Mapping Social Distance:
Ethnic Residential Segregation in a Multiethnic Metro

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Abstract

The increasing diversity of immigrant-receiving countries calls for measures of residential segregation that extend beyond the conventional two-group approach. Our objective in this study is to represent simultaneously the relative social distance occupied by a wide array of ethnic groups. We use census tract tabulations for the Toronto CMA in 1996 and the technique of multidimensional scaling to summarize the residential neighborhood pattern of the city’s largest 50 ethnic groups. To do so, we work with a matrix of 1,225 pairwise entropy statistics. We find that African/Caribbean groups and Blacks were highly clustered and shared common patterns of segregation with other groups. There is also evidence of clustering along the lines of work region for other nationality groups. At the same time there are some noticeable distinctions and anomalies in the pattern. This study highlights the value of looking beyond broad racial or pan-ethnic classifications in understanding ethnic congregation and residential segregation patterns. Our results point to the value of new methods in providing a more conceptually meaningful way to understand social distance between groups.

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Introduction

Residential patterns offer a crucial window on the social relations of groups. Who one chooses – or is permitted to have – as a neighbor speaks volumes about the driving forces of urban ecology and also about social relationships in the wider society. Current immigration patterns to high-income societies further contribute to a “sorting” process, as real or perceived group differences are manifested in residential outcomes. These outcomes have now been accepted as one dimension of a larger process of structural integration in contemporary theories of immigrant incorporation and racial stratification (Gordon 1964; Kymlicka 1998). In essence, Robert Park’s adage that spatial distance reflects social distance has been taken to heart by social scientists who study urban social structure resulting in the development of numerous indices to quantitatively measure levels of residential integration.

Residential segregation statistics have become so well established that they are now cited regularly in policy documents and even in the more popular news media. However, the growing ethnic diversity of many immigrant-receiving countries has challenged traditional approaches to segregation studies that reflected the dominant racial structure as a dichotomy of blacks and whites. The context of the new migration calls for measures that extend beyond the conventional two-group index. Our objective in this study is to develop a methodology for analyzing residential clustering that more accurately captures contemporary social and spatial realities. Using multidimensional scaling techniques and the entropy index, we illustrate simultaneously the relative social distance occupied by a wide array of groups in Toronto.

Metropolitan Toronto provides a particularly appropriate context for this study due to its considerable ethnic diversity and the availability of recent data. In 1996, Toronto had the largest metropolitan population in Canada. The Toronto Consolidated Metropolitan Area (CMA) contained over 4.2 million residents (14 percent of the total national population) and of those 4.2 million, approximately 42 percent were foreign-born. This is a larger foreign-born contingent than New York or Los Angeles, which had 34 percent and 36 percent respectively. The only major North American metropolis with a larger immigrant presence is Miami, which recorded 50 percent foreign-born in the 2000 US Census. Compared with other CMA’s in Canada, Toronto’s foreign-born population (1.8 million) was approximately triple that of Vancouver (633,740) and Montreal (586,465).

The next section provides some background and motivation for this work on residential segregation measurement and we argue that the proposed method will improve our substantive and methodological understanding of segregation. Subsequent sections describe our data, methods and results. We conclude with a discussion of the ways in which this approach might advance segregation analyses more generally.

Background and methodological motivation

As contemporary industrial societies have become more ethnically diverse – and as this ethnic diversity has become a central feature of public attention – there is pressure on social science to better understand the socio-spatial arrangements that accompany ethnic diversity advancement and socioeconomic achievement. At one point in time, not long ago, viewing a society in black and white literally, was sufficient for understanding a major element of social cleavage in the United States. In Canada, the dualism involved the two charter groups, the English and French

(Driedger 2001). Consequently, studies of residential patterns could be limited to dichotomies. For the U.S., Taueber and Taueber's (1965) landmark *Negroes in Cities* and could offer a definitive view of the ethnic landscape with reference to a dichotomy of race and the use of the workhorse of segregation measurement, the Index of Dissimilarity. Even as of 1993, Massey and Denton's *American Apartheid* still viewed American urban ecology as a contested ground of blacks and whites. Again, the index of dissimilarity, exposure and isolation indexes – all limited essentially to dichotomous data – offered evidence on segregation and housing discrimination.

