Options for Measuring Residential Segregation Across Small- and Intermediate-Scale Spatial Domains Using Restricted IPUMS Microdata

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Abstract

I review options for measuring residential segregation using small- and intermediate-scale spatial domains using the restricted IPUMS microdata from the 1940 US decennial census. I give special attention to the "eta" measure developed by Logan and Parman and contrast it with other available alternative measures. The main contribution of my research is to establish that the measurement problems Logan and Parman address with their formulation of "eta" can be and have been independently solved for many alternative and more familiar measures of residential segregation. Logan and Parman's eta implements a welcome innovation in the approach to segregation measurement; namely, a focus on households' residential contact with "neighbors" instead of "area population". But eta has major limitations that preclude recommending it for adoption as a general purpose index. In particular, the formulation of eta as applied in previous research fails to meet multiple important accepted criteria for segregation measures. Additionally, the key innovation of focusing on neighbors instead of area population is implemented in Fossett's (2017) refined formulations of more familiar and widely used segregation measures which fare better than eta on technical considerations. Significantly, the refined index formulations introduced by Fossett (2017) can be applied in the small spatial domains considered by Logan and Parman. I evaluate claims that eta should be viewed a viable candidate for wider use and recommend against this because eta's limitations become more severe when it is applied in less specialized circumstances. My key finding is that alternative approaches to measuring segregation at small spatial scales – the use case considered by Logan and Parman – are available and provide superior options for segregation measurement. I review these options and compare results obtained when a wide range of traditional and refined versions of popular indices are applied to measure residential segregation at small and intermediate spatial scales.

Introduction

The restricted historical IPUMS microdata files produced by Ruggles and colleagues (2015) have created new opportunities for measuring and investigating residential segregation of social groups. Traditional practice in segregation research has been to assess segregation by computing index scores from aggregate-level tabulations of group population counts for aspatial areas such as census blocks and census tracts. While such tabulations were not generally produced for historical censuses, it is possible to use restricted IPUMS microdata to prepare comparable tabulations for analogous aspatial administrative areas such as census enumeration districts. However, the restricted historical microdata provide new and broader opportunities for measuring residential segregation of groups based both explicit and implicit spatial information contained in the data. Researchers have explored these opportunities to formulate new approaches to measuring residential segregation using microdata. In this paper I review and evaluate some of the important new options that have been considered including the recently introduced "eta" index formulated and implemented in an important study by Logan and Parman (2017). In addition, I call attention to certain attractive available options that currently are not widely recognized. Specifically, I note that new refined formulations of familiar, widely used indices such as the Dissimilarity Index (D) and the Separation Index (S) (also known as "the revised index of isolation," "eta squared," and the "variance ratio") make it possible for researchers to implement the indices at small- and intermediate-level spatial domains and using spatially- and quasi-spatially defined neighborhoods that are feasible when using restricted microdata as well as having the option to implement the indices using more traditional population tabulations for aspatial neighborhoods.

Conceptual and Methodological Issues

Residential Segregation

Residential segregation of social groups is viewed as having multiple dimensions (Stearns and Logan 1986; Massey and Denton 1988). Of these, the dimension of uneven distribution is by far the most widely studied. It assesses the extent to which groups are residentially separated and live and apart from each other in different areas of the city. It is seen as intrinsically interesting for the basic fact of group separation and in addition it is a logical prerequisite for group inequality in social, economic, and political outcomes that tied to area of residence.

I evaluate the recently introduced eta index as a candidate for serving as a general purpose measure of uneven distribution. I compare eta with several alternative indices giving special attention to the two indices that have been most widely used in previous research on residential segregation: the Dissimilarity Index (D) and the Separation Index (S) (also known as "the revised index of isolation," "eta squared," and the "variance ratio"). S is superior to D on technical criteria. But D is better known and has been more widely used in previous research.

I draw on "difference of means" framework introduced in Fossett (2017) to compare and contrast the measures. When placed in this framework, the Logan and Parman eta index, D, S, and other widely used measures of uneven distribution all are expressed as a group "difference of means" on a household-level residential outcome (y) that is scored based on the group composition (p) of the neighborhood in which the household resides. Stated another way, the eta index and all popular measures of uneven distribution including D and S all are formulated and expressed as group differences in scaled contact with the reference group in the comparison (Fossett 2017). The following generic computing formulas implement the group difference of means approach.

