Diversity and Segregation in Metropolitan Contexts: Los Angeles as a Paradigm for our Changing Ethnic World.

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Abstract

Los Angeles can be seen as a metaphor for the kinds of changes which are occurring and will continue to accelerate in the large metropolitan areas of the United States and global cities more generally. New immigrants are changing the ethnic patterns of neighborhoods and communities and the old patterns of black white segregation are increasingly a picture of the past. In this paper we provide a variant of a nearest neighbor approach and a statistic SI (Spatial Isolation) and a methodology (Equipop) to map, graph and evaluate the likelihood of individuals meeting other similar race individuals or of meeting individuals of a different ethnicity, income level or socio-economic status more generally. The results of a new measure of the spatial patterns of segregation reveal more complex patterns of ethnic segregation, declining levels of segregation and, as harbingers of the future, changes in the patterns of mixed race households in interstitial areas in the Los Angeles Metropolitan area.

Extended Abstract

Ethnic and socio-economic separation continues to be a defining characteristic of 21st Century global cities. At the same time the patterns and extent of separation are changing as the waves of immigration from the Middle East, Central and South America, China and Korea expand the complex mixtures of residents in large global cities. Two changes in particular are increasingly notable, the increased in Hispanic populations in the United States and the growth of Middle Eastern populations in European cities but also a growth of a wide range of new immigrant populations and their children more generally. Second, in the US context, inter- marriage and the children of these families are changing the future of segregation.

Measuring these patterns and the nature of how groups splinter and segregate into particular locations is central to understanding ethnic and racial patterns and as we attempt to understand the impact of residential sorting separation and inequality. We measure segregation because at the core we want to understand how much separation there is in our societies and how it varies across urban areas. The best measures of separation will capture the amount of potential interaction in the urban structure. We also measure segregation because we think that environments shape our experiences and that more separated environments-

the inability to meet people who are different, may influence life course opportunities.

For the most part previous work has relied on aggregated indices of segregation which do not do an adequate job of capturing the spatial dimension of segregation. A new distance based approach to measure isolation (Reardon et al, 2008) is an improvement but we believe another approach which utilizes nearest neighbor notions to measure the probability of contact is equally and perhaps more behaviorally relevant. In addition we are able to graph the changing levels of interaction with scale changes. In this paper we construct a spatial measure based on a nearest neighbor measure to map, graph and evaluate the likelihood of individuals meeting other similar race individuals or of meeting individuals of a different race, ethnicity or other characteristic. The index is an advance on the classic dissimilarity index, is as straightforward to calculate and the spatial expression of the index provides a rich interpretation of segregation in metropolitan areas.

In this study we measure the spatial patterns of segregation for the principal ethnic and racial groups in Los Angeles and their changes over time. Equally important we analyze the patterns of the mixed race population as an indicator of how mixing might occur in the future. At the same time, our theme that demography, and demographic change, is in the end a local area destiny, we examine the increasing Hispanic population and its interaction with other groups as an indicator of how the transition from one majority (white) to another majority (Hispanic) will alter the patterns of interaction.

There are two main reasons for an additional approach to spatial inequality (and isolation). First, and to reiterate most of the existing techniques for measuring inequality (segregation and separation) in the urban structure, although widely used, yield only an aggregate single index and do not provide us with the ability to provide spatial images of inequality. Those measures which do incorporate a spatial dimension are perhaps not as readily computable although that is a debate that we need to have. Second, most of the current measures are dependent on the fixed boundaries of some pre-defined spatial unit, usually tracts in the United States or administrative units in the United Kingdom. With the current techniques and the limitation of national administrative boundaries it is problematic to construct international comparisons of spatial inequality. We know that the level of segregation is dependent on the level of spatial aggregation, which implies that measures taken from different urban areas cannot be meaningfully compared unless it is known that the spatial sampling schemes are comparable. This fact has proved an obstacle for the development of comparative research on both segregation patterns and segregation effects.

Two additional reasons for an additional index are the ability to draw on the availability of increased computing power and the increasing availability of spatially referenced data. Such data has become commonplace as government

statistics are now collected with geo-referenced links, including address information. This greater spatial identification and the increasing interest among different social science disciplines in the identification of contextual effects on individual outcomes creates a need for new tools. It also implies that economists, sociologists, health researchers and planners are confronted with issues concerning spatial modeling that earlier were of interest mainly for geographers. Radically improved access to geo-referenced individual level data in combination with the availability of new GIS software have helped to foster this trend, and now increased interest in contextual effects has created an expanding demand for improved methods for measurement and analysis. Much of this focus has been on creating local area statistics (Anselin, 1995).

