Dimensions of age and aging in Toronto: An inter-decade socio-ecological analysis

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

The aging of global populations long forecasted by demographers, governments, and other public and private actors is now rapidly being realized in many countries around the world, particularly in advanced, industrial economies like Canada. Driving this population aging are members of the Baby Boomer generation, a group larger and in many ways more socially influential than preceding birth cohorts, that are now entering life's later stages and (if social theorists are correct) redefining concepts of older adulthood we currently rely on to plan for the aged. However, the portended impacts of this aging and proposed policy responses largely remain focused at the national/provincial level, with scant attention paid to how the aging of community and neighbourhood populations will occur and how aging will impact these local spaces. Only in recent years have researchers seriously attempted to understand how age and aging overlap the other complex forces that structure urban space and influence how neighbourhoods change. Drawing on theories of social ecology, this thesis assesses the roles age and aging play in urban structure and changes processes, using perspectives of life stage and generation to discern how the aging of Baby Boomers is enmeshed therein. Using the City of Toronto, Canada as study area, this research employs factorial analysis – here, principal component analysis – on a sample of 468 Toronto neighbourhoods for which a comprehensive dataset of social and spatial measures, with an emphasis on age, is created for the years 1996, 2006, and 2016 and for the decades 1996 to 2006 and 2006 to 2016. A set of components are generated for each year and period to serve as measures of dimensions which underlie how these measures relate e.g., how age and aging relate to Toronto's other social and spatial elements; importantly, these components are also mapped to reveal of how different parts of Toronto reflect the conceptual constructs depicted. These sets of components and their spatial patterning are then assessed for their analytical import, focusing on where and how age and aging overlap other elements of Toronto's urban social ecology. Findings reveal that while Toronto continues to be primarily organized by socioeconomics that are heavily inflected by ethnic and immigrant status, age still plays a vital role structuring the city's social ecology, a role more complex than foundational theories account for, even if these are useful for understanding how the aging of residents interacts with neighbourhoods' other social and spatial elements. Further and in terms of how Toronto changes, while other social elements appear to crystalize, or remain stable between years, resident aging takes a more prominent role defining the changes Toronto's neighbourhoods are undergoing. As for where Baby Boomers factor into this, while the earliest-born half of the generation follows a similar trajectory as preceding generations in entering older age, the younger half of the generation diverges from this trajectory and thus from established norms of life's later stages. Moving forward, it seems age and aging are becoming a more definitive a factor in the structuring of urban environments like Toronto and that concepts of life stage and generation, that have been developed more concretely in other research disciplines, will be crucial for continuing to unravel the complex ways in which demography interweaves itself into urban social ecology.

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1.0 – Introduction

Global populations have been rapidly aging for several decades and will continue to do so for several more, rather dramatically in the world's advanced economies (Lee & Mason, 2010). This trend will reshape our cities' age structures, and consequently our work as planners (WHO 2002; 2007). Canada typifies this aging: its share of persons aged 65+ increased from 12.2% of the national population in 1996, to 13.7% (2006), then 16.9% by 2016. Older adults will make up 23.4% of the Canadian population by 2036 and maintain said share for 30-plus years (Statistics Canada, 1998; 2008; 2017a; 2019a). The social and economic implications of this population aging are not lost on demographers, gerontologists, and governmental and public agencies, as well as private corporations and entrepreneurs (Hartt & Bigleiri, 2018; CHMC, 2020). Population aging and its impacts will be "felt most acutely" at the local level (Newbold, 2015 p.365), where older adults' daily lives occur and from where they draw support and social connection (Hodge, 2008). Whether engaged in urban land use, social services, economic development, or similar functions, we as planners play a vital role preparing the physical and social infrastructure of our communities for current, ongoing, and anticipated challenges and opportunities presented by this population aging.

Yet, the problem motivating my research is that our focus on population aging remains nationally or provincially anchored (McCann, 2017; Carbonaro et al, 2018; Hartt & Biglieri, 2018). Study of this demographic effect at the local scale i.e., in communities and neighbourhoods, is much less common. Thus, knowledge of how, why, and where aging occurs – information much-needed to effectively plan for aging populations – is lacking. This is not only in terms of focus on local-level aging (Atkins, 2017), but upon how these shifts affect myriad other social, economic, and physical elements of urban space. Much research on neighbourhoods has built up over the years (Teernstra & van Gent, 2012; Bailey et al, 2017). This vast body of work draws considerable inspiration from seminal theories of human or social ecology, a perspective which views cities' neighbourhood as a "[socio-]ecological niches" where social similarity is reinforced by complex, yet discernable principles related to inhabitants' social status and resources as well as to local geographic features (Brown, 2001 p. 1).

Before delving into this research tradition, I first clarify my use of social ecology. While contemporarily, 'social ecology' has taken on a range of meanings, depending on discipline of study[1], my use reflects study of "the dynamic interplay between characteristics of people and places to understand the spatial distribution of populations and social behaviour" (Caves, 2005 p. 415). I focus my use of 'social ecology' even further upon the first of these i.e., the aging of neighbourhood populations and how this relates to urban space in an aggregate, systems-level sense[2]. This framework – which looks at cities as an ecological system, indeed using many of the same 'biological' precepts – originated in the early-20th Century with Parks, Mckenzie, and Burgess (1925), who identify underlying patterns in

[1] For instance, natural ecologists see 'social ecology' as a body of theory concerning how nature and society relate and how they could relate more harmoniously (Bookchin, 2007).

[2] Many, such as those in social work, apply social ecology in a 'bottom-up' perspective, studying how individuals interact with and respond to their surrounding environment and the implications this has for their personal behavior and well-being (Citation).

how residents of different status 'compete' for residency in Chicago's neighbourhoods[3] (Brown, 2002). Early urban researcher such as Hoyt (1939) and Hoover and Vernon (1959) build on these foundations by introducing and refining concepts such as urban space sorting according to incomes and the presence of a neighbourhood life cycle which underlies patterns of urban change. These theoretical perspectives, wherein cities' organization reflects a socio-spatial hierarchy of relations – akin to natural environments – serves as the basis of this thesis research which examines the where, how, and why of age and aging within the complex social and spatial patterns that shape urban environments i.e., how population aging shapes the human ecology of cities at the neighbourhood level and indeed how these ecological patterns and processes influence how local populations undergo aging.

While less emphasized in contemporary urban studies since reaching a zenith of popularity in the 1950-1960s (Viaud, 1995), the perspective that cities and neighbourhoods operate according to socio-logical principles continues to reverberate throughout urban geography. The extensive (and ongoing) study of gentrification since the 1960s and, more contemporaneously, innumerable other forms of neighbourhood change[4] continue to utilize socio-ecological concepts to describe how and why cities come to be spatially organized according to residents' social attributes. However, while parallel social sciences like demography and sociology have focused on where and why people reside in certain places at certain ages (Rossi, 1955; Newbold, 2011), relatively few urban geographers explore the intersections between neighbourhood age structure and their other social and spatial characteristics (Rummo, 2016). For instance, while gentrification studies recognize that social and economic change is "produced by populations of different ages", the integration of age into "analyses of urban socio-spatial inequality" is only recently being taken seriously (Hochstenbach, 2018 p. 1-2), a trend likely motivated by the current and impending aging of populations at all spatial scales, including the neighbourhoods we all reside within.

Given the increasing pace of global population aging, we can ill-afford this disconnect between research on aging and urban social ecology. Aging is not so much absent from urban studies as it is under-emphasized or assumed predictive and linear[5]. A common trope is that older adults passively remain in their homes through retirement and their children's departure, contributing to declining local vitality until they move out of their homes; this allows the neighbourhood to renew as incoming younger residents reinitiate the neighbourhood's life cycle (Foote & Walker, 2017). While aging studies advance these basic constructs by exploring diverse life trajectories for the young and old alike (Coulter et al, 2016), advance of these constructs within urban studies is noted to be halting at best (Rummo et al, 2016; Hochstenbach, 2018). This thesis instead foregrounds age and related notions of life stage and generation to assess how well, if at all, cities' shifting demography conforms with these sorts of normative expectations.

A generational perspective is important because passage through life's varied stages is likely to be experienced differently as social, economic, political, and cultural conditions change with the course of time. This

[3] Ergo, early work in human ecology is often thought synonymous with the 'Chicago School' of thought.
[4] Such as shifts in local age and family status, racial/ethnic character, and built form (Owens, 2012; Delmelle, 2017).
[5] E.g., in how older adults (65+) are considered quite homogenous and thus so their role in neighborhood change.

generational effect means that aging as we know it is said to be changing (Green, 2006). Baby Boomers, born in the prosperous, transformative decades post-WWII (1945-1964), are now several years into late career and retirement life stages. They now drive global population aging and will for decades (Hodge, 2008; Davies & James, 2011). Many seminal (Graff & Wiseman, 1978; Litwak & Longino, 1987) and current (Davies & James, 2011; Atkins, 2017) studies look at older adults of prior generations. Contemporary study thus needs to ask how Boomers' aging will converge with and/or diverge from prior generations? Already observed to diverge from prior generations in younger life stages in their behaviour and values (Moschis & McArthur, 2007; Siren & Hostein, 2013), Boomers' general experience of aging is also expected to differ, as will the role their aging plays in social ecology. Conversely, if their aging follows expected norms of the human life course, then in the aggregate, Boomers will largely converge with preceding generations' aging. Given Boomers' "paradigm-busting history" thus far, it is remiss to assume the latter. To do so would be planning our cities for tomorrow using "yesterday's thinking about aging" (Green, 2006 p. 36).

The purpose of my research then is to assess the nature and extent of population aging occurring in an urban environment – here the City of Toronto, Canada – at the neighbourhood level. I then further assess how these shifts overlap other elements of Toronto's social ecology, such as socioeconomic status and built form. Throughout my research, concepts of age, life stage, and generation are empirically foregrounded to support a detailed analysis of Baby Boomers' transition into older adulthood The remainder of this chapter outlines my research approach.

In Section 2, I take a comprehensive approach to exploring these several areas of academic concern, starting with Canada's recent population aging trends, as well as future years' trends using Statistics Canada projections, to underscore the magnitude of demographic shift expected in coming decades. To understand likely neighbourhood-level impacts, I also assess how Canada's older adults differ from younger populations on a series of social and housing-related measures. Having contextualized Canadian population aging, I then explore several literatures related to urban social ecology, including studies of neighbourhood change and of age-based residential mobility i.e., why move people move as they age, as the latter translates demography into urban social ecology. I then survey how and why the Boomer generation, now entering older adulthood, is expected to disrupt existing models of neighbourhood age structure and aging. I conclude Section 2 with my research questions generated from this review.

In Section 3, I begin my study's methodology with an overview of the City of Toronto, my study area. Basic geographic description precedes an outline of Toronto's social, political, and economic development history. I present my use Statistics Canada data to create neighbourhood units of study and clarify my employ of the City of Toronto as study area. I then outline how I structure age in my study and use location quotients to understand spatial patterns of age in Toronto. I then introduce factorial analysis as my means of assessing how these patterns overlap Toronto's social ecology. After I outline the history and core elements of factorial analysis, I introduce my choice of principal component analysis, or PCA, as my specific approach to understand core dimensions underlying Toronto's social ecology and my decision to conduct a two-stage analysis. I first conduct PCA of the years 1996, 2006, and 2016 using static, proportional measures i.e., an age group's population share; I then conduct PCA of change in these

proportional measures in decades 1996-2006 and 2006-2016. I spend the rest of my methodology presenting the various steps of my analyses, including how I develop my variables, test them for statistical adequacy, conduct my PCAs, and, finally, map my findings for visual analysis. This all clarifies my methodological decision-making and walks readers through how PCA works, to provide a foundation for better understanding my results.

In Section 4, I present my findings. I first assess older adult and Boomer populations for Toronto in 1996, 2006, and 2016; I also present neighbourhood-level location quotients for these groups for these years and how they change 1996-2006 and 2006-2016 to contextualize how my study area ages over my study period. I then present my separate but interrelated PCAs: static PCAs of 1996, 2006, and 2016 are introduced 'together' to assess continuity and change in Toronto's social ecology over the study period. I then explore these dimensions, beginning with 1996 before proceeding through 2006 and 2016. I then present my 2 change PCA of 1996-2006 and 2006-2016 in similar fashion, exploring the set of dimensions emerging each decade and how these relate back to my static PCA. Throughout my analysis, I focus on the implications of age and aging, life stage, and generation.

In Section 5, I discuss my findings relative to other recent research on how demography overlaps with human ecology and to today's population aging trends. I first explore my findings according to two major themes relating to age as an element of urban structure and aging as a process of urban change. I then discuss the trajectories Boomers have taken in Toronto's social ecology and what to expect of their future aging. I follow with contributions my work makes to the study of urban demography and urban social ecology more generally, as well as my study's limitations and the lessons these provide for future applications of factorial analysis. I conclude my discussion and my thesis by briefly outlining some potential directions for future research of how age and aging shape our cities and why continual research on this front is needed to keep up with generational change.

2.0 – Literature Review

2.1 – Introduction

To begin my review of research relevant to my objectives, I first define and contextualize population aging. I then assess how this process has occurred in Canada since 1996 and project these trends to 2066 to illustrate the magnitude of current and expected aging. Using a range of Census measures, I then assess how Canada's older adults differ from those younger than age 65. While these trends are national in scope, they indicate how neighbourhoods' social character could be expected to change as these spaces age. At the local geographic scale, variation in population aging results from peoples' decisions to move or stay during certain life stages, actions shaped by their preferences for certain dwelling and neighbourhood characteristics and the resources to secure them; these preferences and resources are often quite informed by age e.g., the need for family-suitable housing once children arrive. These demographic dynamics in turn influence and are influenced by other socio-spatial processes. For instance, the proliferation of early families or retirees may incite developers to develop appropriate housing in areas experiencing growth of these households. Conversely, the rapid expansion of said populations may overwhelm the supply of these dwellings relative to available supply, reducing affordability and possibly driving early families or retirees to other areas, instigating changes in those places. Thus, population aging should be more integrated within the study of neighbourhood change instead of being treated as separate social and spatial process as it has been.

To better understand population aging as a type of urban change, I dive into neighbourhood studies generally. This contextualizes where and how population aging could better feature in urban social ecology. I review seminal theories from the early-mid 20th Century, prominently studied gentrification processes, then contemporary studies extending beyond these. While age and aging play an often-rudimentary role in studying neighbourhood and change, demography is better integrated in closely related fields of study. A prominent example of where individual and population aging feature is research on age-based residential mobility. Essentially, neighbourhoods change via residents' in- and out-movement[6]. Core concepts, such as human life course and migratory push-pull, model age's role in where, how, and why people reside in different places throughout their lives. Just as neighbourhoods and populations change, the ways that age and aging influence these changes are shifting. I highlight generational change and specifically how Boomers may transform intersections of aging, residential mobility, and urban change. Their outsized role in Canada's recent and expected demographic shifts justifies research on how their aging influences other elements of human ecology. This informs a basic understanding of how we might expect them to influence urban change in the decades to come. I conclude with a set of research queries arising from my literature review.

[6] These behaviors shaped by age and household status, as well as elements of socio-economic status or ethnicity.

2.2 – Population Aging in the Canadian Context

A population consists of all people living in a defined geography (Newell, 1989) i.e., a country, city, or neighbourhood. We compare populations by their traits i.e., contrasting two nations' age; we also define and assess sub-populations i.e., Canada's older adults. Populations 'age' via processes of fertility, mortality, and migration (Davies & James, 2011). People enter or leave, via birth, death, and/or moving at certain ages, making a population older or younger. Since the early 20th Century, declining fertility and increasing life expectancy have generally aged the global population (Lesthaeghe, 2010). An increasing number of countries now experience dwindling youth shares while older groups swell. This trend varies by nations' relative prosperity: the most economically developed countries (with lowest birth rates and highest life expectancy) also age most rapidly (Lee & Mason, 2010). Even many developing parts of Africa, Asia, and Latin America, where youth populations continue to explode experience unprecedented increases to their number and share of older adults (WHO, 2007). Population aging is often portrayed via simple stats, such as an increase to average age over time, or escalating rates of growth among older age groups (Hodge, 2008). Yet, demographics are influenced by the complex interplay of social, economic, cultural, political, and environmental forces over time (Shwanen et al, 2012; Coulter et al, 2016). So, while the world ages generally, the aging of various populations, like other socio-spatial change is marked by intense *spatial variability* at all geographic scales, including the local or neighbourhood level (Davies & James, 2011).

Tables 2.1 outlines Canada's total count and percentage share of select age groups from 1996 to 2066. Table 2.2 shows how these groups grow and/or decline during each decade[7]. The share of older adults (65+) in Table 2.1, initially 12.2% in 1996, increases to 13.7% in 2006 and again to 16.9% by 2016. Rates of growth for older adults each decade, 22.9% (1996-2006) and 36.9% (2006-2016), outpace respective national rates (9.6%; 11.2%; Table 2.2). The 65+ group continues to capture 3-4% more share of the total population each decade, reaching 23.4% in 2036. While growth and gains in share taper after 2036, by 2066, 25.6% of Canadians will be aged 65 or older. A reversal occurs in Canada's demographic structure as older adults capture population share from younger age groups. Children (0-14) and early households (25-34) see 1996 shares of 20.5% and 15.6% decline to 16.6% and 13.1% by 2016. Absolute decline in each of their total populations between 1996 and 2006 (-5.4%; -11%) underlies share loss, even as these groups grow in subsequent decades. Population share loss between 2016 and 2066 is less dramatic, with 0-14 staying at roughly 15% throughout; however, 25-34's population share keeps sliding to 12% by 2066. While projected growth stabilizes during this period, it never catches up to 65+ rates, even as these taper off. Juxtaposing older and younger age groups shows how populations age via groups' relative increase, stability, or decline relative.

[7] To focus on older adulthood (65+, 85+) and those about to enter it (55-64), some age groups (15-24, 35-54) are left out of this broad overview. Age groups 0-14 and 25-34 serve as markers for young families and for early, transitional adulthood (referred to as early households) to depict how countervailing old and young(er) residents inform population age and aging.

Table 2.1

Canadian Population by Age Group, 1996-2066

Age Group			1996	2006	2016	2026	2036	2046	2056	2066
Total Population		#	28,846,760	31,612,900	35,151,730	40,314,900	44,113,900	47,478,200	50,728,200	54,386,300
0-14	**Children**	#	5,901,280	5,579,840	5,839,565	6,261,200	6,593,100	7,117,000	7,638,400	8,050,800
		%	20.5	17.7	16.6	15.5	14.9	15.0	15.1	14.8
25-34	**Early Households**	#	4,498,910	4,005,805	4,615,385	5,280,800	5,482,100	5,861,500	6,124,900	6,514,200
		%	15.6	12.7	13.1	13.1	12.4	12.3	12.1	12.0
55-64	**Pre-seniors**	#	2,489,455	3,674,495	4,910,750	5,072,400	4,917,100	5,701,200	6,003,200	6,252,500
		%	8.6	11.6	14.0	12.6	11.1	12.0	11.8	11.5
65+	**Older Adults**	#	3,527,845	4,335,250	5,935,635	8,398,300	10,337,600	11,316,200	12,510,600	13,899,900
		%	12.2	13.7	16.9	20.8	23.4	23.8	24.7	25.6
85+	**Oldest Adults**	#	337,070	520,610	770,780	993,100	1,642,400	2,476,100	2,813,700	3,066,200
		%	1.2	1.6	2.2	2.5	3.7	5.2	5.5	5.6

Source: Statistics Canada, 1998; 2008; 2017a; 2019a

The age groups 55-64[8] and 85+ further illustrate this. The former shows Boomer's impact on national age: in 1996, Boomers (age 32-50) had yet to reach older adulthood. As they do in subsequent decades i.e., ages 42-60 (2006), then ages 52-70 (2016), the 55-64 group swells from 8.6 to 14% of Canada's population, reflected in staggering growth rates of 47.6 (1996-2006) and 33.6% (2006-2016). By 2026, as most Boomers age past 55-64, the group's share growth stalls abruptly, as subsequent generations, smaller than Boomers (Green, 2006), fail to replace it, seen in 2026-2036's 3.1% total decrease. The 85+ group nearly doubles in population share from 1.2% (1996) to 2.2% (2016), driven by growth of 54.5 (1996-2006) and 48.1% (2006-2016). The group more than doubles in number by 2016. Here, we see Boomers aging into the projected decades: the earliest-born Boomers hit age 85 in 2031, and thus the 85+ group's population share jumps from 2.5% in 2026 to 3.7% in 2036, then to 5.2% in 2046, when all Boomers will be between ages 82-100. The 85+ group's 2026 population share (933,100) swells by 649,300 (2026-2036) and then 833,700 (2036-2046) over the two decades, outpacing the combined increase of the children and early household groups in the same period (1,483,000 to the younger groups' 1,436,500).

Table 2.2

Canadian Population Growth (10-year) by Age Group, 1996-2066

Age Group			1996-2006	2006-2016	2016-2026	2026-2036	2036-2046	2046-2056	2056-2066
Total Population		#	2,766,140	3,538,830	5,163,170	3,799,000	3,364,300	3,250,000	3,658,100
		%	9.6	11.2	14.7	9.4	7.6	6.8	7.2
0-14	**Children**	#	-321,440	259,725	421,635	331,900	523,900	521,400	412,400
		%	-5.4	4.7	7.2	5.3	7.9	7.3	5.4
25-34	**Early Households**	#	-493,105	609,580	665,415	201,300	379,400	263,400	389,300
		%	-11.0	15.2	14.4	3.8	6.9	4.5	6.4
55-64	**Pre-seniors**	#	1,185,040	1,236,255	161,650	-155,300	784,100	302,000	249,300
		%	47.6	33.6	3.3	-3.1	15.9	5.3	4.2
65+	**Older Adults**	#	807,405	1,600,385	2,462,665	1,939,300	978,600	1,194,400	1,389,300
		%	22.9	36.9	41.5	23.1	9.5	10.6	11.1
85+	**Oldest Adults**	#	183,540	250,170	222,320	649,300	833,700	337,600	252,500
		%	54.5	48.1	28.8	65.4	50.8	13.6	9.0

Source: Statistics Canada, 1998; 2008; 2017a; 2019a

[8] I.e., 'pre-seniors' given their proximity to said life stage (CMHC, 2015; Atkins, 2017).

Canada's population is aging and will continue to grow older for many years, as Boomers travel further into later life. These national trends have and will keep resonating down to the local level i.e., most communities and neighbourhoods will undergo population aging. Further, it is argued that Boomers' approach to aging is expected to transform long-held conceptions of life's later stages in respect to lifestyle and consumption of goods and services, including housing (Green, 2006; Atkins, 2017). As populations age in Canada as elsewhere, what sorts of changes can we expect neighbourhoods to incur from increasing numbers and proportions of older inhabitants? Any changes in local social ecology depend upon older adults diverging from younger people in their traits and preferences, such that the aging of a neighbourhood's population influences its socio-spatial traits over and above its age structure. Understanding the range of observed differences between older and younger age groups and the potential impacts that these divergences might have upon local social ecology are important for informing my theoretical framework and subsequent analyses I employ in my research that looks at overlaps between population aging and urban change.

2.3 – Divergences Between Old and Young

Table 2.3 examines older Canadians (65+) both as a total population and split between female and male populations. Canadians under the age of 65 are used for comparative purposes. Because life's later stages are reported to differ according whether one is in early (65-74), middle (75-84), and late (85+) older adulthood (Bradley & Longino, 2009; Atkins, 2017), these groups also feature to provide further context into the process of population aging. As populations grow older, they tend to grow progressively more female, as per a gender gap in life expectancy i.e., women tend to outlive men (Hodge, 2008). Older adults are generally far less employed and they more likely live with a spouse or alone than do younger age groups. They also have twice as likely to be living with constraints on their daily activities via various forms of illness or disablement incurred with age. Early-, middle-, and late-stage older adults differ along several axes, with notable gender differences also emerging amongst these groups.

Employment for males ages 65-74 is under half (24.8%) and females aged 65-74 is under a third (15%) their younger counterparts' rates of 58 and 54.7%. Employment rates then continue to drop sharply with age, a notable gender gap in labour force activity remaining for 75-84 and 85+. In terms of household conditions, older women more often live alone, while older males more likely continue to reside with a spouse. While rates of spousal living at ages 65-74 differ by 'only' 15.5% (male 76%; female 60.5%), the gap widens for the 75-84 and 85+ groups; as females outlive their male counterparts, they thus more often alone or with others as they continue aging through later life stages. From early to late older age, activity constraints increase for most people, likely a major contributor to both genders seeing a four-fold increase in the share of older adults in 'collective' living situation[9] for by age 85

[9] This includes residential care facilities and similar settings intended to provide ongoing health and social support.

Table 2.3

Canadian Population by Age Group and Gender, 2016

	Total Population					Total Female Population					Total Male Population				
	Age <65	**65+**	**65-74**	**75-84**	**85+**	**Age <65**	**65+**	**65-74**	**75-84**	**85+**	**Age <65**	**65+**	**65-74**	**75-84**	**85+**
Total Population (# in 1,000s)	29,216	5,936	3,393	1,771	771	17,888	3,240	1,762	976	502	17,264	2,695	1,631	795	269
Females as % of Population	50.1	54.6	51.9	55.1	65.1	-	-	-	-	-	-	-	-	-	-
% with an Activity Limitation	27.1	54.6	47.2	61.3	80.8	28.4	55.7	47.3	62.6	82.6	25.9	53.3	47.1	59.8	78.0
% that are Employed	56.4	12.8	19.7	4.8	1.1	54.7	9.1	15.0	2.7	0.6	58.0	17.4	24.8	7.3	2.2
% of Canadians Living…															
… with a spouse	44.6	58.5	67.9	54.4	26.1	45.9	47.1	60.5	40.4	12.9	43.3	72.1	76.0	71.5	50.7
… alone	8.8	29.0	21.8	32.2	53.3	8.0	36.8	26.6	41.8	62.4	9.6	19.7	16.6	20.4	36.3
… with others	46.6	12.5	10.2	13.4	20.6	46.1	16.2	12.9	17.8	24.7	47.1	8.1	7.4	8.1	13.0
… in a collective dwelling*	0.8	7.7	1.9	8.1	32.0	0.6	9.6	2.0	9.6	36.5	1.0	5.3	1.9	6.1	23.6

Source: CMHC, 2020

** overlaps with other living situations; thus, %s total > 100*

Table 2.4 presents a range of information regarding Canadian households, in terms of the types and size of household they occupy, as well as the types of housing they reside in and some general housing conditions. Again, the data for older adults (65+) have been delineated against data portraying the characteristics of younger Canadian households; successive stages of early, middle, and late older adulthood feature, as in Table 2.3. Using households here provides a considerable amount of contextual information often missed at the individual level[10]. Because much of this household data has been gathered and retabulated by the Canadian Mortgage and Housing Corporation (CMHC), it and subsequent tables featuring household data are also organized according to tenure i.e., owner vs. renter households. Among the 65+ population, owner households outnumber renters by roughly 3:1, a ratio even more pronounced than that of the under-65 population's 2:1. This reflects how a longer lifetime's earning and saving have made ownership more likely. However, once in older adulthood, households' rate of homeownership then begins to decline with further age; from ages 65-74 to the age of 85+, the rate of ownership declined from 76.5 to 68.7% (nearly back at par with the 65.9% of the under-65 population). Distinguishing between owner and renter households here and in subsequent tables proves a useful lens, given tenure is a vital link to the types of dwellings and therefore neighbourhoods these differing segments of the population – both older and younger – are likely to occupy. Further, the two tenure groups differ markedly in terms of typical household structure and factors relating to socio-economic status (referred to as SES hereafter).

Starting with household structure (Table 2.4), all older adult age groups (early, middle, and late) tend to see smaller family households e.g., couples without as compared to with children and higher rates of living alone (1-person households) across both owner and especially rental tenure than do younger Canadians. Amongst older adult (65+) households, those of 2+ persons tend to own more than rent (68.4>33.9%) while 1-person households age 65+ tend to rent more than own (66.14>31.6%). Among 65+ households of 2+ people, couples are the prevailing type, especially those without children. While smaller household size and childlessness is a far more common trait of older adult households, certain age groups, particularly among owners, maintain vestiges of a family lifestyle: 9.7% of owners aged 65-74 have children living in their home. Adding lone-parent owner households (4.7%) to this, households with children reach a 14.4% share of the 65+ owner group. Older adult, lone parent owners also increase in share with each successive age group. I posit this increase may reflect a trend of children returning home to live with their elderly, single parents to help them or potentially for mutual support. The presence of (adult) children in the home reveals diversity among older adult household structure and type. However, couples without children still form the lion's share of all 65+ households consisting of 2+ people.

[10] Statistics Canada collects data for individuals and households e.g., age, labour status vs. tenure, income. However, these largely fail to overlap (Viaud, 1995). Urban studies generally benefit from household analyses as they are "the basic decision-making unit [for] . . . housing, amenity use, consumption" and "most [demographic] phenomena: fertility, nuptiality, divorce, and migration" i.e., forces shaping population aging (Kuijsten & Vossen 1988, p. 5). Household age is defined by the age of its primary maintainer (which can be either male or female). For brevity, I use the shorthand households aged 65+, 85+, etc. even though these can consist of individuals of other ages i.e., a maintainer's younger spouse and/or their children (potentially).

Table 2.4

Canadian Households Organized by Age and Tenure, 2016

Owner Households and Dwellings	Age <65	65+	65-74	75-84	85+
Total # of Owned Dwellings	**6,926,375**	**2,614,945**	**1,551,495**	**797,735**	**265,715**
Owners as a % of All Households	**65.9**	**74.8**	**76.5**	**73.7**	**68.7**
% of Owners with a Mortgage	59.7	25.1	30.9	17.4	11.0
% of Owners in a Condominium	13.2	15.7	13.7	17.8	21.1
% of Owners in Core Housing Need	6.3	7.7	6.5	8.4	12.0
% of Owner Households Living in a…					
… Single-Detached House	72.1	71.2	72.9	69.4	67.0
… Semi-Detached House	5.8	4.9	5.0	4.9	4.6
… Other Single-Attached House	0.2	0.2	0.2	0.2	0.2
… Row House	6.4	5.1	5.3	5.0	4.4
… Apartment	13.9	16.6	14.5	18.6	22.6
- Duplex	*4.0*	*3.8*	*3.7*	*4.0*	*4.2*
- Building with 1-4 Storeys	*6.0*	*7.1*	*6.4*	*7.9*	*9.3*
- Building with 5+ Storeys	*3.9*	*5.6*	*4.4*	*6.7*	*9.1*
Total # of 2+ Person Owner Households	**5,771,265**	**1,788,485**	**1,145,390**	**512,150**	**130,940**
	These as a % of All Owner Households				
2+ Person Households	**83.3**	**68.4**	**73.8**	**64.2**	**49.3**
Family Households	80.9	66.4	71.6	62.5	47.7
Couple Family Households	69.1	58.1	64.6	53.5	33.5
w/ children	*44.3*	*7.9*	*9.7*	*5.8*	*3.9*
w/o children	*24.8*	*50.1*	*54.8*	*47.7*	*29.7*
Lone-Parent Family Households	9.0	6.3	4.7	7.3	13.0
Multiple Family Households	2.8	2.0	2.3	1.7	1.1
Non-Family Households	2.4	2.0	2.2	1.7	1.6
Total # of 1-Person Owner Households	**1,155,110**	**826,460**	**406,105**	**285,585**	**134,775**
	These as a % of All Owner Households				
1-Person Households	**16.7**	**31.6**	**26.2**	**35.8**	**50.7**
Female 1-Person Households	7.7	21.6	16.9	25.5	37.3
Male 1-Person Households	9.0	10.0	9.3	10.3	13.4

Renter Households and Dwellings	Age <65	65+	65-74	75-84	85+
Total # of Rented Dwellings	**3,591,285**	**883,245**	**477,370**	**284,860**	**121,020**
Renters as a % of All Households	**34.1**	**25.2**	**23.5**	**26.3**	**31.3**
% of Renters in Subsidized Housing	13.0	21.8	20.3	22.5	24.2
% of Renters in a Condominium	13.8	10.9	10.3	11.6	11.7
% of Renters in Core Housing Need	26.8	32.8	31.7	33.4	35.4
% of Renter Households Living in a…					
… Single-Detached House	15.3	9.6	10.7	8.6	7.6
… Semi-Detached House	4.1	2.7	3.0	2.6	1.9
… Other Single-Attached House	0.4	0.3	0.4	0.3	0.3
… Row House	7.6	5.0	5.3	4.9	4.3
… Apartment	71.9	81.9	80.2	83.2	85.5
- Duplex	*9.3*	*6.5*	*7.5*	*5.8*	*4.4*
- Building with 1-4 Storeys	*42.8*	*45.2*	*46.4*	*44.5*	*41.8*
- Building with 5+ Storeys	*19.7*	*30.2*	*26.2*	*32.8*	*39.3*
Total # of 2+ Person Renter Households	**2,198,650**	**299,115**	**174,830**	**94,085**	**30,205**
	These as a % of All Renter Households				
2+ Person Households	**61.2**	**33.9**	**36.6**	**33.0**	**25.0**
Family Households	51.9	31.1	33.0	31.1	23.7
Couple Families Households	34.6	24.1	25.8	24.7	16.4
w/ children	*18.8*	*2.9*	*3.9*	*1.9*	*1.1*
w/o children	*15.7*	*21.3*	*21.9*	*22.8*	*15.3*
Lone-Parent Family Households	16.2	6.3	6.4	5.8	7.0
Multiple Family Households	1.1	0.7	0.9	0.5	0.3
Non-Family Households	9.3	2.7	3.6	2.0	1.3
Total # of 1-Person Renter Households	**1,392,635**	**584,130**	**302,540**	**190,775**	**90,815**
	These as a % of All Renter Households				
1-Person Households	**38.8**	**66.1**	**63.4**	**67.0**	**75.0**
Female 1-Person Households	17.7	45.4	39.5	49.1	59.8
Male 1-Person Households	21.1	20.7	23.9	17.9	15.2

Source: CMHC, 2020

In terms of Canadians who live alone (Table 2.4), 1-person households make up roughly twice the share of renting households compared to their share of owners, both at ages 65+ (66.1>31.6%) and under-65 (38.8>16.7%); however, 1-person owner households form a larger total population than 1-person renters for all noted ages. One-person households age 65+ are more often female, and increasingly so moving from early to late older age; this aligns with aging's general feminization (Tables 2.3). Aging itself seems a major predictor of living alone: 26.2% of owner households aged 65-74 consist of a one person, a share increasing to 50.7% for 85+ owner households. For older adult renter households, 63.4% of the 65-74 group increases to a 75% share of the 85+ group. While not a majority share of Canada's older adult population generally, people over the age of 65 living alone are a population of concern for many in the health and aging policy fields considering their vulnerability and potential for isolation (WHO, 2007). The following discusses the dwelling situation of Canadian households in 2016, in terms of type and conditions, to further illuminate the differing attributes of older adult households compared to those younger.

Single-detached homes are the dominant form of dwelling for owner households, both over and under age 65, and likewise apartment dwellings for renter households (Table 2.4). Dwelling patterns for 65+ owners tend to mirror those for owners under age 65; however, advancing from the 65-74 to the 85+ owner group sees a shift from larger, single/semi-detached and row homes into various apartments. The observed shrinking of households with age, alongside increasing activity limitations (Table 2.3), likely contributes to small(er) homes being more frequent or popular among increasingly older groups. Apartment dwellings also tend to be in more-urbanized areas and thus near age-supportive infrastructure such as transit and health care (Davies & James, 2011; Mulliner et al, 2020). Four-fifths of 65+ renter households live in an apartment of some form. Of all types, those of 5+ storeys seem increasingly popular with age. While all other dwelling types see a decline in share, 5+ storey apartments increase to represent 39.3% of the dwellings occupied by 85+ renter households, a share only slightly outranked by 1-4 storey's 41.8%.

As per housing conditions, the share of under-65 owner households holding a mortgage (59.7%) is over twice that of 65+ households (25.1%) (Table 2.4), which implies lower housing costs and generally more housing equity among older adult owners. Similarly, renter households age 65+ more often live in some form of subsidized housing, which also implies lower housing costs in respect to receiving fiscal support[11]. While rates of condominium living are quite comparable for both owner and renter households aged under-65, 65+ households diverge on this measure according to tenure. At ages 65-74, owner households' 13.7% outweighs renters of the same age range (10.9%); this increases to 17.8 and 21.1% for owner households aged 75-84 and 85+ (respectively), while the rate for same-aged renter households stays rather flat at 11.6 and 11.7%. For owner households in Canada, there appears to be a notable if still minor shift towards downsizing into condominium style dwellings with advancing age[12].

[11] Provincial housing policies ensure homes are (somewhat) more affordable for older Canadians (Government of Canada, 2021).
[12] A trend likely varying considerably by local geography i.e., densely urban environments such as the Toronto and Vancouver CSDs and surrounding regions where condominiums have been densely developed (Filion et al, 2010).

Despite observing smaller (thus likely less costly) dwellings for older adult households, in addition to fewer/smaller mortgages and the provision of subsidies, 65+ households (especially renters) fall into *core housing need* (CHN[13]) more than households under age 65. While CHN rates among 65+ owners as a group do not dwarf the under-65 group (rates being roughly par for 65-74 owners), rates swell such that by ages 85 and over, owner households are twice as likely to live in CHN than the under-65 group, even with a far greater share of them being mortgage free. This is likely due to households' higher incidences of being 1-person (i.e., a single, fixed income) and being decidedly more female-led amongst the 75-84 and especially 85+ age groups; the implications of being female-led here deriving from women largely earning lower incomes than their male counterparts at all age ranges (Statistics Canada, 2019b). Hence, far greater incidences of CHN are observed among 65+ renter households, given 66.1% of the group lives alone and 45.4% are female (compared to males' 20.7%) (Table 2.4), with shares of solitary living and female-led households rates escalating as one proceeds from households led by those in early to late older adulthood. Looking specifically at incomes and housing costs will, help to further clarify these trends.

The median household income of age 65+ households is roughly two-thirds that of the all-age group, both for owners and renters[14] (Table 2.5). The incomes of owners are roughly double that of renters at all ages, ages 65+ and age 65-74; for owners aged 75-84 and 85+, this gap narrows to owners earning about 44% and 36% more than their renting peers. Besides the two tenures tending to vary in their SES 'foundations'[15] (Haider & Moranis, 2020), 66.1% of renter households age 65+ live alone compared to 38.8%% of those under age 65, and more are female (Table 2.4), factors which both partly explain income disparity. That 65+ households' shelter costs are generally lower than that of the all-age group, implied by mortgage and subsidy rates (Table 2.4), is verified by totals observed in Table 2.5, especially for 65+ owners. However, while the shelter costs of 65+ owner households decline from early to later older age, older renters' increase, consuming more of their limited income (which also shrinks with age). This is another factor contributing to higher rates of CHN among 65+ households (Table 2.4),

Table 2.5

Canadian Households Incomes and Dwelling Costs, 2016

	All Ages	65+	65-74	75-84	85+
Owner Households					
Median Household Income ($)	**90,232**	**59,279**	**66,522**	**51,821**	**42,739**
- After Taxes ($)	76,878	53,347	58,965	47,720	40,054
Median Monthly Shelter Costs ($)	**1,126**	**618**	**650**	**584**	**565**
- as % of Median Annual Income	17.6	13.9	13.2	14.7	16.9
Renter Households					
Median Household Income ($)	44,159	30,013	31,570	28,962	27,477
- After Taxes ($)	40,323	28,980	30,307	28,140	26,464
Median Monthly Shelter Costs ($)	**915**	**801**	**785**	**802**	**857**
- as % of Median Annual Income	27.2	33.2	31.1	34.2	38.9

Source: CMHC, 2020

[13] A household is in CHN if housing is inadequate, unsuitable and/or unaffordable and would have to spend >30% its pre-tax income to access acceptable local housing. Adequate housing does not require major repair; suitable housing has bedrooms sufficient for household structure; Affordable housing costs <30% of pre-tax household income (CMHC, 2020)

[14] Unfortunately, the median incomes and shelter cost data derived from CMHC (2020) for these series of tables is not provided numerically for the under-65 groups; therefore, I was unable to disaggregate them from the 65+ groups as is the case with other tables e.g., Table 2.4. Thus, here I employ an all-ages group to at least highlight general divergence of older from younger households (even if 65+ semi-obscure a purer comparison by being included among an all-ages group).

[15] I.e., owners and renters tend to diverge in general occupation, education, assets, household status, and other measures which greatly influence income and thus their economic positioning within housing markets and other arenas.

observed in how owner and especially renter households over age 65 devote increasingly larger shares of their income to shelter costs, even considering senior-favorable taxation policies and government benefits[16]. Looking at how incomes are received by older and younger households proves useful here.

Table 2.6 breaks down, for both tenures, the sources from which households derive their income. As older adults leave the labor force at age 65 and especially by age 75, employment income is increasingly replaced by retirement sources (registered savings plans, or RSPs; employer-provided pensions) and government transfer (Old Age Security, or OAS; Guaranteed Income Supplement, or GIS); older adult owners tend to receive more retirement income as a source than renters, while the opposite is true when considering their shares of government transfer. While retirement sources as a share of total income remains roughly stable from ages 65-74, through 75-84, to ages 85 and beyond for both tenures, age 75 sees a marked jump in government transfer's share of owner and renter incomes. Because these are fixed sources set by government policy, 65+ households tend to fall further into CHN with increasing age. This indicates how local aging could affect neighbourhood SES via a downward trend in local incomes. Conversely, retirement makes employment far less influential upon older adult preferences. Older adults' exit from the labor market and reliance on stable forms of retirement income and government transfer may prove more resistant to economic downturn than the employment sources of working households (Davies & James, 2011) e.g., aged neighbourhoods may respond better to recession than younger, labor-dependent households.

Table 2.6

Canadian Household Income Sources as Share of Total Income, 2016

Income Source as %	Age <65	65+	65-74	75-84	85+
Owner Households	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Wages and Salaries	81.4	18.2	24.7	9.2	7.5
Self-employment	5.1	2.2	3.0	1.3	0.9
Government Transfers	5.2	41.2	33.5	50.5	58.4
Investment Income	3.6	5.2	5.3	4.8	6.4
Retirement Income	3.5	32.4	32.7	33.9	26.4
Other Income	1.1	0.6	0.8	0.4	0.4
Renter Households	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Wages and Salaries	68.9	11.4	17.6	4.6	2.8
Self-employment	4.3	1.0	1.5	0.4	0.2
Government Transfers	22.2	69.9	64.1	76.2	78.0
Investment Income	1.2	1.4	1.2	1.3	2.7
Retirement Income	1.0	15.8	14.9	17.2	16.0
Other Income	2.1	0.5	0.6	0.4	0.2

Source: CMHC, 2020

Table 2.7 highlights different types of residential moves made by Canadians (according to age) between 2011 and 2016. As moving underlies how and why local population ages vary so widely, assessing the residential mobility patterns of people over and under age 65 informs how population aging influences other neighbourhood traits (Newell, 1989; Davies & James, 2011). Case

Table 2.7

Canadian Residential Mobility by Age Group, 2016

Mobility Status (5-year Span)	Age <65	65+	65-74	75-84	85+
Did Not Move	57.7	82.0	80.7	83.6	85.1
Moved	42.3	18.0	19.3	16.4	14.9
Moved Locally	22.9	9.9	10.1	9.5	9.3
Migrants	19.3	8.1	9.2	6.8	5.6
Internal Migrants	14.4	7.1	8.0	5.9	5.2
Intraprovincial	*11.6*	*6.0*	*6.7*	*5.1*	*4.5*
Interprovincial	*2.8*	*1.1*	*1.3*	*0.8*	*0.7*
External Migrants	4.9	1.0	1.2	0.9	0.4

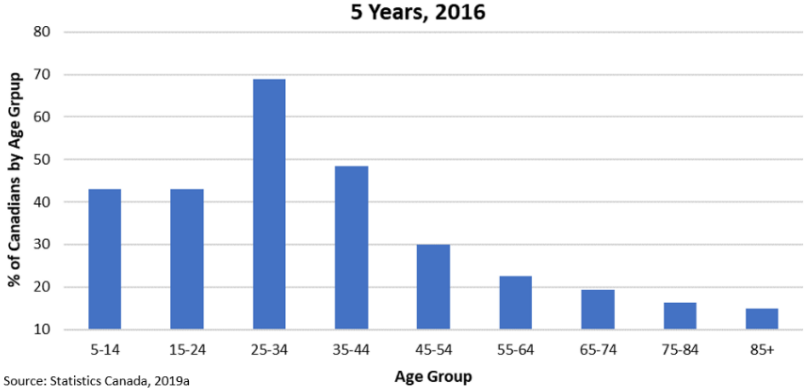
Source: CMHC, 2020

[16] After-tax income is used to reflect 'true' income after entitlements have been incurred; older adults are eligible for benefits like Old Age Security (OAS), a public pension (CPP), and the Guaranteed Income Supplement (GIS) (Government of Canada, n.d.).

in point: people age 65+ move less than half the rate (18%) people under age 65 (42.3%) do. While the 65-74 group relatively more mobile in their early old age (Litwak & Longino, 1987), only 19.3% of them moved between 2011-2016; this already lower share then declines further with age. When they do move, Canadians age 65+ lean towards moves that are local in geographic scope[17]. While most move types decline with age, local moves stay relatively level from early to late older age. Older adults prefer to age in place, if not in the same home, then in the same locality, so they can preserve social connections and their level of place familiarity (Atkins, 2017; Mulliner et al, 2020).

Older adults differ from those younger and from each other according to age, gender, and tenure. As national aging (Tables 2.1 and 2.2) diffuses locally, it will vary (Hodge, 2008). However, some convergence occurs by late old age, despite society's increasing diversity (Walks, 2001; Coulter et al, 2016). As cities grow older, expect households to shrink and for their labor force activity and incomes to decline. With advancing age, peoples' health constraints increase as do the likelihood that households are led by one person and/or a female. How these trends are realized in spatial terms i.e., geographically depends on the neighbourhood e.g., a suburb of owned, detached homes compared to an urban area dense with rental dwellings. If older adults residing in these places differ, then these areas' aging will also differ. A constant among older adults generally, however, is that they have resided in place longer than younger adults (Aurand et al, 2014)[18]. Peoples' mobility overall declines well before age 65, after peaking for transitory early households (25-34)[19] (Figure 2.1). However, mobility rates for adults aged 35-54 still dwarf those aged 65+. As both fertility and mortality rates tend to be stable at the national level and therefore downwards to state/provincial and local levels (Murray et al, 2016), the aging occurring within cities is most influenced by residential mobility (Rosenberg et al, 1989; Moore & Pacey, 2004). More accurately, older adults' general tendency to not move appears to influence how they 'age' neighbourhoods. I thus conclude this section to explore how residential mobility interacts with local population aging processes.

Figure 2.1: Canadian Age Groups by Shares Having Moved in Last 5 Years, 2016



Source: Statistics Canada, 2019a

[17] Within the same census subdivision (CSD), Statistics Canada's depiction of a city or town as defined by its municipal boundaries.
[18] Not only via their age making such a reality possible but by the fact that they move less (Figure 2.1; Newbold, 2011; Smetcoran, et al, 2017). This applies to older owners and renters compared to younger counterparts, respectively, even if renters move more than owners at all ages (Seguin et al, 2016) (unfortunately, CMHC's residential mobility data is not sorted by tenure).
[19] Years of departing home to attend university; enter and leave various living scenarios, including partnering; and/or make early career moves (this particularly fragmented since 2008's Great Recession) in overlapping fashion (Newbold, 2011; Moos, 2016)

2.4 – A Geography of Neighbourhood Aging

Wiseman and Graff (1978) cite several ways age-based migration shapes local geography: residents aging in place, their dying, older adult in-migration, and in- and out-migration of the young (p.390). Hodge (2008) distills these further as aging in place, elderly in-migration, and young out-migration. Surprisingly, he ignores young in-migration, and both ignore older out-migration, forces which drive local 'youthification' (Seidentop et al, 2019). Combined, these demographic mobility processes diversify urban age structures e.g., when younger people move into homes vacated by older residents or vice versa[20]. Spatial segregation by age (Sabater et al, 2017), akin to that by race/ethnicity or class (Bailey, 2012) can emerge, albeit it is far less explored (Vanderbeck, 2007). A period's aging influences subsequent demographic change: clustered aging may attract special services and housing, reinforcing appeal to older over younger adults, resulting in 'naturally occurring retirement communities' (NORCs[21]) that persist over time. While much work describes population aging proportionally, planners should look beyond average age or 65+ share increase as their sole means of understanding this demographic process. This could include approaches such as distinguishing older adult age groups during analyses; including relevant neighbourhood attributes; assessing commonalities and difference between different aging trajectories; and/or assessing how aging trends respond to local factors i.e., how certain traits influence local aging and other socio-spatial change more generally.

The following provides a few examples of how aging neighbourhoods can also starkly differ in their social trajectory. An area ages as young people leave e.g., due to lacking work. Older adults also out-migrate, just at a lesser pace. Despite local decline, some older residents choose to stay, or lack the resources to move. Another neighbourhood grows older as 55-64 and 65+ age in place; a lack of new homes and no out-migration makes it so that nothing countervails local aging. This stability endures for decades until the aged eventually move on. Elsewhere, affluent older adults downsize into an amenity-rich urban area. Businesses then target housing and services to older adults, increasing demand among this demographic, leading to exclusion of younger people with less fiscal capacity. Even incumbent elderly residents – who at one point might have been well-to-do in-migrants – are priced out eventually, their tenure destabilizing with age amidst rising rent (Burns et al, 2012). While all three examples qualify as neighbourhood aging, the various factors mediating these differing demographic shifts result in distinctly declining, stable, and upgrading neighbourhoods. Besides demonstrating clear variance in neighbourhood aging according to both cause and outcome (Davies & James, 2011), the preceding indicates that aging is a type of urban change, and indeed one of its core elements. If age groups differ in trait and behaviour, then aging is indelibly an urban change, even if, to date, this role is underplayed (Rummo et al, 2016; Hochstenbach & Boterman, 2018).

2.5 – The Birth of a Theory of Neighbourhood Change

Since the early 20th Century, the social and spatila organization or urban environments, often referred to as human or social ecology, has been extensively researched. Seminal theories, notably the Chicago School pioneered

[20] Obviously, residents of like age replace each other e.g., one young family for another; the example merely illuminates dynamics.
[21] Areas with high shares of older adults relative to their surrounding environs (Bookman, 2008; Davies & James, 2011).

by Parks, Mckenzie, and Burgess (1925), posit that households "'filter up' through the housing supply" with increasing size, resources, and status while "[h]ousing and neighbourhoods. . . filter downward" with age/decline, becoming "economic[ally viable] for progressively lower income groups" (Gale, 1979 p. 293). Thus, cities manifest 'ecological niches' of low, middle, and high status (Brown, 2002). The construction of new residential developments at the urban periphery initiates ecological change. As the newest, 'best' housing enters the market at the city's edge, high status households leave their older, high-status housing in more-central neighbourhoods, thus providing residential vacancies for lower class households to move into. Declining social status resulting from these out-, then in-movements by the different groups drives further exodus of high(er)-status residents, opening more room for lower class households and continuing the process of local class-based decline. A concentric pattern emerges upon the urban landscape as the oldest, deteriorating core neighbourhoods host those residents of least means while successively more affluent residents dwell further out in increasingly distal and new(er) suburbs. The physical age and aging of local housing, relative to other neighbourhoods, underlies these shifting ecological patterns whereby lower status households initially 'invade' and eventually 'succeed' neighbourhoods previously held by higher status households who have left these aging districts for more desirable, peripheral areas (Owens, 2012).

While simple, this concentric zone model makes it clear that although urban change is driven by shifts in local population, the ways in which residents sort themselves is highly dependent on factors related to neighbourhoods' spatial qualities, housing quality primary among these (Teernstra & Van Gent, 2012; Weisel, 2012). These qualities, such as the supply and distribution of dwellings; their conditions, desirability, and access to employment and amenities; and local attributes (nature, traffic, social delinquency) inform the value of local real estate (Gaddy & Hart, 1993; Mathur, 2019). These values in turn mediate who can access certain dwellings. Following closely the work of the Chicago School, Hoyt (1939) drew early connections between cities' distribution of rents and the ecological sorting of residents according to income, an attribute highly reflective of their social status[22]. Income and real estate values conjointly moderate the process of *income sorting* i.e., that different types of households locate in a city according to their status and resources[23]. The social character of cities thus shifts in myriad ways as housing 'values' fluctuate (Reardon & Bischoff, 2011; Gurran & Bramley, 2017). Diminishing home values, brought on by the aging of neighbourhoods, relative to each other, instigates socio-spatial change. As neighbourhoods age and decline in social status[24], ongoing income sorting fundamentally organizes the social ecology of urban environments (Gale, 1979: Weisel, 2012). For Hoyt (1939), the allocation of housing by age and type, as well as other local attributes, over time – via income sorting processes – produced a social ecological pattern that resembled a pie-shaped, sectorial configuration of low-, middle-, and high-status areas throughout the studied city (Chicago).

[22] Income also highly varies according to age, gender, household structure, tenure, occupation, education, and ethnic status.
[23] Preferences also drive sorting; "choices related to household type, cultural background, and lifestyle preferences can cut across those based on income" (Bailey et al, 2017 p. 2). Given major portions of household income is spent to maximize the benefit of dwelling and neighborhood choices, income is nonetheless a major determinant (Dube et al, 2014; Duranton & Puga, 2015).
[24] A social marker made explicit and in fact operationalized via housing values that regulate who can live where.

Building on this, 'spatial equilibrium' models (Alonso, 1964; Mills, 1967; Muth, 1969) contend households will optimize their overall utility between housing consumption and access to employment (Dube et al, 2014; Duranton & Puga, 2015), which is found solely in a Central Business District (CBD) where homes are priciest. As price decays with distance, housing then tends to cost less, albeit commuting to and from the CBD then costs more. Thus, a familiar concentricity emerges in cities based on the continual equilibrium of housing and transport costs as one ranges further from the CBD towards the urban periphery. Households balance trade-offs to arrive at their own state of equilibrium between these costs, shifts in their income and/or needs provoking a move to restore equilibrium. Households will live further from the CBD if they save more on housing than spent commuting (Revington, 2015). Thus, the post-WWII era's burgeoning use of the automobile and resultant highway building contributed to mass expansion of residential development in cities' suburban peripheries. As housing values and thus the desirability of neighbourhoods shifted in respect to their new positionality relative to the CBD and to highways as access, households with the means to do so optimized themselves out of core areas, leaving behind housing now degraded in value which would then become occupied by poorer residents (Higgins & Kanaroglou, 2016). While not necessarily revolutionizing the study of urban social ecology, these models introduced a systems-level, and highly quantitative perspective into the conceptualization and study of how cities' structure and restructure themselves with time, one founded upon the utility achieved by individual households in their locational decisions.

Hoover and Vernon (1959) draw heavily on concepts of social ecology in their stage-based, neighbourhood life cycle model that integrates dwelling and population traits, including age, to explain how (and why) neighbourhoods undergo consistent, successive phases of urban decline and renewal.

- Stage One: Development and occupation of new housing oriented towards younger, single-family households
- Stage Two: Continued residential development, but at higher densities i.e., new apartment buildings
- Stage Three: Now aging homes 'downgrade' towards denser ('overcrowded') rental tenure[25]
- Stage Four: The neighbourhood 'thins out' as its populace ages, and older, smaller households prevail[26]
- Stage Five: Dwellings and residents terminally decline, thus replaced by new builds and younger households[27]

Life cycle theory assumes predictively linear co-decline in markers of local demography, tenure, and housing quality (Wiesel, 2012). Invasion and succession of households by their status occurs in clearly delineated stages (Schwirian, 1983). As neighbourhoods are built and occupied, the initial inhabitants and their homes age. New(er) areas then attract newer i.e., younger households. As aging neighbourhoods are abandoned by those "with the income and wealth necessary to occupy" new housing built elsewhere, they become "occupied by households who [themselves] previously resided in a slightly older neighbourhood" (Aurand et al, 2014 p. 138). The development of new housing and the formation of new households tend then to co-occur such that neighbourhoods' physical age and population

[25] This stage is also marked by transitions in social, ethnic, and cultural make-up.
[26] This stage also portends dwellings' continual physical decline given residents' limited incomes.
[27] I.e., a return to Stages One or Two (Schwirian, 1983; Wiesel, 2012; Demelle, 2017).

age structure begin to overlap. While staged local income sorting is drawn from prior models, the neighbourhood life cycle seminally incorporates residents' age and aging (as well as shifts in household type, racial/ethnic character, and tenure) to explain local "social and physical decline and renewal" (p.146). These early attempts to discern cities' socio-spatial patterns – from the Chicago School to the neighbourhood life cycle – continue to inform urban studies, the city as 'ecological' construct permeating contemporary research on neighbourhood income sorting (Weisel, 2012; Duranton & Puga, 2015; Bailey et al, 2017; Silver & Silva, 2021). Ignoring the neighbourhood life cycle model's linear determinism for now, let us assume its staged local downgrading proceeds to a final phase of degradation. This provides opportunity to explore how 'upward' urban change unfolds i.e., how neighbourhood upgrading, both in population and structural elements, is said to occur once downgrading reaches a terminal point.

2.6 – Gentrification's Ascent within Urban Geography

If any urban change but that of neighbourhood decline "was generally ignored" in the early 20th Century (Teernstra & van Gent, 2012 p. 91), research on neighbourhood upgrading has matured substantially since. Specifically, the revitalization of downtrodden, working-class urban areas, referred to as gentrification[28], has for decades occupied the academic study of urban change (Owens, 2012; Bailey et al, 2017). While other types of urban transitions are vital to understand, for now gentrification proves a useful departure from the life cycle. Coined mid-1960s to describe rehabilitation and ensuing status increase of degraded housing in working-class London[29] (Glass, 1964), gentrification is now argued to be global in scope (Smith, 2002; Maloutas, 2012), the process itself changing over time in both the factors driving it and resulting outcomes (Lees, 2000; Hackworth & Smith, 2001). Broadly defined as "the class-based transformation" of the city (Hochstenbach & Boterman, 2018 p. 1; Lees et al, 2008; Shaw, 2008), gentrification comprises a process of local upgrading via the in-migration of high(er)-status residents, the revitalization of local housing, and the deconversion of rental housing[30] back to owner-occupation (Walks & Maranaan, 2008 p. 3). More accurately, higher-status newcomers 'displace' existing locals via escalating housing values that put rent or ownership out of original inhabitants' income reach; similarly, rental stock deconversion eliminates access for many lower-status households unable to afford ownership (Slater, 2006; 2009). This upward process of invasion and succession via income sorting is the ironic inverse of similar, downward filtering processes observed by the Chicago School and further refined by neighbourhood life cycle models (Teernstra & van Gent, 2012). Selective in-migration of higher-status residents is distinct from social change driven by a neighbourhood's existing residents, referred to often as *in situ* change e.g., if residents increase their social status via education or career advancement while staying in in the same neighbourhood (Bailey, 2012; Hochstenbach & van Went, 2015).

Whether gentrification is a demand- or supply-side process once bifurcated debate. Each theoretical stance, however, is useful for highlighting and assigning key roles to various actors and social and spatial processes involved

[28] When the affluent in-migrate to previously underinvested boroughs for economic, social, and aesthetic reasons; destinations' socioeconomic and physical upgrading typically displaces poor(er) incumbents (Glass, 1964; Walks & Maraanan, 2008).
[29] Soon observed as a process occurring in other major urban centers, such as New York (Hackworth & Smith, 2001).
[30] Rental housing, often in poor condition, being the spatial legacy of previous stages of neighborhood downgrading.

in gentrification (Maloutas, 2012; Rigolon & Nemeth, 2019). On one side, demand-side theory attributes upgrading to the residential location choices of a young, upwardly mobile middle class that prefers urban qualities such as amenity proximity, walkability, and historical aesthetic (Teernstra & van Gent, 2012; Chapple et al, 2017). These align well with the depressed housing of inner-city neighbourhoods hollowed out by postwar suburbanization (Bounds & Morris, 2006). Ley's (1996; 2003) work on the gentrification of Canada's largest cities, including Toronto, specifically highlights the role artists and others with high cultural capital play in driving early stages of neighbourhood upgrading. Despite their own economic marginality, these sorts of pioneers catalyze the local transformation of social character away from working-class traits deemed less desirable by potential gentrifiers (Rose, 1984; Zukin, 1995). On the other side, supply-side contends that capital flows in and out of neighbourhoods define gentrification. Despite diminished home values, many degraded areas are still rich in amenity access or urban character. This marks a gap between low actual rent and higher potential rent that incites the purchase, rehabilitation, and repositioning of homes in these downgraded areas towards occupation by high(er)-status residents (Smith, 1979; Shaw, 2008). Whole neighbourhoods are now bought, demolished, and rebuilt as 'new build' gentrification, often accompanied by significant commercial elements meant to serve incoming residents (Smith, 1996; Shaw, 2008; Rankin & McLean, 2015). Wholesale urban revitalization is increasingly supported by municipal incentives and policy (Zuk et al, 2018).