A household-level computing formula can be applied with microdata using either separate, spatially-defined neighborhoods for each household (per Logan and Parman), or the more usual aspatial neighborhoods (e.g., blocks, tracts, etc.).

$$\text{Index Score} = (1/N_1) \cdot \Sigma\, y_{1ki} - (1/N_2) \cdot \Sigma\, y_{2ki}$$

An "area-level" computing formula can be applied when using aggregate-level tabulations for blocks, enumeration districts, census tracts, and other aspatial areas.

$$\text{Index Score} = (1/N_1) \cdot \Sigma\, n_{1i} y_i - (1/N_2) \cdot \Sigma\, n_{2i} y_i$$

where:

k is an index for households in a group (household-level computing formula),

i is an index for areas (i.e., the neighborhoods in which households reside),

y_i is a residential outcome scored from the group composition (p_i) of the area where a household (or set of households) resides,

p_i is area group composition given by $n_{1i}/(n_{1i} + n_{2i})$,

n_{1i} and n_{2i} are group counts by area,

N_1 and N_2 are group counts for the city, and

P is city group composition given by $N_1/(N_1 + N_2)$,

One feature of this frame work is that the differences between alternative measures of uneven distribution are reduced to a single point of comparison; namely, the specific manner in which residential outcomes (y_i) are scored from area group proportions (p_i). For all indices, the residential outcome (y_i) registers residential contact with the reference group (p_i). The only difference between measures is how the index in question scores or "scales" this contact.

The separation index (S) scales contact with the reference group in its original "raw" or "natural" metric. That is, for S, the values of residential outcomes (y_i) are set to the values of p_i. Thus, S measures the group difference in average contact with the reference group.

The dissimilarity index (D) scales contact in a much different way. Specifically, D rescales the original or raw metric of contact (p_i) into two values: "contact at or above parity" (scored y=1) or "below parity" contact (scored y=0). That is, for the dissimilarity index (D), residential outcomes (y_i) are set to 1 if ($p_i \geq P$) and 0 otherwise. Thus, D measures the group difference in average level of "parity" contact with the reference group.

In the case of Logan and Parman's eta index, whites are the designated reference group and contact with the reference group is scaled on the basis of whether or not a household has any contact with white neighbors. That is, for eta, residential outcomes (y_i) are scored as 1 if a household has one or more white neighbors ($p_i \geq 0$) and 0 if a household has no white neighbors ($p_i = 0$). Thus, eta measures the group difference in average level of "non-zero" contact with the reference group.

For later reference, I note that eta differs from S and D in an additional significant way. The value of eta is contingent on defining a particular group – whites in the Logan and Parman application – as the "reference" group in the comparison. In the case of S, D, and other popular measures of uneven distribution the choice of the reference group is arbitrary as it has not impact on the resulting value of the index score. This is not the case for eta. Thus, for example, the value of the eta index for white-black segregation can and often will change depending on whether whites or blacks are adopted as the reference group.

The first benefit of the difference of means framework is to clarify differences between indices. For example, it is clear from the above that S registers all differences in neighborhood racial composition while D and eta are oblivious to some differences. D does not register group differences in neighborhood racial composition in the ranges between parity and homogeneity. Similarly, eta does not register group differences in having two white neighbors vs. having one white neighbor.

The second benefit of the difference of means framework is that it creates the potential to refine popular segregation indices to eliminate the vexing problem of index bias which distorts values of all standard measures, and especially the widely used D, when segregation is measured at small spatial scales (Winship 1977; Fossett 2017). The refinement that leads to unbiased versions of popular indices is reviewed in detail in Fossett (2017). In brief it consists of two parts. The first is that of formulating indices as group differences of means on residential outcomes (y) scored on the basis of the racial composition of the neighborhood in which a household resides. The second is to measuring residential outcomes based on the racial composition of a household's "neighbors" in the area where the household resides instead of the racial composition of the "population" of the area where the household resides. The shift from population to neighbors removes the inherent bias introduced from combining self-contact which intrinsically varies by race of household with contact with neighbors which can in principle can be a random draw. The refinement eliminates the problem of index bias with D, S, and other well known segregation indices.

The eta index is innovative in having the feature of being originally formulated in terms of the racial mix of a household's neighbors instead of the racial mix of the population of the neighborhood involved. As a result, the original formulation of eta is free of the problem of index bias and it takes an expected value of zero under random assignment. This characteristics of the eta index makes it possible to apply eta to very small spatial domains; namely, next-door-neighbors.

In this regard, Logan and Parman's eta index compares favorably with the standard formulations of more widely used alternative measures. But, this particular advantage is lost when eta is compared with the unbiased versions of D, S, and other widely used segregation indices given in Fossett (2017). With this advantage negated, eta then fares less well when compared with alternative measures of residential segregation.

