R. J., & Turner, R. N. (2011). Cognitive adaptation to the experience of social and cultural diversity. *Psychological bulletin*, *137*(2), 242.

33. Fiske, S. T., & Neuberg, S. L. (1990). A continuum of impression formation, from category-based to individuating processes: Influences of information and motivation on attention and interpretation. In *Advances in experimental social psychology* (Vol. 23, pp. 1-74). Academic Press.

34. Schmid, K., Hewstone, M., & Ramiah, A. A. (2013). Neighborhood diversity and social identity complexity: Implications for intergroup relations. *Social Psychological and Personality Science*, *4*(2), 135-142.

35. Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of general psychology*, *2*(2), 175-220.

36. Fiske, S. T. (1998). Stereotyping, prejudice, and discrimination. In D. T. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *Handbook of social psychology* (4th ed., Vol. 2, pp. 357-411). New York: McGraw-Hill.

37. Brewer, M. B. (1988). A dual process model of impression formation. T. K. Srull, R. S. Wyer, Jr., eds. Advances in Social Cognition, Vol. 1. Erlbaum, Hillsdale, NJ, 177–183.

38. Hirschman, A. (1964.) The paternity of an index. *The American Economic Review 54:* 761–762.

39. Alesina A, Devleeschauwer A, Easterly W, Kurlat S, Wacziarg R (2003) Fractionalization. *J Econ Growth* 8(2):155-194.

40. Fiske, S. T., & Durante, F. (2016). Stereotype content across cultures. *Handbook of advances in culture and psychology*, *6*, 209-258.

41. Lee, T. L., & Fiske, S. T. (2006). Not an outgroup, not yet an ingroup: Immigrants in the stereotype content model. *International Journal of Intercultural Relations*, *30*(6), 751-768.

42. Cuddy, A. J., Fiske, S. T., Kwan, V. S., Glick, P., Demoulin, S., Leyens, J. P., ... & Htun, T. T. (2009). Stereotype content model across cultures: Towards universal similarities and some differences. *British Journal of Social Psychology*, *48*(1), 1-33.

43. Kervyn, N., Fiske, S. T., & Yzerbyt, V. Y. (2013). Integrating the stereotype content model (warmth and competence) and the Osgood semantic differential (evaluation, potency, and activity). *European journal of social psychology*, *43*(7), 673-681.

44. Wu, S. J., Bai, X., & Fiske, S. T. (2018). Admired rich or resented rich? How two cultures vary in envy. *Journal of Cross-Cultural Psychology*, *49*(7), 1114-1143.

45. Grigoryan, L., Bai, X., Durante, F., Fiske, S. T., Fabrykant, M., Hakobjanyan, A., ... & Maloku, E. (2019). Stereotypes as Historical Accidents: Images of Social Class in Postcommunist Versus Capitalist Societies. *Personality and Social Psychology Bulletin*, 0146167219881434.

46. Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, *51*(6), 1173.

47. Koopmans, R., & Schaeffer, M. (2015). Relational diversity and neighbourhood cohesion. Unpacking variety, balance and in-group size. *Social science research*, *53*, 162-176.

48. Angrist, J. D., & Pischke, J. S. (2008). *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.

49. Massey, D. S., & Charles, C. (2006) *National longitudinal survey of freshmen.* Office of population research, Princeton university.

50. Christ O, Schmid K, Lolliot S, Swart H, Stolle D, Tausch N, ... Hewstone M (2014) Contextual effect of positive intergroup contact on outgroup prejudice. *Proc Natl Acad Sci USA* 111:3996-4000.

51. Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of personality and social psychology*, *9*(2p2), 1.

52. Sears, D. O. (1983). The person-positivity bias. *Journal of personality and Social Psychology*, *44*(2), 233.

53. Tversky, A. (1977). Features of similarity. *Psychological review*, *84*(4), 327.

54. Tenenbaum, J. B., Kemp, C., Griffiths, T. L., & Goodman, N. D. (2011). How to grow a mind: Statistics, structure, and abstraction. *science*, *331*(6022), 1279-1285.

55. Konovalova, E., & Le Mens, G. (2019). An information sampling explanation for the in-group heterogeneity effect. *Psychol Rev, online.*

56. Linville, P. W. (1982). The complexity–extremity effect and age-based stereotyping. *Journal of personality and social psychology*, *42*(2), 193.

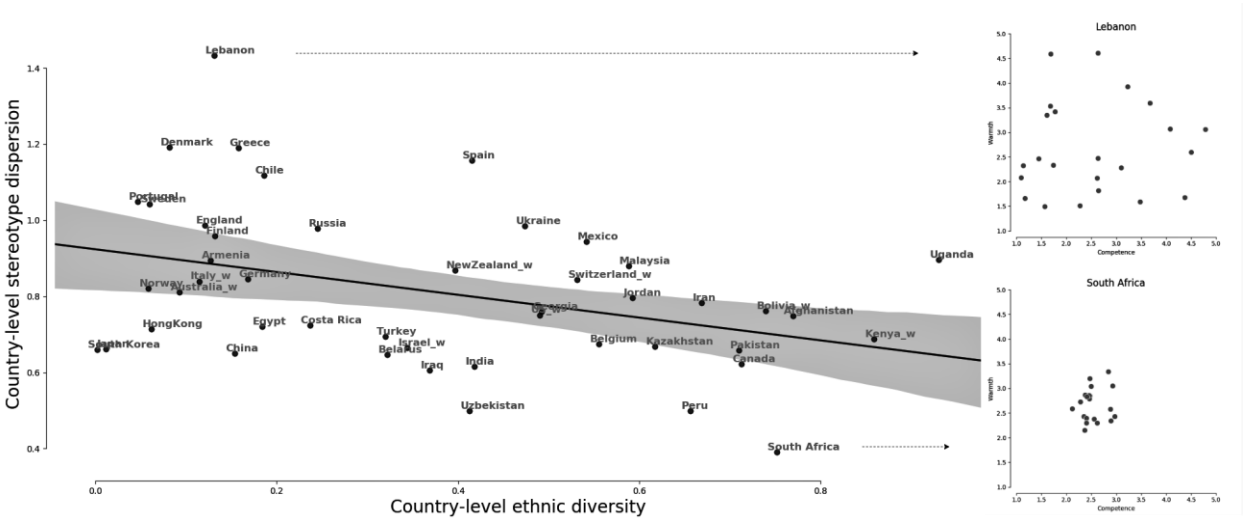
57. Koch, A., Imhoff, R., Dotsch, R., Unkelbach, C., & Alves, H. (2016). The ABC of stereotypes about groups: Agency/socioeconomic success, conservative–progressive beliefs, and communion. *Journal of Personality and Social Psychology*, *110*(5), 675.

58. Nicolas, G., Bai, X., & Fiske, S. T. (in prep). *Natural language analysis of spontaneous stereotype content.*

59. Martinez, J. E., Feldman, L., Feldman, M., & Cikara, M. (2018). Narratives shape cognitive representations of immigrants and policy preferences. https://doi.org/10.31234/osf.io/d9hrj

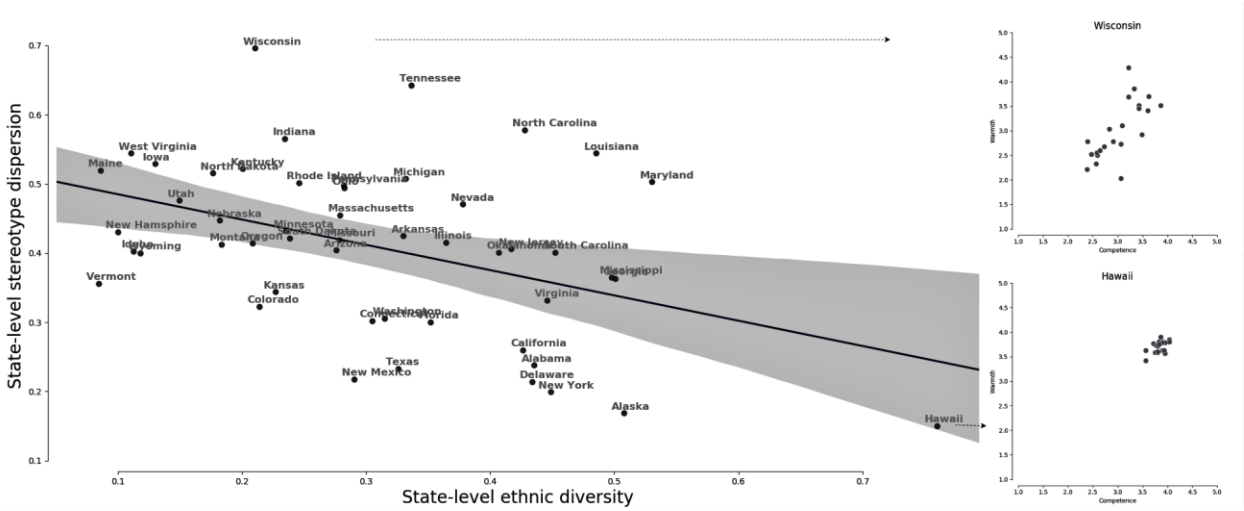
Figures.

Fig 1. Inverse linear relationship between ethnic diversity and stereotype dispersion in 46 nations.



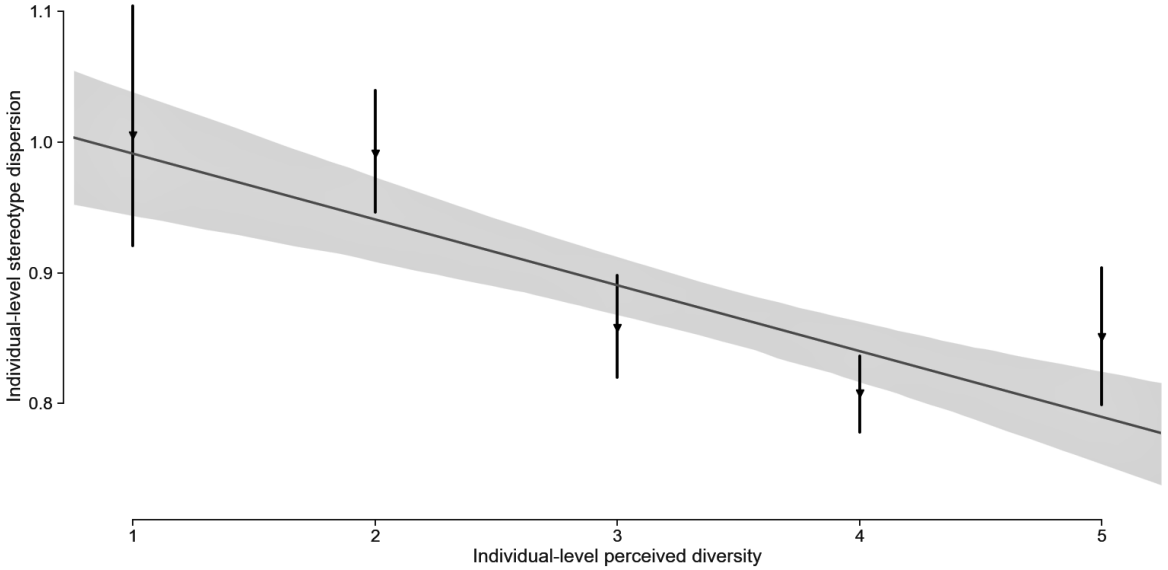
Note. Analysis unit is country or region, $N = 46$. X-axis indicates contextual ethnic diversity from the most homogeneous (left) to the most diverse (right). Y-axis indicates stereotype dispersion from the least dispersed (bottom) to the most dispersed (top) maps in warmth-by-competence space. Each dot represents one country; see main text for statistics. We depict the extreme cases (i.e., Lebanon and South Africa) as clearly illustrating the range of stereotype dispersion. See main text for statistics and *SI Appendix* for maps for each country.

