Visualizing superdiversity and "seeing" urban socio-economic complexity

Steven Vertovec, Dan Hiebert, Paul Spoonley & Alan Gamlen

Published online: 02 Dec 2022.

Submit your article to this journal

Article views: 1853

View related articles

View Crossmark data

Routledge
Taylor & Francis Group

Visualizing superdiversity and "seeing" urban socio-economic complexity

Steven Vertovec [a], Dan Hiebert[b], Paul Spoonley [c] and Alan Gamlen [d]

aMax Planck Institute for the Study of Religious and Ethnic Diversity, Göttingen, Germany; bDepartment of Geography, University of British Colombia, Vancouver, Canada; cCollege of Humanities and Social Sciences, Massey University, Auckland, New Zealand; dSchool of Regulation and Global Governance, The Australian National University, Canberra, Australia

ABSTRACT

Recent migration has made traditional destination cities so diverse that many conventional social science concepts and methods have become inadequate to the task of understanding complex diversity, or what is now often termed superdiversity. Here, we address the need for new methods of "seeing" urban superdiversity in two ways. First, we highlight the need to understand urban contexts by examining new combinations and intersections of multiple social variables. Second, we demonstrate a suite of new interactive tools. We attempt to enable users to picture, perceive and apprehend complex analyses of multidimensional data on urban diversity in new, more intuitive ways. This visualization draws on multivariate geo-spatial data on different kinds of diversity, across three major destination cities: Sydney, Vancouver, and Auckland. We believe this approach contributes to the theoretical and methodological refinements needed to study contemporary superdiversity in urban settings, and to contribute to better public understanding and policies regarding the processes of urban diversification.

Cities have been transformed over the past few decades by immigrants from an expanding array of countries, ethno-linguistic groups, religions, and socio-economic backgrounds, who are motivated by a complex array of reasons and admitted through more legal channels than ever before (see, among others, Engbersen & Snel, 2013; Abel & Sander, 2014; Czaika & de Haas, 2014; IOM, 2015; Bijak & Czaika, 2020). Diversification is continuing to evolve and define those major cities that have served as immigrant destinations since the nineteenth century, as older patchworks of immigrant enclaves are reshaped and superseded in the twenty-first century by newer and ever more complex combinations and permutations of different types of diversity. Immigration has made immigrant destination cities so diverse, in so many different ways, that

many existing social science conceptual and analytical tools can no longer capture the nuances of what is happening in urban neighborhoods.

The need for new conceptual models and methodological tools to capture and account for the new urban diversity is indicated by the extensive and rapid growth of studies concerning "superdiversity" (Vertovec, 2007) – a concept that denotes the multidimensional character of current-day diversity. While the superdiversity concept has been variously invoked and critiqued (see Creese & Blackledge, 2018; Vertovec, 2019; Meissner et al., in press), many scholars find the concept useful because, similarly to the concept of intersectionality (Khazaei, 2018), it emphasizes the need to look beyond ethnicity as a primary or sole marker and determinant of migrant trajectories of settlement, integration and social mobility (Piekut et al., 2012). In a condensed way, the concept of superdiversity seeks to emphasize the complex nature of these trajectories and their outcomes (Crul, 2016). For example, it acknowledges that new configurations of recent migrants tend to inhabit those urban spaces that still host previous waves and generations of migrants and their descendants – in many cases alongside Indigenous Peoples (Meissner et al., 2015).[1] Despite the considerable interest in superdiversity from academics, policy-makers and NGO practitioners (e.g. Phillimore et al., 2020), such combinations of "old" and "new" diversities remain sorely under-researched by social scientists and under-addressed by policymakers (Vertovec, 2015) – in part, because such complexity is literally difficult to visualize.

In this article, we argue that visualizing urban superdiversity is important in in two ways. First, because social, cultural and economic characteristics are rapidly having compound effects in urban areas inhabited by old and new diversities, we highlight the need to understand urban contexts by *examining new combinations and intersections of multiple variables* – including those variables that are neglected or entirely new. Second, because such multivariate explorations require better ways of "complex thinking" (cf. Walby, 2021), we advocate *developing innovative data visualization tools* that are equipped to handle analyses of multivariate data on urban diversity, while enabling a wider range of audiences to picture and apprehend abstract information about different combinations of social variables in more intuitive ways. In sum, we argue that studies by urban geographers and migration researchers would benefit from reconceptualizing diversity in multidimensional ways, and developing compelling new ways of "seeing" this multidimensional superdiversity in the available data. This, we believe, can help to advance the methods and theories needed to study the unprecedented diversification occurring in contemporary cities, and to underpin more effective policies and more comprehensive public understanding of urban superdiversity.

To be clear, though, we believe that while our approach represents an important step forward in visualizing and understanding contemporary diversity, we do not claim it to be a panacea. Data, including the information collected by governments, both simplifies social reality and is predicated on the perceived need to govern and control. In using these data, we inevitably incorporate the limitations inherent in their collection, such as the assignment of individuals to ethnic or religious categories based on their answers to a survey instrument, or the assumption that individuals spending, say, 40 percent of their income on housing are facing equal financial pressure. Data and maps, of course, emphasize certain phenomena and ignore others, and while they have been used to enlighten people they also subjugate and oppress populations. Further,

our tools emphasize *visual* representations of data and cannot capture the sounds, smells, and sense of human life and interaction in cities.[2] These are very real limitations and concerns, but we argue that our approach represents a useful addition in representing and comprehending data, given these limitations.

Social geographies of difference in the study of cities

Social scientists have been interested in urban diversity for more than a century and this topic has been enmeshed with the development of sociology and geography as disciplines. Georg Simmel wrote about "the stranger," for example, in 1908 and some of his ideas were embraced by Robert Park and the Chicago School of urban sociology, which had an enormous impact on twentieth century understandings of the city. Their arguments about residential segregation – together with their over-simplified maps of the socio-cultural spaces of Chicago, with concentric parts of the city designated as "ghetto", "Deutschland", "Chinatown" and "Little Sicily" – became iconic. This work set in motion several abiding assumptions about the supposedly natural and proper incorporation of immigrants, and the resulting residential order of the city: that ethnic groups are coherent "communities" sharing a range of socio-cultural and economic traits; that these communities occupy relatively homogenous spaces as "immigrant colonies" (Burgess, 1925, p. 56); that residential location is a proxy for socio-economic status; and that assimilation is an inevitable, even natural, process.

Twentieth-century urban studies is therefore characterized by maps of cities that reflect what we call "ghetto thinking": the idea that the segregation of bounded and coherent minority groups is an inherent urban condition that is deeply and pervasively intertwined with the "problem" of socio-economic deprivation (Wirth, 1928; Peach, 2003, 2009; Collins, 2012). Early efforts to generate statistical indices of segregation and economic marginalization were products of this approach.

This scholarly consensus was both reinforced and challenged by the quantitative revolution that brought digital analysis into urban studies during the 1960s. At the time, it was considered revolutionary that researchers could acquire comprehensive data and feed this information into mainframe computers to generate maps and statistics; this was heralded as a new field of study and dubbed "spatial science" (Billinge et al., 1984). This era also saw the application of multivariate statistics to urban analysis and the development of the factorial ecology model, which involved subjecting a large matrix of socio-economic data to factor-analytic approaches in an effort to discern the underlying structure of urban social geography (Berry, 1971). Typically, within the factorial ecology model, complex data were distilled into three core factors that were believed to shape the residential order: ethnic difference; socio-economic inequality; and family life cycle. Although later authors in this tradition acknowledged that the three-factor model was insufficient, these techniques produced more nuanced models of cities than was previously possible; nonetheless, their problematic overall goal was to "cut through" complexity and to simplify it (Davies & Murdie, 1993).

Subsequently, the Chicago School and quantitative models of urban geography were panned by various humanist, neo-Marxist, feminist, and post-colonial scholars (Plummer, 1997). During the late twentieth century, urban geography and sociology favored critical approaches stressing the nature and forms of urban inequality;

meanwhile, methods drifted from the quantitative to the qualitative. Post-modern urban theorists pointed to the breakdown of the homogenous, concentric functional zones modelled by Burgess and others, and highlighted the emergence of more chaotic, multi-nodal urban structures (Ellin, 1996; Dear & Flusty, 1998). Significantly, all this occurred as the social geography of immigrant-destination cities was being profoundly transformed by new and more complex global migration flows (Castles et al., 2013), and by gentrification (see Lees et al., 2013), often under the influence of neo-liberal policies (Pinson and Journel, 2016). Together, these developments displaced whatever salience the Chicago School model of inner-city ghettos and assimilated suburbs might have had – though perhaps more fully in scholarly circles than in the public imagination.