The dualism of race continues to play an important role in society and accordingly, in studies of residential segregation (Alba, Logan and Stults 2000; Darden 1995). However, throughout these several decades there has been concern about more groups than two, and of course, some studies have looked beyond the dualism to understand segregation patterns (Alba and Logan 1993; Balakrishnan and Hou 1999; Fong 1994; Freeman 2000; Frey and Farley 1996; Johnston, Forrest and Poulsen 2001; White, Dymowski and Wang 1994; White and Glick 1999; White and Omer 1997). The studies are now too numerous to recap here, but beginning in the 1970s and 1980s increasing numbers of studies have investigated other ethnic groups. Some focused on new and growing minority groups such as Latinos and Asians (Alba and Logan 1993; Darden and Kamel 2000; Fong 1994; Freeman 2000; Frey and Farley 1996). The preponderance of these studies continued to view segregation as a dichotomy: Group vs. Others (what we call the "all others" approach) or Group vs. Whites. In these instances, the measurement index might have been dissimilarity, isolation, exposure, or one of about another two dozen measures, but in most cases the analysis was still limited in ethnic detail.

At the same time, while recognizing the increasing ethnic diversity of North American cities, most analyses still limited work to rather broad – pan-ethnic – categorizations. Typically those analyzing US census data made calculations from Race-Spanish origin tabulations (often these were in Summary File 1 of USBC data products). Thus, a typical ethnic array would consist of: Non-Hispanic Black; Non-Hispanic White; Hispanic; Asian and Pacific Islander; American Indian; Other. Such were the tabulations published for 1990 census data by the US Census Bureau and by both the Census and the Mumford Center at SUNY Albany for the 2000 census. To be sure, these ethnic categories captured much of what had been the focus of analysis for some time, while also picking up the new pan-ethnic groupings of Latino and Asian.

Virtually all research on ethnicity generally and residential segregation specifically recognizes that these categories are broad and often crude. They persist, it seems, for three reasons. First, census tabulations in these broad categories offer a compelling convenience and a social recognition of major ethnic divisions in society. Second, one might argue that these broad classifications still guide social relations, that in some sense identification within a pan-ethnic group (White, Black, Latino, Asian, American Indian) trumps or dominates the more refined ethnic and ancestry subgroups. Third, in a polyglot nation with many individuals of mixed heritage and a complex web of tabulations, it is neither easy nor obvious to disentangle an alternative comprehensive tabulation of the ethnic categories. Consequently, getting a summary picture of the inter-ethnic segregation among dozens of distinct groups still presents a challenge. How does one distill?

While few would argue that the subgroups within a defined census category (Irish, Italian, Greek within Whites; Mexican, Cuban, Dominican among Spanish Origin) are equivalent socially or fully intermingled residentially, we have precious little information on the differential segregation of such detailed groups. Partly for reasons of sufficient sample size, the availability of data, including the difficulty of ascertaining subgroup counts from census data, and consistency with past practice, most studies are limited to these broad groupings. Some notable exceptions exist, such as Lieberson's *Piece of the Pie* (1980), which compared the experience of European immigrant groups with racial minorities in the U.S., and these exceptions appear well on their way to becoming the norm (Balakrishnan 2001; Johnston, Forrest and Poulsen 2001; White, Fong and Cai 2003).

An issue raised by the current methodological toolkit available to segregation analysts is the designation of an appropriate *reference group*. Many studies of segregation proceed by examining selected groups to (a) "all others" not in the group; or (b) some key reference group. The first approach has been the case in the many dissimilarity index or exposure index studies that use group-vs-not-group measures. In the exposure framework, this is commonly termed an "isolation" index. The second option – the use of one key group – implies that this comparison is particularly meaningful or appropriate. If one takes the view that there is an established group to which one should compare others, then this set of pairings may be informative and the comparisons implicit in many conceptualizations of assimilation, most notably that of Anglo-conformity, are consistent with this approach. Thus, the social distance of a group from the culturally dominant group would be captured by the pairwise segregation index and applications using Black vs. English ancestry or Polish vs. English ancestry would convey this implicit comparison. In North America, the reference group of English origin persons is an obvious choice. For Canada, French-Canadians in Québec would also serve this role. Across studies of segregation, the reference group has shifted amongst Whites, the English and Native Whites of Native Parentage (NWNP).

More recent thinking about immigration, ethnicity and segregation would suggest that the pairwise reference group and the "all others" approaches are ill-advised or incomplete. Given the rise and persuasiveness of more pluralistic notions of ethnicity and immigration, there is little that is sociologically compelling about privileging a single reference ethnic group, much as in the Anglo-conformity approach. Further, segregation seen only as residential separation from English (or some other) stock conveys a partial picture. A group could be relatively well integrated with the reference group while being relatively isolated from others and the reference group may be highly segregated even though it is often not defined in these terms. On the other hand, the limitation of analysis to "isolation indices" (group vs. "all others") exhibits the misfortune of extensive aggregation. While such aggregate pairwise indices inform us about the overall pattern of residential integration for a group, they reveal little about the ethnic residential mosaic itself.