Polarized versus Dispersed Displacement

The differences between D and S make them sensitive to different aspects of uneven distribution. D registers contact as a binary (0,1) score for "parity". This makes it highly sensitive to group differences in attaining parity contact and insensitive to the quantitative magnitude of the average departures from parity contact that signal group separation. In contrast, S registers contact in its natural metric. This makes it sensitive to the large group differences in average contact with the reference group that arise when groups live apart from each other in separate areas of the city. It renders it relatively insensitive to group differences in parity contact that involve quantitatively small departures from parity.

Based on these characteristics, values of D and S can be concordant or discordant. When the value of D is high, we know groups differ in the extent to which they achieve parity contact with the reference group. But we do not know whether they live apart from each other in separate areas of the city. The value of S provides a basis for knowing this. If the value of S is low, group differences in parity contact involve quantitatively small departures from parity. As a result, the two groups live in areas that on average are similar on group composition. If the value of S is large, group differences in parity contact involve quantitatively large departures from parity. As a result, the two groups live in areas that on average differ markedly on group composition.

Both patterns –D-S concordance and D-S discordance – are common in empirical research (Fossett 2017) including the research reported here. Unfortunately, the distinction between the two patterns is substantively important but is not widely appreciated. We highlight the difference in terms of the distinction between polarized and dispersed displacement.

Polarized Displacement (Prototypical Segregation). Values of D and S are concordant. Groups are highly separated; that is, they live apart from each other in different areas that are highly "polarized" on ethnic composition. Polarized displacement thus is characterized by the combination of High-D and High-S. This pattern is universally depicted in "textbook" examples illustrating high levels of segregation. It establishes a necessary precondition for group inequality that arises from groups from living in different areas of the city. Figure 1 provides a representative example of this residential pattern.

Dispersed Displacement. Values of D and S are discordant. Groups live together in areas with generally similar ethnic composition. Dispersed displacement thus is characterized by the combination of High-D and Low-S. Surprisingly, the pattern is empirically common, but it is rarely discussed. This is unfortunate, because it is substantively different from polarized displacement. Specifically, the pattern indicates that groups extensively co-reside in the same areas of the city which in turn mitigates against group inequality arising from groups living in different areas of the city. Figure 2 provides a representative example of this residential pattern.

Where Does Eta Fit? The eta index does not fit neatly into this discussion. On the one hand, eta does not register group separation and area racial polarization as well as S because it does not distinguish between multiple possible levels of contact with whites. Separation and area polarization are maximized when areas divide into contrasting homogeneous enclaves. Eta registers any contact with whites and as such does not distinguish homogeneous areas from integrated areas.

On the other hand, the eta index does not necessarily have the same troubling behavior of D in being able to take very high scores when most blacks reside in predominantly white areas. So, eta falls between S and D. Methodological analyses I will conduct in completing this paper will establish where eta falls on this continuum of being sensitive to polarized and dispersed displacement from even distribution.

Technical Criteria for Segregation Measurement

Reardon and Firebaugh (2002) provide an authoritative summary of accepted principles of segregation measurement. I have provided detailed discussion of how some of these principles apply to popular measures of uneven distribution elsewhere (Fossett 2017). Here I provide a brief summary of the most important issues and additionally comment on how these technical criteria apply to the Logan and Parman eta index.

Among the most widely used indices of uneven distribution, the Separation Index (S), the Theil Entropy Index (H), the Hutchens Square Root Index (R), and the Gini Index (G) fare best in meeting technical criteria for segregation measurement. Of these, the Separation Index (S) is most reliable in identifying the presence of polarized displacement leading to group separation and area racial polarization. At the other end of the spectrum, the Gini Index (G) is most susceptible to taking a high value under conditions of dispersed displacement. In fact, if one views this with concern as I do, G is even worse than D in this regard. The Theil Index (H) and the Hutchens Index (R) are in an intermediate position. H is closer to S in behavior and is more reliable in signaling the presence of polarized displacement while R is closer to D and G in behavior and is more likely to take high values under conditions of dispersed displacement. It is likely eta will also fall in an intermediate position and behave in a manner closer to D than S.

The most widely used measure of uneven distribution, D, violates two accepted principles of segregation measurement. Specifically, D fails to satisfy the principles of transfers and the principle of exchanges. The eta index also fails to satisfy these two principles. For present purposes the issue reduces to the following concern. D and eta are "cut point" measures. They evaluate whether the reference group proportion (p) in neighborhood reaches or exceeds a specific value. For D, the issue whether the reference group proportion in the area (p) equals or exceed the reference group proportion in the community overall (P). For eta, the issue is whether the reference group proportion in the area (p) is greater than 0. The problem with cut point measures is that they are insensitive to differences in residential patterns that occur on one side of the cut point. Yet segregation measurement theory – via the principles of transfers and exchanges – sets forth guidelines for how an index should respond to these differences when they occur.