Fig 2. Inverse linear relationship between ethnic diversity and stereotype dispersion in 50 states in the US.



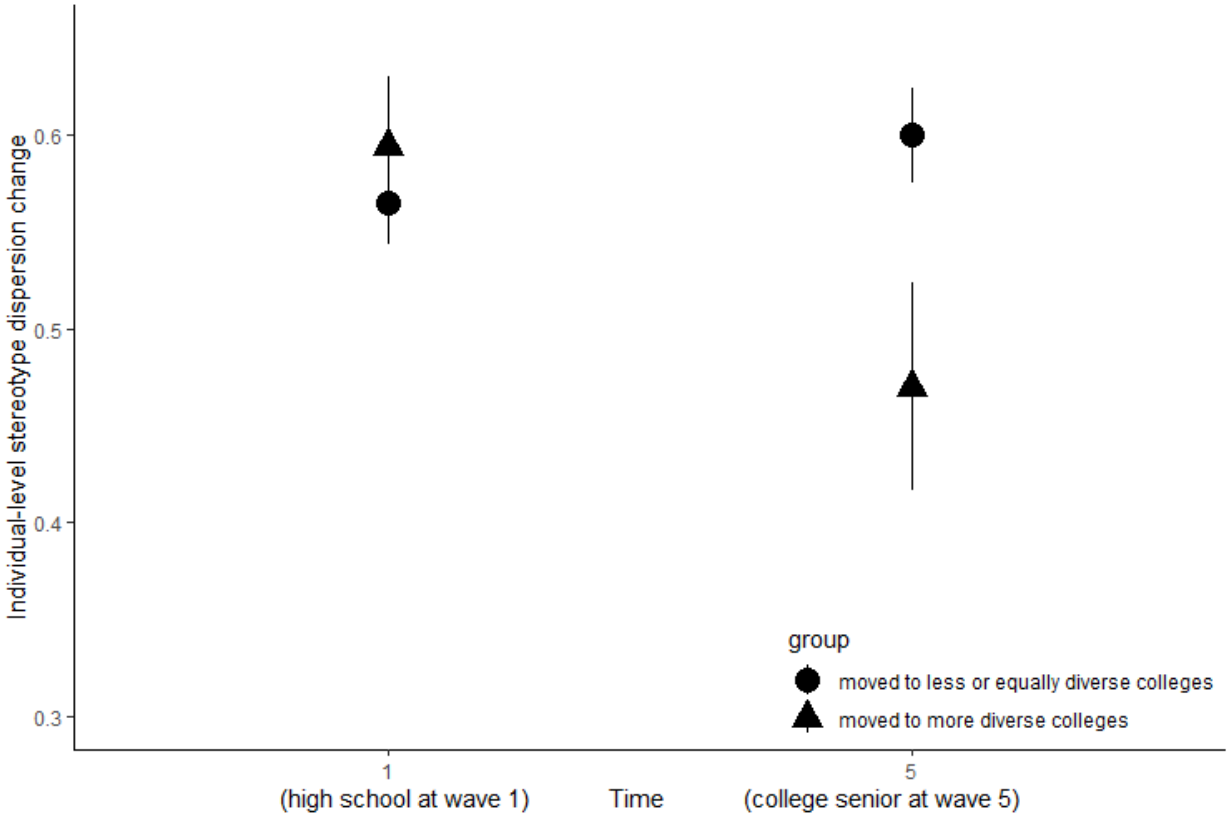
Note. Analysis unit is state in the US, $N = 50$. X-axis indicates contextual ethnic diversity from the most homogeneous (left) to the most diverse (right). Y-axis indicates stereotype dispersion from the least dispersed (bottom) to the most dispersed (top) maps of warmth-by-competence space. Each dot represents one state; see main text for statistics. We depict the extreme cases (i.e., Wisconsin and Hawaii) as clearly illustrating the range of stereotype dispersion. See main text for statistics and *SI Appendix* for maps for each state.

Fig 3. Individual-level perceived diversity associates with individual stereotype dispersion.



Note. Analysis unit is online American participant, N = 1502. X-axis indicates self-report of perceived diversity, ranging from 1 *not diverse* to 5 *very diverse*. Y-axis indicates stereotype dispersion from the least dispersed to the most dispersed maps in warmth-by-competence space. Line displays central tendency and 95% confidence intervals for each diversity interval. Full model estimates individual-level linear effects while controlling for within-state dependencies with clustered errors. See statistics in main text.

Fig 4. Students who attended more diverse colleges show larger decrease in stereotype dispersion from high school to college.



Note. Analysis unit is American college student, at two time points, N = 3924. X-axis indicates two time points: end of high school and end of college. Y-axis indicates stereotype dispersion change, from less increase to more increase. Error bars in red represent students who experienced less diversity changes from high school to college, while error bars in blue represent students who experienced more diversity changes. As shown, students who experienced more diversity changes decreased dramatically in stereotype dispersion, comparing to the other group. See statistics in main text.

Supplementary Materials for

As diversity increases, people paradoxically perceive social groups as more similar

Xuechunzi Bai, Miguel R. Ramos, Susan T. Fiske

Correspondence to: sfiske@princeton.edu

Open access to data, code, survey, experiment, and pre-registration report at *here*.

Supplementary Information

0. Study 0 mental map of stereotype content model: an illustration

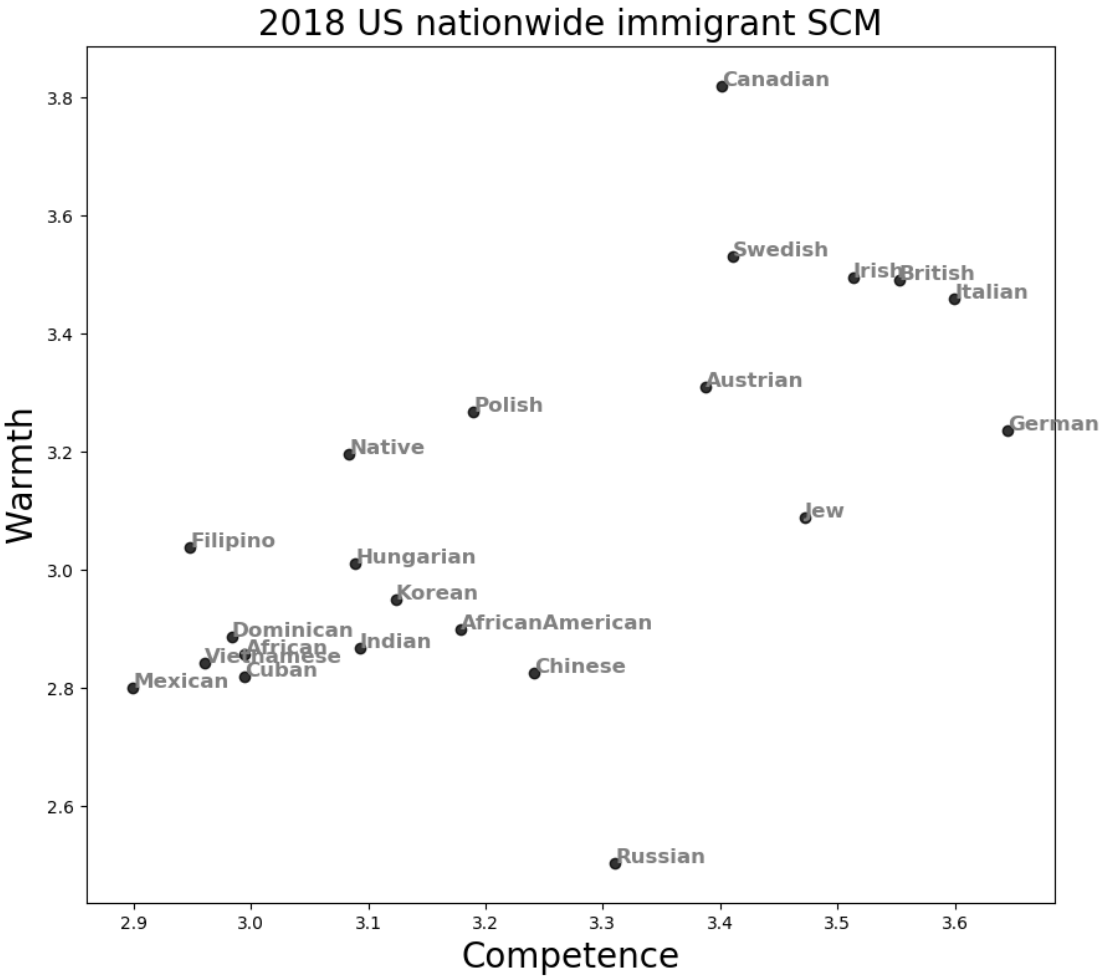


Fig.S 1 – Stereotype content model in the US

Note. American online participants ($N = 1502$) gave ratings on perceived competence and warmth of the 20 largest immigrant groups in the Untied States. Each dot represents how an immigrant groups is perceived by individuals in that society. The main analysis rests (Euclidean norm) on similar stereotype content maps, but varies at the level of responses and social groups. See main text for details.