Demand and supply merge in stage-based models of gentrification (Walks & Marannan, 2008). Albeit not all gentrifying areas traverse each stage, nor complete them (Rose, 1996), these sorts of models illustrate the mechanics said to underlie gentrification. Initially, pioneers with incomes and status not too far removed from existing, working- class residents in-migrate and (via their own labor and investment) revitalize local homes, shifting local social character and reversing the assumed decline of the neighbourhood (Ley, 2003; Rose, 1984). In subsequent stages, those of higher status view the area as a safer, more appealing residential location, inviting further upgrading and the ongoing increase of local rents. The neighbourhoods rising status (demand) and the potential profit to be earned on rising home values (supply) inspire the "deconversion of former rental housing to ownership, and renovation of commercial properties" which drives further expulsion of lower-status residents (Walks & Maraanan, 2008 p. 4; Teernstra & van Gent, 2012). Final stages see 'complete' socio-spatial renewal. In some cases, escalating property values inspire wholesale reconstruction, ironically displacing original gentrifiers (Lees, 2000; Shaw, 2008). As in downgrading, gentrification sees local SES and dwelling values co-improve as households and other actors respond to opportunities and incentives e.g., initially low costs and/or ascending status.

Today's gentrification starkly differs from earlier decades, given significant global changes (re)shaping cites i.e., post-industrialization, globalization, economic liberalization, and real estate financialization (Hackworth & Smith, 2001; Bounds & Morris, 2006; Butler & Hamnett, 2009). 1960/1970s' gentrification is attributed to the early adulthood of a "distinctive new middle class" whose values formed in 1960's youth movements (Lees, 2000 p. 396)

and who reject suburbia[31] (Ley, 1996; Bonvalet & Ogg, 2007). De-industrialization, then neoliberalization during the 1970/1980s, saw fiscally motivated owners and developers more prominently rehabilitate degraded homes (Hackworth & Smith, 2001). In response to economic shocks in the early 1990s and more recently 2008, municipal and other government actors support private renewal of disinvested urban spaces into high status residential and commercial enclaves (Teernstra & van Gent, 2012; Zuk et al, 2018). The macro-level social, economic, and political context in which each wave occurred (or is occurring) ensures today's older and recently gentrified areas differ as much as "ungentrified and gentrified property [did] back" then (Lees, 2000 p.398). Despite divergence, however, all waves represent a distinct form of neighbourhood upgrading via class transformation, insofar as change is driven by in-migration of higher status households who replace lower status incumbents (Slater, 2006 p. 747).

With demand- and supply-side compromised (Shaw, 2008), whether gentrification occurs via "class politics resulting in displacement or population shifts related to demography and economic restructuring" is the debate *du jour* (Hochstenbach & van Went, 2015 p. 1480) Age now features more prominently compared to an early, nominal role e.g., the young, upwardly mobile (Bonvalt & Ogg, 2007; Hochstenbach & Boterman, 2018). While many insist gentrification only applies to higher status households displacing existing residents (Atkinson, 2002; Slater, 2006, 2009; Shaw, 2008), others argue that social upgrading can also occur as an aging working class downsizes or passes on through demographic replacement (Buzar, 2005; Bailey, 2012; Hochstenbach & van Went, 2015). Class transition can occur via two distinct pathways, in turn influencing the neighbourhoods that emerge.

Bailey (2012) refers to how young adults' housing career begins with their launch from the family home into low status areas. A "demographic conveyor" of young people – whose education, income, and status tends to out-scale these places' existing inhabitants – flows through downtrodden areas (p. 707). Local uplift of social status may stall, however, if these in-movers are transitory. Van Criekingen and Decroly (2003), drawing on Rose (1984), describe spaces that initially upgrade as young adults capture cheaper housing found within. However, gentrification flatlines as many move out at familial age, replaced by new streams of younger adults. Local status change can also derive from de-industrialization that has "led to an overall [absolute] growth of middle-class professionals and a [corresponding] decline in [the] working class" (Hochstenbach & van Went, 2015 p. 1484; Butler & Hamnett, 2009). This differentiation is not meant to deny the presence of displacement in either process, that this displacement is worth preventing (Slater, 2006), or that "housing become[s] harder to [afford] as gentrification advances" (Shaw, 2008 p. 1702). It is meant to broaden understanding of urban change processes beyond 'traditional' gentrification by depicting more complexly nuanced transitions in neighbourhood social and spatial character.

2.7 – Moving Beyond Gentrification

Most gentrification research centers on a particular socio-spatial ascent involving entry of middle- or upper-class households, displacement of existing residents, reinvestment of capital, and clear social and physical change.

[31] These are the same Boomers driving, and supposedly changing population aging in the current period, in much the same way they 'pioneered' early forms of upgrading in urban neighbourhoods in preceding decades (Hochstenbach, & Boterman, 2018).

While sharing life cycle theory's staged income sorting, research now extends beyond change as being ahistorical, predictive, linear, and uniform across urban space (Bounds & Morris, 2006; Slater, 2009; Hochstenbach & Boterman, 2018). Lees (2003b) is among many (Rose, 1996; Shaw, 2008) for whom gentrification is a "chaotic concept. . . contingent [as a rule] and [the] geographically specific result of different processes operating [differently] in different contexts" (p. 2491). However, variance is also attributed to researchers who continue to include more forms of social 'upgrading' increasingly removed from gentrification's core definition (Van Criekingen & Decroly; 2003; Owens, 2012). Some deem this to stray too far conceptually, weakening gentrification as an analytical construct while obscuring the specific, and unique nuances of other forms of socio-spatial upgrading (Maloutas, 2012).

Shaw (2008) calls for a 'continuum' to organize this increasing inner complexity (p. 1719-20), defining what gentrification is and is not, to clarify changes within and without its sphere (Owens, 2012). For instance, Walks and Maranaan (2008), examining change between 1960-2001 in Toronto, Montreal, and Vancouver, require studied neighbourhoods to first have income and housing values lower than a regional average but then later become above average for them to qualify as 'gentrified'[32]; anything outside of this is considered an incomplete change. They also do not count instances where (originally) middle- and high-status areas ascend into high(er)-status neighbourhoods. Along these same lines, should local transition from low(er) to high(er) status via demographic replacement be considered similarly distinct? Suppose a new, middle-class neighbourhood's housing is settled in the 1960s. As residents retire, incomes decline yet home values do not (Teernstra & van Gent, 2012). As these aging residents later age out, replaced by younger, working households, uplift in local SES occurs, but only in a technical sense since no genuine residential class change occurs. Is this genuine gentrification, especially absent displacement, or a meaningful change in housing tenure or condition (Butler & Hamnett, 2009)? Given calls to explore urban change beyond gentrification, I use these distinctions as a springboard to identify and discuss other types of urban change more generally. This helps uncover where population aging currently rests in said constellation of neighbourhood dynamics and where it could be better integrated as a means of understanding demography's role in urban change.

2.8 – Changing Perspectives on Neighbourhood Change

Walks and Maranaan (2008) identify continual middle- and upper-class neighbourhoods' 'consolidation', as well as their decline and recovery ('recapture') as "trajectories of upgrading" distinct from 'true' gentrification (p. 18-19). However, focus on start and finish overlooks how and why changes occur. Focus on selective in-migration also denies existing residents' capacity to change *in situ* (Clay, 1979; Owens, 2012), via their own social mobility (Hochstenbach and Van Went, 2015; Bailey et al, 2017). Neighbourhoods can internally upgrade as people improve their own incomes and homes. This social mobility is shown to be a comparable if not superior driver of local uplift compared to in-migration (Bailey & Livingston, 2007; Bailey, 2012). Areas with low turnover ascend and decline, while others "remain socially stable [despite] high turnover" (Schwirian, 1983 p. 93; Schwirian & Berry, 1982).

[32] They also incorporate changes in shares of artists and residents of status, and tenure and housing stock transition to further clarify these 'gentrifications' and their 'completeness' over the series of decades, as per changing historical contexts.

Middle-class areas experience the decay of local incomes via their residents' departure from the work force, without other social decline (Teernstra & van gent, 2012) while transitory spaces remain marginally gentrified by a constant flow through of transitory early households (Van Criekingen & Decroly, 2003; Seguin et al, 2016). Moving further afield from gentrification's focus on SES up- and downgrading, and the theories seeking to assign causality to these processes, the following reviews recent empirical studies of neighbourhood change. Here, many studies return to more seminal constructs deriving from social ecology e.g., neighbourhood life cycle. However, they do so in a more theoretically relaxed sense, and allow the patterns which emerge in their results to speak for themselves as opposed to adhering to prescriptive frameworks as is more often the case in gentrification research. In doing so, this growing cohort of studies find socio-spatial patterns outside of narrow, linear trajectories of housing and income status.

Hedman et al (2011) and Owens (2012) identify several types of up- and downgradings with their own distinct demographic, dwelling, and racial/ethnic attributes. They find household choices to sustain equilibrium between preferences, status, and neighbourhood status underpin the reproduction, or social stability of neighbourhoods. Foote and Walter (2017), categorizing neighbourhoods demographically and by housing type to assess their social restructuring, find a relatively diverse range of neighbourhood types as opposed to a presumed uniformity, among both suburban and immigrant-dominant spaces' character and the transitions these spaces undergo. They note the vital role of 'place'[33] in moderating the nature and extent of the varied socio-spatial changes they observe. Mikelbank (2011) and Delmelle, (2015; 2016) use cluster analyses to group studied neighbourhoods into 'types' according to their shared features (i.e., their statistical similarity); they then map and assess how each type tends to change[34]. They uncover several common types, which they refer to as *Suburban, Stability, Struggling,* and *New Start*[35], that are distinct in SES, demography, residential turnover, housing, and urban location. Further, each type experiences different trajectories of transition between types over time[36]. Using principal component analysis, Murdie, Logan, and Maranaan (2014), in the Canadian context, also find several types of urban change i.e., three forms of aging in place, each distinct in SES trajectory. They also find that ethnically concentrated neighbourhoods tend to change along differing trajectories according to their respective age structures.

Delmelle (2017) finds suburbs diversifying socioeconomically and racially, relative to homogenizing central cities, building on Ehrenhalt's (2012) 'great inversion' thesis whereby those of high(er)-status now return to core neighbourhoods while suburbs increasingly play host to lower-SES residents. This diverges from prior, seminal

[33] I.e., neighbourhoods' location in the core versus the periphery, local access to transportation and amenities.
[34] As with many quantitative approaches urban geographers employ to identify and typologize neighbourhoods (e.g., factorial ecology, cluster analysis), these authors label the 'types' they uncover to portray neighbourhood character in a manner easily relatable both to readers and to types uncovered in other research. Davies (1984) devotes an entire chapter in his foundational text on factor analyses to the importance of labelling that is clear, reflexive, and relatable to existent precedent i.e., general conceptual domains uncovered in prior studies, as seen via overlap in types used by Mikelbank (2011) and Delmelle (2015; 2016).
[35] Additional types not common to all three include *Blue Collar, Struggling African American,* and *Elite.*
[36] E.g., *Suburban* ('newer', family-oriented housing, peripheral) become the *Stability* type (more akin to aging, inner suburbs) via residents' aging-in-place. Meanwhile, *New Starts* (denser housing in/near core areas, mobile early households) tend to remain that type as residents in early stages of adulthood filter through continuously (akin to places 'stuck' in marginal gentrification).

conceptions of a diversely precarious 'urban' and a homogenously affluent 'suburban'. She also finds diverse neighbourhoods that remain so, avoiding the concentration of certain attributes. Stability, she notes somewhat ironically, is the most common trajectory of change: "most neighbourhoods remain the same, at least over. . . several decades", despite academic focus on change (p. 2409). Silver and Silva (2021) assess a broad array of Toronto's changing socio-spatial attributes from 1996 to 2016. They find neighbourhoods diverge along axes of social 'creativity'[37], urban v. suburban lifestyle, and marginality. These continuums also overlap, such as in high- and low-income immigrant areas and suburbs that are socially diverse and others homogenous. They find several types of change (albeit reproduction/stability are common), including how neighbourhoods' proximity to those of other types influences the change they experience[38]. Unsurprisingly, studies such as these which incorporate many socio-spatial attributes, and which avoid narrow(er) conceptions of how change can occur uncovers diversely complex neighbourhood types and change patterns beyond life cycle decline and gentrification.

2.9 – A Role for Aging Beyond Neighbourhood Decline

In terms of situating the role demography plays in the study of urban change (Buzar et al, 2007; Rummo, 2016), let us recall the crude function of age in the neighbourhood life cycle: newly built areas initially populate with young families while "beyond a certain tipping point, ageing neighbourhoods [undergo] complete take-over by an elderly population", resulting in "devastating" physical and social decline (Weisel, 2012 p. 150). The heuristic is not entirely errant: dwellings and people age; household size and income decline with age; and the elderly tend to stay, 'locking' in aging. Homes must eventually turn over to younger, often larger, and higher-income households. However, this determinism belies urban complexity (Delmelle, 2017; Silver & Silva, 2021) and age's role therein (Bonvalet & Ogg, 2007; Burns et al, 2012). Gentrification studies also prioritize young adults, with supposedly high social and (eventual) economic capital, as key drivers of this form of urban change (Ley, 1996; Walks & Maranaan, 2008; Boterman et al 2010). Even as age begins to feature both more prominently and in ways more nuanced than in the urban research of prior decades (Buzar et al, 2007; Teernstra & van Gent, 2012), the young still play a dominant role (Seidentop et al, 2019) while older age constructs evolve little. 'Replacement' is but a tidier way of saying the aged impede turnover in their later years until eventual departure (Hochstenbach & van Went, 2015). Recent works foreground age, exhibiting a highly generational gentrification where older adults feature prominently.

While older adults are often seen as victims of gentrification via displacement or as enduring disruptive neighbourhood changes (Burns et al, 2012; Buffel & Phillipson, 2019), they are now increasingly seen as active contributors to urban change. In early waves, social and physical renewal in depleted inner cities was driven by Baby Boomers (Hochstenbach & Van Went, 2015), who while young adults and early households, are now the ones driving population aging. Many Boomers in large cities such as Toronto likely still inhabit those inner-urban areas that they

[37] At the high end, typified by educated, young(er), mobile households working in jobs requiring high social and cultural capital and living in trendy urban neighbourhoods (p. 15), reminiscent of Florida's (2002) 'Creative Class'.

[38] I.e., marginal areas close to creative spaces tend to transition into creative spaces themselves more often than those marginal spaces which are more distal from creative spaces.

initially gentrified years ago, or other neighbourhoods they have uplifted in their housing careers (Bonvalet & Ogg, 2007). Whether staying urban or eventually suburbanizing, early gentrifiers still transmit social-spatial tastes to their offspring and fund the housing careers of their children in competitive real estate markets (Revington, 2018; Hochstenbach & Boterman, 2018). Recent research focus also shifts from young gentrifiers to other age groups, including families (Boterman et al, 2010; Goodsell, 2013) and near/recent retirees (Bounds & Morris, 2006; Danyluk & Ley, 2007). Hochstenbach and Boterman (2018) argue this age-broadening of who can gentrify reflects sustained "efforts to 'sell' neighbourhoods or new developments" as culturally resonant "lifestyles where class and age intersect"[39] (p. 11). While still conceptually bound under a gentrification lens, these and similar works highlight how age is increasingly seen as foundational to peoples' social situatedness and their roles in urban change, which extends the field beyond early binaries of young/ascent and old/decline.

Recent works center aging. Rummo et al (2016) assess four major US cities' (1980-2011) to find that, while increasing older adult shares correlate with density decline (life cycle 'thinning out'), declining poverty and increasing incomes and education rates do not support aging as downgrading. Aurand et al (2014) identify NORCs across a mid-size US city (2010), finding old age "under-represented in economically disadvantaged, residentially unstable" areas and concentrating in the opposite (p. 153). Both find aging relatively prosperous, stable, and suburban. Channer et al (2020) find that while Canadians age 65+ lean suburban, those "in low income, [in] immigrant neighbourhoods, and [who speak a] foreign language" are distinctly urban[40] (p. 5). In Toronto, however, ethnically diverse older adults cluster in the suburbs, reflecting a regional specificity to older adults' socio-spatial patterns. Seguin et al (2016) find middle ground in Montreal neighbourhoods' aging trajectories (1981-2006), correlating these to 1981 measures and 25-year change. Many inner-urban elderly concentrations diminish, while inner and outer suburbs age, albeit both trajectories delineate further by magnitude. The strongest predictors are 1981 shares of 45-64; 1981-2016 change in 0-14; and 1981 1-person household shares and 25-year change. Aging-in-place and young family migration informs local aging. Living alone is more complex within trajectories of increasing and decreasing elderly concentrations, as younger individuals also traverse solitary, and precarious, early housing careers (Van Criekingen, 2010).

Early households, which are comprised largely of young(er) adults, factor heavily in urban changes occurring specifically in many cities' core areas. Recent decades see journeys into adulthood marked by housing and labour market precarity and increasingly extended, erratic transition from home into career, housing, and family trajectories which early on are distinctly urban (Van Criekegen, 2010; Hochstenbach, 2018). Central city rental dwellings (ideal for multiple single tenants) clustered near jobs, transit, and amenity, grow increasingly youthified and/or studentified[41] (Moos, 2016; Revington, 2018). As an already dynamic life phase further upended by adverse structural conditions, early households mould urban demography as they cluster in shared circumstances, recalling

[39] An oft-cited example is the empty nester household recently enriched by downsizing the family home.
[40] The authors also cite how these vulnerabilities overlap with age-increasing solitary living and activity constraints (Section 2).
[41] A variation marked by student concentration proximate to post-secondary institutions (Smith, 2005; Seidentop et al, 2018).

marginally gentrified (Van Criekegen & Decroly, 2003) and *New Start* areas (Delmelle, 2015; 2016). Given suburban aging / urban 'younging', age segregation is an emerging theme (Winkler, 2013; Seidentop et al, 2018), although some note core area's costs can decentralize young adults (Moos, 2016; Revington, 2018). Further, Walks et al (2021) find Boomers primarily drive growth in central Montreal, Toronto, and Vancouver in the 20 years between 1991 and 2011. They find that these CBDs are not getting younger, but instead are aging at a slower rate than are surrounding suburbs. This is due to young(er) adults tending to live as centrally as possible, which counterbalances shares of adults in later stages of life which contribute to a generally more aged population structure.

This complex interweaving of demographic and socioeconomic processes support Van Criekingen's (2010) claim that a proper understanding of urban change requires understanding how it is that social status influences dynamics of aging and household formation/dissolution. Bonvalet & Ogg (2007) assess the housing trajectories of London's and Paris's upper-, middle-, and lower-class Boomers. The former were the ones to pioneer local gentrification in the 1960/1970s, while those of lower-class cannot afford to reside in neighbourhoods they grew up in. Demographic shifts give rise to different forms of urban change (Van Criekegen, 2010; Revington, 2018) while these changes in turn influence local demographic structure. Urban change is varied in its underlying dynamics and outcomes at a local level, but also in how neighbourhoods undergo change in the different regional and (as evident via Boomers' unique role transforming urban space in prior eras) historical contexts in which they occur. One constant, however, is that aging largely affects urban change via households' locational behavior as they seek certain neighbourhoods at various stages of their journey from early through late and into older adulthood. These life stages influence where and why people move via, for instance, the different demographic and socioeconomic processes which people experience in their 20s vs. their 40s. vs their 60s.[42]. Thus, age-based residential mobility is the primary axis that ties together neighbourhood social and spatial characteristics and the changes these incur with time.

2.10 – Age and its Role in Mobility Patterns

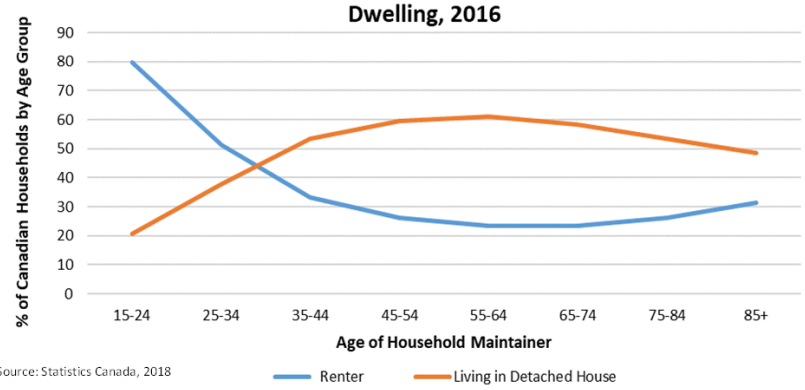
Neighbourhoods demonstrate considerable variability, in terms of socio-spatial attributes and how these covary together. However, discernable patterns emerge when comparing urban and suburban neighbourhoods, or when considering things such as dwelling costs and income sorting. It is also clear that these sorts of social and spatial factors converge via household decisions to move, or to stay and change *in situ* (Rosenberg et al, 1989; Bailey et al, 2017). Having surveyed urban change (including age's role therein), I reorient to the discussion of resident mobility, where age plays a prominent role both in theory and empirical analyses. Fundamentally, peoples' progress through predictive stages of life strongly influences location (Rossi, 1955; Plane & Jurjevich, 2009), including in later life (Litwak & Longino, 1987; Davies & James, 2011). The following explores how age-based mobilities have adapted to "the de-standardization of life" via recent decades' economic, social, cultural, and political change (Coulter et al, 2016). Then, I review specific findings of factors influencing residential mobility, particularly that of older adults.

[42] I.e., family formation and dissolution, educational and career advancement, retirement.

Seminal migration theory heavily cites the concept of life cycle, this time of humans (not neighbourhoods). From early to late adulthood, households move to optimize their resources, lifestyle, and success during succeeding stages of school, work, coupling, child rearing, and retirement (Rossi, 1955). The life cycle model assumes preferences follow a linear "social timetable"[43] (Elder, 1975 p.165), informed by the era's social homogeneity. Such "staged chronologies", however, could not withstand the 20th Century's increasing social diversity (Schwanen et al, 2012 p.1293; Coulter et al, 2016). Deviance from education, career, and household formation norms, in addition to social fragmentation, make age a less effective mobility indicator (Moos, 2016), yet Plane and Jurjevich (2009) contend, "the 'age schedule of migration' [maintains]. . . a strong empirical regularity" (p.5). Despite 'de-standardization', the following is common in aggregate: leaving home, mobile young adults seek affordable, flexible, urban rentals near work or school (Davies & James, 2011; Moos, 2014). If/as they form families, they suburbanize to satisfy space requirements, settling there for mid/late adulthood (Plane & Jurjevich, 2009; Newbold, 2011). While most older adults age in home, some moves occur near retirement, or with advancing age, for financial or health needs (Hodge, 2008). A nuanced life course succeeds the life cycle, reconciling social diversity with a sustained, age-based regularity to where we live and why, but not without new irregularities (Coulter et al, 2016). These concepts are also advocated for in urban change analyses (Hochstenbach & Boterman, 2018).

Households weigh homes' suitability in respect to new and/or anticipated conditions (i.e., work, childbirth) to maximize utility in their day-to-day activities. Moves also reflect household resources i.e., younger people, incomes limited in early careers, live in small, cheap(er), flexible urban units, then tend to favour home ownership as their tastes, needs, and assets develop with age (Figure 2.2) (Van Creikengen, 2010; Seidentop et al, 2018). Litwak and Longino (1987) contend three major events define the moves of older adulthood: retirement (move to optimize lifestyle); moderate disability (to be near family/support); and eventually major disability (to receive institutional support). Not all older adults make these moves, but these late life events often motivate older households to relocate and lead to demographic replacement (Buzar et al, 2007; Bailey, 2012). The life course is agential: peoples' aged-based resources and preferences underlie why they reside in different types of homes and neighbourhoods. A parallel is demand-side gentrification driven by in- and out-movers (Ley, 1996).

Figure 2.2: Canadian Age Groups by Share of Tenure and Dwelling, 2016



Source: Statistics Canada, 2018

[43] One of 3 age(ing) concepts; the others are a) chronological-developmental aging: the physio-social aspects of aging e.g., maturity, declining health, and b) age as historical location: how collective experiences differentiate birth cohorts.

The life course is one of several concepts informing migration behaviourism, emerging as "decision-based models . . . for characterizing residential change" (Wiseman, 1980 p. 146). Households constantly weigh current to potential home. Migratory push and pull help deconstruct this decision-making (Hear et al, 2017). Push factors are adversities driving households from current residence e.g., local decline, failing health (Pope & Kang, 2010); pull factors are destinations' valued attributes e.g., amenities, suitable housing (Tyvimaa & Kemp, 2011). Attachment to current location exacts pull. Many older adults' long tenure informs place affection that reinforces staying (Hodge, 2008). However, if motivating factors reach excess, households move (Hansen, 2005; Atkins, 2017). Recent mobility research delineates voluntary from involuntary relocation (Smetcoran et al, 2017). Gentrification epitomizes how rapidly rising rents and tenure conversion act as a 'push' (Slater, 2009). Similarly, not all staying occurs by choice (Bonvalet & Ogg, 2007). 'Stillness' (voluntary) differs from 'stuckness' (involuntary) when limited income cannot secure suitable housing in a more desirable area (Cresswell, 2012; de Jong & Brouwer, 2012).

Agential models should more fully consider agent-structure relations (Geist & McManus, 2008; Coulter et al, 2016). Gerontology's person-environment framework pits agents' capacity against environmental stress (Lawton & Namehow, 1973). If stress overcomes capacity and in situ fixes are lacking, people relocate. These are familiar, later life moves made as physiological decline limits activity (Litwak & Longino, 1987; CMHC, 2020). Lacking capacity also informs inertia despite distress (Hodge, 2008). Clearly, relevant household-exogenous factors represent structural influences, not only from the built environment, but economic conditions and urban policy. Stockdale and Catney (2014) argue residential mobility is too complex "to be reduced to [age-based] pattern norms" given the role of "structural factors" (p.85). These resemble supply-side gentrification, in that macro factors shape not just where moves occur, but functional inputs of preference and resource: mobility is economically embedded (Fielding, 2012; Findlay et al, 2015). As with demand-supply convergence, agential and structural both inform mobility's role in urban change. The following explores factors influencing mobility, especially in later life. While most are settled, several e.g., income (Weeks et al, 2012) and urban form inclination (Patterson et al, 2014) remain contested, inviting review.

2.10.1 – Mobility Factors Relating to Household Characteristics

Older adults move less than younger people (Smetcoran, et al, 2017). However, the process of aging, for most people, corresponds to shifts in lifestyle and major events, such as family formation and retirement that inspire people to move house (Hodge, 2008; Dorfman & Mandich, 2016). Individuals move more than couples at all ages (King & Newbold, 2009; Seguin et al, 2016). Widows especially favour supportive housing (Weeks et al, 2012). Childless couples move more often, evoking an 'empty nest' (Davies & James, 2011; Atkins, 2017). Income affects mobility, both generally (Moos, 2014) and for older adults specifically (Smetcoran et al, 2017). However, whether higher (Han & Kim, 2016; King & Newbold, 2009) or lower income households (Dorfman & Mandich, 2016; Séguin et al, 2016) move more is still vague (Weeks et al, 2012): while more money implies more capacity to undertake a move, those poorer are likely unstable in their tenure, which is often rental and therefore less secure. Conversely, meagre incomes can inform peoples' 'stuckness' in an unsuitable home (Cresswell, 2012; Ostrovesky, 2004; Weeks

et al, 2012). Households' tenure i.e., owning as opposed to renting, matters for their propensity to move: renters move far more frequently. Length of tenure is also seen to influence mobility, insofar as longer residency via aging-in-place (at any age) tends to decrease the chances a given household moves (King & Newbold, 2009; Han & Kim, 2016). People also seek social homogeneity i.e., to live near those they resemble (in status, age, race/ethnicity) (Bailey, 2012; Musterd et al, 2015). For instance, those of higher income, homeowners, and Caucasians appear more sensitive to lower status groups' adjacence and are more likely to want to leave as local status declines (Owens, 2012; Bailey et al. 2017). While agential factors help conceptualize mobility, understanding is limited without considering neighbourhoods' changing social ecology and the built form of their dwellings and the surrounding area.

2.10.2 – Mobility Factors Relating to Housing and Locational Characteristics

Housing mediates peoples' access, income, and health, especially in old age (Hodge, 2008). The "residence", a concept inclusive of the neighbourhood and wider community homes exist in, impacts aging decisions (Davies & James, 2011 p.127). Preferences also diverge from early to oldest stages. Older adults, whether owner or renter, respond to housing costs (Seguin et al, 2016). Being over- or under-housed both induce households to correct said imbalance (Han & Kim, 2016). These moves are typically not motivated by 'unlocking' equity, but to rebalance space and support needs (Ostrovesky, 2004). With age, older adults gravitate to smaller, rented homes (Abramsson & Anderson, 2015; CMHC, 2020). High shares of older adults in local areas are also linked to declines in the price of detached homes and to increases in rents (Hiller & Lerbs, 2016). As the viability of certain housing for certain ages varies spatially, the spatial preferences of older adults also tend to change from early to later older adulthood.

The distance which older adults will move tends to shorten with age (King & Newbold, 2009; Abramsson & Anderson, 2015). While most moves are intraurban (Northcott & Petruik, 2011), moves outside of current community lean to smaller cities in early old age, then with increasing age back to mid/large-sized cities to access key services such as health care more accessible in larger centres (Plane & Jurjevich 2009; Newbold, 2011). Walters (2002) attributes penturban moves in early old age to smaller centers and rural areas' affordability and natural amenity, and their relative lack of "urban disamenity" e.g., traffic congestion, crime (p.256). While a preference for 'country' over 'town' marks early old age, rural aging is often more challenging than urban (Glasgow & Brown, 2008; Weeks et al, 2012), leading to higher mobility among the rural elderly (Turcotte & Schellenberg, 2006; Sergeant et al, 2008). While interurban moves are a minor portion of older moves, they reveal later life's push and pull factors and how aging mediates these relations. These factors are mirrored in local moves within/between neighbourhoods.

While some studies find increasing urban affinity (Davies & James, 2011; Abramsson & Anderson, 2015), others reveal elderly inclination for dispersed, peripheral areas (Patterson et al, 2014; Moos, 2016; Seguin et al, 2016). Differentiating older adults clarifies these patterns, given the pre- (55-64) and oldest old (85+) differ in health, income, and household status (Hodge, 2008; Statistics Canada, 2016). Generational values also mould preference (Inglehart, 2008; Coulter et al, 2016). Many early old prefer suburbs, where homes are larger and less dense (Atkins, 2017; Mulliner, 2020). 'Cashing out' of inflated urban home values is conjectural, especially given Ostrovsky's (2004)

work on income, assets, and mobility, where moves reflect suburbs' physical and social appeal. Greying suburbs also reflect aging in place (Kroll & Kabisch, 2012). Reality eventually pushes the oldest to smaller rentals (Abramsson & Anderson, 2015; Hiller & Lerbs, 2016) in supportive urban areas (Davies & James, 2011; Tyvimaa & Kemp, 2011). These tendencies cohere with older adults' interurban moves (Newbold, 2011; Dorfman & Mandich, 2016).

Conversely, assessing claims older adults "will increasingly move to the city", Patterson et al (2014) find increasing age inversely relates to moving (p.116). Seguin et al (2016) also link aging to lower density and turnover. Some contend "individual [social] characteristics and housing satisfaction are consistently . . . more important" mobility drivers (Bailey et al, 2012 p 26). However, if neighbourhoods differ in attribute e.g., building age, resident tenure, these traits inform who lives where and when, establishing their role in local aging mobilities. This is supported by studies linking population aging to neighbourhood social ecology and built form (Clark & Coulter, 2015; Seguin et al, 2016; Channer et al, 2020). While there is no pure consensus on factors such as urban form and income, recognizing the diversity of life stage is vital. Further, so is realizing how age-based mobility continues to evolve.

2.11 – The Changing Nature of the Aging Process

If age and life course influence location and lifestyle preferences, change therein will lead to concurrent change in aging mobilities. Life stages are socially constructed (Elder, 1975; Coulter et al, 2016) via economy, demography[44], government, and media (Stockdale & Catney, 2014; Atkins, 2017). Old age would drastically differ if not for early 20th Century industrial restructuring giving rise to 'mandatory' retirement[45]. This impoverished age, remedied in later decades by welfare measures to afford retirees a modest dignity, inflected by limited social utility (Laws, 1993; WHO, 2002). Meanwhile "[y]oung adults born post-1965 . . . deal with very different economic, social, and political conditions" than those born prior (Van Criekengen, 2010 p. 383). The result is extended or cyclical stays in the family home, delayed household formation, and concentration in specific urban forms i.e., central city youthification (Moos, 2016; Seguin et al, 2016). These are but two examples of the life course's evolution over time.

Broad demographic (cohort) and historical (period) effects are shown to restructure the life course (Atkins, 2017). Cohort effects depict how generations experience societal structure, and changes therein 'together', which shapes shared values[46] (Moschis & McArthur, 2007; Sander & Bell, 2016). Boomers grew up "under [unmatched] prosperity", with a welfare state considerably more robust than afforded to prior generations (Inglehart, 2008 p. 131). Period effects are historical events that vary in their impact for different ages (Findlay et al, 2015). For example, 1970's deindustrialization led cities to abandon manufacturing for service and consumptive industries, altering labor prospects for those just entering, amid, or leaving the workforce (Green, 2006; Bonvalet, Clement, & Ogg, 2015).

[44] I.e., increasing life expectancy meant older adulthood became something people more commonly reached, thus becoming a socially normative part of the average lifespan; much like childhood and 'working years' adulthood, older adulthood and retirement has now become more fully entrenched in our social institutions (Laws, 1993).

[45] It should be noted that prior era's shorter lifespans and more precarious working conditions meant 60-65 at the dawn of the early 20th Century was more equivalent to today's later ages for 75, even 80 or more.

[46] Generations are cohorts of people "born around the same time, experience[ing] historical events at the same ages, and consequently develop[ing] similar worldviews and life courses" (Komp & Johannson, 2016 p. 194; Elder, 1975).

The resulting decline of most cities' urban core, compounded by their increasingly obsolete industrial land bases (Smith, 1979), can also be considered a generational process: it was early family households from the 1950s onwards who led suburban expansion, their exodus from core, urban areas both aging and contracting may central city populations. These spaces of course eventually recover via gentrification and through more general re-urbanization by early households (Van Criekingen, 2010). Ironically, this re-urbanization occurs alongside the suburban aging-in-place of prior era's early families which has left many inner- and even newer, outer suburbs much older (Seguin et al, 2016; Hochstenbach & Boterman, 2018). Cohort and period effects situate life courses in "time-space within . . . changing economic, social, and cultural structures" (Findlay et al, 2015 p. 390), which informs how Boomers could remold conventional understandings of life's later stages as they proceed through their own processes of aging.

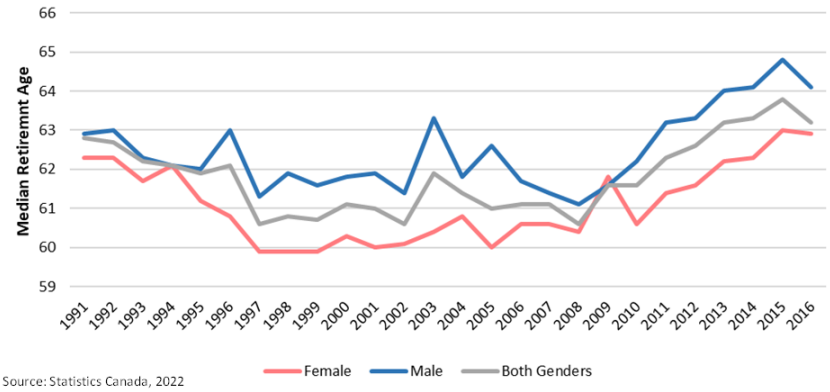
By enduring differing cohort and period effects than their parents, Boomers are posited to have developed differing cultural and attitudinal values that will lead them to diverge from their parents in their expectations of aging and how to live out their older adulthood. Those born 1945-1964 have been the vanguard of social change throughout their lives, included (but not limited to) the rollout of the modern welfare state; fragmentation of the nuclear family household into a range of household types, both family and non-family; the mass entry of females into paid employment; the rise of dual-earners as the dominant family type[47]; the civil rights movement and resulting societal change; the expansion of consumer media and its influences upon both people and the economy; and the incredible advance of various technologies, especially computers (Green, 2006; Moschis & McArthur, 2007). According to Bonvalet, Clement, and Ogg (2015), Boomers are considerably "privileged . . . as far as employment and home ownership [go], by both their parents' and children's standards" (p. 235). Their parents endured the Great Depression and WWII, while subsequent generations, including their own children, now endure unstable employment conditions and soaring housing costs. Many Boomers, however, attest to erratic career trajectories owing to labor redundancy via offshoring and automation (Pinnegar et al, 2012). Socioeconomic, demographic, and other diversity is expected among the total population of Boomers, leading to contrasting findings of whether they are better/worse off than their parents in finance, health, and other lifestyle factors (Moschis & McArthur, 2007; Siren & Hostein 2013). Given the generations' size and innumerable life courses experienced, comparing Boomers on these sorts of individual axes may prove less fruitful than identifying influences borne of common experiences.

[47] The fragmentation of the nuclear family totally changed cities' social ecology and rendered traditional models of residential location, based on household social status, totally obsolete (Viaud, 1995). By this, the occupation of households' single male earner, which defined households and their neighbourhoods by class e.g., (white-collar/upper-class, blue-collar/middle-to-lower-class), was no longer a valid construct. As females, both single and coupled, began to work, and as males and females spent longer as living alone, and as couples began to defer having children – as just a few examples – existing understandings of households and their relations both to space and to various social hierarchies had to be completely redeveloped (Viaud, 2022). From a social class perspective, it is the rise of dual-earner households – and their use as an indicator of neighbourhood status – during the 1970s and beyond that made traditional interpretations much less relevant; an example of this breakdown being females working white-collar jobs yet living in what were considered blue-collar neighbourhoods because of their male partners' job status.

Boomers are largely seen to have similar cultural and attitudinal values owing to shared cohort and period effects (Gilleard & Higgs, 2007; Roth et al, 2012). Many want an independent aging, including driving (Siren & Hostein 2013), staying in their home (Pinnegar et al, 2012; Roth et al., 2012), and enjoying a consumption-based retirement (Olsberg & Winters, 2005), instead of their parents' more austere old age (Green, 2006). These accord with a suburban lifestyle, a likely influence on their peripheralization (Seguin et al, 2016; Atkins, 2017), indicating where future aging will be rather intense. The suburbs' pull may lie in continued space needs: owing to medical advance, Boomers are the first sandwich generation, caught between caring for aged parents and supporting young adult children. In some cases, 'dependents' live with them (Moschis & McArthur, 2007; Van Criekingen, 2010). Boomers' workload here is far more pronounced than prior generations, impacting their time and money as well as needs.

This informs why Boomers continue to work into their older adulthood (Moschis & McArthur, 2007). As per Figure 2.3, through the 1990's, the Silent Generation (b. 1926-1945), tends to retire sooner[48]. Canadians' median retirement age remains stable through the 2000s until 2008, when age of workforce exit for both genders escalates[49]. For context, Boomers as a group enter and pass-through retirement age from 2008 (age 44-62) to 2016 (52-70)[50]. Besides differing generational values informing their career extension, cohort and period effects may play a role in Boomers' delayed retirement. In 2008, Canadian employers could no longer impose retirement at age 65 (CBC, 2009); while not initiating a labor sea change, this highlights a structural effect mostly experienced by Boomers, not preceding generations. Median retirement age nearly reaches 65 for males and 63 for females by 2015, showing many Boomers (then 51-69) still retire on schedule. However, half of retirees were over this 63-65 age range when retiring that year. Some older adults (often those more educated) "enjoy their work and are reluctant to [go]. And many [of all educations] . . . [value] the camaraderie, sense of purpose or routine" provided by going to work every day (CBC, 2009). Yet, many older adults are found to continue their labor force participation for need of the income (Moschis & McArthur, 2007; Pinnegar et al, 2012). This condition of lacking fiscal resources, for many, may result from the ongoing impact of a major, recent period effect.

Figure 2.3: Canadian's Median Retirement Age, 1991-2016



Source: Statistics Canada, 2022

2008 marks (at the time) the largest financial crisis and protracted economic turndown since the Great Depression, lasting until 2012 (Kingsley, 2012), the fallout of which many still endure (Hochstenbach & Boterman,

[48] Aging from 46-65 (1991) to 55-74 (2000).
[49] Females match males' median age in 2009, only to drop 2010; while both climb afterward, females still retire a full year earlier.
[50] The Silent Generation are 63-82 in 2008, largely past 'normal' retirement. Meanwhile 2000-2008, Boomers aged 36-54 to 44-62, putting the generation's 'leading edge' on the cusp of older adulthood.

2018). Loss of job prospects and career stability, wealth erasure, and increased poverty negatively impact households' ability to work, purchase homes, form households, or save for retirement. While much is said of outsized impact on younger adults given already-fragile work/housing careers (Moos, 2016; Hochstenbach, 2018), Boomers are not unscathed. In addition to asset deflation forcing reconsideration for those nearing/in retirement, some suffer career turbulence, including reduced earnings and job loss (Bonvalet, Clement, & Ogg, 2015). This impacts female Boomers especially i.e., erratic retirement age 2008-2011 relative to steady male increase, influenced by lower overall earnings and predominance in industries suffering the recession's worst (Sutherland, 2009; Wiseman, 2011). Ipsos Reid finds 65% of the Canadians age 66+ they sample continue to work out of need, revealing how such events and ramifications can and have altered the life courses of older as well as younger adults (Haig, 2019).

However, other period effects enrich many Boomers e.g., the highly inflated home values of those who purchased decades ago at drastically lower prices in the now desirable neighbourhoods of major urban centers (Olsberg & Winters, 2005; Pinnegar et al, 2012). Further, as age and wealth generally correlate (based upon the premise that more years of life allow for greater career- and especially asset-building), older people tend to weather economic downturn better than do younger people, especially during 2008's uneven recovery where housing and financial assets recovered faster than wages (Zewde & Crystal, 2021). Also, retirement benefits drawn on in older adulthood remain constant amidst outright job loss or reduced hours faced by still-working populations during economic downturn. Thus, later-stage and older adults tend to emerge in 'relatively' better shape than those younger, all else considered. Of course, clear divides emerge within later/older adult populations, for instance between those who own a home and those who continue to rent, as renters have no equity to secure retirement, nor can they (or many young people) nowadays aspire to own a home, a rift wrought by the interplay of period effects on differing Boomers and this generation relative to ensuing cohorts (Pinnegar et al, 2012; Hochstenbach & Van Went, 2015). The net impacts of historical-structural effects results in greater wealth inequality between those at older as opposed to younger ages (Zewde & Crystal, 2021), providing for wider socio-spatial divergence between populations both of older adults and of Boomers, who eventually enter their older adulthood during the extent of my study. Why such a focus on Boomers and their recent and ongoing life course? If they now redefine the aging process and thus population aging (Atkins, 2017), then their diverging incomes, labor status housing and consumption preferences, and living arrangements matter, as these affect Boomers' residential and social mobility by which they come to influence processes of urban change (Teernstra & van Gent, 2012; Bailey et al, 2017).

2.12 – Neighbourhoods and Their Aging: Converging Towards Inquiry

Canada's population aging will have impacts across geographic scales, right down to the cities we live in. Because older Canadians diverge in household type, dwelling preference, income, and mobility from those younger, their increasing proportions will induce changes in the social ecology of neighbourhoods where they concentrate. These demographic transitions spatially vary just as do other forms of urban change, precisely because population aging is an urban change. Reviewing the study of neighbourhoods, first seminal ecological and life cycle constructs,

through gentrification's expansion as socio-spatial processes, then contemporary, broader conceptual views of urban structure and change – reveals three key findings: a) neighbourhoods, as socio-ecological constructs, are complex and diverse in their structures and in how these structures change, yet interplay between certain factors, such as income and life stage, produce and reproduce distinct, often familiar patterns over time; b) until recently, the role of age and aging in these socio-ecological patterns and processes has been treated in a narrow, assumptive manner, leading them to be relatively understudied; and c) what marries social traits to spatial form is residents' propensities to move in, out, or stay in certain spaces throughout their life courses; in other words, our collective aging through life's stages has direct implications for the social ecology of cites and neighbourhoods we reside in.

While urban studies have at many times tended to underplay how age shapes neighbourhoods, the study of mobility behaviors that 'shape' them certainly has not. Demography, specifically age, is prominent in research on where, when, and why people move (or stay) as they follow familiar trajectories referred to as the human life course: individuals intertwined physiological and social development and its molding of our preferences, capacity, and resources during successive life stages. Structural factors, such as period effects also considerably shape where and how life courses occur. This is clear in how contemporary young adulthood has evolved from seminal life course models, transforming not only their career, familial, and housing pathways, but the cities they inhabit in living these.

Likewise, population aging, driven by Boomers' transition into older adulthood, ushers in structural demographic change. Questions arise as to how their divergence from preceding generations will reshape their relationships to urban space and in turn and the neighbourhood aging patterns molded by their aging. Further, as aging is inextricably tied to other social, economic, and cultural patterns, it is crucial to better understand how aging overlaps other elements of cities' social ecology and changes occurring within. Based on my review of urban social ecology and where age and aging (might best) fit within it, I therefore propose the following research questions:

1. *How is age structured across urban space and how do these patterns change over time?*
2. *How do age and aging factor into urban social ecology?*
3. *How do Boomers relate to these patterns, and what can this tell us about their future aging?*
4. *In mapping these patterns, how do they emerge across urban space and change over time?*

These questions are left somewhat broad to reflect that what I intend to do is largely an exploratory analysis of how and where age and aging (with a focus on Boomers) relates to other aspects of human ecology. While shaped with intent to test certain socio-ecological hypothesis i.e., 'do urban aging patterns reflect stages of the neighborhood life cycle (or not)?', these questions allow me to address the expectations set by this and other models, such as the human life course in how I answer them. In short, in developing a methodology for these questions, and responding to them, I refer to the body of urban socio-ecological and demographic theory covered in this literature review.

3.0 – Methodology

3.1 – Introduction

The following outlines the study's methodology. I first describe the City of Toronto, or the Toronto Census Subdivision (CSD) as my study area. The Toronto CSD is a Statistics Canada geographic aggregation that mirrors the City of Toronto's municipal borders[51, 52]. I then introduce how I model and measure neighbourhoods using Statistics Canada data. I then introduce the location quotients I use to assess Toronto's age structure in 1996, 2006, and 2016 and changes occurring in the periods 1996-2006 and 2006-2016. These analyses both answer Research Questions 1a and 1b and provide context for age's role in the broader factorial analysis I conduct for the same years and periods. I then outline factorial analysis and its use to uncover socio-spatial complexity (Murdie & Logan, 2014). I outline how the techniques work and review key analytical principles, as technical concerns need due attention to ensure rigour and validity. I introduce my static (1996, 2006, and 2016) and change (1996-2006 and 2006-2016) datasets and how I treat my data to improve analytical clarity. My factor analyses answer Research Questions 2a and 2b. Boomers are highlighted throughout to address Research Question 3. Mapping my results addresses Research Question 4.

3.2 – The City of Toronto as Study Area

As Canada's foremost urban area in terms of population, growth, economic output, and global relevance (Harris, 2015), Toronto provides a dynamic, complex study area. For many, Toronto invokes the vast urban region known as the Greater Toronto Area (GTA), which includes a host of large cities, towns, and swaths of suburban and semi-rural area. I, however, employ the more tightly defined City of Toronto. While not entirely representing urban Canada, Toronto contains 2.62 million people in 2016, and represents 7-8% of Canada's population during my 20-year study period (Table 3.1).

Table 3.1

Toronto CSD Population, 1996-2016

	Toronto CSD	Canada	CSD as % of Canada's Population
1996	2,385,421	28,846,761	8.3
2006	2,503,281	31,612,897	7.9
2016	2,615,060	35,151,728	7.4

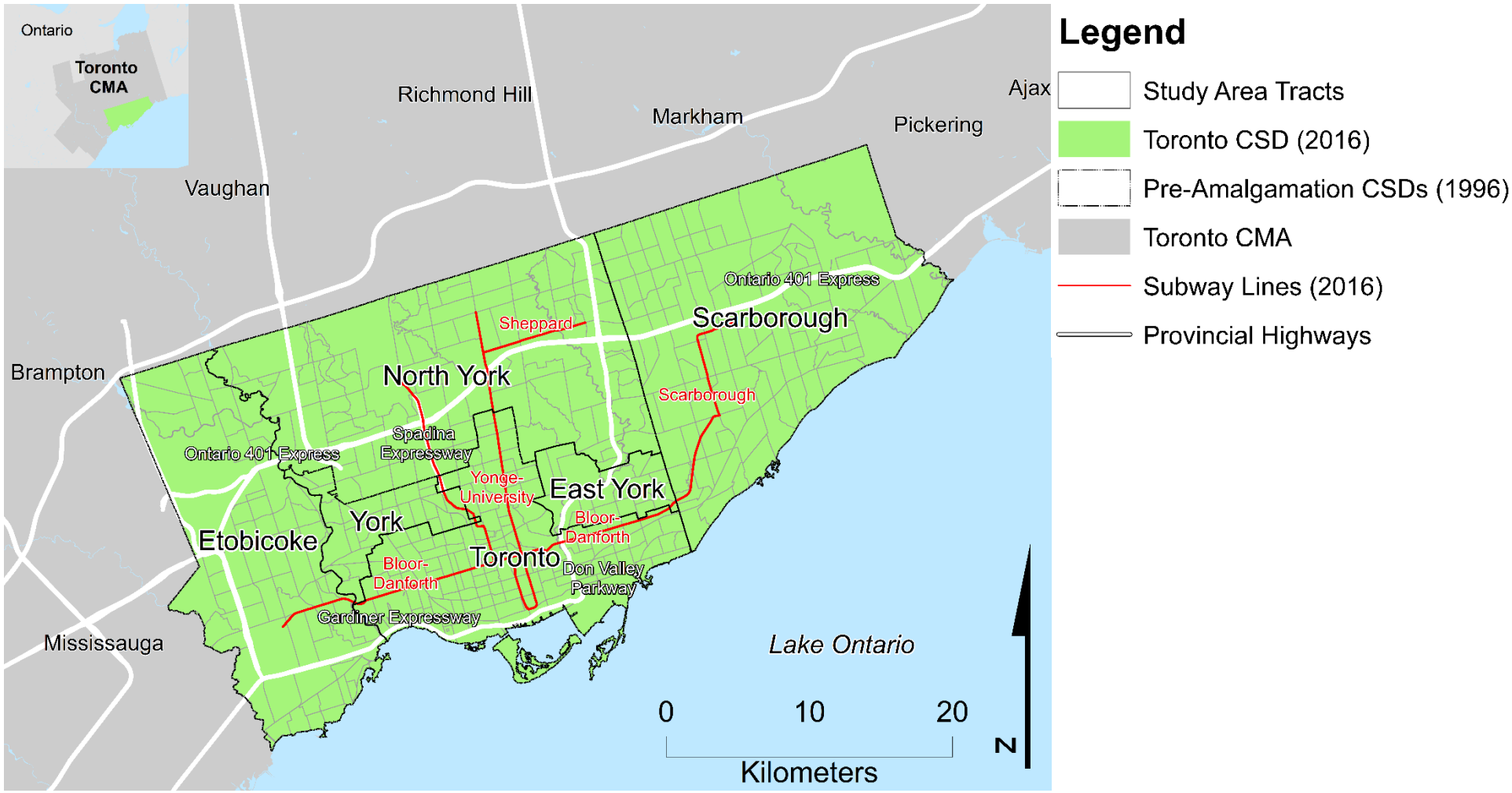
Source: Statistics Canada, 1998; 2008; 2017a

The City of Toronto, in southwestern Ontario (Fig. 3.1), is the capital of Canada's most populated province. On the northern shore of Lake Ontario, its population of 2,615,060 (2016) covers 630.2 km^2 at the heart of Canada's most extensive urban area. Founded in 1793, Toronto has long been an economic, cultural, and political center; in the 20th Century's latter half, it grew from a provincial capital into Canada's pre-eminent global city (Toronto History Museum, 2006). The City of Toronto results from a 1998 provincial amalgamation of Toronto with neighboring cities of Etobicoke, York, North York, East York, and Scarborough[53]. My analyses refer to these 5 cities as Toronto's 'inner suburbs'. These 5 areas and 'Old' Toronto are used to spatially describe patterns revealed by my various maps. The following sub-section outlines Toronto's development since the mid-20th Century to contextualize my results.

[51] For context, I use 'City of Toronto', 'Toronto', and 'Toronto CSD' interchangeably throughout the rest of this study.
[52] Conversely, Census Metropolitan Areas (CMAs) consist of several CSDs which Statistics Canada deems interrelated.
[53] Although the Metro government had led regional development and administration since 1954 (Sorenson & Hess, 2015).

Figure 3.1

City of Toronto (CSD) as Study Area



Source: Statistics Canada, 1998; 2017; Esri, 2017

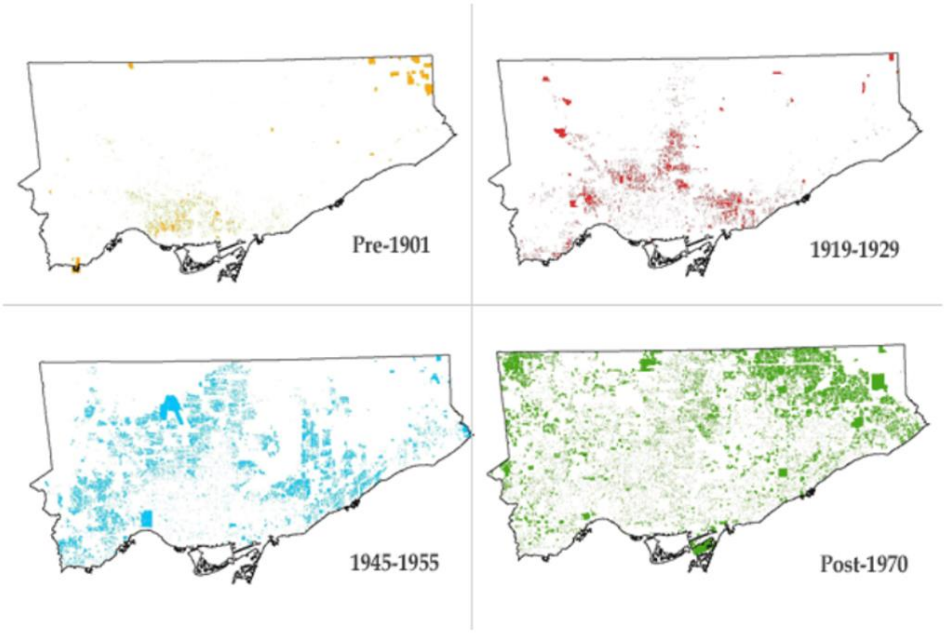
3.2.1 – The City of Toronto's Development History Post-WWII

Toronto's urban form continues to be defined by foundational development occurring prior to the Second World War, such as by that the time the Metro government was formed in 1954. The Metro government was established to balance the competing and interrelated development concerns of Toronto's densely urban core and its 5 surrounding inner suburbs, which according to Richard Harris (2015):

> *had always been physically and socially diverse . . . Before 1950 there were industrial suburbs with working-class residents, and one with professionals; there were upper class residential suburbs outside the city, as well as inside; and there were working-class residential suburbs, with immigrants living in owner-built homes. The built environment persists, and so Toronto's early postwar suburbs remained varied (p. 31-32).*

Harris emphasizes how Toronto diverges from many American cities, where downtowns and suburbs are much more spatially and socially distinct. Toronto and its inners suburbs began to boom both economically and demographically during the general post-war prosperity gripping North America (Sorenson & Hess, 2015). Both manufacturing and business functions took off after the lean interwar years, as population exploded via the Baby Boom and waves of immigrants seeking a fresh start from war-torn Europe (Toronto History Museums, 2006). These trends created a need for regional coordination of housing, commerce, employment, and transportation functions.

Figure 3.2: Toronto CSD's 20th Century Development Trends

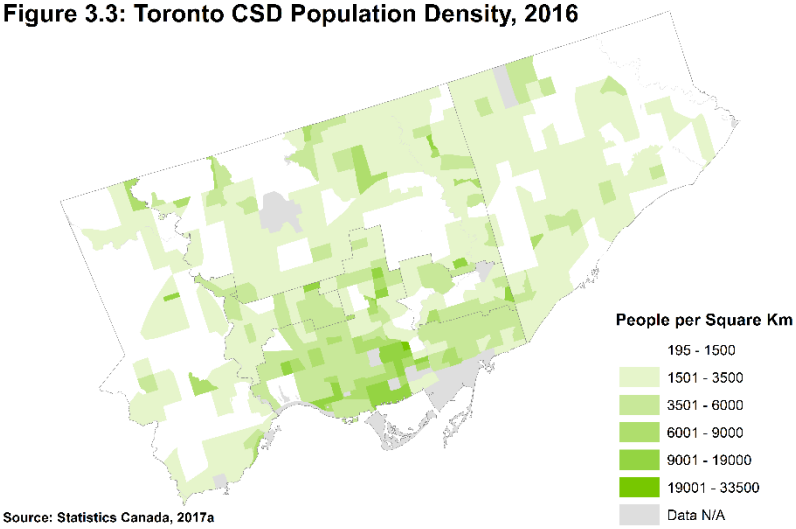


Source: City of Toronto Survey and Mapping Services (accessed 2022 via Toronto History Museums)

From the war's end to the 1970's (and since), Toronto grew increasingly far flung and dispersed than before (Fig. 3.2). Growing vehicle use supported suburban residential development and construction of adjoining highways

and major arterials[54]. Development of Toronto's subway system, particularly the Yonge (1954), University (1963), and Bloor (1966) lines, also fundamentally shaped adjacent boroughs, and more importantly the mobility patterns of thousands of Torontonians[55]. In general, "Metro was committed to a mixed transportation policy, focused on both expressways and rapid transit, and to mixed [residential] density, which explains numerous pockets of high density in the inner suburbs" (Filion et al, 2010), a pattern still defining Toronto's diverse urban landscape.

Figure 3.3: Toronto CSD Population Density, 2016



Source: Statistics Canada, 2017a

These patterns of development and settlement have and continue to shape Toronto. While core areas play host to most of the CSD's population-rich neighbourhoods, density is atypical at all distances from the CBD (Fig. 3.3). Trends that influence this are the rampant pace of public housing development until the 1970's (Harris, 2015), development then largely replaced by private construction, particularly of condominiums; the onset and continuation of gentrification gripping central Toronto; deindustrialization and devolution of local labor markets into high- and low-pay sectors; and considerable shifts in the nature and destination of the CSD's immigrant inflows. As per Metro policy, 'typical' build out of low- and medium-density homes was accompanied by construction of affordable (often socially funded) units in high-rise towers (Harris, 2015). "By the 1970s . . . Metro suburbs contained more than 70% of all [Toronto's]assisted housing" (Frisken, 2007, p. 169). The 1970's Recession initiated the drying up of federal public-housing funds, which precipitated a steep decline in new construction of affordable rentals and the general decay of existing units (August & Walks, 2018). The decline of this era's apartment developments was and continues to further amplify their undesirability, supported by their location in areas with rather poor access to transit and other amenities e.g., employment, parks (Harris, 2015). Their current fate is discussed later in the section.

High-density housing transitioned from public to private, and thus to a profit driven model. 1970/1980s deregulation of condominium policies led to a construction boom in/near Downtown or beside highly accessible subway stations radiating from Toronto's core (Harris, 2015); major building waves occurred in the 1980s and early 1990s, then from 2000 to present (Filion et al, 2010). Rosen and Walks (2015) count roughly 200,000 condo units entering Toronto's housing market between 1970-2010, increasing yearly from period start to finish by a factor of

[54] The Provincial 401 entering from Etobicoke, through North York, and travelling out via Scarborough; the Gardiner Expressway running into/along Toronto's waterfront (bisecting Downtown from the lake; the Don Valley Parkway running north from the Gardiner's end along the Don Valley (meets the 401 in North York); and the Spadina Expressway, famously halted mid-project by vocal, well-organized Downtown residents. It would have cleaved Downtown, irrevocably damaging the cityscape (Harris, 2015).
[55] The Sheppard Line was added in 2005 (Toronto History Museum, 2006).

seven. Marking a distinct form of density from peripheral public housing, these booms catalyzed central Toronto's re-urbanization following post-war suburban exodus, helping the core maintain "a consistent proportion of the region's population [via] vigorous residential redevelopment. . . [of] late 19th and early 20th century" areas (Filion et al, 2010 p. 546). Dwelling construction is but one trend by which the core's density not only reverses decline, but also by which central Toronto's social character shifts, which in turn also influencing the inner suburbs.