There is also a behavioral argument for creating a measure which reflects people's likely behavior and activities. The argument is also consistent with the growing interest in agent based approaches to creating simulated patterns of segregation (Clark and Fossett, 2008, Fossett, 2006).When we design measures of segregation we are relying on an implicit assumption that we are capturing people's potential interactions. Yet that assumption is not true of most current techniques, especially the dissimilarity index. The latter is simply a mechanistic assignment processes used to compare the actual distribution with one in which both populations are distributed similarly across urban space. In this presentation we review the most commonly used indices, examine the spatial critique of these measures and the solutions, and then introduce a spatial index SI with an associated procedure to illustrate how the technique can be used to measure and map inequality.

There has been a half century of interest in measuring segregation and several spatial and a-spatial approaches to measuring separation have been developed (Massey and Denton, 1988; Morrill, 1991; White, 1983; 1986). Overall, two indices have dominated the evaluation of separation in the residential fabric – the dissimilarity index and the exposure index. These measures are single indices, usually bi-variate measures, although there have been attempts to generalize the D value (Sakoda, 1981), and use some form of administrative unit – for example, tracts, cities or counties. Of course the spatial unit will influence the statistical outcome and we will return to this topic. In turn, different spatial units in different contexts make comparability problematic.

The literature on a measure of segregation is extensive, and different authors have argued for one or other measure of the patterns of segregation. These discussions can be embedded in the larger literature on ecological inference and the modifiable area unit problem (Openshaw, 1984, Fotheringham and Wong, 1991; Griffith, 2000). They are also embedded in the underlying issues of accessibility –for example the isolation index is measuring whether or not individuals have access (can interact) with other individuals across some spatial structure (Black and Conroy, 1977; Tobler, 1987, 1989). For the most part the issues of accessibility are not foremost in the discussions of isolation, rather the

attempts to create spatial measures are set within the context of modifying existing indices with some form of weighting or other modification to capture the nature of the distributions of the underlying populations which are being tested for their level of clustering and concentration.

More recently there has been a specific attempt to generate new indices which are truly spatial – that is they represent the underlying spatial patterns of the groups being studied and can provide both indices and spatial representations of the underlying patterns. In many ways these new measures build on the ideas of earlier studies which tried to bring distance in to the index function (Jakubs, 1981; Morgan, 1983; Getis and Ord, 1992). A recent model uses distance and density to generate a mapping of the amount of separation between racial groups. The technique involves computing a measure of segregation at various scales when the scales are defined by local radii. By considering increasing radii of 500m to 4000m and within each specified radius computing a spatial information theory index comes closer to providing a spatial measure of segregation (Reardon et al, 2008). The index is based on a distance decay function which weights nearby locations more heavily than more distant locations in computing the racial composition in each local environment. Using this tool one is able to provide a map of levels of segregation. This is clearly an advance over previous attempts to provide a spatial measure of segregation. The index we use in the next section builds on the ideas of Reardon et al (2008) but is simple in formation, readily 'mapable' and has an intuitive presentation in, map and graphical form.

In segregation studies, isolation is defined as the probability that individuals will meet others individuals belonging to their own group when they interact with people in their local area. Traditionally, this probability has been equated to the population share of the group in a statistically defined geographical sub-unit such as a census tract. With the measure we propose, interaction probabilities are no longer based on population shares in statistical areas. Instead interaction probabilities are based on the population composition of individually defined, egocentric neighborhoods with a fixed population threshold. That is, one proceeds by expanding a buffer around the residence of an individual. When the population included in the buffer reaches the pre-determined threshold one stops and the probability of contact is computed using the composition of the buffer population. Technically, the measure being proposed uses individual data which can be persons or households or some very small spatial unit such as a street block and then measures the probability of meeting another person (or aggregate of persons if it is a very small spatial unit) within some defined set of nearest people or nearest spatial units (Malmberg et al, 2011; Östh 2011).