1. Study 1 stereotype dispersion and ethnic diversity in 46 nations

Table.S 1 – Stereotype dispersion and ethnic diversity in 46 nations

Country	Stereotype dispersion	Ethnic diversity	GDP	GINI	Year	Country	Stereotype dispersion	Ethnic diversity	GDP	GINI	Year
Afghanistan	0.7481	0.7693	612.0697	34.4	2014	Japan	0.6622	0.0119	37217.6487	30.2	2005
Armenia	0.8941	0.1272	3614.7000	34.6	2017	Jordan	0.7961	0.5926	3992.8671	39.3	2013
Australia_w	0.8110	0.0929	42742.9990	33.1	2009	Kazakhstan	0.6676	0.6171	7713.6000	28	2017
Belarus	0.6468	0.3222	4986.5000	22.8	2017	Kenya_w	0.6876	0.8588	1335.0646	42.1	2014
Belgium	0.6747	0.5554	36967.2829	26.3	2005	Lebanon	1.4327	0.1314	8406.2852	38	2013
Bolivia_w	0.7620	0.7396	1776.8665	46.1	2009	Malaysia	0.8795	0.588	8513.6295	43.9	2008
Canada	0.6224	0.7124	46596.3360	31.3	2008	Mexico	0.9445	0.5418	7986.7984	46.1	2005
Chile	1.1177	0.1861	10243.3282	47.9	2009	NewZealand_w	0.8681	0.3969	28200.9419	32	2009
China	0.6498	0.1538	7683.5000	51.5	2014	Norway	0.8208	0.0586	102910.4350	24.6	2013
Costa Rica	0.7239	0.2368	4697.0111	44.4	2005	Pakistan	0.6587	0.7098	1272.4411	35.7	2013
Denmark	1.1910	0.0819	62425.5392	25.3	2014	Peru	0.4995	0.6566	4166.0934	48.4	2009
Egypt	0.7201	0.1836	3213.3892	47.2	2013	Portugal	1.0489	0.0468	22780.0585	35.3	2007
England	0.9866	0.1211	46523.2655	34	2008	Russia	0.9784	0.2452	8748.4000	42.1	2017
Finland	0.9580	0.1315	49914.6186	25.5	2014	South Africa	0.3909	0.7517	5414.6343	58	2005
Georgia	0.7594	0.4923	3865.8000	40.4	2017	South Korea	0.6597	0.002	18639.5222	30.2	2005
Germany	0.8458	0.1682	34696.6209	28.2	2005	Spain	1.1565	0.415	35578.7362	32.4	2008
Greece	1.1896	0.1576	31997.2820	32.6	2008	Sweden	1.0426	0.06	59180.1990	25.8	2014
HongKong	0.7134	0.062	26649.7508	40.9	2005	Switzerland_w	0.8436	0.5314	69672.0047	29.6	2009
India	0.6149	0.4182	1345.7702	48	2010	Turkey	0.6946	0.32	12542.9357	40.4	2013
Iran	0.7827	0.6684	5424.3100	37.9	2014	Uganda	0.8970	0.9302	647.0108	38.9	2009
Iraq	0.6060	0.3689	6925.2240	34.5	2013	Ukraine	0.9856	0.4737	2185.7000	25	2017
Israel_w	0.4289	0.3436	20611.1793	36.6	2005	US_w	0.7510	0.4901	48373.8788	37	2010
Italy_w	0.8397	0.1145	31959.2622	32.5	2005	Uzbekistan	0.4984	0.4125	2110.6000	35.2	2017

Note. See calculations and data source in the main text for each variable. *w* denotes aggregate results from multiple regions (e.g., French, German, and Italian Canton in Switzerland) or multiple samples (e.g., students and adults in Italy) in one country. Year denotes data collection time for stereotype content model research (Fiske et al., 2002).

Fig.S 2 – Stereotype dispersion in 46 nations

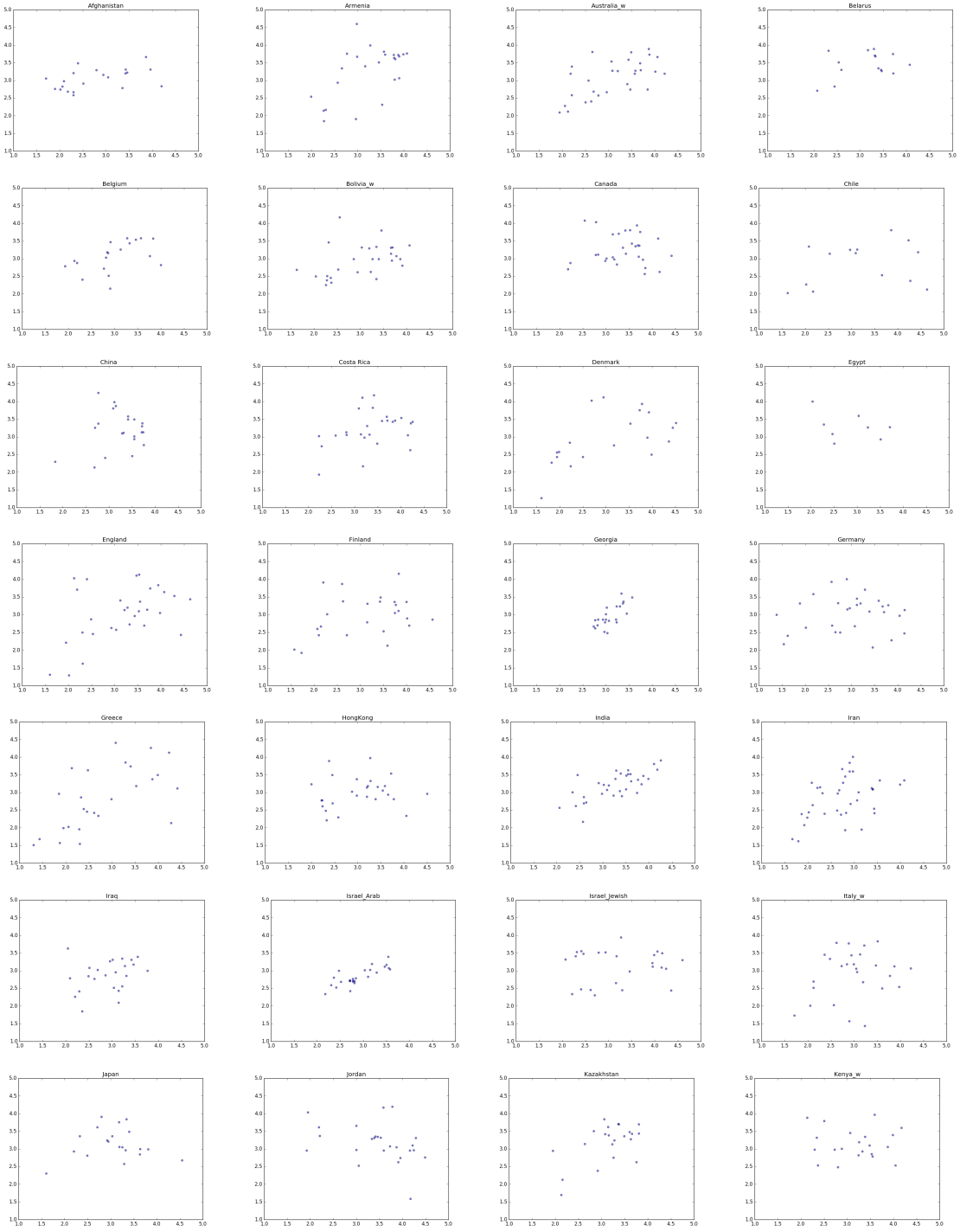
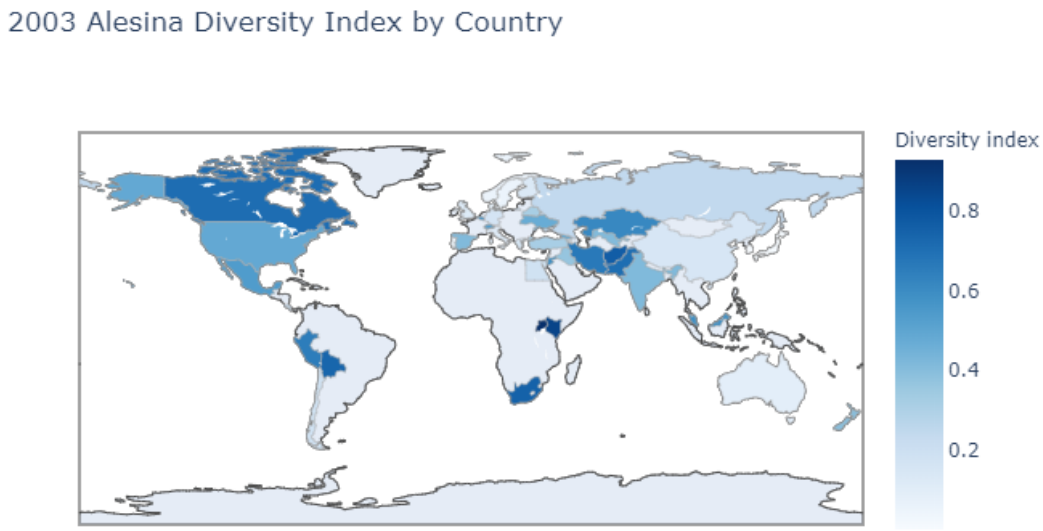


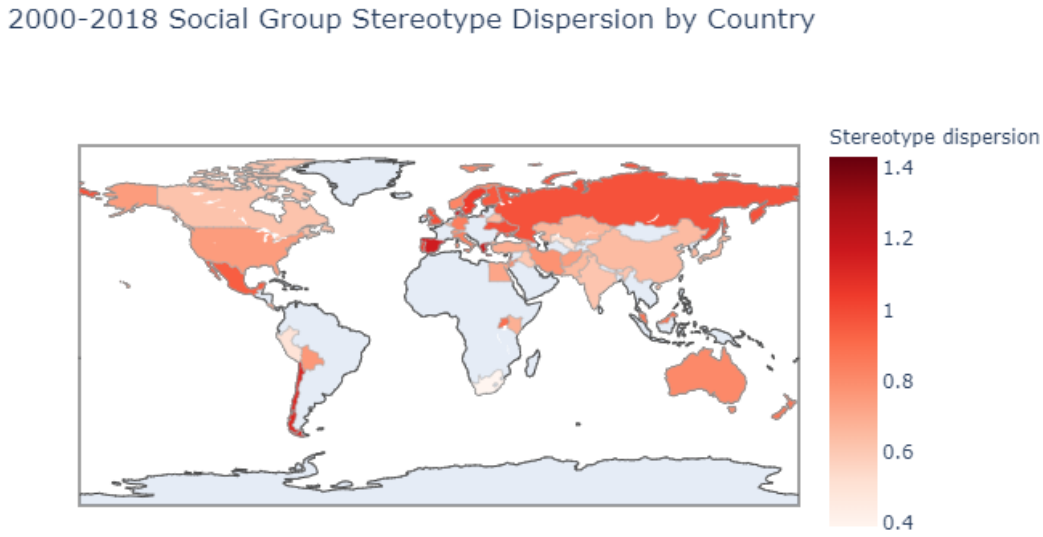
Fig.S 3 – Stereotype dispersion in 46 nations cont.

Note. Visualization of stereotype content map in each country, warmth on the x-axis and competence on the y-axis, scale range $[1,5]$, continuous. *w* denotes aggregate results from multiple regions (e.g., French, German, and Italian Canton in Switzerland) or multiple samples (e.g., students and adults in Italy) in one country. For sample size, sample feature, group label, clustering analysis, and other detail information in online data file or Durante et al. (2017). Zoom in to see figure titles.

Fig.S 4 – Geographical world heatmap showing inverse relations between diversity and dispersion.



(a) Ethnic diversity in 46 nations and regions



(b) Stereotype dispersion in 46 nations and regions

Note. Heatmaps plotting country-level stereotype dispersion and ethnic diversity. The upper figure indicates diversity, with darker blue showing higher diversity. The lower figure indicates stereotype dispersion, with darker red showing larger dispersion. Gray areas indicate no data.