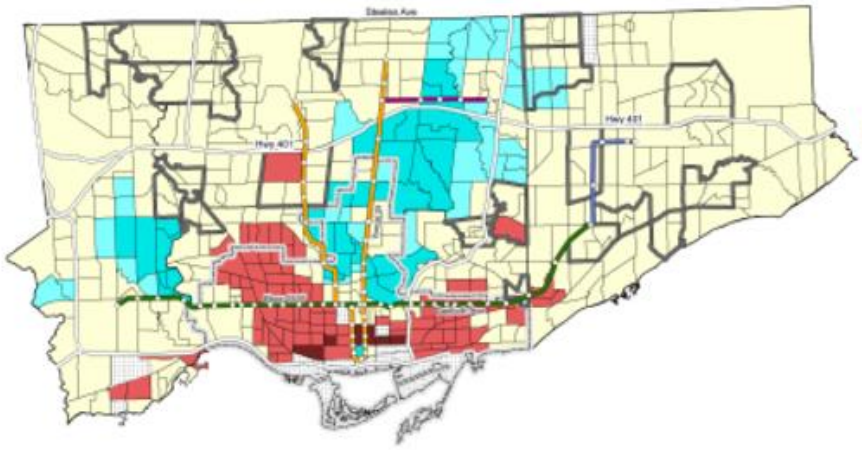
As post-war prosperity dissipates by the 1960's end, successive structural change in the global economy manifest in Toronto's development. Firstly, North America's widespread deindustrialization (generally devastating to southwest Ontario's automotive and other manufacturing concerns) negatively impacted Toronto as well as surrounding areas (Toronto History Museum, 2006). However, these were somewhat braced by administrative, cultural, and particularly financial sectors diversifying Toronto's economy (Harris, 2015). As manufacturing industries declined, the inner city where these activities took place and populations of 'blue-collar' workers located declined also. The former is seen in abandoned warehouse and factory sites, while the trades and manufacturing workers were "more than replaced by white-collar work[ers]" (p. 36), replacement which was driven by the transformation of Toronto into Canada's corporate and financial capital (Toronto History Museum, 2006). These shifts support gentrification of Toronto's previously working-class, inner neighbourhoods as residents associated with emerging economies (crucially with higher income than existing locals) make considerable inroads (Walks & Maranaan, 2008). Initially isolated to select few inner-city districts in the 1960/1970s, the transition of Toronto's core from low to increasingly higher levels of socio-economic status eventually radiates through much of the Old City, taking on more drastic forms of restructuring as the areas' renewed popularity and escalating land values instigate the condo booms during recent decades and into the contemporary period (Filion et al, 2010). These development projects occur not only upon demolished neighbourhoods, but on abandoned industrial sites, a most prominent neighbourhood 'revitalization' being that of Toronto's massively redevelopment waterfront district (Harris, 2015).

Concurrent to these periods of upgrading occurring in Toronto's core[56], surrounding inner suburbs more often experience socio-economic stagnation and decline. The "considerable expansion of Toronto's high order service industry" fuelling gentrification (Filion, 1993 p. 558) is but half the mounting rift "between 'good' well-paid professional and managerial jobs and a rapidly increasing number of 'bad', low paid, nonunionized jobs, and 'casual' (part time, temporary, or contract) jobs" (Keil, 2002 p. 593); the middle of this spectrum e.g., solid, unionized manufacturing careers, withered in deindustrialization's wake. This spatializes via the power of well-paid white-collar workers to compete over Toronto increasingly expensive, amenity-laden core, while those working 'bad' occupations relegate to peripheral suburbs where access to transit, services, and secure work is sparse. Many of these areas host post-war apartments now considerably degraded and thus dwellings of last resort for the city's

[56] These processes were/are also accompanied by what Walks and Maranaan (2008) identify as the consistent consolidation and upgrading of districts considered middle- and upper-class from before WWII and since. Thus, these places were never really open to working-class populations and so the authors refrain from labelling these escalating status shifts as gentrification.

marginal and working poor (Harris, 2015; Stapleton & Kay, 2015). Thus, larger global economic shifts reverberate to the regional and local level, increasingly delineating Toronto's social structure into divergent 'high' and 'low' occupational status residents spatially organized according to their relative level of income and SES.

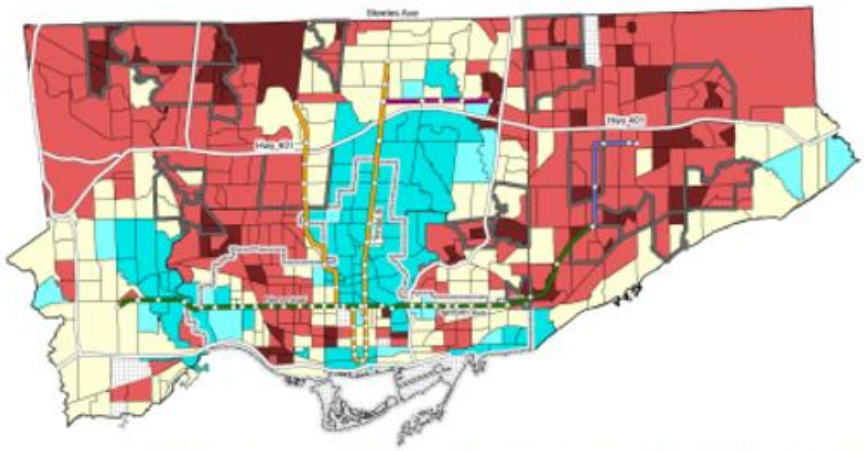
Figure 3.4: Average Individual Income, Toronto CSD, relative to Toronto CMA, 1970 & 2005



Census Tract Average Individual Income Relative to the Toronto CMA Average of $30,800* (estimated to 2001 census boundaries)

Very High	High	Middle Income	Low	Very Low
More than 40% Above	20% to 40% Above	20% Below to 20% Above	20% to 40% Below	More than 40% Below
36 Tracts, 7% of City	*41 Tracts, 8% of City*	*341 Tracts, 66% of City*	*91 Tracts, 18% of City*	*6 Tracts, 1% of City*
*Average = $54,700**	*Average = $39,000**	*Average = $29,800**	*Average = $22,300**	*Average = $17,000**

* *Average incomes in constant 2005 dollars*



Census Tract Average Individual Income Relative to the Toronto CMA Average of $40,704 (estimated to 2001 census boundaries)

Very High	High	Middle Income	Low	Very Low
More than 40% Above	20% to 40% Above	20% Below to 20% Above	20% to 40% Below	More than 40% Below
76 Tracts, 15% of City	*21 Tracts, 4% of City*	*152 tracts, 29% of City*	*206 Tracts, 40% of City*	*67 Census Tracts, 14% of City*
Average = $104,000	*Average = $53,500*	*Average = $39,000*	*Average = $28.000*	*Average = $22,500*

Source: Hulchanski, 2011, map 2, p. 4; map 3, p. 5

Hulchanski (2011) clarifies this by highlighting Toronto's 'Three Cities' of high-, middle-, and low-income areas, which have spatially polarized over several decades. Figure 3.4 borrows his maps of Toronto's average

individual incomes for the years 1970 and 2005, relative to the Census Metropolitan Area (CMA) average[57]. Clear patterns emerge in how high-, middle-, and low-income areas transition in their location and extent between 1970 and 2005. Toronto's higher-income residents consolidate their presence and/or recapture core parts of the CSD from poor(er) residents, turning these spaces into high-status areas (City 1). Middle income areas (City 2) diminish in both prevalence and extent, becoming either higher- or lower-income areas; what of these spaces remain provide for thin(ner) buffers between Toronto's richest and poorest neighbourhoods. Finally, low-income areas (City 3) proliferate in northwestern and northeastern sections of the CSD's inner suburbs. Walks (2013) and Stapleton and Kay (2015) contextualize this last trend, finding Toronto the most income-polarized Canadian city and host to the highest shares of residents that live in working poverty[58]. Walks ties this specifically to income disparity between immigrants and non-immigrants, highlighting vital, yet unfortunate links between marginalization and racialization in post-war Toronto. This has occurred during a general transformation in Canadian immigration. Quick and Revington' (2021) recent analysis of Toronto confirms the continuation of these trends through 2016 and finds that high-income residents' self-segregation from low- and middle-income residents plays as much of a role in this ongoing polarization as does the relegation of low-income residents to undesirable areas.

Toronto has long been a major immigrant destination (Murdie, 2008; Harris, 2015). In 2016, 47% of CSD residents were born out of country (Statistics Canada, 2016). Immigration has evolved through the 20th Century. Although early waves are predominately European[59], immigrants since the 1970's increasingly hail from parts of Africa, Central and South America, the Caribbean, and Asia (Hou & Bourne, 2006; Murdie, 2008). They also confront Toronto's shifting urban structure and resultant impacts on settlement and integration. Many lack the fiscal and language capacity of domestic residents, thus more-recent immigrants increasingly flow into entry-level service sector jobs. Further, while Downtown settlement was common post-war[60], where access to work and transit are plentiful, as gentrification massively eroded affordability (Walks & August, 2008) and displaced an existing working-class (Skaburskis, 2012), more-recent immigrants are increasingly forced to Toronto's margins, both spatially i.e., at the CSD's periphery (Hulchanski's City 3) and socially, via income sorting to relatively lower-quality neighbourhoods far from primary transit networks (Harris, 2015), in often overcrowded, physically degraded housing (Murdie, 2008).

Further driving Toronto's racialization of poverty is that lower-income, non-immigrant residents tend to leave the CSD while higher income, non-immigrant professionals flow into more-advantaged areas (Hou & Bourne, 2006; Ley, 2007). While overlapping divergence between socio-economic and racial-ethnic status are prevalent, immigrations' shaping of contemporary Toronto is far from a binary reduction. Many immigrants stay in the CSD despite insecure income because of economic/cultural support from existing ethnic communities. Qadeer et al

[57] Brief reference to the legend shows blues denotes higher ends of the income spectrum, yellow the middle, and reds the lower.
[58] Their base description being those with after-tax income below Statistics Canada's Low-income Measure (LIM); that earn at least $3,000 a year; are between ages 18-64; are not students; and who live independently (Stapleton & Kay, 2015 p. 33).
[59] In the early 20th Century, more often from the United Kingdom, Northern Europe, and Scandinavia, shifting to parts of Southern (Greece, Italy, Portugal), Central, and Eastern Europe with the passage of time (Murdie, 2008).
[60] Prominent examples include Little Italy and Portugal west of the CBD and Greektown across the Don River.

(2010) highlight the evolution of various 'ethnic enclaves' throughout Toronto in the early 2000's, a continuation of processes occurring since the 19th Century, just now among 'newer' immigrants. Unlike US ghettos, here many ethnic concentrations are communities of choice for just these reasons, not necessarily the result of groups' spatial exclusion (even if socioeconomic conditions constrain where these communities emerge). Further, not all new arrivals to Canada are marginal. There are now "two very different groups of recent immigrants in Toronto, both located primarily in the suburbs, but differentiated by socio-economic status and their ability to bid for housing in Toronto's suburban neighbourhoods" (Murdie, 2008 p. 8). Thus, just as with housing development and economic (re)structuration, immigration's vital role shaping Toronto has evolved considerably, not just in terms of where new Canadians arrive from, but as to how their considerable inflows interact with the former two processes.

While Old Toronto and its inner suburbs (officially 'married' into one City of Toronto in 1998) conform to many normative expectations of how built form, location, affluence, and ethnicity overlap and they experience changes common to many other cities (e.g., deindustrialization, gentrification), the Toronto CSD continues to defy many urban/suburban stereotypes, even as these constructs usefully "illuminate its particular character" (Harris, 2015 p. 30). The outlined array of global, regional, and local processes creates a rich sample of varied, dynamic neighbourhoods to study. Thus, the Toronto CSD proves ideal for examining relations between population aging and other urban change processes. In designing this study, effort was given to employing the broader Toronto Census CMA, in which the study area is included (Figure 3.1) as in other urban change studies (Seguin et al 2016), including those using a factorial ecology approach (Murdie, Logan, & Marannan 2014). I employ the Toronto CSD, however, to study 'accurate' neighbourhoods i.e., relatively contained urban areas, fully developed in 1996, which likely reflect one if not more life cycle stages. Using all Toronto CMA tracts, while providing a broader catchment of potential neighbourhood units to study, presents my research with obstacles both conceptual and technical in nature, especially for my ability to accurately assess urban changes in consistent units of observation.

First, many parts of the CMA are large, undeveloped tracts in 1996 (many still in 2016). Over the ensuing decades, many fully/partially develop into suburbs which 'should' ideally depict the early neighbourhood life cycle. However, these nascent urban areas' overweighting of my sample leads their traits to dominate both my static and temporal, or change-based analyses[61]. Yet I seek to uncover a more fulsome view of the neighbourhood life cycle and age's place within. My choice is further cemented by technical shortcomings in how Statistics Canada captures these urban areas. These issues are discussed after introducing Census Tracts and their use in the rest of the study.

[61] In a study of neighborhood up- and downgrading, Owens (2012) highlights ascent via suburbanization: sparsely populated, peripheral tracts quickly become socially homogenous family areas. Demonstrating the problem that I hope to avoid, the changes occurring in these suburbs dominate his ascending neighborhood types relative to other types of change occurring in core areas.

3.3 – Studying Neighbourhoods

Statistics Canada uses Census Tracts (CTs) as a sub-unit of CSDs, which define municipalities by their political boundaries. In effect, CTs can be considered as neighbourhoods constitute 'communities' (CSDs). CTs contain 2,500-10,000 people (averaging 5,000). Borders tend to follow recognizable physical features e.g., roads, rivers. While not a perfect neighbourhood, broad data collection and their relative stability over time underlie use here as in most Canadian urban research[62] (Patterson et al, 2014; Seguin et al, 2016). Relative here reflects that CT boundaries do change over time, albeit in a way supporting manageable, inter-year comparison. A CT's size is determined by the extent of its population. In older, densely populated urban areas, CTs tend to be small and stable as they have typically reached a mature stage of neighbourhood development, while rural or suburban CTs, where a similar number of people are dispersed over a wider area, are larger. As newly built suburbs emerge in these areas (or urban CTs re-develop and add considerable population), CTs are subdivided between censuses, as their population growth exceeds Statistic's Canada's established thresholds. To support inter-year comparison of Toronto from 1996 to 2016 requires that I re-aggregate 2006's and 2016's divided CTs into their 'original' 1996 borders[63] (Table 3.2 outlines each year's pre-aggregation number of CTs). Before exploring how these CTs are analyzed, elaboration of their changing delineation also highlights shortfalls in how Statistics Canada captures the emergence of many nascent urban areas, a technical issue supporting my use of the Toronto CSD as study area.

Table 3.2

Number of Census Tracts by Census Year, 1996, 2006, 2016

Census Year	# of CTs	Difference from 1996
1996	**468**	-
2006	517	49
2016	561	93

Source: Statistics Canada, 1998; 2008; 2017a

Through the Toronto CMA, many areas, are large single tracts of dispersed rural area in 1996 and incur considerable development by 2016. As populations swell over several censuses, tracts are divided. Figure 3.5 depicts this between the 1996 and 2006 censuses: one massive tract (5450403.00) becomes seven CTs; six are tightly clustered at the original CT's southern edge where development occurs, leaving a large surrounding CT[64]. While 2006 and 2016 data for all seven CTs *can* be recombined into one unit, this conceptually deviates from a neighbourhood. First, the six 'new' nascent suburban CTs differ starkly from the 'original' CT in spatial character (the latter remaining quite rural). Reaggregation creates a unit somewhere between the two that poorly represents either[65]. In addition to compromising divergent traits into a single unit, modelling density becomes onerous if not impossible, given growth clusters at the margins and is dispersed throughout the rest of 2006 CT 5350403.03. Further, this single unit's

[62] The next lowest census unit, Dissemination Area (400-700 persons) was considered. However, before 1996, Statistics Canada employs Enumeration areas (defined by dwelling, not population counts), impeding inter-year comparison.

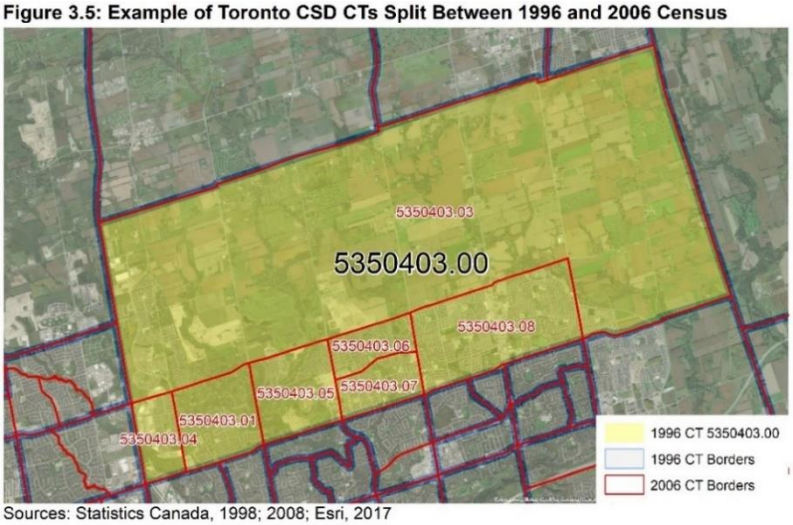
[63] Each CT has a unique identifier for reference and further, to indicate tracts from which it has been split. Researchers use these to recombine – as I have – 2016's tracts into their 2006 and/or 1996 borders to make them spatially consistent and comparable.

[64] Most of the 'original' 1996 CT 5350403.00 becomes 2006 CT 5350403.03 surrounding these 6 smaller suburban CTs.

[65] It could be argued that amalgamating any 2006/2016 CT back into its 1996 border will provoke the same issue; however, reaggregating 2-3 CTs that are nearly or wholly built out in 1996 (i.e., CTs in the Toronto CSD) does so only in a marginal sense.

growth is so massive as to skew the entire analyses towards change in CTs like these at the urban periphery, stifling important forms of change occurring in the urban core and Inner Suburbs. This is one of many cases in the Toronto CMA where Statistics Canada poorly captures nascent, often peripheral urban areas. While technically surmountable via tract reaggregation, this introduce conceptual ambiguity in my study sample.

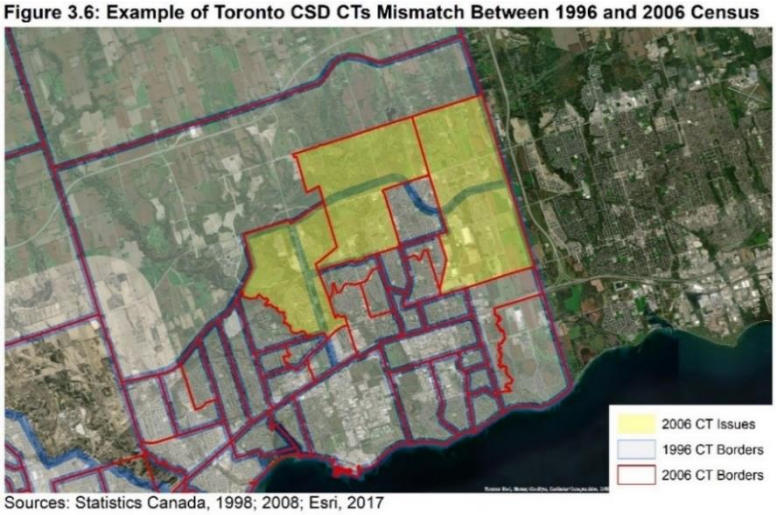
Figure 3.5: Example of Toronto CSD CTs Split Between 1996 and 2006 Census



Sources: Statistics Canada, 1998; 2008; Esri, 2017

Yet, in several cases throughout the Toronto CMA, tract re-aggregation is near-impossible. Figure 3.6 shows a cluster of CTs at the eastern edge of the Toronto CMA, which cover the Pickering and Ajax CSDs in 1996 and 2006 (Fig. 3.1). The 1996 CTs not only splits by 2006 but do so incoherently; looking at the yellowed 2006 CTs (Figure 3.6), portions of the 1996 CTs become part of one 2006 CT, while other portions join other 2006 tracts. Solutions to this and similar issues include either merging all the involved CTs into one artificial 'super' tract or excluding them all from my analysis. In fact, I pursued selectively excluding tracts not built up in 1996 via inventory of the entire CMA for these problematic boundary issues between years. However, increases to my overall sample size were marginal at best while introducing further issues[66]. To avoid these, and to accurately model urban change without weighting my analysis towards nascent suburban CTs, I employ the Toronto CSD instead of the Toronto CMA as my study area. This is because CTs falling within the Toronto CSD from 1996 to 2016 represent a more balanced range of urban and suburban neighbourhoods and avoid the issues outlined via Figures 3.5 and 3.6. Having outlined how I adapt neighbourhoods from Statistics Canada CT data, I now present my framework for analyzing population aging alongside other types of social and spatial change occurring across the Toronto CSD's 468 Census Tracts.

Figure 3.6: Example of Toronto CSD CTs Mismatch Between 1996 and 2006 Census



Sources: Statistics Canada, 1998; 2008; Esri, 2017

[66] Of just over 300 potential CTs for my sample that would be provided by expanding my study area to the entire Toronto CMA, roughly 100 are easily discardable for reasons established thus far, with another ~50 at the margin of these problems, where much discretion is needed to settle inclusion. For instance, many 1996 CTs have a small, developed corner while the rest is rural.

3.4 – Structuring Age over Time and Space

Research on how people's mobility changes with age (Plane & Jurjevich, 2009) and on the typical locations of certain age groups (Moos, 2016; Seguin et al, 2016) focus on age in study design, disaggregating groups for comparison. Common groupings are meant to reflect life stages, such as childhood (0-14 years of age), early household formation (25-34), and older adulthood (60-65+). These delineations are also employed in neighbourhood studies, in terms of the roles these groups play in shaping the urban social ecology i.e., Moos' work on young adults' preference for dense, urban living (2014; 2016). However, much of this research takes a simpler, often sparser view of age's role. These studies often rely on one, maybe two groups to serve as an indicator variable for broader constructs. For instance, neighbourhood life cycle frameworks employ local shares of children and older adults to differentiate neighbourhoods in initial family-oriented stages from later stages marked by aging and decline. To assess aging's role(s) in urban change, I employ as many age groups as possible to better understand how Torontonian's successive transition through these life stages overlaps other aspects of urban structure and change.

Table 3.3

Baby Boomer and Other Generation Ages, 1996-2016

	Generations													
	GI		Silent		**Early Boom**		**Trailing Boom**		Gen X		Millenial (Gen Y)		Gen Z	
Birth Years	1911*	1925	1926	1945	**1946**	**1955**	**1956**	**1964**	1965	1979	1980	2000	2001	Ongoing
Study Period	*Onset*	*End*	*Onset*	*End*	***Onset***	***End***	***Onset***	***End***	*Onset*	*End*	*Onset*	*End*	*Onset*	*End*
1996	85 (+)	71	70	51	**50**	**41**	**40**	**32**	31	17	16	-	-	-
2006	95 (+)	81	80	61	**60**	**51**	**50**	**42**	41	27	26	6	5	-
2016	105 (+)	91	90	71	**70**	**61**	**60**	**52**	51	37	36	16	15	-

Source: Green, 2006 * 1911 chosen as approximate base year for transition from a prior generation; hence totals here include the + sign

To understand aging's role(s) in urban change and, specifically, Boomers' trajectory through human and neighbourhood life cycles, I employ a 20-year time span of 1996 to 2016 (including 2006), drawing on a broad range of variables curated from available census data. Certain age groups underscore this study. As indicated earlier, 1946 marks the onset of the Baby Boom, a period of sustained fertility in North America and other western nations that lasted until 1964 (Green, 2006). This two-decade generational group is often separated into leading- (1946-1955) and trailing-edge (1956-1964) Boomers (Moschis & McArthur, 2007). Table 3.3 situates the age ranges occupied by Boomer from 1996 through 2006 to 2016. Generations on either side of Boomers are also featured here for context e.g., the GI and Silent Generations preceding them, born before and during the inter-war period. Identifying Boomer age groups and incorporating them into my analyses supports my ability to answer my third research question:

3. How do Boomers relate to these patterns, and what can this tell us about their future aging?

Boomers collectively age from 32-50 to 42-60 from 1996 to 2006 and from 42-60 to 52-70 between 2006 and 2016, passing through young, middle- and late adulthood into early older adulthood. Splitting this range in two requires 10-year ranges. Statistics Canada collects 5-year age data e.g., 0-4, 55-59, limiting groups to these intervals or an array thereof. Five years is too brief a proxy life stage, so most use 10-year groups i.e., early households (25-34) or early older adults (65-74). This balances accuracy with analytical clarity far more than, say, broad categories

such as working (25-64) and older (65+) adults. Yet, Boomer age ranges from 1996 through to 2016 make many of these traditional groups ineffective: 2006's 55-64 (b. 1942-1951) end up split across leading-edge Boomers and the Silent Generation, while the rest are allocated into the 45-54 group. Therefore, I employ groups of 0-14, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80+ to capture a range of delineated life stages that also overlap much better with the age ranges occupied by Boomers throughout my study period. While this reduces the direct comparability of my research to other studies, that these groups far more accurately capture Boomers (a focal point of my study) outweighs any minute divergence. I now outline how I map older adult and Boomer populations in Toronto in 1996, 2006, 2016 and change in these populations between 1996-2006 and 2006-2016 before outlining my factor analysis.

3.5 – Location Quotients as a Means of Assessing Population Concentration

The following introduces the location quotients I use to address my first research question,

1. How is age structured across urban space and how do these patterns change over time?

I first visually assess concentrations of older adults and of Boomers in 1996, 2006, and 2016 as well as inter-decade shifts in these proportions using age-specific location quotients (LQ) to visually map Toronto's age structure over time. LQs situate local traits in a regional context; they are derived via dividing local units' share of variable X by a surrounding area's share of variable X. Figure 3.7 depicts this process and the resulting LQs by comparing a CT's older adult share to a surrounding CSD. In one case, the CT's 10% share is twice the CSD's 5%, resulting in an LQ of 2, interpretable as the CT being over-concentrated compared to the CSD (in fact, doubly so). Conversely, if the CSD's share is 20%, the CT's same 10% share results in an LQ of 0.5, reflecting under-concentration. LQs close to 1 express a local share roughly par with regional trends. Simple data needs, interpretive ease, and practicality ensure LQ's prevalence throughout urban geographic (Tonts & Taylor, 2010; Crawley et al, 2013). LQs can be mapped as choropleths to depict over-, under-, and average concentrations throughout the Toronto CSD for visual analyses (Esri, 2017).

Figure 3.7: Location Quotients

$$\frac{\text{CT's \% of Older Adults}}{\text{CSD's \% of Older Adults}} = \text{Location Quotient}$$

$$\frac{\text{CT's 10\% of Older Adults}}{\text{CSD's 5\% of Older Adults}} = 2.0$$

$$\frac{\text{CT's 10\% of Older Adults}}{\text{CSD's 20\% of Older Adults}} = 0.5$$

I assess two types of LQ, based on each CT's 1996, 2006, and 2016 share of persons aged 60+ and of Boomers (compared to the Toronto CSD[67]). While the 60+ variable is constant throughout, the Boomer generation shifts a decade forward each of my studied years to reflect their passage through successive age ranges (Table 3.3), resulting in LQs for ages 30-49 (1996), 40-59 (2006), and 50-69 (2016). To assess how these concentrations change, for 1996-2006 and 2006-2016, I measure the increase or decrease each CT experiences in the respective 60+ and

[67] Totals, representing shares from which LQs derive, are in Table 4.1 (Section 4), for ease of reference with associated maps.

Boomer LQs. If LQs identify concentration, these measures contextualize how local 'hot', 'cold', or average spots change or remain stable. These findings greatly inform my subsequent analyses and discussion of results by spatializing where and to what degree older adults and Boomers locate themselves in the Toronto CSD throughout the study period. I now outline how I identify relationships between these groups and a broader, comprehensive array of potential socio-spatial patterns using factor analysis. Much like LQs, factor analysis results can be mapped to increase interpretive efficacy. Once I briefly introduce how factorial analysis works, I outline how I gather and organize my data and employ it in a factor analysis to uncover latent dimensions of Toronto's social ecology.

3.6 – Factor Analysis: A Brief History

The following introduces the factor analytical approach that I use to address my second research question,

2. How do age and aging factor into urban social ecology?

Different "approaches within the human ecology tradition which use a factor analytical . . . model" have been employed since the 1960s (Viaud, 1995 p. 20) to distill large, complex datasets into smaller sets of meta-variables to preserve data's explanatory power while improving interpretive efficacy (Kim & Mueller, 1978; Davies, 1984). The factor analytical approach uncovers core structural elements which underlie complex interrelations between observed units of data i.e., the CTs used in my research. Components are often conceptualized as the higher-order correlations, or conceptual dimensions, that underlie more granular correlations between individually measured variables. Specifically in geography, factor analysis unravels cities' complexly overlapping social, economic, cultural, and spatial dimensions (Viaud, 1995). If measures relate via "linear [groups] of underlying source variables" (Kim & Mueller, 1978 p.8), factor analysis generates a series of components, the first several of which explain considerably more dataset variance than several variables can (Wyly, 2012). Components, also referred to as axes, are often used as variables in further analyses, such as regression. This helps researchers create stronger measures of a concept, such as SES, using a singular measure instead of several at the same time e.g., income, education, occupation, housing values[68]. Another common approach, that which I employ, is to generate a set or sets of components which serve as the object of analysis and interpretation (Moos et al, 2015). As I assess a large sample of neighbourhoods on a broad series of social and spatial measures, the resulting components can be seen as the fundamental dimensions underlying the studied urban area i.e., the City of Toronto. As a flexible, effective multivariate research approach, factor analysis is well-suited to develop a series of components that I can use to assess population aging's interrelation with other socio-spatial phenomena occurring throughout Toronto from 1996 to 2016 (Viaud, 1995).

However, factor analytical approaches epitomize the expression 'garbage in, garbage out' (Carlin, 2001), in that poorly conducted data selection results in components poorly suited to researchers' objectives. For instance, if variables used to indicate certain social and spatial phenomena fail to conceptually capture their intended urban

[68] It is often the case that using several of these variables in the same, say, regression, results in issues with their all being highly collinear with each other, which disrupts the proper employ of such techniques (Moos, 2016).

dimension(s), the resulting components will be accordingly limited in scope, accuracy, and/or relevance, potential shortfalls magnified if the data selection process is lacking in rigour. These concurrent (mis)steps have contributed to factor analysis earning a less-than-stellar reputation at times in recent decades[69] (Davies, 1984; Viaud, 1995).

The most prominent critique levelled at PCA, argues Wyly (2012), is its inescapable subjectivity: "there is no independent, undisputed basis for deciding what aspects of [cities] . . . should be measured" nor for these methods' application (Wyly, 2012 p.26). Hence, seminal factorial studies of the 1950's to 1970's produce strikingly similar socioeconomic, family, and ethnic axes (Berry, 1971; Murdie, 1974;), these seen then as tripartite enduring urban dimensions. However, the continual use of battle-tested measures related to these domains underlies their ubiquity (Viaud, 2021). In many ways, the *a priori* assumptions of patterns expected to emerge in urban space dictated the use of associated indicator variables (to the exclusion of other measures). The resulting components then had little choice but to depict the expected patterns, with these being what limited variable selection in the first place (resulting in an increasing degree of investigative circularity). Drawing on previous research, subsequent factor analyses further entrenched this normative variable selection (Davies & Murdie, 1991a, 1991b). As a methodological approach, factor analysis thus waned in popularity for several decades as researchers turned to other quantitative tools or to qualitative approaches to neighbourhood study, a trend aligned with geography's more general turn towards post-modernist theoretical and empirical frameworks in the late 20th Century (Viaud, 1995).

Despite intractable subjectivity, the factor analytical approach regained respectability by repositioning its supposed flaw. As Wyly (2012) argues, factorial analysts can employ topic knowledge, reflexivity, and interpretive creativity to understand complex social and spatial phenomena, even if unbiased causal findings are unattainable. Many explore, for example, the gendered spatial variation of cities (Viaud, 1995) or traditional suburbanism's temporal continuity as both a lifestyle and development pattern (Moos et al, 2015) by incorporating measures relating to these socio-spatial constructs in their study design, specifically in their curation of indicator variables. Since my research objective is to uncover potential overlaps between population aging and urban change, I select a host of variables depicting various age groups, as well as key social and spatial aspects of the urban system, including many reflecting demographic and neighbourhood life cycle stages i.e., family status and local built form. Thoughtful selection and employment of data, when aligned with core methodological best practices, can greatly constrain the worst shortfalls of factor analysis's subjectivity, and produce legitimate results (Kline, 2002; Brown, 2009c). This reasoning is better illustrated via a basic introduction to what factor analysis does and how its results are interpreted.

[69] Another trend contributing to this is researchers' key misunderstanding of how the techniques function and their strengths and limitations, resulting in their misemploy; these sorts of issues are discussed more fully in subsequent sections.

3.7 – Factor Analysis: Developing and Refining Conceptual Measures

I begin my outline of factor analysis and its use in my research with my initial selection and treatment of variables that a) reflect potential social and spatial dimensions underlying Toronto's urban structure; b) are temporally consistent; and c) accord with factor analysis statistical requirements. While initial conceptualization of my research design led to an expansive list of potentially desirable variables, many of these are left out of my study due to either data unavailability or their inclusion in my model resulting in statistical issues. Detailing these decisions provides readers with a useful introduction to factor analysis that I build upon in subsequent sections. Also, discussion of my variable curation provides a link between the reviewed literatures on neighbourhood change and age-based mobilities (Section 2) and how socio-spatial concepts core to these topic areas come to be operationalized in my research as individual measures which I then employ in my factor analysis (Section 4).

First, my dataset development is illuminated by reviewing how factor analysis decomposes a dataset's correlation matrix into a series of linear variable combinations. These 'components', equal to the dataset's original count of variables, explain 100% of that dataset's variance (Gorsuch, 1983). While this seems antithetical to the goal of data reduction for which researchers employ factor analysis, the first several components explain the most variance, far more than any single variable or even several variables. Every subsequent component extracted then explains the next highest variance and so on until all variance is accounted for (Wyly, 2012). However, only the first few components, which together explain a substantial portion of total dataset variance, are retained for use as variables in further empirical procedures or to be analyzed in and of themselves[70]. In either case, researchers assess components to identify which variables from the larger dataset have the greatest level of mutual association and use these observations to infer the underlying structural meaning portrayed by each axis in the set[71]; these meanings then inform descriptive labels that best encapsulate the suggested urban socio-ecological constructs (Viaud, 2022).

Factor analysis effectively breaks complex datasets down into the fundamental dimensions which underlie most of the variance observable of the entire set of studied units (in my work, all CTs in the Toronto CSD) across a series of measures. This basic heuristic informs my dataset curation in the following ways. First, relations between unincluded variables cannot be uncovered nor will variables that are weak indicators for their intended conceptual constructs meaningfully covary with other measures[72]. Second, if certain variable domains, e.g., income and ethnicity, overweigh a dataset, these domains will then dominate or bias resulting axes (Murdie, Logan, & Maranaan, 2013; 2014). With these points as backdrop, I now detail how I developed my sets of indicator variables used to assess overlaps between population aging and neighbourhood change in the Toronto CSD from 1996 to 2016.

[70] A basic rule of thumb: retain only components which explain more variance than any single variable in the original dataset.
[71] The nature of this relation and how it is measured, akin to correlation, is discussed subsequently.
[72] The term covary or covariance here (and throughout this thesis) refers to how variables change 'together', because they correlate to some degree, whether positively or negatively e.g., if/when local incomes increase or decrease alongside increases or decreases to local education levels, income and education are said to covary, a relation measurable as their level of covariance.

3.7.1 – The Variable Selection Process

Table 3.4 features the 53 (1996), 55 (2006), and 57 (2016) variables that make up each of my static data sets. Table 3.5 lists the 50 and 52 variables used to assess the same indicators' changes between 1996-2006 and 2006-2016, respectively. The static analysis of datasets, the far more common approach (Perle, 1982), still provides researchers a means to interpret change. As in previous studies, I compare the component sets resulting from each years' dataset for notable constancy and change (Moos, 2014; Wyly, 1999). However, despite being a more direct approach to identifying and assessing urban change, the analysis of change occurring over 10-year increments proposed here is the far rarer approach in factor analysis, typically due to data comparability issues e.g., shifting census borders and census data definitions (Murdie, Logan, & Maranaan, 2014). Factor analysis conducted on measures of variable change provides a vastly different perspective by directly assessing how changes in these variables occur together. Using both static and change data sets gives me a more fulsome sense of where, how, and why Toronto's neighbourhoods evolved between 1996-2016 and how age fits into these patterns.

In essence, measures should reflect larger social and spatial domains measures of age and family status, of income, and of education, measures of urban location and housing type. Most of my included variables are derived from Statistics Canada's 1996, 2006, and 2016 Census Profiles, with density and urban location variables created using ArcGIS (ESRI, 2017). Static measures (unless noted) represent variables' percentage share of CTs' total population of residents or dwellings. They measure local presence of certain groups relative to others i.e., a CT's share of children compared to older adults. Change measures can take several routes in how they depict and assess change. While rates of growth or decline e.g., an X% increase in the number of Y, might seem obvious, these are difficult to consider relative to each other i.e., increase or decrease in certain measures will remain specific to that measure[73]. Measures need to relate the multiple variable changes occurring in observed CTs together, so that their covariance as competing percentage shares of a total population is clearly expressed and measurable.

Two primary forms these change measures take are relative change and point change, both graphically lain out in Figure 3.8. Relative change is measured by dividing a variable's time 2 proportion by its time 1 proportion e.g., '2006 % of X' / '1996 % of X'. Results of 1.0 indicate no change, while values below or above 1.0 indicate decline

Figure 3.8: Relative and Point Change Examples

Time 2's % of X / Time 1's % of X = Relative Change

2006's 25% of 65+ / 1996's 20% of 65+ = 1.25

Time 2's % of X - Time 1's % of X = Point Change

2006's 25% of 65+ - 1996's 20% of 65+ = 0.05

[73] E.g., variable A may increase by 20% in one CT as group X increases from 1,000 to 1,200 between time 1 and 2; meanwhile, another CT experiences a 200% as group X increases from 50 to 150. Theses rates are specific to each CT's base year conditions and imply vastly different changes. Further, these changes are difficult to interrelate with others, as these rates both vary widely and lack any sort of proportional relation to how CTs' other variables change. Also, as change rates between diverse variables (representing absolute shifts in large and small groups) range from near-0 into the 1000's of %, the latter will dominate my axes.

or growth of that variable's relative proportion. Distance from 1.0 depicts magnitude of change. In similar fashion, point change measures result from subtracting a variable's time 2 proportion from its time 1 proportion e.g., '2006 % of X' - '1996 % of X'. Negative results indicate a decrease and positive results indicate an increase of CTs' relative share of a variable (Le Bourdais & Beaudry, 1988). As they derive from change in variables' percentage of total population, increase in CTs' share of older adults is tied to shifts in other groups' shares e.g., children. While similar measures, I employ point change because it handles percentage values of 0 better than relative change measures[74].

Point change in age group proportions takes on specific meaning worth unpacking. For example, the 60-69 group increase as a share of a CT's population between 1996 and 2006, If its 1996 population of 50-59-year-olds age in place until 2006 (to ages 60-69), this informs the CT's increasing proportion of the 60-69 group. However, other processes could be at play e.g., 50-59 entering the CT during the decade, thus being there as 60-69 in 2006, or other age groups leaving the CT, increasing 2006's proportion the 60-69 group. Unfortunately, discerning how factors like aging-in-place and migration each contribute to these changing proportions is beyond my point change measures. Caution should also apply to their generational interpretation. A generation is a given age in each year of my study e.g., trailing-edge Boomers are 30-39 in 1996 and 40-49 in 2006. However, this generation ages from 30-39 to 40-49 between 1996 and 2006. A CT's increasing proportion of the 40-49 group between 1996 and 2006 is likely then the result of trailing edge Boomers who aging-in-place. It is not correct to say, however, that trailing edge Boomers increase here, because it is (roughly) the same Boomers aging from one group (30-39) to the next (40-49); said generation's in-movement to the CT during the decade could lead to proportional increase of the 40-49 group. Thus, I describe change in CTs' population proportion of age groups, from a generational perspective, as 'trailing edge Boomers' have a presence in and/or in-migrate into' the neighbourhood over the decade during my analysis.

Also, my change datasets use certain spatial variables for housing type, condition, and age; CTs' dwellings density; and CTs' distance from Toronto's Central Business District (CBD) as static, not point change measures. This reflects conceptual difference between spatial and social and how change in the two realms occurs. Perle (1982) and Le Bourdais and Beaudry (1988) both note their housing change measures perform are underexplained in their results. Perle (1982) responds that, because housing is a "form of relative stability over a decade", change in social measures (e.g., shares of family type or ethnic group) will near always be of greater magnitude and prevalence, resulting in more 'extractable' variance (p. 319). To avoid my social measures outweighing my spatial measures, I draw on the neighbourhood life cycle. While housing ages, it is by and large not going anywhere for a while once built. However, either via residents' aging in place, other *in situ* change, or their moving, neighbourhood populations change much more readily than buildings do. To capture the fixity of housing and urban form, I employ these variables' base year percentage share; for the period 1996-2006, this is 1996 and for 2006-2016, this is 2006[75]. This

[74] If a variable has a percentage value of 0 in base year 1996 or end year 2006, dividing X by 0 or 0 by X is problematic.

[75] The exception to this rule is that, for each decade's dataset, I employ the most recent era of housing as captured via the end, and not the base year i.e., 2006's housing built 1990-2000 in the 1996-2006 dataset and 2016's housing built 2000-2010 in the 2006-2016 dataset; this should reveal where newest homes are being built, both locationally and in relation to CT characteristics.

operationalizes how social patterns occur 'on top of' neighbourhood built form and location. This results in a more conceptually accurate depiction of how changes occur in Toronto's urban social ecology.

3.7.2 – The Building of the Static and Temporal Datasets

As mentioned earlier, the initial (ideal) variable list was much larger than the final ones retained in my static and temporal datasets (Tables 3.4 and 3.5). Gorsuch (1983) and Davies (1984) contend that oversaturating datasets with redundant or useless measures is ill-advised. That said, factor analyses produce more statistically significant results and overcome issues in correlation matrix decomposition by including many variables. Further, as per Viaud (2021), meaningfully modelling cities requires measuring as many aspects as is reasonable. If an insufficient breadth and depth of measures are employed, one risks repeating early studies' mistaken approach to variable selection based on *a priori* pattern expectations[76]. Conceptual accuracy, representativeness, and breadth should be balanced; so, I use several age groups, occupations, housing types, as opposed to 1-2 from each domain. However, certain measures in each domain are absent e.g., the 20-29 age group. The following accounts for these choices.

Statistics Canada limits the extent, availability, and comparability of publicly available data. Recalling Viaud (1995), social data is provided for either individuals or households, with little way to conceptually connect them. I lean to the former for whom a broader range of measures exists, except variables for household/family composition. While Statistics Canada aggregates 2016 data for useful potential measures such as senior-led households or the age of household maintainers, their absence in prior years prevents use in my analysis. In addition to erratically released data types year to year, Statistics Canada tends to profoundly alter data types and aggregations between censuses, forcing concessions from researchers on certain data categories in their creation of variables. Some of these obstacles require creativity to arrive at relevant, useful measures. Before I specify these obstacles and their resulting impact on variable generation, I first discuss how several indicators fail important statistical screening tests.

[76] Broadening the initial set of potential measures is also advisable given many could suffer from inherent statistical issues.

Table 3.4

Variable Domains and Variables used in Toronto 1996, 2006, and 2016 Static Analyses

Domain	Variable	1996 n = 53	2006 n = 55	2016 n = 57
Age / Life Stage	% 0-14 yrs old			
	% 30-39 yrs old			
	% 40-49 yrs old			
	% 50-59 yrs old			
	% 60-69 yrs old			
	% 70-79 yrs old			
	% 80+ yrs old			
Family & Household Characteristics	% 2-person HHds			
	% 4+ person HHds			
	% Legally Married Persons			
	% Separated / Divorced Persons			
	% Common-Law Couples			
	% Lone Parent Families			
	% Multi-Family HHds			
Educational Attainment	% No High School Certificate			
	% High School Certificate Only			
	% Non-University Certificate			
	% Trades Certificate			
Labour Force & Occupation	Female Participation Rate			
	% Business, Admin, Management			
	% Arts, Science, Public Sector			
	% Sales / Service			
	% Trades, Transport, Manufacturing			
Immigration & Integration	% Immigrated Pre-1980s			
	% Immigrated 1981-1990			
	% Immigrated 1991-2000	n/a		
	% Immigrated 2001-2010	n/a	n/a	
	% No Knowledge of Official Languages			
Visible Minorities	% Black			
	% South Asian			
	% Chinese, Korean, Japanese			
	% Southeast Asian, Filipino			
	% Arabic, West Asian			
	% Latin American			
Income	% Government Transfer Income			
	% Other Income Sources			
	% Persons in Low Income			
	% Persons in Near-Avg Income			
Commuting	% Auto Commuting			
	% Transit Commuting			
Residential Mobility	% No Moves in Last 5 yrs			
	% Moved Locally in Last 5 yrs			
Tenure	% Renting			
	% of Annual Income on Housing			
	Average Dwelling Value LQ			
Housing Type	% Single-Detached			
	% Missing Middle			
	% 1-4 Storey Apts			
	% 5+ Story Apts			
Housing Age & Condition	% Homes Need Major Repair			
	% Homes Built Pre-1960s			
	% Homes Built 1961-1980			
	% Homes Built 1981-1990			
	% Homes Built 1991-2000	n/a		
	% Homes Built 2001-2010	n/a	n/a	
Urban Form	Dwelling Density			
	Distance from CBD			

Table 3.5

Variable Domains and Variables used in Toronto 1996-2006 and 2006-2016 Change Analyses

Domain	Variable	1996-2006 n = 50	2006-2016 n = 52
Age / Life Stage	Change in % of 0-14 yrs old		
	Change in % of 30-39 yrs old		
	Change in % of 40-49 yrs old		
	Change in % of 50-59 yrs old		
	Change in % of 60-69 yrs old		
	Change in % of 70-79 yrs old		
	Change in % of 80+ yrs old		
Family & Household Characteristics	Change in % of 2-person HHds		
	Change in % of 4+ person HHds		
	Change in % of Legally Married Persons		
	Change in % of Separated / Divorced Persons		
	Change in % of Common-Law Couples		
	Change in % of Lone Parent Families		
	Change in % of Multi-Family HHds		
Educational Attainment	Change in % of No High School Certificate		
	Change in % of High School Certificate Only		
	Change in % of Non-University Certificate		
	Change in % of Trades Certificate		
Labour Force & Occupation	Change in Female Participation Rate		
	Change in % of Business, Admin, Management		
	Change in % of Arts, Science, Public Sector		
	Change in % of Sales / Service		
	Change in % of Trades, Transport, Manufacturing		
Immigration & Integration	Change in % of Immigrated Pre-1980s		
	Change in % of Immigrated 1981-1990		
	Change in % of Immigrated 1991-2000	n/a	
	Change in % of No Knowledge of Off. Language		
Visible Minorities	Change in % of Black		
	Change in % of South Asian		
	Change in % of Chinese, Korean, Japanese		
	Change in % of Southeast Asian, Filipino		
Income	Change in % of Government Transfer Income		
	Change in % of Other Income Sources		
	Change in % of Persons in Low Income		
	Change in % of Persons in Near-Avg Income		
Commuting	Change in % of Transit Commuting		
Residential Mobility	Change in % of No Moves in Last 5 yrs		
Tenure	Change in % of Renting		
	Change in % of Annual Income on Housing		
	2006 Average Dwelling LQ	1996	2006
Housing Type	% Single-Detached	1996	2006
	% Missing Middle	1996	2006
	% 1-4 Storey Apts	1996	2006
	% 5+ Story Apts	1996	2006
Housing Age & Condition	% Homes Need Major Repair	1996	2006
	% Homes Built Pre-1960s	1996	2006
	% Homes Built 1961-1980	1996	2006
	% Homes Built 1981-1990	1996	2006
	% Homes Built 1991-2000	2006	2006
	% Homes Built 2001-2010	n/a	2016
Urban Form	Dwelling Density	1996	2006
	Distance from CBD		

Because factor analyses require employed data to be normally distributed (Davies, 1984), any of my variables that skew > ±.70 require arithmetic transformation to be usable[77]. Types of transformation include using the square-root, cube-root, Log10, square, cube, and or the reciprocal of an original data point. The most improved result I was able to generate replaces its original, non-normal data. Where no transformation could yield skew within the ±.70 range, variables are excluded from analysis. The 20-29 age group, despite playing a vital role shaping cities, is one such variable that could not be sufficiently normalized[78]. Some claim that transformation is unnecessary or that it "spuriously increases [data] intercorrelations" (Wyly, 1999 p.325); however, as a multivariate linear statistic (Gorsuch, 1983), factoring methods require a minimum degree of linearity to ensure their results are both legitimate and clear (Cattell, 1978; Davies, 1984; Viaud, 1995). Further, my transformed variables retain > 90% of their original information, in many cases > 95-99%. Only a few variables could not be normalized by this process[79].

Two other issues also possibly impede factor analysis: multicollinearity and non-correlation, respectively are when variables over- and do not relate. Multicollinearity, of far more concern in refining data for Toronto's static analyses, is an issue in that, if two (or more) variables correlate 'too much' (threshold identified subsequently), they effectively measure the same aspect of 'reality', which overloads a dataset with identical constructs, making said construct(s) appear far more crucial than they are. From a technical perspective, multicollinearity also inhibits statistical algorithms inherent to factor ecological models, preventing proper axis extraction (Viaud, 2022). Non-correlation, conversely, is the larger issue with change data. Because factorial analyses identify axes of covariance between measures, variables that hardly correlate with others will necessarily register little to no covariance and tend to form their own axes. As this belies the data reduction for which factorial analyses are employed and as said variables demonstrate little covariance in this preliminary stage, they can safely be excluded from a dataset. Despite aiming to include as many measures as possible, a quick glance of Table 3.4 and 3.5 reveals several gaps. Why, for instance, 2- and 4+ person households, but not 1-person? Similarly, shares of university education lack from the education domain. Simply, these and other notably absent measures correlate problematically with others in my datasets. Unlike normality exclusions, however, handling excess correlation is a more holistic balance of maintaining conceptual coverage and the accuracy of resulting models. Shaping this process are further guidelines. Hair (2010) argues a maximum tolerance for correlation forms the first basis. I employ his cap of ±.90 correlation[80]. Also, closed variable sets are to be avoided, obvious ones being measures which are binary opposites[81]. Thus, my employed variable domains each intentionally exclude at least one variable to avoid instigating this issue in my factor analysis.

[77] Many measures of spatially concentrated patterns e.g., certain age or minority groups, built forms, etc. inherently skew to some degree; while transformation can tame this to a tolerable level, excess skew can lead to questionable results.
[78] While tolerating an overall higher level of skew throughout the dataset (e.g., +/- .75-80) was explored, the 20-29 group's skew in several periods exceeded 1, far too egregious an exception to adopt without the risk of compromising the study more generally.
[79] Such as the mentioned 20-29 age group, or the share of commuters travelling to work by foot and/or bicycle.
[80] While Viaud (2021) and even Hair (2010) suggest +/- .95 is tolerable, the latter says those as 'low' as +/- .82 are high in some analyses; +/- .9 balances this while preserving a wider range of measures to reflect my study area's complexity.
[81] E.g., a tract's share of renting and owning households are not only perfectly-inverse (i.e., they correlate -1.0), but they represent 100%, or the entire 'closed set' of measurable households.

While these form a useful 'objective' heuristic during variable refinement, it is also useful to assess datasets for overlaps in the different conceptual constructs that justify variable inclusion, and which likely underlie instances of multicollinearity. For instance, I use multicollinearity to indicate where and how opposed concepts relate to each other. A prominent example found in all my experimental static datasets for 1996, 2006, and 2016 is that the % University Certificate variable correlates between -.89 and -.93 with % No High School Certificate variable (and nearly the same with the % Trades, Transport, Manufacturing variable) in any given year. To avoid multicollinearity between these variables (indicators for residents at the highest and lowest ends of the education spectrum), I remove the university degrees variable, since it is indirectly captured by 'white-collar' occupations (requiring post-secondary education in many cases). However, because shares of persons with no high school degree and shares of persons with a university degree inversely correlate so strongly in the underlying datasets (which represent the Toronto CSD), the strong presence of people with no high school degrees in a CT is also interpreted to indicate a weak incidence of people with university degrees (and vice versa). Thus, even though the dataset lacks a 'university degree' measure, the presence (or lack) of Toronto's most educated residents can still be inferred. This makes my dataset's education domain more robust than might be implied by this 'missing' university degree measure[82].

Combined, these prescriptions result in the host of variables which populate my datasets (Tables 3.4 and 3.5). In the following section, I introduce principal component analysis as the specific form of factorial analysis I employ to achieve my research objectives. A detailed discussion of my variable domains in terms of the measures used and the social and spatial concepts they are meant to serve as indicators for can be found in Appendix #.

3.8 – Factorial Ecology via Principal Component Analysis: Extracting and Refining Meaningful Axes

Many factorial analyses have been developed and reviewed for their specific strengths and weaknesses over time, in terms of applications for which they are best suited and the purposes for which researchers need data reduction (Davies, 1984). They fall into two main camps: common factor models and principal component models. The first depend on *a priori* knowledge, whereby analysts employ hypothesized dimensions in a deductive or confirmatory context. An example: when psychologists extract information about personality types from data gathered by established tests[83]. Conversely, principal component models reflect an exploratory, *a posteriori* approach where researchers extract un-hypothesized dimensions, latent within their data, that they then make inductive inferences about (Viaud, 2022). I do not test hypotheses about components I expect to find; I intend to infer if and how factors relating to age and aging overlap with other social and spatial aspects of the Toronto CSD based on the axes emerging from my factorial analyses. Therefore, I employ principal component analysis (PCA) to explore overlaps between population aging and urban social ecology in Toronto from 1996 through 2016.

[82] Similarly, inverse multicollinearity between 1-person and 4+ person households justifies the removal of 1-person households, yet (as the inverse of the 4+ person variable) 1-person households can still be inferred in subsequent analyses and discussion.
[83] These tests being composed of a standard battery of questions developed for such a purpose and which they and/or other researchers have typically employed and tested many times before, therefore establishing *a priori* knowledge.

I now outline my PCA of the 5 datasets created for the years 1996, 2006, and 2016 and the decades 1996-2006 and 2006-2016 (Tables 3.4 and 3.5). This illustrates how PCA works, which is informative for subsequent interpretation of resulting components or axes of differentiation[84]. Further, it illustrates how the several process which make up PCA influence my refinement of axes sets I ultimately retain and analyze (Section 4). An example axis illustrates how they are interpreted. PCA reduces dataset correlations into simpler arrays of 'new' meta-variables that represent constructs underlying the convoluted surface patterns observed of large, complex datasets[85]. Several extensive, stepwise calculations decompose a dataset's correlation matrix into an initial set of axes[86]. These are then treated arithmetically to arrive at more meaningful, interpretable results that satisfy methodological criteria. Below, I emphasize PCA's conceptual underpinnings over its mathematical minutiae, the latter used sparingly for clarity.

Component extraction can be thought of in a clear manner as the process of fitting a series of best-fit lines to an array of data, a process occurring in a multidimensional space[87]. Each resulting line, or component explains a decreasing proportion of the total variance in the dataset, from the first line fit to the data array (capturing the most variance) through to the last (capturing the least variance). As mentioned previously, because the first axes extracted typically explain a considerable share of a dataset's total variance[88], these can be retained as a set of more useful meta-variables describing the dataset while components ordinally succeeding those axes which are retained – these explaining far less variance – can be discarded as superficial. This process is best understood after a brief outline (via an example axis) of how axes 'express' their respective 'saturations', a term used to describe the measure of a component's relationship to individual variables in the dataset from which it has been extracted (Table 3.6[89]).

The saturation column in Table 3.6 depicts a set of 6 negative saturations opposed to 4 positive. Each set is sorted by variables' conceptual domain to aid in their interpretation i.e., most saturations observed are of age and family / household variables. As indicated, saturations can be understood just like correlations: the higher is a saturation, the more strongly the axis relates to a variable[90]. Returning to our line analogy, every axis relates to every variable in the data array to some degree. However, the highest saturations on an axis's negative and positive poles reflect how variables meaningfully covary, either in the same direction e.g., both variables on the positive pole, or if they inversely to each other e.g., one on the positive pole and the other on the negative. To support analytical clarity, I intentionally suppress those saturations < ±.40 as these ultimately prove superficial to axis meaning. On the other

[84] Throughout, I use 'component' and 'axis' interchangeably. The latter term, axis, refers to the fact that components represent axes of socio-spatial differentiation i.e., where and how concepts vary from each other most strongly. By this, axis depict opposing ends of different conceptual spectrums e.g., highest vs. lowest socioeconomic status, most vs. least 'urban' built forms, etc.
[85] Such as mine which depict the 468 CTs making up the Toronto CSD using roughly anywhere from 50-60 variables.
[86] All computations are done via SPSS Version 26.0 (IBM 2017), a statistical software offering a range of factor analysis procedures.
[87] Truthfully, lines are fit post-extraction, to visually assess initial models and inform further axes refinement (Gorsuch, 1983; Davies, 1984); explanatorily though, the line analogy is both conceptually valid and much more easily digested.
[88] Certainly, more variance than any individual variable can (in fact, more than many variables considered together could).
[89] The example axis employed here is part of a trial 7-axis solution for 1996 that I ultimately did not analyze.
[90] A saturation > .7 is considered 'good'; of .5-7 is 'adequate'; and of < .5 is considered marginal (Perle, 1982; Viaud, 1995).

hand, communality defines how much of the common variance in a variable is accounted for by the entire component solution. Higher communality means higher variable contribution to the solution[91]. Communality depicts how much of variable variance is captured by the set of extracted axes: communality is the sum of all axis saturations for a variable. As low communality indicates a variable is relatively 'unaccounted for' by resulting components, I suppress variables with communality < ±.30 from my analyses, as these prove superficial to my solutions for each of the analyzed years (1996, 2006, and 2016) and decades (1996-2006 and 2006-2016)[92].

Table 3.6

Example of Axis Saturation and Communality

Domain	Indicator	Saturation	Communality
Age	% 60-69 yrs old	-0.82	0.84
Age	% 70-79 yrs old	-0.91	0.85
Age	% 80+ yrs old	-0.75	0.64
Family / Household	% 2-person HHds	-0.62	0.71
Immigration (Period)	% Immigrated Pre-1980s	-0.43	0.70
Income	% Other Income Sources	-0.59	0.83
Age	% 0-14 yrs old	0.71	0.89
Age	% 40-49 yrs old	0.41	0.67
Family / Household	% 4-person HHds	0.58	0.95
Family / Household	% Lone Parent Families	0.46	0.79

When interpreting components, more importance or weight is given to higher than to lower saturations. Looking to Table 3.6, old and young(er) age groups register the highest saturations; therefore, this axis 'primarily' differentiates age / life stage. Additional meaning can be derived from family / household variables that also saturate to a lesser degree, denoting the typical type / size of household persons of these respective older and younger age groups belong to (in the Toronto CSD at least). Given higher saturations equate to stronger component-variable relations, this axis explains the socio-spatial location of the 70-79 group (-.91) and the 80+ group (-.82) better than it does the 60-69 group (-.63)[93]. The major takeaway for axis interpretation is that the clustering and divergence of variables within certain conceptual domains informs axes' labelling as dimensions of socio-spatial differentiation.