Obviously, it is undesirable for a measure to fail to satisfy accepted principles of segregation measurement. The main defense of D has been based on practical performance of D in empirical segregation studies. The prevailing consensus has been that, despite its technical deficiencies, D ranks segregation comparisons in a manner similar to other indices that have superior technical properties. Fossett (2017) shows that this empirical pattern has been established using a narrow set of segregation comparisons and that D deviates from other technically superior measures more often and to a greater degree when the set of segregation comparisons is expanded to include a more diverse set of communities and wider range of group comparisons.

An empirical defense of eta has not been established. Possibly it will come to be viewed as being like D in failing to meet accepted technical criteria but nevertheless being serviceable in empirical research. I am skeptical on this due to the unusual nature of eta. But I will explore this issue empirically in the full paper.

Unfortunately, eta suffers from another measurement problem that no other widely used measure suffers from. It is that scores on eta do not follow the principle of symmetry identified by White (1986). The principle is simple, the choice of the reference group should not matter for measures of uneven distribution. Thus, for example, White-Black segregation should take the same value as Black-White segregation. This is true for D, S, G, H, and R. It is not true for eta. As set forth by Logan and Parman, the calculation of eta specifies Whites as the reference group and then registers whether having any contact with Whites departs from expected levels. In the difference of means formulation eta registers the White-Black difference on the proportion have any contact with Whites. If Blacks are adopted as the reference group, the value of the index and its substantive interpretation both can change dramatically. The issue revolves around the cut-point criterion of "any" contact. Having any contact with Whites is not the "flip side" of having any contact with Blacks. To the contrary, if Blacks are taken as the reference group, the relevant question would be whether the household has "only" contact with Blacks. Candidly, this is unnecessarily messy and confusing. There are alternative measures that, like eta, and, unlike eta, meet all accepted principle so segregation measurement. If there is a compelling reason to adopt eta over these other options, it has yet to be established.

Neighborhood and Spatial Scale

I have completed analyses in which I measure areas (neighborhoods) using census Enumeration Districts (EDs). These aspatial administrative units are roughly comparable to census block groups in more recent censuses.

I also will explore new methodologies for measuring segregation at levels of spatial scale below the census enumeration district. Specifically, I will explore the potential to use the individual pages of the census manuscript records as "pseudo-blocks". In general, households on the same enumeration form are located in a small subarea within an enumeration district and contain a number of households and persons comparable to medium-to-large city blocks. Using pseudo-blocks for spatial units has the potential to capture patterns of segregation that would be missed using enumeration districts. This is likely to be especially useful for assessing segregation that plays out at smaller spatial scale as is often the case for smaller groups and in smaller cities. When measuring segregation for pseudo-blocks, we will used "unbiased" versions of segregation indices developed by Fossett (2017) so segregation index scores are not distorted by the complex patterns of bias that can distort standard scores.

Finally, I will explore the methodology of using over-lapping runs of neighbors to assess segregation at small- and near-small spatial domains. The spatial "runs" will be defined as a span of consecutive households that includes households that precede and follow a given household in sequence as listed in the manuscript records within an enumeration district. A starting point will be the three-household span used by Logan and Parman (2017) which consists of the household in question, the household that preceded it on the manuscript record, and the household that followed it on the manuscript record.

This measurement circumstance will be particular demanding for traditional approaches to calculating index scores. At this small spatial scale, the difference between group composition computed using counts for a household's two neighbors and group composition computed using the counts for the population of the three-household domain can be very large and it will produce systematic and large upward bias in index scores that are computed using traditional formulations. The eta index has the advantage in this situation based on avoiding bias by computing group composition based on counts of neighbors. However, eta does not have an advantage over the refined, unbiased versions of D, S, and other popular segregation indices introduced in Fossett (2017). The refined versions of D and S can be applied at small- and intermediate-scale spatial domains as well as large spatial domains.

Logan and Parman focus on the three-household run. I will contrast findings using this implementation with runs of alternative lengths such as 5, 7, 9, 11, 13, and 15. This will address whether index behavior changes with spatial scale. Fossett (2017) has already established that the behavior of the unbiased versions of D, S, and other measure he has introduced is easy to summarize. The expected values of the measures under random residential distributions are 0 across spatial domains ranging from small to large in spatial scale. However, the variation in index scores around zero is greater when spatial domains are small. This variation is small trivial for S but larger and potentially more consequential for D. Additionally, volatility in scores for D is greater when group size is imbalanced in contrast to balanced. I expect the behavior of eta will be more like the behavior of D than S.