However, the late twentieth and early twenty-first centuries have also seen the re-emergence of efforts to offer new insights about urban diversity. One key intervention has been the concept of intersectionality, developed from within Black feminist scholarship to emphasize the mutually constitutive nature of social categories, particularly race, class, and gender (see Hill Collins & Bilge, 2016). Leslie McCall (2005, p. 1772), for example, has called for extending the insights of intersectionality approaches to "the complexity that arises when the subject of analysis expands to include multiple dimensions of social life and categories of analysis." Our interests in superdiversity are grounded in the same mode of understanding: it is important to recognize the combined effects of multiple variables in producing socio-economic outcomes. Further, we share McCall's (2001) concerns about the need for better methods and theories regarding how new complexities, and new combinations of social variables, create and (re)produce forms of multi-layered inequalities.

The term superdiversity, coined by Vertovec (2007), refers to the increasingly multidimensional effects of contemporary diversity. Rather than fixating on differences of nationality and ethnicity when analysing diversity, it draws attention to variations in "language, and religion as well as the motives, patterns and itineraries of migration, and the processes of insertion into the labour and housing markets of destination cities" (Blommaert & Rampton, 2011, p. 1). Scholars who work with the concept are thus interested in disaggregating the black boxes of conventional social categories, positing "complexity" as the new baseline for social analysis (Meissner et al., 2015). Whereas – following a Chicago School perspective – places once deemed "multicultural" were perceived as containing large spatial concentrations of nominally homogenous and minority ethno-religious groups, places considered superdiverse are recognized as containing multidimensional kaleidoscopes of smaller groupings, in which new and old forms of diversity interact to form new configurations and categories of social difference along with new challenges for service providers (Vertovec, 2015; Phillimore, 2010; Berg et al., 2019).

Crucially, the different phases in the understanding of cities that we have just outlined are each associated with different ways of "seeing" urban life. The Chicago School, and the decades of research it inspired, saw inner cities as patchwork quilts of areas each dominated by particular, often immigrant, groups – all of which were in the process of ultimately achieving cultural assimilation and economic affluence, so that they eventually moved "upward and outward" to leafy suburbs that exemplified the "American dream". Cities were not only widely understood in this way but also designed accordingly (e.g. through zoning regulations which stipulated building densities). Quantitative models of the 1960s and 1970s encouraged a view of urban complexity as superficial

"noise", distracting scholars and others from the impacts of diversification. Cities, and their neighbourhoods, were seen as variations on a limited number of themes. Rather than acknowledging and grasping the complexity of urban contexts, the views of urban planners "seemed to be premised on (and … sought to impose) a homogeneity across the diverse urban field" (Fincher & Iveson, 2008, p. 2).

Conversely, intersectionality and superdiversity encourage us to see urban complexity as just that: *complexity*. We underscore complexity by drawing on several key notions in complexity theory in both natural and social sciences and specifically: complexity as characterized by phenomena such as an increase in the number of variables or agents in a system; an increase in the differentiation of characteristics; an increase in interdependencies among agents and variables; and the highly contingent, unpredictable and non-linear emergence of new systems and effects (cf. Jörg, 2011; Portugali et al., 2012; Byrne & Callaghan, 2013). Various forms of stratification are present because of factors associated with age, class relations, patriarchy, racialization, heteronormativity, and legal differentiation – but none of these is the single ordering principle of urban life. Rather, urban society is the product of all these forces – and more – operating simultaneously and interactively, with this complexity amplified by the arrival of migrants from diverse source countries and regions, via varied legal or extra-legal pathways.

To fully grasp the nature of superdiversity, we need new ways of unpacking conventional social science categories and new ways of seeing complex and evolving interactions among multiple forms of social difference. To address this challenge, at least in part, our central aim in this paper is to demonstrate a new suite of interactive data visualization tools that enable users to conduct intersectional analyses of multidimensional urban datasets. Our demonstration draws on innovatively compiled new datasets on the populations of three major immigrant-destination cities: Sydney, Vancouver, and Auckland. These tools adapt and update some established quantitative methods for analysing diversity, guided by new and more nuanced conceptual understandings of intersectionality and superdiversity. In doing so, we aim to contribute to a new methodological and analytical approach to exploring the nature and significance of urban superdiversity.

Visualizing superdiversity on various scales

The methodological field of multidimensional data visualization has mushroomed over the last quarter century. During the 1990s, greatly decreasing data storage costs and exponentially increasing network bandwidth were already enabling the construction of enormous, fine-grained multidimensional datasets in many companies and government agencies. However, until the early 2000s, the tools and technologies for reporting, analyzing, distributing, and making decisions based on these data were rudimentary (Eick, 2000, p. 61). A number of popular visualization methods did enable the presentation of two or three variables (dimensions) at the same time; standard techniques included "*x-y* (-z) plots, line graphs, bar and column charts, area, staked bar and column graphs, histograms, pie charts, doughnut charts, box plots, radar graphs [and] Pareto graphs" (Marghescu, 2007a). But due to the dearth of tools for effectively displaying more than three variables simultaneously, much of the new and bigger data remained in raw relational tables that required extensive training to access, manipulate and report. Over the past 15 years, however, the tools and techniques of multidimensional

data visualization have expanded and improved significantly, driven both by the need to analyze new "big data" produced by the contemporaneous worldwide expansion of hand-held internet devices, social media, and processes such as algorithmic financial trading. By the end of the 2000s, financial and other big-data researchers had added a range of 4 + dimensional data visualization methods to their analytical toolkits, such as multiple line graphs, permutation matrices, survey plots, scatterplot matrices, parallel coordinates, treemaps, Sammon mapping, self-organizing maps, star-glyphs, and dendrograms (see reviews by Marghescu, 2007a, 2007b). As the range of users demanding insights from big data has expanded over the past decade from fields as wide-spread as healthcare analytics, energy provision, entertainment, accounting, paralegal and marketing, the fields of data science and immersive data visualization have become more dynamic and a firmly entrenched area of research at major research institutions around the world (Pezanowski et al, 2022; Bergmann & Lally, 2021; Fernandez et al., 2021).

Across a number of social science disciplines, a growing literature demonstrates the power of the new class of multi-dimensional data visualization techniques for conducting analyses of social difference (see, for instance, Dorling, 2012; Jung & Anderson, 2017; Healy, 2019). However, it is surprising how seldom such analytical approaches have been applied to the study of intersectionality and superdiversity, even though these concepts explicitly call for multivariate analyses of social difference. Below, we address this research gap, presenting a variety of data visualizations that allow the viewer to "see" superdiversity by way of different combinations of variables and their significance. We hope that by bringing together concepts, data, and techniques of visualization, we can encourage a re-imagination of the complexity of contemporary cities. The visualizations depicted and described below can be accessed on a special website, where interactive elements can be found for each of the three cities and their respective data (https://superdiv.mmg.mpg.de/). On this website, the viewer can choose a range of variables, time periods and views, and can also explore comparative aspects of superdiversity across the cities.

Our argument is that (1) many cities are becoming superdiverse, (2) superdiversity is a multi-dimensional concept and (3) contemporary data visualization approaches can help us to perceive, picture and apprehend its multiple dimensions. The contribution of this article is therefore methodological and analytical rather than empirical: we do examine some specific multidimensional datasets on urban superdiversity, but we do so in order to demonstrate the potential of these new interactive data visualization tools rather than to present any specific new empirical findings from these data. Details on the data sources, definitions of terms, statistical techniques, decision-making processes and other aspects surrounding the creation of the superdiversity data visualizations can be found in a technical paper (Hiebert, 2019).[3]

The cities we use to demonstrate our tools – Sydney, Vancouver, and Auckland – share several similarities and differences that make them excellent candidates for exploring new methods in urban superdiversity studies. They do not by any means represent the epitome or the entirety of urban diversity. There is much research on cities outside the so-called Angloworld, but we do not talk about them because we do not live in them do not have anything to add directly to the excellent work being done there. Instead, we write about the cities which we live in and know a lot about and which we think are important for a range of reasons. For example, the three cities share similar colonial and settler origins, and have all transitioned through the late

twentieth century to become key migrant destinations and gateway cities within a globalized migration system (Freestone et al., 2006; Gilbertson & Meares, 2013; Good, 2009; Spoonley & Bedford, 2001). This has led to profound change whereby local historical industrial and urban landscapes have been transformed, especially those situated near the metropolitan cores. Gentrification has proceeded apace in centrally located neighbourhoods and new, highly diverse, migrant settlement has suburbanized, leading to highly complex patterns of diversity across and within cities along with significant, and largely unprecedented, planning challenges (Burnley & Hiebert, 2001; Gurstein & Hutton, 2019). Also, while the profile of migrant groups varies between the cities, in all cases, there are complex relationships between migrant status, a variety of intersecting variables, and inequality.