Here, a relatively clear, simple axis illustrates how components are extracted and interpreted. However, this ease and clarity is typically not the case with an entire set of initially extracted components. Further refinement is critical to arrive at useful axes. The overarching criteria is to arrive at components simple in structure, a significant ideal in factorial ecology as per Thurstone (1947)[94]. While any axes set is unlikely to achieve this criterion *perfectly*, this guideline is nevertheless worth striving for. As per Cattell (1978), Davies (1984), and Viaud (1995), Thurstone's benchmark pushes researchers to arrive at axes clear and distinct in meaning. It is a vital framework for using other

[91] Communalities are vital for refinement and interpretation of resulting components (Wyly, 1999). For example, retaining 53 axes for the same number of variables in my 1996 dataset would provide each variable a communality of 1.

[92] By this, a variable is only excluded from the analysis of a year / decade where its communality is < ±.30, not from all analyses.

[93] Saturations express axes' unique contribution to measures' variance (Gorsuch, 1983), revealed by their squaring e.g., ($.96^2$), ($.83^2$), and ($.63^2$) explain 92%, 69%, and 40% of variance for 70-79, 80+, and 60-69, respectively (Cattell, 1978; Davies, 1984).

[94] Thurstone argues that, in factor analyses, variables should have one or more 0/near-0 saturations on at least one extracted axis; each axes should have enough 0/near-0 saturations to match the total number of axes; pairs of axes should have variables that saturate highly on one axis and 0/near-0 on the other; axes pairs should have a large share of 0/near-0 saturation on both axes; and each axis should have minimal 'complex' variables (those that saturate > ±.40 on more than one axis).

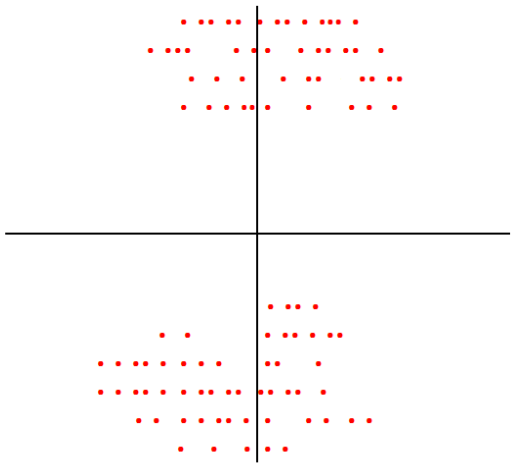
heuristics of factorial analysis to produce meaningful components. However, in advance of employing this simple structure criteria to determine an ideal component set, I discuss the key concept of axis rotation.

The axes extracted during initial decomposition of a dataset's correlation matrix align themselves within the multi-dimensional data array as best they can, in terms of maximizing explained variance via a contained series of best-fit lines. While unrotated axes are technically usable, they rarely attain a simple structure which makes them useful (Viaud, 1995). Thus, over the decades factor analysts have devised many arithmetic treatments referred to as 'rotations' which adjust components within the multi-dimensional data array. Analysts rotate axes around the data array's center or origin point, so that these lines better fit the data i.e., reflect patterns of relation between variables. Rotating axes clarifies their meaningful variable saturations while reducing the saturation of superfluous variables. Rotation 'works' because axes are linear equations that respond to adjustment via a range of mathematically consistent arithmetic treatments i.e., lines are not redrawn in an ad hoc fashion to create a desirable axis position.

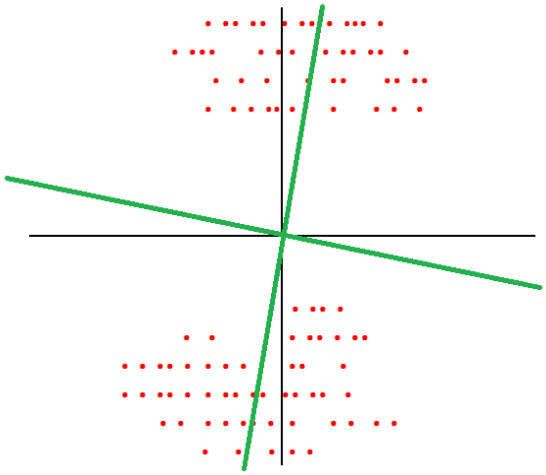
Figure 3.9 demonstrates rotation using a two-axis model. The initial array of red data points is seen in A), with black horizontal and vertical lines for spatial reference. There are effectively two types of rotations: orthogonal approaches and obliques approaches. Orthogonal rotations, shown in B, maintain a 90^{o} relation between all fitted axes so that rotating one axis rotates all. The underlying premise is that axes are uncorrelated (Davies, 1984; Brown, 2009c). This means underlying dimensions do not (cannot) relate, that the components are independent from one another. In B, we see that one of the green axes fits the data quite well, with both poles in the relative center of each data cluster; however, the other axis (which must maintain a 90^{o} relation to its partner) does not relate well to the data. Oblique approaches, shown in C, independently allow axes to rotate freely of each other, at less than 90^{o} angles, to obtain the best fit possible to the data array. This avoids imposing any structural rigidity while revealing relations between extracted components which themselves are interpretable. In C, the two axes both fit the data clusters quite well because their placement is not restricted. Oblique rotations allow axes to correlate i.e., the socio-spatial dimensions they represent are separate but can relate to each other. Many social ecologists interpret this approach as better representing the social and spatial realities they seek to measure (Viaud, 1995). To that point, the data clusters of Figure 3.9 are quite opposed, or negatively correlated such that the two axes in C appear on the verge of aligning precisely because the dimensions they depict correlate with each other. Figures 3.9 also clarifies that rotation does not invent patterns between variables, but (by advancing past initial extraction) allows axes to better express the data's latent patterns. Thus, I make use of rotation in refining the axes resulting from my PCA.

Figure 3.9: Visualized Axis Rotation in Multi-Dimensional Data Array

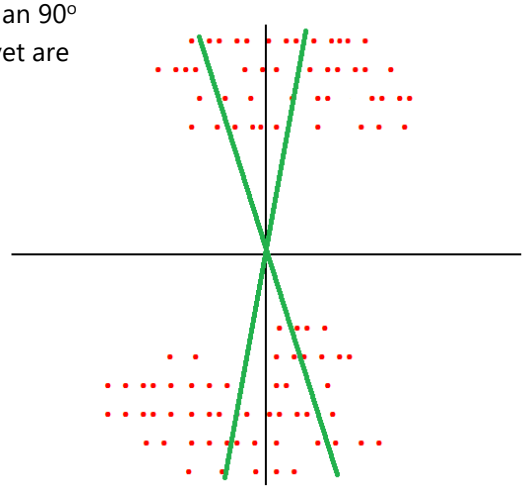
A) No Rotation



B) Orthogonal rotation: 90° angle; no correlation between



C) Oblique rotation: less than 90° angle; axes can correlate, yet are



While rotations are extensively scrutinized and their varied benefits and minutiae extensively detailed (Davies, 1978; Brown, 2009b), analysts ultimately decide how to influence their results, even if rotation techniques are applied consistently (Wyly, 2012). Further, Gorsuch (1983) argues that rotations may be redundant if "any of the more popular procedures" reliably produce similar axes when underlying data structure is innately clear (p.205). Those using PCA to refine a psychological assessment may prefer orthogonal if they know/hypothesize in advance the traits their queries should evoke and require distinct/exclusive measures. However, imposing structural limits on 20-year study of Toronto's complexity denies how latent, socio-spatial constructs such as SES, housing tenure, ethnicity, and urban location might overlap even if the precise nature of these are yet revealed[95]. I use the Promax oblique rotation (Promax) as an effective means by which to extract more information from my PCAs[96].

However, since obliquely rotated axes correlate with each other and these correlations in fact influence said components, their interpretation tends to be more complex. Oblique axes are an interrelated set of meanings, compared to unrelated orthogonal axes (Viaud, 1995). Further, while orthogonal rotations produce a single, new matrix of rotated axes, oblique rotations produce two, interrelated matrices: a pattern and a structure matrix. While often quite similar in their resulting components, the pattern and the structure matrix each express different meaning about underlying social and spatial dimensions. The following outlines the import of this for my analysis.

Two types of matrices result from oblique rotations, a factor pattern matrix and a factor structure matrix. They are similar in that they both portray and quantify a form of relation between axes and their respective variables. The pattern matrix displays the strength of axes' *unique* contribution to the variance expressed by each variable in the dataset[97]. The structure matrix, conversely, features zero-order correlations between an axis and its featured variables; these loads, however, do not account for the influences of other axes upon the respective indicators. However, these loads reveal the axis-variable relations which lead axes to correlate together, a feature which can prove useful in certain analytical circumstances. Viaud (1995) and others (Gorsuch, 1983; Davies, 1984) prioritize use of the pattern matrix precisely because, by expressing the unique variance accounted for by each axis, it provides for cleaner results that are more easily interpreted and more meaningful, thus providing a stronger basis for

[95] Trialing an oblique rotation is common practice, such that if minimal correlation emerges between extracted axes, their lack of relatedness justifies reversion to orthogonal rotation (Cattell, 1978; Bryant & Yarnold, 1995).

[96] Promax is a type of oblique rotation that (for each axis in an extracted set) raises all unrotated saturations to a higher power i.e., Promax squares, cubes, etc. these saturations. As all of them are < 1.0, Promax will supress all these values, yet the smaller, less significant saturations are reduced much more so than are the larger, more/most significant saturations e.g., squaring saturations of .50 and .90 results in rotated saturations of .25 and .81. This process maximizes difference between low saturations' 'noise' and high saturation, which represent the dataset's most meaningful relations. Thus, the variables relations that 'matter' emerge clearly i.e., they are much more simply structured (Gorsuch, 1983; Viaud, 1995). Davies and Murdie (1991a) find "oblique solution[s] . . . produce [the] clear[est] axes" (p.70) and of these, Promax reliably achieves simple structure (Cattell, 1978; Gorsuch, 1983). The power to which saturations are raised to is referred to the 'kappa' or 'k' value, arrived at by trialling which 'k' results in the most 0 or near-0 saturations (Viaud, 1995); however, the higher is 'k', the more axes will correlate, which can be detrimental if axes start to duplicate each other, which impedes interpretation (Gorusch, 1983). The goal is to maximize high (meaningful) saturations while limiting axis correlation to a tolerable threshold. Preliminary testing led me to employ a 'k' of 3.

[97] Effectively, pattern matrix saturations are regression coefficients indicating the predictive power of that component's unique ability to estimate the associated variables controlling for the variance predicted by the other components (Cattell, 1978).

interpretation (Viaud, 1995). Thus, for the most part I focus solely on analysis of the factor pattern matrices resulting from the PCA I conduct on each of my datasets. However, in one instance for the 1996 results, I draw upon use of two axes' factor structure matrices to better understand the nature of their relatively significant correlation; this is because their pattern matrices focus upon unique variance is unsurprisingly ill-equipped for expressing their points of shared variance, given said shared variance is necessarily not unique to either axis[98]. With rotation's place in my analyses outlined, I now discuss the final steps I employ in refining my component sets for interpretation.

To balance explanatory power with simple structure, extracting the appropriate number of axes is vital. Tabachnick and Fidell (1983) illustrate the dilemma: "the more [axes] . . . the better the fit and the greater . . . variance in the data explained . . . However, the [more axes] . . . the less parsimonious the solution" (p.405). The meaning of any set of axes is unique to the dataset from which it is extracted. This forces researchers to rely both on their content knowledge and their discretion. In respect to these, several factor analysis 'rules of thumb' prove useful (Kim & Mueller 1978; Davies 1984; Brown, 2009b). First, eigenvalues (EVs) measure the dataset variance each component accounts for; axes with an EV < 1.0 explain less variance than an original variable and are easily discarded (Moos, 2014). Second, scree tests visually plot EVs to illustrate their decreasing explanatory power. A sudden drop in the scree line often justifies a 'cut off' point for axes (even if their EVs are > 1.0) (Brown, 2009b). Third, cumulative variance helps assess axes for superfluity i.e., if the N^{th} axis increases a set's cumulative explained variance by a few percent but is conceptually inconsistent or ambiguous, excluding it likely benefits results more than its inclusion[99]. These rules are more objective and applicable to any dataset relative to the intelligibility criterion.

Finally, the informed judgement of analysists is needed to instruct the retention or exclusion of axes based on their general interpretability (Viaud, 1995), such as when axes saturate few and/or only 'trivial' variables (±0.40 to ±0.50 or less), resulting in less intelligible measures. Similarly, when experimenting on a decreasing number of components i.e., moving from N-1 to N-2 axes, if the interpretability of the last-most axes in the 'potential' set shifts erratically[100], said set of axes is likely unfit for analysis (Brown, 2009b; Davies & Murdie, 1991a). I select my final component solution for each year (1996, 2006, and 2016) and period (1996-2006 and 2006-2016) by first extracting a raw set of axes where the sole criteria is they all have an EV > 1.0. I then iteratively work from the original N-axis set through N-1, N-2…., weighing shared and individual variance, eigenvalues, scree breaks, inter-axes correlation, and overall intelligibility of solution sets to arrive at those which best balance this host of methodological considerations. The component solutions ultimately retained for 1996, 2006, 2016 and for the periods 1996-2006 and 2006-2016 are an ideal balance of explanatory power and intelligibility based on these outlined practices.

[98] While seemingly *ad hoc*, I still rely entirely upon pattern matrices to determine axes' specific meaning, employing structure matrices solely to understand an axes' correlation, a purpose to which they are well-suited. While structure matrices seem redundant given pattern matrices' superior expression of axis identity i.e., unique variance, structure matrices are only redundant until they are needed to understand axes interrelations, an uncommon circumstance which does arise in one of my five PCAs.
[99] In oblique rotation, however, 'superfluous' axes should be considered for their impact on inter-set correlation (Davies, 1978).
[100] Like when variables saturate axes in a manner inconsistent with prior extractions; axes begin to over-correlate; or axes present variable relations inconsistent with well-understood conceptual linkages found in prior research of socio-spatial patterns.

3.9 – Spatializing Dimensions via Use of Component Scores

Finally, using SPSS, I generate component scores for my extracted dimensions and assign them to Toronto's 468 CTs. A component score "is a numerical value that indicates a [CT]'s relative . . . standing on a [component]" (Grice, 2002). In essence, scores measure how strongly CTs align to socio-spatial constructs the dimensions portray. For instance, scores on the 'older adult / early family' component (Table 3.6) indicate the degree and intensity of relation to that component as a composite measure. Thus, the higher the score, either negative (older adulthood) or positive (early families), the stronger the degree of association between the CT and that pole i.e., qualities associated with that socio-ecological construct. Component scores are mapped via ArcGIS to visualize where and how Toronto CTs align with my extracted axes. This allows a direct means to answer my fourth research question,

4. In mapping these patterns, how do they emerge across urban space and change over time?

Scores also prove quite useful in interpreting my PCA results in that I can reference contextual knowledge of different Toronto locations and trends which have occurred in and around the CSD over time to better understand why certain areas score upon certain dimensions. Having fully outlined the methodological considerations undertaken in developing my data and refining my axis sets – in respect to answering my research questions – I conclude this section and commence my analysis of the resulting component sets, then provide a discussion thereof.

4.0 – Analysis

4.1 – Introduction

The following presents my analysis of population aging in Toronto between 1996-2016 and how this process fits within broader patterns of urban structure and change occurring in this sizable, urban municipality. I first portray Toronto's age structure in 1996, 2006, and 2016 and changes occurring between 1996-2006 and 2006-2016 via age-based location quotients. I then delve into separate PCAs I conduct for each of these years and period, proceeding chronologically through component sets resulting from my static, then change-based analyses. While the static and change PCA are conducted and presented separately, the latter refers to the three static PCA (1996, 2006, and 2016) given these depict a general structure upon which changes occur in each decade (1996-2006 and 2006-2016). Maps of how each Toronto CT 'scores' on each component also support my analyses by providing a spatial reference of where and to what degree the urban dimensions revealed by my PCA emerge throughout the Toronto CSD. Having extensively detailed the process and metrics associated with PCA (Section 3), here I focus more so on results; where factor analytical terminology is employed, it is sparingly in support of my axes interpretation. I now introduce the location quotients (LQs) I generate and map for the 60+ cohort and for Boomers in the Toronto CSD from 1996-2016.

4.2 – Analysis of Location Quotients: Patterns of Aging in the Toronto CSD 1996 to 2016

Recalling Section 3, LQs measure CT's relative concentration of an relative relative to a comparator region within which they are located. Table 4.1 provides – for both the Toronto CSD and the CMA – an overview of the total number and respective share of total population made up by older adults (60+ cohort) and Boomers for 1996, 2006, and 2016. Focusing first on older adults, the CSD and CMA experience increases in their 60+ cohort of ~120,000 and ~366,000 over the two decades, which aligns with the increases in their older adult share from 17.9 to 21.3% (CSD) and 15 to 20.1% (CMA). Interestingly, the gap between CSD and CMA share of 60+ narrows over the period, the City of Toronto still maintaining a slightly older population by 2016. While the total number of older adults differs between CSD and CMA, as per relative scale of size and population, they experience similar aging.

Table 4.1

Toronto CSD/CMA Number and Share of 60+ and Boomer Residents, 1996, 2006, and 2016

Toronto CSD	1996		2006		2016	
	#	%	#	%	#	%
Total Population	2,385,425	-	2,503,285	-	2,731,570	-
Age 60+ (Older Adults)	427,060	17.9	462,915	18.5	580,800	21.3
Boomers*	788,260	33.0	723,145	28.9	669,615	24.5
Toronto CMA	**1996**		**2006**		**2016**	
	#	%	#	%	#	%
Total Population	4,263,760	-	5,113,150	-	5,928,040	-
Age 60+ (Older Adults)	639,295	15.0	825,160	16.1	1,191,325	20.1
Boomers*	1,442,985	33.8	1,522,110	29.8	1,481,290	25.0

Source: Statistics Canada, 1998; 2008; 2017a *Boomers are age 30-50 in 1996; age 40-60 in 2006; and age 50-70 in 2016

Boomers, however, experience declining population share for both CSD and CMA. Boomers decline from about one-third to one-fourth of the CSD's population between 1996-2016, aligning with inter-decade decline from 788,260 (1996) to 723,145 (2006) to 669,615 (2016) residents (presumably driven by emigration from the City of Toronto to the surrounding CMA). However, the Toronto CMA also experiences decline in Boomer population share from 33.8 (1996) to 25% (2016). While the CMA sees numerical increase from 1,442,985 to 1,522,110 Boomers from 1996-2006 – supporting a CSD to CMA migration flow at least for that decade – they then decline to 1,481,290 by 2016. This is likely due to Boomers moving beyond the GTA as well as being outnumbered by influx of subsequent generations (given early households propensity for urban living; Newbold, 2011; Moos, 2016) and/or younger immigrants for which Toronto CSD and CMA are both popular destinations (Hou & Bourne, 2006; Harris, 2015). Another underlying reason for this is the reduction of overall Boomer populations via increasing mortality with age; in other words, Boomer populations reduced as a result of their dying as they age from 30-50 to 50-70. These trends both countervail narratives of Boomers' number and presence surpassing other generations and exemplify the spatial variance with which population aging can occur across geographic scales (Davies & James, 2011).

Thus, while Toronto's older adults (60+) increase in prevalence over the 20-year study period, Boomers become less so[101]. However, these trends should be considered from the perspective that the fact Boomer-aged residents constitute a quarter of Toronto's 2016 population still makes them a significant segment of the city's demography, just less so than when they made up a third of the CSD's population in 1996. This decrease is prevalence over time, probably via their out-migration, also indicates that those Boomers who remain in the Toronto CSD likely differ from their peers who leftover the 20-year period[102]. Having now regionalized both the 60+ and Boomer age groups in the Toronto CSD and CMA) context, I now turn to the LQs, starting with those for the Toronto older adults.

4.2.1 – Older Adults (Age 60+)

Figure 4.1 displays 60+ LQs for each Toronto's 468 CTs in 1996, 2006, and 2016 while Figure 4.2 shows the magnitude and direction of changes occurring between 1996-2006 and 2006-2016. In the former, blue and red hues denote "under" and "over" concentrations of older adults, respectively, with white signifying shares roughly at par with the CSD. Change maps' colouring shows magnitude of LQ decrease (blue) or increase (red), with white hues denoting CTs with concentration of older adults roughly stable over the 10-year period.

Most of 1996 Toronto's core neighbourhoods are under-represented in older adults (60+) except for some middling clusters at Trinity-Bellwoods and Kensington-Chinatown near Downtown. 60+ residents concentrate heavily in Rosedale, Yonge-St. Clair, and Forest Hill where Toronto converges with York/East York and in High Park

[101] This means that, for 60+ LQs, CTs' older adult shares are compared against increasingly higher CSD shares while CTs' proportion of Boomer are weighed against declining CSD shares. In either case, however, LQs still depict if CTs contain greater or lesser shares than expected for their comparator region; even if CSD share declines, Boomers still concentrate in some CTs over others.
[102] Whereas the segments of Boomers were likely more alike in lifestyle and resources at earlier ages, as per contemporary life course findings that age-based values and behaviours have increasingly diverged in the last several decades (Coulter et al, 2016).

bordering Etobicoke[103]. While York presents lower shares of 60+, East York and especially southern Etobicoke are among the most elderly of the CSD's Inner Suburbs, along with most of North York south and east of Downsview Airport[104]. While west Scarborough (bordering North/East York) is more aged, tracts at the CSD's eastern edge are some of 1996's youngest, having been recently constructed and inhabited by younger, family households. While in most cases, average aged areas buffer older adult 'hot' and 'cold' spots, these 60+ over- and under concentrations do occur in direct adjacence. The Toronto CSD's general age structure in 1996 is that of a generally young(er) core – ergo, underrepresented in 60+ residents – that is surrounded by more aged inner suburbs, these then surrounded by young(er) areas at the CSD's outer edge. However, several outlying CTs register rather high 60+ LQs while inner suburbs, such as the Mount Dennis area extending through York and eastern parts of Old Toronto centred on the Don River (e.g., St. Jamestown, Cabbagetown, Regent Park, and Riverdale), under-concentrate in older adults. Thus, 1996 Toronto presents a more complex age structure, one that is less purely concentric, than neighbourhood life cycle theory might posit as typical for most urban regions developing outward from their CBD over time.

By 2006, much of the CSD's 1996 pattern had held over the course of the 10 years between Census observations, although the generally greater prevalence of averagely aged LQs (white) seems to indicate that Toronto's older adult populations had diffused spatially. For instance, several areas that in 1996 were quite under- or over-concentrated by 60+ residents shift to more average age structure by 2006. By capturing changes in these LQs between 1996 and 2006 (as well as 2006-2016, discussed subsequently), Figure 4.2 provides direct evidence of this 'averaging' trend by highlighting how these areas experience large increase or decrease in their older adults LQs. An example would be parts of South Etobicoke and East/North York that see sharp decline in their 60+ LQ measure. This can be seen as a sign of these areas' passage through later neighbourhood life cycle stages, ergo 1996's 60+ concentrations decline as younger residents seem to replace local elderly residents, or at least move into these neighbourhoods in sufficient numbers to dilute the overall representation of remaining older adult Torontonians.

Conversely, the Kensington-Chinatown and Rosedale / Yonge-St. Clair / Forest Hills areas, already rather aged in 1996, experience even further concentration of their elderly populations over the decade. Given that the Toronto CSD's 60+ share also grew in this time (Table 4.1), these area's increase of their already high 1996 60+ LQs reveals considerable local aging. Extending this, most of Toronto's core neighbourhoods either remain stable or increase in their 60+ LQ, e.g., in both Little Italy and Little Portugal. Some of the largest, most widespread upward LQ shifts occur in the CSD's northeast, for instance previously quite young parts of North York and Scarborough. By and large, however the decade's main pattern is that of stability, as per minimal shifts in 60+ LQ through most of the CSD. Where change does occur, a rather prevalent pattern is for young(er) areas to age while 60+ concentrations tend to diffuse. These speak to general trends of neighbourhood aging and eventual population renewal.

[103] The six pre-amalgamation municipalities of Toronto, York, North York, East York, Etobicoke, and Scarborough that now constitute the City of Toronto (2001) spatially reference various patterns emerging in my analyses (Section 3, Fig. 3.1).
[104] CTs north and west of there, surrounding York University, feature low 60+ shares, given prevalence of student-aged residents.

Figure 4.1

Older Adult (60+) Location Quotients by Census Tract, Toronto CSD, 1996, 2006, and 2016

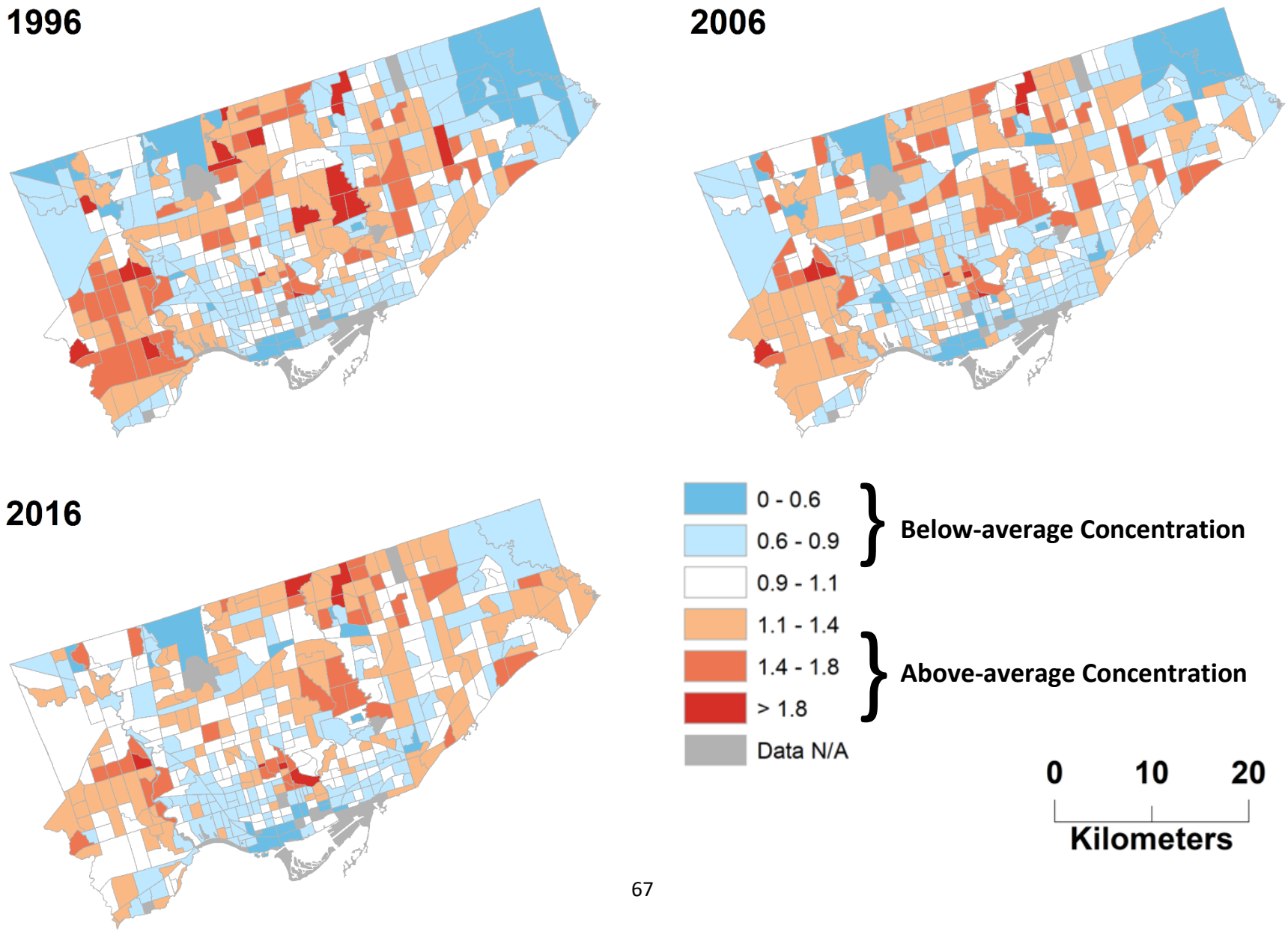
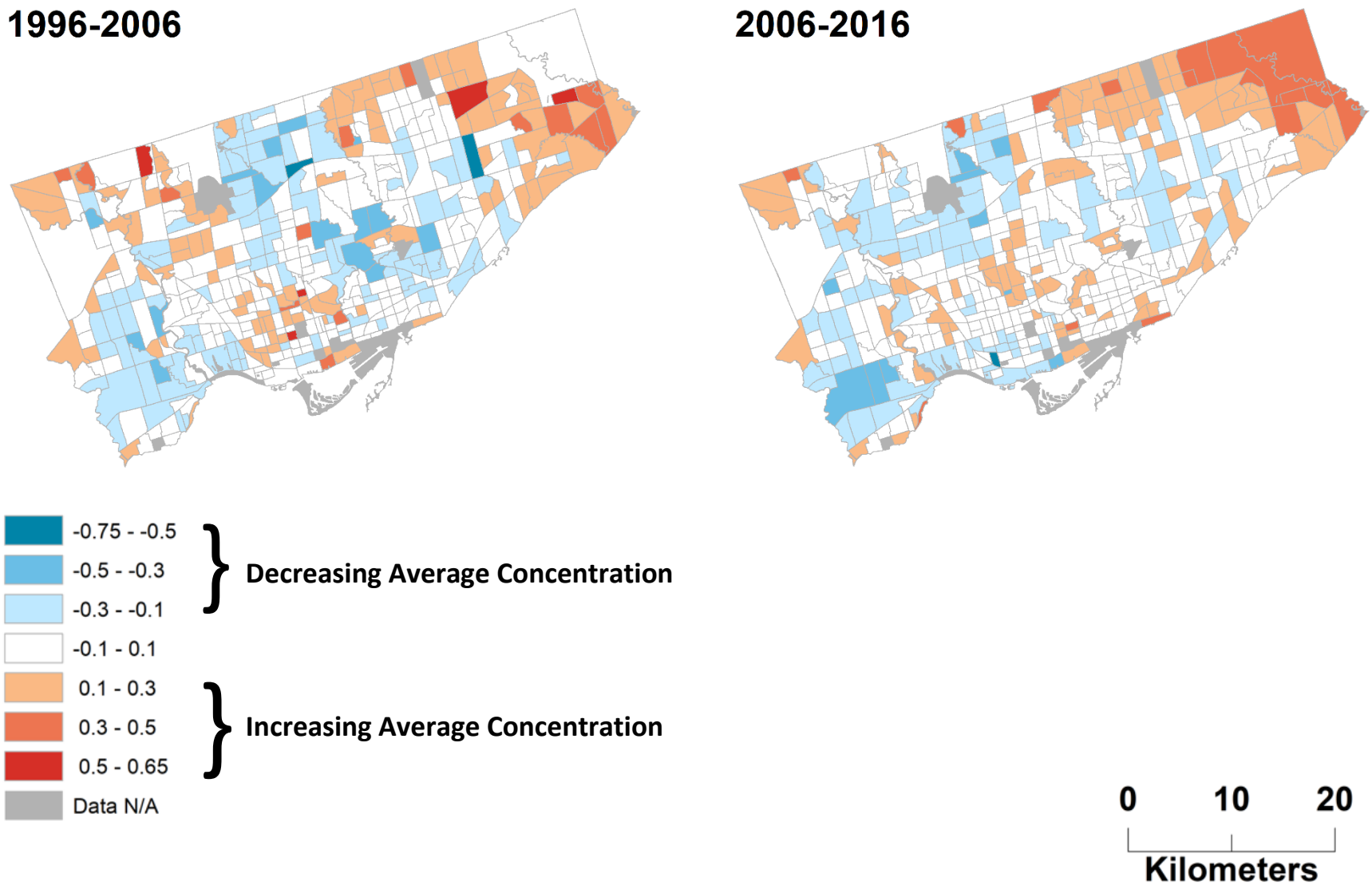


Figure 4.2

Change in Older Adult (60+) Location Quotients by Census Tract, Toronto CSD, 1996-2006 and 2006-2016



By 2016, most concentrations present in 2006 hold, albeit with lesser intensity. Average LQs continue to increase their relative frequency throughout the CSD, while 2006's high and low concentrations soften. However, elevated 60+ LQs continue to be quite prevalent in Rosedale / Yonge-St. Clair / Forest Hills, central Etobicoke, and North York and Scarborough's convergence at the outer edges of the Toronto CSD. The first of these areas, adjacent to Toronto's Downtown, has stood out since 1996 as likely the most prominent instance of an aged 1996 population that continues to intensify over 20 years as opposed to seeing older adult shares diminish (as per 60+ LQ softening). This trend makes the area – for the period 1996 to 2016 at least – likely Toronto's clearest example of a Naturally Occurring Retirement Community, or NORC (Bookman, 2008). The general trend for most older neighbourhoods, however, is that of experiencing an eventual reversal from over- to under concentrated 60+ populations.

In terms of neighbourhoods that go from under- and averagely concentrated to overconcentrated in older adults between 2006-2016, Scarborough and northeast North York experience considerable structural aging (as they began to in the 1996-2006 period), demonstrating neighbourhoods experiencing further passage through the demographic stages of the neighbourhood life cycle). The 2006-2016 change map (Fig. 4.2) confirms this finding, with many CTs of outer Scarborough seeing a marked increase in 60+ LQs, representing a landscape of formerly 'young' suburbs undergoing population aging as they also physically grow older i.e., the aging of their dwellings. Meanwhile, parts of Etobicoke and North York that surround Downsview Airport that saw LQ decline between 1996-2006 experience similar drops from 2006 to 2016 as residents aged 60+ either leave or are outnumbered by inflows of other, younger (than age 60+) residents. These seem to represent neighbourhoods undergoing the final stages of the neighbourhood life cycle as any remaining elderly residents decrease in significance as a population segment.

For all the talk of neighbourhood population aging (and the opposite) between 2006 and 2016, most CTs of the Toronto CSD, as during the 1996-2006 period, experience relative stability in their 60+ share as compared to the CSD overall. As the entire Toronto CSD grows older from 1996 to 2016 i.e., the CSD-wide share of 60+ increases (Table 4.1), under- and over-concentration of older adults at the CT level appears to grow more muted in overall intensity as more tracts revert to a share of 60+ aligning with the CSD's share. In other words, as Toronto grows 'older', its individual neighbourhoods all seem to be generally growing older as well, leading to less extreme variation in CTs share of residents aged 60+ from the beginning to the end of the 20-year study period. Toronto's older adults are less concentrated and more diffused throughout the CSD when using the regional share of older adults as a measure of expectation via the LQ measure. However, some bastions of neighbourhood aging, particularly in central Etobicoke, much of North York and west Scarborough, and (in the core) Rosedale / Yonge-St. Clair / Forest Hill, hold up well over 20 years as per their persistently high 60+ LQs. The latter even grows to include the St. Jamestown and Cabbagetown districts, which were under-concentrated in 60+ in 1996.

4.2.2 – The Baby Boomer Generation

Figures 4.3 displays LQs for the 20-year age groups corresponding to the age ranges in which Boomers fell in the years 1996, 2006 and 2016 and Figure 4.4 shows changes occurring in these LQs for the decades in between. Instead of modelling the location patterns of a static, older adult age group (60+), these LQs track Boomer's collective progress through several stages of adulthood and into early old age, ranges included with the respective figures.

In 1996, Boomer-aged residents (ages 30-49) exist as a share of most CTs' population roughly at par with the Toronto CSD's 33% of all residents (Table 4.1), these 'average' tracts distributed through most of the Inner Suburbs (Fig. 4.3). Their most consistent over-concentration occurs centrally in Old Toronto, starting near High Park, along the lake through Parkdale into the CBD, then north and east to Bloor-Yorkville, St. Jamestown / Cabbagetown, and east of the Don in Riverdale and stretching through The Beaches east to Scarborough. Interestingly, high LQ clusters between the University of Toronto and Don River lie just south of Rosedale / Yonge-St. Clair / Forest Hill, juxtaposing Boomers quite close to where the CSD's older adults were concentrated in 1996 (Fig. 4.1). They tend to under concentrate in places with high 1996 60+ concentrations, namely large swaths of North York and central-north Etobicoke, as well as tracts stretching from Scarborough's northwest down to Scarborough Village on the lakeshore. Although average 1996 Boomer LQs are the majority, there is a clear core-periphery trend to their over and under concentration. While a 33% share of neighbourhood residents is not a majority, that one in three residents in most Toronto CTs were a Boomer in 1996 is a marked level of generational representation.

While the overall magnitude of Boomer's (ages 40-60) spatial concentration in 2006 sees most Toronto CTs scoring roughly par with the CSD's 28.9% (Table 4.1), Figure 4.3 shows they made a retreat from much of the Downtown, especially west of the CBD, while their populations consolidate in CTs further from the core compared to their location in 1996. However, parts of Old Toronto east of the CBD, on both sides of the Don River (e.g., Mount Pleasant, Rosedale, St. Jamestown, Cabbagetown, Riverdale and The Beaches) appear to remain popular for Torontonians of this generation. Several peripheral clusters of high Boomer concentration also emerge, namely along Etobicoke's shoreline, further north in Kingsway-Islington, and at Scarborough's far shoreline CTs. As Boomer concentrations in and near Downtown dissipate – indicating their likely exodus from these neighbourhoods – many Toronto CTs laying further afield in the CSD's inner suburbs see their low 1996 Boomer LQs become average or even over concentrate. While difficult to pin down causality, the increasing peripherality of Boomer concentrations over time likely results both from previously more centralized Boomers moving further away from Toronto's core as well as the aging in place of these more distal areas' existing Boomer populations. Concentration could well occur as the children of these (now) late-stage adults vacate the family home with their own increasing age, seen as a core part of these suburbs' transition from their early to later family household stages of residential occupation.

Figure 4.3

Boomer Location Quotients by Census Tract, Toronto CSD, 1996, 2006, and 2016

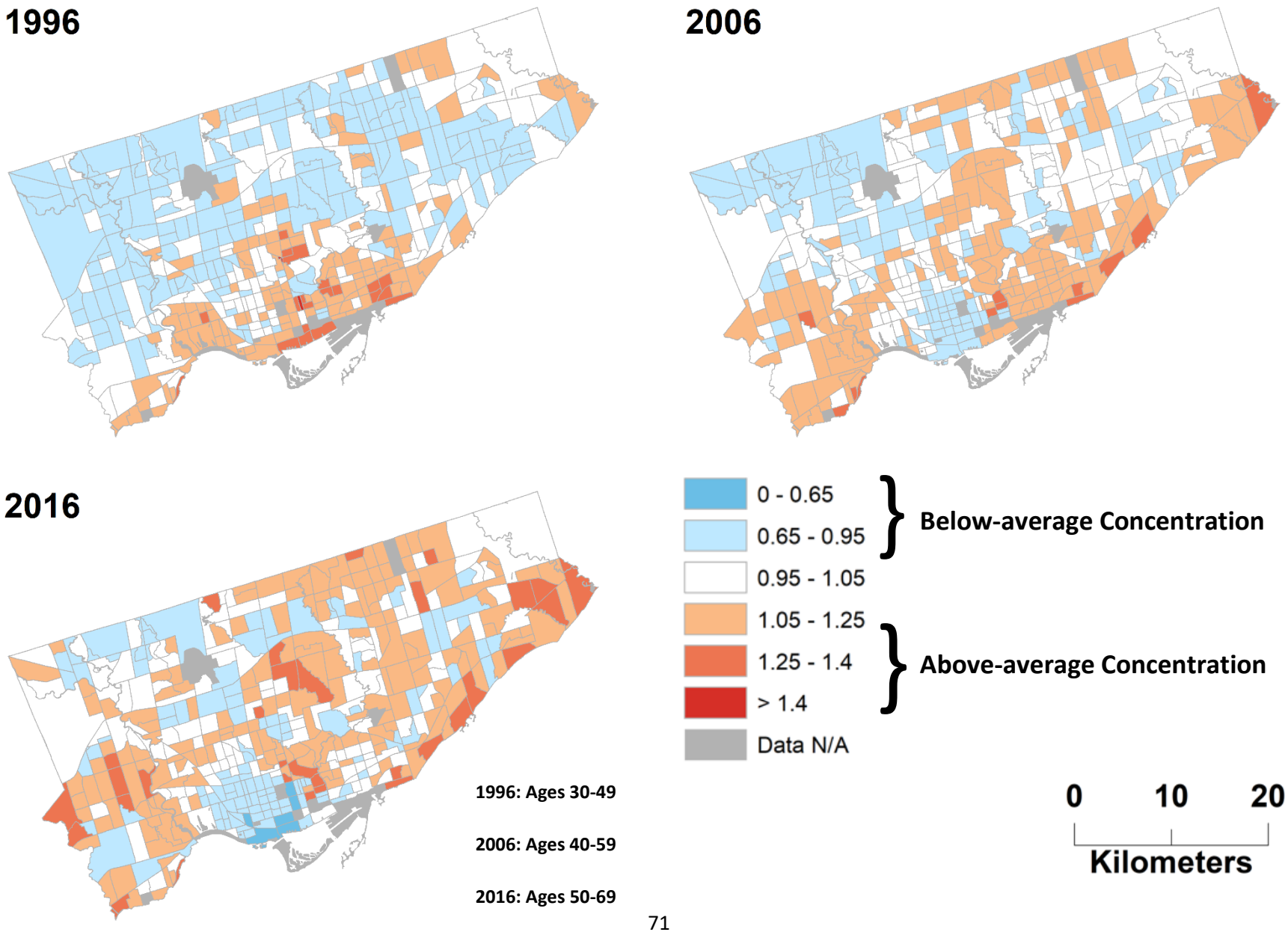
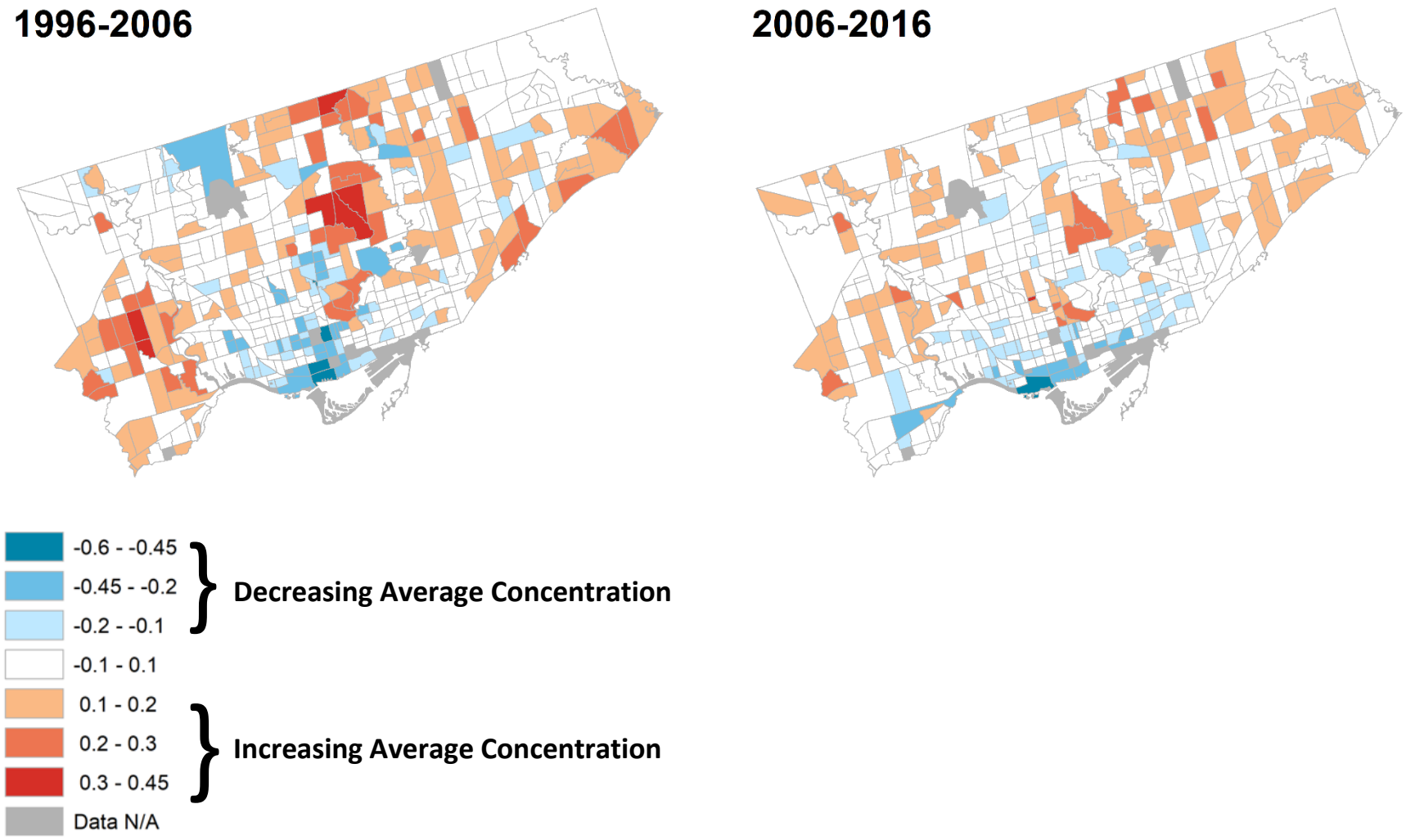


Figure 4.4

Change in Boomer Location Quotients by Census Tract, Toronto CSD, 1996-2006 and 2006-2016



1996-2006: Boomers age from 30-49 to 40-59

2006-2016: Boomers age from 40-59 to 50-69

Figure 4.4 supports this by directly depicting LQ increase in these areas and several others. Etobicoke, Scarborough[105], much of North York, especially York/Don Mills and near the CSD's northern edge, all experience an increase in Boomer LQ between 1996 and 2006. While Boomers leave most of Downtown, they consolidate nearby in sought-after Rosedale and Cabbagetown by 2006. Given the CSD's Boomer share level drops from 33 to 29%, that many of these CTs still go from over- to under concentrated in Boomer residents illustrates the generation's considerable outflow from Toronto's core. This pattern follows life course theory, in that – from 1996 to 2006 – Boomers' trailing edge leaves early adulthood while the leading edge enters late career/family stages, nearing retirement. Similar patterns whereby Boomers appear to vacate highly urban CTs (in terms of built form and density) occur in the Mount Pleasant and Yonge-Eglinton areas, although CTs just surrounding these urban nodes see their Boomer LQs increase. This exodus from areas with Toronto's densest forms of housing is quite consistent throughout the CSD insofar as large 'town center' style urban nodes or outlying tower apartment blocks also suffer LQ decline as Boomers age further into the life course. Boomers thus tend to suburbanize spatially, but also transition away from the most urban forms of housing in many (but not all) parts of the Toronto CSD during the period 1996-2006.

By 2016, the location patterns of Toronto's Boomer residents (ages 50-70) – now representing 24.5% of the CSD population (Table 4.1) – build upon the prior decade's (2006) trends. As a population segment, they also converge with Toronto's 60+ population that year (with half of Boomers in 2016's 60+ group[106]). Their general process of retreat from the CBD and surrounding Downtown districts is near complete (Fig. 4.3). Within Old Toronto itself, however, Boomers do appear to solidify in Forest Hill, Rosedale, Cabbagetown, and Riverdale. LQs further east diminish except for the Danforth and Beaches areas, where they pick up considerably along Scarborough's lakeshore all the way through to the CSD's eastern limits. Most of Toronto's inner suburbs – particularly central Etobicoke, North York's York/Don Mills and the north and east edges of North York and Scarborough – have sizable Boomer shares[107]. Under-concentrations outside the core share a predominance of multi-dwelling housing, although several rise to average LQ. While still prevalent, average shares no longer dominate the CSD as in 1996. Except for the CSD's most-core neighbourhoods where they appear rather absent, Boomer-aged residents over-concentrate at varying distances from the CBD, except for tracts running northwest from Toronto, through York, and along the border of Etobicoke and North York. Older adult maps for 2016 (Fig. 4.1) indicate lacking 60+ concentration here too; this seems to indicate a population largely dominated by residents under age 50 at least, if not younger.

Figure 4.4 shows 2006-2016 LQ shifts are of lesser magnitude than those of 1996-2006, with patterns of increase and decline in CTs' LQs supporting Boomers' further exodus from the core and their consolidation in Toronto's Inner Suburbs. The life course transition between the examined age ranges (40-60 to 50-70) is one of residential stability in terms of these age group's propensity to move (Fig. 2.1); this seems to dampen how residential

[105] The former's escalating LQs likely explain decline in 60+ LQs (Fig. 4.1.3) as Boomers succeed the prior cohort over 10 years.
[106] 2016 Toronto has 385,210 persons aged 50-59 and 284,405 60-69; LQs lean to trailing edge Boomers (Statistics Canada, 2016).
[107] With Boomers making up 24.5% of the CSD's population share in 2016, the 1.1-1.25 LQs represent 27-31.5% of the populace, with the next-most LQ of 1.25-1.4 depicting population share of 31.5-34%.

movement contributes to changing Boomer patterns for the decade 2006-2016. Thus, those concentrations of Boomers which crystallize over the 10-year period are more than likely the result of Boomers' aging in place while other age groups – both younger and older – become less significant population segments in those areas by 2016.

Taken together, 60+ and Boomer LQs illustrate marked, but not seismic shifts in Toronto's age structure over two decades. Older adult settlement patterns are more varied than to be regarded as just general suburbanization, as parts of both core and peripheral Toronto experience population aging. Areas such as Rosedale / Yonge-St. Clair / Forest Hill consolidate already high 1996 elderly populations for a further 20 years, defying life cycle expectations where aged neighbourhoods reach terminal decline then demographically 'renew'. Boomer's consolidation in these areas will sustain older adult concentration. That said, other areas quite aged in 1996, such as central Etobicoke and East York, grow younger as per a 'typical' life cycle, although aging in place of their Boomer populations may see 60+ shares resurge in coming years. The general pattern, however, is that as all of Toronto ages, less variation in older adult shares (high and low) occurs as they diffuse throughout Toronto, increasing proportion in many neighbourhoods. Parts of North York and Scarborough see both 60+ and Boomer trends converge as their CTs age. Both population groups seem to be 'pulled' toward Toronto's more affluent areas, e.g., Forest Hill / Rosedale / Cabbagetown, and 'pushed' away from less prosperous parts of West Toronto (Rankin & McLean, 2015). For Boomers, desirable lakefront areas stretching from The Beaches to Rouge Hill, and in Etobicoke also appear to increasingly align with their needs in ever-maturing life stages. Thus, as the Boomer generations ages toward older adulthood, their settlement patterns by 2016 become those defining both current population aging and where next several decades aging will occur most strongly as their households continue to age in place in later life.

While population aging is generally pervasive and Boomers shift locational preference with age, age LQs and the preceding observations can only hint anecdotally at how these demographic patterns overlap other elements of Toronto's social ecology over the study period. Further, because the CSD's Boomer share drops from 1996 to 2016, assessing change is obscured by whether tracts gain or lose Boomers or if CSD-level decline is shifting the goal post i.e., do CTs maintain above-average LQs compared to the Toronto CSD, despite possibly experiencing lower shares over time[108]. To better assess this aging's place in Toronto's, Sections 4.3 and 4.4 present component sets extracted for the years 1996, 2006 and 2016 and the periods 1996-2006 and 2006-2016.

[108] For tracts shifting up in LQ, this is minimized: a 1.1 in 1996 is 37.2%; to reach 2006's 1.25 requires a 36.1%. Conversely, since CSD's Boomer drops, LQ downshift marks a large loss in CT Boomer share: 1996's 1.1 (37.2%) must drop to 26% to be .90 in 2006.

4.3 – Using PCA to understand Population Age in the Toronto CSD as part of Urban Structure

In line with prior studies that use both static and change PCA (Perle, 1982; Le Bourdais & Beaudry, 1988), I first analyze the years 1996, 2006, and 2016 (Section 4.3) before analyzing the decades 1996-2006 and 2006-2016 (Section 4.4). This Section 4.3 is constructed as follows: communalities and overall explained variance outline the explanatory power of each year's respective PCA. The static PCA results are similar enough each year to feature side-by-side for inter-year comparison (Table 4.3). Starting with the earliest, 1996 set, I discuss how each axis is saturated and spatially oriented across the CSD, aided by maps of Toronto CTs' dimensional component scores. Concluding the analysis of each year's axes, I discuss how the set depicts Toronto's socio-spatial structure, emphasizing elements of age and generational change, aided by the correlations between each set's components.

Experimenting on 8-, 9, and 10-axis sets for 1996, 2006, and 2016 (respectively), guided my methodology (Section 3), 5-component solutions are retained for 1996 and 2006, and a 4-component solution for 2016. Table 4.2 presents each set's variable communalities and total explained variance. The 5, 5, and 4 axes for 1996, 2006 and 2016 respectively explain 69.9, 68, and 65.1% of their set's variance, demonstrating PCA's capacity to reduce data complexity yet preserve explanatory power. With a few exceptions, communalities are acceptable for most variables in each set, the majority having 50% or more of their variance explained. Housing era variables post-1981 tend to score poorly across all three years. Another domain where scores tend to be middling all three years are those for visible minority groups. In some cases, variables such as % Transit Commuting see communality decline from 1996 to 2016, while others such as % High School Certificate Only experience increase over the period. The 40-49 and 50-59 age groups, occupied at times by leading- and trailing-edge Boomers, score as low as 40% and high as 67%, sensible given they exist in most of Toronto's 468 CTs in shares roughly par with the CSD (Section 4.2). Here, low(er) communality does not indicate a variable's lack of presence in the study area, so much as indicating that the variable does not covary with other variables as much as those with high(er) communalities[109,110].

[109] Twenty-seven of the 53 variables for 1996 have more than 70% variance explained, while 8 measures register less than 50%. Homes Built 1981-1990 has a communality less than 30% and is excluded from 1996 analysis. For 2006, 26 of 55 variables have more than 70% communality, while 10 score less than 50%; Homes Built 1991-2000 scores less than 30% and is excluded from 2006 analysis. Finally, for 2016, 30 of 57 variables score a 70% or higher communality, while 12 score less than 50%; Missing Middle and Homes Built 2001-2010 have a communality below 30% and are excluded from the 2016 analyses.

[110] Case in point: in 1996, % High School Certificate Only registers a low communality when this level of education could likely still access a decent range of jobs, whereas by 2016, those with only their high school are far more socio-economically limited.

Table 4.2

Communalities and Total Explained Variance for 5, 5, and 4-Axis Solutions, Toronto CSD, 1996, 2006, and 2016

	Year	1996	2006	2016
	# of Components	**5**	**5**	**4**
	# of Variables	**53**	**55**	**57**
	% Explained Variance	**69.9**	**68**	**65.1**
	Variable Communalities by Domain			
Age / Life Stage	% 0-14 yrs old	0.66	0.64	0.67
	% 30-39 yrs old	0.76	0.74	0.77
	% 40-49 yrs old	0.67	0.40	0.50
	% 50-59 yrs old	0.57	0.49	0.51
	% 60-69 yrs old	0.78	0.61	0.64
	% 70-79 yrs old	0.85	0.88	0.82
	% 80+ yrs old	0.63	0.67	0.66
Family & Household Characteristics	% 2-person HHds	0.70	0.61	0.63
	% 4+ person HHds	0.95	0.93	0.90
	% Legally Married Persons	0.84	0.80	0.75
	% Separated / Divorced Persons	0.77	0.65	0.52
	% Common-Law Couples	0.64	0.76	0.80
	% Lone Parent Families	0.76	0.78	0.86
	% Multi-Family HHds	0.79	0.77	0.80
Educational Attainment	% No High School Certificate	0.93	0.87	0.78
	% High School Certificate Only	0.49	0.69	0.80
	% Non-University Certificate	0.45	0.40	0.31
	% Trades Certificate	0.68	0.79	0.72
Labour Force & Occupation	Female Participation Rate	0.68	0.61	0.72
	% Business, Admin, Management	0.84	0.81	0.85
	% Arts, Science, Public Sector	0.87	0.85	0.81
	% Sales / Service	0.53	0.62	0.77
	% Trades, Transport, Manufacturing	0.85	0.86	0.87
Immigration & Integration	% Immigrated Pre-1980s	0.56	0.68	0.73
	% Immigrated 1981-1990	0.83	0.61	0.57
	% Immigrated 1991-2000		0.84	0.81
	% Immigrated 2001-2010			0.82
	% No Knowledge of Off. Languages	0.85	0.84	0.46
Visible Minorities	% Black	0.73	0.74	0.74
	% South Asian	0.69	0.68	0.56
	% Chinese, Korean, Japanese	0.52	0.60	0.41
	% Southeast Asian, Filipino	0.43	0.49	0.53
	% Arabic, West Asian	0.50	0.53	0.51
	% Latin American	0.52	0.53	0.49
Income	% Government Transfer Income	0.89	0.87	0.90
	% Other Income Sources	0.81	0.77	0.82
	% Persons in Low Income	0.78	0.80	0.77
	% Persons in Near-Average Income	0.45	0.48	0.45
Commuting	% Auto Commuting	0.88	0.86	0.79
	% Transit Commuting	0.72	0.60	0.47
Residential Mobility	% No Moves in Last 5 yrs	0.83	0.83	0.81
	% Moved Locally in Last 5 yrs	0.66	0.50	0.55
Tenure	% Renting	0.84	0.71	0.69
	% of Annual Income on Housing	0.83	0.80	0.79
	Average Dwelling Value LQ	0.61	0.67	0.68
Housing Type	% Single-Detached	0.78	0.81	0.75
	% Missing Middle	0.46	0.37	0.12
	% 1-4 Storey Apts	0.62	0.64	0.50
	% 5+ Story Apts	0.86	0.86	0.72
Housing Age & Condition	% Homes Need Major Repair	0.41	0.50	0.42
	% Homes Built Pre-1960s	0.87	0.85	0.81
	% Homes Built 1961-1980	0.68	0.55	0.49
	% Homes Built 1981-1990	0.29	0.46	0.49
	% Homes Built 1991-2000		0.19	0.30
	% Homes Built 2001-2010			0.23
Urban Form	Dwelling Density	0.63	0.68	0.70
	Distance from CBD	0.86	0.81	0.78

Ahead of and in support of a more detailed analyses of the 1996, 2006, and 2016 components sets, Table 4.3 presents these year's respective 5-, 5- and 4-component sets in a combined format to demonstrate how quite similar dimensions emerge consistently each year, in terms of saturating variable groups and the conceptual themes these elicit. While mild variation in axes' explained variance and saturations does occur over time[111], the consistent patterning of the following axes' strongest saturations reflects a general stability in the Toronto CSD's social ecology:

1. Socio-Economic Status (SES) and Visible Minorities (Axis 1 in 1996, 2006, 2016)
2. Urban vs. Suburban Lifestyle (Axis 2 in 1996, 2006, 2016)
3. Life Cycle / Stage (Axis 3 in 1996; Axis 4 in 2006, 2016)
4. Apartments by Age, Type, and Occupants (Axis 4 in 1996; Axis 3 in 2006, 2016)
5. East Asians vs. Vocational Educations (Axis 5 in 1996, 2006; not extracted in 2016)

Further, due to their relative consistency over time, analysis of the 1996 axes extracted focuses on their core structure, while analyses of 2006 and 2016 components highlight how these structures change year-to-year, both in terms of evolving saturations and the spatial patterning of corresponding component scores. To support this, the dimension's saturation tables, and factor score maps for 1996, 2006, and 2016 are all introduced in corresponding tables and figures alongside their 1996 analysis. This highlights what if any changes occur across Toronto over the 1996-2016 study period while reducing repetition. In the following, Table 4.4 and Figure 4.5 correspond to the SES and Visible Minorities dimension; Table 4.5 and Figure 4.6 to the Urban vs. Suburban Lifestyle dimension; Table 4.6 and Figure 4.7 to the Life Cycle / Stage dimension; Table 4.7 and Figure 4.8 to the Apartments by Age, Type, and Occupants dimension; and Table 4.8 and Figure 4.9 to the East Asians vs. Vocational Educations dimension. Each of these features an a, b, and c sub-section to denote the 1996, 2006, and 2016 saturation table and component score map of the dimension[112]. Tables are organized by variable domains and depict the strength of saturation and communality for each variable. Negative and positive saturations are separated to highlight the opposition of variables. For each year, the dimension's extraction order, explained variance, and cumulative explained variance are displayed[113]. Component score maps use shades of blue to denote CTs scoring to the axis's negative pole, while shades of red-orange denote CTs' scoring to the positive pole's attributes. Tracts left white denote CTs scoring minimally to either the negative or positive pole[114]. Having outlined my 1996, 2006, and 2016 axes sets, I now analyze the 1996 axis set beginning with that (and every other static) set's first extracted axis: SES and Visible Minorities.