2. Study 2 stereotype dispersion and ethnic diversity in 50 states in the US

Table.S 2 – Stereotype dispersion and ethnic diversity in 50 states in the US

State	Stereotype dispersion	Ethnic diversity	Perceived diversity	GDP	GINI	State	Stereotype dispersion	Ethnic diversity	Perceived diversity	GDP	GINI
Alabama	0.238	0.435	3.700	204201	0.4847	Montana	0.413	0.184	2.400	46478	0.4667
Alaska	0.169	0.508	3.688	50542	0.4081	Nebraska	0.447	0.182	2.846	118945	0.4477
Arizona	0.404	0.276	3.700	304357	0.4713	Nevada	0.471	0.378	4.267	148216	0.4577
Arkansas	0.425	0.330	3.400	121275	0.4719	New Hamsphire	0.431	0.100	2.710	77843	0.4304
California	0.260	0.426	4.387	2619639	0.4899	New Jersey	0.406	0.417	4.167	576228	0.4813
Colorado	0.323	0.214	3.529	323762	0.4586	New Mexico	0.218	0.290	3.903	93242	0.4769
Connecticut	0.302	0.305	3.935	257038	0.4945	New York	0.199	0.449	4.133	1500152	0.5129
Delaware	0.214	0.434	3.467	70927	0.4522	North Carolina	0.578	0.428	3.633	518378	0.478
Florida	0.300	0.352	4.067	930375	0.4852	North Dakota	0.516	0.176	2.550	53328	0.4533
Georgia	0.363	0.501	3.800	532657	0.4813	Ohio	0.494	0.283	3.333	624372	0.468
Hawaii	0.150	0.760	4.000	84904	0.442	Okalahoma	0.401	0.407	3.300	181480	0.4645
Idaho	0.403	0.113	2.767	68616	0.4503	Oregon	0.415	0.208	2.935	227032	0.4583
Illinois	0.415	0.365	3.833	796906	0.481	Pennsylvania	0.497	0.282	3.333	723962	0.4689
Indiana	0.565	0.235	2.867	345207	0.4527	Rhode Island	0.502	0.246	3.867	57507	0.4781
Iowa	0.529	0.130	2.767	186200	0.4451	South Carolina	0.401	0.452	3.938	210876	0.4735
Kansas	0.344	0.227	3.333	154806	0.455	South Dakota	0.422	0.238	3.300	48652	0.4495
Kentucky	0.522	0.201	2.839	195527	0.4813	Tennessee	0.643	0.337	3.387	332094	0.479
Louisiana	0.544	0.485	3.938	237598	0.499	Texas	0.233	0.326	3.967	1601517	0.48
Maine	0.519	0.086	2.400	59475	0.4519	Utah	0.476	0.150	2.933	157404	0.4263
Maryland	0.503	0.530	4.065	380805	0.4499	Vermont	0.356	0.085	2.533	31292	0.4539
Massachusetts	0.455	0.279	3.879	505689	0.4786	Virginia	0.332	0.446	3.968	491221	0.4705
Michigan	0.508	0.332	3.867	486874	0.4695	Washington	0.305	0.315	4.100	476934	0.4591
Minnesota	0.432	0.235	3.438	338746	0.4496	West Virginia	0.544	0.110	2.633	72569	0.4711
Mississippi	0.365	0.498	3.467	109034	0.4828	Wisconsin	0.696	0.211	3.333	314247	0.4498
Missouri	0.419	0.278	3.375	297074	0.4646	Wyoming	0.400	0.118	2.567	37925	0.436

Note. See calculations and data source in the main text for each variable. All data collected in July, 2018.

Fig.S 5 – Stereotype dispersion in 50 states

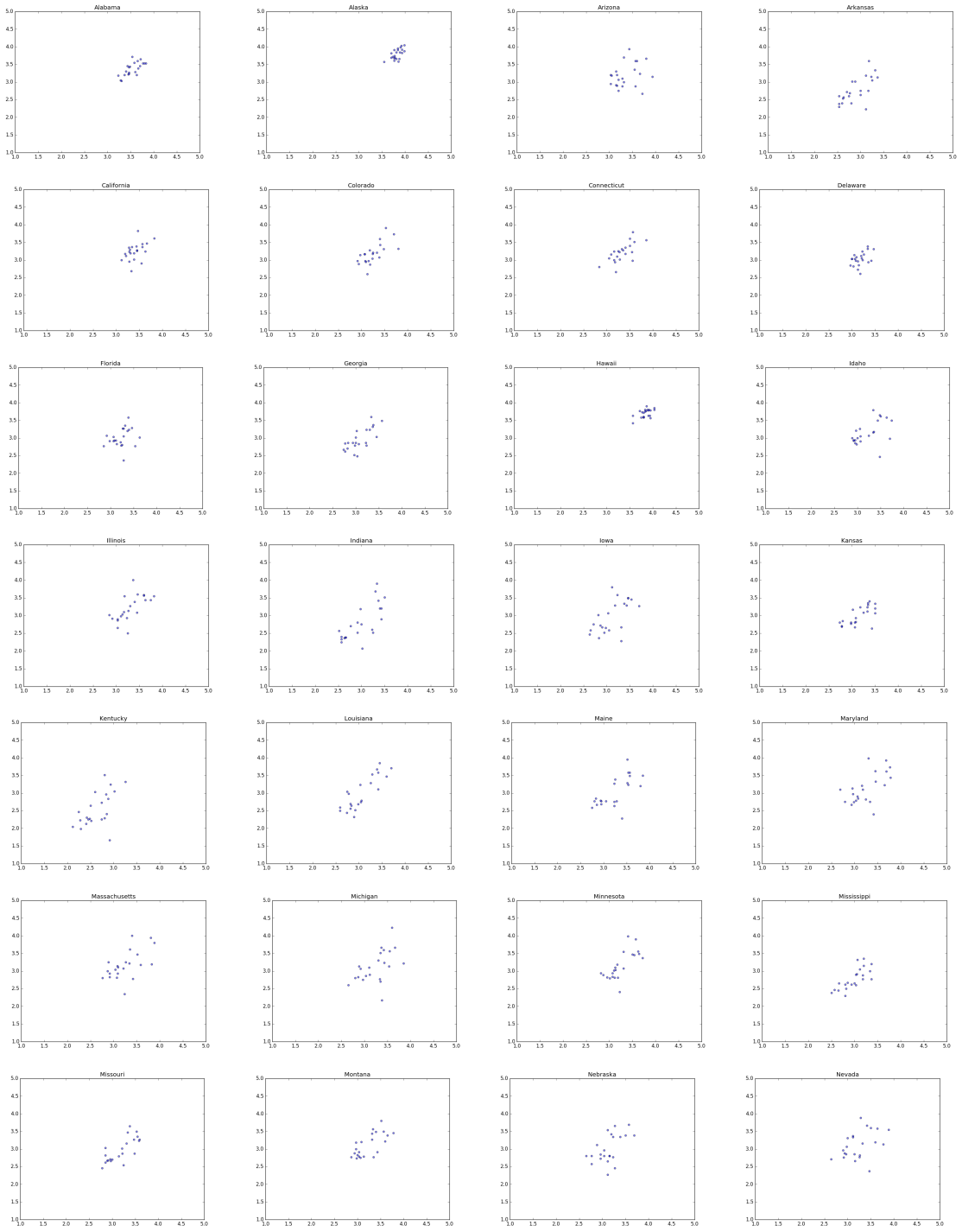
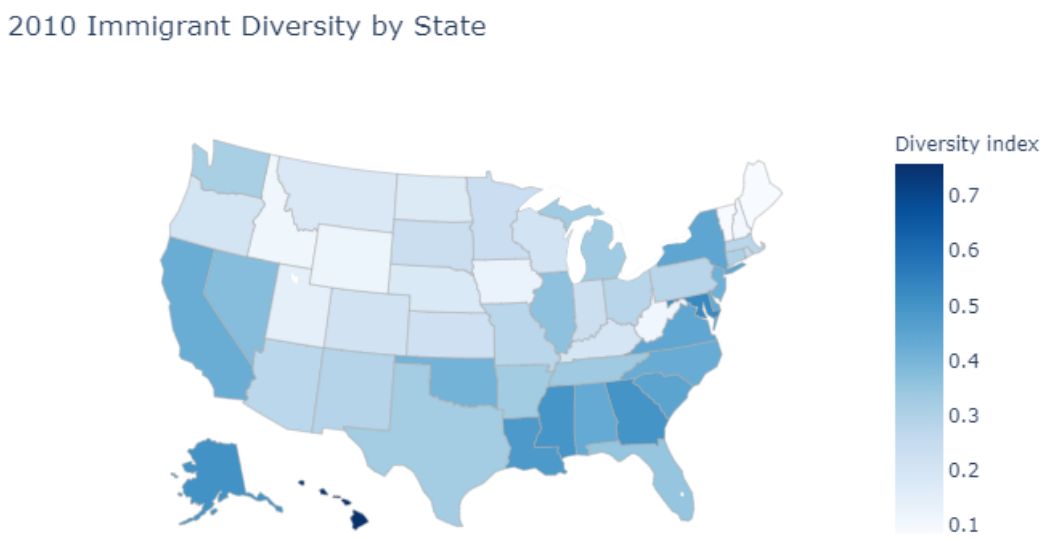


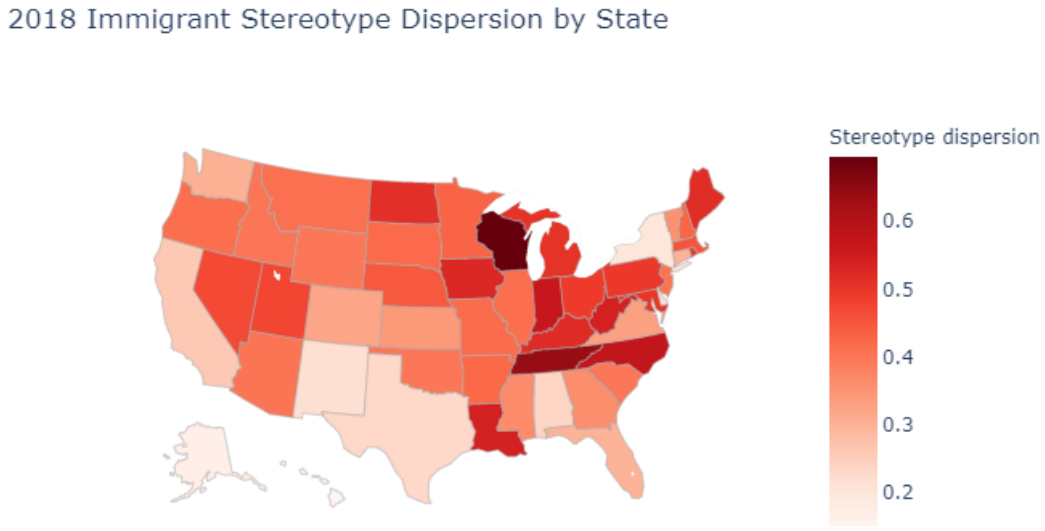
Fig.S 6 – Stereotype dispersion in 50 states cont.

Note. Visualization of stereotype content map in each state in the US, warmth on the x-axis and competence on the y-axis, scale range $[1,5]$, continuous. Participants from each state evaluated 20 immigrant groups on perceived warmth and competence, see main text for details (Methods) and group labels for each dot in each state in online data. Zoom in to see figure titles.