In the sections below, we selectively report data and visualizations from these cities in order to exemplify specific features of the visualization tools, and offer specific multivariate relationships that allow us to see, and to illustrate, how these analyses can support more nuanced understandings of the nature and significance of urban superdiversity. We provide a range of different visualization tools, from conventional displays such as line charts, treemaps, and Sankey diagrams with interactive components, to innovative "dials" for interacting with intersectional data, to immersive multidimensional maps that we consider prototypes for more advanced geostatistical tools. The idea is that different user groups with different levels of expertise and different purposes (from exploration and analysis to communication) will find different tools useful.

Data visualization tool #1: origin country and migration category

The point of our data visualization tools is to help audiences understand the presence and outcomes of intersections of different types of social difference in cities. Our first visualization tool does this by contextualizing national-level migration data on a modified stacked area chart. Here, the x-axis shows the year of arrival, and the y-axis shows immigrant numbers per year, by admission category. However, where a simple stacked area chart displays only these two variables, our visualization tool allows users to also disaggregate the data by region and country of immigrant origin. The user does this by clicking the stacked chart on their screen to select a given stream-year (e.g. economic migration in 1996 or humanitarian migration in 2001), which generates and displays a treemap of the same data (Shneiderman & Wattenberg, 2001, P. 1). In this way, users of our site can simultaneously picture and apprehend four key variables: origin country, origin region, visa category, and arrival year.

Multivariate analyses using this data visualization tool can reveal a range of important patterns. For example, Figure 1 is a screenshot showing how this data visualization tool can be used to explore permanent immigration to Canada over time. It shows how permanent immigration has grown, especially in the last decade, and has come from a growing number of different source countries and regions. (Though not shown here, the tool reveals the same pattern in all three countries). The method can also reveal changing relationships among the places where immigrants originate from on one hand, and the visa categories on which they enter a country on the other – thus revealing how different admission categories (humanitarian, family, etc.) draw immigrants from different places at different points in time. For example, the humanitarian treemaps in
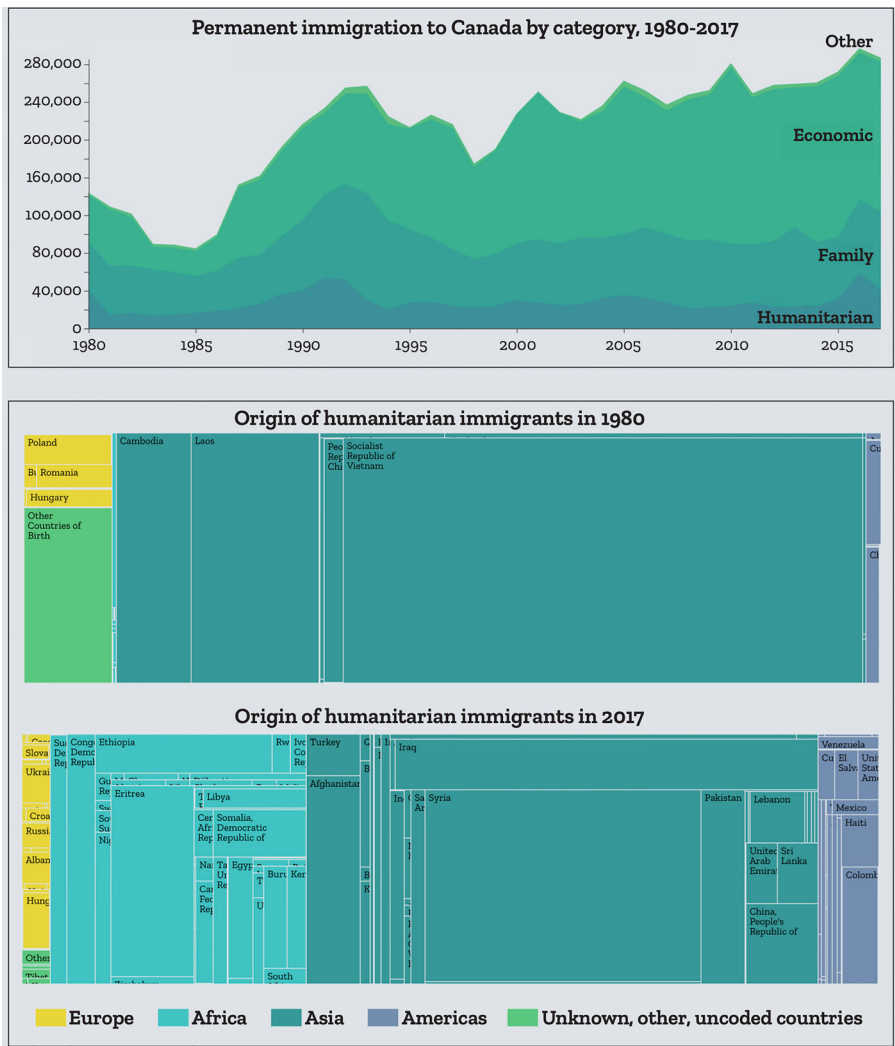
Figure 1. Permanent immigration to Canada 1980–2017 and Countries of origin for immigrants to Canada, "Humanitarian" category, 1980 and 2017.

Figure 1 show how the flow of refugees and other humanitarian immigrants to Canada was dominated by people escaping Cold War conflicts such as Vietnam in the 1980s but, over time, other conflicts and places became important sources, notably those in sub-Saharan Africa and the Middle East. By displaying four key variables on the same chart (origin country, origin region, visa category, and arrival year), the tools let viewers picture and apprehend how the changing flow volumes through different migration corridors between places, and different immigration channels defined by visa category, have shaped elements of superdiversity in each city.

Data visualization tool #2: ethnicity and religion

Our modified stacked chart is useful for visualizing the changing size of simple categorical data over time, but less apt for visualizing more complex categorical social data. Our next superdiversity visualization addresses this problem using a modified "Sankey diagram" of diversity at the metropolitan scale (Figure 2). Named after the Irish engineer, Matthew H.R Sankey, who originally used it to map power flows in steam engines, such diagrams are often used to show the interaction between two highly complex variables (Schmidt, 2008). Figure 2 shows the intersection between two kinds of highly complex diversity: ethnicity and religion, both of which break down into very large numbers of distinct categories.[4] Both are also "nested" variables: "Lutherans" are nested in the category of "Protestant Christians"; Germans are nested in the larger group of "Europeans". This nesting is shown on the left and right sides of the graphic. The specific relationship between the most basic ethnic and religious categories is shown in the middle column, with lines connecting specific ethnic and religious categories. These lines are proportional in width to the number of people included in each ethnicity/religion intersection (say, German Lutherans). They are also shaded so that the line begins with the colour on the opposite side of the diagram to enable viewers to quickly see the composition of a group (e.g. those identifying as "Australians" are mainly affiliated with "Christianity" (purple) or "No religion" (yellow)). If the relationship between ethnicity and religious affiliation was simple, this part of the diagram would be dominated by single, non-intersecting lines – for example, between Swedes or Germans and the Lutheran faith, Italians and Catholicism, or between Indians and Hinduism.