Significant effort has been directed toward modifying segregation methods to capture the multi-ethnic milieu (Reardon and Firebaugh 2002; Wong 1998). Still, some of the ethnic richness may be obscured. In any case, the availability of improved measures, data management techniques, and the rapidly evolving conceptualization of ethnicity and metropolitan residence (pluralism, multi-ethnic metros, and the like) converge to argue for a window on residential patterns that is at once comprehensive and revealing of the pattern of that ethnic residential mosaic.

In this paper we offer a method for making progress on these fronts. We develop a method that incorporates *detailed* ethnic diversity and provides a descriptive summary measure of the segregation of an ethnic group with reference to the panoply of all groups. The summary is graphical, and it is designed to show where the group is positioned in social space among dozens of other groups. To foreshadow, our approach consists of two major elements. First we reorganize census data into a set of many exclusive and exhaustive categories of ethnic identification. Second, we use multidimensional scaling to provide an overarching portrait of pairwise segregation among these dozens of groups. We choose to analyze Toronto because the city is arguably the most ethnically diverse in North America. Canadian census data are suited for the task and the results can carry over to other settings in the US and in other ethnically diverse societies. We turn now to describing our data and method in more detail.

Data

We used 1996 census data from the Toronto Census Metropolitan Area[1] (CMA), in which 100 distinct ethnic groups are identified in the 20 percent sample data. The open-ended question of ancestry in the census recognized multiple identities and asked respondents to specify as many ancestry groups as were applicable, providing space for up to four groups. Almost 1.3 million people (over 30 percent of the Toronto CMA population) chose more than one group. The most frequent multiple response categories were European origin groups, namely English, Scottish, Irish, French and German. For sole ancestry, Chinese, Italian, Canadian, and East Indian had the greatest numbers of responses.

To estimate residential segregation amongst these ethnic groups, we used census tract tabulations. Statistics Canada subdivided the Toronto CMA into 813 census tracts[2] and 804 tracts were available for the analysis due to the suppression of tracts with low numbers of residents. Of these available tracts, the average census tract held 5,275 people. Thus, Canadian census tracts in concept and execution are quite parallel to the census tracts used in the United States and some other industrialized settings.

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[1] Statistics Canada defines a CMA as an area with an urban core population of at least 100,000 with adjacent rural and urban areas that have a high degree of social and economic integration with the urban core.

[2] A census tract is defined as small geographic units representing neighborhood-like communities within CMA's.

Method

There were three stages in the analysis of data. The first step required us to determine the ethnic group tabulation most appropriate for the analysis. In the second stage, we calculated ethnic residential segregation by employing the pairwise entropy index. In the final stage, the application of a multidimensional scaling (MDS) technique provided the visual summary of the estimated segregation statistic. It is this multi-way summary that we seek, and we discuss it in detail below. The statistical package STATA version 7.0 facilitated computations for the data analysis.

We have chosen to assign ancestry on the basis of what we call “allocated responses.” For those of single ancestry the assignment is a straightforward 1-1 mapping. For those of multiple ancestry we make proportional assignments, as we describe shortly. Although an analysis based only on those who report a single ancestry would have enabled a readily tractable approach, it would have also resulted in the omission of over 30 percent of the population. An alternate option was to use total responses for an ethnic group (i.e. the total number of times an ethnic origin was identified in both single and multiple responses), but that approach would have overestimated the significance of certain groups, underestimated others and not reflected a count of persons, hence it was not suitable. In the end, we chose to allocate responses, which allowed us to include the entire population and to account for the numbers of responses by using a weighted measure.