Fig.S 7 – Geographical US heatmap showing inverse relations between diversity and dispersion.



(a) Immigrant diversity in 50 states in the US



(b) Stereotype dispersion in 50 states in the US

Note. Heatmaps plotting state-level stereotype dispersion and ethnic diversity. The upper figure indicates diversity (the most recent available year), with darker blue showing higher diversity. The lower figure indicates stereotype dispersion, with darker red showing larger dispersion.

3. Study 2 demographics of online American participants

Table.S 3 – US study participant demographic information

State	N	Gender (% female)	Age (mean)	Years of living	Education level	Social ladder	Household income	Area of residence	Ancetry immigrant
Alabama	30	0.23	36	25	4.2	6.5	4.2	47% Big city	33% Mexican 20% African American
Alaska	30	0.27	29	21	4.7	6.4	4.7	40% Big city	40% Native American 30% African American
Arizona	30	0.37	35	21	3.8	4.9	3.8	40% Suburbs	23% Mexican 23% German
Arkansas	30	0.47	37	23	3.4	4.7	3.4	43% Town or small city	27% Irish 20% German
California	30	0.4	35	27	3.9	5.1	3.9	37% Suburbs	17% Irish 13% German; Italian
Colorado	30	0.33	33	20	4.2	5.5	4.2	43% Suburbs	40% German
Connecticut	30	0.4	30	23	4.2	5.6	4.2	43% Town or small city	23% African American 23% Native American
Delaware	30	0.4	31	18	3.8	5.4	3.8	47% Suburbs	33% German 20% African American
Florida	30	0.43	35	24	4.4	5.5	4.4	53% Suburbs	23% British 23% African American
Georgia	30	0.47	33	24	3.9	5.1	3.9	53% Suburbs	17% British 17% African American
Hawaii	30	0.33	31	20	4.8	7.2	4.8	60% Big city	47% Native American 43% African American
Idaho	30	0.6	35	23	3.8	4.7	3.8	40% Suburbs	23% German 23% British
Illinois	30	0.4	36	28	4.3	5.2	4.3	50% Suburbs	30% Native American 23% German
Indiana	30	0.37	33	23	3.7	4.6	3.7	43% Town or small city	27% British 23% German
Iowa	30	0.43	35	22	3.7	4.6	3.7	43% Town or small city	43% German
Kansas	29	0.55	36	24	4.2	5.5	4.2	41% Big city	28% German 28% Native American
Kentucky	30	0.57	37	29	3.1	4.2	3.1	43% Town or small city	30% German 27% British
Louisiana	30	0.4	35	32	3.7	5	3.7	40% Town or small city	20% German 20% African American
Maine	30	0.5	34	24	3.7	4.6	3.7	47% Town or small city	23% British 13% German; Italian; Irish
Maryland	30	0.43	33	25	3.8	5.1	3.8	47% Suburbs	30% German 13% South Korean
Massachusetts	30	0.37	34	25	4.3	5.3	4.3	47% Suburbs	23% German 17% Other

Table.S 4 – US study participant demographic information cont.

State	N	Gender (% female)	Age (mean)	Years of living	Education level	Social ladder	Household income	Area of residence	Ancestry immigrant
Michigan	30	0.43	31	27	3.6	4.7	3.6	47% Suburbs	37% German
Minnesota	30	0.43	35	30	3.7	4.3	3.7	43% Suburbs	53% German
Mississippi	30	0.67	33	22	4	5	4	50% Town or small city	23% British 13% African; Native American
Missouri	30	0.43	34	28	3.6	5	3.6	37% Big city	37% German 20% Native American
Montana	29	0.45	35	14	4.3	5.2	4.3	53% Town or small city	33% German 17% British
Nebraska	13	0.54	31	21	4.2	4.5	4.2	46% Big city	69% German
Nevada	30	0.37	36	14	3.5	4.3	3.5	67% Big city	33% German
New Hampshire	30	0.37	36	26	4	5.3	4	40% Town or small city	33% British
New Jersey	30	0.3	38	31	3.7	5.3	3.7	47% Suburbs	27% Italian 17% Native American
New Mexico	30	0.27	35	24	4.7	6.1	4.7	63% Big city	43% Mexican
New York	30	0.3	32	24	4.7	6.5	4.7	57% Big city	23% African American 20% Native American
North Carolina	30	0.47	40	22	3.4	4.5	3.4	37% Suburbs	27% British 20% German
North Dakota	20	0.4	35	18	4	4.9	4	55% Town or small city	40% German
Ohio	30	0.37	31	24	3.8	4.4	3.8	53% Suburbs	33% German
Oklahoma	30	0.47	36	27	3.6	4.3	3.6	33% Suburbs	30% British 23% German
Oregon	30	0.6	40	21	3.5	3.7	3.5	43% Town or small city	37% German 20% British
Pennsylvania	30	0.43	33	26	3.5	4.3	3.5	37% Town or small city	40% German
Rhode Island	30	0.33	36	23	3.6	4.8	3.6	70% Town or small city	23% Irish 20% Italian
South Carolina	30	0.53	35	23	4.3	4.7	4.3	40% Town or small city	37% German
South Dakota	30	0.37	32	20	4.2	6.2	4.2	43% Town or small city	33% African American 27% German
Tennessee	30	0.6	39	28	3.5	4.4	3.5	43% Suburbs	37% German 23% British
Texas	30	0.27	34	25	4.2	6	4.2	47% Big city	33% Native American
Utah	30	0.37	37	23	3.9	4.4	3.9	60% Suburbs	30% German 27% British
Vermont	30	0.43	33	20	4.4	4.8	4.4	37% Town or small city	27% German 17% British; Italian
Virginia	30	0.57	33	23	3.9	5	3.9	43% Suburbs	23% German 13% African American
Washington	30	0.53	34	21	3.6	5	3.6	47% Big city	23% German
West Virginia	30	0.33	34	21	4.3	5.6	4.3	47% Town or small city	27% German 27% African American
Wisconsin	30	0.53	35	29	3.6	4.7	3.6	37% Town or small city	70% German
Wyoming	30	0.33	34	23	3.9	5.4	3.9	53% Town or small city	33% British

Note. See variable manipulations in the main text Methods section.

4. Study 2 stereotype dispersion by ethnic group

An alternative explanation for less stereotype dispersion in diverse states is group identity. In more diverse states, we could have drawn more minority group participants, whereas in less diverse states, we might have collected more majority group participants. Therefore, both diversity and group identity may associate with stereotype dispersion. Table below provides descriptive statistics on stereotype dispersion ratings by immigrant group. We did not observe clear patterns. Spearman's rank correlation coefficient, $\rho(48) = -.051, p = .816$, also showed null relationship between group membership and stereotype dispersion. Moreover, in the main model, we observed the effect conditional on group membership. Accordingly, we rule out this explanation.

Table.S 5 – Stereotype dispersion by immigrant group.

Ancestry immigrant	Stereotype dispersion	N
Mexican	0.7782 (.393)	71
German	0.9136 (.363)	369
British	0.9093 (.363)	215
Italian	0.9719 (.430)	87
Canadian	0.9150 (.350)	34
Irish	0.9779 (.324)	115
Russian	0.8541 (.391)	14
Filipino	0.8628 (.614)	9
Chinese	0.8588 (.354)	20
Australian	0.8255 (.302)	2
Indian	0.6940 (.323)	9
Hungarian	0.9975 (.218)	5
Cuban	1.1028 (.339)	3
Dominican Republican	0.7831 (.739)	6
Swedish	1.0295 (.422)	16
South Korean	1.0847 (.629)	19
Vietnamese	0.8365 (.520)	8
Polish	1.0338 (.422)	27
African	0.8514 (.309)	17
African American	0.6875 (.338)	144
Native American	0.7211 (.359)	162
Jew	1.0680 (.415)	12
Other	0.8439 (.350)	107

Note. For each participant, we have their self-report immigrant ancestry data. If multiple groups were selected, we used their first selected ancestor as the proxy for their own ethnicity. *N* therefore denotes participants' self-report ethnicity. For stereotype dispersion, we calculated average and standard error within each ethnicity.

5. Study 2 multilevel regression and state random effects

Below we show the main model output for Study 2. GDP is denoted in unit 10^7. We included ancestry variable in the actual model, but for space concern, omit reporting here, see online data for details. Area of living is tested as continuous and discrete variable, results remain unchanged. Continuous variables are centered and discrete variables are factorized.

Therefore, state diversity effect should be interpreted as: for participants living in states with same levels of inequality (.465) and wealth (37305), for one-unit increase in state diversity, we expect to see .282 decrease in stereotype dispersion.

Likewise, individual perceived diversity should be interpreted as: within participants who are the same gender (female), with similar age (34yrs), similar socio-economic backgrounds (some college degree, social ladder 5 out of 9, annual income 30k to 50k), live in the same type of areas (suburbs of a big city or small city), have similar frequency of contact with other groups (3.81 out of 5), and within the same ancestry immigrant groups (out of 20 groups), those who perceived more diversity showed less stereotype dispersion; 1-unit increase in micro-diversity corresponds to .034 to .031 decrease in stereotype dispersion.

Table.S 6 – Mixed-effects multiple regression

	Model 1: state diversity	Model 2: perceived diversity	Model 3: both
Intercept	.870***(.014)	0.838***(.045)	.839***(.045)
Fixed effects			
Model 1 variables			
state diversity	-.282**(.102)		-.046 (.092)
state gini	1.612†(.819)		1.329†(.687)
state gdp	-.821*(.393)		-.716*(.285)
Model 2 variables			
perceived diversity		-.034***(.010)	-.031**(.011)
age		-.000 (.001)	-.000 (.001)
gender		.079***(.020)	.078***(.200)
education		-.010 (.009)	-.010 (.009)
social ladder		-.033***(.007)	-.033***(.007)
income		.025**(.008)	.025**(.008)
years living		-.000 (.000)	-.000 (.000)
living area		.008 (.010)	.006 (.010)
contact frequency		.003 (.010)	.002 (.010)
Random effects			
intercept	.004 (.066)	.002 (.049)	.002 (.042)
residual	.140 (.375)	.131 (.362)	.131 (.362)
Number of observations			
state-level	50	50	50
individual-level	1471	1458	1458

Note. Statistical significance level: † $p < .10.$, * $p < .05$, $^{*}* p < .01$, $^{*}** p < .001$.

Fig.S 8 – Individual perceived diversity predicts individual stereotype dispersion, random effects.