[111] Reflecting shifts in the underlying dimensions tying together the Toronto CSD's socio-spatial attributes between 1996-2016.
[112] The portion of the figure for each year is suffixed by the letters 'a' for 1996, 'b', for 2006, and 'c' for 2016.
[113] Accounts for the variance of the axis *added to* each prior axis's variance e.g., third axis = first, second, and third axis variance.
[114] Conceptually, these are tracts striking somewhat of a balance between the observed oppositions of socio-spatial attribute.

Table 4.3

Components by Domain and Variable for 5, 5, and 4-Axis Solutions, Toronto CSD, 1996, 2006, and 2016

		SES and Visible Minorities			Urban vs. Suburban Lifestyle			Life Cycle / Stage			Apartments by Age, Type, and Occupants			Ethnicity and Household Characteristics		
	Explained Variance (%)	*27.4*	*27.4*	*30.2*	*20.0*	*19.1*	*18.9*	*9.4*	*6.4*	*5.8*	*7.4*	*9.6*	*10.2*	*5.7*	*5.5*	-
Domain	**Indicator**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**
Age / Life Stage	% 0-14 yrs old		0.44			-0.44	-0.55	0.60	0.47	0.59						
	% 30-39 yrs old				0.81	0.79	0.79									
	% 40-49 yrs old	-0.84						0.41	0.41	0.50		-0.50	-0.54			
	% 50-59 yrs old	-0.48	-0.48		-0.54	-0.44	-0.67									
	% 60-69 yrs old				-0.49		-0.44	-0.75	-0.62	-0.59						
	% 70-79 yrs old							-0.92	-0.89	-0.82						
	% 80+ yrs old							-0.79	-0.75	-0.77						
Family & Household Characteristics	% 2-person HHds		-0.46	-0.41				-0.60	-0.41	-0.40				0.43		
	% 4+ person HHds				-0.69	-0.80	-0.83	0.59								
	% Legally Married Persons			-0.46	-0.91	-0.87	-0.78									
	% Separated / Divorced Persons			0.62	0.79	0.62	0.47								0.48	
	% Common-Law Couples				0.58	0.61	0.55				-0.41	-0.50	-0.66			
	% Lone Parent Families	0.59	0.82	0.75				0.43								
	% Multi-Family HHds		0.70	0.52	-0.46		-0.47							-0.40		
Educational Attainment	% No High School Certificate	0.92	0.92	0.86												
	% High School Certificate Only		0.72	0.72							0.42					
	% Non-University Certificate			0.57										0.49	0.61	
	% Trades Certificate	0.59	0.70	0.87										0.62	0.57	
Labour Force & Occupation	Female Participation Rate	-0.72	-0.40						0.49				-0.58			
	% Business, Admin, Management	-0.76	-0.86	-0.85												
	% Arts, Science, Public Sector	-0.82	-0.77	-0.66												
	% Sales / Service	0.67	0.79	0.76												
	% Trades, Transport, Manufacturing	0.85	0.90	0.84												
Immigration & Integration	% Immigrated Pre-1980s	0.40			-0.41				-0.70	-0.72						
	% Immigrated 1981-1990		0.65	0.55							0.45					
	% Immigrated 1991-2000*		0.56									0.55	0.73			
	% Immigrated 2001-2010**												0.81			
	% No Knowledge of Off. Languages	0.56	0.74	0.44									0.42	-0.61	-0.49	

* 2006 and 2016 only ** 2016 only

Table 4.3

Components by Domain and Variable for 5, 5, and 4-Axis Solutions, Toronto CSD, 1996, 2006, and 2016 continued

		SES and Visible Minorities			Urban vs. Suburban Lifestyle and Life Stage			Life Cycle / Stage			Apartments by Age, Type, and Occupants			Ethnicity and Household Characteristics		
	Explained Variance (%)	*27.4*	*27.4*	*30.2*	*20.0*	*19.1*	*18.9*	*9.4*	*6.4*	*5.8*	*7.4*	*9.6*	*10.2*	*5.7*	*5.5*	-
Domain	**Indicator**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**	**1996**	**2006**	**2016**
Visible Minorities	% Black	0.47	0.71	0.77												
	% South Asian		0.49								0.49	0.49	0.61			
	% Chinese, Korean, Japanese			-0.53							0.43		0.51	-0.61	-0.71	
	% Southeast Asian, Filipino	0.44	0.61	0.63												
	% Arabic, West Asian										0.71	0.70	0.71			
	% Latin American	0.69	0.60	0.69												
Income	% Government Transfer Income	0.97	0.92	0.79												
	% Other Income		-0.61	-0.71				-0.65	-0.49	-0.44						
	% Persons in Low Income	0.56	0.70	0.51									0.56	-0.41		
	% Persons in Near-Average Income	0.66	0.56	0.68											0.44	
Commuting	% Auto Commuting				-0.87	-0.89	-0.83									
	% Transit Commuting				0.76	0.73	0.60									
Residential Mobility	% No Moves in Last 5 yrs				-0.82	-0.67	-0.82					-0.53				
	% Moved Locally in Last 5 yrs				0.78	0.52	0.71									
Tenure	% Renting				0.85	0.78	0.79									
	% of Annual Income on Housing	0.45	0.64	0.43	0.55	0.51	0.56						0.43			
	Average Dwelling Value LQ	-0.60	-0.71	-0.59												
Housing Type	% Single-Detached				-0.78	-0.82	-0.84									
	% Missing Middle													-0.53	-0.40	
	% 1-4 Storey Apts				0.48	0.46					-0.59	-0.63	-0.65			
	% 5+ Story Apts				0.54	0.51	0.65				0.79	0.81	0.61			
Housing Age & Condition	% Homes Need Major Repair		0.45	0.59	0.50	0.46										
	% Homes Built Pre-1960s										-0.90	-0.86	-0.91			
	% Homes Built 1961-1980										0.77	0.58	0.50			
	% Homes Built 1981-1990											0.62	0.65			
	% Homes Built 1991-2000*												0.55			
	% Homes Built 2001-2010**			-0.41												
Urban Form	Dwelling Density				0.76	0.81	0.82									
	Distance from CBD				-0.68	-0.67	-0.56				0.41		0.52			

* 2006 and 2016 only ** 2016 only

4.3.1 – Toronto in 1996

1996's SES and Visible Minorities Dimension (Axis 1; 27.4% Dataset Variance)

In 1996, Toronto's first extracted axis differentiates high- from low-SES neighbourhoods. More precisely, 40- to 59-year-olds, high status white-collar occupations, female labour participation, and above-average home values saturate the axis's negative pole, denoting affluent, high-status areas (Table 4.4a). The positive pole saturates lower-tier occupations, low education achievement, middle-to-low-incomes[115], government transfers, high income shares spent on housing, lone parent families, pre-1980 immigrants, and visible minorities[116]. These saturations suggest far less affluent, racialized neighbourhoods[117]. The most prescient finding is that Toronto's SES structure reflects clear ethnic patterns. While this SES axis is extracted in each year of the study period, the 40-49 group is the strongest negative saturation in 1996. Alongside the 50-59 group, this dimension locates Toronto's mid-to-late adults (persons typically in more advanced, secure stages of their career) in affluent social and spatial traits; specifically, they congregate in Toronto's more/most affluent districts (as per high average home values). Generationally, these are leading-edge Boomers (reflecting how post-war generations thrived amidst the era's fortune) and Torontonians of the Silent Generation[118], also in their early working years during the post-war prosperity of the 1950s and 1960s.

Turning to Figure 4.5a, negative scores for 1996 Toronto's high-status, mid/late-adults congregate in central Old Toronto, from the CBD, through Cabbagetown, Rosedale and Forest Hills, up to Yonge-Eglinton, and through into North York and east at The Beaches. Notable exceptions include positively-scoring St. Jamestown and Regent Park, and (east across the Don) parts of Riverdale extending through the Danforth. The former two areas are quite marginal, the latter less so. Marginal, racialized districts also emerge west from Downtown through Kensington-Chinatown, Little Italy, Little Portugal, and Trinity-Bellwoods. Further north in Weston and The Junction, low SES factor scores intensify through York to the CSD's northern edge, covering much of north Etobicoke and North York. A high-SES cluster is found at the western edge of this marginal swath, starting in High Park, extending north into central Etobicoke. While not scoring as intensely for low-SES, starting in East / North York's Thorncliffe and Flemington Park areas and extending east, much of Scarborough (except its outer periphery) leans to low-SES and to higher incidences of visible minorities. As *the* first axis extracted in 1996, 2006, and 2016, thus explaining the most total variance (Table 4.3), the SES and Visible Minorities dimension confirms these elements are fundamental to Toronto's social ecology. Given Toronto is noted for its diversity of physical and social character (Harris, 2015), low, high, and middle-SES neighbourhoods can be found in central, peripheral, and in-between parts of the CSD. Worth noting also, as being both semi-expected and easily referenced in subsequent analyses, is how the negative (affluent) and positive (marginal) factor scores in Figure 4.5 resemble Hulchanski's (2011) Three Cities (Section 3; Figure 3.4).

[115] Those making > 40 and 70-100% the regional income average.
[116] Latin American, Black, and Southeast Asian or Filipino (in order of strength of saturation).
[117] The lack of knowledge of English or French also suggests less-integrated immigrants.
[118] Born mid-1930s until the end of WWII.

Table 4.4

SES and Visible Minorities Dimension - Saturation and Communality Table, Toronto CSD, 1996, 2006, 2016

Table 4.4a

Year	**1996**
Extraction Order	**First (1)**
Variance	**27.4**
Cumulative Variance	**27.4**

Domain	Indicator	Saturation	Comm.
Age	% 40-49 yrs old	-0.84	0.67
Age	% 50-59 yrs old	-0.48	0.57
Labour Force	Female Participation Rate	-0.72	0.68
Occupation	% Arts, Science, Public Sector	-0.82	0.87
Occupation	% Business, Admin, Management	-0.76	0.84
Housing Value	Average Dwelling Value LQ	-0.60	0.61
Family / Household	% Lone Parent Families	0.59	0.76
Education	% No High School Certificate	0.92	0.93
Education	% Trades Certificate	0.59	0.68
Occupation	% Sales / Service	0.67	0.53
Occupation	% Trades, Transport, Manufacturing	0.85	0.85
Immigration (Period)	% Immigrated Pre-1980s	0.40	0.56
Language	% No Knowledge of Off. Language	0.56	0.85
Ethnicity	% Black	0.47	0.73
Ethnicity	% Southeast Asian, Filipino	0.44	0.43
Ethnicity	% Latin American	0.69	0.52
Income	% Government Transfer Income	0.97	0.89
Income	% Persons in Low Income	0.56	0.78
Income	% Persons in Near-Avg Income	0.66	0.45
Tenure	% of Annual Income on Housing	0.45	0.83

Table 4.4b

Year	**2006**
Extraction Order	**First (1)**
Variance	**27.4**
Cumulative Variance	**27.4**

Domain	Indicator	Saturation	Comm.
Age	% 50-59 yrs old	-0.48	0.49
Family / Household	% 2-person HHds	-0.46	0.61
Labour Force	Female Participation Rate	-0.40	0.61
Occupation	% Business, Admin, Management	-0.86	0.81
Occupation	% Arts, Science, Public Sector	-0.77	0.85
Income	% Other Income	-0.61	0.77
Housing Value	Average Dwelling Value LQ	-0.71	0.67
Age	% 0-14 yrs old	0.44	0.64
Family / Household	% Lone Parent Families	0.82	0.78
Family / Household	% Multi-Family HHds	0.70	0.77
Education	% No High School Certificate	0.92	0.87
Education	% High School Certificate Only	0.72	0.69
Education	% Trades Certificate	0.70	0.79
Occupation	% Sales / Service	0.79	0.62
Occupation	% Trades, Transport, Manufacturing	0.90	0.86
Immigration (Period)	% Immigrated 1981-1990	0.65	0.61
Immigration (Period)	% Immigrated 1991-2000	0.56	0.84
Language	% No Knowledge of Off. Language	0.74	0.84
Ethnicity	% Black	0.71	0.74
Ethnicity	% South Asian	0.49	0.68
Ethnicity	% Southeast Asian, Filipino	0.61	0.49
Ethnicity	% Latin American	0.60	0.53
Income	% Government Transfer Income	0.92	0.87
Income	% Persons in Low Income	0.70	0.80
Income	% Persons in Near-Avg Income	0.56	0.48
Tenure	% of Annual Income on Housing	0.64	0.80
Housing Condition	% Homes Need Major Repair	0.45	0.50

Table 4.4c

Year	**2016**
Extraction Order	**First (1)**
Variance	**30.2**
Cumulative Variance	**30.2**

Domain	Indicator	Saturation	Comm.
Family / Household	% 2-person HHds	-0.41	0.63
Family / Household	% Legally Married Persons	-0.46	0.75
Occupation	% Business, Admin, Management	-0.85	0.85
Occupation	% Arts, Science, Public Sector	-0.66	0.81
Ethnicity	% Chinese, Korean, Japanese	-0.53	0.41
Income	% Other Income	-0.71	0.82
Housing Value	Average Dwelling Value LQ	-0.59	0.68
Family / Household	% Separated / Divorced Persons	0.62	0.52
Family / Household	% Lone Parent Families	0.75	0.86
Family / Household	% Multi-Family HHds	0.52	0.80
Education	% No High School Certificate	0.86	0.78
Education	% High School Certificate Only	0.72	0.80
Education	% Non-University Certificate	0.57	0.31
Education	% Trades Certificate	0.87	0.72
Occupation	% Sales / Service	0.76	0.77
Occupation	% Trades, Transport, Manufacturing	0.84	0.87
Immigration (Period)	% Immigrated 1981-1990	0.55	0.57
Language	% No Knowledge of Off. Language	0.44	0.46
Ethnicity	% Black	0.77	0.74
Ethnicity	% Southeast Asian, Filipino	0.63	0.53
Ethnicity	% Latin American	0.69	0.49
Income	% Government Transfer Income	0.79	0.90
Income	% Persons in Low Income	0.51	0.77
Income	% Persons in Near-Avg Income	0.68	0.45
Tenure	% of Annual Income on Housing	0.43	0.79
Housing Condition	% Homes Need Major Repair	0.59	0.42

Figure 4.5

SES and Visible Minorities Dimension - Component Scores, Toronto CSD, 1996, 2006, 2016

Figure 4.5a

1996

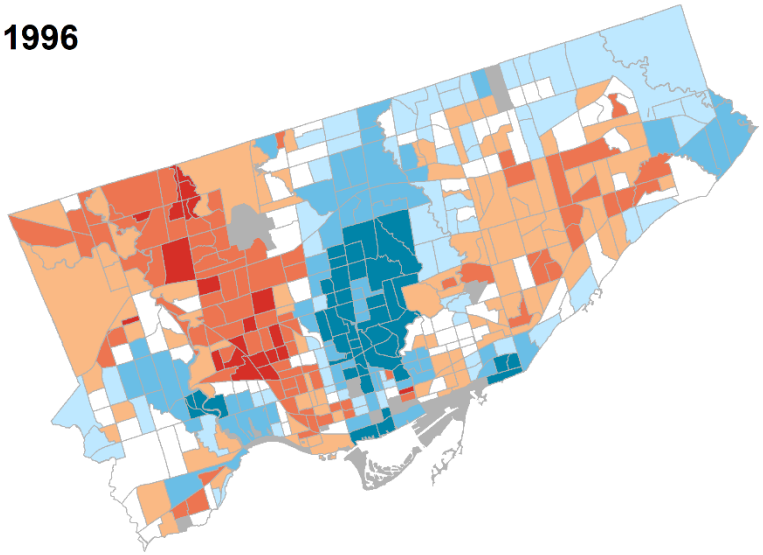


Figure 4.5b

2006

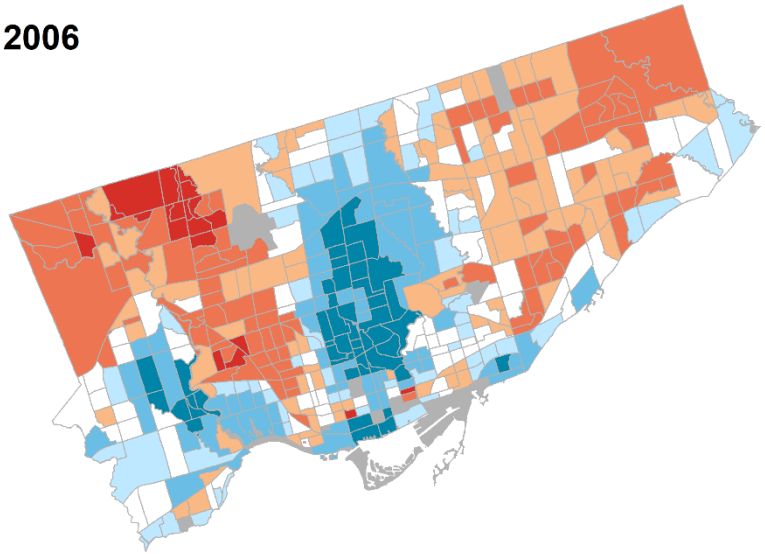
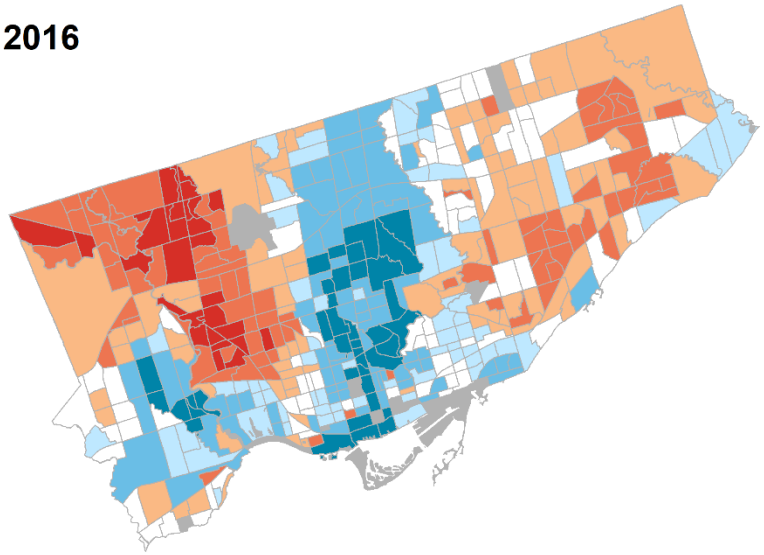
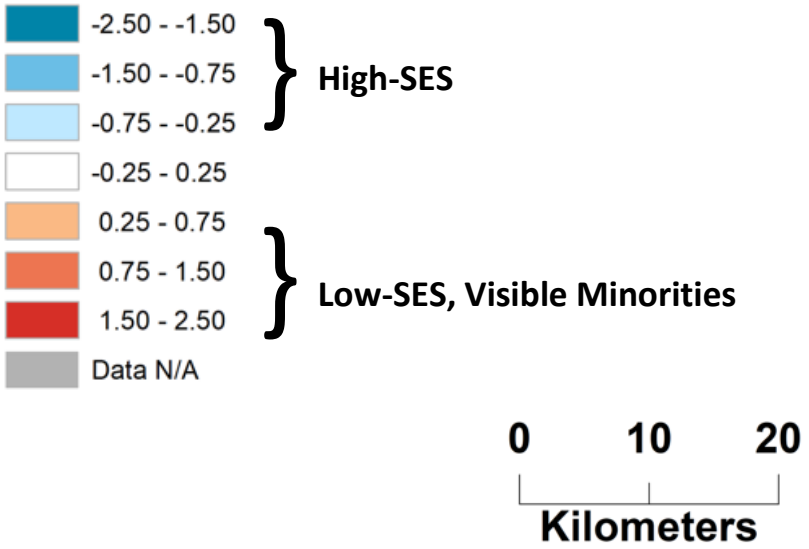


Figure 4.5c

2016





1996's Urban vs. Suburban Lifestyle Dimension (Axis 2; 20.0% Dataset Variance)

In 1996, Toronto's second-ranked dimension[119] differentiates the 'urban' from the 'suburban', opposing household types / forms, lifestyles, life stages, and built form attributes associated with these ideals. Specifically, the negative pole saturates 50-69-year-olds, legally married and 4+ person households, single-detached homes, auto commuting, no moves in the last 5 years, and distance from Toronto's CBD (Table 4.5a), depicting stable, suburban residential areas comprised of older, traditionally structured families[120]. Young children (0-14) do not saturate here. Instead, residents aged 50-59 and 60-69 in late career / early retirement[121] gravitate to traditional suburban form and family-oriented lifestyles. The positive pole saturates individuals aged 30-39, common-law, separated / divorced, transit commuting, high shares of income on housing, renting, 1-4 and 5+ story apartments, dwelling density, need of major repairs, and high shares of moves in the last 5 years. This depicts early, often small households in Toronto's dense, central urban areas, places where renting is the most common tenure and residential turnover is quite frequent[122]. Note that 30-39 here are trailing-edge Boomers; in 1996 Toronto, it seems these younger adults reside plentifully in/near Toronto's core as early households, placing this generation within early life course stages.

Component scores for 1996's Urban vs. Suburban Lifestyle dimension follow a consistent concentric pattern, sensible given saturations of Distance from the CBD and density (Fig. 4.6a). Core CTs tend to be dense, apartment and transit rich, and to host early households. Meanwhile, suburban form and traditional family traits intensify as one moves into Toronto's Inner Suburbs and to its periphery i.e., most of outer Etobicoke, Scarborough, and North York. Yet, this concentricity takes exception in areas such as Rosedale in Old Toronto (extending into Bridal Path and Don Mills) scoring negatively i.e., to 'sub-urbanity'. Meanwhile, scoring highly for urban qualities are the Yonge-Eglington area adjoining Rosedale on the west and the Weston and Mount Dennis areas. Old city centers or towering apartments further from the core also score positively (for urbanity). Many CTs throughout 1996 Toronto score average on the dimension, reflecting areas more mixed in their built form and household composition.

[119] A rank maintained throughout the study period, akin to the SES and Visible Minority dimension's maintenance of first-most.
[120] Minor saturation of pre-1980 immigrants and multi-family households reflect Toronto residents' diverse origins (Harris, 2015).
[121] In 1996, members of the Silent Generation chronologically generationally preceding Boomers.
[122] Several saturations here reveal how inferring their inverse on the other pole is informative i.e., saturations for renting and dwelling density on this positive pole mean the peripheral, single-detached dwellings on the negative are most often owned and relatively dispersed. Similarly, negative saturation of Distance from the CBD implies the positive pole leans to the CSD's core.

Table 4.5

Urban vs. Suburban Lifestyle Dimension - Saturation and Communality Table, Toronto CSD, 1996, 2006, 2016

Table 4.5a

Year	**1996**
Extraction Order	**Second (2)**
Variance	**20.0**
Cumulative Variance	**47.4**

Domain	Indicator	Saturation	Comm.
Age	% 50-59 yrs old	-0.54	0.57
Age	% 60-69 yrs old	-0.49	0.78
Family / Household	% 4+ person HHds	-0.69	0.95
Family / Household	% Legally Married Persons	-0.91	0.84
Family / Household	% Multi-Family HHds	-0.46	0.79
Immigration (Period)	% Immigrated Pre-1980s	-0.41	0.56
Commuting	% Auto Commuting	-0.87	0.88
Residential Mobility	% No Moves in Last 5 yrs	-0.82	0.83
Housing Type	% Single-Detached	-0.78	0.78
Urban	Distance from CBD	-0.68	0.86
Age	% 30-39 yrs old	0.81	0.76
Family / Household	% Separated / Divorced Persons	0.79	0.77
Family / Household	% Common-Law Couples	0.58	0.64
Commuting	% Transit Commuting	0.76	0.72
Residential Mobility	% Moved Locally in Last 5 yrs	0.78	0.66
Tenure	% Renting	0.85	0.84
Tenure	% of Annual Income on Housing	0.55	0.83
Housing Type	% 1-4 Story Apts	0.48	0.62
Housing Type	% 5+ Story Apts	0.54	0.86
Housing Condition	% Homes Need Major Repair	0.50	0.41
Urban	Dwelling Density	0.76	0.63

Table 4.5b

Year	**2006**
Extraction Order	**Second (2)**
Variance	**19.1**
Cumulative Variance	**46.5**

Domain	Indicator	Saturation	Comm.
Age	% 0-14 yrs old	-0.44	0.64
Age	% 50-59 yrs old	-0.44	0.49
Family / Household	% 4+ person HHds	-0.80	0.93
Family / Household	% Legally Married Persons	-0.87	0.80
Commuting	% Auto Commuting	-0.89	0.86
Residential Mobility	% No Moves in Last 5 yrs	-0.67	0.83
Housing Type	% Single-Detached	-0.82	0.81
Urban	Distance from CBD	-0.67	0.81
Age	% 30-39 yrs old	0.79	0.74
Family / Household	% Separated / Divorced Persons	0.62	0.65
Family / Household	% Common-Law Couples	0.61	0.76
Commuting	% Transit Commuting	0.73	0.60
Residential Mobility	% Moved Locally in Last 5 yrs	0.52	0.50
Tenure	% Renting	0.78	0.71
Tenure	% of Annual Income on Housing	0.51	0.80
Housing Type	% 1-4 Storey Apts	0.46	0.64
Housing Type	% 5+ Story Apts	0.51	0.86
Housing Condition	% Homes Need Major Repair	0.46	0.50
Urban	Dwelling Density	0.81	0.68

Table 4.5c

Year	**2016**
Extraction Order	**Second (2)**
Variance	**18.9**
Cumulative Variance	**49.1**

Domain	Indicator	Saturation	Comm.
Age	% 0-14 yrs old	-0.55	0.67
Age	% 50-59 yrs old	-0.67	0.51
Age	% 60-69 yrs old	-0.44	0.64
Family / Household	% 4+ person HHds	-0.83	0.90
Family / Household	% Legally Married Persons	-0.78	0.75
Family / Household	% Multi-Family HHds	-0.47	0.80
Commuting	% Auto Commuting	-0.83	0.79
Residential Mobility	% No Moves in Last 5 yrs	-0.82	0.81
Housing Type	% Single-Detached	-0.84	0.75
Urban	Distance from CBD	-0.56	0.78
Age	% 30-39 yrs old	0.79	0.77
Family / Household	% Separated / Divorced Persons	0.47	0.52
Family / Household	% Common-Law Couples	0.55	0.80
Commuting	% Transit Commuting	0.60	0.47
Residential Mobility	% Moved Locally in Last 5 yrs	0.71	0.55
Tenure	% Renting	0.79	0.69
Tenure	% of Annual Income on Housing	0.56	0.79
Housing Type	% 5+ Story Apts	0.65	0.72
Urban	Dwelling Density	0.82	0.70

Figure 4.6

Urban vs. Suburban Lifestyle Dimension - Component Scores, Toronto CSD, 1996, 2006, 2016

Figure 4.6a

1996

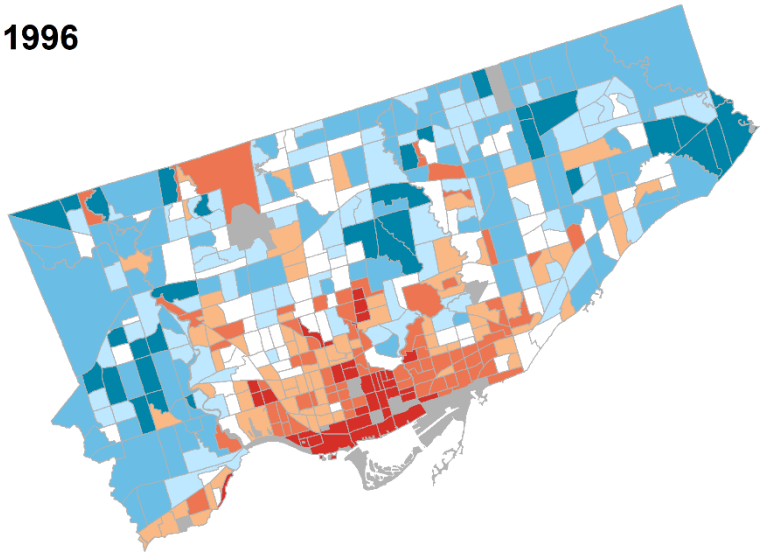


Figure 4.6b

2006

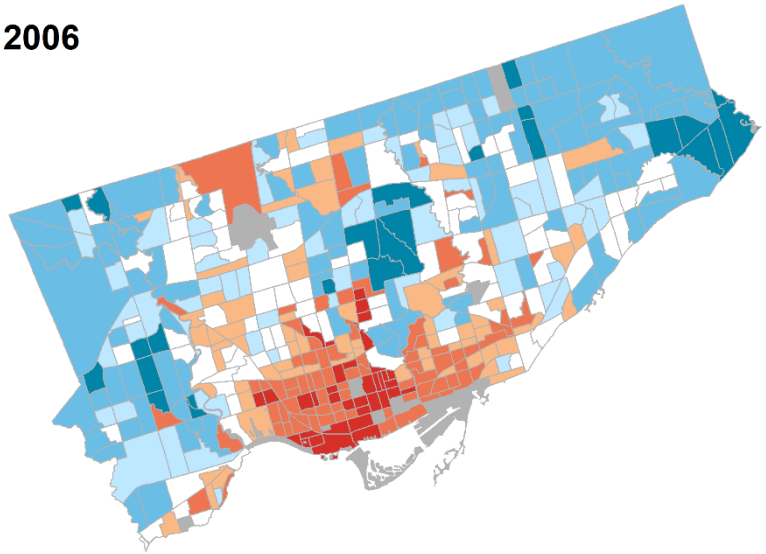
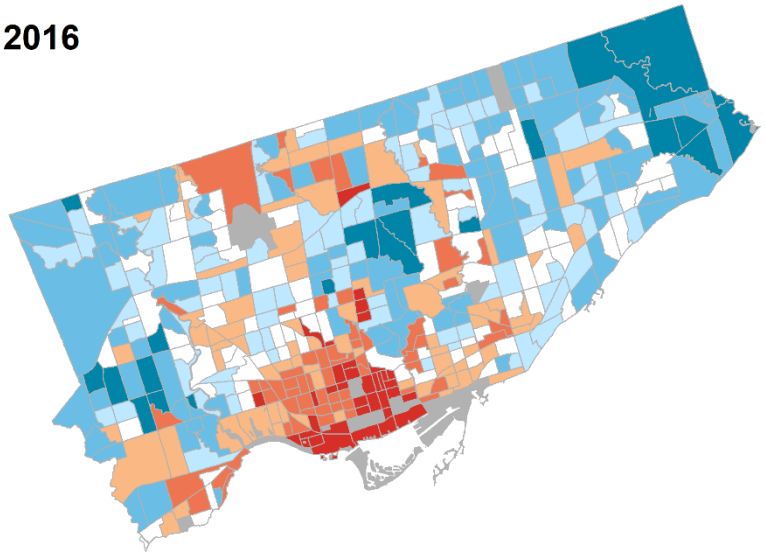
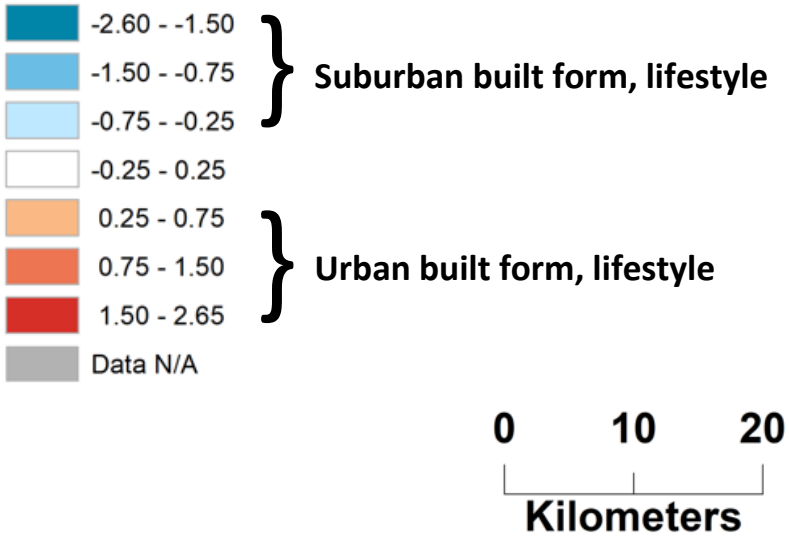


Figure 4.6c

2016





1996's Life Cycle / Stage Dimension (Axis 3; 9.4% of Dataset Variance)

The third axis extracted for 1996 distinguishes between early family and older adult life stages. The negative pole saturates ages 60+ (the 60-69, 70-79, and 80+ groups), 2-person households and other incomes[123](Table 4.6a). Portrayed are aged neighbourhoods i.e., older adult concentrations, along with retired households' traits. The positive pole saturates persons aged 0-14 and 40-49, 4+ person households, and lone parent families[124], depicting early families with newborn to middle school-aged children. While saturating only .41, the 40-49 group's presence in 1996 pertains to leading-edge Boomers. While useful for identifying how population age overlaps other urban elements, this Life Cycle / Stage dimension's 9.4% explained variance is roughly one-third and one-half the variance explained by the first, SES and Visible Minorities (27.4%) and second, Urban vs. Suburban Lifestyle (20%) axes

Given the dimension's strong saturation of 60+ groups, it is little surprise its component scores (Fig. 4.7a) resemble the high-, low-, and average older adult concentrations in 1996's 60+ LQ maps (Fig. 4.1). Aged CTs (negative scores) cover south Etobicoke and North York. Entering Old Toronto west of Downtown, Trinity-Bellwoods and Kensington-Chinatown lean to agedness, as do Rosedale, Yonge-St. Clair, Bloor-Yorkville, and Forest Hill. Meanwhile, CTs with positive scores, representing high shares of early families are found in west Old Toronto's South Parkdale and Niagara areas leading right up to the CBD, in Regent Park, and (across the Don River) in much of Riverdale and the Danforth. In the Inner Suburbs, two major clusters scoring for early families are found at the CSD's northwest and (especially) northeast corners, where Etobicoke and North York converge and through much of Scarborough east of the Pacific Mall. These scores reflect these area's recent construction and settlement of Toronto's 'newest' families. Through the Junction area to Mount Dennis in York is a similar stretch of CTs scoring towards early families and away from older adult households, although these neighbourhoods were built out much longer ago.

[123] As indicated in Appendix 1, these sources include various government and employment-derived retirement income sources such as pensions and RRSPS, as well as forms of investment income; they are definitively sources other than those directly from employment or transferred from various levels of government.

[124] 0-14 and 4+ person households saturate more strongly (0.60 and 0.59) than 40-49 and lone parent families (0.43; Table 4.6a).

Table 4.6

Life Cycle / Stage Dimension - Saturation and Communality Table, Toronto CSD, 1996, 2006, 2016

Table 4.6a

Year	**1996**
Extraction Order	**Third (3)**
Variance	**9.4**
Cumulative Variance	**56.8**

Domain	Indicator	Saturation	Comm.
Age	% 60-69 yrs old	-0.75	0.78
Age	% 70-79 yrs old	-0.92	0.85
Age	% 80+ yrs old	-0.79	0.63
Family / Household	% 2-person HHds	-0.60	0.70
Income	% Other Income	-0.65	0.81
Age	% 0-14 yrs old	0.60	0.66
Age	% 40-49 yrs old	0.41	0.67
Family / Household	% 4+ person HHds	0.59	0.95
Family / Household	% Lone Parent Families	0.43	0.76

Table 4.6b

Year	**2006**
Extraction Order	**Fourth (4)**
Variance	**6.4**
Cumulative Variance	**62.5**

Domain	Indicator	Saturation	Comm.
Age	% 60-69 yrs old	-0.62	0.61
Age	% 70-79 yrs old	-0.89	0.88
Age	% 80+ yrs old	-0.75	0.67
Family / Household	% 2-person HHds	-0.41	0.61
Immigration (Period)	% Immigrated Pre-1980s	-0.70	0.68
Income	% Other Income	-0.49	0.77
Age	% 0-14 yrs old	0.47	0.64
Age	% 40-49 yrs old	0.41	0.40
Labour Force	Female Participation Rate	0.49	0.61

Table 4.6c

Year	**2016**
Extraction Order	**Fourth (4)**
Variance	**5.8**
Cumulative Variance	**65.1**

Domain	Indicator	Saturation	Comm.
Age	% 60-69 yrs old	-0.59	0.64
Age	% 70-79 yrs old	-0.82	0.82
Age	% 80+ yrs old	-0.77	0.66
Family / Household	% 2-person HHds	-0.40	0.63
Immigration (Period)	% Immigrated Pre-1980s	-0.72	0.73
Income	% Other Income	-0.44	0.82
Age	% 0-14 yrs old	0.59	0.67
Age	% 40-49 yrs old	0.50	0.50

Figure 4.7

Life Cycle / Stage Dimension - Component Scores, Toronto CSD, 1996, 2006, 2016

Figure 4.7a

1996

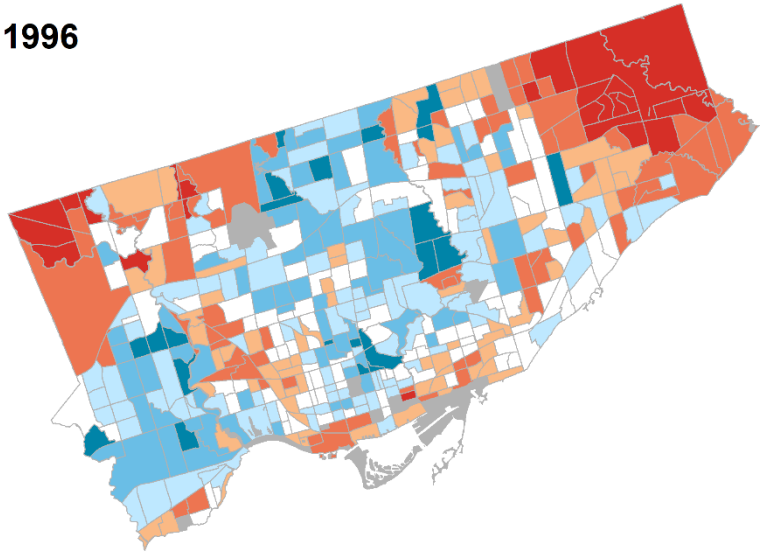


Figure 4.7b

2006

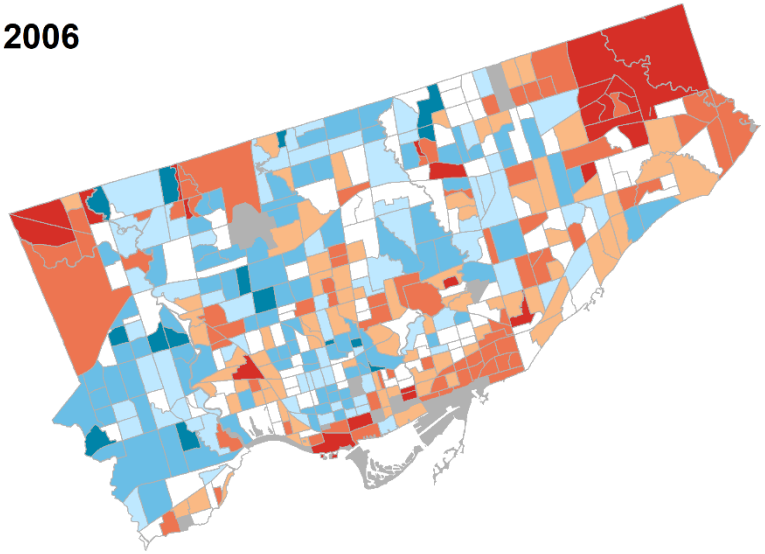
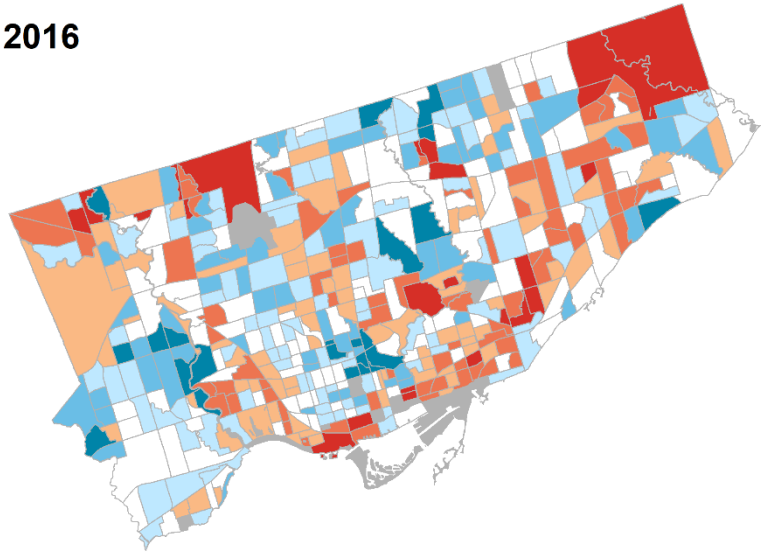


Figure 4.7c

2016



1996's Apartments by Age, Type, and Occupants Dimension (Axis 4; 7.4% Dataset Variance)

In 1996, Toronto's fourth dimension differentiates two major eras of apartment building by type, form, and location, with secondary saturations portraying these areas' 'typical' occupants. Table 4.7a shows a negative pole strongly saturating pre-1960 dwellings alongside (to lesser degree) 1-4 story apartments and common-law couples. These older areas (plentiful in small apartments) seem to avoid widespread redevelopment compared to other parts of Toronto, such as the CBD, which have seen their pre-1960 housing stock supplanted with more recent building. The positive pole saturates dwellings built 1961-1980, many of these 5+ story apartments, and distance from the CBD. Saturating also are several visible minority groups[125], 1981-1990 immigrants, and high school certificate only. These reflect 1961-1980 Toronto, an era when both publicly funded housing projects and private condo development created many of the CSD's large apartments (see Section 3). Visible minorities, immigrants, and limited education hint at local SES; these groups are also relatively absent in pre-1960 areas i.e., the axis's negative pole.

The 1996 Apartments by Age, Type, and Occupants dimension's factor scores feature some concentricity (Fig. 4.3.4a), albeit different than the Urban vs. Suburban Lifestyle axis (Fig. 4.8a). While strong, positive component scores i.e., those denoting high shares of homes built between 1961-1980 and 5+ story apartments tend towards the CSD's edges, the CBD also hosts a consistent block of CTs with positive scores, extending from the lake right up to Yorkville and North St. Jamestown. However, this cluster halts abruptly as – immediately surrounding the CBD to the west, east, and north – apartments tend to be 1-4 stories and local homes generally predate 1960. Strong negative factor scores associated with this built form predominate much of Old Toronto, in the West End up into York, Yonge / St. Clair, Forest Hill, and Lawrence Park, and (across the Don River) Riverdale and the Danforth. These traits stretch further into the Inner Suburbs, covering much of south Etobicoke, York, and south North York. Besides clusters in East / North York's Thorncliffe and Flemington Park and where Etobicoke and North York converge, the strongest swath of CTs scoring to 1961-1980 dwellings begins at the eastern edge of North York's Town Center and extends right to Scarborough's outer limits, with marked intensity around Pacific Mall. In addition to these area's construction era and built form, noted local presence of immigrants could in part explain the particularly high, positive factor scores observed in CTs in this outer region of the CSD.

[125] Arabic or West Asian, South Asian, and Chinese, Korean, or Japanese (in order of strength of saturation).

Table 4.7

Apartments by Age, Type, and Occupants Dimension - Saturation and Communality Table, Toronto CSD, 1996, 2006, 2016

Table 4.7a

Year	**1996**
Extraction Order	**Fourth (4)**
Variance	**7.4**
Cumulative Variance	**64.2**

Domain	Indicator	Saturation	Comm.
Family / Household	% Common-Law Couples	-0.41	0.64
Housing Type	% 1-4 Story Apts	-0.59	0.62
Housing Age	% Homes Built Pre-1960s	-0.90	0.87
Education	% High School Certificate Only	0.42	0.49
Immigration (Period)	% Immigrated 1981-1990	0.45	0.83
Ethnicity	% South Asian	0.49	0.69
Ethnicity	% Chinese, Korean, Japanese	0.43	0.52
Ethnicity	% Arabic, West Asian	0.71	0.50
Housing Type	% 5+ Story Apts	0.79	0.86
Housing Age	% Homes Built 1961-1980	0.77	0.68
Urban	Distance from CBD	0.41	0.86

Table 4.7b

Year	**2006**
Extraction Order	**Third (3)**
Variance	**9.6**
Cumulative Variance	**56.1**

Domain	Indicator	Saturation	Comm.
Age	% 40-49 yrs old	-0.50	0.40
Family / Household	% Common-Law Couples	-0.50	0.76
Residential Mobility	% No Moves in Last 5 yrs	-0.53	0.83
Housing Type	% 1-4 Storey Apts	-0.63	0.64
Housing Age	% Homes Built Pre-1960s	-0.86	0.85
Immigration (Period)	% Immigrated 1991-2000	0.55	0.84
Ethnicity	% South Asian	0.49	0.68
Ethnicity	% Arabic, West Asian	0.70	0.53
Housing Type	% 5+ Story Apts	0.81	0.86
Housing Age	% Homes Built 1961-1980	0.58	0.55
Housing Age	% Homes Built 1981-1990	0.62	0.46

Table 4.7c

Year	**2016**
Extraction Order	**Third (3)**
Variance	**10.2**
Cumulative Variance	**59.3**

Domain	Indicator	Saturation	Comm.
Age	% 40-49 yrs old	-0.54	0.50
Family / Household	% Common-Law Couples	-0.66	0.80
Labour Force	Female Participation Rate	-0.58	0.72
Housing Type	% 1-4 Storey Apts	-0.65	0.50
Housing Age	% Homes Built Pre-1960s	-0.91	0.81
Immigration (Period)	% Immigrated 1991-2000	0.73	0.81
Immigration (Period)	% Immigrated 2001-2010	0.81	0.82
Language	% No Knowledge of Off. Language	0.42	0.46
Ethnicity	% South Asian	0.61	0.56
Ethnicity	% Chinese, Korean, Japanese	0.51	0.41
Ethnicity	% Arabic, West Asian	0.71	0.51
Income	% Persons in Low Income	0.56	0.77
Tenure	% of Annual Income on Housing	0.43	0.79
Housing Type	% 5+ Story Apts	0.61	0.72
Housing Age	% Homes Built 1961-1980	0.50	0.49
Housing Age	% Homes Built 1981-1990	0.65	0.49
Housing Age	% Homes Built 1991-2000	0.55	0.30
Urban	Distance from CBD	0.52	0.78

Figure 4.8

Apartments by Age, Type, and Occupants Dimension - Component Scores, Toronto CSD, 1996, 2006, 2016

Figure 4.8a

1996

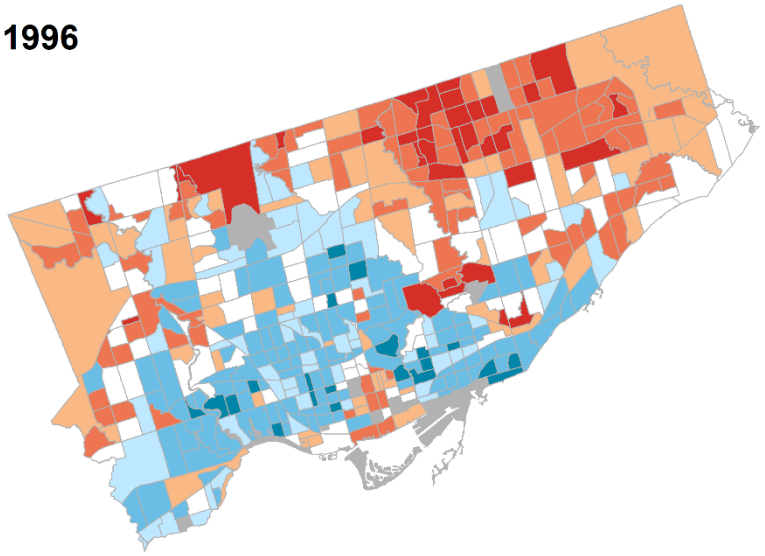


Figure 4.8b

2006

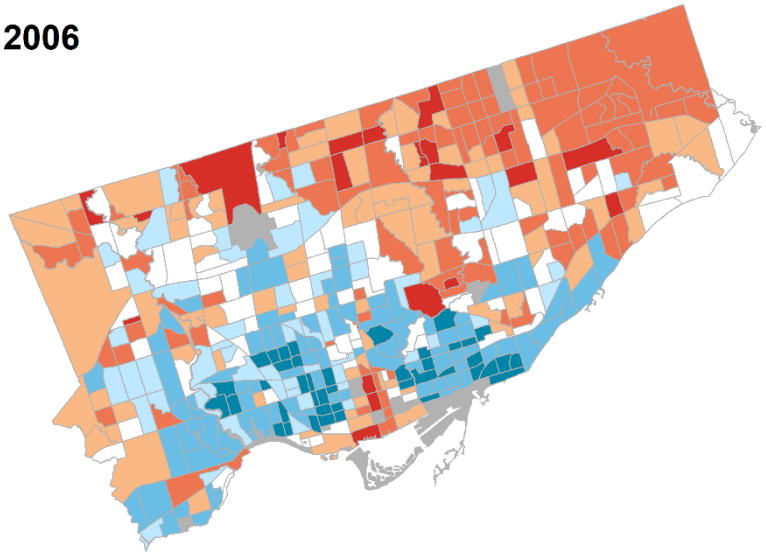
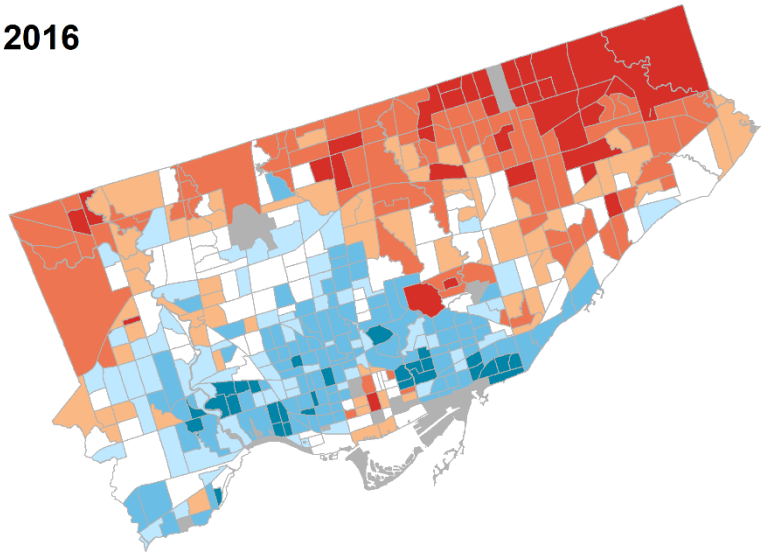
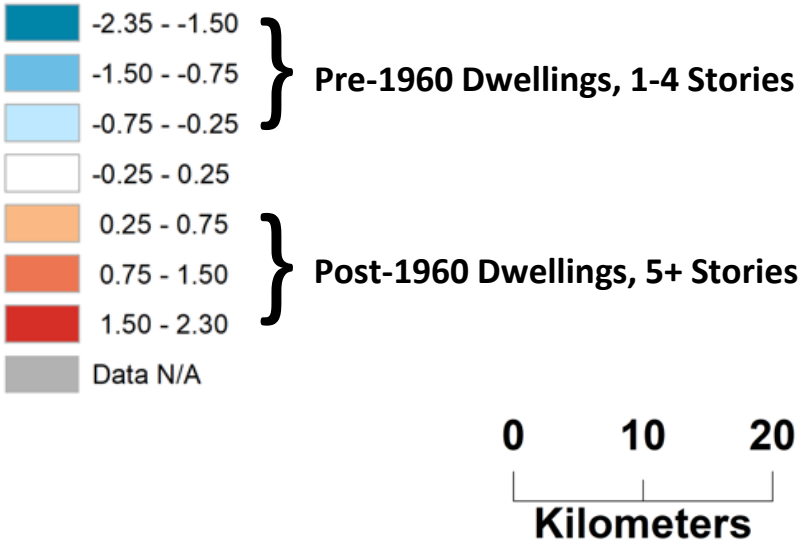


Figure 4.8c

2016





1996's East Asians vs. Vocational Educations Dimension (Axis 5; 5.7% Dataset Variance)

The fifth dimension of 1996 Toronto distinguishes areas concentrated with East Asian visible minorities (Chinese, Korean, or Japanese) from parts of the city with minimal concentrations. Minimally concentrated areas also happen to feature higher shares of certain vocational educations. The negative pole saturates East Asians, no official language knowledge, missing middle[126], multi-family households, and low incomes (Table 4.8a). These depict the socio-spatial location of 1996 Toronto's East Asian visible minority population, in this case a tendency towards relatively lacking economic and language integration. The positive pole opposes these traits with trades and non-university certificates, and 2-person households, denoting couples with middling degrees of educational attainment. These attributes, inverse of the negative pole, imply traits far less associated with Toronto's East Asian residents.

With Figure 4.9a marking where the CSD's East Asian visible minorities tend to congregate in 1996, three major clusters of negatively-scoring CTs emerge. Two of them surround the CBD in Old Toronto: the larger, more severely scoring of these Downtown clusters is west of the CBD, through Kensington-Chinatown, Little Italy and Portugal, Trinity-Bellwoods, then north through York to the Yorkdale Mall. The other Downtown-adjacent East Asian cluster starts east of Yonge Street and heads across the Don River into Riverdale then through The Danforth up to East York. The third major cluster of these residents, considered far more suburban, is spread across North York and Scarborough along the CSD's edge, most intensely centered on the Pacific Mall (a known East Asian enclave; Zhuang, 2016). This area is also popular for the settlement of immigrants generally[127] (Qadeer et al, 2010). Areas scoring to the dimension's positive pole are found throughout the CSD (and indeed many CTs score to neither pole), most of Etobicoke and much of south Scarborough along the lake register consistently away from East Asians and associated attributes and towards the 'middling educated couples' depicted by variables saturating the positive pole.

[126] As per Appendix 1, these consist of Toronto's semi-detached and row houses.

[127] The positive pole of 1996's Apartments by Age, Type, and Inhabitants component (Table 4.7a) indicates there are high shares of recent immigrants and certain ethnic groups here; in fact, the East Asian visible minority group also saturates said pole.

Table 4.8

East Asians and Vocational Educations Dimension - Saturation and Communality Table, Toronto CSD, 1996, 2006, 2016

Table 4.8a

Year	**1996**
Extraction Order	**Fifth (5)**
Variance	**5.7**
Cumulative Variance	**69.9**

Domain	Indicator	Saturation	Comm.
Family / Household	% Multi-Family HHds	-0.40	0.79
Language	% No Knowledge of Off. Language	-0.61	0.85
Ethnicity	% Chinese, Korean, Japanese	-0.61	0.52
Income	% Persons in Low Income	-0.41	0.78
Housing Type	% Missing Middle	-0.53	0.46
Family / Household	% 2-person HHds	0.43	0.70
Education	% Non-University Certificate	0.49	0.45
Education	% Trades Certificate	0.62	0.68

Table 4.8b

Year	**2006**
Extraction Order	**Fifth (5)**
Variance	**5.5**
Cumulative Variance	**68.0**

Domain	Indicator	Saturation	Comm.
Language	% No Knowledge of Off. Language	-0.49	0.84
Ethnicity	% Chinese, Korean, Japanese	-0.71	0.60
Housing Type	% Missing Middle	-0.40	0.37
Family / Household	% Separated / Divorced Persons	0.48	0.65
Education	% Non-University Certificate	0.61	0.40
Education	% Trades Certificate	0.57	0.79
Income	% Persons in Near-Avg Income	0.44	0.48

Table 4.8c

Year	**2016**
Extraction Order	**N/A**
Variance	**N/A**
Cumulative Variance	**N/A**

Domain	Indicator	Saturation	Comm.

Figure 4.9

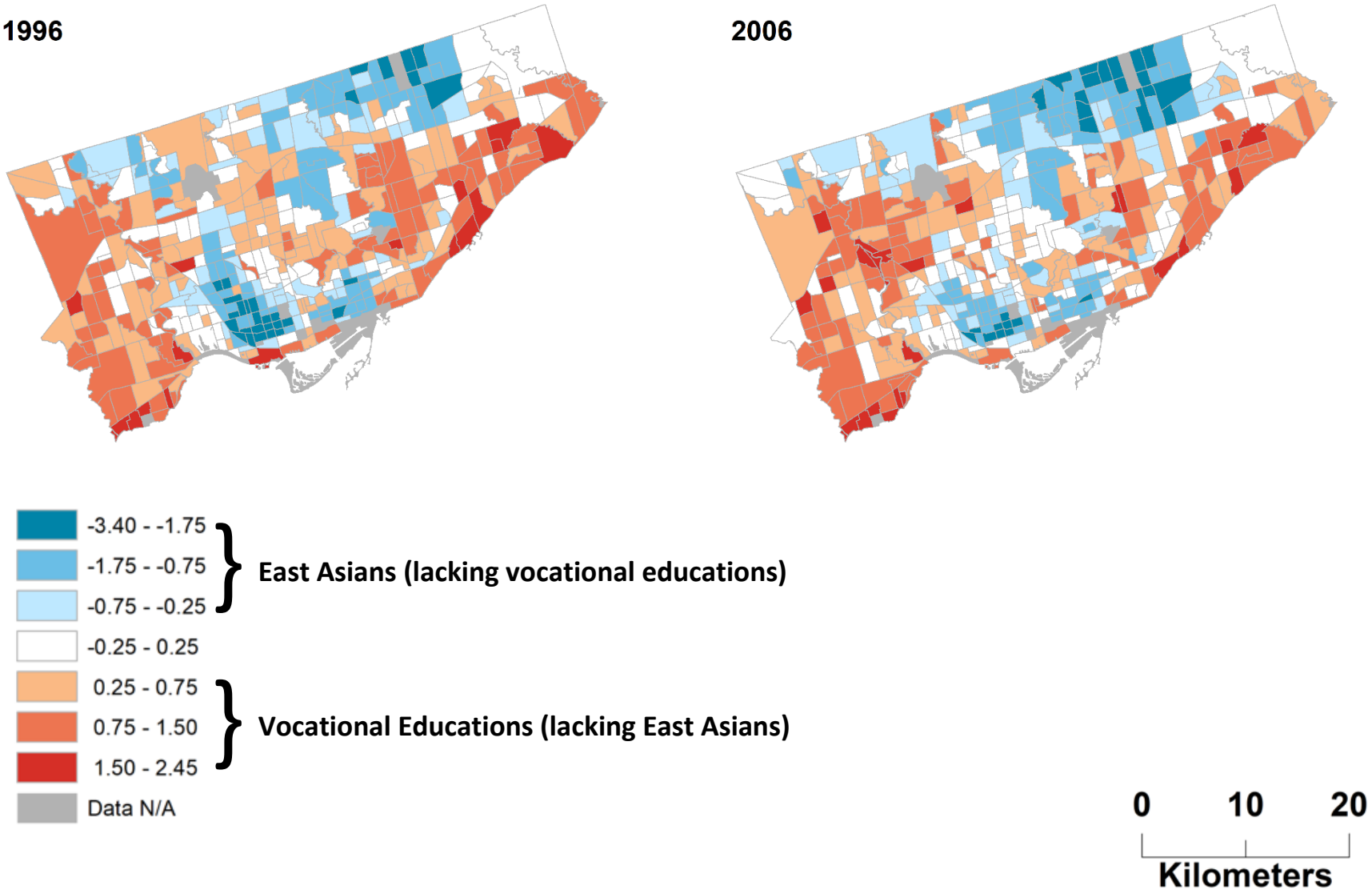
East Asians and Vocational Educations Dimension - Component Scores, Toronto CSD, 1996, 2006, 2016

Figure 4.9a

1996

Figure 4.9b

2006



1996 Components: Analysis Summary (5 Axes; 69.9% Dataset Variance)

My summary analysis of 1996's set of 5 dimensions (as with subsequent sets) first assesses any meaningful correlations between individual components and what these contribute to the meaning of the entire set. Looking to Table 4.9, the only correlation of relevance is the .33 relation between the SES and Visible Minorities dimension and the Life Cycle / Stage dimension. Although a mild correlation overall, this relation suggests overlap of age and life course with other vital aspects of neighbourhood structure and change in Toronto, which I now discuss.