What the Sankey diagram reveals is that the social worlds of these cities are anything but simple. For example, in the Sydney chart shown in Figure 2, there are 6,433 lines,
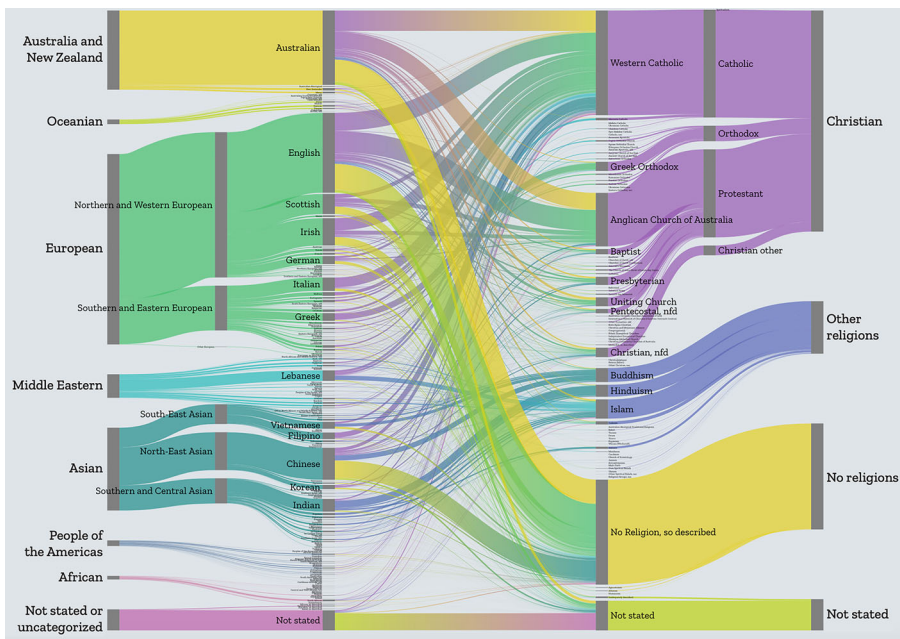

Figure 2. Linkage of ethnic and religious identities in Sydney, 2016.

each representing a distinct pairing of ethnicity and religion. We see familiar associations (e.g. Indians and Hinduism, Greeks and Orthodox Christianity), but also a myriad of finer details that, upon close examination on the website, reveal unexpected combinations, an example being those individuals who choose to portray themselves as Jewish when asked about their ethnicity, and Muslims when answering the census question on their religious identification.[5]

Such analyses allow us to better comprehend one of the central conceptual points about superdiversity, which is that it involves increasing diversity *within* conventional categories of social difference. The members of nearly every ethnic group follow a mixture of religions, just as nearly every religion has adherents from many ethnic backgrounds. Muslims in Sydney, for example, indicate 228 ethnic or ancestral origins, including many Middle Eastern groups but also dozens that might surprise many, such as Irish and Brazilian. There are also 150 ethnicities associated with Buddhism, 194 with the Pentecostal faith, and 145 associated with Greek-Orthodox Christianity. Switching perspective, Australians of English ancestry are fragmented into 124 religious affiliations (including non-believers). Significantly, Arab-Australians subscribe to 41 different faiths and Australians who identified as Māori indicated 54 religious affiliations. Australia's growing religious diversity has been highlighted before (e.g. Bouma, 2012: 2016; Bouma & Hughes, 2014; Bouma et al., 2022) but never visualized in such kaleidoscopic detail. As mentioned previously, this intra-category complexity not only has implications for the labels we use in social research, but also for social policy and practice, in which individuals have heretofore often been selected to "represent" the interests of a purportedly homogenous "community" (see Phillimore et al., 2020). In line with the more abstract descriptions of the previous superdiversity literature, what our visual analyses suggest is not just that the number of communities in cities has increased through successive waves of immigration, but that we need to fundamentally rethink the categories of social analysis that we use to classify and measure social difference and solidarity in twenty-first Century cities.

Data visualization tool #3: income diversity and ethnic diversity

Sankey diagrams can cope with two variables, but superdiversity involves multiple variables such as arrival time, admission category, residential mobility, educational achievement, and income level. Moreover, Sankey diagrams cannot reveal the spatial distribution of diversity in cities. We have therefore developed two further superdiversity data visualization tools which process Census data collected at the fine-grained scale of lived spaces in cities, thereby providing insights into the social composition of neighbourhoods.[6]

Our tools are deliberately innovative and to some extent experimental, and their visual outputs (shown in Figures 3 and 4) are unconventional. Traditional maps of urban diversity typically show the location of ethnic or income groups, using colour ramps that pull the eye toward areas where specific groups are concentrated, giving the impression that the city is made up of a patchwork of relatively discrete social areas with each group occupying a distinct space – a way of seeing that reflects what we referred to at the outset of this paper as outdated "ghetto thinking". To address this traditional cartographic limitation, we took an alternative approach: instead of mapping different types of social group, we created a new geospatial tool for mapping *different types of diversity*. Our maps
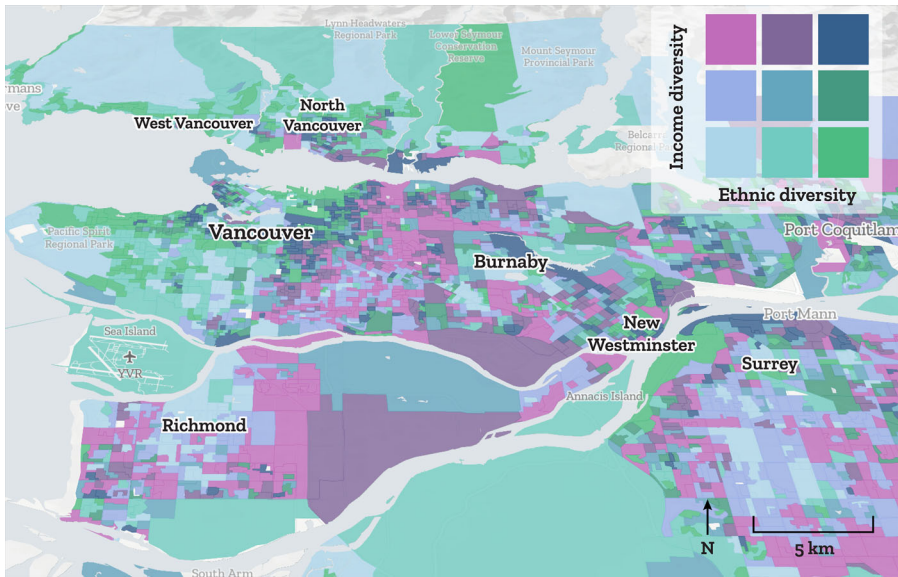
Figure 3. Ethnic and income diversity in metropolitan Vancouver, 2016.

contrast areas of social simplicity (low diversity) with areas of social complexity (high diversity), highlighting where people from many different backgrounds mix. We envision *superdiverse* places as those containing many different types of diversity, where everyday encounters routinely involve multiple forms of social difference, and where residents at least have the potential to engage with newcomers on a regular basis.[7]

We focus on several key types of diversity: Ethnic Diversity, Income Diversity, Educational Diversity, Generational Diversity, Admission-category Diversity, and Degree of Mobility. We calculated an index for different types of diversity, giving each city neighbourhood a score for each type of diversity. To simplify the user learning curve with these "multi-dimensional" maps, we developed two visualization tools: one designed to reveal complexity through a relatively simple approach based on traditional cartographic methods (Tool #3, shown in Figure 3); and the other deploying a more complex and interactive set of options which will appeal to readers comfortable with the use of multivariate statistics (Tool #4, shown in Figure 4).