To compute the probability of an individual of one group meeting individuals from the same or a different group we use of novel software (Östh, 2011) that makes it possible to find the k-nearest neighbor (using a variety of *k* values between 50 and 409 600 persons) of each individual or small populated unit in datasets containing millions of locations and vast amounts of people. The

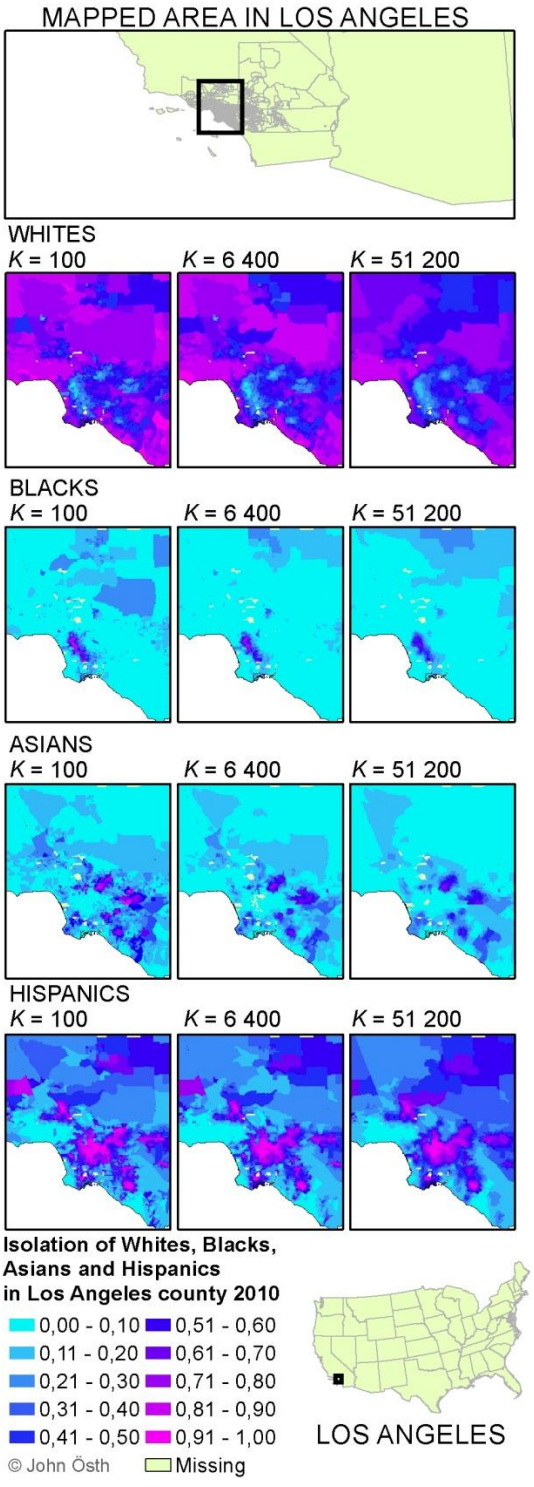
software calculates the share of individuals belonging to a user-specified subgroup for each *k* (user-defined count of surrounding individuals) at each populated location in the studied area. The share can then be used to describe exposure (interaction or isolation) at *k* various scales on block level. In this paper block level population data from Los Angeles (US Censuses 2000 and 2010 data) are used to show how the SI index and the associated Equipop methodology creates an interpretable structure of the residential fabric.