Table 4.9

Axis Correlations for Toronto CSD 1996 Dimensions

Dimension Label	Axis	1	2	3	4	5
SES and Visible Minorities	**1**	1				
Urban vs. Suburban Lifestyle	**2**	0.00	1			
Life Cycle / Stage	**3**	**0.33**	0.06	1		
Apartments by Age, Type, and Occupants	**4**	0.23	-0.06	0.23	1	
East Asians vs. Vocational Educations	**5**	-0.16	-0.01	-0.01	0.05	1

Few clues emerge via their shared variables (Table 4.3). Saturation of the 40-49 group (in 1996, leading-edge Boomers) on the affluent pole of Axis 1 (Table 4.4a) and on the early family pole of Axis 3 (Table 4.6a) seems to indicate that, in 1996 Toronto, early family areas lean affluent while neighbourhoods in their latest demographic stages, replete with older adult households, associate with marginality and with high concentration of visible minority and/or immigrant households. This would confirm the neighbourhood life cycle proposition that areas undergo social and economic decline as they age. Given the considerable import of making such an assumption, particularly on such a paucity of mutual variables seems ill-advised. Thus, so I delve into the structure matrices of 1996 Toronto's Axis 1 and Axis 3 to better clarify the nature of overlap between these two dimensions[128].

Table 4.10 compares structure matrices of the 1996 SES and Visible Minorities and Life Cycle / Stage dimensions (mutual variables bolded for reference). It contradicts the theoretical expectation that local population aging begets SES decline *at least in 1996 Toronto*. Axis 1's high-SES pole shares 2-person households, white-collar occupations, other incomes, and high average home values with Axis 3's aged pole. As for these dimensions' low-SES and early family poles, every variable loading with early families (minus 4+ person households) also loads with low-SES. This implies, with import for my work, that Toronto's aged neighbourhoods lean towards affluence and decidedly away from low SES traits and concentration of visible minorities and/or recent immigrants. Conversely, 'early family' tracts lean towards these marginal attributes. As part of a correlated component set, Axes 1 and 3 tell a more complete story of how neighbourhood life cycle overlaps SES and ethnicity in 1996 Toronto.

[128] Recalling Section 3, variables *load* the structure matrix (as opposed to *saturate* the pattern matrix). While pattern matrix saturations indicate an axis's unique expression of variable variance, structure matrix loads indicate the strength of axis-variable relation, with no regard for how other axes also relate to the variable. While structure matrices often result in interesting but superfluous information (thus why I near entirely eschew them), they can prove usefully revealing axis-variable relations which lead axes to correlate. This is one such case wherein employing the structure matrices of two correlating axes proves invaluable.

Table 4.10

Structure Matrices of Toronto CSD 1996 Axis 1 and Axis 3

SES and Visible Minorities (Axis 1)

Domain	Indicator	Structure	Comm.
Age	% 40-49 yrs old	-0.72	0.67
Age	% 50-59 yrs old	-0.49	0.57
Family / Household	% 2-person HHds	-0.41	0.70
Labour Force	Female Participation Rate	-0.65	0.68
Occupation	**% Business, Admin, Management**	**-0.80**	**0.84**
Occupation	% Arts, Science, Public Sector	-0.87	0.87
Income	**% Other Income Sources**	**-0.56**	**0.81**
Housing Value	**Average Dwelling Value LQ**	**-0.69**	**0.61**
Age	**% 0-14 yrs old**	**0.52**	**0.66**
Family / Household	**% Lone Parent Families**	**0.75**	**0.76**
Family / Household	**% Multi-Family HHds**	**0.57**	**0.79**
Education	% No High School Certificate	0.92	0.93
Education	% Trades Certificate	0.51	0.68
Occupation	% Sales / Service	0.66	0.53
Occupation	**% Trades, Transport, Manufacturing**	**0.88**	**0.85**
Immigration (Period)	**% Immigrated 1981-1990**	**0.63**	**0.83**
Language	% No Knowledge of Off. Language	0.69	0.85
Ethnicity	**% Black**	**0.65**	**0.73**
Ethnicity	**% South Asian**	**0.51**	**0.69**
Ethnicity	**% Southeast Asian, Filipino**	**0.55**	**0.43**
Ethnicity	% Latin American	0.67	0.52
Income	% Government Transfer Income	0.92	0.89
Income	**% Persons in Low Income**	**0.74**	**0.78**
Income	% Persons in Near-Avg Income	0.56	0.45
Tenure	**% of Annual Income on Housing**	**0.61**	**0.83**

Life Cycle / Stage (Axis 3)

Domain	Indicator	Structure	Comm.
Age	% 60-69 yrs old	-0.69	0.78
Age	% 70-79 yrs old	-0.87	0.85
Age	% 80+ yrs old	-0.79	0.63
Family / Household	**% 2-person HHds**	**-0.67**	**0.70**
Occupation	**% Business, Admin, Management**	**-0.42**	**0.84**
Income	**% Other Income Sources**	**-0.74**	**0.81**
Housing Value	**Average Dwelling Value LQ**	**-0.47**	**0.61**
Age	**% 0-14 yrs old**	**0.68**	**0.66**
Family / Household	% 4-person HHds	0.60	0.95
Family / Household	**% Lone Parent Families**	**0.65**	**0.76**
Family / Household	**% Multi-Family HHds**	**0.48**	**0.79**
Occupation	**% Trades, Transport, Manufacturing**	**0.47**	**0.85**
Immigration (Period)	**% Immigrated 1981-1990**	**0.59**	**0.83**
Ethnicity	**% Black**	**0.60**	**0.73**
Ethnicity	**% South Asian**	**0.58**	**0.69**
Ethnicity	**% Southeast Asian, Filipino**	**0.42**	**0.43**
Income	**% Persons in Low Income**	**0.44**	**0.78**
Tenure	**% of Annual Income on Housing**	**0.52**	**0.83**

Having highlighted the place of population age in Toronto's social ecology, more generally the five 1996 components reveal the CSD is primarily delineated by SES, a dichotomy quite inflected by ethnicity. Divergences between urban and suburban form and lifestyle comprise another defining axis. These two dimensions together explain nearly half the variance for 1996. The SES and Visible Minorities dimension is more 'socially' saturated, locating high- and low-SES across the CSD, while the Urban vs. Suburban Lifestyle (more 'spatial') presents as inner-urban / outer-suburban. However, Toronto's unique development history prevents a pure concentric pattern, nodes of urban and suburban found peripherally and centrally, respectively; these built forms are also often quite proximal (Harris, 2015). While Toronto is a difficult fit with concentric ecological models, income sorting of core, peripheral, and 'in-between' areas is clear. Several of the oldest, inner urban tracts register as quite affluent while marginal CTs with more-recently built, dense apartments cluster the CSD, interspersed in Toronto's periphery aside traditional suburbs. As the SES and Visible Minorities dimension roughly analogs Hulchanski's (2011) Three Cities, the core, extending into North York leans to higher status attributes while low-SES defines much of west Toronto, York, and parts of Scarborough. This re-urbanization of upper-class residents marks a reversal of previous era's high-SES outflow to the suburbs, as central, urban tracts grow seemingly more desirable for higher-SES residents due to appeal of their built form and spatial location i.e., proximity to the numerous amenities of Downtown Toronto. As per how the Apartments by Age, Type, and Occupants dimension's component scores overlap with the SES and Visible Minorities dimension (Figs. 4.5a and 4.8a), several parts of core Toronto built prior to 1960 have been long

gentrified if not always considered upper class[129]. At the same time, Toronto's peripheral, inner-suburban neighbourhoods, often replete with large, unappealing, and physically degrading apartment blocks built 1961-1980 seem to be less desirable, from the perspective that those of higher-SES i.e., with economic capacity to reside elsewhere largely do so. Thus, the CSD's lower/lowest SES residents more often congregate in these spaces because relatively better housing in more suitably serviced neighbourhoods closer to Downtown is unaffordable for them. Further, despite these distal area's age and apparent physical and SES decline, many have yet to undergo urban 'renewal' of the kind having occurred closer to Toronto's Downtown, as per the typical neighbourhood life cycle[130].

While the most age-centric axis of 1996 Toronto – the Life Cycle / Stage dimension – is third most, explaining just 9.4% of dataset variance, seeming separation of population age from other *more* explanatory axes of urban structure belies two key points: the first is that age groups – representing distinct, recognizable life stages – populate this set's first three axes. The 40-49 and 50-59 groups, representing middle-to-late adulthood, feature with high-SES on the SES and Visible Minorities dimension, ascribing said leanings to leading-edge Boomers and the Silent Generation's trailing edge. This arrangement of variables also implies 1996 Toronto's visible minority residents (saturating that axis's opposite, marginal pole) were rarely in this life stage or of these generations. The Urban vs. Suburban Lifestyle dimension juxtaposes the 30-39 age group (younger, early households) from later-stage adults and early retirees i.e., the 50-59 and 60-69 age groups, representing another element of life stage emerging in Toronto's social ecology. The Life Cycle / Stage dimension, opposing age groups 0-14 and 40-49 (children and their parents) from all 60+ age groups (older adults) provide a normative picture of residential neighbourhoods in their earliest and latest life cycle stages, as per the predominant age and composition of resident households. Generally, early family, early household, and older adult areas follow their own patterns, a key question being how stable these remain in subsequent analyses of 2006 and 2016. Given older adults overlap with high SES and 'better' socio-spatial location, in 1996 Toronto at least, they do not fit the neighbourhood life cycle's aging-decline supposition. Finally, from a generational perspective, 1996 sees Boomers straddling one of adulthood's major transitions: the leading-edge (40-49) mostly associates with elements of higher SES and to Toronto's more desirable neighbourhoods, while the trailing edge (30-39), saturating with the city's most-urban areas and to associated lifestyle elements, are still in life stages of early household formation, likely explaining why these urban spaces are so residentially transitory. Having assessed and summarized my major findings for 1996 Toronto, I now assess my PCA results for 2006 Toronto.

[129] See Walks and Maranaan's (2008) exposition of neighbourhood SES shifts in Toronto between 1960-2001.
[130] A stage which may be some ways off for many large apartment towers, especially those hosting government-funded and/or non-profit housing which tend to contribute to slower redevelopment given these area's undesirability (August & Walks, 2008).

4.3.2 – Toronto in 2006

2006's SES and Visible Minority Dimension (Axis 1; 27.4% Dataset Variance)

While still juxtaposing high-SES from low in 2006, the SES and Visible Minorities dimension changes. The negative pole's biggest difference from the 1996 analysis is that the 40-49 group (saturating -.84 in 1996) fails to saturate in 2006, although the 50-59 group still does (Table 4.4b). Generationally, leading-edge Boomers are 50-59 in 2006 (40-49 in 1996) while trailing-edge Boomers are now 40-49; Toronto's leading-edge Boomers still affiliate with high SES in their later adulthood, yet their trailing edge peers fail to 'follow in their footsteps'[131]. Generally, the negative pole in 2006 sees 2-person households and other incomes saturate with 1996's white-collar occupations, high home values, and high female participation[132]. The positive pole in 2006 sees the 0-14 group and multi-family households join with 1996's saturation of lone parent families to depict households more likely in low SES[133]. Lower-status occupations and low incomes increase in saturation from 1996-2006, and high school certificates now associate with low SES along with no high school certificate. Most of 1996's visible minorities increase saturation and are joined by South Asians in 2006. Further, 1981-1990 and 1991-2000 immigrants saturate in 2006. The SES and Visible Minorities dimension's general change trend over the decade is further entrenchment of household, occupational, educational, and ethnic / immigrant traits that distinguish Toronto's high and low SES neighbourhoods.

Figure 4.5b shows Toronto CT component scores for the dimension in 2006, resembling, as in 1996, Hulchanski's (2011) Three Cities. Tracts surrounding the CBD and northward still score negatively. West Downtown's 1996 swath of low-SES CTs 'retreats' west (Fig. 4.5a), leaving many of these CTs as average SES by 2006. South Etobicoke scores to higher SES than in 1996. Meanwhile, the CSD's northwestern and northeastern CTs lean to moderate-to-high positive factor scores, depicting marginality; while the former, occupying most of York and northern Etobicoke, remains higher-scoring, by 2006 more of Scarborough – including peripheral tracts around the Pacific Mall – shift to positive factor scores, including several CTs scoring to the negative, affluent pole in 1996.

2006's Urban vs. Suburban Lifestyle Dimension (Axis 2; 19.1% Dataset Variance)

In 2006, the Urban vs. Suburban Lifestyle dimension continues to contrast household and lifestyle traits commonly associated with urban and suburban Toronto. The negative, suburban pole maintains core saturations of 4+ person and legally married households, auto commuting, single detached, distance from the CBD, and no recent moves, in most cases stronger than 1996, with most 1996-2006 change being of age saturation (Tables 4.5a and b). The 60-69 group that saturates in 1996 is, in 2006, replaced by the 0-14 group (early families); the 50-59 group (leading-edge Boomers) maintains mild saturation. This dimension's positive pole, depicting household and lifestyle

[131] This may also reflect the 40-49 group's much lower, .40 communality in 2006 compared to .67 in 1996, implying the trailing edge's spatial variance associates with factors outside my employed variables in 2006 more than in 1996 (Tables 4.4a and b).
[132] Interestingly, 2006 sees female participation rate saturate .40 compared to .72 in 1996, as female employment becomes less definitive in differentiating high from low SES neighbourhoods ergo households of all social classes now host working females.
[133] Namely these areas host high shares of early family, single-parent, and/or multi-family households; the negative pole's 2-person household saturation adds to these archetypes of well-off professional couples and struggling families.

attributes of 'urban' Toronto, undergoes minimal change since 1996; of minor note, separated / divorced and moving in the last 5 years decrease saturation, making these traits less definitive of 'urban' Toronto. This dimension's continuity demonstrates a degree of socio-spatial fixity in the Toronto CSD. From a life course perspective, the 30-39 group (Generation X which succeeds Boomers) continue to associate with 'urban' Toronto in location and lifestyle.

Component scores for the 2006 Urban vs. Suburban Lifestyle dimension follow 1996's general core-urban / periphery-suburban pattern (Figs. 4.6a and b). This is attributable to the axis's physical and spatial variables (that tend to little change over a decade) relative to resident traits (Perle, 1982; Le Bourdais & Beaudry, 1988). Changes between 1996-2006 are a general expansion of average-scoring tracts, those in white, neither highly negative (urban) or positive (suburban), through the CSD's middle reaches. An explanation may be that expanded urban development throughout the CSD has made neighbourhoods more 'mixed' in their built form and associated lifestyle[134].

2006's Apartments by Age, Type, and Occupants Dimension (Axis 3; 9.6% Dataset Variance)

Table 4.7b shows the 2006 Apartments by Age, Type, and Occupants dimension is third extracted and explains 9.6% of dataset variance (fourth and 7.4% in 1996; Table 4.7a). Still essentially distinguishing Toronto's pre- and post-1960 development eras and prominent dwelling type, some resident trait variables change. While the negative pole's strong saturations are still pre-1960s homes and 1-4 story apartments, common law couples are joined by the 40-49 group and no moves in the last 5 years. This spatializes where trailing edge Boomers (40-49 in 2006) reside; these pre- and (just) post-war areas, often popular among gentrifiers (Walks & Maranaan, 2008), also now appear less subject to residential turnover. The positive pole's strongest saturations continue to be 5+ story apartments, Arabic / West Asian residents, and post-1960 homes (2006 sees 1981-1990 homes join 1961-1980[135]). Milder saturations include South Asians (as in 1996) and 1991-2000 immigrants (replacing 1996's saturation of the 1981-1990 group). One can infer these areas feature low shares of no recent moves. As in 1996, this pole depicts CTs with tall(er) apartments, developed post-1961, that are landing areas for recent immigrants (particularly of Arabic, West Asian, and South Asian descent). Despite shifting variable composition, 2006's component scores largely resemble 1996's, with the CBD seeing an increase in positive factor score (Figs. 4.8a and b).

2006's Life Cycle / Stage Dimension (Axis 4; 6.4% Dataset Variance)

Table 4.6b places the Life Cycle / Stage dimension as 2006's fourth axis, explaining 6.4% of dataset variance (9.4% as 1996's third axis; Table 4.6a). The dimension remains stable over the decade: its negative pole saturates ages 60+ and 1996's 2-person households and other incomes are joined in 2006 by pre-1980 immigrants, as these Torontonians age into later life. The 60-69 group desaturates somewhat, and even more so 2-person households

[134] This should be tempered, however, by acknowledging that the 1996 and 2006 factor scores being compared relate back to two different components. They are similar but not identical meta-variable measuring Toronto CTs on the entire body of measures saturating each of the axes, saturations that differ in composition and magnitude each year.

[135] From 1996-2006, saturation of 1961-1980 homes declines from .77 to .58 (the variable's communality also declines), meaning its co-variance with other variables lessens over time and/or co-occurs with measures outside the dataset (Table 4.3.4a and b).

and other incomes over the course of the decade[136]. The positive pole undergoes more drastic change: of the variables 0-14, 40-49, 4+ person households, and lone parent families saturating in 1996, only the two age groups remain by 2006, the 0-14 group also losing saturation. However, 2006 sees female participation join the positive, early family pole. The 40-49 group represents trailing-edge Boomers in 2006, showing some life course continuity with their leading-edge peers who in 1996 were ages 40-49 and saturate the 1996 Life Cycle / Stage dimension.

This dimension's component scores (Fig. 4.7b) indicate similiar 'young' and 'old' CTs as 1996 (Fig. 4.7a). However, several areas shift from older to younger, vice versa, or from average to younger or older. For instance, much of central Old Toronto, west of the CBD through Kensington-Chinatown and Little Italy and Little Portugal sees increasingly negative factor scores, indicating population aging. Conversely, East York's Leaside-Bennington and Thorncliffe Park areas, and much of north Old Toronto adjoining these (including Rosedale, Lawrence Park, and Forest Hill) see a proliferation of positive factor scores as early families begin to concentrate these districts. This trend occurs just north of the Bloor-Yorkville / Yonge-St. Clair areas, CTs which score strongly for agedness in 1996 and continue to in 2006[137]. This shows how proximal neighbourhoods' aging trajectories can vary considerably. From 1996 to 2006, Scarborough's outermost periphery continues to remain a bastion of early family formation, yet this cluster's magnitude and breadth diminishes to some degree. Several tracts revert to average scores as these once 'new' neighbourhoods advance through their life cycle. Overall, factor score changes are fragmented and granular, as smaller pockets of CTs demographically shift in a way at odds with the trends occurring in adjacent CTs.

2006's East Asians vs. Vocational Educations Dimension (Axis 5; 5.5% of Dataset Variance)

In 2006, the East Asians vs. Vocational Educations dimension still identifies Toronto's East Asian and vocationally educated residents as being divergent populations. East Asians increase their negative saturation while multi-family households and low incomes disappear such that, by 2006, they only saturate with no official language and missing middle, both less than 1996 (Tables 4.8a and b). The positive pole still saturates non-university and trade certificates between in 2006 but drops 2-person households. Saturating instead in 2006 are separated / divorced and near-average income. While this dimension's saturations are mild, points of stability and change in both axis poles indicate Toronto's East Asians no longer track with low incomes and multi-family households as in 1996, yet they continue to diverge from middling educations and associated class implications in 2006. The dimension's 2006 component scores largely resemble 1996 (Figs. 4.9a and b). East Asian concentration in the Kensington-Chinatown and Riverdale areas lessen, while scores near Scarborough's Pacific Mall intensify and spread over the decade.

[136] Saturations for 2-person households decrease from -.60 (1996) to -.41 (2006) and other incomes from -.65 to -.49 over the same period (Tables 4.6a and b).

[137] A stability also reflected in the relevant 60+ LQs of Section 4.2's Figure 4.1

2006 Components: Analysis Summary (5 Axes; 68% Dataset Variance)

No 2006 axes correlations warrant analysis (Table 4.11), making for relatively independent axes[138]. Yet, many variable domains saturate several 2006 dimensions, especially for life stage i.e., the 0-14, 40-49, and 50-59 age groups (Table 4.3). These can be called complex socio-spatial indicators[139]. The first group, 0-14 (index of early families) saturates dimensions of social status and ethnicity, urban form and lifestyle, and life cycle / stage, implying each dimension influences how the 0-14 group situates, making family formation in 2006 Toronto less predictable solely by life stage i.e., axes of SES and sub/urban location and lifestyle also playing a role[140]. Similarly, the 40-49 and 50-59 groups (in 2006, trailing- and leading-edge Boomers, respectively) feature on several axes[141]. This illustrates different ways axes relate via mutually hosting certain variables, thus jointly contributing to explaining said groups' socio-spatial variance. I now analyze 2006's combined set of socio-spatial dimensions in a more general sense.

Table 4.11

Axis Correlations for Toronto CSD 2006 Dimensions

Dimension Label	Axis	1	2	3	4	5
SES and Visible Minorities	**1**	1				
Urban vs. Suburban Lifestyle	**2**	-0.05	1			
Apartments by Age, Type, and Occupants	**3**	0.17	-0.05	1		
Life Cycle / Stage	**4**	-0.11	-0.10	-0.10	1	
East Asians vs. Vocational Educations	**5**	-0.03	-0.03	-0.05	0.02	1

The prominence of 2006's first and second axes indicate Toronto continues to be differentiated mainly by SES (inflected by ethnic / immigrant status) and by divergence between urban and suburban form. These axes explain 46.5% of 2006's variance (Table 4.3). Further, despite shifts in these dimensions' saturations and component scores, their spatial patterning remains quite consistent between 1996 and 2006, showing that, despite the CSD's decade of change (e.g., new development, immigration), its underlying structure is stable, ensuring continuity in Toronto's social ecology. Some of this stability appears to be attributable to elements of urban form, such as those depicted via the Apartments by Age, Type, and Inhabitants dimension which increases in overall explanatory power. Its growing relevance supports Hulchanski's (2011) claims that Toronto's social ecology – specifically, socioeconomic differentiation of neighbourhoods by construction era and ethnicity – is increasingly crystalizing.

Relations between population age and urban structure appear less relevant than other dimensions over time i.e., the age-centric, Life Cycle / Stage dimension's declining explanatory power. Divergence between older adulthood and early family life stages and their 'typical' household composition (by size, type) also support claims that age is becoming a less effective predictive measure (Moos, 2016); for instance, distinguishing neighbourhoods'

[138] Compared to the 1996 dataset, where inter-axis correlations were generally higher (Table 4.9).

[139] The term complex has specific import, as per 'simple structure' in PCA (Section 3): variables saturating many axes are 'complex' relative to variables that 'simply' saturate one e.g., the 30-39 and the 70-79 age groups consistent saturations (Table 4.4).

[140] This refers to the 0-14 age group's saturation on the Life Cycle / Stage (with 40-49), the SES and Visible Minorites, and the Urban vs. Suburban Lifestyle dimension (respectively; Table 4.4).

[141] Trailing-edge Boomers on the Life Cycle / Stage and Apartments by Age, Type, and Inhabitants dimensions and leading-edge Boomers on the SES and Visible Minorities and Urban vs. Suburban Lifestyle dimensions. Trailing- and leading-edge also co-vary with 0-14 on the Life Cycle / Stage and the Urban vs. Suburban Lifestyle axes (respectively), albeit both mildly at best (Table 4.4).

life cycle stage solely via age structure is harder, given life stage is less definitive of household composition[142, 143]. However, lessening relevance does preventage and life stage from influencing Toronto's social ecology. The CSD's pre-1980 immigrants now age into later life stages, impacting their neighbourhoods' general age structure. West Old Toronto's known settlement areas for said groups i.e., Little Italy, Little Portugal, and Kensington-Chinatown increasingly lean to negative scores for the Life Cycle / Stage dimension between 1996-2006 (Fig. 4.7b). Compared to 1996, emergence of the 0-14 group on the Urban vs. Suburban Lifestyle dimension in 2006 shows increasing links between family formation and built form[144]; furthermore, family formation is increasingly delayed to later life stages, as per juxtaposition of early households (the 30-39 group) from children on the axis's opposing pole. Perhaps age is not growing less definitive so much as its relations to urban structure are evolving, requiring existing models' update.

Finally, as for Boomer's socio-spatial position in the Toronto CSD as they pass through successive adult life stages, the most striking change is that the prominent relation between leading-edge Boomers at ages 40-49 in 1996 and high SES is not recreated by their trailing-edge peers in 2006 (Tables 4.4a and b), indicating a lesser bond between this life stage and certain social and material conditions e.g., established, white-collar career success and residence in upmarket Toronto. However, leading-edge Boomers, 50-59 in 2006, maintain relation to the SES and Visible Minorities dimension's high-SES elements (as the preceding, Silent Generation did in 1996). This indicates that the two 10-year age cohorts making up the Boomer generation take divergent paths through the Toronto CSD's social ecology. At ages 50-59, the leading-edge follows Silent Generation predecessors in saturating with suburban form and lifestyle (Table 4.5b), marking life course continuity. The trailing edge, having left ages 30-39 and urban Toronto behind for ages 40-49 between 1996-2006 maintains the same mild relation to early family formation as their leading-edge peers did i.e., saturation of the 40-49 group on the Life Cycle / Stage dimension both years. More interestingly, trailing edge Boomers in 2006 lean to pre-1960 neighbourhoods comprised of 1-4 story apartments (and away from areas built 1961-1990 and taller, 5+ story apartments), as well as these spaces' associated household and ethnic characteristics. Given CTs that score to the pre-1960 pole, and thus to heightened shares of the 40-49 group, are largely centralized in Old Toronto, an area also scoring towards the Urban vs Suburban Lifestyle dimension's urban pole (where 30-39 saturates), trailing edge Boomers seem to maintain relatively stable residence in Old Toronto's residential tracts over the decade even as they progress into later adulthood. Thus, Toronto's 2006 dimensions show a segment of the trailing-edge Boomer population carving out their own ecological niche over time, one diverging from leading-edge peers who following a more typical path of suburbanization.

[142] Compared to 1996, 2-person households and other incomes saturate the 2006 SES and Visible Minorities dimension -.46 and -.61, respectively (Table 4.4). Their variance is now shared between the two dimensions of socioeconomic status and of life stage.
[143] Section 4.2's 60+ LQs for 1996 and 2006 index this i.e., CTs lean increasingly to an average 60+ concentration (Fig. 4.1).
[144] I.e., family formation is increasingly a suburban-oriented process and occurring less and less in Toronto's highly urban areas.

4.3.3 – Toronto in 2016

2016's SES and Visible Minorities Dimension (Axis 1; 30.2% Dataset Variance)

In 2016, the SES and Visible Minorities dimension continues to differentiate Toronto by SES, increasing to 30.2% of explained variance relative to 2006's 27.4% (Table 4.4b and c). While the negative pole still saturates white collar occupations, other incomes, high home values, and 2-person households, neither the 50-59 group or female participation do as in 2006. Legal marriage saturates instead which, with 2-person households, makes household composition increasingly SES-relevant. More striking, however, is saturation of East Asians demonstrate their ascent from lower-SES in 1996 to high-SES[145]. Generally, the pole continues to denote upper-class Toronto, though 1996's elements of later adulthood are replaced by household type. As other incomes also saturate stronger in 2016 than in 1996, financial investments (likely real estate) are core to households' upward shift in Toronto's social ecology[146].

This dimension's positive pole changes little between 2006-2016. Lower educational attainment is its among the pole's stronger saturations; as in how 2006 saw the addition of high school certificates to the low-SES pole, 2016 sees non-university certificates join in 2016. The 0-14 group no longer saturates as in 2006, but other household types (lone parents, multi-family households) remain, joined by separated / divorced individuals. The pole's visible minority saturations remain mostly stable[147], as do low and near-average income, government transfers, high annual housing costs, and major home repairs. Primarily then, education / occupation status continues to define SES, with income growing less relevant (in saturation) and household type more so. Toronto's visible minorities also take different paths through the CSD's social ecology[148]. Lastly, the lessening relevance of age i.e., loss of the 40-49 and 50-59 groups over time, is generational. As trailing-edge Boomers (40-49 in 2006) already diverge from the material success enjoyed by their leading-edge peers (40-49 in 1996), it is not surprising that in 2016, trailing-edge Boomers, aged 50-59, would fail to associate with the CSD's high-SES dimensional construct.

Component scores for 2016's SES and Visible Minorities dimension resemble 2006 (Figs. 4.5b and c). Most change occurs near Toronto's core. Downtown's swath of negative-scoring, high-SES tracts continue to expand west into areas that in 1996 and 2006 scored to average- or low-SES. A similar trend occurs in Regent Park, which scored heavily to low-SES in both 1996 and 2006. By 2016, the redevelopment of public housing here (August & Walks, 2012) has led these CTs' SES upshift. In the Inner Suburbs, 2006's patterns largely hold, while low-SES further entrenches in northwestern and northeastern Toronto. This 2016 SES and Visible Minorities axis represents a 10-year evolution of Hulchanski's (2011) 2006 observations of a socially polarizing Toronto CSD.

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[145] Briefly, as it is not my research focus, the fifth axis for 1996 (East Asians vs. Vocational Educations; Table 4.8a) associates this group to low-income, multi-family households, and lacking official languages, variables that all occupy Axis 1's positive pole, which East Asians now oppose in their saturation of the SES and Visible Minorities dimension's negative pole.

[146] Conversely, female participation saturates .72 in 1996 and not at all in 2016 (Tables 4.4a and c), marking a steep decline in how female labor activity delineates high from low-SES; ergo, the archetype of a high-SES, dual income professional couple now requires a third source of income (or more) to meaningfully differentiate themselves as high-SES.

[147] Although South Asian and immigrated 1991-2000 drop off, with 1981-1990 immigrants remaining.

[148] I.e., Black residents grow more entrenched in low-SES by 2016 while East Asian residents simultaneously achieve higher SES.

2016's Urban vs. Suburban Lifestyle Dimension (Axis 2; 18.9% Dataset Variance)

The 2016 Urban vs. Suburban Lifestyle dimension maintains many of its core 2006 and even 1996 saturations (Table 4.5a, b, and c). The negative pole still saturates the 0-14 and 50-59 groups (stronger than 2006), with the 60-69 group rejoining as in 1996. Marriage, 4+ person households, auto commuting, single-detached, and no recent moves are still major saturations, depicting a suburban built form populated by stable, large families. Distance from the CBD and multi-family households (new from 2006) saturate to lesser degree. In 2016 Toronto, both early families and late career / early retirement adults (ages 50-59, 60-69) lean stronger to suburban Toronto than in 2006. The positive, 'urban' pole continues to saturate 30-39-year-olds, density, renting, 5+ story apartments, transit use, high local move shares, and high annual housing costs, with common law and separated / divorced denoting urban area's 'looser' household structure trends. Absent in 2016 are saturations of 1-4 story apartments and need for home repairs[149]. Generally, the pole still depicts urban Toronto, where early households predominate, and (given the negative pole) early families and those aged 50-59 and 60-69 under-concentrate. In 2016, these older age groups represent trailing- and leading-edge Boomers in late career / early retirement. Their mutual saturation of this axis, after prior years' divergences, indicating they somewhat reconverge in 2016 as they both finally reach later stages of adulthood and early old age. Overall, the Urban vs. Suburban Lifestyle dimension is Toronto's most stable of the static PCA, sensible given its many entrenched, built form variables.

Given this, 2016 component scores largely align to 2006, and even 1996 (Figs. 4.6a, b, and c), yet change occurs in some parts of the CSD. South Etobicoke leans more to positive scores i.e., urban traits, as do CTs around North York's Town Center. In the latter, immediately adjacent CTs increase their negative suburban score, indicating Toronto's proximity of divergent built forms and associated populations. Similarly, Yonge-Eglington, distinctly urban since 1996, sees adjacent districts such as Rosedale, Bennington Heights, Lawrence Park, and Davisville emerge as suburban residential enclaves. Thus, despite this dimension's generally 'fixed', concentric pattern 1996-2016, several areas experience transition along this spectrum of urban and suburban built forms and associated social traits.

2016's Apartments by Age, Type, and Occupants Dimension (Axis 3; 10.2% Dataset Variance)

As third axis of 2016 Toronto, the Apartments by Age, Type, and Occupants dimension delineates the CSD according to its pre- vs. post 1961 development, related built forms, and typical inhabitant traits. The negative pole's strongest saturation is still pre-1960 homes, and it retains the 40-49 group, 1-4 story apartments, and common-law couples[150] (Table 4.7c). Low 5-year move shares that saturate in 2006 are replaced in 2016 by female participation, indicting mature, dual-income couples favor Toronto's pre-1960 districts. The dimension's positive pole undergoes

[149] Table 4.3 shows these variables increasingly find their variance explained by other dimensions over time, namely those for development era (Apartments by Age, Type, and Inhabitants) and SES, specifically marginal status (SES and Visible Minorities), making these features less definitive of Toronto's urban spaces as opposed to its suburban locations.

[150] This variable's increasing saturation over the two-decade study period (1996 at -.41, 2006 at -.50, and 2016 at a markedly higher -.66; Table 4.3) demonstrates an increasing prevalence of looser household structure – likely those in nascent stages of 'coupling' – in these areas, or at minimum the eschewing of traditional marriage as a form of rigid cohabitation.

far more significant change in how it depicts post-1961 Toronto. Retained in 2016 are 5+ story apartments (albeit at .61 saturation relative to 2006's .81) and mild saturation of 1961-1980[151], 1981-1990, and (new) 1991-2000 homes. Distance to the CBD saturates as in 1996, relative to 2006's non-saturation[152], making the pole more peripheral in character than before. This pole's shifts in household and ethnic characteristics, however, markedly alter this axis.

While Arabic / West Asian still saturate as in 1996 and 2006, by 2016 other indicators come to this positive pole's forefront (Tables 4.7a, b, and c). The 1991-2000 immigrant group saturates more in 2016 than in 2006 and is joined by an even stronger saturation of 2001-2010 immigrants[153]. South Asians saturate more than 2006 and are joined by East Asians. Finally, low income now saturates, as do high housing costs and lacking official languages. The way the Apartments by Age, Type, and Occupants dimension transitions between 2006 and 2016 i.e., the increasing magnitude of immigrant and ethnic saturations, relative to the waning of housing type and age (the axis's strongest saturations in 1996 and 2006), alters the positive pole's meaning; however, socio-spatial connection between Toronto's post-1961, peripheral tracts and their ethnic and recent immigrant populations continues to define the construct. This shift stands out further given how little the opposing, negative pole changes in depicting Toronto's central, pre-1960 neighbourhoods. Yet, the 'new to 2016' traits now bundled on the positive pole reveal social characteristics found in low share in pre-1960 areas i.e., there are increasingly fewer immigrant, visible minority, and/or low-income residents in these spaces in 2016 relative to 2006[154].

Despite these changes, there remains a general temporal continuity in the spatial distribution of component scores (Fig. 4.8a, b, and c). High positive scores still surround Toronto's CBD, ensconced by a swath of negatively scoring Downtown CTs stretching into the Inner Suburbs, this then surrounded by a more peripheral band of post-1960s development. In fact, CTs with high negative scores (pre-1960) generally remain as such from 2006. It is mainly positive factor scores (post-1961) that change, sensible given how the respective saturations change. For instance, the CBD, containing Toronto's highest density of tall buildings (5+ stories), scores lower in 2016 than 2006, which aligns with how that variable less meaningfully saturates the pole; likewise, intensification of positive factor scores in northeastern Scarborough reflects considerable intensification of positive ethnic and immigrant saturations. More broadly, this 2016 axis's evolution assigns Toronto's immigrants and visible minorities an increasing degree of social socio-spatial marginality, a condition well-entrenched in many respects by the SES and Visible Minorities dimension.

[151] Whereas this variable saturated .77 in 1996, it now saturates only .50 in 2016, showing housing of the 1961-1980 era has varied more in socio-spatial trajectory with the passage of time (Table 4.7a and c).
[152] This also implies Toronto's pre-1960s neighbourhoods and their social characteristics lean more towards core parts of Toronto.
[153] Also, while 1996's 1981-1990 group falls off the 2006 axis, 2006's analogously 'newest' 1991-2000 group maintains and even increases saturation by 2016 (Table 4.3); the 1981-1990 group left these 'spaces' while 1991-2000 remains, to be joined by 2001-2010 immigrants. Considering low-SES measures also saturating here, these 'landing areas' seem to be increasingly marginal spaces that new arrivals find it increasingly more difficult to out-migrate from.
[154] This is relative to previous iterations, more so than in how other dimensions 'restructure' between 1996-2006 or 2006-2016.

2016's Life Cycle / Stage Dimension (Axis 4; 5.8% Dataset Variance)

The 2016 Life Cycle / Stage dimension remains quite stable from 2006, although explanatory variance reduces further from 6.4% to 5.8% (Tables 4.6b and c). The negative pole saturates 60+ groups, 2-person households, pre-1980 immigrants, and other incomes (at near-2006 levels), depicting Toronto's older adult population. Even as new generations pass into and through later life, this dimension varies little; leading-edge Boomers (60-69 in 2016) follow preceding generation's 'footsteps', despite theorized divergent aging. The positive pole also remains stable, if anything consolidating itself with higher saturations of the 0-14 and 40-49 groups while eschewing 2006's female participation. The picture is of neighbourhoods predominated by early family households. Considering both poles together, the Life Cycle / Stage dimension in 2016, as in 1996 and 2006, distinguishes CTs in their earliest and latest neighbourhood life cycle stages, even as life stage becomes less explanatory of Toronto's socio-spatial variance.

The Life Cycle / Stage dimension's 2016 component scores generally resemble 2006 (Figs. 4.7b and c), though several areas grow older or younger. Yonge-St. Clair / Yorkville in Old Toronto maintains strong, negative factor scores; this agedness intensifies and spreads south into Cabbagetown. Conversely, west Downtown, including Kensington-Chinatown, generally revert to average scores by 2016, as the aging populations are replaced by younger ones. South Etobicoke undergoes similar structural 'younging'. Further into the Inner Suburbs, towards the CSD's edge, many areas scoring positively early families) in prior years now register average or negative scores, as they pass through the neighbourhood life cycle. A prominent example is outer Scarborough, where CTs increasingly age from 2006, and even more so compared to 1996. Many parts of the Inner Suburbs, however, experience the reverse, registering higher positive factor scores as young families replace the elderly. Overall, this dimension's component scores undergo the most change over time compared to other axes, given many of the latter's indicators are spatially fixed (built form, building era) or quite entrenched i.e., the SES and Visible Minorities dimension while population aging can occur in any CT, despite these neighbourhoods' other local social and spatial tendencies.

2016 Components: Analysis Summary (4 Axes; 65.1% Dataset Variance)

Before assessing 2016 axis correlations, the biggest change in these dimensions is the shift from a 5 to 4-axis set, as 1996 and 2006's fifth dimension (East Asians vs. Vocational Educations) disappears (Table 4.3). The year's strongest, East Asian saturation seemingly absorb into 2016's SES and Visible Minorities dimension with affluent traits and opposite other ethnicities. While shifts like this occur when experimenting with extractions[155], the relations are accurate; here, a meaningful portion of Toronto's East Asian variance is explained by SES. However, East Asians also saturate 2016's Apartments by Age, Type, and Inhabitants dimension with several ethnic and immigration variables (and Toronto's post-1961 development). Thus, the East Asian group is heterogenous: some lean to one bundle of local traits while others lean toward a starkly different collection of socio-spatial attributes.

[155] I.e., that variables tend to increasingly cluster together as fewer axes remain in the set.

While 2016's axis correlations are relatively low (Table 4.12) the SES and Visible Minorities and Apartments by Age, Type, and Occupants dimensions correlate 0.28, supporting already noted connections between Toronto's high- and low-SES and its pre- and post-1960 neighbourhoods, respectively[156]. Common to the dimensions' related positive poles i.e., marginal, post-1960 tracts are different visible minority and immigrant groups (even if not the same on each). Despite their diversity, Toronto's different ethnic and immigrant populations trend to lower SES than the CSD's non-ethnic or non-immigrant residents. The Apartments by Age, Type, and Occupants dimension's increasing ethnic, immigrant, and low-SES saturations in post-1961 Toronto further supports this.

Table 4.12

Axis Correlations for Toronto CSD 2016 Dimensions

Dimension Label	Axis	1	2	3	4
SES and Visible Minorities	**1**	1			
Urban vs. Suburban Lifestyle	**2**	0.09	1		
Apartments by Age, Type, and Occupants	**3**	**0.28**	0.08	1	
Life Cycle / Stage	**4**	-0.14	0.12	-0.06	1

Toronto's major 2006 to 2016 structural trend is continued entrenchment of SES and ethnic / immigrant status, changes being further divergence and refinement of traits differentiating high and low SES. Toronto's 2016 social ecology is also considerably delineated by built form, dwelling era, and CBD-proximity. The general result is higher-SES, non-ethnic/immigrant households centralize near Downtown while low-SES residents, many of visible minority and/or immigrant status, peripheralize further from the CBD in low-SES areas. While this trend increases its explanatory prominence, the role that age as life stage plays 1996-2016 seems to decline. The Life Cycle / Stage dimension takes a 1996-2016 decline from 9.4 to 5.8% of explained variance, although remaining markedly consistent in differentiating the neighbourhood life cycle beginning from end. As the CSD ages (Table 4.1), generally higher older adult shares across Toronto soften distinctions between oldest and youngest neighbourhoods as local age structures grow more mixed. Association between older adults and affluence and early families and marginality witnessed in 1996 Toronto[157] is no longer by 2016 (or even 2006), showing how later life course stages grow more varied in social character, as opposed to 1996's firmer archetypes of the well-to-do elderly and struggling families.

However, life stage strongly differentiates the CSD's social ecology in 2016, as in prior years, when viewed against the Urban vs. Suburban Lifestyle dimension. Urban Toronto is predominated by early households (30-39 group) while the city's suburbs are replete with Torontonians in later adulthood i.e., the 50-59 and, in two of three years, 60-69 groups (Table 4.3). Further, early families i.e., 0-14 group, increasingly associate to suburban Toronto, including the 50-59 and 60-69 groups, which in 2016 are trailing- and leading-edge Boomers (respectively). Before exploring how Boomers traverse Toronto's social ecology, the Urban vs. Suburban Lifestyle dimension's continued explanatory prominence and juxtaposition of life stages means that although the neighbourhood life cycle (the Life Cycle / Stage dimension) becomes less explanatory of neighbourhood structure and change in Toronto, associations between elements of built form (housing type, location) and associated lifestyle factors (household type, journey to work, residential mobility) remain heavily associated with specific stages of the human life course.

[156] Their mutually saturating variables are no official language knowledge, low income, and high annual housing costs (Table 4.3).
[157] The 1996 set's 0.33 correlation between the SES and Visible Minorities and the Life Cycle / Stage dimensions (Table 4.9).

The passage of two decades sees Boomers traverse adulthood into older life stages, impacting Toronto's social ecology in different ways. Leading-edge Boomers lean to high-SES in 1996 at ages 40-49 along with slightly older (50-59) Torontonians, a pattern they hold at ages 50-59 by saturating the SES and Visible Minorities dimension's affluent pole in 2006, and the Urban vs. Suburban Lifestyle dimension's suburban pole (as 50-59 did in 1996). In 2016, they still saturate with suburban Toronto at ages 60-69, a group also saturating the Life Cycle / Stage dimension with other elderly groups (70-79, 80+) in the CSD's aged neighbourhoods. At least in the context of Toronto 1996-2016, leading-edge Boomers proceed through adulthood into older adulthood roughly along the same path of the preceding, Silent Generation, a journey marked by relatively high(er) SES and traditional suburbanism. Trailing-edge Boomers thus stand out for how their passage through the life course contrasts their older peers'. Leaving 1996's early household formation (ages 30-39), trailing edge Boomers do not associate with high-SES at ages 40-49 in 2006; instead, they lean to pre-1960 Toronto[158] and away from neighbourhoods built 1961-1990. However, by 2016, the trailing edge (ages 50-59) tracks the leading edge (ages 60-69) more closely, both saturating the Urban vs. Suburban Lifestyle dimension's suburban pole; this marks a circumspect journey from 1996, when trailing edge Boomers were early households on that axis's opposing, urban pole. Thus, while trailing-edge Boomers follow a different SES trajectory, they do end up suburbanizing by later adulthood. This reveals that, although different halves of the prominent Boomer generation take different life course paths, later life seems to have a homogenizing effect on whatever generational differences existed between the two cohorts in previous, younger life stages. More broadly, at least in the case of Toronto's leading-edge Boomers, there does not seem to be any striking difference thus far in their life course trajectory relative to the generations which proceed it with – if anything – the trailing edge being the ones to experience a different middle and later adulthood than those age cohorts born before it[159].

While comparing these 1996, 2006, and 2016 dimensions allows me to assess the relative continuity of important underlying components which structure the Toronto CSD's social ecology, as discussed in Section 3, this approach is still unable to directly expose the explicit nature of change i.e., PCA on static data provides me with some certainly useful information upon which to infer change but fails to yield a direct measure of how changes overlap in relation to each other. To that end, I now turn to my analysis of axes resulting from PCA of direct measures of change occurring during the decades 1996-2006 and 2006-2016, these outlined in Section 3's Table 3.5.

[158] Areas which overlap to considerable degree with the same central parts of Toronto they inhabited in their 30's.

[159] Two major caveats follow. First, discussed patterns of and differences between each Boomer edge need contend with the fact age variables representing each achieve, at most .76 and at worst .40 communality in the data (Table 4.2), meaning a considerable portion of each's variance is unaccounted for. Second, my study period and the age ranges of leading- and trailing-edge Boomers in 1996, 2006, or 2016 prevent observations for leading-edge Boomers when they are age 30-39 (in 1986) or the trailing-edge as they enter ages 60-69 in 2026, forestalling a more a comprehensive comparison of each edge's full life stage transitions.

4.4 – Using PCA to Understand Population Aging in the Toronto CSD as Part of Urban Change

This section analyses dimensions of socio-spatial changes in the Toronto CSD between 1996-2006 and 2006-2016. I first outline how PCA using change-based data differs from static PCA; this contextualize how my change results are more 'experimental' than familiar, static dimensions, given the latter's longer, broader history of use in factorial analyses. Since one difference is that change PCA tends to present as 'less explanatory' than static (Perle, 1982; Le Bourdais & Beaudry, 1988), I introduce and discuss the 1996-2006 and 2006-2016 components' communalities and overall explained variance (Table 4.13), then outline other nuances of change PCA interpretation. As for the analyses, while Section 4.3 presents the static 1996, 2006, and 2016 axes together (Table 4.3), dissimilarity in the change axes sets precludes this; however, the 1996-2006 and 2006-2016 analyses are both prefaced by a summary table of the decade's axes (Tables 4.14 and 4.21, respectively). Each decade's analyses proceed from the first- to the last-extracted axis before I assess sets in their entirety. As before, I emphasize elements of ageing and generational change. I now discuss change PCA generally to set the stage for the analytical sections which follow.

The major advantage of using change-based data in PCA is to provide a *direct* measure of how different socio-spatial changes interrelate, as opposed to inferring changes by observing two years' static PCA components. However, this results in generally less capacity to explain variance and adds to the complexity of interpretating the changes (or lack thereof) portrayed. I now speak to explanatory variance issues, exemplified by the 1996-2006 and 2006-2016 axes sets' communalities, before outlining interpretation issues. As discussed in Section 3, a core purpose of PCA and other factorial analysis is to simplify complex datasets into multivariate dimensions that represent axes of maximum differentiation in the data e.g., high- from low-status, most to least urban. As per Section 4.3, despite change occurring in those dimensions underlying Toronto's social ecology, their general trend is to maintain a stable continuity throughout the 1996-2016 study period. This echoes other urban change studies, in that the most common pattern is that of little or no change at all (Delmelle, 2017). This means my change-based datasets have less overall and extreme variation than occurs in my static datasets. This translates into the corresponding components for 1996-2006 and 2006-2016 having lower explained variance and lower communalities, strikingly so in some cases compared to the static axes. PCA conducted on direct measures of change is not 'less effective' than static PCA so much as, in the context of assessing the Toronto CSD's socio-spatial reality from 1996 to 2016, change is hard(er) to come by, resulting in a lesser magnitude of variation to be extracted from the data as principal components[160].

Comparing Table 4.13 to Section 4.3's Table 4.2, overall explained variance for the 5 change component solutions extracted for 1996-2006 and 2006-2016, which account for 44.5% and 46% of respective dataset variance, are roughly 20-25% lower than for the 1996, 2006, and 2016 static sets[161]. This is mirrored in the change sets' variable

[160] An important caveat is that socio-spatial elements outside my datasets may be responsible for variations occurring in the Toronto CSD's change data; however, the relative paucity of change in neighbourhood social ecology still forms the primary basis for the lower communalities and explained variance of my change PCA sets compared to my static.

[161] The 1996-2006 set results from an initial extraction of 15 axes, and 2006-2016 from 14 initial axes. My change datasets result in more raw axes (14-15) than my static PCA (8-10), despite having fewer variables; however, while keeping more change axes may reduce their noted gap in explanatory power, many are superfluous and difficult to interpret and thus are excluded.

communalities: less than half in each exceed .50 communality. More striking, in both decades, 13-14 register below .30 communality, resulting in their exclusion from that decade's analyses. As per general trends, change in the 80+ group fails to achieve sufficient communality in either decade, as does change in the 40-49 group for 2006-2016 (the 60-69 group also has a minimal .33). Population share change for Black, South Asian, and Southeast Asian and Filipino Torontonians fail to warrant analysis, as too those renting, transit commuting, and of near-average income. As change measures, low communality does not necessarily mean the variable does not change at all, so much as that CT-level change in the variable lacks the level of covariance that occurs among the dataset's higher communality variables. Given change occurring among other variables in these datasets, which I consider rather comprehensive in their coverage of social and spatial domains, it is not unfair to assume that low communality variables' minimal covariance translates to minimal or at least lesser overall change in population proportion at the CT level. These low communality variables represent groups that maintain their CT population share, even if these proportions in a given year vary considerably across Toronto. For example, while Black Torontonians saturate the SES and Visible Minorities dimension (Table 4.4), indicating spatial variance in the CSD's high and low concentrations of the group, their lack of communality in the change axes means these varied static patterns hold over time. In other words, Toronto neighbourhoods tend to maintain their population share of Black residents. Built form measures, conversely, mostly achieve above .50 and even as high as .70-80 communality, given they represent (ironically) stable points of data variation in Toronto, compared to the lesser covariance and overall variance of many change measures[162].

This is a useful segue into discussing how interpretating change axes differs from relatively simpler static axes. In static PCA, variables' saturation indicates their degree of covariance with other saturating variables i.e., they co-exist in high proportion together. Conceptually, positive or negative component scores indicate the degree to which CTs associate with the social construct depicted by the component's positive or negative saturations. They associate with these constructs, for instance 'older adulthood' (a strong negative score on the Life Cycle / Stage dimension; Table 4.6), if they have high proportions of negatively saturating variables, here older adult groups (60-69, 70-79, 80+). By extension, they do not associate with the dimension's positive construct, 'early families', due to their low proportions of positively saturating measures e.g., the 0-14 group. Importantly, the meaning of 'high' or 'low' proportion is that these are the highest or lowest values found in the dataset i.e., CTs with strong negative scores for 'older adulthood' are where Toronto's highest CT shares of the 60-69, 70-79, and 80+ age groups are found *whatever these shares might be*. This explanatory schema, while seemingly redundant, provides a clear basis for understanding how change-based data function in said schema and how this impacts what change axes 'mean'.

[162] Only 6 of 1996-2006's 50 variables have more than 70% communality, while 32 measures have less than 50%. Change in % of 80+, Multi-Family HHds, Trades Certificate, Business, Admin, Management, Immigrated Pre-1980s, Black, South Asian, Southeast Asian / Filipino, Other Incomes, Persons in Near-Avg Income, Transit Commuting, Renting, and 2006's % Homes Built 1991-2000 have communality less than 30% and are excluded from 1996-2006 analysis. For 2006-2016, 8 of 52 variables have more than 70% communality, while 27 score less than 50%. Change in % of 40-49, 80+ Multi-Family HHds, High School Certificate Only, Non-University Certificate, Trades Certificate, Immigrated 1981-1990, Black, South Asian, Southeast Asian / Filipino, Persons in Near-Avg Income, Transit Commuting, Renting, and 2006's % Missing Middle score less than 30% and are excluded for 2006-2016.

Table 4.13

Communalities and Total Explained Variance for 5 and 5-Axis Solutions, Toronto CSD, 1996-2006 and 2006-2016

	Decade	**1996-2006**	**2006-2016**
	# of Components	**5**	**5**
	# of Variables	**50**	**52**
	% Explained Variance	**44.5**	**46**
	Variable Communalities by Domain		
Age / Life Stage	Change in % of 0-14 yrs old	0.48	0.54
	Change in % of 30-39 yrs old	0.63	0.55
	Change in % of 40-49 yrs old	0.59	0.20
	Change in % of 50-59 yrs old	0.42	0.55
	Change in % of 60-69 yrs old	0.61	0.33
	Change in % of 70-79 yrs old	0.50	0.62
	Change in % of 80+ yrs old	0.17	0.25
Family & Household Characteristics	Change in % of 2-person HHds	0.69	0.63
	Change in % of 4+ person HHds	0.85	0.79
	Change in % of Legally Married Persons	0.52	0.78
	Change in % of Separated / Divorced Persons	0.52	0.45
	Change in % of Common-Law Couples	0.43	0.39
	Change in % of Lone Parent Families	0.36	0.50
	Change in % of Multi-Family HHds	0.15	0.26
Educational Attainment	Change in % of No High School Certificate	0.65	0.63
	Change in % of High School Certificate Only	0.37	0.23
	Change in % of Non-University Certificate	0.43	0.25
	Change in % of Trades Certificate	0.26	0.18
Labour Force & Occupation	Change in Female Participation Rate	0.34	0.54
	Change in % of Business, Admin, Management	0.25	0.51
	Change in % of Arts, Science, Public Sector	0.42	0.35
	Change in % of Sales / Service	0.34	0.35
	Change in % of Trades, Transport, Manufacturing	0.42	0.52
Immigration & Integration	Change in % of Immigrated Pre-1980s	0.23	0.46
	Change in % of Immigrated 1981-1990	0.49	0.26
	Change in % of Immigrated 1991-2000		0.56
	Change in % of No Knowledge of Off. Language	0.52	0.51
Visible Minorities	Change in % of Black	0.26	0.20
	Change in % of South Asian	0.24	0.18
	Change in % of Chinese, Korean, Japanese	0.40	0.34
	Change in % of Southeast Asian, Filipino	0.20	0.25
Income	Change in % of Government Transfer Income	0.61	0.74
	Change in % of Other Income Sources	0.12	0.48
	Change in % of Persons in Low Income	0.39	0.42
	Change in % of Persons in Near-Average Income	0.11	0.14
Commuting	Change in % of Transit Commuting	0.24	0.19
Residential Mobility	Change in % of No Moves in Last 5 yrs	0.49	0.49
Tenure	Change in % of Renting	0.29	0.03
	Change in % of Annual Income on Housing	0.41	0.32
	2006 Average Dwelling LQ	0.62	0.61
Housing Type	% Single-Detached	0.73	0.81
	% Missing Middle	0.42	0.27
	% 1-4 Storey Apts	0.53	0.53
	% 5+ Story Apts	0.73	0.81
Housing Age & Condition	% Homes Need Major Repair	0.42	0.57
	% Homes Built Pre-1960s	0.86	0.86
	% Homes Built 1961-1980	0.71	0.54
	% Homes Built 1981-1990	0.43	0.60
	% Homes Built 1991-2000	0.19	0.38
	% Homes Built 2001-2010		0.46
Urban Form	Dwelling Density	0.50	0.71
	Distance from CBD	0.71	0.77

Extending this framework to change-based data, wherein variables measure changes occurring in a CT's population proportions between a start and end period, saturations indicate where the dataset's greatest positive shifts in percentage share covary with each other. While 'greatest positive shift' is usually a proportional increase, if a variable largely suffers proportional decline throughout the CSD's 468 CTs over a decade, saturation instead indicates the variable's lowest proportional decrease, as this is the 'most positive' change incurred by the variable during the period[163]. Thus, saturation represents variables' greatest proportional increase *and/or* least proportional decrease. Taken together, while change dimensions depict conceptual constructs on their negative and positive poles just as is in static PCA, the types of change portrayed can be more complex to understand depending on how variables change at the CT level. Following this, positive and negative component scores still indicate CTs' association with dimension's positive or negative constructs, such that CTs with strong component scores are where respectively saturating variables experience the dataset's largest increase or least decrease. In other words, component scores still function the same as in static PCA, it is just that the constructs portrayed by change-based dimensions can be more complex. While potentially more difficult from an analytical perspective, this reflects possible ways in which socio-spatial change can occur e.g., large proportional increase in measure A might covary with large increase in B and at the same time covary with minimal proportional decrease in measure C, a measure that declines considerably in CTs where measures A and B do not increase. Clarifying change measure saturations as meaning 'greatest increase and/or least decline' also allows me to shorthand the concept in my analyses for brevity. Specifically, a pole's saturations indicate the most increase (in the dataset) for those change-based variables and the most decrease (in the dataset) for change-based variables on the opposing pole (the inverse meaning implied rather than stated)[164].

Given my change components' generally lower explanatory power, more complex interpretation, and novel employ of certain static, spatial measures alongside change-based measures[165] (Perle, 1982; Le Bourdais & Beaudry, 1988; Murdie, Logan, & Marannan, 2014), my change-based PCA of Toronto is more 'experimental' than Section 4.3's static PCA. However, this does not preclude the 5-axis component solutions extracted from my change datasets from providing a detailed picture of the nature and extent of socio-spatial change in the Toronto CSD for 1996-2006 and for 2006-2016. With these nuances regarding change PCA lain out, including an assessment of their capacity to explain variance in my datasets, I now analyze first my 1996-2006 then my 2006-2016 component sets.

[163] Likewise, if a variable mostly experiences proportional increases across the dataset, the pole opposing its saturation depicts where the dataset's least increase occurs

[164] Static measures on any pole indicate the dataset's highest shares are found there, and likewise the dataset's lowest shares of said measure are found upon the opposing pole (just as the case was in Section 4.3's static analyses).

[165] 'Novel' here means that the cited studies use datasets comprised entirely of change-based measures, even those for 10-year percentage share shifts in certain entrenched physical variables such as housing stock which (in PCA's context of discerning axes of maximum difference) results in low communality and non-saturation of said variables; see Section 3.7.1's discussion of dataset development for further context behind my rationale to diverge from these preceding studies.

4.4.1 – Toronto from 1996 to 2006

For this analysis of change in Toronto 1996-2006, and for the subsequent 2006-2016 analysis, a summary table of the decade's 5 axis solution (here, Table 4.14), organized by variable domain, provides a contextual basis for discussion of the set and highlights if and how variable domains saturate multiple dimensions. Table 4.14 presents the following 5 dimensions of change in Toronto's social ecology 1996-2006, labelled according to major saturations.

1. Urbanization / Peripheralization by SES
2. Generational SES and Household Change
3. Density of Apartments vs. Single Residential
4. Household Size by Neighbourhood Life Cycle
5. Aging-in-place vs. Succession

The following enumerates the tables of axis saturations and communalities and component score maps that support my analyses[166]. Table 4.15 and Figure 4.10 correspond to the Urbanization / Peripheralization by SES dimension; Table 4.16 and Figure 4.11 to the Generational SES and Household Change dimension; Table 4.17 and Figure 4.12 to the Density of Apartments vs. Single Residential dimension; Table 4.18 and Figure 4.13 to the Household Size by Neighbourhood Life Cycle dimension; and Table 4.19 and Figure 4.14 to the Aging-in-place vs. Succession dimension.

[166] As before, component score maps use shades of blue to denote CTs scoring to the axis's negative pole, while shades of red-orange denote CTs scoring to the positive pole. White denote CTs scoring minimally to either the negative or positive pole.