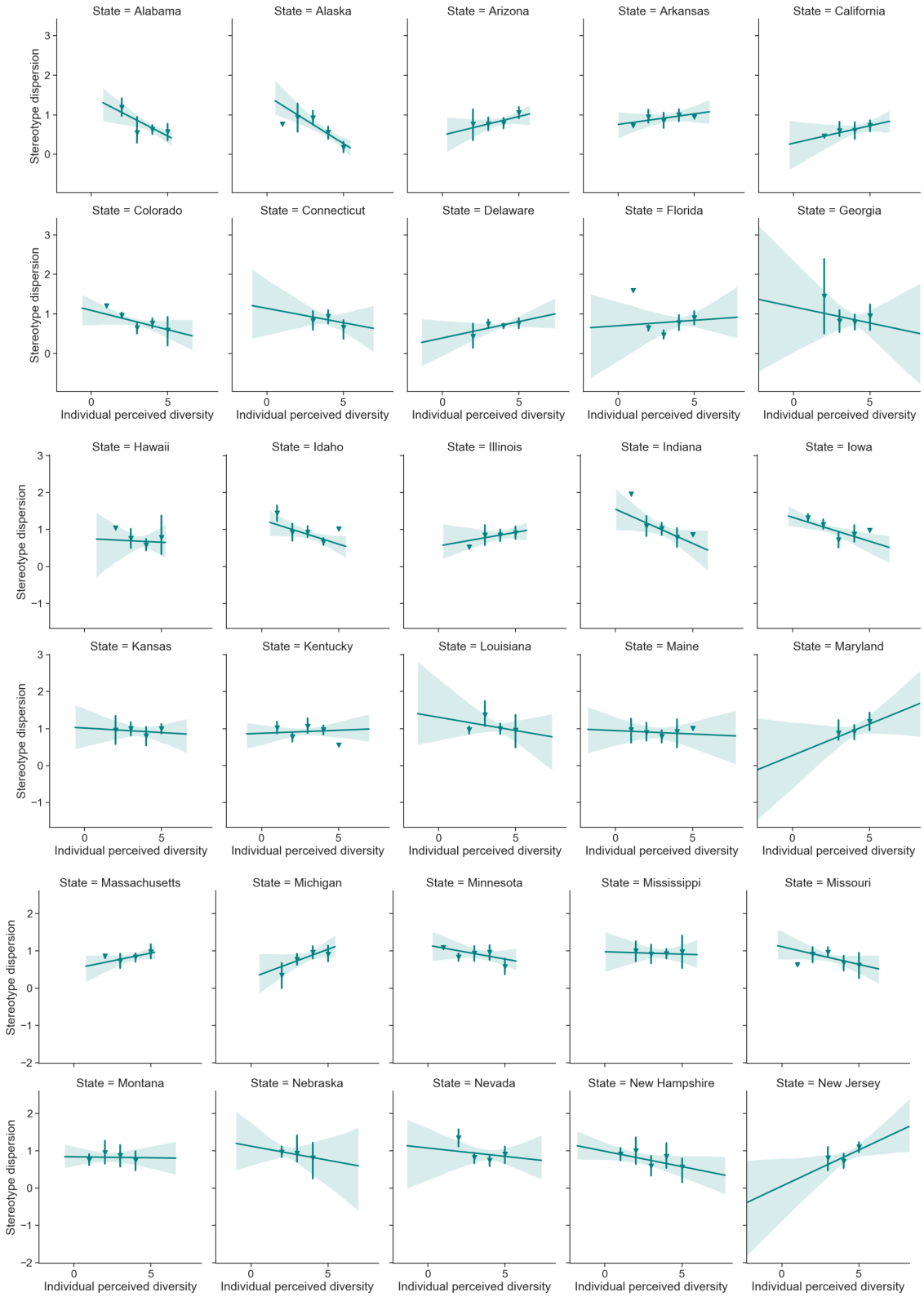
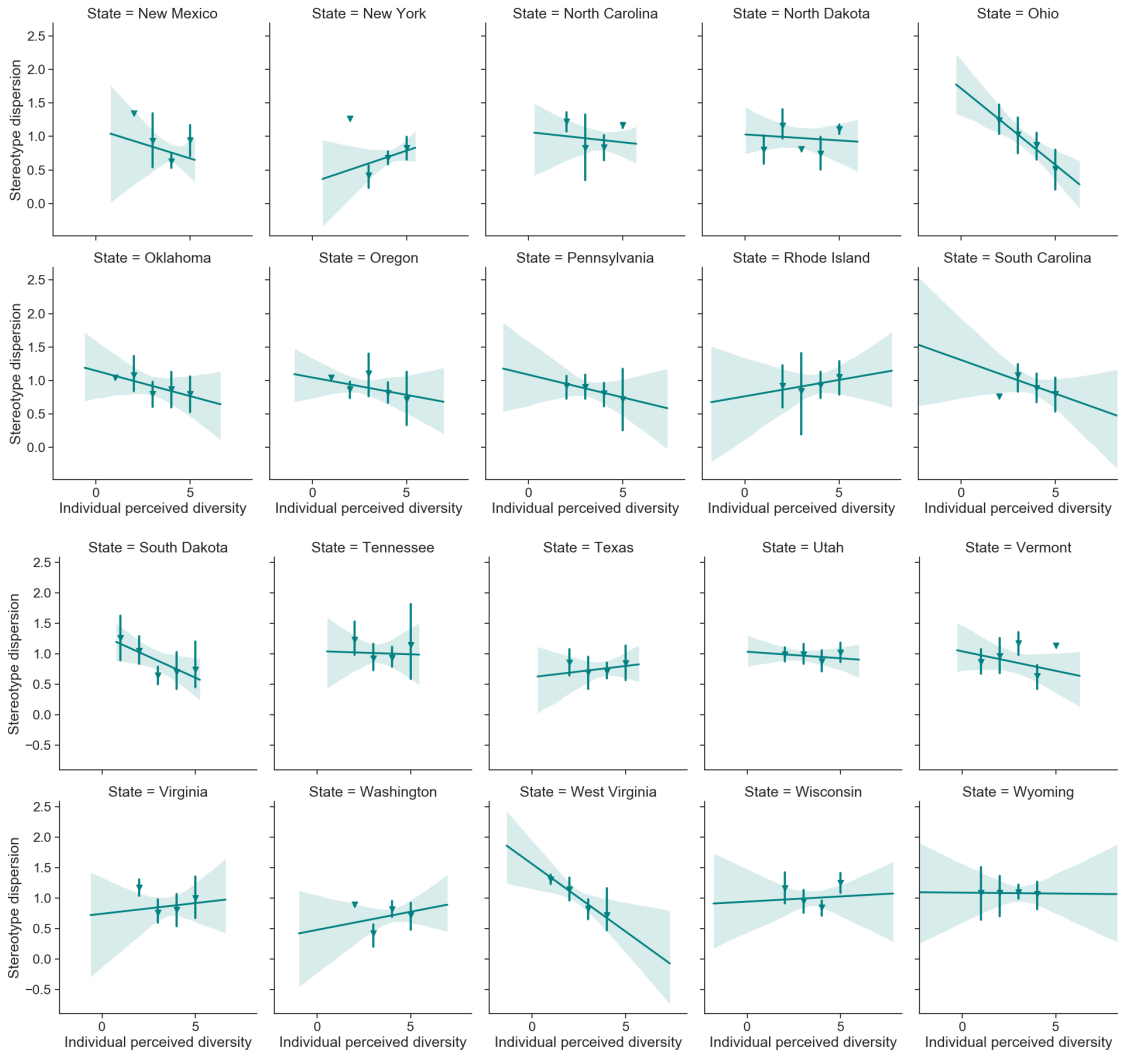


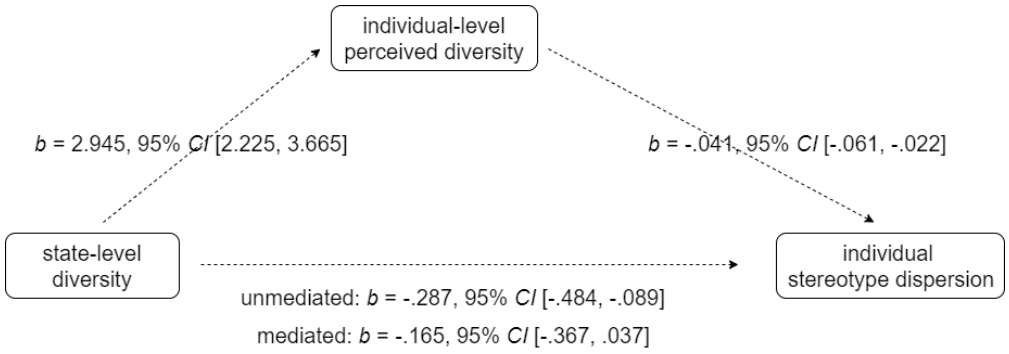
Fig.S 9 – Individual perceived diversity predicts individual stereotype dispersion, random effects contd.



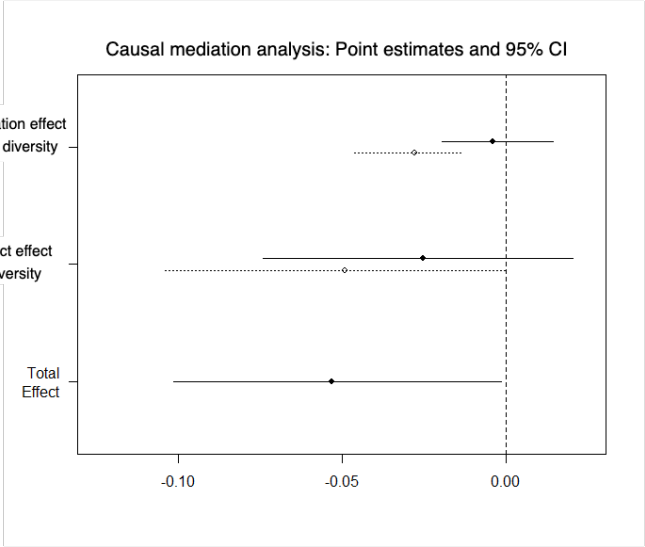
Note. Visualization of perceived diversity effects on individual stereotype dispersion, per state. Interpret with caution, more descriptive than inferential, given unstable estimates from small sample size per state.

6. Study 2 mediation analysis

Mediation SI-1 Mediation effects of perceived diversity between contextual diversity and stereotype dispersion. First, LSEM mediation analysis indicates that perceived diversity statistically accounted for the observed tendency for individuals who live in diverse states display less stereotype dispersion. Individuals in diverse states high tendency to report less stereotype dispersion ($b = -.287, 95\% CI[-.484, -.089]$) was reduced ($b = -.164, 95\% CI[-.367, .037]$) after accounting for their perceived diversity. See path figure below.



Mediation SI-2 Next, Causal Mediation Analysis (Imai, 2010) using R mediation package (Tingley, et al., 2017), under sequential ignorability assumption, we found that on average the contextual diversity decreases participants stereotype dispersion by .02 (with a 95% confidence interval of [-.03, -.01]) because of heightened individual-level perceived diversity. Because the total causal effect of contextual diversity was -.05 ([-.10, .00]) and the direct effect was -.04 ([-.09, .01]), we conclude that about 28% of the total effect was mediated through the perceived diversity mechanism.