I additionally expect that the behavior of eta will change substantially as the scale of spatial domain changes. Eta registers any contact with whites. As neighborhood scale increases in size, the sociological meaning and empirical probability of having at least one white neighbor will change. This will not affect expected values under random residential distributions. But it will likely impact volatility of scores under random distribution and it also is likely to impact values of the index in application to observed group distributions.

Racial and Ethnic Groups

I will measure segregation across a wide variety of group combinations for different racial/ethnic groups. These include, Native-Born Whites, Native-Born Blacks, and Foreign-Born Whites by country of origin (e.g., Canada, United Kingdom, Germany, Ireland, Poland, Italy, Russia, etc.). I will assess racial /ethnic status for persons (not households).

Cities – Metropolitan Areas

I define cities using county-based metropolitan area definitions from the 1950 census. In addition, since Logan and Parman applied their index in non-metropolitan counties, I will also define county-based units comparable to the "micropolitan areas" of the US Census Bureau's contemporary "core-based statistical areas." And I will also define "non-core" counties using similar criteria.

Data and Methods

1940 IPUMS 100% Restricted-Use Decennial Census Microdata.

I conduct analyses using the 100% count restricted-use IPUMS files. The restricted files contain full individual and household records including relevant social and demographic characteristics and census enumeration district (ED) codes.

Racial/Ethnic Tabulations. We obtain the counts for racial and ethnic groups needed to compute segregation indices by preparing relevant tabulations of group distributions across enumeration districts (EDs).

Neighborhood Exclusions. In metropolitan and micropolitan areas, I will exclude population from segregation calculations for households that reside in EDs where: (a) the population is at or above 50% rural farm, or (b) when the population is at or above 30% group quarters and/or inmates of institutions.

Segregation Comparisons. For each city in the analysis I computed segregation index scores for all possible comparisons of groups meeting the following criteria in a given comparison: (a) both groups have a minimum community-level population of 50 households and (b) the smaller of the two groups in the comparison is at least 1% of the combined group populations.

Data Disclaimer. Statistical analyses reported here were conducted under the guidelines and review policies of a project approved by the Minnesota Population Center (MPC). The views expressed in this research, including those related to statistical, methodological, technical, or operational issues, are solely those of the authors and do not necessarily reflect views of MPC. All results have been reviewed to ensure that no confidential information is disclosed.

Preliminary Findings and Conclusions

Work I have conducted to date establishes preliminary findings regarding variation in both the level of segregation and the nature of segregation across group comparisons in 1940. Selected findings are documented in Table 1 and Figure 3. The findings are consistent with many aspects of spatial assimilation theory. But there are several important exceptions and nuances.

These preliminary results apply to analysis of D and S computed using data for enumeration districts for metropolitan areas.

Results for the final paper will additionally include results for the eta index. The final paper will also report results based on using neighborhoods defined from “sheet blocks” (defined from manuscript records) and neighborhood spans of 3-15 consecutive households.

Preliminary Findings Consistent with Spatial Assimilation Theory

• Segregation between Native Whites and Foreign-Born European groups varies inversely with (a) the duration of substantial group presence in the US and (b) the degree of cultural and socioeconomic similarity of the group.

Preliminary Findings Consistent with Discrimination Theory

• Segregation between Blacks and all White groups – Native-Born and Foreign-Born is high.

Several Novel and Sometimes Surprising Findings

• European immigrant groups are more segregated from each other than from Native Whites.