Allocated responses were calculated for each census tract by dividing the total number of people who responded with multiple ancestries by the total number of multiple responses across all ethnic groups for that tract, giving us a fraction of people to responses and weighting that figure to the multiple response column for each ethnic group. The computing formula is as follows:

$$ARE = [(MRP_i \ / \ ({}^{100}{}_{k=1} \sum MR_k)) \text{ x } MR_{ik}] + SR_{ik}$$

ARE – allocated response per ethnic group
MRP_i – multiple response population per tract
MR_k – multiple responses per ethnic group
MR_{ik} – multiple responses per ethnic group per tract
SR_{ik} – single responses per ethnic group per tract

This calculation sums to the census-based population tally for the census tract (unlike options based on multiple counting of responses), and it appropriately weights the population in a count of persons for statistical purposes. It does have the slight unwieldiness – or perhaps in the eyes of some, exact appropriateness -- of a assigning partial persons to given ethnic groups, to wit, 0.5 Chinese and 0.5 Italian for someone who reports Chinese-Italian ancestry. A short thinking exercise will reveal that this is the statistical equivalent of 1 Chinese-ancestry individual and 1 Italian ancestry individual in a census tract where all populations are exactly doubled. Thus this approach preserves the relative size of various ancestry groups and allows the unique patterns of poly-ethnicity to be represented. Except for an intermediate calculation, the approach is straightforward in the methodology as well.

The sample was then limited to the largest 50 ethnic groups to allow for a more manageable data analysis (for a list of groups, please see Appendix A). As Table 1 shows, the largest 50 groups comprised 94 percent of the CMA population with the smallest 50 ethnic groups taking up the remaining 6 percent. Table 1 also indicates that even in a city as diverse as Toronto, there is a considerable degree of population concentration in a moderate number of ethnic groups. Five groups account for nearly half of the identified ethnic membership in metropolitan Toronto; ten groups account for about two-thirds. After that, ethnicity diversifies considerably, and a total of 30 groups are needed to account for 88 percent of the population. Another 20 groups are needed to account for an additional six percent of the population. We also note from Table 1 that the patterns for sole ancestry and our allocated response procedure are quite similar.

To test the reliability of the findings we conducted a separate analysis for each type of tabulation (i.e. single and allocated responses) and compared the results. The correlation between single and allocated responses were very high (r=0.92) and this paper focuses on the results of one analysis, the allocated responses. (The results of the single responses are available upon request to the authors.)

Table 1. Cumulative percentage of ethnic groups

Number of Ethnic groups	Single responses		Allocated responses	
	Population	Cumulative percentage	Population	Cumulative percentage
Top 5 groups	1,418,585	48	1,927,396	46
Top 10 groups	1,918,550	65	2,760,765	65
Top 20 groups	2,380,080	81	3,477,432	82
Top 30 groups	2,571,325	87	3,710,753	88
Top 40 groups	2,694,320	91	3,878,911	92
Top 50 groups	2,775,715	94	3,993,711	94
Total population	2,947,375		4,232,905	

Once the allocated responses were calculated for each ethnic group, we estimated two indices of segregation with these new figures, the pairwise entropy index and the dissimilarity index. The pairwise entropy index is an adjusted measure of the more general entropy or information index (H), which provides an indication of the deviation in diversity of the average tract from the diversity of the city. Introduced by Theil and Finizza (1971), the entropy index offers some advantages over the commonly used segregation statistic, the dissimilarity (D) index.[3] This index is bounded from 0 to 1, where 0 indicates no segregation between two ethnic groups and 1 suggests complete segregation. The results for the English ethnic group are presented in Appendix B. In the *pairwise* entropy index, we have a measure of the deviation of the average tract diversity of each *pair* of ethnic groups from their citywide diversity. The pairwise entropy index follows the expression:

$$H = (H^* - \bar{H}) / H^*$$

$\bar{H} = (-1)\ \Sigma\quad [(n_{1i} + n_{2i}) / (N_1 + N_2)]\ [p_i \log(p_i) + (1 - p_i) \log(1 - p_i)]$
$p_i = n_{1i} / (n_{1i} + n_{2i})$
where n_1 *is the population of ethnic group 1 in census tract i*
n_2 *is the population of ethnic group 2 in census tract i*
$\bar{H}$ *is the average census tract pairwise entropy measure*
$H^* = (-1)\ P \log(P) + (1 - P) \log(1 - P)$
$P = N_1 / (N_1 + N_2)$
where N_1 *is the citywide population of ethnic group 1*
N_2 *is the citywide population of ethnic group 2*
H^* *is the citywide pairwise entropy measure*

The dissimilarity index, also known as *D*, is one of the most commonly applied indices of segregation. We calculated dissimilarity for comparability with the host of segregation studies, since it is, after all, the “workhorse” of segregation measurement (White 1986). Its deficiencies are several, and they mostly have to do with technical properties of responses to varying compositional features of the population, inability to be aggregated and the like (White, 1986).

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[3] For a thorough critique on the properties of both the entropy and dissimilarity indices, please refer to James and Taeuber (1985) and White (1986).