The simpler tool (Tool #3) is shown in Figure 3: a bivariate choropleth map of Vancouver showing the degree of ethnic and income diversity simultaneously. A bivariate choropleth map is a traditional cartographic technique that shows two different characteristics of the same geographical area simultaneously. Figure 3 does this by using two color scales. The pink scale shows ethnic diversity while the green scale shows income diversity. In this scheme, pink + green = blue: that is, blue neighbourhoods have high degrees of both ethnic and income diversity. The central business district, just north of the "Vancouver" label, is light colored, indicating that the population living in the CBD is comparatively homogeneous in terms of ethnic origin and income – in keeping with an area dominated by loft conversions and recently-built condominium towers that appeal to a quite specific and narrow demographic. However, inner-city neighbourhoods surrounding the CBD contain either people from different ethnic
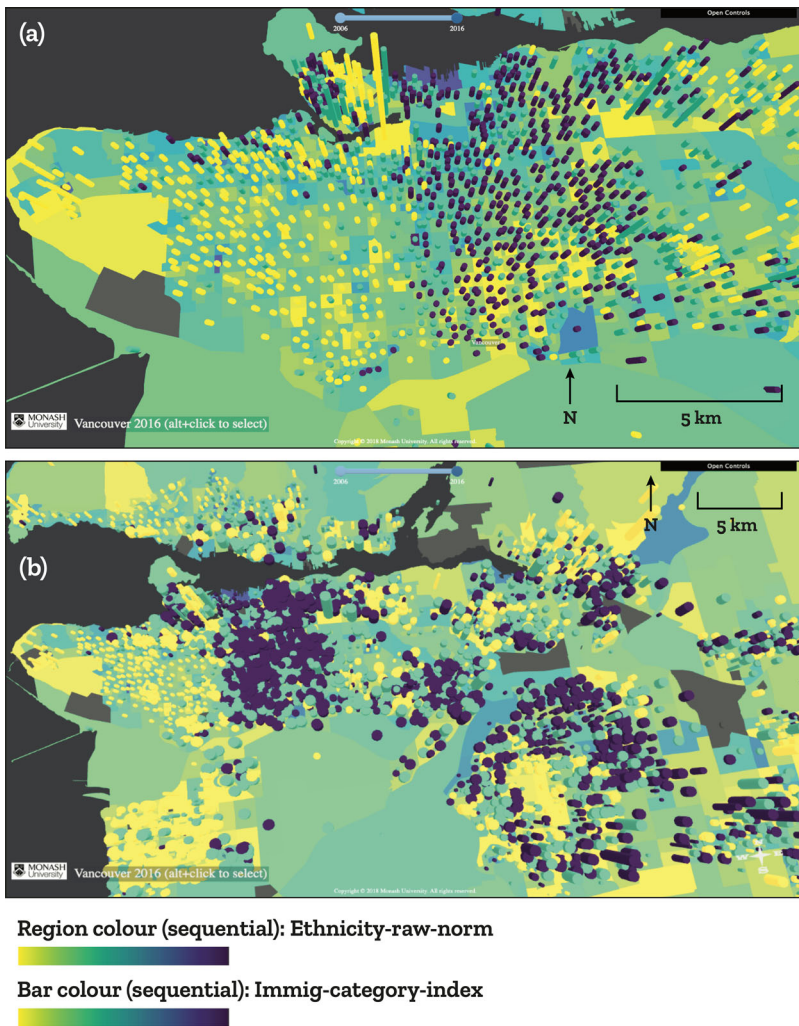
Region colour (sequential): Ethnicity-raw-norm

Bar colour (sequential): Immig-category-index

Figure 4. Inner Vancouver, population size, ethnic diversity, and admission category diversity, 2016 and Wider Metropolitan Vancouver, population size, ethnic diversity, admission category diversity, and income diversity, 2016.

backgrounds but similar income levels (pink), or from both diverse ethnic and diverse income groups (blue). In other words, people likely encounter socio-economic difference in these areas on a regular basis – a finding which naturally raises questions for migration and diversity researchers about whether such encounters lead to mutual respect (Valentine, 2008). Further out from the urban core, the map shows patches of pink (indicating high ethnic diversity coupled with low levels of income diversity), and patches of green (indicating high income diversity coupled with low ethnic diversity) – moving us to ask how and why specific types and configurations of diversity gravitate towards specific locations. Thus, the key benefits of the visual analyses facilitated by our new tools is to suggest new and important questions for further research.

Data visualization tool #4: diversity of income, ethnicity, and admission-category

Our maps reveal an urban landscape of many different types of diversity and their myriad combinations, inviting viewers to pay attention to more complex juxtapositions and layers of difference and belonging. Rather than stopping at two kinds of social difference, our more complex maps show many different types of diversity simultaneously. Each different diversity index is displayed as a map color or as a superimposed column that may vary in color, opacity, height, and width. These graphics are hard to display on a printed page; they work better on screen, and best through virtual reality goggles or in an immersive visualization Cave (Cruz-Neira et al., 1992). But as with our other visualizations, the core aim of the tool is to enable viewers – in this case viewers with some level of expertise – to see urban superdiversity in complex, multivariate data.

Figure 4 is an illustration of how this tool can be used to picture, perceive, and apprehend the intersection of many different types of diversity. The top of the figure zooms in on ethnic diversity (depicted by map background color, from low-yellow to high-purple) in central metropolitan Vancouver. Population size has been added to the graphic, indicated by the height of a column atop each neighborhood, as well as an index of admission category diversity (depicted by column color). That is, most of the immigrants living in areas with yellow columns were admitted to Canada through a single category, while areas with purple columns have received immigrants from multiple categories where, for example, refugees and economic immigrants mix with those who came to Canada through family reunification provisions or other means. A clear east/west divide appears. In the affluent west, most immigrants were admitted through economic channels, particularly as skilled workers, entrepreneurs, or investors. In the east, a greater proportion of immigrants came as family or humanitarian entrants. Interestingly, many ethnically diverse neighbourhoods (purple backgrounds) have low admission category diversity (yellow columns), suggesting a complex relationship between ethnic diversity and legal status that, once again, invites further research (e.g. Meissner et al., 2017).

The complexity becomes visually overwhelming in the lower part of Figure 4, which zooms out to the wider metropolitan region, while adding yet another dimension: income diversity, shown by wider columns. Now, differing levels of ethnic, category and income diversity are splashed haphazardly across all metropolitan areas. Almost no neighbourhoods have narrow, yellow bars on yellow backgrounds, which would indicate inhabitants with similar ethnic, admission category and income backgrounds. Much more common are neighbourhoods with wide purple bars on purple backgrounds, indicating the presence of ethnic, admission and income diversity all at once. The only obviously discernable pattern is one of complex diversity, though additional research might identify important, previously unexplored factors.

These maps generate many questions that deserve more research, for example, concerning the relationship between diversity and affluence, between diversity and transportation accessibility, and between diversity and "urbanity" in major twenty-first century cities. Gone entirely are the traditionally expected concentric zones, and even the simple east/west pattern of immigration category diversity breaks down at this scale. What emerges is a chaotic, multi-nodal layout of social complexity (see Piekut et al., 2012).

Data visualization tool #5: multiple characteristics by multiple outcomes

Our maps operate at the scale of urban neighbourhoods, but an important point about superdiversity is that individuals simultaneously fall into multiple social categories, specific intersections of which may have significance to social life in each city. The next visualization, Figure 5, therefore enables users to explore superdiversity and intersectionality at the level of the individual person, studying the interaction of ethnicity, immigration arrival, age, and gender with five or six socio-economic characteristics. This set of "dashboard" visualizations enables viewers to consider the socio-economic outcomes associated with an imaginary individual, once they select that person's age, gender, ethnicity, and immigration history (again, on our website, the viewer can interact with the visualization tools to do this).

Once these controls are set, the visualization shows the statistical likelihoods that the person will: have a university education; be employed; speak English (or, for Vancouver, French) at home; have at least a modest income (i.e. not be experiencing low income); live in affordable housing; and own a home. For each of these variables, a dial indicates their propensity to have the attribute in question relative to that of the entire working-age population, which is set to the top of the dial. Therefore, the indicator would be to the left of the dial for employment, for example, if the selected individual is less likely than average to be employed, and to the right if they are more likely to be employed.
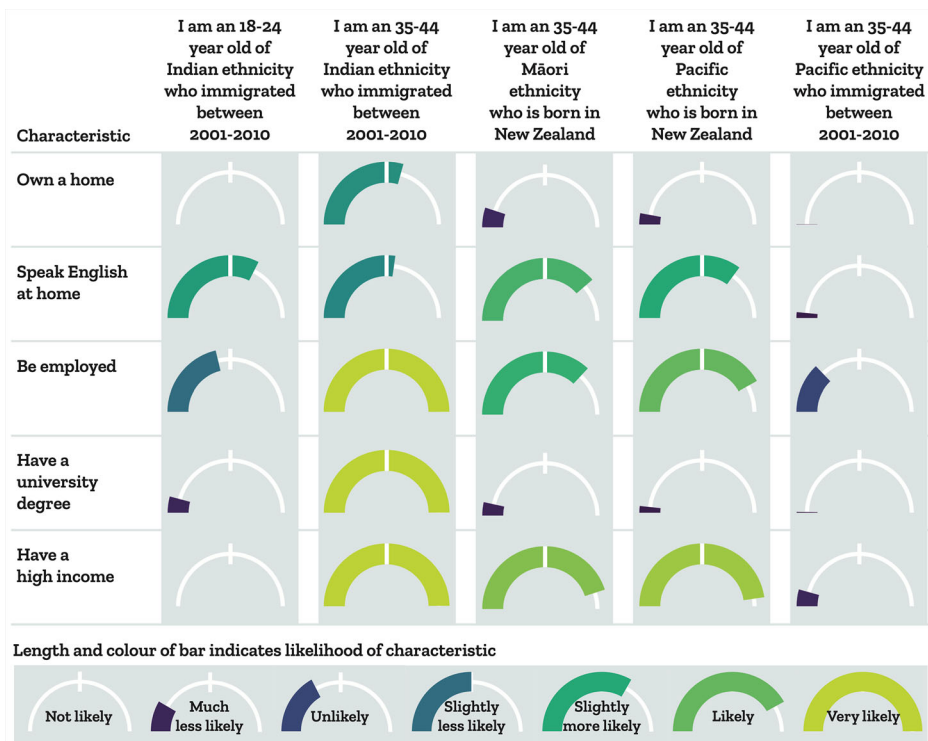

Figure 5. Characteristics of selected Auckland residents, 2013.