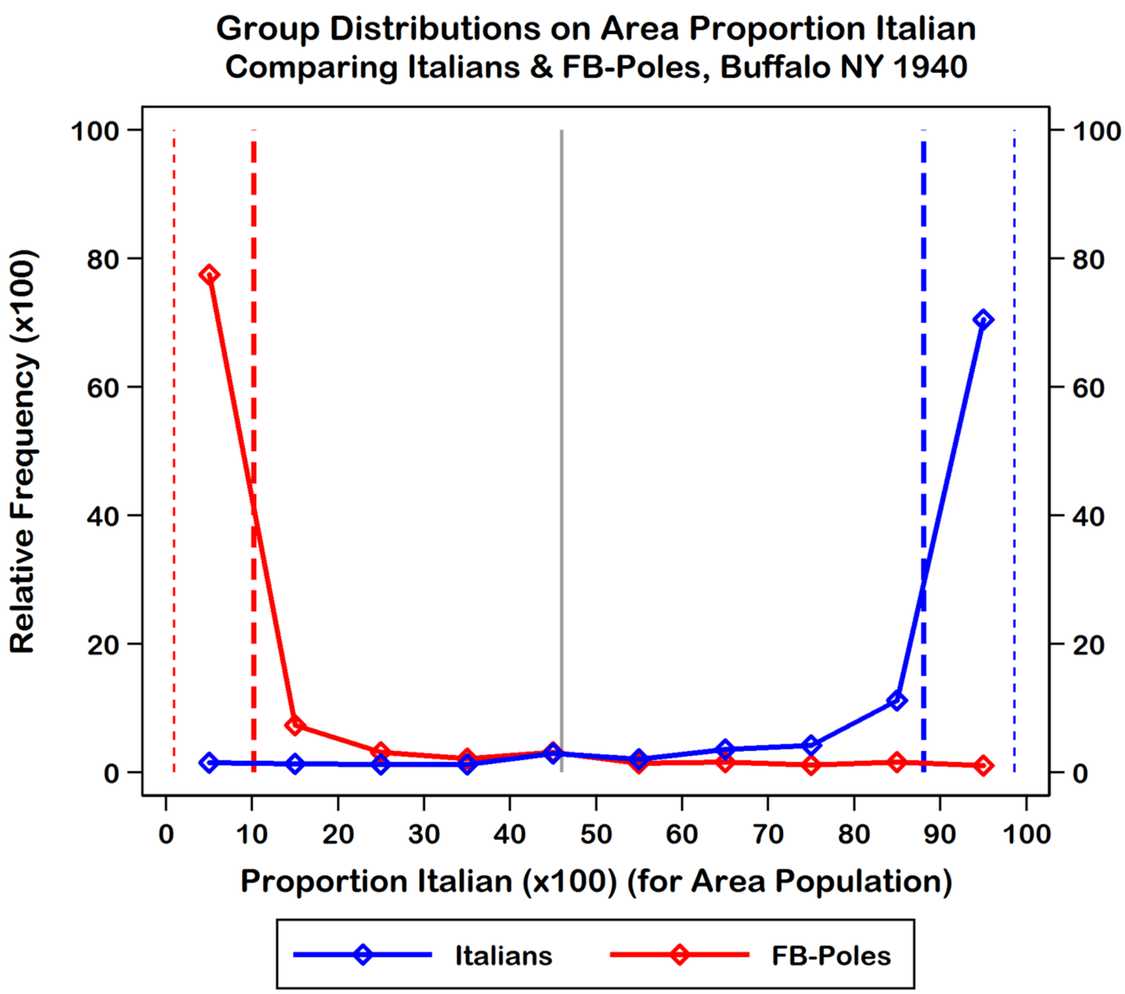
• Segregation of European immigrant groups from Native Whites is not "prototypical"; it involves dispersed displacement and minimal group separation.

• Segregation of European immigrant groups from each other is "prototypical"; it involves polarized displacement and substantial group separation.

• Segregation of European immigrant groups from Native Blacks is "prototypical"; it involves polarized displacement and substantial group separation.