The superiority in the entropy index rests in its inherent ability to handle multiple groups, and its decomposition properties. Used in pairwise form, entropy and dissimilarity give rank-order consistent results in the Toronto setting (r=0.86).

With two series of segregation statistics computed for each of the 1,225 pairs of ethnic groups, we summarized all pairwise segregation values using multidimensional scaling (MDS) procedures in STATA 7.0.[4] This technique is advantageous due to its ability to illustrate simultaneously patterns of distance amongst a set of objects, in this case, ethnic groups. Given the 50 by 50 matrix of segregation statistics between each pair of ethnic groups, MDS generated a matrix of Euclidean distances in n-dimensional space to correspond to the data in the original matrix. Then each group was assigned coordinates on a two-dimensional graph in relation to the magnitude of values between it and each of the 49 other groups. In this graph, the axes and orientation are arbitrary and points on the graph are to be interpreted in relation to other points. Larger values in the original matrix were read as greater distances between pairs and smaller values were interpreted to show proximate ethnic pairs by the MDS technique. Therefore, ethnic pairs sharing low levels of segregation should appear in closer proximity than those sharing high levels of segregation based on estimates of the pairwise entropy index. The final product that emerges is a graph or "map" of segregation of each ethnic group with every other.

Results

Taking each pair of segregation values as a measure of distance, we generated a multidimensional scaling graph (Figure 1) or a map of social distance. This visual MDS illustration represents the segregation between each pair of ethnic groups such that those with higher segregation values are situated at greater distances and ethnic pairs with lower segregation values appear as closer neighbors on the graph. The significance of such a two-dimensional representation lies in the relative position of the various ethnic groups. The overall position in the center or periphery and the pattern of clustering are quite meaningful as well.

The figure is quite revealing in terms of the overall pattern of ethnic segregation – multi-group proximity – in Toronto. Much of this information would not be revealed in a conventional "in-group vs. all others" analysis of dissimilarity or isolation. We observe, for instance, that the two charter groups of French and English origin, are found fairly proximate to one another. This is so, despite the heritage of linguistic and political distance between the groups. Interestingly, those who identify as Canadian fit in this circle of ethnic groups. We also find that pairwise entropy (dissimilarity) of these two groups is relatively low, at 0.019 (0.139).

From the map, we observe some evidence of clustering based on regional identities. African and Caribbean groups and Blacks appear to be highly clustered suggesting high levels of residential integration and shared patterns of segregation with other ethnic groups. While the graph suggests clustering along other regional lines, e.g. Western Europe and South Asia, they do not appear to follow any systematic pattern. Clustering suggests some evidence of residential sorting of neighborhoods based on ethnic and racial characteristics. However, we find there is as much variation across racial groupings as there is within them.

For Asian subgroups, there is evidence of dispersion across the graph. Chinese, Korean and Filipino groups appear to be closer to one another than they are to Western European stock and African, Caribbean and Black groups, yet they are similarly, if not more, distant to other Asian groups, namely the Japanese, Pakistani, East Indian, Vietnamese and Punjabi groups. This has significant implications. Many studies of urban residential patterns group Asians into a catchall category and analyze patterns of segregation for such an aggregate. This detailed

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[4] The program file was created by STATA and is available upon request to the authors.