These kinds of data have been analysed, and presented by researchers for decades, either in tabular form or via regression models. However, relatively few people have the capacity to absorb information from highly detailed tables and fewer still understand econometric interpretations of data. We argue that audiences, by interacting with data and seeing outcomes change with each different combination of selection variable categories, will instantly gain a deeper appreciation of both the complexity of society and the degree of contingency of socio-economic outcomes. The power of this visualization can be seen by maintaining as many choices constant as possible and just changing one or two elements at a time.

We turn to Auckland to illustrate how the dashboard visualization can be used to compare the characteristics and outcomes for both migrants and the locally born, and how this process underscores the importance of both intra-ethnic and as well as inter-ethnic differences and dynamics. We focus on one aspect here for the case of Auckland: migrants and their descendants versus the Indigenous Māori. To demonstrate the point that immigrants themselves typically experience a socio-economic trajectory as they settle and come to terms with the host society, we compare one immigrant group, Indians, at two different age points. The first concerns those Indians 18–24 years of age, who might be undertaking post-secondary education or have entered the workforce (the left-most panel of Figure 5). The second concerns those Indians who are older (35-44), and clearly shows the high number in this cohort who have now obtained a university degree, and the fact that many earn a high income (the second panel of Figure 5). These Indian migrants were likely admitted under the Skilled Migrant [Visa] Category and the favorable economic results can be seen in post-arrival socio-economic outcomes. Nevertheless, despite this upward mobility, the homeownership rate for this cohort is only slightly above average, perhaps not so surprising given that the cost of housing in Auckland is so high (Auckland Council, 2018).

A very different set of outcomes is apparent if the comparison is made with the Indigenous Māori population (middle panel, Figure 5). Māori from the same age group (35-44 years old) are much less likely than the Indian migrants to have a degree, to be employed or to own a home. In settler cities like the three we focus on, this dimension of migrant socio-economic mobility, when compared with apparently fewer opportunities for Indigenous Peoples, is a sensitive and challenging concern. To pursue this further, we compare migrant and New Zealand-born Pasifika communities (these include migrants and their descendants who originate in a range of Pacific states such as Samoa, Tonga, Fiji, Cook Islands, Tokelau, and Niue), again concentrating on the same age group. The final two panels of Figure 5 provide dashboard stories for Pasifika peoples who have been born in New Zealand and for Pasifika who are immigrants to New Zealand.

The socio-economic indicators for Māori and New-Zealand-born individuals who identify as Pasifika are roughly similar but differ sharply from other groups. Both, as noted, are less affluent than their India-born counterparts in the same age cohort. But on all five indicators the situation is particularly bleak for relatively new immigrants who identify as Pasifika in origin. This reinforces the point that there are some immigrant communities, or parts of those communities, that experience socio-economic poverty, labor or housing market deprivation and disengagement, and educational outcomes

that are similar to those of a marginalized and impoverished Indigenous community. Why?

This is a modest interrogation of the material that is available for Auckland, but it highlights the sharply differing stories of migration, diversity and diversification, both in relation to ethnicity/indigeneity and the intersection of ethnic diversity with a range of socio-economic factors. There are multiple ways of exploring and "seeing" these stories of diversity but there are two elements that deserve to be emphasized: one is the complexity that results from the intersection of ethnicity with other forms of diversity (particularly socio-economic profiles), both between groups and *within* groups. And the other is the layering of migration as recent groups join those from earlier migrations while, as settler cities, all three are host to Indigenous populations. The nuances of these complex intersections and configurations of social variables are difficult to convey using conventional social science methods such as bivariate tabulation, static charts, and abstract statistical models. By contrast, the contribution of our dashboard and other visualizations is to enable viewers to picture, perceive and apprehend complex, multivariate, intersectional social information.

We also note that in numerous public presentations of the dashboard tool, participants have been struck by the technique of holding everything but one variable constant and cycling through the categories of the variable of interest. For example, in Vancouver, for individuals aged 25–34 who were born in Canada to immigrant parents, the ratio of those with a completed university degree varies widely between groups, with the corresponding dial at a low position on the left side for those identifying as Black or Latin American, and at the opposite extreme for those identifying as Korean, Indian, or Chinese. For those who are already engaged in these issues, the visualization confirms what they know and can be used to illustrate their requests for additional resources; for those just exploring these issues for the first time, the results are often registered as shocking.

Conclusion

In this paper we seek to add our voice to those of others working in the innovative field of multidimensional urban data visualization, by developing new tools and applying existing ones to the topic of urban superdiversity. Our paper does not advance the idea that current-day diversity is unprecedented and everywhere. Instead, we note that more and more people are becoming interested in superdiversity as a concept, and that empirical work needs to catch up with theoretical speculation. To address this, the paper introduces a set of new visual analytic tools designed to test whether superdiversification is actually happening in specific places. Our tools show how four specific cities of interest are getting more superdiverse, and we suggest that similar tools may be useful for exploring whether similar trends are happening in other cities.

This paper is not intended as an empirical contribution to the study of migrant-driven diversity in Sydney, Vancouver, and Auckland. Instead, the contribution is methodological and analytical: it demonstrates a suite of five new data visualization tools developed by the authors to enable various users to comprehend multidimensional urban superdiversity in innovative ways. As we noted at the outset of this article, earlier approaches to the geography of cities explained the city in terms of discrete ethnic minority socio-spatial

zones and assumed an inevitable endpoint of "assimilation". While these perspectives have been criticized for half a century and have been shown to be outmoded, they nevertheless continue to influence scholarly thinking about diversity in urban settings, characterized by a view of ethnicity as a primary determining characteristic, ethnic groups as relatively homogeneous "communities", and enclaves as monopolized by particular groups. Academics may have come to eschew the ideas of the Chicago School, but many still think of "Chinatowns" or "Little Italy's" in ways that are often not far removed from those original caricatures. Many still tend to "see" the city as a patchwork of neighbourhoods defined by their ethnicity.

We offer an alternative to much of the earlier work on urban complexity and the underpinning assumptions by stressing the need to re-conceptualize the nature of the contemporary immigrant-destination city and by providing a means of understanding the resulting configurations of complexity. It is not enough to focus just on the ethnicity of those involved as agents. Intersectionality requires that there be a recognition of age, gender, legal status, religion, and class as an important step in acknowledging categorical diversity that, in turn, highlights the need for much deeper intersectional analysis that recognizes and explains intra-category diversity.

To underscore this, we have discussed selected ways of visualizing superdiversity and the kinds of things that it is possible to "see" and understand as a result. The main advantage of such superdiversity visualizations, as we have demonstrated through the selected examples, is the ability to observe the combined effects or intersections of multiple variables and the outcomes they produce. But we would also invite readers to note that these are our visualization selections and interpretations. The information that has become accessible can be used in different ways and for different purposes by others. In the spirit of this paper, which stresses the complex nature of urban diversity, there are endless options in visualizing that diversity available from the data that we offer – and a similar opportunity to interpret the data. Subsequently, there are at least three benefits such combined-variable visualizations afford by way of our understanding of urban complexity.