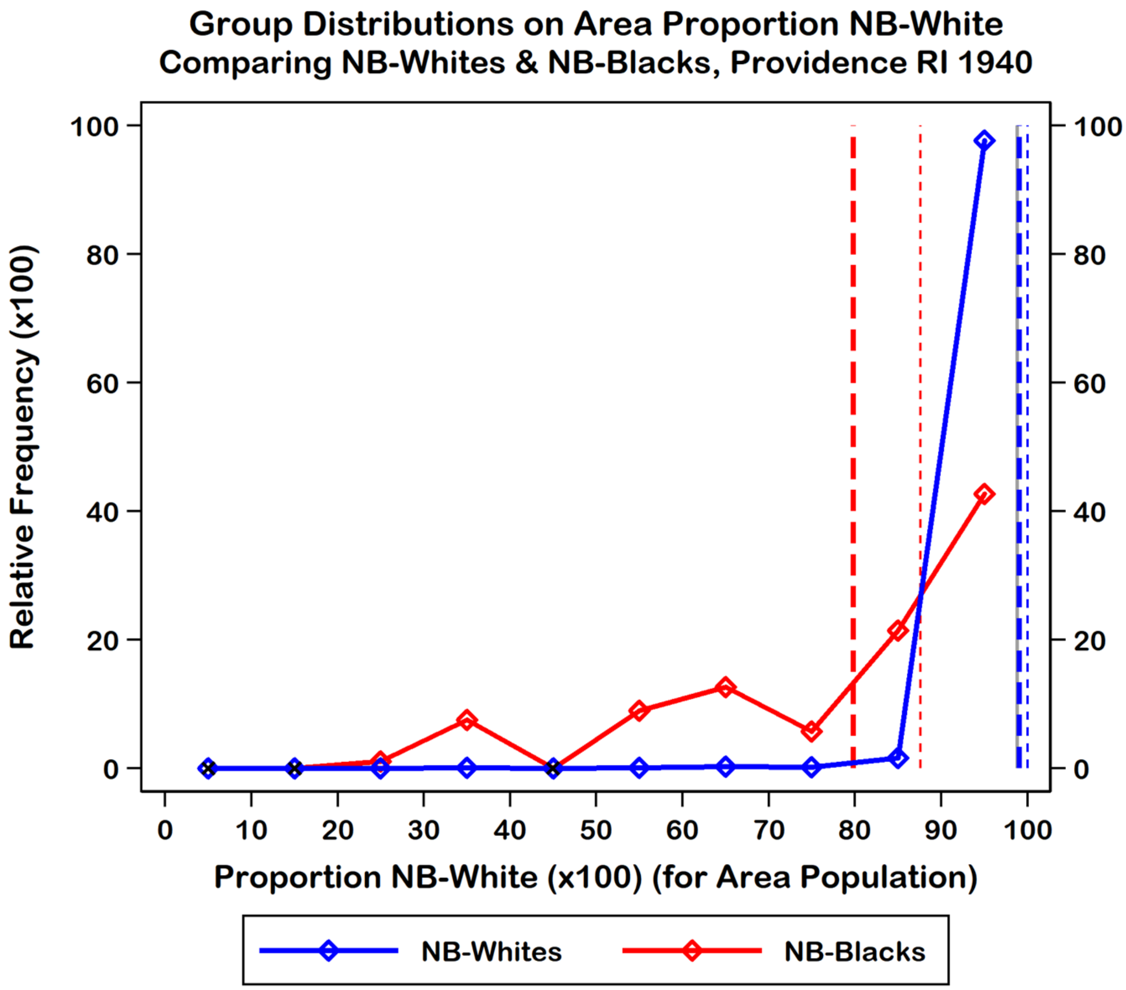
• Segregation of Native Whites from Native Blacks is not always "prototypical". In some cases it involves polarized displacement and substantial group separation, but in many other cases it involves dispersed displacement and minimal group separation.

Figure 1. Polarized Displacement (High D, High S)



Notes: Standard S = 77.9 = (Y_1 - Y_2) = (88.0 - 10.2) for y_i = p_i based on area population.
Dashed lines denote group means (thick) & medians (thin). (S_{P50} = 97.6, D = 84.8, P = 46.0.)

Figure 2. Dispersed Displacement (High D, Low S)