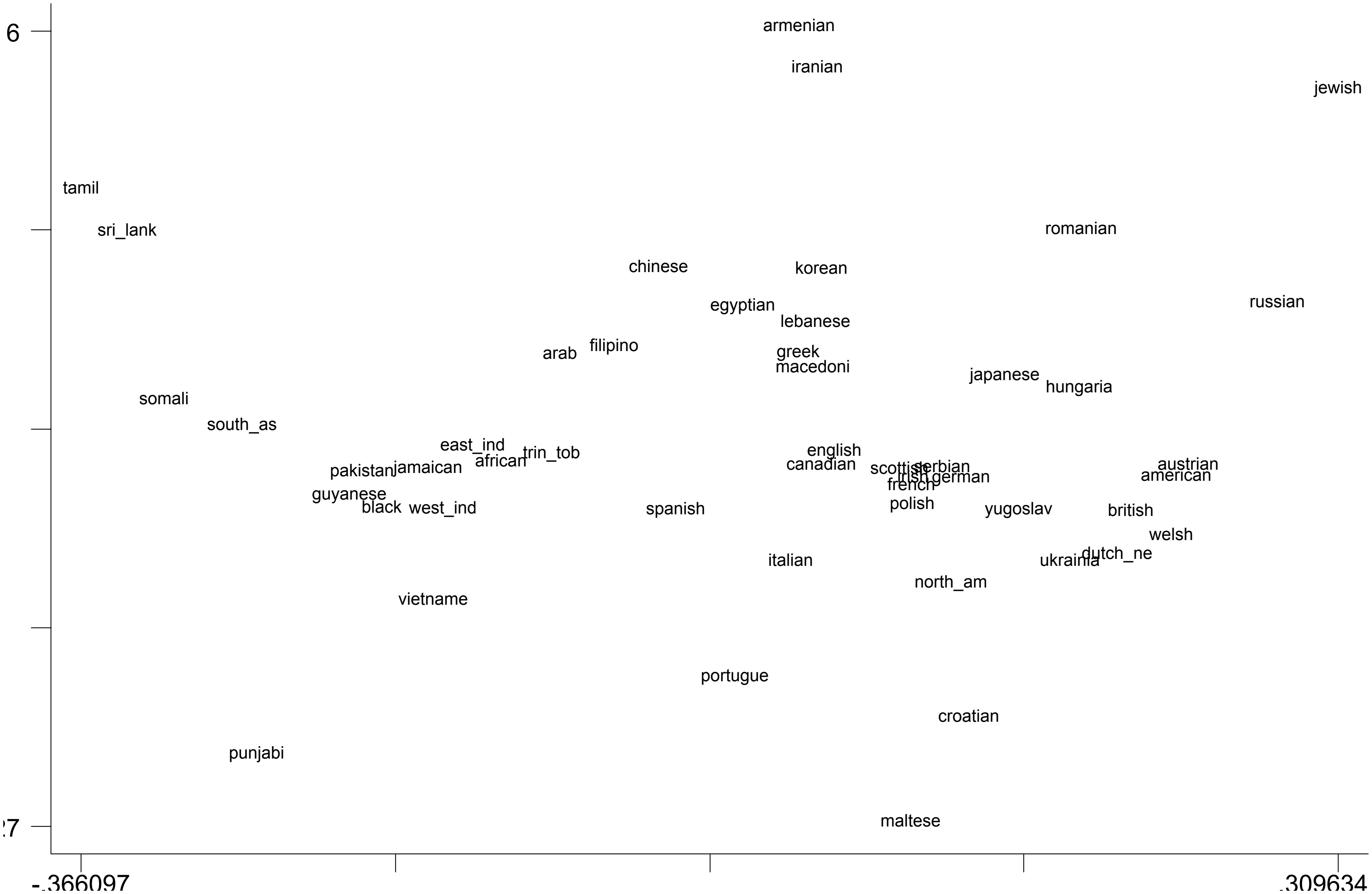
segregation map implies broad categorizations may provide a distorted picture of residential segregation since groups at either extreme will heavily influence segregation statistics.

Similarly, some of the most highly segregated groups (i.e. those located at the periphery in the geometric sense, Jews, Maltese, Armenians and Iranians) would be included in the racial classification of White. Here we observe within-group differences as substantial as differences across racial groups despite their shared location in the right half of the graph. Finally, the omission of Latino subgroups due to their low numbers in Toronto precludes us from investigating whether similar conclusions can be made about this other pan-ethnic grouping.

Other than with resulting patterns of relative location, consumers of segregation statistics should be concerned with the scale of segregation. Unfortunately, the MDS graph does not inform us of the actual size of segregation amongst groups hence we are unaware of the magnitude of the entropy index between them. We refer to the original matrix since we cannot tell how close to complete segregation (the value of 1 in the entropy index) are the two most distant groups. For the case of Toronto, the largest value of segregation is between the Jewish and Punjabi with an entropy (dissimilarity) value of 0.825 (0.93). This suggests that there is minimal overlapping of residential space between these two groups such that a neighborhood with many Punjabis would be unlikely to also consist of people of Jewish ethnicity. While the groups are not numerous, the point remains. The point applies with a somewhat more force for other pairings, such as the Vietnamese and the Filipino populations. There is, for sure a relative clustering of the European stock population, yet the relative distances among such national origin groups tells us that even that common amalgamation in the segregation literature may be somewhat dubious.

Figure 1.

Entropy for 50 ethnic groups in Toronto 1996, allocated



Discussion

The foregoing analysis and proposed analytical tool for viewing residential segregation suggests that segregation is much more complex than the picture offered by the crude racial and pan-ethnic classifications often utilized by social scientists. The results confirm what social scientists have always known about racial constructions, that there is as much variation within racial groupings as across them and that ethnic distinctions at a finer scale provide a greater understanding of residential integration. Yet they also underscore the assertion by racial stratification theory that argues Blacks face some of the greatest barriers in the U.S. In Canada, there also appears to be evidence of racial divisions, at least in Toronto, as Toronto's segregation map demonstrates residential clustering of Blacks, Africans, Caribbeans and South Asians at one end and of Europeans on the other.