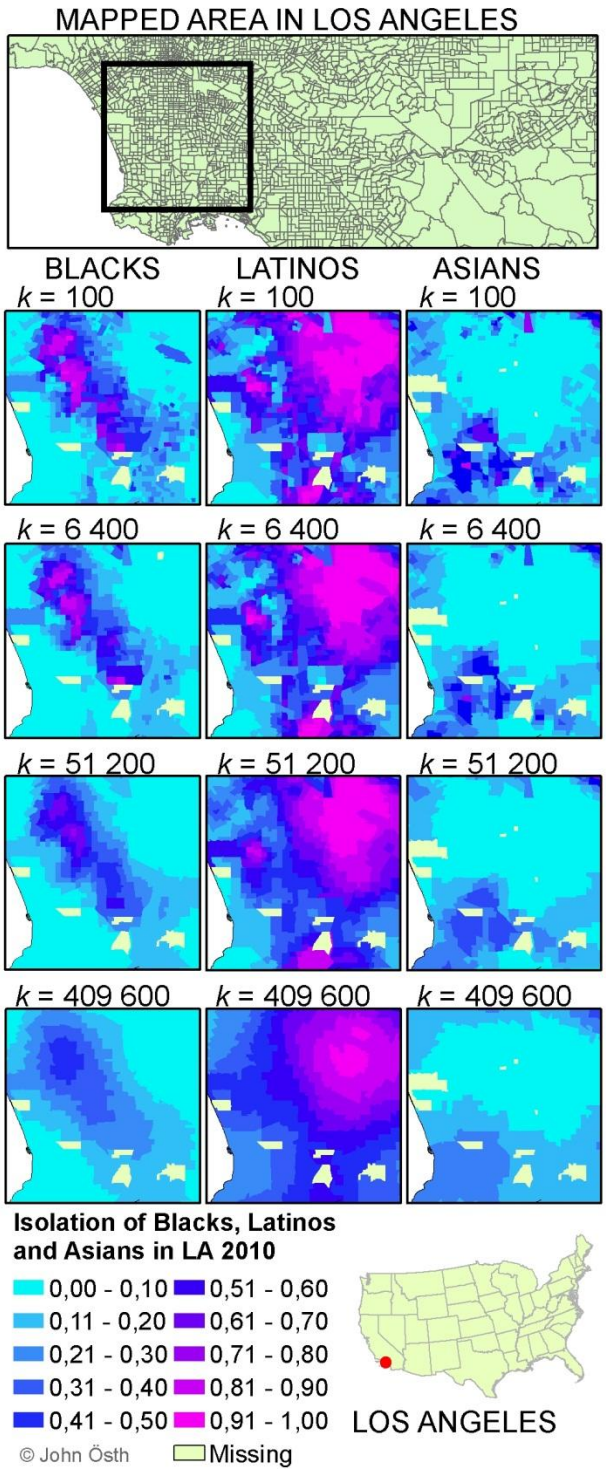
The maps below are local values of isolation based on different population thresholds, *k*. We also present a graph that presents aggregate values of isolation for different ethnic groups and geographical scales. Aggregate isolation with a population threshold *k* is computed as:

$$Isolation_k = \frac{\sum_{i=1}^{n} x_i * \frac{x_{i,k}}{k}}{\sum_{i=1}^{n} x_i}$$

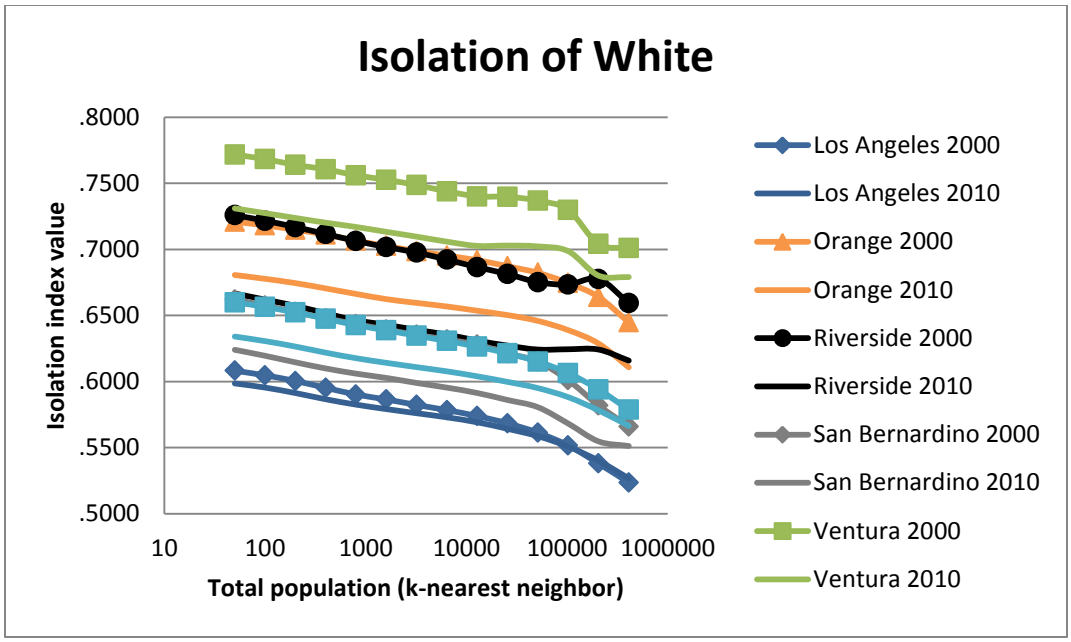
where x_i is the size of the minority population in block *i*, and $\frac{x_{i,k}}{k}$ is the population share of the minority population among the *k* nearest neighbors of individuals living in block *i.*

In this extended abstract and preliminary analysis we include two sets of maps for different scales and levels of contact to demonstrate the power of the technique and the richness of the spatial presentation.