Table 4.14

Components by Domain and Variable for 5-Axis Solution, Toronto CSD, 1996-2006

Domain	Indicator	*Explained Variance (%)*	Urbanization / Peripheralization by SES *14.0*	Generational SES and Household Change *9.4*	Density of Apartments vs. Single Residential *8.7*	Household Size by Neighbourhood Life Cycle *6.8*	Aging-in-place vs. Succession *5.7*
Age / Life Stage	Change in % of 0-14 yrs old					0.62	
	Change in % of 30-39 yrs old			-0.52			-0.49
	Change in % of 40-49 yrs old			0.61			
	Change in % of 50-59 yrs old						0.45
	Change in % of 60-69 yrs old						0.66
	Change in % of 70-79 yrs old					-0.62	
	Change in % of 80+ yrs old						
Family & Household Characteristics	Change in % of 2-person HHds					-0.81	
	Change in % of 4+ person HHds					0.90	
	Change in % of Legally Married Persons			-0.60			
	Change in % of Separated / Divorced Persons			0.50			
	Change in % of Common-Law Couples		-0.64				
	Change in % of Lone Parent Families			0.43			
	Change in % of Multi-Family HHds						
Educational Attainment	Change in % of No High School Certificate			-0.45	0.43		
	Change in % of High School Certificate Only			0.61			
	Change in % of Non-University Certificate			0.56			
	Change in % of Trades Certificate						
Labour Force & Occupation	Change in Female Participation Rate						
	Change in % of Business, Admin, Management		-0.49				
	Change in % of Arts, Science, Public Sector		-0.42				
	Change in % of Sales / Service			0.44			
	Change in % of Trades, Transport, Manufacturing		0.63				
Immigration & Integration	Change in % of Immigrated Pre-1980s						0.42
	Change in % of Immigrated 1981-1990				0.65		
	Change in % of No Knowledge of Off. Language		0.56				

Table 4.14

Components by Domain and Variable for 5-Axis Solution, Toronto CSD, 1996-2006 continued

Domain	Indicator	*Explained Variance (%)*	Urbanization / Peripheralization by SES *14.0*	Generational SES and Household Change *9.4*	Density of Apartments vs. Single Residential *8.7*	Household Size by Neighbourhood Life Cycle *6.8*	Aging-in-place vs. Succession *5.7*
Visible Minorities	Change in % of Black						
	Change in % of South Asian						
	Change in % of Chinese, Korean, Japanese			-0.42			-0.44
	Change in % of Southeast Asian, Filipino						
Income	Change in % of Government Transfer Income		0.69				
	Change in % of Other Income Sources						
	Change in % of Persons in Low Income		0.54				
	Change in % of Persons in Near-Avg Income						
Commuting	Change in % of Transit Commuting						
Residential Mobility	Change in % of No Moves in Last 5 yrs						0.67
Tenure	Change in % of Renting						
	Change in % of Annual Income on Housing						-0.48
	1996 Average Dwelling LQ			-0.43	0.60		
Housing Type	1996 % Single-Detached				0.80		
	1996 % Missing Middle					-0.60	
	1996 % 1-4 Storey Apts		-0.68				
	1996 % 5+ Story Apts		0.42		-0.72		
Housing Age & Condition	1996 % Homes Need Major Repair				-0.48		
	1996 % Homes Built Pre-1960s		-0.80				
	1996 % Homes Built 1961-1980		0.71				
	1996 % Homes Built 1981-1990						0.43
	2006 % Homes Built 1991-2000						
Urban Form	1996 Dwelling Density				-0.63		
	Distance from CBD		0.76				

1996-2006's Urbanization / Peripheralization by SES Dimension (Axis 1; 14% Dataset Variance)

The first axis extracted for 1996-2006, the Urbanization / Peripheralization by SES dimension, explains 14% of dataset variance. The negative pole saturates the most increase of common-law couples and white-collar occupations between 1996-2006, as well as high 1996 shares of pre-1960 homes and 1-4 story apartments (Table 4.15). The positive pole saturates most increase of government transfers, low incomes, no official language knowledge, and blue-collar occupations between 1996-2006, as well as distance from the CBD and high 1996 shares of 1961-1980 homes and 5+ story apartments[167]. This dimension builds on the static results by showing that socioeconomic patterns of 1996 (SES and Visible Minorities dimension; Table 4.4a) further consolidate from 1996-2006, as – using the built form measures on same year's Apartments by Age, Type, and Occupants dimension (Table 4.7a; Fig. 4.8a) and indeed same measures featuring here (Table 4.15) – Toronto's core, pre-1960 areas decline in low-SES measures and peripheral, 1961-1980 CTs see low-SES measures increase. There is also some overlap with household formation or dissolution among common-law couples. The analytical import of this change dimension is that it makes a finding arrived at in the static analyses (one arrived at via inference of inter-year change in several static axes and their component scores) directly explicit, showing the specific measures contributing most to SES change in Toronto's social ecology and those aspects of the CSD's built forms to which these changes relate.

Figure 4.10 shows that component scores for the Urbanization / Peripheralization by SES dimension take on a core-periphery orientation sensible given its built form and spatial saturations. High negative scores, indicating increasing shares of high-income measures and white-collar occupations, occur largely within Old Toronto, though south Etobicoke, York, and even southern stretch of North York generally experience upward SES shift. Positive scores, indicating increasing shares of low-income measures and blue-collar occupations between 1996-2006 (thus resulting in overall decline in local SES), are largely peripheral, the strongest locating at Toronto's edges in north Etobicoke, North York, and most of Scarborough (heaviest around Pacific Mall). Scores in part derive from saturation of distance from the CBD, 1961-1980 homes, and 5+ story apartments. However, some core Toronto neighbourhoods e.g., Bay Street, Queen's Park, and University score positively, as do the Thorncliffe and Bennington Park areas, rather severely despite being just removed from Old Toronto (demonstrating considerable SES decline). These scores also overlap the static Urban vs. Suburban Lifestyle dimension (Fig. 4.6), sensible given shared spatial variables. Worth noting is that 1996's SES and Visible Minorities static dimension (Fig. 4.5a) shows west Old Toronto as low-SES, yet the area scores for SES increase (negatively) here, as affluent populations re-urbanize a previously lower-SES inner-city area; this is also the case in Old Toronto's Riverdale and Danforth areas. The trend bridging this axis of change to Toronto's urban structure in 1996 and 2006 are centralization of high-SES attributes and peripheralization of low-SES attributes in the CSD's periphery, areas already of low or middling SES.

[167] With this and subsequent axes, poles depict where opposing saturations are low in share or experience the most decrease i.e., distance from the CBD's positive saturation peripheralizes other positive saturations and centralizes the negative saturations.

Figure 4.10

Urbanization / Peripheralization by SES Dimension

- Component Scores, Toronto CSD, 1996-2006

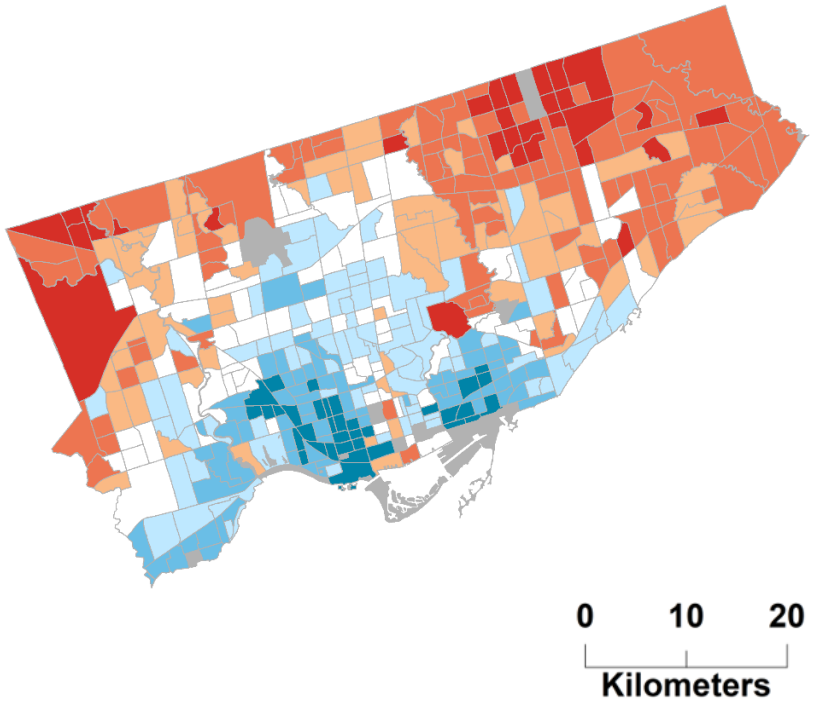


Table 4.15

Urbanization / Peripheralization by SES Dimension

- Saturation and Communality Table, Toronto CSD, 1996-2006

Decade	**1996-2006**
Extraction Order	**First (1)**
Variance	**14.0**
Cumulative Variance	**14.0**

Domain	Indicator	Saturation	Comm.
Family / Household	Change in % of Common-Law Couples	-0.64	0.43
Occupation	Change in % of Arts, Science, Public Sector	-0.42	0.42
Housing Type	1996 % 1-4 Storey Apts	-0.68	0.53
Housing Age	1996 % Homes Built Pre-1960s	-0.80	0.86
Occupation	Change in % of Trades, Transport, Manufacturing	0.63	0.42
Language	Change in % of No Knowledge of Off. Language	0.56	0.52
Income	Change in % of Government Transfer Income	0.69	0.61
Income	Change in % of Persons in Low Income	0.54	0.39
Housing Type	1996 % 5+ Story Apts	0.42	0.73
Housing Age	1996 % Homes Built 1961-1980	0.71	0.71
Urban	Distance from CBD	0.76	0.71

1996-2006's Generational SES and Household Change Dimension (Axis 2; 9.4% Dataset Variance)

The second axis extracted for 1996-2006, the Generational SES and Household Change dimension, explains 9.4% of dataset variance. The negative pole saturates most increase of the 30-39 group, legal marriage, East Asians, and no high school certificates between 1996-2006, as well as 1996's high home values (Table 4.16). The positive pole saturates most increase of the 40-49 group, separated / divorced, lone parents, high school and non-university certificates, and sales/service occupations. Generationally, trailing edge Boomers 'became' 40-49 between 1996-2006 (aging from 30-39). The axis shows 1996-2006 SES change based on educational attainment, household composition, and life stage. The positive pole shows Toronto CTs with relatively low 1996 home values experience household dissolution and increasing shares of middling educations and sales / service workers. This trend links to trailing-edge Boomers' passage from ages 30-39 to 40-49, supporting static analyses that Toronto's later-born Boomers are less aligned with affluence than their leading-edge peers. The negative pole indicates 1996 Toronto's high-SES areas generally increase in SES by 2006, as middling educations, sales/service jobs, and separated, divorced, and lone parent households decline, and marriage rates increase amidst an influx of early households (30-39) and/or East Asians[168]. The increase of 30-39 here evokes a 'demographic conveyor' effect whereby (despite being in early household formation stages associated with lesser resources) the 'younger' adults increasing in share here come from a higher-SES background than working-class incumbents whose population shares diminish (Teernstra & van Gent, 2012). While saturating no high school certificate contradicts SES increase, 1996 already saw low shares of this variable in Toronto's high-SES areas (where this dimension's component scores are strongest; Fig 4.11); these CTs experience minimal decline in already low share, a lack of change accompanied by large decreases in high school and non-university certificates associated with a declining working-class[169].

Figure 4.11 shows the Generational SES and Household Change dimension's component scores spatially orient like the static SES and Visible Minorities dimension (Fig. 4.5), thus also resembling Hulchanski's (2011) Three Cities. Negative scores show increasing SES and household formalization in Old Toronto's core, extending to outer North York, as milder scores spread east through north Scarborough. Positive scores show household fragmentation and decreasing SES predominate in two major clusters: the first and most intense is in York and spreads further north into west North York. The other starts just east of the CBD and spreads east through Riverdale, the Danforth, and parts of East York before coming to cover much of south Scarborough. This dimension's component scores support Hulchanski's claim that high- and low-status Toronto grow increasingly polarized via their respectively increasing and decreasing SES; it also shows these trajectories of change align with distinctions in household type and education. Tying this together is trailing-edge Boomers' aging from 30-39 to 40-49, a generational life course transition (either as aging-in-place or in-migration) that aligns to further decline in Toronto's low-SES, City #3 (Section 3.2.1; Fig. 3.4).

[168] East Asians' SES increase here clarify static PCA results where they gradually align with high SES by 2016 (Table 4.3).
[169] The implied premise being that 'some other' education type is increasing in share here considerably, which via process of inference and elimination, would be the 'university certificate and above' measure excluded from the dataset for multicollinearity, the presence of which, however, can and should still be inferred in findings such as these (Section 3.7.1).

Figure 4.11

Generational SES and Household Change Dimension

- Component Scores, Toronto CSD, 1996-2006

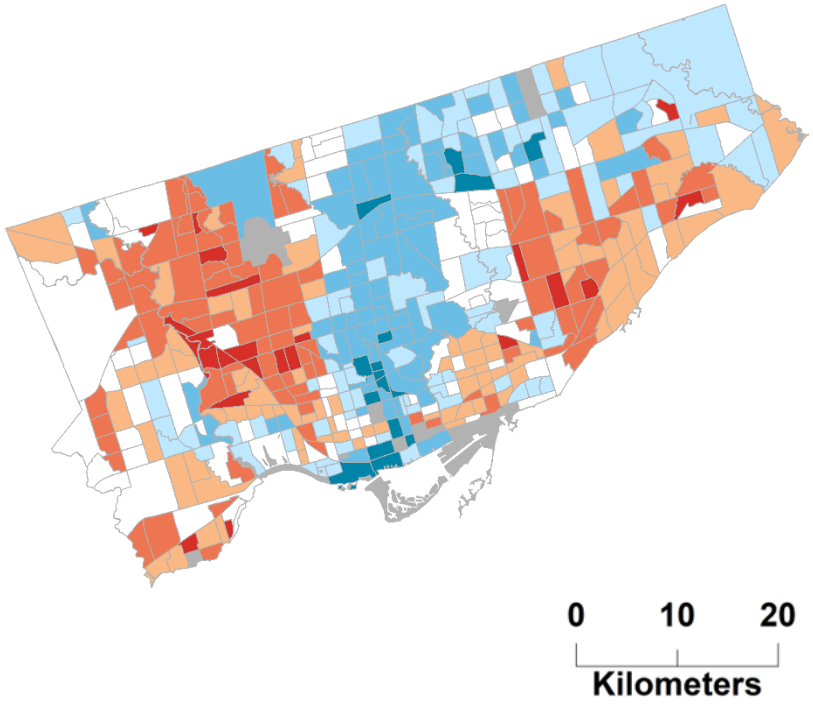


Table 4.16

Generational SES and Household Change Dimension
- Saturation and Communality Table, Toronto CSD, 1996-2006

Decade	**1996-2006**
Extraction Order	**Second (2)**
Variance	**9.4**
Cumulative Variance	**23.3**

Domain	Indicator	Saturation	Comm.
Age	Change in % of 30-39 yrs old	-0.52	0.63
Family / Household	Change in % of Legally Married Persons	-0.60	0.52
Education	Change in % of No High School Certificate	-0.45	0.65
Ethnicity	Change in % of Chinese, Korean, Japanese	-0.42	0.40
Housing Value	1996 Average Dwelling LQ	-0.43	0.62
Age	Change in % of 40-49 yrs old	0.61	0.59
Family / Household	Change in % of Separated / Divorced Persons	0.50	0.52
Family / Household	Change in % of Lone Parent Families	0.43	0.36
Education	Change in % of High School Certificate Only	0.61	0.37
Education	Change in % of Non-University Certificate	0.56	0.43
Occupation	Change in % of Sales / Service	0.44	0.34

1996-2006's Density of Apartments vs. Single Residential Dimension (Axis 3; 8.7% Dataset Variance)

The third axis extracted for 1996-2006, the Density of Apartments vs. Single Residential dimension explains 8.7% of dataset variance. The negative pole saturates high 1996 shares of 5+ story apartments, density, and major repairs (Table 4.17). The positive pole saturates most increase of 1981-1990 immigrants and no high school certificates between 1996-2006, as well as high 1996 home values and shares of single-detached dwellings. The dimension differentiates Toronto's densest, physically downgrading, apartment-rich areas (negative pole) from its least-dense residential districts, where single detached homes predominate (positive pole). The suburban built form depicted by the positive pole sees shares of 1981-1990 immigrants increase or at least remain stable, supporting claims that recent immigrants tend to peripheralize into the Inner Suburbs and away from Downtown (Qadeer, 2010), as opposed to previous eras when Toronto's Downtown was a far more prominent immigrant landing area.

Somewhat predictably, component scores for the Density of Apartments vs. Single Residential dimension (Fig. 4.12) adhere to a familiar distribution of Toronto's urban vs. suburban areas (the static Urban vs. Suburban Lifestyle dimension; Fig 4.6). Here, negative scores denote dense, degrading 5+ story apartments located largely within the CSD's center (albeit with definite clusters quite far into Scarborough and North York), and positive scores – denoting dispersed, higher-value, single-family residential neighbourhoods, found closer to Toronto's edges. Notable exceptions to this are Old Toronto's Cabbagetown, Rosedale and Forest Hills neighbourhoods, which stand out as residential enclaves not far removed from Downtown. Differences between this axis and the similar static dimension can be attributed to the Density of Apartments vs. Single Residential dimension lacking a distance from the CBD saturation; this makes this axis (which also features home values as a distinguishing factor) a purer measure of urban form, and less so of urban location than the Urban vs. Suburban Lifestyle dimension (Tables 4.17 and 4.5).

Figure 4.12

Density of Apartments vs. Single Residential Dimension

- Component Scores, Toronto CSD, 1996-2006

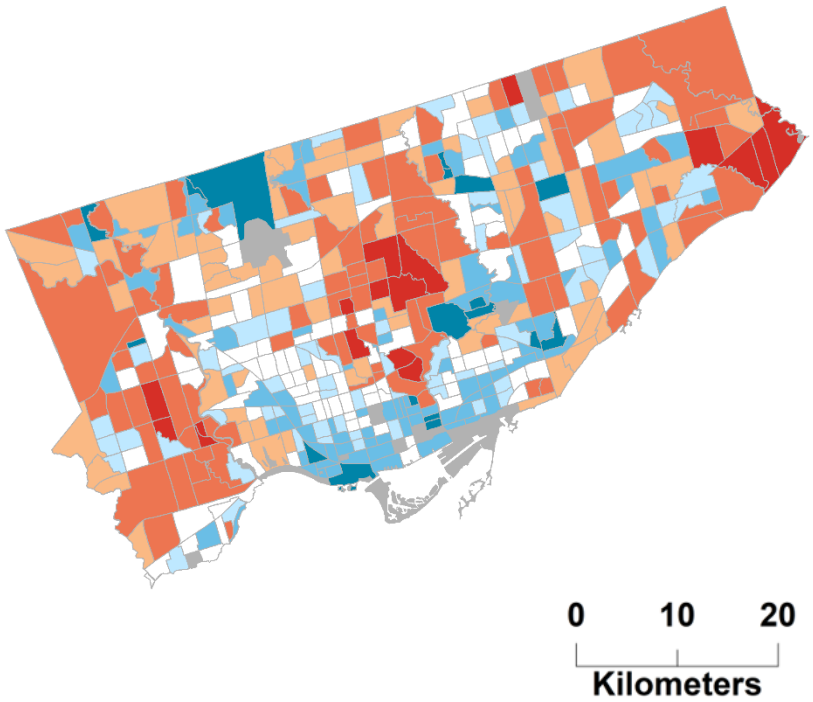


Table 4.17

Density of Apartments vs. Single Residential Dimension
- Saturation and Communality Table, Toronto CSD, 1996-2006

Decade	**1996-2006**
Extraction Order	**Third (3)**
Variance	**8.7**
Cumulative Variance	**32.0**

Domain	Indicator	Saturation	Comm.
Housing Type	1996 % 5+ Story Apts	-0.72	0.73
Housing Condition	1996 % Homes Need Major Repair	-0.48	0.42
Urban	1996 Dwelling Density	-0.63	0.50
Education	Change in % of No High School Certificate	0.43	0.65
Immigration (Period)	Change in % of Immigrated 1981-1990	0.65	0.49
Housing Type	1996 % Single-Detached	0.80	0.73
Housing Value	1996 Average Dwelling LQ	0.60	0.62

1996-2006's Household Size by Neighbourhood Life Cycle Dimension (Axis 4; 6.8% Dataset Variance)

The fourth axis extracted for 1996-2006, the Household Size by Neighbourhood Life Cycle dimension explains 6.8% of dataset variance. The negative pole saturates most increase of the 70-79 group and 2-person households between 1996-2006 and high 1996 shares of missing middle (Table 4.18). The positive pole saturates most increase of the 0-14 group and 4+ person households between 1996-2006. The dimension shows the shrinking or growth of households that occurs during the neighbourhood life cycle. The negative pole represents late stages where aging households downsize, while the positive pole reflects initial stages where new families predominate, whether in newly built areas or neighbourhoods 'renewing' from their prior life cycle. Smaller missing middle homes align sensibly with smaller, older households. This axis mirrors the static analysis's Life Cycle / Stage dimension (Table 4.6) in juxtaposing older adult and smaller household measures from children and larger households, although this time as a process (i.e., aging, 'younging') instead of a structural outcome (i.e., aged or early family neighbourhoods).

Component scores for 1996's Household Size by Neighbourhood Life Cycle dimension (Fig. 4.13) present rather distinct negative score (increase of smaller, older households; decrease of larger, early families) and positive score (showing the opposite) patterns[170]. A major cluster of household shrinking / aging occurs west of Downtown, in Kensington-Chinatown, Little Italy and Portugal, Trinity-Bellwoods, and into York. Heading northwest, negative scores drop off somewhat until reaching North York, where CTs south and west of York University also score negatively. Another cluster of shrinking / aging occurs in the CSD's eastern reaches in west North York and most of north-east Scarborough. Recalling the static Life Cycle / Stage dimension, this area scores quite towards early families and away from older adults (Table 4.6; Fig.4.7) in 1996. The Household Size by Neighbourhood Life Cycle dimension's negative scores in these areas, which represent increasing proportions of 2-person households and 70-79 group and decreasing proportions of 4+ person households and 0-14 group, show that 1996 Scarborough passes further through the neighbourhood life cycle by 2006. The other end of this life cycle, wherein early family proportions increase, is depicted by strong positive scores in north Old Toronto extending into North and East York. Starting in east Old Toronto and stretching through south and central Scarborough, as well as in south and central Etobicoke, neighbourhood renewal and related changes in household composition are also shown to occur (though to a lesser magnitude as per milder positive scores) as young families occupy greater population shares in these CTs.

[170] The magnitude and extent of these component scores should also be considered with respect to the role played by saturation of Toronto's 1996 shares of missing middle dwellings.

Figure 4.13

Household Size by Neighbourhood Life Cycle Dimension

- Component Scores, Toronto CSD, 1996-2006

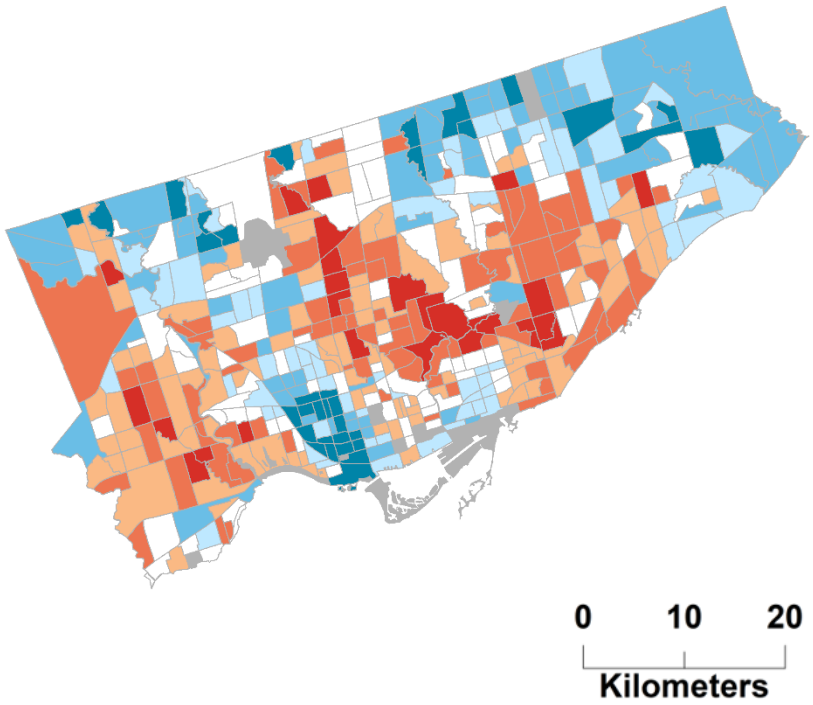


Table 4.18

Household Size by Neighbourhood Life Cycle Dimension
- Saturation and Communality Table, Toronto CSD, 1996-2006

Decade	**1996-2006**
Extraction Order	**Fourth (4)**
Variance	**6.8**
Cumulative Variance	**38.8**

Domain	Indicator	Saturation	Comm.
Age	Change in % of 70-79 yrs old	-0.62	0.50
Family / Household	Change in % of 2-person HHds	-0.81	0.69
Housing Type	1996 % Missing Middle	-0.60	0.42
Age	Change in % of 0-14 yrs old	0.62	0.48
Family / Household	Change in % of 4+ person HHds	0.90	0.85

1996-2006's Aging-in-place vs. Succession Dimension (Axis 5; 5.7% Dataset Variance)

The fifth axis extracted for 1996-2006, the Aging-in-place vs. Succession dimension explains 5.7% of dataset variance. The negative pole saturates most increase of the 30-39 group, East Asians, and the share of annual income spent on housing between 1996-2006 (Table 4.19). The positive pole saturates most increase of the 50-59 and 60-69 groups and of no recent move shares between 1996-2006, as well as high 1996 shares of homes built from 1981 to 1990. Generationally, leading-edge Boomers 'became' 50-59 between 1996-2006 (aging from 40-49). As on prior axes, life stage elements play an important role defining the Aging-in-place vs. Succession dimension. The negative pole is where early households grow increasingly prominent, as do recent moves, a process associated both with Toronto's East Asian populace and with increasingly high housing costs. The positive pole demonstrates neighbourhood maturation as late-stage adults predominate via aging-in-place, a process increasing local residential stability. This process is partly driven by leading edge Boomers i.e., increase of the 50-59 group, who (referring to the static analysis) follow similar patterns to the previous, Silent generation (here, increase of the 60-69 group).

Component scores for the Aging-in-place vs. Succession dimension showcase two major clusters of positive scores, i.e., increasing neighbourhood stability related to 50-69-year-olds aging in place (Fig. 4.14). The first occurs from Downtown north through Forest Hills and Lawrence Park into North York and east across the Don Valley into Riverdale and the Danforth. Aging and neighbourhood stability also predominate in eastern Scarborough, which, as per complementary scores on the Household Size by Neighbourhood Life Cycle dimension for aging and household shrinking in these areas (Fig. 4.13), show another angle to these suburb's overall trajectory of neighbourhood aging and accompanying shifts in local social character. Conversely, most of the rest of the Toronto CSD (excepting some minute clusters) tends to score negatively on this dimension, showing decreasing residential stability and presence of the 50-69 groups as early households (30-39), East Asians, and housing costs increase. This implies these CTs experience out-movement of their late adult populations and in-movement i.e., the neighbourhood succession of younger, early households (a process mildly associated with Toronto's East Asians). Notably, average scores are prevalent, showing CTs where these age groups stay relatively stable, as do recent moves between 1996 and 2006.

Figure 4.14

Aging-in-place vs. Succession Dimension

- Component Scores, Toronto CSD, 1996-2006

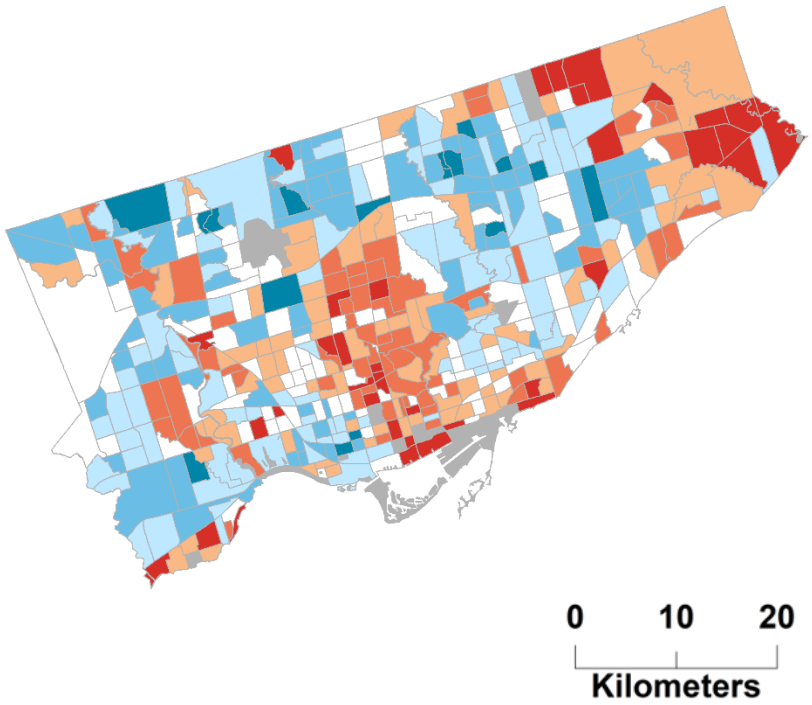


Table 4.19

Aging-in-place vs. Succession Dimension

- Saturation and Communality Table, Toronto CSD, 1996-2006

Decade	**1996-2006**
Extraction Order	**Fifth (5)**
Variance	**5.7**
Cumulative Variance	**44.5**

Domain	Indicator	Saturation	Comm.
Age	Change in % of 30-39 yrs old	-0.49	0.63
Ethnicity	Change in % of Chinese, Korean, Japanese	-0.44	0.40
Tenure	Change in % of Annual Income on Housing	-0.48	0.41
Age	Change in % of 50-59 yrs old	0.45	0.42
Age	Change in % of 60-69 yrs old	0.66	0.61
Residential Mobility	Change in % of No Moves in Last 5 yrs	0.67	0.49
Housing Age	1996 % Homes Built 1981-1990	0.43	0.43

1996-2006 Components: Analysis Summary (5 Axes; 44.5% Dataset Variance)

In 1996-2006, there are no axes correlations are worth analyzing (Table 4.20). However, worth exploring is how low-communality variables show socio-spatial stability around which saturating variables incur change. In other words, visible minority (except East Asian), renter, and transit commuter measure have meaning *in absentia.* For instance, despite relative prominence of visible minority and immigrant variables in the static axes (i.e., these groups vary spatially across the Toronto CSD, often in relation to CTs' SES) their non-saturation on the 1996-2006 axes means Toronto neighbourhoods tend to maintain their visible minority shares, even as they change along other lines. Similarly, local shares of renters and transit commuters, measures that reflect entrenched spatial realties i.e., CTs' rental stock or transit service, stay constant as these physical elements less likely to shift much over 10 years.

Table 4.20

Axis Correlations for Toronto CSD 1996-2006 Dimensions

Dimension Label	Axis	1	2	3	4	5
Urbanization / Peripheralization by SES	**1**	1				
Generational SES and Household Change	**2**	-0.12	1			
Density of Apartments vs. Single Residential	**3**	0.03	-0.01	1		
Household Size by Neighbourhood Life Cycle	**4**	0.03	0.03	-0.11	1	
Aging-in-place vs. Succession	**5**	-0.04	-0.09	0.05	-0.07	1

As for the 1996-2006 axes, the first two, most primary dimensions of change occurring across Toronto are of a socio-economic nature. However, while static axes illuminate structural SES dimensions overlapped by ethnic and immigrant measures (Tables 4.4 and 4.5), dimensions of changes in Toronto's SES structure instead heavily relate to the CSD's built form (Urbanization / Peripheralization by SES dimension; Table 4.15) and household type and life stage (Generational SES and Household Change dimension; Table 4.16). The first relates SES change to Toronto's spatial attributes, resulting in consolidation of high-SES residents in central, pre-1960-built parts of the CSD (mostly Old Toronto) while low-income earners and blue-collar workers increasingly concentrate in peripheral, post-1961-built parts of the Inner Suburbs. This familiarity with this trend originates in the static PCA, however, there it is an inference born of comparing several axes' saturations and component scores over the 1996-2006 period; this change dimension instead directly depicts the nature of said change and where it occurs most strongly. The second 1996-2006 axis is also laden with SES measures, but which overlap shifts in household type as well as illustrating a life stage transition for trailing edge Boomers. Before assessing this transition more fully, I discuss how household composition and life stage play a more vital role differentiating Toronto's urban change than so for its structure.

The 1996-2006 set's second, fourth, and fifth axes all saturate age groups i.e., life stages and indeed are largely defined by them (Table 4.14). For instance, the Aging-in-place vs. Succession dimension distinguishes household formation (30-39) from the aging-in-place of 50-69-year-olds (Table 4.19). The second and fourth axes also expose the covariance of age and household traits: the Generational SES and Household Change dimension saturates 30-39 and 40-49 on poles opposed in household type and education level, and the Household Size by Neighbourhood Life Cycle dimension juxtaposes older adulthood (70-79) against early family formation (0-14) and these two life stages' typical household size. All three axes are phases of the neighbourhood life cycle, a broader system of continual and successive demographic change which seems to underlie much variation in the Toronto CSD's 1996-2006 dataset.

Relative to the static PCA's illumination of variance in Toronto's urban structure, elements of life stage play a comparably more prominent role in the 1996-2006 changes occurring in the CSD's social ecology[171]. For instance, that increasing early households align with declining shares of several working-class measures implies an interweaving of class and demographic change. The importance of household composition is also sensible given households achieve security as they formalize (i.e., marry) and grow increasingly vulnerable in their dissolution i.e., increasing incidences of lone parenthood and marital break-up experienced by trailing edge Boomers as they age from 30-39 to 40-49. As the Boomer generation is a primary focus of my research, I conclude this section of the analysis exploring what the 1996-2006 components say about their trajectory of aging in Toronto that decade.

In a recurring analytical theme of my change PCA, an inferred static PCA finding (here, that trailing-edge Boomers' adulthood does not align with high-SES attributes like their leading-edge peers') is made explicit by a change axis. The Generational SES and Household Change dimension directly associates the presence and/or in-movement of trailing-edge Boomers with increasing shares of associated education types (high school, vocational) and fragmented households[172]. This seems to underlie their SES divergence from their older, leading-edge peers (in the Toronto CSD). That associated static component scores are strong in Toronto's lower-SES areas, as per strong, low-SES scores on the SES and Visible Minorities dimension (Fig. 4.5a and b) and thus to Hulchanski's low-status City 3 (Section 3; Fig 3.4), further supports this. As for leading-edge Boomers, they appear to follow the same change trajectories as Silent Generation Torontonians on the Aging-in-place vs. Succession dimension (Table 4.19); the term 'change' might seem ironic, in that covariance of increasing shares of 50-59 and 60-69 with decreasing residential moves depicts later adulthoods' aging-in-place, a neighbourhood life cycle stage marked by general stability. Worth noting also is both 1996-2006 'Boomer' axes[173] see increase of the 30-39 group saturate their opposing dimensional pole. This marks a degree of convergence between the two edges, in that they associate away from spaces experiencing process of early household formation associated with increase of the 30-39 group. With the 1996-2006 dimensions outlined, I now analyze my 2006-2016 axes. In terms of the Boomer edges' general divergence, inferred in the static analyses and made more explicit here, a major point of interest will be determining the degree to which they maintain this divergence as they both continue to age through the 2006-2016 period in the Toronto CSD.

[171] Part of this is because certain variables pre-eminent in the static analyses (i.e., visible minorities, renters, transit) remain stable over the decade, allowing changes occurring in CTs' shares of life stage and household measures to stand out more.
[172] Both education types, by 2006 and especially 2016 are shown in the static PCA to covary inversely with high-SES (Table 4.4), while the same holds for these fragmented household types, likely as said households' singular income limits fiscal capacity.
[173] Trailing-edge on the Generational SES and Household Change axis, leading-edge on the Aging-in-place vs. Succession axis.

4.4.2 – Toronto from 2006 to 2016

Table 4.21 summarizes 2006-2016's 5 axis solution to provide a contextual basis for discussing the set and highlights if and how variable domains saturate multiple dimensions. The following 5 dimensions of socio-ecological change are extracted from the Toronto 1996-2006 dataset and are labelled according to major saturations.

1. Urbanization / Peripheralization by SES
2. Household Size by Neighbourhood Life Cycle
3. SES of the Neighbourhood Life Cycle
4. Density of Apartments vs. Single Residential
5. New vs. Old(er) Neighbourhoods

The following enumerates the tables of axis saturations and communalities and component score maps that support my analyses. Table 4.22 and Figure 4.15 correspond to the Urbanization / Peripheralization by SES dimension; Table 4.23 and Figure 4.16 to the Household Size by Neighbourhood Life Cycle dimension; Table 4.24 and Figure 4.17 to the SES of the Neighbourhood Life Cycle dimension; Table 4.25 and Figure 4.18 to the Density of Apartments vs. Single Residential dimension; and Table 4.26 and Figure 4.19 to the New vs. Old(er) Neighbourhoods dimension. In the analysis that follows, I also reference the 1996-2006 dimensions of change to provide a basis for discussing the relative continuity of general trajectories of change in the Toronto CSD over the entire 1996-2016 study period.

Table 4.21

Components by Domain and Variable for 5-Axis Solution, Toronto CSD, 2006-2016

Domain	Indicator	*Explained Variance (%)*	Urbanization / Peripheralization by SES *17.2*	Household Size by Neighbourhood Life Cycle *9.6*	SES of the Neighbourhood Life Cycle *7.7*	Density of Apartments vs. Single Residential *6.3*	New vs. Old(er) Neighbourhoods *5.1*
Age / Life Stage	Change in % of 0-14 yrs old			0.60			
	Change in % of 30-39 yrs old		-0.41		-0.43		
	Change in % of 40-49 yrs old						
	Change in % of 50-59 yrs old		0.55				0.43
	Change in % of 60-69 yrs old				0.55		
	Change in % of 70-79 yrs old				0.76		
	Change in % of 80+ yrs old						
Family & Household Characteristics	Change in % of 2-person HHds			-0.70			
	Change in % of 4+ person HHds			0.87			
	Change in % of Legally Married Persons		-0.80				
	Change in % of Separated / Divorced Persons		0.63				
	Change in % of Common-Law Couples		-0.43				
	Change in % of Lone Parent Families		0.65				
	Change in % of Multi-Family HHds						
Educational Attainment	Change in % of No High School Certificate		0.50		0.46		
	Change in % of High School Certificate Only						
	Change in % of Non-University Certificate						
	Change in % of Trades Certificate						
Labour Force & Occupation	Change in Female Participation Rate		-0.45		-0.53		
	Change in % of Business, Admin, Management		-0.70				
	Change in % of Arts, Science, Public Sector						
	Change in % of Sales / Service		0.55				
	Change in % of Trades, Transport, Manufacturing			0.45			
Immigration & Integration	Change in % of Immigrated Pre-1980s				0.61		
	Change in % of Immigrated 1981-1990						
	Change in % of Immigrated 1991-2000		-0.42	0.44			
	Change in % of No Knowledge of Off. Language				0.43		

Table 4.21

Components by Domain and Variable for 5-Axis Solution, Toronto CSD, 2006-2016 continued

Domain	Indicator	*Explained Variance (%)*	Urbanization / Peripheralization by SES *17.2*	Household Size by Neighbourhood Life Cycle *9.6*	SES of the Neighbourhood Life Cycle *7.7*	Density of Apartments vs. Single Residential *6.3*	New vs. Old(er) Neighbourhoods *5.1*
Visible Minorities	Change in % of Black						
	Change in % of South Asian						
	Change in % of Chinese, Korean, Japanese						-0.47
	Change in % of Southeast Asian, Filipino						
Income	Change in % of Government Transfer Income		0.74				
	Change in % of Other Income Sources				0.58		
	Change in % of Persons in Low Income		0.63				
	Change in % of Persons in Near-Avg Income						
Commuting	Change in % of Transit Commuting						
Residential Mobility	Change in % of No Moves in Last 5 yrs		0.47				
Tenure	Change in % of Renting						
	Change in % of Annual Income on Housing						-0.55
	2006 Average Dwelling LQ		-0.45			0.40	
Housing Type	2006 % Single-Detached					0.85	
	2006 % Missing Middle						
	2006 % 1-4 Storey Apts		-0.60				
	2006 % 5+ Story Apts					-0.77	
Housing Age & Condition	2006 % Homes Need Major Repair						0.60
	2006 % Homes Built Pre-1960s		-0.63				0.40
	2006 % Homes Built 1961-1980		0.67				
	2006 % Homes Built 1981-1990						
	2006 % Homes Built 1991-2000						-0.55
	2016 % Homes Built 2001-2010						-0.66
Urban Form	2006 Dwelling Density					-0.77	
	Distance from CBD		0.78				

2006-2016's Urbanization / Peripheralization by SES Dimension (Axis 1; 17.2% Dataset Variance)

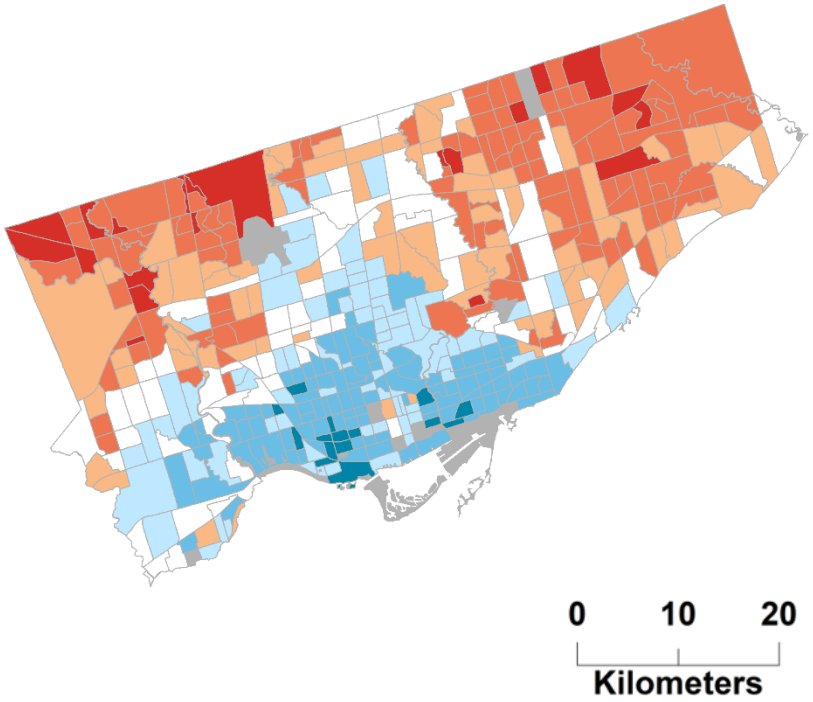
The Urbanization / Peripheralization by SES dimension is the first axis for 2006-2016, explaining 17.2% of dataset variance. The negative pole saturates most increase of the 30-39 group, legal marriage, common-law, female participation, white-collar workers and 1991-2000 immigrants between 2006-2016, as well as high 2006 home values and shares of pre-1960 homes and 1-4 story apartments (Table 4.22). The positive pole saturates most increase of the 50-59 group, separated / divorced, lone parents, no high school, sales / service, government transfer, low income, and no recent moves between 2006-2016, as well as distance from the CBD and high 2006 shares of 1961-1980 homes. Generationally, trailing edge Boomers 'became' 50-59 between 2006-2016 (aging from 40-49). Core pre-1960 CTs, already high SES in 2006, increase in share of several high-SES education, occupation, and income measures and decrease in low-SES traits. Toronto's periphery experiences SES decrease via increasing shares of low-SES traits and a decline of high-SES attributes. Household changes overlap these shifts: central-affluent Toronto sees coupling increase while peripheral-marginal Toronto increases in separated / divorced and lone parents. Positive saturation of no recent moves means core-affluent Toronto grows less residentially stable, peripheral-marginal Toronto more so. Notable for my research is how life stages also colour in these spatialized SES and household shifts. As in 1996-2006, increasing 30-39 and SES upgrade in central Toronto portrays continuation of a demographic conveyor i.e., younger households of 'higher' class background replacing working class populations, in this case of older ages, ergo the 50-59 age group (in 2006-2016, trailing edge Boomers) who decline in share in these spaces while they align with peripheral, decreasing SES. This generation, when turning 40-49 between 1996-2006, also track with similar low-SES and household measures (Table 4.15). Finally, this dimension combines many elements of 1996-2006's first and second axes (Tables 4.15 and 4.16), converging that decade's two stands of SES change.

As spatial measures saturate 2006-2016's Urbanization / Peripheralization by SES dimension, corresponding component scores take on a core-periphery orientation (Fig. 4.15). Negative scores define most CTs in Old Toronto and adjacent tracts of the Inner Suburbs; portions of south Etobicoke and central North York also experience increasing SES and household formation. While the negative pole indicates a 'centralizing' trend, the strongest negative scores are just outside the core (in the West End and Riverdale / the Danforth) with CTs in the CBD having minimally negative, average, or even positive scores (in Queen's Park and North St. Jamestown), a countervailing trend of SES decrease in otherwise increasingly affluent, central Toronto. Strong negative scores in parts of the West End and Riverdale / the Danforth stand out in CTs that in 2006 present for low-SES (SES and Visible Minorities Dimension; Fig. 4.5b), demonstrating these area's inter-decade SES increase. Positive scores, showing an overlapping decline of SES and household fragmentation associated with trailing edge Boomers, are strongest in the CSD's northwest and northeast, where Etobicoke and North York converge and in Scarborough generally. Sensible given when these areas were built and their distance from the CBD, strong positive scores in these distal parts of Toronto represent their further crystallization of low status i.e., growing shares of low-income and smaller / fragmented, thus more vulnerable households. This underlies these spaces strong positive scores on the SES and Visible Minorities and Apartments by Age, Type, and Occupants dimensions (Figs. 4.5c and 4.8c), the latter saturating low-SES by 2016.

Figure 4.15

Urbanization / Peripheralization by SES Dimension

- Component Scores, Toronto CSD, 2006-2016



-3.40 - -1.75
-1.75 - -0.75
-0.75 - -0.25
-0.25 - 0.25
0.25 - 0.75
0.75 - 1.50
1.50 - 2.50
Data N/A

Increasing SES, 30-39, Recent Moves, Household Formation; Central, Pre-1960 Dwellings, 1-4 Story Apartments, High Home $

Decreasing SES, Recent Moves, Increasing 50-59, Household Fragmentation; Peripheral, 1961-1980 Dwellings, Low Home $

Table 4.22

Urbanization / Peripheralization by SES Dimension, Toronto CSD

Decade	**2006-2016**
Extraction Order	**First (1)**
Variance	**17.2**
Cumulative Variance	**17.2**

Domain	Indicator	Saturation	Comm.
Age	Change in % of 30-39 yrs old	-0.41	0.55
Family / Household	Change in % of Legally Married Persons	-0.80	0.78
Family / Household	Change in % of Common-Law Couples	-0.43	0.39
Labour Force	Change in Female Participation Rate	-0.45	0.54
Occupation	Change in % of Business, Admin, Management	-0.70	0.51
Immigration (Period)	Change in % of Immigrated 1991-2000	-0.42	0.56
Housing Type	2006 % 1-4 Storey Apts	-0.60	0.53
Housing Age	2006 % Homes Built Pre-1960s	-0.63	0.86
Housing Value	2006 Average Dwelling LQ	-0.45	0.61
Age	Change in % of 50-59 yrs old	0.55	0.55
Family / Household	Change in % of Separated / Divorced Persons	0.63	0.45
Family / Household	Change in % of Lone Parent Families	0.65	0.50
Education	Change in % of No High School Certificate	0.50	0.63
Occupation	Change in % of Sales / Service	0.55	0.35
Income	Change in % of Government Transfer Income	0.74	0.74
Income	Change in % of Persons in Low Income	0.63	0.42
Residential Mobility	Change in % of No Moves in Last 5 yrs	0.47	0.49
Housing Age	2006 % Homes Built 1961-1980	0.67	0.54
Urban	Distance from CBD	0.78	0.77

2006-2016's Household Size by Neighbourhood Life Cycle Dimension (Axis 2; 9.6% Dataset Variance)

The second axis extracted for 2006-2016, the Household Size by Neighbourhood Life Cycle dimension explains 9.6% of dataset variance. The negative pole saturates most increase of 2-person households between 2006-2016 (Table 4.23). The positive pole saturates most increase of the 0-14 group, 4+ person households, and blue-collar workers between 2006-2016. This familiar axis depicts household size change linked to life stage, wherein size increases in tracks with increasing shares of children (depicting early family formation). The negative pole quite simply showcases where the growth of 2-person households occurs, and (as inverse of the positive pole) commensurate decline of households with 4+ persons and/or 0-14-year-old children. The positive pole indicates that increasing shares of large, early families over the decade is mildly associated with Toronto's 1991-2000 immigrants and/or blue-collar workers. Unlike the same-named 1996-2006 axis (Table 4.13), 2006-2016's household shrinking is not linked to increase of the 70-79 group[174]. Instead, the presence of children differentiates household growth or shrinkage. This may mean 2-person households grow more common among all Toronto age groups as opposed solely to older adults. While this dimension changes from 1996-2006, the still quite similar process depicted by the 2006-2016 axis is extracted second (not fourth) explaining 9.6%'s of 2006-2016 relative to 6.8% in the 1996-2006 set.

Component scores for the 2006-2016 Household Size by Neighbourhood Life Cycle dimension are fragmented. Many CTs with shrinking households are adjacent to those where early families drive household size increase (Fig. 4.16). Clusters of strongly scoring CTs show areas passing through the neighbourhood life cycle, patterns semi-continuous with 1996-2006 (Fig. 4.13). Household shrinking (negative scores) is quite widespread in outer Scarborough, areas which in the 1996 and 2006 static analyses present for early families but increasingly less so by 2016 (Life Cycle / Stage Dimension; Fig. 4.7). Western parts of Toronto's Downtown and extending into York also undergo this process, with milder negative scores through the CBD and across the Don Valley into Riverdale. In both cases, similar patterning occurred with the 1996-2006 dimension, showing decreasing early family shares are a multi-decade trend. Positive scores in residential enclaves in the north of Old Toronto and extending into North and East York (encompassing areas such as Rosedale, Yonge-St. Clair, Mount Pleasant, and Lawrence Park; Fig. 4.16) identify increasingly large households, as occurred for many in the 1996-2006 period, showing a continued incursion of Toronto's early family households into these spaces, even if (by 2016) many still lean to agedness (Fig. 4.7c), implying demographic structure in these spaces is softening in overall magnitude of difference. While southern parts of Etobicoke and Scarborough saw strong household size growth 1996-2006, 2006-2016 scores in these areas tend to soften across numerous CTs, although where Old Toronto converges with Etobicoke and Scarborough at High Park and The Beaches (respectively) present strongly for increasing shares of large, early family households (Fig. 4.16).

[174] Neither does the presence of missing middle dwellings in the period's 2006 base year appear to matter as in the similar 1996-2006 dimension (Table 4.18), albeit said variable fails to achieve sufficient communality in the 2006-2016 PCA to warrant analysis.

Figure 4.16

Household Size by Neighbourhood Life Cycle Dimension

- Component Scores, Toronto CSD, 2006-2016

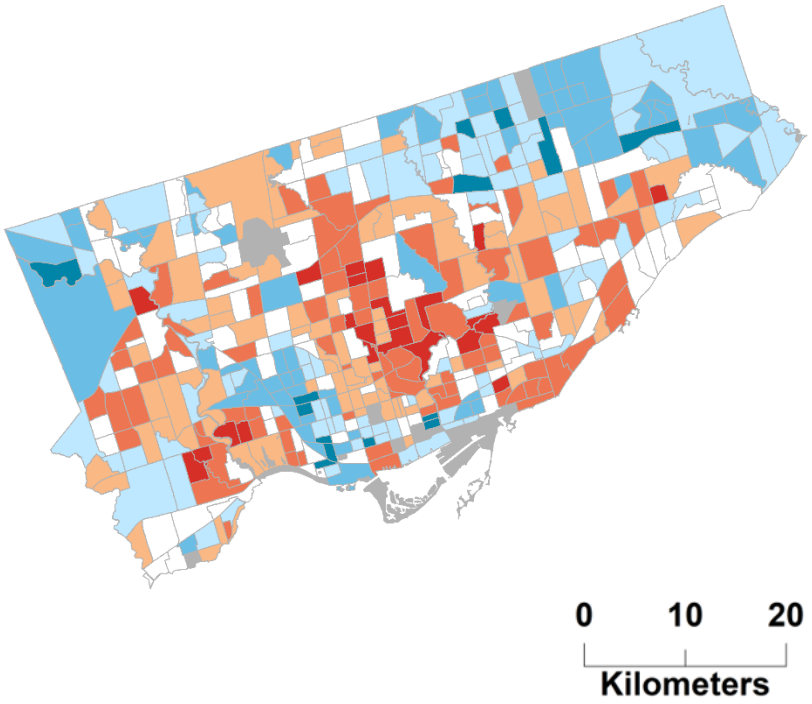


Table 4.23

Household Size by Neighbourhood Life Cycle Dimension
- Saturation and Communality Table, Toronto CSD, 2006-2016

Decade	**2006-2016**
Extraction Order	**Second (2)**
Variance	**9.6**
Cumulative Variance	**26.9**

Domain	Indicator	Saturation	Comm.
Family / Household	Change in % of 2-person HHds	-0.70	0.63
Age	Change in % of 0-14 yrs old	0.60	0.54
Family / Household	Change in % of 4+ person HHds	0.87	0.79
Occupation	Change in % of Trades, Transport, Manufacturing	0.45	0.52
Immigration (Period)	Change in % of Immigrated 1991-2000	0.44	0.56

2006-2016's SES of the Neighbourhood Life Cycle Dimension (Axis 3; 7.7% Dataset Variance)

The third axis extracted for 2006-2016, the SES of the Neighbourhood Life Cycle dimension explains 7.7% of dataset variance. The negative pole saturates most increase of the 30-39 group and female participation between 2006-2016 (Table 4.24). The positive pole saturates most increase of the 60-69 and 70-79 groups, no high school, pre-1980 immigrants, no official language knowledge, and other income. Generationally, leading-edge Boomers 'became' 60-69 between 2006-2016 (aging from 50-59). This axis differentiates local increase of early households (30-39) from increase of adults aged 60-69 and 70-79, while also highlighting related social shifts. Neighbourhood 'younging' aligns with increasing female participation, and declining residents without high school education or official language knowledge. Meanwhile, Toronto's 2006-2016 population aging aligns with increasing shares of pre-1980 immigrants, other incomes, and persons lacking high school and/or official language knowledge. Leading-edge Boomers, aging to 60-69, continue to track with the Silent Generation (70-79), quite like 1996-2006 in co-saturating as ages 50-59 with their then-60-69 predecessors on the Aging-in-place vs. Succession dimension (Table 4.19). In this sense, the two axes relate across decades by juxtaposing successive ranges of local aging (increase of 50-69 and then of 60-79) from CTs where these groups decline and the 30-39 group increases, making for a younger age structure.

Overlapping component scores for the 2006-2016 SES of the Neighbourhood Life Cycle dimension and the 1996-2006 Aging-in-place vs. Succession dimension further support noted continuity of the two axes, in how their respective arrays of negative and positive scores overlap considerably (Figs. 4.17 and 4.14). Said spatial continuity is likely the result of the noted leading-edge Boomers and slightly older Torontonians of the Silent Generation aging-in-place from 1996 through 2006 to 2016, explaining why the same areas increase in 50-59 and 60-69 and then 60-69 and 70-79. Areas most strikingly experiencing population aging i.e., positive scores are the are east North York and Scarborough[175] and residential enclaves of north Old Toronto and south-central North York, many of which also increases their shares of early families (Household Size by Neighbourhood Life Cycle dimension; Fig. 4.16). While seeming to describe countervailing changes in household composition, these overlapping scores are not contradictory so much as showcasing different trajectories of change that could be occurring simultaneously in many of these neighbourhoods i.e., the increasing age of some local households while some early families move in, creating a more varied household composition[176]. This also explains the 70-79 group does not track with household shrinking in 2006-2016 as in 1996-2006, as Toronto's central residential enclaves experience aging *and* household turnover. While negative scores i.e., growth in early households is of generally lesser magnitude, they orient to western Toronto, extending from Trinity-Bellwoods in Downtown right to the CSD's northern border and prevailing through most of York, west North York, and Etobicoke. Central Scarborough also presents for i.e., early household formation and elderly decline, although these CTs scores are milder with a much higher prevalence of average scores.

[175] A transition inferable via said area's 2016 Life Cycle / Stage dimension scores (Fig. 4.7c), but which are directly implicated here.
[176] These overlaps also need be considered in respect to the fact component scores are an aggregate measure i.e., a complex bundles of source variables and thus may represent CTs' stark shifts in some saturating variables and less so others in a given CT.

Figure 4.17

SES of the Neighbourhood Life Cycle Dimension

- Component Scores, Toronto CSD, 2006-2016

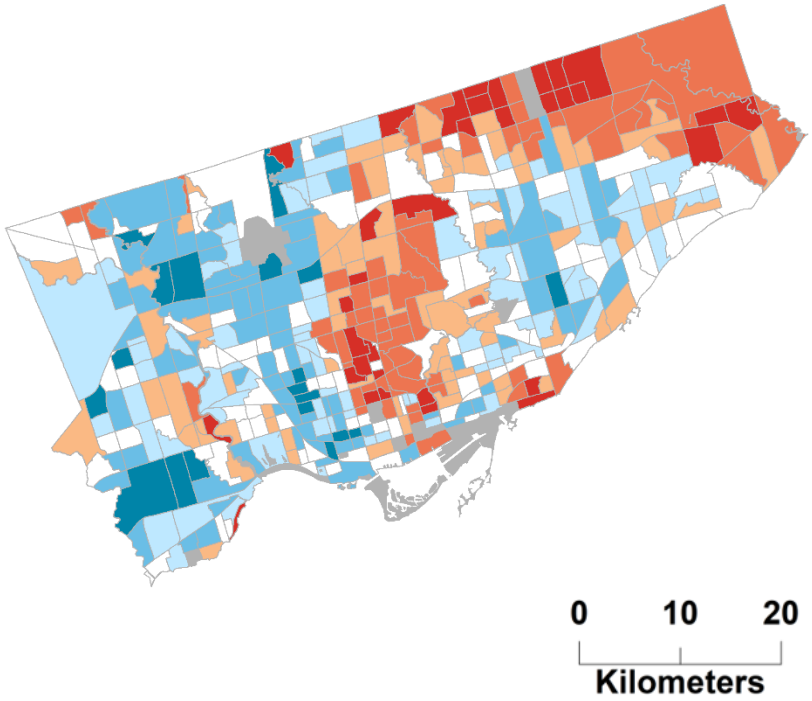


Table 4.24

SES of the Neighbourhood Life Cycle Dimension
- Saturation and Communality Table, Toronto CSD, 2006-2016

Decade	**2006-2016**
Extraction Order	**Third (3)**
Variance	**7.7**
Cumulative Variance	**34.5**

Domain	Indicator	Saturation	Comm.
Age	Change in % of 30-39 yrs old	-0.43	0.55
Labour Force	Change in Female Participation Rate	-0.53	0.54
Age	Change in % of 60-69 yrs old	0.55	0.33
Age	Change in % of 70-79 yrs old	0.76	0.62
Education	Change in % of No High School Certificate	0.46	0.63
Immigration (Period)	Change in % of Immigrated Pre-1980s	0.61	0.46
Language	Change in % of No Knowledge of Off. Language	0.43	0.51
Income	Change in % of Other Income Sources	0.58	0.48

2006-2016's Density of Apartments vs. Single Residential Dimension (Axis 4; 6.3% Dataset Variance)

The fourth axis extracted for 2006-2016, the Density of Apartments vs. Single Residential dimension explains 6.3% of dataset variance. The negative pole saturates high 2006 density and shares of 5+ story apartments (Table 4.25). The positive pole saturates high 2006 home values and shares of single-detached dwellings Juxtaposing Toronto's densest, apartment-rich areas from its neighbourhoods comprised of dispersed, single-detached homes (these among the CSD's higher-value districts), this dimension is quite like one emerging 1996-2006 (Table 4.17). Here, the dimension is 'purer' in terms saturating 'only' built form measures, whereas the 1996-2006 axis depicts some social change. Further comparison indicates the 2006-2016 axis is extracted fourth instead of third, declining in explained variance from 8.7 to 6.3%. Further, the dimension's relation to household condition declines considerably in that need of home repair no longer saturates the negative pole and the positive pole's saturation of average dwelling LQ declines from .60 to .40 by 2006-2016. Despite this, however, the fixity of Toronto's built environment in terms of where and how densely its large apartment blocks and its single-family residential neighbourhoods are built ensures component scores for the 2006-2016 Density of Apartments vs. Single Residential dimension are nearly identical to the 1996-2006 version of the axis throughout the CSD (Figs. 4.18 and 4.12).