Several competing explanations might be invoked to help to shed some light on the patters observed. On the one hand, the "vintage-SES" explanation might hold. Seen as a rudimentary application of straight-line assimilation theory applied to space, the vintage SES explanation would argue that residential patterns of immigrant groups are primarily a function of socioeconomic resources and time. (The most extreme form of this would argue that vintage should explain all, since convergence with time should perforce eliminate SES differentials among ethnic descendents.) Differential distributions of racial and ethnic groups should be then explained by their differential socioeconomic status and length of residence such that with rising social and economic resources, ethnic groups should become more integrated. In terms of the visual depiction, we would expect those ethnic groups that are situated in close proximity to one another to share similar levels of socioeconomic resources and to have arrived in Canada around the same period. The isolated groups at the extremes in the graph should occupy the lowest levels of the socioeconomic ladder and should reflect the newest arrivals according to this model. To be sure one should be sceptical of such a simple and overarching pattern applying is the mti-ethic context, particularly since work on black-white residential dynamics some time ago challenged any universal application of the conventional residential succession model (Lee and Wood, 1991; Massey and Denton, 1993).

So too the Canadian case is more variegated. Studies that have controlled for socioeconomic status show that segregation persists (Balakrishnan 2001; Balakrishnan and Hou 1999; Darroch and Marston 1971; White, Fong and Cai 2003). The residential pattern of Jews – identifiable in the Canadian census but not the US census -- provides further evidence contrary to spatial assimilation theory as its level of segregation has endured as one of the highest for, at minimum, 4 decades (Balakrishnan and Hou 1999; Darroch and Marston 1971; Kalbach 1990).

Other explanations for such patterns of residential segregation would invoke other behaviors and social mechanisms, including discrimination and prejudice and ethnic cohesion. As with almost all studies of residential patterns from census data, summary statistics cannot separate these mechanisms. To the extent that social distance social distance (Peach 1975) is reduced with time, the degree of social interaction between immigrants and natives should increase and so should geographic proximity. Preferences and attitudes of group members play a large role in bringing about residential patterns and these are played out through residential mobility and discrimination in real estate practices. Ethnic cohesion is also named as a contributor to residential separation. Still others have argues that residential distinctiveness is a result of the values of multiculturalism and the promotion of cultural pluralism (Balakrishnan and Hou 1999). Finally, members of some groups are not able to exercise their preferences but are settled in particular areas by government authorities. Specifically, refugees and asylumseekers are housed in a few pockets around the city and their arrivals in large numbers may partly explain the high levels of residential segregation. The groups most likely to be affected by government intervention are the Tamils, Sri Lankans, Croatians, Somalis and Iranians.

We cannot fully distinguish these explanations in our analysis. In that respect our results and limitations match those of any study of small area residential census data. Pushing the analysis across all groups, however, we gain better insight into the plausibility of various explanations, while simultaneously representing the urban mosaic more accurately.

It is difficult to compare this analysis with past studies on segregation of ethnic groups in Canada as there is a paucity of studies that have systematically addressed the residential segregation of all groups. Most available studies have examined the segregation of major visible minority groups such as Asians, Chinese, South Asians and Blacks (Balakrishnan 2001; White, Fong and Cai 2003) or focused on one particular group such as Latin Americans (Darden and Kamel 2000). A further complication in comparability is the inclusion of additional metropolitan areas in measures of urban segregation. However, one study did examine 12 ethnic groupings (Balakrishnan & Hou 1999) and our results appear to be consistent with their findings.

Despite advancement in measures to study patterns of segregation in the context of an ethnically diverse society, there are some limitations to our proposed approach. First, we have identified clusters of ethnic groups based on a subjective visual examination. While there may not be much disagreement in the reading of the graph, the development of a systematic technique to delineate boundaries may lend more credibility to the analysis. One potential response to this challenge is to find ethnic groups that fall within specified Euclidean distance buffers or to demarcate congregations of ethnic groups by bounding ranges of values of the segregation statistic. Second, we have not yet determined a single summary statistic for the metropolitan area, impeding comparability with other areas. Remember that for each ethnic group in our data, we obtained 49 segregation values furnishing a total of 1,225 ethnic pairings. Other than through the demonstrated graphical procedure, current analytical tools as well as the human brain have not yet developed the capability of absorbing and synthesizing this information in a way that will facilitate the coherent comparison across cities. This situation can be addressed by deriving a summary statistic such as the mean or median segregation level for each group in the study.