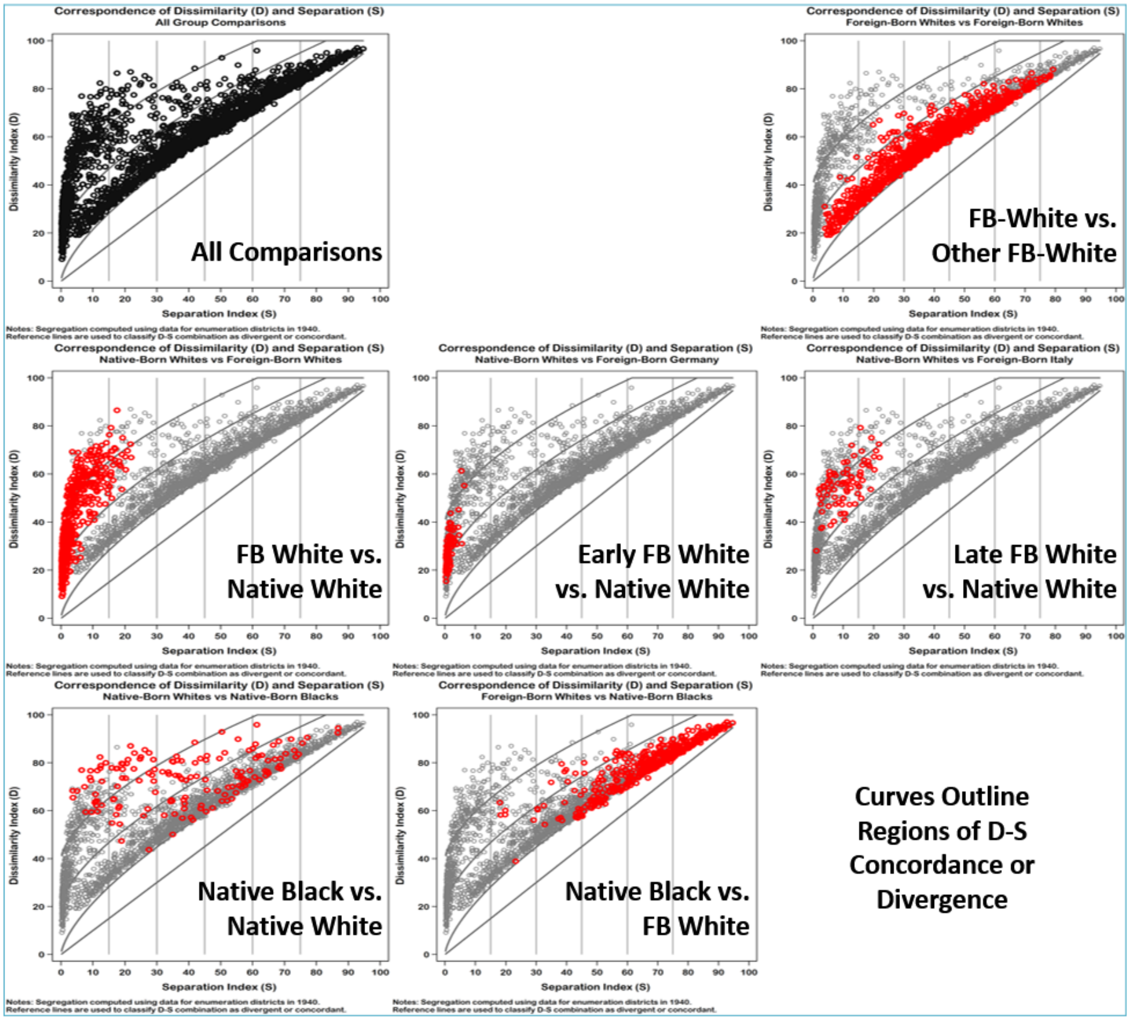


Notes: Standard S = 19.2 = (Y_1 - Y_2) = (99.0 - 79.8) for y_i = p_i based on area population.
Dashed lines denote group means (thick) & medians (thin). (S_{P50} = 12.4, D = 77.3, P = 98.8.)

Table 1. Average Segregation Index Scores for Comparisons of Selected Immigrant Groups with Native-Born Whites, Other Immigrant Groups, and Native-Born Blacks

	Group vs. Native-Born White			Group vs. Other Foreign-Born White			Group vs. Native-Born Black		
Groups	D	S	N	D	S	N	D	S	N
Canada & UK	22.1	1.2	110	50.4	32.1	388	80.5	66.5	89
Germany	28.1	1.4	100	49.7	31.9	366	80.3	68.3	82
Ireland	35.4	2.1	37	54.0	35.2	193	79.4	68.4	31
Sweden	35.6	2.5	29	49.5	30.8	142	82.4	72.3	22
Austria	46.4	3.4	36	55.5	37.1	210	80.2	69.3	31
Czechoslovakia	59.8	7.3	24	63.8	47.1	143	82.8	73.5	18
Poland	57.3	8.1	59	62.8	46.0	288	80.0	70.0	48
Italy	55.4	10.5	83	63.2	44.6	353	74.9	59.5	67
Native-Born Black	73.5	38.7	152	79.4	67.0	415	---	---	---

Figure 3. D-S Concordance and Discordance by Type of Comparison



References

Fossett, Mark. 2017. *New Methods for Measuring and Analyzing Segregation*. New York: Springer.

Logan, Trevon D. and John M. Parman. 2017. "The National Rise in Residential Segregation." *Journal of Economic History* 77(1):127-170.

Massey, Douglas S. and Nancy A. Denton. 1988. "The Dimensions of Residential Segregation." *Social Forces* 67: 281-309.

Reardon, Sean F., and Glenn Firebaugh. 2002. "Measures of Multi-Group Segregation." *Sociological Methodology* 31:33-67.

Ruggles, S., K. Genadek, R. Goeken, J. Grover, and M. Sobek. Integrated Public Use Microdata Series: Version 6.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2015. (1940 IPUMS 100% Sample, Restricted File.)

Stearns, Linda B. and John Logan. 1986. Measuring Segregation: Three Dimensions, Three Measures." *Urban Affairs Quarterly* 22:124-150.

White, Michael J. 1986. "Segregation and Diversity: Measures of Population Distribution." *Population Index* 65:198-221.

Winship, Christopher. 1977. "A Re-evaluation of Indices of Residential Segregation." *Social Forces* 55:1058-1066.