MAPPED AREA IN LOS ANGELES
WHITES
K = 100
K = 6 400
K = 51 200
BLACKS
K = 100
K = 6 400
K = 51 200
ASIANS
K = 100
K = 6 400
K = 51 200
HISPANICS
K = 100
K = 6 400
K = 51 200
Isolation of Whites, Blacks, Asians and Hispanics in Los Angeles county 2010
0,00 - 0,10
0,11 - 0,20
0,21 - 0,30
0,31 - 0,40
0,41 - 0,50
0,51 - 0,60
0,61 - 0,70
0,71 - 0,80
0,81 - 0,90
0,91 - 1,00
Missing
© John Östh
LOS ANGELES



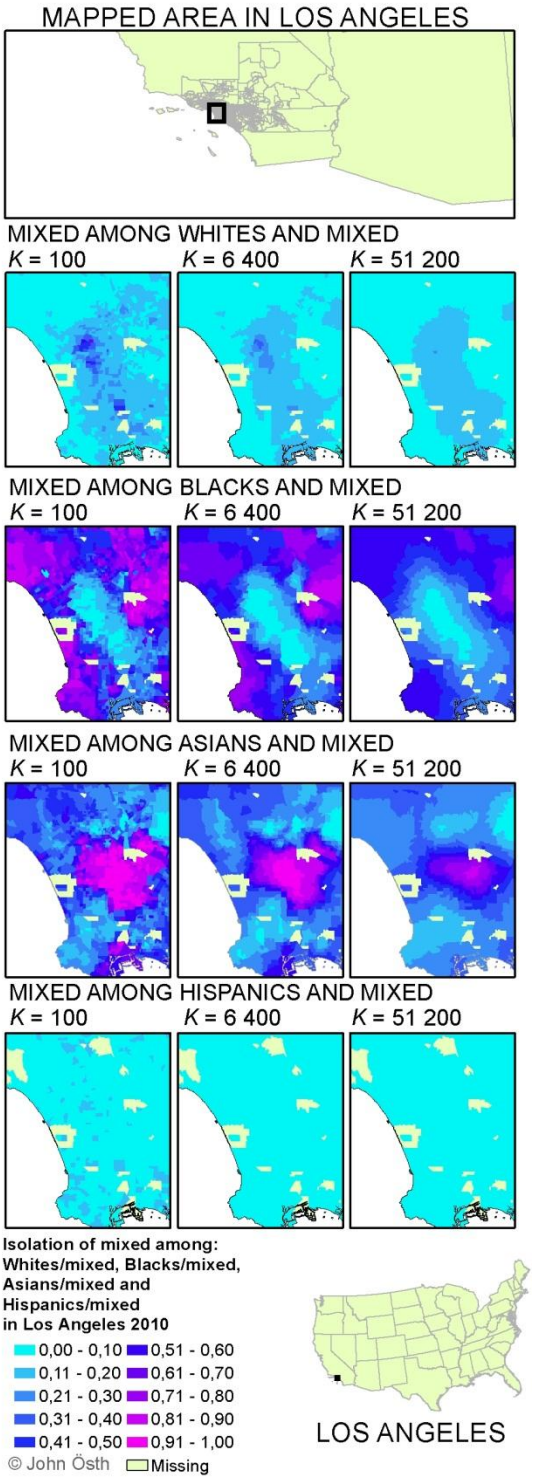
As an illustration of the power of the SI index we plot the changing levels of isolation across counties and over the scale of contact from a neighborhood of 100 to a community of several hundred thousand. We will elaborate these graphs in the formal presentation.