Third, the axes offer no decipherable information with respect to the scale of segregation amongst groups and given the graphs of different cities, an assessment as to the degree of segregation of one particular group from others in different locations would not be feasible although relative positions can be discerned. Fourth, with this approach we do not capture the spatial relationships of areas on the ground. In other words, we miss the geographic patterning of neighborhoods and continue to have what White (1983) referred to as the checkerboard problem. Most of the existing techniques have been criticized as being non-spatial, that segregation statistics do not reflect how neighborhoods are distributed over space (Grannis 2002; White 1986; Wong 1998) and the proposed technique also neglects this dimension as it does not inform us as to the degree of spatial clustering. Fortunately, most of these weaknesses are not intractable and they leave open avenues and opportunities for improvement.

Conclusion

In terms of methodology, this approach offers advancement over current methods in a couple of key ways. First, MDS does not restrict the number of ethnic groups that can be included in the analysis. Analysts are no longer limited to a small number of groups as we demonstrated in our analysis of the 50 largest ethnic groups in Toronto. Without limitations in computational technology and legibility, we could have generated a map of all 100 ethnic groups. In theory, any number of groups can be analyzed with this technique.

Second, the need to choose a reference group is eliminated with this approach offering an advantage over extant methods. While we implemented pairwise segregated statistics, we are no longer limited by our analytical techniques to select one group (or the "all others" group) as a reference. Our methods are now compatible with critiques of theories of integration which have challenged the simplistic view of immigrant adaptation as a dichotomy of integration or segregation (Breton 1964). Integration should be more precisely conceptualized as integration with particular groups, recognizing that in a diverse society, individuals can be integrated with any number of ethnic groups or with none at all. The MDS graph represents one possible manifestation of the adaptation process and we may achieve more comprehensive interpretations through the observation of long-term trends in multi-ethnic residential patterns.

Dichotomies have become disconnected with the social realities that face contemporary post-industrial societies as they fail to adequately represent the range of groups that are spatially and temporally connected. We have shifted from viewing the world in terms of black and white to a world comprised of a spectrum of ethnicities. The context of increasing international migration provides the impetus for methodological innovations that promote congruity between our methods and social life.

We constructed a map of social distance of 50 ethnic groups in Toronto by calculating the entropy (and dissimilarity) index among all pairwise groupings. We summarized this information with multidimensional scaling techniques. We argue that the method proposed in this paper provides a more adequate representation of the ethnic diversity in urban areas and that it is an improvement over current procedures for analyzing ethnic group segregation.

Future work should address some of the limitations and challenges identified above but one of the most important imperatives re-affirmed in this analysis is the need for data collection in surveys and censuses to expand beyond pan-ethnic/racial identifiers and for workable tabulations of ethnic groups. There are now methods to take into account the diversity of ethnic groups in North America and other high immigrant-receiving societies. We do not have to confine ourselves to conventional methods but can be innovative in trying to understand and to capture the nuances of urban life.

Appendix A - List of the 50 largest ethnic groups in the Toronto CMA, 1996 (allocated)

Ethnic group	Population Size
English	514,455
Canadian	465,943
Italian	350,923
Chinese	333,436
Scottish	262,639
Irish	229,902
East Indian	223,530
Portuguese	141,052
German	119,797
Jewish	119,088
Polish	113,774
French	112,329
Jamaican	112,175
Filipino	92,392
Greek	68,760
Ukrainian	60,345
Dutch	49,457
Spanish	41,216
Vietnamese	36,553
Hungarian	29,666
Sri Lankan	29,193
Korean	28,301
West Indian	27,248
Iranian	25,826
Croatian	23,332
Guyanese	21,913
Russian	20,820
Tamil	18,975
Macedonian	18,932
Welsh	18,781
African	18,692
Trinidadian Tobagonian	18,511
British	17,371
Black	17,306
South Asian	17,077
North American Indian	16,233
Pakistani	16,219
Somali	16,216
Japanese	15,785
Punjabi	14,748
Serbian	13,034
Lebanese	13,032
Arab	12,721
Romanian	12,421
Maltese	12,112
American	11,755
Austrian	10,284
Armenian	9,883
Yugoslav	9,841
Egyptian	9,717
Total	3,993,711

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