More on the computation: In this analysis, we examined whether state-level diversity influences individual-level perceived diversity which in turn influences stereotype dispersion. Specifically, to estimate the average causal mediation effects, we first fitted regression models for the mediator and the outcome. The mediator (individual-level subjective diversity) is modeled as a function of the treatment (state-level macro diversity; dichotomized into 0 or 1 with 0 indicates low diversity group and 1 indicates high diversity group) and any relevant pretreatment covariates (i.e., age, gender, socio-economic status, and living area). The outcome is modeled as a function of the mediator, the treatment, and the pretreatment covariates. Based on the mediator model, we then generated two sets of predictions for the mediator, one under the treatment (predicted values of perceived diversity in high diversity states) and the other under the control (predicted values of perceived diversity in low diversity states). Next, the outcome model is used to make potential outcome predictions. For example, suppose we are interested in estimating the average causal mediation effects under the treatment (high diversity states). First, the outcome (stereotype dispersion) is predicted under the treatment using the value of the mediator predicted in the treatment condition (predicted perceived diversity under high diversity states). Second, the outcome is predicted under the treatment condition but now uses the mediator prediction from the control condition (predicted perceived diversity if they were assigned in low diversity states, which is counterfactual). The average treatment effect is then computed as the average difference between the outcome predictions using the two different values of the mediators. In other words, this would correspond to the average difference in stereotype dispersion from fixing the treatment status but changing the level of perceived diversity between the level predicted after being exposed to high versus low diversity states. Then, we used nonparametric bootstrap with 100 samples to compute statistical uncertainty of the effect.

7. Study 3 derivation of diff-in-diff estimator

$$y_{i,t} = \alpha + \beta_1 T_t + \beta_2 D_{i,t} + \beta_3 (T_t * D_{i,t}) + \gamma X_{i,t} + \varepsilon_{i,t} \tag{1}$$

T_t is binary, 1 if college; 0 if high school.
$D_{i,t}$ is continuous $\in$ [0,3], perceived diversity.
$d_{i,1}$ if in college; $d_{0,t}$ if in high school.

When $T_t = 0, D_{i,0} = d_{i,0}$, the stereotype dispersion of student i when in high school with $d_{i,0}$ perceived diversity, is:

$$y_{i,0} = \alpha + \beta_2 d_{i,0} + \gamma X_{i,t} + \varepsilon_{i,t} \tag{2}$$

When $T_t = 0, D_{i,1} = d_{i,1}$, the stereotype dispersion of student i when in high school with $d_{i,1}$ perceived diversity, is:

$$y_{i,0} = \alpha + \beta_2 d_{i,1} + \gamma X_{i,t} + \varepsilon_{i,t} \tag{3}$$

When $T_t = 1, D_{i,0} = d_{i,0}$, the stereotype dispersion of student i when in college with $d_{i,0}$ perceived diversity, is:

$$y_{i,1} = \alpha + \beta_1 + \beta_2 d_{i,0} + \beta_3 d_{i,0} + \gamma X_{i,t} + \varepsilon_{i,t} \tag{4}$$

When $T_t = 1, D_{i,1} = d_{i,1}$, the stereotype dispersion of student i when in high school with $d_{i,0}$ perceived diversity, is:

$$y_{i,1} = \alpha + \beta_1 + \beta_2 d_{i,1} + \beta_3 d_{i,1} + \gamma X_{i,t} + \varepsilon_{i,t} \tag{5}$$

The difference between Eq (4) and Eq (2) represents time trends, for students who have same levels of perceived diversity ($d_{i,0}$), how likely are the stereotype dispersion have been changed due to the fact that they went to college, which is $\beta_1 + \beta_3 d_{i,0}$.

Likewise, the difference between Eq (5) and Eq (3) represents time trends for students with perceived diversity ($d_{i,1}$), which is $\beta_1 + \beta_3 d_{i,1}$.

To attenuate individual or group baseline difference, by subtracting the above two terms gives us $\beta_3(d_{i,1} - d_{i,0})$. This is the change in stereotype dispersion of student i when he or she has changed perceived diversity from d_0 to d_1.

The coefficient of β_3 is thus our main quantity of interest, the difference-in-difference estimator.

8. Study 3 robustness check

Table.S 7 – diff-in-diff, robust check with multiple pre-high school diversity

	high school (1)	high school (2)	3-block at 13 (1)	3-block at 13 (2)	high school at 13 (1)	high school at 13 (2)
Intercept (female, average income, Asian)	.565*** (.021)	.556*** (.025)	.583*** (.017)	.580*** (.020)	.586*** (.020)	.581 (.023)
Fixed effects						
Step 1 variables						
perceived diversity : college	-.155** (.054)	-0.116* (.055)	-.111* (.052)	-.045 (.053)	0.110* (.052)	-.062 (.054)
perceived diversity	.029 (.037)	.012 (.037)	-.020 (.033)	.067* (.034)	-.022 (.034)	-.048 (.035)
college	.035 (.025)	.017 (.025)	.018 (.021)	-.004 (.022)	.015 (.023)	-.007 (.024)
Step 2 variables						
male		.065*** (.014)		-.028** (.011)		.065*** (.014)
income		-.014*** (.004)		-.000 (.001)		-.014*** (.004)
race Black		.094*** (020)		.093*** (.020)		.094*** (.020)
race Hispanic		.021 (.020)		.020 (.020)		.020 (.020)
race White		-.012*** (.020)		-.124*** (.020)		-.121*** (.020)
Random effects						
high school state intercept	.004 (.061)	.002 (.041)	.004 (.061)	.002 (.042)	.004 (.061)	.002 (.042)
subject intercept	.096 (.310)	.089 (.298)	.096 (.310)	.089 (.298)	.096 (.310)	.089 (.298)
residual	.134 (.367)	.136 (.369)	.135 (.367)	.136 (.369)	.135 (.367)	
Number of observations						
state-level	49	49	49	49	49	49
subject-level	3735	3586	3730	3581	3732	3583
number of obs	6463	6233	6451	6222	6445	6216

Table.S 8 – diff-in-diff, robust check with multiple pre-high school diversity, cont.

	high school (1)	high school (2)	3-block at 6 (1)	3-block at 6 (2)	first-grade (1)	first-grade (2)
Intercept (female, average income, Asian)	.565*** (.021)	.556*** (.025)	.589*** (.016)	.583*** (.020)	.588*** (.017)	.578*** (.021)
Fixed effects						
Step 1 variables						
perceived diversity : college	-.155** (.054)	-0.116* (.055)	-.090† (.052)	-.026 (.053)	-0.102* (.052)	-.060 (.052)
perceived diversity	.029 (.037)	.012 (.037)	-.041 (.033)	-.084* (.034)	-.030 (.033)	-.050 (.033)
college	.035 (.025)	.017 (.025)	.012 (.021)	-.008 (.021)	.014 (.022)	-.003 (.022)
Step 2 variables						
male		.065*** (.014)		.066** (.014)		.066*** (.014)
income		-.014*** (.004)		-.014*** (.004)		-.014*** (.004)
race Black		.094*** (020)		.095*** (.020)		.094*** (.020)
race Hispanic		.021 (.020)		.021 (.020)		.021 (.020)
race White		-.012*** (.020)		-.123*** (.020)		-.121*** (.020)
Random effects						
high school state intercept	.004 (.061)	.002 (.041)	.003 (.059)	.002 (.040)	.004 (.060)	.002 (.041)
subject intercept	.096 (.310)	.089 (.298)	.097 (.311)	.089 (.299)	.097 (.311)	.090 (.300)
residual	.134 (.367)	.136 (.369)	.135 (.367)	.136 (.369)	.134 (.366)	.135 (.368)
Number of observations						
state-level	49	49	49	49	49	49
subject-level	3735	3586	3721	3574	3724	3575
number of obs	6463	6233	6432	6204	6412	6183

Table.S 9 – diff-in-diff estimations with inverse probability weighted and unweighted data.

	unweighted		weighted	
Intercept (female, average income, Asian)	.565*** (.021)	.556*** (.025)	.570*** (.020)	.413*** (.038)
Fixed effects				
Step 1 variables				
perceived diversity : college	-.155** (.054)	-.116* (.052)	-.136** (.047)	-.094* (.048)
perceived diversity	.029 (.037)	.012 (.037)	.023 (.034)	.007 (.034)
college	.035 (.025)	.017 (.025)	.030 (.022)	.009 (.022)
Step 2 variables				
male		.065*** (.014)		.067*** (.013)
income		-.014*** (.004)		-.012*** (.003)
race Black		.094*** (.020)		.106*** (.017)
race Hispanic		.021 (.020)		.027 (.018)
race White		-.012*** (.020)		-.116*** (.017)
Random effects				
high school intercept	.004 (.061)	.002 (.041)	.079 (.282)	.073 (.270)
subject intercept	.096 (.310)	.089 (.298)	.003 (.056)	.001 (.036)
residual	.134 (.367)	.136 (.369)	.125 (.354)	.127 (.356)
Number of observations				
state-level	49	49	49	49
subject-level	3735	3586	3773	3618
number of obs	6463	6233	7546	7236

Note. Regression analyses with inverse probability weighting. We assume missing values are missing at random conditional on observed covariates: gender and race. Both weighted and unweighted analyses are present in the table, giving same conclusions.

Table.S 10 – robustness check: placebo outcomes

	stereotype dispersion	bright future	life as failure	enjoy life
Intercept	.565*** (.021)	.030 (.040)	1.448*** (.028)	4.286*** (.032)
Fixed effects				
perceived diversity : college	-.155** (.054)	.014 (.128)	-.062 (.087)	.228* (.099)
perceived diversity	.029 (.037)	-.036 (.079)	.126* (.054)	-.201** (.062)
college	.035 (.025)	-.011 (.060)	-.228*** (.040)	-.275*** (.046)
Random effects				
high school state intercept	.004 (.061)	.002 (.041)	.002 (.609)	.002 (.048)
subject intercept	.096 (.310)	.131 (.362)	.088 (.297)	.168 (.410)
residual	.134 (.367)	.853 (.924)	.371 (.609)	.463 (.680)
Number of observations				
state-level	49	49	49	49
subject-level	3735	3772	3772	3770
number of obs	6463	6071	6071	6068

Note. In wave 1, on a scale from 1 (strongly agree) to 4 (disagree). In wave 5, on a scale from 0 (never) to 4 (all the time). All responses rescaled.

- Wave 1: You feel your future is limited. Wave 5: You felt hopeful about the future.
- Wave 1: All in all, I am inclined to feel that I am a failure. Wave 5: You thought your life had been a failure.
- Wave 1: On the whole, I am satisfied with myself. Wave 5: You enjoyed life.

We explored how stereotype dispersion, the mental maps on participants' heads relate to general attitudes in this section. Longitudinal survey in wave 5 asked 18 general attitudes. We report statistics below. The items, on a scale from 0 (totally disagree) to 10 (totally agree), include:

- If I had to do all over again, I would choose to attend (name of most recent college attended).
- My college experience has made me a better person.
- My college experience has made me more tolerant of other racial and ethnic groups.
- My college experience has improved my relationships with other racial and ethnic groups.
- I am very satisfied with the friends and acquaintances I made at college.
- My college experiences have prepared me for the future.
- College has given me a sense of mastery of the subjects I studied.
- College has better prepared me to deal with the real world.
- I am satisfied with the courses I took at college.
- I am satisfied with the professors I had at college.
- I am satisfied with the quality of instruction I received at college.
- I would recommend (name of most recent college attended) to a friend or relative as a place to attend college.
- I am likely to contribute to (name of most recent college attended)'s future fund raising efforts.
- How much interaction have you had over the past four years with members of the following group: whites? blacks? hispanics? asians? 0 (no interaction) to 10 (great deal of interaction).
- How do you see (name of most recent college attended)'s commitment to racial and ethnic diversity on campus? is diversity emphasized: 1 (way too little) to 3 (just enough) to 5 (way too much).