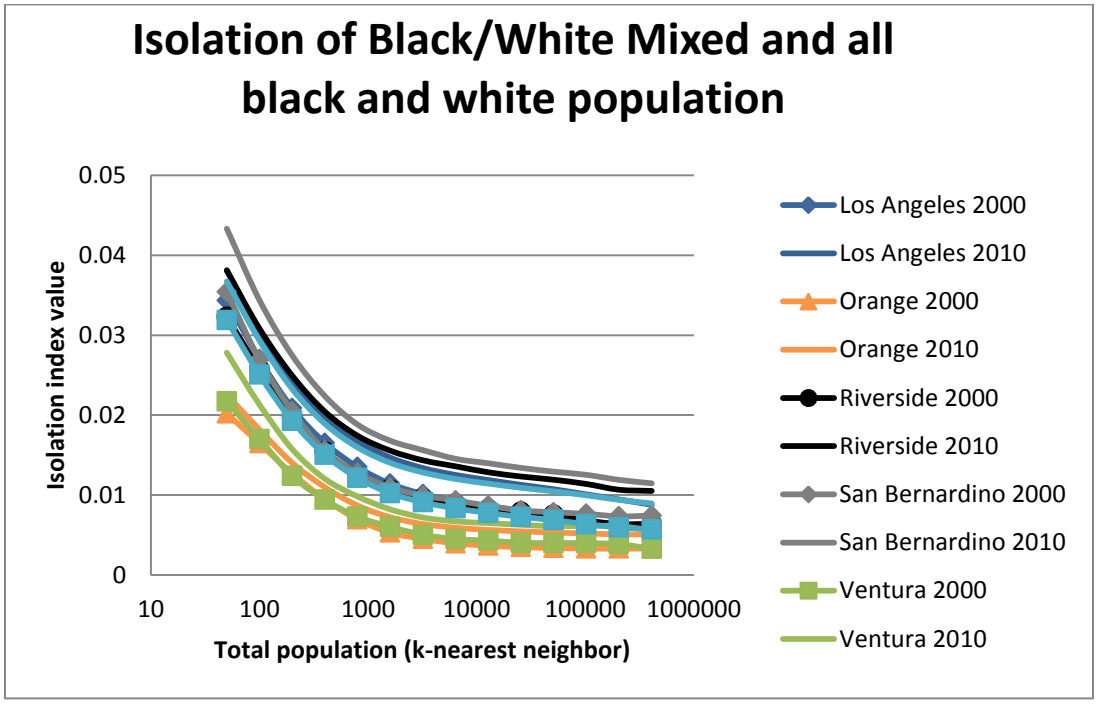
One of the gains from the SI index is the ability to calculate a scale of segregation and a set of maps which reflect varying levels of contact from neighborhood to community to city. We demonstrate these outcomes and their relevance with data from studies of minorities in Los Angeles. What is critical in the substantive findings is that both the graphs and the maps capture the complexity of the spatial distributions in a multi-ethnic metropolis. They show the distributions, scaled so that one can identify the level of segregation at any point in the city, and they show the way this distribution changes with changes in the structural context (how many people are in the local area).

It is the visual nature of the presentation, with specific details of the level of segregation and a scale which recognizes specifically the way in which scale influences the levels of segregation, which is central to this presentation. Scale matters and it is a substantial improvement over using a single index of segregation when we know that it varies across space not to mention across time. We show in the maps that the probability of meeting another minority captures the reality of how people are sorted across metropolitan areas. This contribution is both more clearly connected to theory, to what people do and who they are likely to meet, and reflects the need to provide a more nuanced way of capturing the extent to which populations are likely to interact.

The gains from the SI index are particularly notable when we examine the patterns of the mixed race population. To draw attention to just two findings in this preliminary presentation we can note, first that the mixed race population is indeed in the interstitial areas of the metropolitan area but for Hispanic mixed race individuals they are widely spread amongst the Hispanic population as a whole.


MAPPED AREA IN LOS ANGELES
MIXED AMONG WHITES AND MIXED
K = 100
K = 6 400
K = 51 200
MIXED AMONG BLACKS AND MIXED
K = 100
K = 6 400
K = 51 200
MIXED AMONG ASIANS AND MIXED
K = 100
K = 6 400
K = 51 200
MIXED AMONG HISPANICS AND MIXED
K = 100
K = 6 400
K = 51 200
Isolation of mixed among:
Whites/mixed, Blacks/mixed,
Asians/mixed and
Hispanics/mixed
in Los Angeles 2010
0,00 - 0,10
0,11 - 0,20
0,21 - 0,30
0,31 - 0,40
0,41 - 0,50
0,51 - 0,60
0,61 - 0,70
0,71 - 0,80
0,81 - 0,90
0,91 - 1,00
© John Östh
Missing
LOS ANGELES

Evaluating the interaction for mixed race individuals graphically demonstrates how important this group is for the way in which segregation and contact is likely to evolve in the coming decades. The fact that the levels of isolation for these mixed-race households are so low and that the probabilities are meeting individuals of other racial ethnic identification are so high suggests that levels of integration will change substantially as these context continue over the coming years.



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