1. "Seeing" the combined and differential effects of variables raises a range of critical *research questions*, including: why do particular outcomes occur, over what period? What social, historical, or policy-based condition(s) is(are) responsible for such outcomes (especially ones relating to specific modes of inequality such as employment or education)? Addressing the questions raised by new visualizations in turn encourages the *development of theory* surrounding migration and urban diversification.
2. Placing such visualizations side-by-side enables new methods for understanding through *comparison*. For instance, significant similarities and differences between groups in corresponding cities – Vancouver, Auckland, and Sydney – are immediately apparent in ways that were largely unrecognized previously. Better comparisons, of course, lead both to a better understanding of each place and to overarching insights and theory.
3. By rendering detailed and multifaceted data into quickly grasped formats, *a wider, non-academic audience* can gain a better appreciation of a range of diversification outcomes – especially modes of inequality. As we have already found in presenting these superdiversity visualizations to politicians, policymakers, NGOs and members of the

public, compelling graphics offer a successful way for non-specialists to comprehend complicated data. In this way, we hope that a more nuanced understanding of complex inequalities might occur and that a more effective use of targeted resources results. Further, these can help generate evidence-based discussions about critical policy and political concerns. The political tendency in some quarters to simplify reality represents an important obstacle to debates about such matters as social cohesion or representation in diverse cities. As Peach (2009) warned, debates about segregation have mis-characterized the data on residential diversity and therefore, the political response.

It is anticipated that the increasing complexity of global migration will continue to change cities and add to their already existing complexity (IOM, 2018). The dynamics involved and the resulting outcomes entail a range of processes and factors. As researchers, we need to ensure that we are successfully adapting our methods and conceptual understanding to engage with these emergent complexities of intersections, divergences, and outcomes. New datasets, new software programmes and – as we have argued here – new ways of visualizing data have crucial roles to play in fostering complex thinking and more comprehensive understandings of the ways that global migration is shaping cities and influencing (or more actively, structuring) the lives of the people who dwell in them.

Notes

1. In this context, where the three cities that we are using to illustrate how we visualize super-diversity are all located in settler-colonial states, "Indigenous" refers to those who occupied the territory prior to European colonization and who remain as tribes/nations, albeit as impacted negatively by that colonization and who remain marginalized and impoverished in several ways.
2. A reviewer of this paper made the point that, in so doing, we are "ocularcentric", which is a valid assessment. However, we note that journal articles and websites, by their very nature, privilege visual information. The lead author of this paper has also constructed a "Datarama" installation, into which users enter and see 360 degree views of urban street life, and can hear the sounds of urban life as well as observe recorded interpersonal interaction – but this is a topic for another paper.
3. The technical paper solely describes how we collected the data, defined our indicators and variables, and how we prepared the data for visualization. The current paper focuses on the overall analytical approach, particularly it's multidimensional character and its visual character.
4. For example, Statistics Canada recognized 256 ethnic categories in the last Canadian Census in 2016, and is considering recognizing over 600 categories for the 2021 Census (personal communication with Daniel Hiebert).
5. We are aware, as one of the reviewers of this paper noted, that "Jewish" can be seen as a religious and/or ethnic category. However, in this case we are reporting that a small group of individuals (without prompting) identify themselves using this combination of categories and, in so doing, indicate that they believe that being Jewish and Muslim are not mutually exclusive forms of identity. We believe that this example illustrates the complexity of urban social life through the formation of unexpected hybridities.
6. The three censuses differ in the granularity of data they release to the public. All our sources, definitions and data matters are covered in an associated technical paper (Hiebert, 2019).
7. Full details of our index definitions and data can be found in Hiebert (2019). Our diversity indices were defined as follows: Ethnic Diversity = number of ethnic group identities per

area, divided by area population; Income Diversity = a Simpson's Entropy Index [SI] based on income deciles; Educational Diversity = SI calculated using broad census-based categories of educational attainment; Generational Diversity = SI based using the following categories: third-generation residents of the country, second-generation residents, long-settled foreign-born residents, recent foreign-born residents, and non-permanent residents; Admission-category Diversity = SI calculated using admission categories of Economic; Family, Humanitarian, and Other; Degree of Mobility = the percentage of residents who did not live in their current geographical area five years earlier. For mapping purposes, we examined both raw index values and simplified each index into an ordinal scale of low, medium, and high diversity.

Acknowledgements

Disclosure statement

ORCID

Steven Vertovec ⓘ http://orcid.org/0000-0003-0177-9194
Paul Spoonley ⓘ http://orcid.org/0000-0001-8487-5717
Alan Gamlen ⓘ http://orcid.org/0000-0003-1432-0526

References

Abel, G. J., & Sander, N. (2014). Quantifying global international migration flows. *Science*, *343* (6178), 1520–1522. https://doi.org/10.1126/science.1248676

Auckland Council. (2018). *Affordable housing in Auckland*. Auckland: Community and Social Policy Team. http://knowledgeauckland.org.nz/assets/publications/Affordable-housing-in-Auckland-snapshot-Auckland-Council-Nov-2018.PDF.

Berg, M. L., Gidley, B., & Krausova, A. (2019). Welfare micropublics and inequality: Urban super-diversity in a time of austerity. *Ethnic and Racial Studies*, *42*(15), 2723–2742. https://doi.org/10.1080/01419870.2018.1557728.

Bergmann, Luke, & Lally, Nick. (2021). For geographical imagination systems. *Annals of the American Association of Geographers*, *111*(1), 26–35. https://doi.org/10.1080/24694452.2020.1750941

Berry, B. J. L. (1971). Introduction: The logic and limitations of comparative factorial ecology. *Economic Geography*, *47*, 209–219. https://doi.org/10.2307/143204

Bijak, J., & Czaika, M. (2020). *Assessing uncertain migration futures – A typology of the unknown. QuantMig project deliverable D1.1*. University of Southampton and Danube University Krems.

Billinge, M., Gregory, D., & Martin, R. (1984). *Recollections of a revolution: Geography as spatial science*. Macmillan.

Blommaert, J., & Rampton, B. (2011). Language and superdiversity. *Diversities*, *13*(3), 1–21.

Bouma, G. (2012). Religious diversity and social policy: An Australian dilemma. *Australian Journal of Social Issues*, *47*(3), 281–295. https://doi.org/10.1002/j.1839-4655.2012.tb00249.x

Bouma, G. (2016). The role of demographic and socio-cultural factors in Australia's successful multicultural society: How Australia is not Europe. *Journal of Sociology*, *52*(4), 759–771. https://doi.org/10.1177/1440783315584210

Bouma, G., Arunachalam, D., Gamlen, A., & Healy, E. (2022). Religious diversity through a super-diversity lens: National, sub-regional and socio-economic religious diversities in Melbourne. *Journal of Sociology*, *58*(1), 7–25. https://doi.org/10.1177/14407833211011256

Bouma, G., & Hughes, P. (2014). Using census data in the management of religious diversity: An Australian case study. *Religion*, *44*(3), 434–452. https://doi.org/10.1080/0048721X.2014.903639

Burgess, E. W. (1925). The growth of the city: An introduction to a research project. In R. E. Park, E. W. Burgess, & R. D. McKenzie (Eds.), *The city* (pp. 47–62). University of Chicago Press.

Burnley, I., & Hiebert, D. (2001). Emerging patterns of immigrant settlement at the metropolitan scale: The need for new concepts and models. In D. Ley and P. Murphy (eds). *Progress in Planning*, *55*, 127–140. https://doi.org/10.1016/S0305-9006(00)00025-8

Byrne, D., & Callaghan, G. (2013). *Complexity theory and the social sciences: The state of the art*. Routledge. DOI: 10.4324/9780203519585

Castles, S., de Haas, H., & Miller, M. J. (2013). *The age of migration: International population movements in the modern world* (5th ed.). Palgrave Macmillan.

Collins, F. L. (2012). Transnational mobilities and urban spatialities. *Progress in Human Geography*, *36*(3), 316–335. https://doi.org/10.1177/0309132511423126

Creese, A., & Blackledge, A. (2018). *The routledge handbook of language and superdiversity*. Routledge.

Crul, M. (2016). Super-diversity vs. assimilation: How complex diversity in majority–minority cities challenges the assumptions of assimilation. *Journal of Ethnic and Migration Studies*, *42*(1), 54–68. https://doi.org/10.1080/1369183x.2015.1061425.

Cruz-Neira, C., Sandin, D. J., DeFanti, T. A., Kenyon, R. V., & Hart, J. C. (1992). The CAVE: Audio visual experience automatic virtual environment. *Communications of the ACM*, *35*(6), 64–72. https://doi.org/10.1145/129888.129892

Czaika, M., & de Haas, H. (2014). The globalization of migration: Has the world become more migratory? *International Migration Review*, *48*(2), 283–323. https://doi.org/10.1111/imre.12095

Davies, W. K. D., & Murdie, R. A. (1993). Measuring the social ecology of cities. In L. Bourne, & D. Ley (Eds.), *The changing social geography of Canadian cities* (pp. 52–75). McGill-Queens.