Table.S 11 – Relations between stereotype dispersion, at college senior years, and other general attitudes

	attend college	better person	tolerant other race	improve relations other race	happy with college friends
Intercept (female, average income, Asian)	7.976*** (.142)	8.815*** (.099)	7.601*** (.147)	7.254*** (.155)	8.434*** (.102)
Fixed effects					
stereotype dispersion	-.360** (.100)	-.207** (.073)	-.196† (.103)	-.206* (.101)	-.226** (.077)
male	-.005 (.110)	-.110 (.080)	-.434*** (.113)	-.272* (.110)	-.215* (.084)
income	.027 (.029)	.009 (.021)	-.072* (.030)	-.095** (.029)	.009 (.022)
race Black	-.022 (.152)	-.149 (.110)	-.275 . (.157)	-.183 (.153)	-.056 (.117)
race Hispanic	.378* (.156)	.034 (.114)	-.095 (.162)	.037 (.158)	.093 (.120)
race White	.485** (.148)	.107 (.108)	.148 (.153)	.128 (.149)	.204† (.084)
Random effects					
high school state intercept	.091 (.302)	.024 (.156)	.097 (.312)	.204 (.451)	.014 (.120)
residual	6.139 (2.478)	3.255 (1.804)	6.542 (2.558)	6.101 (2.488)	3.667 (1.915)
Number of observations					
state-level	49	49	49	49	49
number of obs	2202	2202	2200	2202	2202

Table.S 12 – Relations between stereotype dispersion, at college senior years, and other general attitudes cont.

	prepared for future	mastery of subjects	deal real world	satisfied with courses	satisfied with professors
Intercept (female, average income, Asian)	7.757*** (.101)	7.203*** (.102)	6.873*** (.118)	7.192*** (.097)	7.250*** (.101)
Fixed effects					
stereotype dispersion	-.190* (.076)	-.338*** (.078)	-.067 (.083)	-.259*** (.074)	-.402*** (.071)
male	-.108 (.083)	-.348*** (.085)	.082 (.091)	-.249** (.081)	-.270*** (.078)
income	-.011 (.022)	.022 (.022)	-.008 (.024)	-.010 (.021)	-.007 (.020)
race Black	.377** (.115)	.166 (.118)	.215† (.126)	.274* (.112)	-.038 (.108)
race Hispanic	.432*** (119)	.462 (.122)	.292* (.129)	.578*** (.115)	.418*** (.111)
race White	.274* (.113)	.355 (.115)	.295* (.122)	.619*** (.109)	.474*** (.105)
Random effects					
high school state intercept	.017 (.130)	.013 (.113)	.067 (.258)	.012 (.110)	.043 (.207)
residual	3.562 (1.888)	3.753 (1.937)	4.194 (2.048)	3.338 (1.827)	3.115 (1.765)
Number of observations					
state-level	49	49	49	49	49
number of obs	2201	2202	2201	2202	2201

Table.S 13 – Relations between stereotype dispersion, at college senior years, and other general attitudes cont.

	satisfied with college quality	recommend college to friends	contribute fund raise	interact with Whites
Intercept (female, average income, Asian)	7.347*** (.090)	8.070*** (.130)	6.120*** (.172)	8.578*** (.095)
Fixed effects				
stereotype dispersion	-.360*** (.070)	-.328*** (.090)	-.321** (.120)	-.316*** (.062)
male	-.289*** (.077)	-.013 (.098)	-.209 (.121)	-.144* (.067)
income	.007 (.020)	.032 (.026)	.057† (.034)	.074*** (.018)
race Black	.238* (.107)	-.354** (.136)	-.311† (.182)	-.070 (.097)
race Hispanic	.481*** (.110)	.318* (.140)	.038 (.187)	.567*** (.097)
race White	.508*** (.105)	.402** (.133)	.088 (.177)	1.086*** (.092)
Random effects				
high school state intercept	.003 (.052)	.087 (.295)	.151 (.388)	.073 (.270)
residual	3.082 (1.756)	4.942 (2.223)	8.763 (2.960)	2.972 (1.724)
Number of observations				
state-level	49	49	49	49
number of obs	2202	2201	2199	2776

Table.S 14 – Relations between stereotype dispersion, at college senior years, and other general attitudes cont.

	interact with Blacks	interact with Hispanics	interact with Asians	college commitment to diversity
Intercept (female, average income, Asian)	5.937*** (.117)	4.972*** (.129)	7.847*** (.137)	.413*** (.038)
Fixed effects				
stereotype dispersion	-.194* (.079)	-.467*** (.087)	-.569*** (.087)	.036*** (.011)
male	-.618*** (.087)	-.364*** (.096)	-.009 (.095)	.075*** (.021)
income	-.054* (.023)	-.061* (.025)	-.015 (.025)	-.019*** (.005)
race Black	2.842*** (.121)	1.141*** (.133)	-2.106*** (.133)	.160*** (.029)
race Hispanic	.505*** (.125)	2.080*** (.137)	-1.864*** (.137)	.060* (.030)
race White	.058 (.119)	-.024 (.131)	-1.289*** (.131)	-.132*** (.021)
Random effects				
high school state intercept	.082 (.286)	.098 (.314)	.166 (.408)	.001 (.038)
residual		5.990 (2.448)	5.976 (2.445)	.284 (.533)
Number of observations				
state-level	49	49	49	49
number of obs	2276	2776	2276	2769

9. Stereotype dispersion and well-being

Table.S 15 – Stereotype dispersion and well-being in Study 2

	Life satisfaction		
Intercept	3.616***(.030)	3.616***(.031)	3.616***(.030)
Fixed effects			
stereotype dispersion	-.147*(.069)		
perceived diversity		.110***(.025)	
state diversity			.188 (.217)
Random effects			
state intercept	.010 (.100)	.013 (.114)	.012 (.108)
residual	1.016 (1.008)	1.003 (1.002)	1.017 (1.009)
Number of observations			
state-level	50	50	50
individual-level	1471	1471	1471

Note. See variables and interpretations in the main text. Statistical significance level: † $p < .10.$, * $p < .05$, $^{*}* p < .01$, $^{*}** p < .001$.

Table.S 16 – Stereotype dispersion and well-being in Study 3

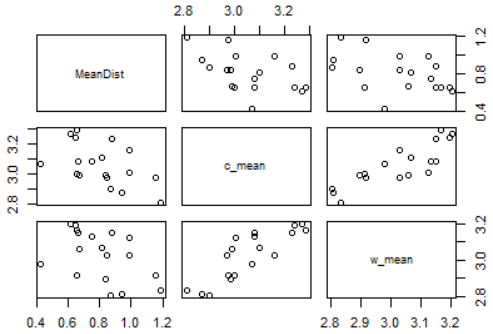
	Life satisfaction				
Intercept	4.174***(.020)	4.161***(.027)	4.197***(.017)	4.227***(.024)	4.285***(.032)
Fixed effects					
stereotype dispersion	-.065**(.022)			-.051†(.030)	
perceived diversity		-.060 (.051)			-.201**(.062)
college			-.170***(.018)	-.147***(.030)	-.275***(.046)
stereotype dispersion : college				-.039 (.040)	
perceived diversity : college					.228*(.100)
Random effects					
state intercept	.003 (.052)	.002 (.049)	.002 (.049)	.003 (.052)	.002 (.048)
individual intercept	.159 (.399)	.159 (.399)	.171 (.413)	.168 (.410)	.168 (.410)
residual	.474 (.689)	.479 (.692)	.458 (.677)	.459 (.678)	.463 (.680)
Number of observations					
state-level	49	49	49	49	49
individual-level	3719	3770	3770	3719	3770
number of obs	5949	6068	6141	5949	6068

10. Positivity and stereotype dispersion

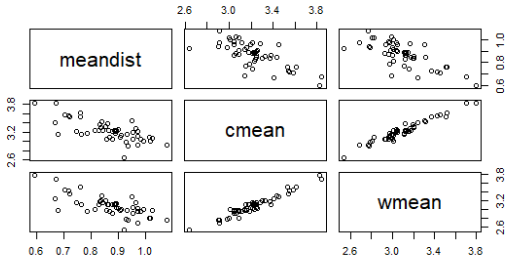
In general discussion, we mentioned that less dispersed stereotype content maps tend to co-exist with more positive evaluations than neutral or negative evaluations. We examine this observation statistically. See figures below.

- In sub-figure (a), countries with higher average competence ($r(48) = -.519, p = .027$) and higher average warmth ($r(48) = -.460, p < .055$) show less stereotype dispersion.
- In sub-figure (b), states with higher average competence ($r(48) = -.716, p < .001$) and higher average warmth ($r(48) = -.724, p < .001$) show less stereotype dispersion.
- In sub-figure (c), individuals with higher average competence ($r(1500) = -.339, p < .001$) and warmth ($r(1500) = -.402, p < .001$) show less stereotype dispersion. Controlling for state-level random effects, both higher average competence ($b = -.196$ 95% CI[-.251, -.198]) and higher average warmth ($b = -.224$ 95% CI[-.225, -.167]) predicts less stereotype dispersion.
- In sub-figure (d), students show less stereotype dispersion also rated lower on average competence ($r(5577) = .212, p < .001$) and lower on average warmth ($r(2133) = .061, p < .001$). Controlling for high school state and individual random effects, both lower average competence ($b = .149$ 95% CI[.130, .169]) and lower average warmth ($b = .024$ 95% CI[.008, .040]) predicts less stereotype dispersion.

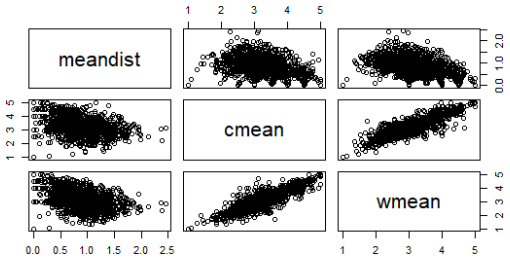
Fig.S 10 – Positivity and stereotype dispersion.



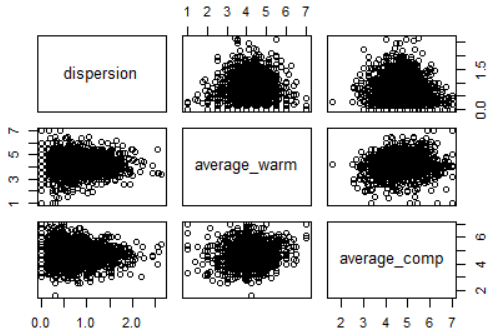
(a) positivity and dispersion in 46 nations



(b) positivity and dispersion in 50 states



(c) positivity and dispersion in 1502 online Americans



(d) positivity and dispersion in 3924 American students