Dear, M., & Flusty, S. (1998). Postmodern urbanism. *Annals of the Association of American Geographers*, *88*(1), 50–72. https://doi.org/10.1111/1467-8306.00084

Dorling, D. (2012). *The visualization of spatial social structure*. Wiley. DOI: 10.1002/9781118353929

Eick, S. G. (2000). Visualizing multi-dimensional data. *ACM SIGGRAPH Computer Graphics*, *34*(1), 61–67. https://doi.org/10.1145/563788.604454

Ellin, N. (1996). *Postmodern urbanism*. Blackwell.

Engbersen, G., & Snel, E. (2013). Liquid migration: Dynamic and fluid patterns of post-accession migration flows. In B. Glorious (Ed.), *Mobility in transition* (pp. 21–40). Amsterdam University Press. Stable URL: www.jstor.org/stable/j.ctt46mwhx.4

Fernandez, G., Maione, C., Zaballa, K., Bonnici, N., Spitzberg, B. H., Carter, J., Yang, H., McKew, J., Bonora, F., Ghodke, S. S., Jin, C., De Ocampo, R., Kepner, W., & Ming, H. S. (2021). The geography of COVID-19 spread in Italy using social media and geospatial data analytics. *The International Journal of Intelligence, Security, and Public Affairs*, *23*(3), 228–258. DOI: 10.1080/23800992.2021.1994813

Fincher, R., & Iveson, K. (2008). *Planning and diversity in the city: Redistribution, recognition and encounter*. Palgrave Macmillan.

Freestone, R., Randolph, B., & Butler-Bowden, C. (2006). *Talking about Sydney: Population, community and culture in contemporary Sydney*. University of New South Wales Press.

Gilbertson, A., & Meares, C. (2013). *Ethnicity and migration in auckland*. Auckland Council. Technical Report TR2013/012. http://www.knowledgeauckland.org.nz/assets/publications/TR2017-008-Immigration-ethnic-diversity-and-cities-literature-review.pdf.

Good, K. (2009). *Municipalities and multiculturalism: The politics of immigration in Toronto and Vancouver*. University of Toronto Press.

Gurstein, P., & Hutton, T. (2019). *Planning on the edge: Vancouver and the challenges of reconciliation, social justice, and sustainable development*. UBC Press.

Healy, K. (2019). *Data visualization: A practical introduction*. Princeton University Press.

Hiebert, D. (2019). Superdiversity and Cities - Technical Report. Max Planck Institute for the Study of Religious and Ethnic Diversity Working Papers WP 19-05. Available online at https://www.mmg.mpg.de/499363/WP_19-05_Dan-Hiebert_Superdiversity-and-Cities.pdf.

Hill Collins, P., & Bilge, S. (2016). *Intersectionality*. Polity Press.

IOM, International Organization for Migration. (2015). *World migration report 2015. Migrants and cities: New partnerships to manage mobility*. International Organization for Migration.

IOM, International Organization for Migration. (2018). *World migration report 2018*. International Organization for Migration.

Jörg, T. (2011). *New thinking in complexity for the social sciences and humanities: A generative, transdisciplinary approach*. Springer. DOI: 10.1007/978-94-007-1303-1

Jung, J.-L., & Anderson, C. (2017). Extending the conversation on socially engaged geographic visualization: Representing spatial inequality in Buffalo, New York. *Urban Geography*, 38(6), 903–926. https://doi.org/10.1080/02723638.2016.1184854

Khazaei, F. (2018). Grounds for dialogue: Intersectionality and superdiversity. *Tijdschrift Voor Genderstudies*, 21(1), 7–25. https://doi.org/10.5117/TVGN2018.1.KHAZ

Lees, L., Slater, T., & Wyly, E. (2013). *Gentrification*. Routledge.

Marghescu, D. (2007a). Multi-dimensional data visualization techniques for exploring financial performance data. *AMCIS 2007 Proceedings*, 509.

Marghescu, D. (2007b). Multidimensional data visualization techniques for financial performance data: A review. *TUCS Technical Report*, 810.

McCall, L. (2001). *Complex inequality: Gender, class and race in the new economy*. Routledge.

McCall, L. (2005). The complexity of intersectionality. *Signs: Journal of Women in Culture and Society*, 30(3), 1771–1800. https://doi.org/10.1086/426800

Meissner, F., Sigona, N., & Vertovec, S. (in press). *The Oxford handbook of superdiversity*. Oxford University Press.

Peach, C. (2003). The ghetto and the ethnic enclave. In J. Doomernik, & J. Knippenberg (Eds.), *Migration and immigrants: Between policy and reality* (pp. 99–122). Aksant Academic Publications.

Peach, C. (2009). Slippery segregation: Discovering or manufacturing ghettos? *Journal of Ethnic and Migration Studies*, 35(9), 1381–1395. https://doi.org/10.1080/13691830903125885

Peck, J., Siemiatycki, E., & Wyly, E. (2014). Vancouver's suburban involution. *City*, 18(4-5), 386–415. https://doi.org/10.1080/13604813.2014.939464

Pezanowski, S., Mitra, P., & MacEachren, A. M. (2022). Exploring descriptions of movement through geovisual analytics. *KN - Journal of Cartography and Geographic Information*, 72(1), 5–27. https://doi.org/10.1007/s42489-022-00098-3

Phillimore, J. (2010). Approaches to health provision in the age of super-diversity: Accessing the NHS in Britain's most diverse city. *Critical Social Policy*, 31(1), 5–29. https://doi.org/10.1177/0261018310385437.

Phillimore, J., Sigona, N., & Tonkiss, K. (2020). *Superdiversity, policy and governance in Europe: Multi-scalar perspectives*. Policy Press.

Piekut, A., Rees, P., Valentine, G., & Kupiszewski, M. (2012). Multidimensional diversity in two European cities: Thinking beyond ethnicity'. *Environment and Planning A: Economy and Space*, 44(12), 2988–3009. https://doi.org/10.1068/a4512. (accessed 27 August 2019).

Pinsen, G., & Journel, C. M. (2016). The neoliberal city – theory, evidence, debates. *Territory, Politics, Governance*, 4(2), 137–153. https://doi.org/10.1080/21622671.2016.1166982

Plummer, K. (1997). *The Chicago school: Critical assessments*. (pp. 4) Routledge. vols.

Portugali, J., Meyer, H., Stolk, E., & Tan, E. (2012). *Complexity theories of cities have come of age: An overview with implications to urban planning and design*. Springer. DOI: 10.1007/978-3-642-24544-2

Schmidt, M. (2008). The sankey diagram in energy and material flow management. *Journal of Industrial Ecology*, *12*(2), 173–185. https://doi.org/10.1111/j.1530-9290.2008.00015.x

Shneiderman, B., & Wattenberg, M. (2001) Ordered treemap layouts. *Proceedings of the IEEE Symposium on Information Visualization 2001 (INFOVIS '01). IEEE Computer Society*, 73-78.

Spoonley, P., & Bedford, R. (2001). *Welcome to our world? Immigration and the reshaping of New Zealand*. Dunmore.

Valentine, G. (2008). Living with difference: Reflections on geographies of encounter. *Progress in Human Geography*, *32*(3), 323–337. https://doi.org/10.1177/0309133308089372

Vertovec, S. (2007). Super-diversity and its implications. *Ethnic and Racial Studies*, *30*(6), 1024–1154. https://doi.org/10.1080/01419870701599465

Vertovec, S. (2015). *Diversities old and new: Migration and socio-spatial patterns in New York, Singapore and Johannesburg*. Palgrave. DOI: 10.1057/9781137495488

Vertovec, S. (2019). Talking around super-diversity. *Ethnic and Racial Studies*, *42*(1), 125–139. https://doi.org/10.1080/01419870.2017.1406128

Walby, S. (2021). Developing the concept of society: Institutional domains, regimes of inequalities and complex systems in a global era. *Current Sociolog*, *69*(3), 315–332. https://doi.org/10.1177/0011392120932940.

Wirth, L. (1928). *The ghetto*. University of Chicago Press.