Figure 4.18

Density of Apartments vs. Single Residential Dimension

- Component Scores, Toronto CSD, 2006-2016

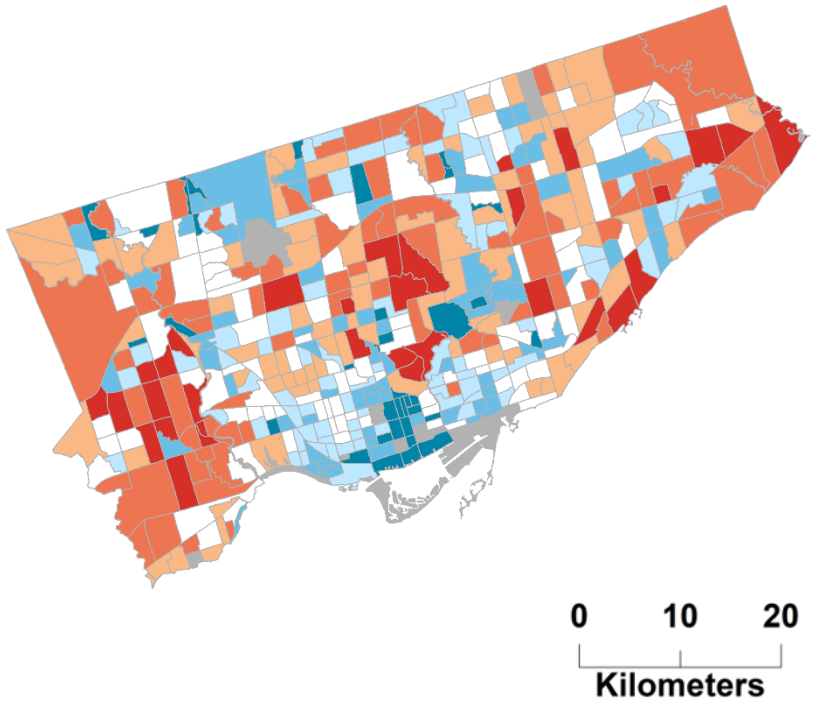


Table 4.25

Density of Apartments vs. Single Residential Dimension
- Saturation and Communality Table, Toronto CSD, 2006-2016

Decade	**2006-2016**
Extraction Order	**Fourth (4)**
Variance	**6.3**
Cumulative Variance	**40.8**

Domain	Indicator	Saturation	Comm.
Housing Type	2006 % 5+ Story Apts	-0.77	0.81
Urban	2006 Dwelling Density	-0.77	0.71
Housing Type	2006 % Single-Detached	0.85	0.81
Housing Value	2006 Average Dwelling LQ	0.40	0.61

2006-2016's New vs. Old(er) Neighbourhoods Dimension (Axis 5; 5.1% Dataset Variance)

The fifth axis extracted for 2006-2016, the New vs. Old(er) Neighbourhoods dimension explains 5.1% of dataset variance. The negative pole saturates most increase of East Asians and shares of annual income spent on housing between 2006-2016, as well as high 2006 shares of 1991-2000 homes and 2016 shares of 2001-2010 homes (Table 4.26). The positive pole saturates most increase of the 50-59 group between 2006-2016, as well as high 2006 shares of major repairs and pre-1960 homes. Generationally, trailing edge Boomers 'became' 50-59 between 2006-2016 (aging from 40-49). This dimension differentiates Toronto's 'newest' areas, built post-1991, from CTs where homes are physically degrading, these sensibly hosting more pre-1960 homes which now grow rather old. The newest tracts grow increasingly expensive between 2006-2016 and see growing East Asian shares. Meanwhile, Toronto's older, decaying districts see housing costs and East Asian shares decline, while increasing in the 50-59 group; as seen in the static analyses and with this decade's Urbanization / Peripheralization by SES dimension (Table 4.22), Toronto's trailing-edge Boomers continue to track away from affluent traits (in this case, newer homes) and toward marginal SES, insofar as neighbourhoods with degrading housing stock are considered lower status. Also, East Asian and the 50-59 group change inversely to each other here just as in 1996-2006 (Aging-in-place vs. Succession dimension; Table 4.19), indicating Toronto's East Asians either decade do not align with these age ranges or respective generations i.e., trailing-edge Boomers in 2006-2016 (possibly via departure from the CSD at said ages).

Component scores for the New vs. Old(er) Neighbourhoods dimension indicate high shares of 1991-2010 housing in the CBD and shoreline of Old Toronto, as per redevelopment of these area's housing stock in said decades (Fig. 4.19). Similar clustering occurs in central North York, outer Scarborough, and most of Etobicoke, although these scores are generally of lesser magnitude than in Downtown. Positive scores denoting degraded, often older housing stock (and a relative dearth of 1991-2010 development) are strongest on the outskirts of Downtown, in Old Toronto's West End (and into York) and just east of Yonge Street in Cabbagetown and extending through Riverdale and the Danforth, then into East York. Central parts of Scarborough and CTs where North York and Etobicoke converge also harbour high scores for degraded housing although these clusters are more mixed in with average and/or negative scores (showing more a more pocketed array of new and old housing stock). Interestingly, while the two major clusters of positive scores lying just adjacent to downtown would seem to indicate a generally lower status in respect to the condition of housing, these area's present considerably for increasing SES and household formalization during the same decade, as per scores for the 2006-2016 Urbanization / Peripheralization by SES dimension (Fig. 4.15).

Figure 4.19

New vs. Old(er) Neighbourhoods Dimension

- Component Scores, Toronto CSD, 2006-2016

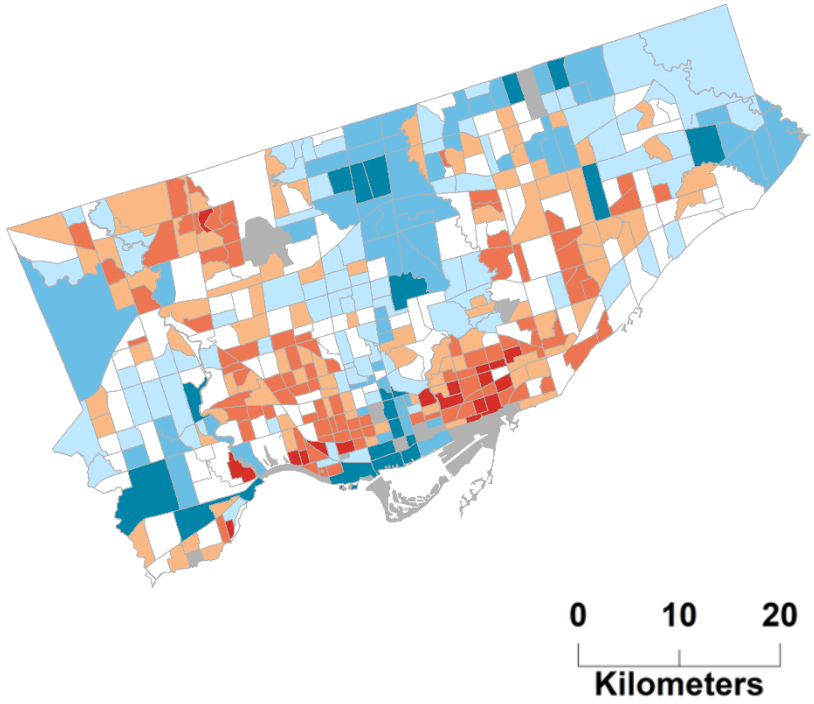


Table 4.26

New vs. Old(er) Neighbourhoods Dimension
- Saturation and Communality Table, Toronto CSD, 2006-2016

Decade	**2006-2016**
Extraction Order	**Fifth (5)**
Variance	**5.1**
Cumulative Variance	**46.0**

Domain	Indicator	Saturation	Comm.
Ethnicity	Change in % of Chinese, Korean, Japanese	-0.47	0.34
Tenure	Change in % of Annual Income on Housing	-0.55	0.32
Housing Age	2006 % Homes Built 1991-2000	-0.55	0.38
Housing Age	2016 % Homes Built 2001-2010	-0.66	0.46
Age	Change in % of 50-59 yrs old	0.43	0.55
Housing Condition	2006 % Homes Need Major Repair	0.60	0.57
Housing Age	2006 % Homes Built Pre-1960s	0.40	0.86

2006-2016 Components: Analysis Summary (5 Axes; 46% Dataset Variance)

As before, 2006-2016 change axes are relatively independent i.e., they hardly correlate (Table 4.21). As well, many variables failing to saturate the previous decade also fail to saturate here, reinforcing their pattern of relative stability over 20 years. Domain-wise, 2006-2016 change in high school and non-university certificates joins 1996-2006's trades certificates in non-saturation (Table 4.13), indicating CT shares of low to middling education remain stable. Considering these measures' 2016 relation to low-SES, it seems said residents further entrench in low-SES areas (SES and Visible Minorities dimension; Table 4.4c); more broadly, these educations decline in relevance as a factor differentiating Toronto's SES change while higher educational attainment (namely, a university degree) becomes far more relevant in discerning high- from low-SES by 2016. While an inferred reason for why the education domain lacks 2006-2016 communality, the result is other factors can emerge as major differentiators of change, such as occurs with the set's primary dimension of change in local SES and household composition.

Table 4.27

Axis Correlations for Toronto CSD 2006-2016 Dimensions

Dimension Label	Axis	1	2	3	4	5
Urbanization / Peripheralization by SES	**1**	1				
Household Size by Neighbourhood Life Cycle	**2**	-0.08	1			
SES of the Neighbourhood Life Cycle	**3**	0.12	0.04	1		
Density of Apartments vs. Single Residential	**4**	-0.02	0.10	-0.09	1	
New vs. Old(er) Neighbourhoods	**5**	0.09	-0.10	0.16	0.01	1

Toronto's SES change, quite spatialized in its upward and downward shifts, is the foremost dimension of 2006-2016 as in 1996-2006, justifying continued use of the Urbanization / Peripheralization by SES dimension (Table 4.22). However, key shifts in saturation warrant further analysis. First, the axis explains more variance in 2006-2016 (17.2% vs. 14%; Table 4.21), an increase corresponding to its merging of the 1996-2006 Urbanization / Peripheralization by SES and Generational SES and Household Change dimensions' saturations (Tables 4.15 and 4.16). By this, SES increase in central, high-status, pre-1960 districts in and adjacent to Old Toronto overlaps increase of 30-39 and household coupling (marriage, common-law) while SES decline in peripheral-marginal Toronto overlaps with trailing-edge Boomers (aging to 50-59) and household fragmentation (discussed subsequently). Further, these SES shifts mark a consolidation of nearly all the income, occupation, and education measures previously split across the two 1996-2006 axes onto a singular 2006-2016 Urbanization / Peripheralization by SES dimension.

While the main take away is that Toronto continues to polarize along SES lines, resulting in an affluent core and marginal periphery, most interesting for my research is how household composition and elements of life stage and generation play into these socio-spatial dynamics, even more so than 1996-2006. Their increasing relevance is further supported by the set's second and third axes being primarily defined by the same domains. The Household Size by Neighbourhood Life Cycle dimension (Table 4.23) explains 9.6% of dataset variance as second axis (compared to 6.8% as 1996-2006's fourth), making the formation or dissolution of larger families a primary way Toronto CTs change 2006-2016, a process continuing similar areas as for 1996-2006 e.g., north Old Toronto's residential enclaves increasing 0-14 shares both decades as they continue their demographic renewal (Figs. 4.16 and 4.13).

Key points in the neighbourhood life cycle also saturate the set's third dimension, SES of the Neighbourhood Life Cycle, which opposes CTs experiencing early household formation (30-39) from those where older adults (60-79) proportionally increasing, along with associated social traits e.g., retirement, pre-1980 immigration (Table 4.24). Akin to the static Life Cycle / Stage dimension (Table 4.7) in differentiating the early from late neighbourhood life cycle albeit here as a process i.e., neighbourhood aging, instead of a structural condition i.e., an aged neighbourhood, component scores for this direct measure of 2006-2016 neighbourhood aging provide an additional interpretive value when considered alongside the Life Cycle / Stage dimension's scores. In the 2006 static analysis, these show agedness (negative scores) in Old Toronto's Yonge-St. Clair / Yorkville areas and in south Etobicoke (Fig. 4.7b); the first area maintains and even intensifies its agedness by 2016, while south Etobicoke's scores revert to average (Fig. 4.7c). Component scores for the 2006-2016 SES of the Neighbourhood Life Cycle dimension render these aging and 'younging' processes' nature and magnitude far more explicit than any static comparison (Fig. 4.17). Old Toronto's aged residential enclaves indeed stand out as the CSD's most prominent NORC by increasing 2006's already high older adult shares while south Etobicoke once-aged CT's undergo demographic renewal via continued increase of the 30-39 group. Before I discuss 2006-2016 findings related to the Boomer generation, I want to point out that while age seems to decline in explanatory relevance in the static PCA over time (relative to, say, SES), variation in the socio-spatial changes occurring in Toronto (as per my change dimensions) makes it clear that processes of aging and life stage transition, those process that drive neighbourhoods though their life cycle, continue to play and indeed increase their overall role transforming Toronto's social ecology over the 1996-2006 study period.

Generationally, by 2016 leading-edge Boomers are age 60-69 and co-saturate with the aged 70-79 Silent Generation on the SES of the Neighbourhood Life Cycle dimension (Table 4.24), confirming a continuing alignment between these two 10-year birth cohorts. Trailing edge Boomers also continue along the previous decade's trajectory, yet this is of more analytical interest than the leading-edge's unsurprising role in population aging. In 2006-2016 Toronto, the trailing edge maintains alignment with SES decline and household fragmentation as in 1996-2006, a trend now definitively linked with urban form and location on (Urbanization / Peripheralization by SES dimension; Table 4.22). Having discussed their socioeconomics (Section 4.4.1), the pressing question is why, despite life course progression, Toronto's trailing edge Boomers cannot seem to transcend an economic marginality exposed by the change PCA. Factor in also that said relation is only hinted at in the static analyses (i.e., that they do not track with high-SES like their older peers) and indeed softened by the 50-59 group's saturation on the 2016 Urban vs. Suburban Lifestyle static dimension alongside social and spatial traits of stable suburbs comprised of family-oriented households (Table 4.6c). A potential underlying cause raised at the outset of my analysis is that of Boomer's absolute decline in the CSD between 1996-2016 (Table 4.1). Change trends for Toronto's remaining trailing-edge Boomers may result from their particular social characteristics concentrating as their counterparts leave the CSD; ergo, as married, white-collar, higher-income trailing edge Boomers move out of Toronto, the CSD's remaining Boomer population will see shares of lone-parent, separated / divorced, low income, and/or less educated residents increase.

While a credible rationale for the observed relation between trailing edge Boomers, SES decline, and household fragmentation, I avoid making grand generalizations, given this axis explains only 30% of variance in the 50-59 group's share changes and the entire 2006-2016 set only explains 55% (Tables 4.22 and 4.13)[177]. Thus, this trend is only a tendency among the group, with 70% of trailing edge Boomers' socio-spatial variance explained elsewhere. Indeed, some variance is found on the set's fifth, New vs. Old(er) Neighbourhoods dimension (Table 4.26), aligning the generation with Toronto's dilapidated, more often older housing and away from its most recently developed areas. While seemingly a further indication of low-SES, many CTs with strong positive scores for increasing 50-59 and degraded, older housing in Old Toronto (Fig. 4.19) are those also with strong negative scores on the Urbanization / Peripheralization by SES dimension (Fig. 4.15) that indicate declining 50-59 shares. These opposing trends are not confounding so much as they display the strength of PCA to illuminate multiple trajectories taken by trailing edge Boomers in Toronto's social ecology. At the same time, it exposes PCA's limited capacity to account for a majority portion of any one variable's variance is exposed. However, this is not the objective of PCA, the point of which is to identify broad, multivariate dimensions of socio-spatial covariance[178]. With my findings related to general change in Toronto's social ecology, and those pertaining to aging and the Boomer generations more specifically explored and contextualized, I conclude my analyses in order to proceed with a discussion of my results relative to recent research and contemporary trends of population aging outlined in my literature review.

[177] The 30% of trailing edge Boomer's dataset variance is a value arrived at by squaring the variable's .55 saturation (Section 3.8).
[178] The results of which, such as my change PCA, need to be considered in further respect to their experimentality, given my relatively novel use of change-based data in PCA as a form of factorial analyses.

5.0 – Discussion

5.1 – Introduction

The preceding analyses make it clear that – in the context of Toronto's overall aging and the specific aging trends of certain areas – elements of age, life stage, and generation overlap other key dimensions of neighborhood social ecology. The following relates these findings back to the research questions which guided my analyses, and in doing so relates my findings back to and builds upon several of the theoretical perspectives that guide my work, as well as recent urban research. This answers recent calls for more nuanced approaches to applying demography within urban studies (Hochstenbach & Boterman, 2018; Hochstenbach, 2018). Those research questions are:

1. *How is age structured across urban space and how do these patterns change over time?*
2. *How do age and aging factor into urban social ecology?*
3. *How do Boomers relate to these patterns, and what can this tell us about their future aging?*
4. *In mapping these patterns, how do they emerge across urban space and change over time?*

In assessing the findings of my location quotients and five separate, yet interrelated principal component analyses, the interrelatedness of these questions became rather clear e.g., that trailing edge Boomers' transition to late adulthood is associated with SES decline in peripheral Toronto provides information in reply to several of my research queries. To avoid repetition in relating my results to the existing literature and contemporary population aging trends, I speak to questions 1, 2, and 4 according to two main themes drawn from my results:

> Theme 1: The role of age in structuring Toronto's social ecology takes on a multivariate nature as the city both demographically and physically ages and grows more socially complex and polarized (Section 5.2).
>
> Theme 2: The roles aging and life stage transition, as change processes, play in Toronto's social ecology grow increasingly prominent, especially as other dimensions of change merge or diminish (Section 5.3).

With Toronto's socio-ecological structures and processes outlined with emphasis on age and aging, I then focus on question 3 by discussing Boomers' life course trajectory from 1996 to 2016 and what to expect of their ongoing aging (and question 4 by default of discussing their spatial patterning). I then discuss my contributions to the study of urban change and population aging before outlining my limitations. I conclude by reflecting on my work generally and suggest several directions for further research. Section 5.1.1 briefly contextualizes my discussed findings.

5.1.1 – Age and Aging in the Context of Toronto's Social Ecology

My age-based themes are well-served by a brief outline of Toronto's social ecology. First, socioeconomic status is the primary dimension underlying Toronto's structure and changes occurring therein from 1996 to 2016. As per expectations, the orientation of SES reflects neighbourhoods' spatial character and location (Teernstra & Van Gent, 2012; Weisel, 2012). With Hulchanski (2011) in Toronto specifically and Delmelle (2017) and Ehrenhalt (2012)

in cities generally, I find Toronto undergoes class 'inversion' as suburbs diversify along lines of SES and ethnic and immigrant status, while central neighbourhoods (abandoned by those of higher status in previous eras; Harris, 2015) continue to concentrate certain high-SES attributes and exclude low-SES traits and racialized residents. Quick and Revington (2022) and Silver and Silva (2021) also find that SES dimensions vitally structure Toronto's social ecology. The latter find axes of social 'creativity', urban vs. suburban lifestyle, and marginality that closely mirror my static PCA's two strongest dimensions (Tables 4.4 and 4.5). What I add to this increasingly resolute picture of a Toronto highly structured by SES are elements of age and aging that overlap this social ecology.

The two major themes of my results are nigh-impossible to relate to existing research on how age and aging factor into human ecology without referring to the neighbourhood life cycle that underlies my analytical framework and contemporary theories of urban demography (Hoover & Vernon, 1959; Owens, 2012). While the model indeed provides a useful basis for understanding how neighbourhoods in my analyses both demographically and physically age, the roles age and aging play in Toronto's social ecology are more complex than a singular neighbourhood life cycle model can encompass. Using my initial descriptive and LQ analyses for foundational context (Section 4.2), the entire population of the Toronto CSD ages as the number and proportion of residents aged 60+ increase from 1996 to 2016. However, and as per expectations set by the literature (Davies and James, 2011) neighbourhood-level aging patterns achieve considerable spatial variance when assessing Toronto CTs' 60+ LQs (Fig. 4.1). Many demographically shift older or younger (in many cases, these opposing CT-level shifts occur quite proximally) while several areas maintain their relative age structure; for instance, most of Downtown stays perpetually 'young' while aged CTs in northern parts of Old Toronto (e.g., the Yonge-St. Clair area) maintain and even further concentrate their elderly population, contrary to expectations that neighbourhoods reaching their late demographic life cycle eventually renew. Most Toronto neighbourhoods, however, follow patterns that resonate with a life cycle trajectory, even if underlying reasons for these cycles' variance are complex. The neighbourhood life cycle influences my analyses' concept of how aging and life stage mesh with urban social ecology, and elements of this cycle emerge as important drivers of neighbourhood structure and change in my findings. Thus, areas of convergence and divergence between my results and theoretical understandings set by the neighbourhood life cycle colour in my discussion.

5.2 – Theme 1: Age as an Element of Urban Structure

Given that Toronto ages and its neighbourhoods undergo a range of demographic shifts from 1996 to 2016, age unsurprisingly emerges as a dimension of urban structure for me as for others (Hochstenbach & van Went, 2015; Delmelle, 2015, 2016; Moos, 2016), including those using PCA (Murdie, Logan, and Maranaan, 2013). However, the role of age in structuring Toronto's social ecology takes on a multivariate nature as the city both demographically and physically ages and grows more socially complex and polarized. This accords with the work of Murdie, Logan, and Maranaan (2013), who also find that some age groups saturate complexly i.e., on more than one axis. My 'finding', i.e., extracted dimension, most clearly connected to the neighbourhood life cycle is the Life Cycle / Stage dimension, near-entirely defined by age and life stage, that distinguishes early family formation from late older

adulthood in all three static PCA (Table 4.6). Expectations set in Section 2 emerge e.g., overlap of resident agedness, smaller household size, and retirement income (CMHC, 2020). In 1996, however, this dimension calls into question the theoretical pairing of old age and low SES. By correlating with 1996's prominent SES dimension, it instead pairs the aged with high SES (Table 4.9 and 4.10). For 1996 at least, this mirrors studies finding older age cohorts tend to be better-off than younger adults (Rummo et al, 2016; Hochstenbach, 2018). That this life stage connection holds in 1996 and fails to in 2006 and 2016 is one of many cases where age impacts other aspects of Toronto's social ecology.

If this were my only static dimension saturating age and life stage, then its decline in explanatory relevance by 2016 would support arguments that age is becoming a less meaningful differentiator of urban space (Moos, 2016). This only holds if this 'early family vs. aged neighbourhoods' axis were the sole locus of saturation for age in my data. In 1996 Toronto, the 40-49 group, in middle adulthood, saturates strongly with high SES, putting leading-edge Boomers in an advantaged position in Toronto's social ecology. While this life stage relation fades as other generations reach ages 40-49, a second prominent juxtaposition of life stage also defines the 20-year study period: early households aged 30-39 congregating in / near Downtown while late-stage adults (50-59), early retirees (60-69) and increasingly early families (0-14) predominate peripheral suburbs (Urban vs. Suburban Lifestyle dimension; Table 4.5; Fig. 4.6). That Old Toronto remains a bastion of early household formation closely reflects other works finding this ongoing if not increasingly prevalent trend (Van Criekegen, 2010; Moos, 2016; Hochstenbach, 2018; Revington, 2018). These urban and suburban constructs also reflect contemporary, age-inflected neighborhood 'types' i.e., young, transitory, centralized *New Start* areas and early/mid family *Suburban* areas aging into an older *Stable* category, respectively (Delmelle, 2015; 2016). While not purely an age dimension, the axis shows urban age-centric segregation premised on built form and life stages' affinity for said locations[179] (Winkler, 2013; Seidentop et al, 2018).

Given age groups vary over time in mutually saturating my static axes, I do not take the declining relevance of my most 'neighbourhood life cycle-centric' dimension to mean that age is less significant a factor in structuring urban environments. I contend instead that its complex saturations indicate that age's role in ecological structure precludes the clear simplicity sought by the neighbourhood life cycle model. The complexity of pinning this role is further evidenced by some age groups' relatively low communality i.e., the covariance middle- and late-stage adults, and even early retirees share with other measures (Tables 4.2). In an ironic turn of phrase, the *commonality* of age, that it cuts across social groups, underlies why many age groups lack covariance with other variables: people of the same age will differ in income, job, education, housing, and/or ethnicity, while (as my results show) many of these other social traits show substantial and specific covariance with each other e.g., high-SES jobs earn high incomes.

Yet, the neighbourhood life cycle and human life stages provide a useful lens for assessing Toronto as an aging "landscape . . . in flux", where many neighbourhoods oscillate between residents' predominate life stages (Seguin et al, 2016 p.77), while others remain perpetually linked to certain ages e.g., as retiree enclave NORCs

[179] E.g., the need for rental housing for the 30-39 group vs. the need/want for family-sized, single-detached homes at later ages.

(Bookman, 2008) or as "forever young" staging grounds of early household formation (Moos, 2016 p. 2916). The spatial variability of Toronto's local demography is complex enough to obscure the identification of causality, or at least that of a singular causal mechanism. However, that several distinct age patterns both conform to and cut across different socio-spatial lines that define the CSD highlights vital insights and points of further inquiry into age's role in urban structure. It also challenges claims that "[a]ge is a separate dimension of socio-spatial differentiation" (Moos, 2016 p. 2915), when age and life stage appear quite intrinsic to the structure of Toronto's social ecology.

5.3 – Theme 2: Aging as a Process of Urban Change

In the social-ecological changes the Toronto CSD experiences for 1996-2006 and 2006-2016, aging and life stage transition, as processes, play an increasingly prominent role, especially as other dimensions of change merge or diminish. Referring to the works of Perle (1982), Le Bourdais & Beaudry (1988), and Murdie, Logan, and Maranaan (2014), as the few change PCA available, aging is also more prominent as a process in their change analysis than age is as a structural element in their static analysis, despite our varied study designs. I also find that shifts in CTs' age group proportions are of a greater magnitude than shifts in other social measures that might be structurally relevant i.e., in static PCA, but which remain stable at the CT level over time while residents age (Section 4.4); hence, aging takes a more prominent role differentiating changes to Toronto's social ecology than age does in differentiating the CSD's socio-ecological structure. The shifts in local age proportion that saturate my change dimensions are also valuable for explicitly connecting life stage transition to other social change, clarifying their nature and where and to what magnitude these overlapping demographic and social shifts occur.

While SES is the primary dimension explaining change in Toronto's social ecology (as also in the static PCA), aging's general prominence in my change dimensions derives from how life stage transitions overlap with shifting social traits, including SES. As residents age from one life stage to the next, their progression through the life course overlaps other important transitions, such as household formation / dissolution, career advancement, and asset accumulation, that all relate to social character and household composition. The clearest example is how my 1996-2006 Generational SES and Household Change dimension ties trailing-edge Boomers' passage from ages 30-39 to ages 40-49 to household fragmentation and declining SES (Table 4.16), this process closely aligned to a distinct spatial pattern (Fig. 4.11) of increasing social marginalization in the CSD's peripheral northeast and northwest i.e., Hulchanski's (2011) City 3. Meanwhile, affluent City 1 sees 30-39 increase as lower-SES, working-class attributes decrease, evoking a clear overlap between these early households' increasing prominence and continuing class transformation (Teernstra & van Gent, 2012; Bailey et al, 2017). Demonstrating longer-term continuity, age- and SES-based trends also emerge on the 2006-2016 Urbanization / Peripheralization by SES dimension (Table 4.22). This first among several overlaps of life stage transition and ecological change in my results justifies calls for further union between the study of demography and urban geography (Hochstenbach, 2018).

Another prominent example of aging and life stage translating into the CSD's social ecology is that, while Downtown Toronto remains a bastion of early households, many adjacent residential enclaves experience influx of

early family households over the study period while more distant suburbs grow both demographically and physically older. Many central, renewing areas are noted for high and increasing SES, while low and decreasing SES afflict the CSD's aging Inner Suburbs. While these spatial patterns resonate with contemporary studies (Seguin et al, 2016; August & Walks, 2018; Silver & Silva, 2021), the centralization of affluence and family formation still leaves open the question as to whether early families actively displace older age groups – in line with 'purist' models of gentrification (Slater, 2006, 2009; Shaw, 2008) – or if older, working class residents 'naturally' depart from these spaces, a process of demographic replacement that also sees SES upgrade via influx of white-collar families (Buzar, 2005; Bailey, 2012; Hochstenbach & van Went, 2015). The latter rationale is further supported by Toronto's general expansion of more-educated, white collar residents over time and commensurate decline of blue-collar workers via deindustrialization (Hochstenbach & van Went, 2015; Statistics Canada, 1998; 2008; 2017a). Regardless of where causality lay, aging as life stage transition grows increasingly prominent and complex in Toronto's social ecology in ways warranting further investigation. Having outlined my results' two overarching themes, I discuss Toronto Boomers' life course trajectory and what we can expect of their further aging in respect to current and anticipated demographic and urban trends.

5.4 – What Now? What Next? Baby Boomers and their Generational Implications

How do Boomers fit into this general complexity and what can we expect of their continued aging in the Toronto CSD? While its leading and trailing edge diverge in several respects, they both generally suburbanize as they age: by 2016, high LQs for their corresponding age groups exist throughout the Inner Suburbs compared to those generally orientating to Old Toronto in 1996 (Fig. 4.3). Further, when each edge gets to ages 50-59, they saturate a static suburban construct (Tables 5.5b and c). Suburban development, including Toronto's, follows the Second World War (Harris, 2015), the end of which begat the Baby Boom. Ironically then, 'traditional' suburban lifestyle and form has matured considerably during Boomers' lives (Moos et al, 2015). Born entirely in the era of modern auto-mobility, many Boomers grew up in residential suburbs. My results indicate that those living in Toronto favour these environs in their mid- to late adulthood[180]. While prior generations see decreasing car use in older adulthood, Boomers show sustained, high driving rates into older age (Siren & Hostein, 2013; Newbold & Scott, 2017). As they concentrate in far-flung Etobicoke, North York, and Scarborough, the ability to drive will be crucial for their successful aging-in-place and the lack thereof will present a rather unforgiving environment for getting around. As Toronto's Inner Suburbs age quite rapidly, as elsewhere (Patterson et al, 2014; Seguin et al, 2016; Atkins, 2017), efforts to support uptake of alternative modes of travel will collide with entrenched patterns of car use among aging Boomers who tend to reside in driving-favourable environments, precisely where and when such interventions are needed most.

Another key element of Boomers' 'suburban-ity' in Toronto is that this dimension saturates high shares of 5+ year tenures (Table 4.5c and b). The aging of both edges to 50-59 in 1996-2006 and 2006-2016, respectively, also saturates with these tenures' increase (Table 4.19 and 4.22), confirming late adulthood's expected aging-in-place

[180] Assuming Boomers leaving the CSD settle further into the Greater Toronto Area, a swath of development around the CSD even more dispersed, single-use, and auto-centric in its built form, then this suburbanizing trend has further purchase.

(Fig. 2.1). I argue that structural impositions like escalating prices and illiquidity of housing will further cement Boomers' residential (im)mobility[181]. Being 'sandwiched' between semi-dependent parents and children (Green, 2006; Horowitz, 2022) also means downsizing should decrease as Boomers sustain need for larger, typically single-detached homes. Further, watching and increasingly supporting their parents' aging has left many Boomers (and members of the Silent Generation) wary of long-term care, especially given systemic gaps revealed by the COVID-19 pandemic[182]. Given these factors and Canadian property markets' general inability to meet residential housing needs, the flow of housing between households that underlies urban social ecology will grow increasingly stagnant, as the neighbourhood life cycle transitions by which older households depart their family homes and free them up for younger slows, the presence of growing families increasingly diminish. Here, Boomers as 'agents' and structural impositions collide, impacting Toronto's demographic structure and broader social ecology (Coulter et al, 2016).

As for urban demographic impacts, I foresee neighborhoods with large shares of older adults not only increasing in prevalence, but also in spatial tenacity, sustained via extended aging in place by residents who in prior eras would downsize sooner. Litwak and Longino's (1987) three stage model of older age moves[183] may be devolving such that retirement and mild disability no longer provoke moving as they once did. This calls for a revamping of urban functionality for residents who want to age in their homes, or in suitable housing close by, with different needs than younger groups for whom now physically aging neighbourhoods were designed (Hodge, 2008; Colangeli, 2010). This applies to Toronto's Inner Suburbs, which while generally more diverse than American comparators feature considerable expanses of dispersed, vehicle-oriented, singular uses of land e.g., single-detached residential districts.

While converging in their suburbanization, the leading and the trailing edge of Toronto's Boomer population tend to diverge, more precisely the younger cohort abandons life course trends followed by their older peers. While we do not get to see leading-edge Boomers as early households (the 30-39 group) in 1996 (as with the trailing edge) whatever their earlier, shared life course experiences, by ages 40-49 in 1996, the group firmly tracks with economic success[184], as per both the demographic and popular literature (Green, 2006, Atkins, 2017). In their transition through ages 50-59 (2006), they follow trends set by the preceding birth cohort (Silent Generation), and in early retirement (ages 60-69) in 2016, they saturate with other older age groups. By demonstrating general adherence to established aging norms here, as well as their saturation with the preceding age cohort on 'neighbourhood aging' change axes (Tables 4.19 and 4.24), Toronto's leading-edge Boomers contradict claims that the generation will redefine aging norms. Their prosperous trajectory through adulthood and into older age also bodes well for their predictable, secure retirement. However, trailing edge Boomers' divergences from the leading edge, and thus from

[181] Despite changing needs for space and support, many aging adults cannot reasonably transition into appropriate housing given the relative lack of affordable local alternatives; "96% of Canadians [age] 55+ plan to stay in their homes as long as possible", in part due to increasing structural limits i.e., in-ability to downsize in constrained property markets (Sharratt, 2021).
[182] According to a recent survey conducted about a year into the pandemic, "half of [all] Canadians (47%) now say they will do everything in their power to avoid entering LTC themselves, and to keep close family members out" (Angus Reid, 2021).
[183] In order, older adult moves are posited to occur at retirement, then upon onset of moderate and then major disability
[184] I.e., they saturate strongly with that year's high-SES construct, a life stage trend not met by subsequent cohorts (Table 4.4)

these established aging norms, indicate that the roles age and aging play in urban social ecology will evolve. Given trailing edge Boomers saturate with declining SES and household fragmentation (Tables 4.16 and 4.22), it seems members of this generational cohort that continue to reside in the Toronto CSD are more likely to experience financial and social insecurity in general, and certainly in comparison to their leading-edge peers, as they age

As per Section 4.3, in 1996 Toronto's trailing-edge Boomers, as early households (30-39), heavily align with urban lifestyles in and near Downtown (Table 4.5a). In subsequent stages of middle and late adulthood (40-49, 50-59), they do not track with the same economic success as their leading-edge peers (Table 4.4a and b). This divergence from generational expectations (Mochis & Mathur, 2007) is substantiated to a much greater degree by the trailing edge tracking with lower-SES and household dissolution as they age to 40-49 (1996-2006; Table 4.15) and even more in aging to 50-59; 2006-2016 sees even further association to a wider range of low-SES markers and a distinct spatial orientation to Toronto's peripheral-marginal northwestern and northeastern Inner Suburbs (Table 4.22; Fig. 4.15). These traits concentrate among trailing edge Boomers who remain in Toronto by 2016, a group quite representative of that "large segment [of the generation] that may be financially unable to cope with full retirement" (Green, 2006 p. *xiv*). In respect to noted trends of increasingly delayed retirement or work force re-entry, even on a part-time or contract basis (Fields, Uppal, & LaRochelle-Cote, 2017; Lundy, 2021), these results imply an unfortunate likelihood that Toronto's trailing edge Boomers are and will be delaying retirement more so out of need than want to work.

A final point to explore, one which may underlie the observed life course patterns of Toronto's trailing edge Boomers, is that these later adulthood and mature family stages of the demographic and neighbourhood life cycles are occurring in the CSD's farther-flung suburbs, areas which are – from a structural perspective – observed to harbour relatively high concentrations of both visible minority / immigrant residents and lower SES traits (Tables 4.4 and 4.7; Figs. 4.5 and 4.8. In other words, these racialized and more-often economically marginalized populations are experiencing life course transitions through later adulthood and early older adulthood, and these are showing up as the change axes patterns observed of trailing-edge Boomers (Tables 4.16 and 4.22; Figs. 4.11 and 4.15). That Boomers will depart from established aging norms, specifically by being better off in many ways than preceding generations, is premised on their upbringing in the prosperous post-war area (Inglehart, 2008; Bonvalet, Clement, & Ogg, 2015). However, assumptions based on shared cultural values formed in similar structural conditions are difficult to extend to immigrants whose values are formed beyond advanced industrial, welfare state democracies i.e., regions where Canada's recent immigration arrives from (Murdie, 2008). Further, post-1980 immigrants face higher barriers to social mobility, leading to more erratic, marginal work histories (Kei et al, 2019). Many in later age may now only be securing enough hours to qualify for government retirement benefits i.e., CPP. Along with structural barriers like housing affordability, Canada's older immigrants tend to SES marginality more than elderly non-immigrants[185]. Boomer-aged immigrants now entering old age may not reasonably be able to retire, an overlap

[185] "[P]roportions of [low-income] senior immigrants" are 24 and 26% of those landing 1-10 and 11-20 years before 2016, respectively, "compared to 11% of senior immigrants . . . in Canada 40+ years and 14% of non-immigrant seniors" (ibid).

of aging and lower-SES that a) reflects the change axis saturations of Toronto's trailing edge Boomers (Tables 4.16 and 4.22) and b) spatially occurs in parts of Toronto recognized for concentration of racialized and/or marginalized populations (Figs. 4.5, 4.11, and 4.15). Major Canadian cities, such as Toronto, where immigrants tend to spatially concentrate (Qadeer et al, 2010) already experience deviance from 'typical', North American- and Eurocentric life courses and neighborhood life cycles. That Toronto's trailing edge Boomers may well be comprised of immigrant, more often working poor residents that will continue to work and age in place past typical retirement (Stapleton & Key, 2015) reshapes existing archetypes of neighborhood aging. Distinctions in generational sub-groups e.g., by SES or immigrant status such as Toronto's sizable foreign-born population (Harris, 2015) provide a rationale for divergence from generational expectations and illustrate key overlaps of age and social ecology that should be explored further in terms of their underlying mechanisms and their implications for neighbourhood aging patterns.

5.5 – Contributions and Limitations

The following explores my contributions to the study of urban demography and social ecology, then transitions into an assessment of my work's limitations. The foregrounding of age in my analysis to highlight age as life stage and Boomers' passage through exposes more granular demographic and generational contours of Toronto's social ecology. It also highlights concepts of urban 'generation-ing' that go beyond dichotomies of young vs. old (Moos, 2016). More generally, my study realizes informative dimensions underlying Toronto's urban structure and changes occurring between 1996 and 2016 by employing a broad battery of socio-spatial measures, enabling insights likely "overlooked [by] viewing neighborhoods according to a singular [conceptual construct]" such as SES (Delmelle, 2015 p. 10). My datasets allow several dimensions of urban structure and change to emerge, including some unexpected in nature, scope, or magnitude (Viaud, 2021). They also allow a multifaceted, temporal perspective of the way(s) in which age and aging weave into other elements of urban social ecology. My specific 10-year age groups (Section 3.1) let me track the social and spatial patterning of Boomers' passage through several adult life stages into older adulthood. This is a relatively novel refinement of staged life course models in the study of urban geography relative to many studies' much more sparing, aggregative treatment of age groups; the primary example is those studies that use only a 65+ group for older adulthood (Seguin et al, 2016; Rummo et al, 2016).

My contributions to factorial analyses such as PCA are founded upon the shoulders of those employing the approach for decades before me (Gorsuch, 1983; Davies, 1984; Viaud, 1995) and in years more recent (Wyly, 2012; Moos, 2016; Murdie, Logan, & Maranaan, 2013). Specific to methodological ground my work breaks, I add two sets of components extracted from change-based data to the limited pool of studies using this approach (Perle, 1982; Le Bourdais and Beaudry, 1988; Murdie, Logan, & Maranaan, 2014). Combined, these inspire my own incorporation of population aging and other socio-ecological domains into a dynamic and direct assessment of how local demographic shifts interrelate with other urban change processes. Specifically, Perle (1982) and Le Bourdais & Beaudry (1988) employ housing variables to model the recognized role of built form in social ecology. However, while acknowledging the underlying issue, they use these variables as change, not static measures, which poorly fit their models. As 10-

year change in housing traits is minimal relative to concurrent social change, the latter dominate their results. For conceptual clarity, my housing measures are static i.e., structures around which social changes, such as aging, occur.

Murdie, Logan, and Maranaan's (2014) recent, prominent change PCA builds on this relatively unexplored area with a 25-year study period, a length of time relatively unmet in urban studies generally. They also use many socio-ecological variables that go un(der)recognized in seminal works; several, such as their housing affordability measure (Appendix 1; 'Tenure'), are exceptionally novel in PCA and are adapted in my own work. We also converge on oblique rotations to support dimensional correlation that go undetected with orthogonal rotation[186] (Section 3.8). While their study greatly informs my approach, their work also reveals some gaps I overcome in my own. These relate to data development, such as their self-limitation to 24 variables, which translates into more reductionist categories i.e., 0-14, 25-34, 50-64, and 65+ age groups that gloss over much of mid-adulthood. Conversely, they use change in immigrants, change in recent (5-year) immigrants, and change in 5-year moves measures that 'double up' these variables' underlying reference groups, distorting their weight in the data. Finally, they barely incorporate physical measures e.g., housing type[187], unlike mine, seminal, and other PCA (Perle, 1982; Moos, 2014).

All this, however, is not meant to chastise these authors, who inspire my work with their employ of change PCA in a novel, informative manner amidst a dearth of these in factorial ecology (Murdie, Logan, & Maranaan, 2014). PCA's beauty lay in that it allows researchers to shape analysis via reflexive judgment and topic knowledge, in an "embrace [of] pluralist methodological and interpretive innovation" that can support a specific research focus (Wyly, 2012 p. 26). On this point, Murdie, Logan, & Maranaan (2014) use PCA to reduce data into meta-variables for a subsequent analysis and run one PCA of 25-year change, factors which may well shape their methodology for reason untold. Using their study here as counterpoint to my own explicates PCA's value to social ecology as a flexible tool that welcomes methodological innovation. Without these authors, I would not only lack a basis by which to refine my socio-spatial concepts and therefore improve the accuracy of my own change-based PCA of Toronto's social ecology (Wyly, 2012), I would have lacked inspiration for said analysis and the need to make such refinements.

As for my work's limitations, these are that some of my variable domains lack my desired specificity given data unavailability, my results lose generalizability given my sole focus on the Toronto CSD, and lastly, PCA generally cannot reveal the causality underlying structural and change dimensions. My PCA also encountered obstacles related to variable generation and usage; I detail these and provide potential adaptations i.e., lessons for future factorial analyses in Appendix 2. Regarding the lack of variable specificity, this is an unfortunate result of discontinuities in public census data that lead conceptual coverage of certain domains in my datasets to be more restrained than I prefer (Section 3.7). Reliance on census data is a self-limitation, as through its use I can only achieve a bird's eye,

[186] However, little discussion is offered as to the point of their application, nor important specifics such as type of oblique rotation used of the k value to which their axes are allowed to correlate, both important considerations (Viaud, 1995).
[187] They ultimately use housing type change measures in their post-PCA analyses. To their credit, these are likely more relevant over their assessed 25-year period, as opposed to Perle (1982), Le Bourdais & Beaudry (1988), or my own study's 10-year periods.

objectivist view of very complex social and spatial phenomena, distorted in their translation into aggregated government census boundaries like CTs. Of course, this applies to the socio-ecological tradition generally (Murdie & Logan, 2014). Over and above my work's general ontological and epistemological limits, however, one limit imposed specifically by how Statistics Canada collects and provides data is a near-entire reliance on individual as opposed to household measures, despite households' vital role in socio-demographic phenomena (Viaud, 1995). Another is their reductionist, inconsistent aggregation of housing, immigration, and income measures over time, which narrow the potential range of useful categories I can employ in my PCA[188]. In short, the practice of social ecology benefits immensely without the presence of these sorts of data discrepancies in the publicly provided (and funded) government databases that factorial analyses, such as my PCA, rely upon for dataset development.

My sole focus on the Toronto CSD undeniably reduces the generalizability of my findings on how age and aging generally, and older adults and Boomers specifically, factor into human ecology. Although my reason for using the Toronto CSD over CMA still holds (Section 3.3), I do miss increasingly important urban structures and changes beyond the City of Toronto, areas housing those employed in the CSD and that are growing urban centers in and of themselves. I originally worked on a parallel analysis of Vancouver[189], but the smaller sample size of available CTs presented technical limitations; for these and practical reasons relating to the scope of my study, analysis of Vancouver was dropped. Thus, despite taking a deep dive into the Toronto CSD's 468 'neighborhoods' from multiple perspectives over 20 years, the ability to contrast observed phenomena against other major Canadian cities could prove to be useful e.g., how do Boomers and older adults in Toronto's exurbs or Vancouver's Downtown converge with and/or diverge these groups in the Toronto CSD, as per saturation on dimensions extracted from said datasets.

Last of my general limitations, despite PCA's capacity to reveal crucial insights into urban structures and change, making it an excellent candidate for exploratory analyses, factorial ecology cannot determine causality for the dimensions it reveals. However, it does not have to. Identifying the nature and magnitude of these dimensions, and how these axes translate spatially (via component scores) can inspire further research of the significant overlaps that dimensions reveal, such how different age, ethnic, and immigrant groups relate to local SES hierarchies, or more pressingly, given current/oncoming trends of suburban and immigrant aging, the suburban aging of these populations and how to support these often socially and spatially peripheral groups. I now conclude my discussion with a few points about my work's place in urban social ecology and some directions for future research

5.6 – Concluding Thoughts

In assessing the nature and extent of population aging occurring in Toronto over a 20-year period, through both an age-only perspective and a socio-ecological lens via several interrelated PCA, I achieve my overall research

[188] A prominent one is they eventually aggregate their pre-1945 and 1946-1960 housing counts in 2016, effectively eliminating my ability to distinguish these key socio-economic periods in Toronto's development history (Harris, 2015).
[189] The Vancouver CSD, as well the Burnaby, Richmond, and New Westminster CSDs immediately adjacent to it, as a means of capturing an urban area of sufficient size, likewise a sample of CTs as my neighbourhood unit of study.

objective of better understanding how this globalized demographic shift translates to the local, or neighbourhood level. The integral, yet complex position of different age groups on both my static and changed based components affirms contentions of my contemporaries that age (as an element of structure) and aging (as a process of transition) belong squarely within, and not apart from the realm of socio-spatial elements relevant to studying neighbourhoods (Hochstenbach, 2018). The stage-based, human life course perspective borrowed from residential mobility studies is also incredibly useful for discerning the roles that age and aging play in urban social ecology, especially as they pertain to how generations inhabit or traverse life's successive stages. Foregrounding age, life stage, and generation within my empirical framework instead of treating these elements as supplementary factors (as many other studies do) also proves invaluable. While not the first to research urban 'generational-ity' (Moos, 2016; Walks et al, 2021), by moulding my work around Baby Boomers and being innovative in doing so i.e., adapting my age groups to best reflect generational birth cohorts, I gain a direct and deeper sense of how their life course progression intersects other key dimensions of urban space. Primarily, I discern, at least in the Toronto context, that this paradigm-shifting generation's purported divergence from established aging norms (Green, 2006) begins with the younger, trailing edge, a trajectory that will be important to confirm and track as they enter their sixties (and beyond) in coming years.

As for making these assessments, mine is among several recent works that re-invigorate the use of factorial analyses specifically and social ecology generally as ideal for unravelling the fundamental complexity of urban space. In addition to the findings garnered by making age, life stage, and generation primary in my work, I also demonstrate the inherent flexibility of factorial analyses such as PCA to be adapted to such purposes, and thus by extension to numerous other empirical pursuits. With obvious need to respect core methodological principles, these techniques can provide a measured and minimally-biased overview of dimensions of structure and/or change which underlie cities' social ecology; further, when these dimensions are mapped, their specific spatial patterns can be followed upon with more in-depth research to gain an even better sense of why certain neighbourhoods score on certain dimensions i.e., to understand how these dimensions translate into the real world, so to speak. As a form of exploratory analysis, techniques like PCA are not just a tool for data reduction or generating meta-variables for other analyses but are a precursor for qualitative approaches in urban geography that can further unravel observed trends when they are unexpected, such as trailing-edge Boomers' alignment with low-SES, or of concern, such as clear overlap of marginality and racialization in Toronto's peripheral suburbs. These two examples are among several directions for future research I more broadly pitch as the need to further examine the distinctly local aging trajectories of Canadian cities and their overlap with class, ethnicity, built form and other key urban elements (Hochstenbach & Boterman, 2018; Walks et al, 2021). Of the several contributions my work makes to the growing body of research into how age and aging relate to urban social ecology, the one I deem most valuable is for it to inspire the continued uptake of factorial analyses to identify these and other vital dimensions of urban complexity.

As the cities and neighbourhoods where we live continue to age, this process occurs alongside numerous others that continually reshape urban space. While proselytized by demographers and government statisticians for

decades now, population aging and its impacts now confront us quite acutely. Research such as mine is only part of the vanguard of work needed into better understanding where, how, and why a) population aging is occurring in cities and b) how these processes both influence and respond to the other powerful social and spatial forces structuring the urban environments we inhabit. In particular, and as demonstrated here, as each subsequent generation passes through adulthood and into older age, it is vital we not plan our cities for the needs of older adults based on norms set by preceding generations, especially as the diversity of (currently) younger Canadians expands considerably, not only through forces such as immigration, but through the structural and cultural influences that shape each generation's progress through life, the values, resources, and expectations they will enter older adulthood with, and thus the role *their* aging will play in the social ecology of cities they inhabit.

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Appendix 1 – Socio-Ecological Variable Domains for Factorial Analysis

The following outlines my rationale in developing my variables and assessing heir suitability for inclusion the datasets employed in my static (1996, 2006, and 2016) and change (1996-2006 and 2006-2016) factorial analyses in detail.

Age: These variables, denoting 10-year ages ranges in most, assess Toronto's demographic structure and let me track the shares and location of Torontonians passing through different life stages and Boomers as a generation over time. While 15-19 is left out to avoid a closed set, the youngest adults (20-29) can not be normalized. However, the 30-39 group I employ covers the upper half of typical young adults (25-34; Moos, 2014).

Family / Household: These represent household size and structure: 1-person households are left out to avoid closed sets (and over-correlate with those of 4+ persons). 3-person households are left out because of conceptual ambiguity (especially change)[190] and for duplicating families. Several types of household structure, such as legal marriage, separated / divorced, and lone parents are used to capture a diverse range of household types. Widows as a variable create a closed set and over-correlate with the 80+ group and are as such excluded. Multi-family households depict the presence of co-habituating extended families, observed to be more prevalent amongst immigrant groups.

Education: These, minus the university educated (closed set and over-correlation), measure social mobility, especially as to whether / to what degree Boomers differ in education from preceding and subsequent generations.

Labour Force & Occupation: Participation rate measures Toronto's labour force against its population of residents age 15+[191]. I use female rates over male rates to sift out the degree to which women's working status in neighbourhoods, whether coupled or as sole household maintainer, reflects the influence of other socio-spatial factors, and to avoid multicollinearity between both rates in some datasets. Occupation groups model the relative status, resources, and locational and lifestyle norms of different classes of workers. The variables % Business, Admin, Management and % Arts, Science, Public Sector build on gentrification's white-collar, professional worker[192] (Walks & Maraanan, 2008). Conversely, the % Sales / Service and % Trades, Transport, Manufacturing variables depict 'blue-collar' work and/or marginal manual/service work at the labour spectrum's lower bounds (Stapleton & Key, 2015).

Immigration & Language: Instead of an 'all immigrants' variable, I use several consistent periods of immigration, the most recent 'new' group added to 2006, 2016, and 2006-2016[193]. Differentiating immigrants by period of arrival[194]

[190] For instance, it could pertain to 2 parents and a child or 1 parent and two children, or even households without children.
[191] Wanting to use % of Full-Time and Part-Time workers as finer labour force indicators, the 2006 Census counts these out of all age 15+ *with employment income*, while 1996/2016 use all age 15+. Participation rate is less detailed, but temporally consistent.
[192] The former is 'traditional' office, financial, and administrative work while the latter is more diverse. While both higher status groups, splitting them allows potential divergence in educational, socio-cultural, and perhaps ideological leanings to emerge.
[193] Successive study years and periods feature one more variable than do preceding sets to assess the next most recent wave of immigration; I exclude those arriving in the last 5 years to avoid closed sets and incongruity between change PCA's start/end year.
[194] This, as in several other variables, is limited by how the 2016 census solely employs a pre-1980 immigration period, eschewing the granularity available in the 1996/2006 census's use of a pre-1960, 1961-1970, and 1971-1980 periods.

helps discern successive waves of immigrants and how they may adapt over time. Official language knowledge models integration in Toronto's English- (and/or French)-speaking majority, which may change for certain groups[195].

Ethnicity: As with immigration, instead of a sole 'visible minorities' measure, several distinct groups identify broader cultural communities consisting of members born in and outside Canada (Qadeer et al, 2010). Preliminary analysis of the single measure reveals over-correlation with immigration, language, and some income variables (not the case for granular groups). Change in shares of Arabic, West Asian, and Latin American are excluded due to severe non-correlation. While relevant groups, relatively smaller, stable concentrations provide fewer/smaller changes for PCA.

Income: these model income sources and ranges. Government Transfers consists of social assistance, child benefits, and (importantly) old age benefits, while Other Incomes are investment and rental proceeds (for all ages), as well as certain age-based, self-funded or career-based benefits e.g., RRSPs/RRIFs and company pensions. Employment income creates a closed set and is captured by participation rate and occupations / educations. Income groups reflect people aged 15+ earning 40% and those earning 70-100% of the CMA's average income i.e., those who are the lowest income earners and those earning near to average the CMA income [196]. This discerns SES structure and shifts better than using CTs' average income, as it also regionalizes CTs' status. The % of Persons in High Income (> 150% the regional average) is excluded for over-correlating with other income, occupation, and education variables[197].

Commuting & Residential Mobility: Commuting reflects urban forms and associated lifestyle e.g., inhabiting transit-rich vs transit-deficient areas. Mobility reflects inhabitant turnover as well as certain groups' tendency to themselves move (Section 2). While shares of non-movers oppose those of local moves, the latter detects who moves within/between CTs; interprovincial, intra-provincial, and international are left out to avoid a closed set. Change PCAs exclude one form each of commuting and of mobility[198]. Each pair's conceptual inversion is mirrored as collinearity in the change PCAs compared to the static (confirmed during my experimentation on early axes sets).

[195] While 'only' 4.9% of the Toronto CSD's 2016 population claimed to speak neither official language, some CTs' share ranges to upwards of 31%, demonstrating considerable spatial variance and thus this measure's suitability as a cultural indicator.
[196] I use age 15+ income groups instead of CTs' average income for those age 15+ or for households. Household is avoided given confounding relation to household size. Groups detect whether tracts host middle-income earners or a more polarized array of low- and high-incomes e.g., early gentrification. However, Statistics Canada not only changes groups, but once 1996/2006 are inflation adjusted to 2016 $s, categories wildly diverge. To allow comparison, each year's $ groups are divided by the Toronto CMA's age 15+ average income. This results in categories of (roughly) the bottom 40% of income earners; those earning 70-100% of the CMA average income; and those earning 150% or more. Use of CMA over CSD here mirrors Walks and Maranaan (2008), who in assessing the Montreal, Toronto, and Vancouver CSDs' gentrification, use CMA totals for income and housing, recognizing the wider CMA's influence upon said CSDs insofar as the latter being part of these larger regional economies and polities.
[197] Their presence is inferred via inverse relation to shares of government transfers and persons in the bottom 40% of incomes.
[198] Respectively, auto-commuting / transit and no moves / local moves in the last 5 years.

Tenure: % Renting shows how/where different groups relate to renting vs. homeownership. The % of Annual Income on Housing is a composite measure of housing affordability[199]. Average Dwelling Value LQ, one of few non-percentage variables, position neighbourhoods' status (as per home prices) within the Toronto CMA[200]

Housing Type, Condition, & Age: Statistics Canada gathers data about homes to proxy urban form. Several dwelling types cover the spectrum from single-detached suburbs to dense urban high-rises i.e., 5+ story apartments. The variable % Missing Middle (semi-detached and row houses[201]) and smaller, 1-4 story apartments capture inner bands of the spectrum. As per life cycle theory, homes and people age together, so I use as many consistent construction periods each year and decade as able[202]. Similarly, % Homes Need Major Repair proxies decline of local housing[203].

Urban: Dwelling density/km^2 measures urban form. CBD distance measures from CTs' center to where Toronto's King and Bay Streets intersect, this nexus serving as the core of Toronto's Central Business District (Filion, 2019). Geographers have long used like measures to 'locate' urban cores[204]. This places CTs relative to Hulchanski's Three Cities (2011), better relating my axes to this and other studies of Toronto's changing urban form in recent decades.

[199] CTs' average ownership and rental costs (monthly) are weighted according to their respective tenure share, then multiplied by 12 to recreate yearly costs. These are then divided by average yearly income to create an annual housing to income ratio; higher ratios imply unaffordability i.e., a greater share of income spent on housing costs (Murdie et al, 2013; 2014) This indicator, in addition to providing a more nuanced metric than average costs, is also far more easily normalized than those are.

[200] Its absence in change PCAs reflects poor transference to a change measure (e.g., a shift in LQ) in terms of non-normality issues.

[201] Duplex apartments are left out of this measure to avoid a closed set and because of the three types of 'missing middle' housing, they are the least numerous and largely mirror the location of row houses.

[202] More granular delineation is truncated by Statistics Canada. 2016 groups homes built prior to 1945 and those built 1946-1960, eliminating ability to distinguish homes built via notable, post-war suburban expansion from those older. Similarly, 1996/2006 has groups for 1961-1970 and 1971-1980, whereas 2016 defaults to a 1961-1980 group. While Statistics Canada databases contain detailed sets for all three years, 2016 data only extends to the CSD- and not the CT-level required for my analyses.

[203] Similarly, earlier censuses also delineated dwelling needing only minor repairs from those needing major intervention, which would have provided a more nuanced range to complement housing data by type, period, and location.

[204] This derives from seminal theories where urban areas develop concentrically from an originating center (Park, McKenzie, & Burgess, 1925; Owens, 2012) and spatial equilibrium theories where CBDs are an economic centrifuge around which households sort themselves by income and preference (Alonso, 1964; Mills, 1967; Muth, 1969; Duranton & Puga, 2015).

Appendix 2 – Lessons Learned About the Data Selection Process

Reflecting on my work, I would employ several methodological tweaks. Despite the value of using many variables, I could be more sensitive to conceptual overlap. While nominally separate, the education, occupation, and income (EOI) domains strongly covary as 'socioeconomic status' and spatially entrench where people (can afford to) live in Toronto. If considered a single conceptual / variable construct for the static PCA, the EOI domains total 13 variables Table 3.4). If variable for housing costs and home values are also included, given their role in income sorting, these would sum to 15 relatively strongly linked variables[205], even if none of them exceed my > +/- .90 multicollinearity threshold. Strong interrelation is not outright bad: different age groups relate to the SES constructs that emerge in my results. However, the strong covariance of EOI measures i.e., their 'weight' in my PCA could be seen to overshadow other, more nuanced socio-spatial relations including those based on age. As this is my primary research focus, it should be weighted more prominently in my datasets, or as here, less eclipsed by other weighty constructs. This recalls Hair's (2010) point that lower multicollinearity thresholds e.g., .82-.88 instead of the .90 I used (Section 3.7.2), can be useful in certain analytic contexts. Using a lower threshold would be one way to 'objectively' consolidate the EOI domain. Ironically based on experience garnered while analyzing my results (as per indicators which may conceptually overlap to a degree) both my static and changed based datasets could merge my two white-collar measures, use either low income *or* government transfer, and/or shed trades certificates as well as % of annual income spent on housing. This would result in reduced set of 11 variables that still broadly reflect SES. I might also strip local moves from the dataset (keeping no recent moves) and remove either auto or transit commuting, given their strong spatial opposition, to allow more latent socio-demographic constructs an opportunity to 'shine through'.

Specific to my change PCA, I would reconsider how I depict proportional change in my age groups i.e., the 'meaning' of their increasing or decreasing population share (Section 3.7.1). I measure how age groups change proportionally over a decade e.g., CTs' proportional change of the 60-69 group between 1996 and 2006. That the 60-69 group increases in local proportion by 2006 is the likely result of 1996's 50-59-year-olds aging in place, yet my measure cannot discern this. Alternatively, I could employ change measures based on, for example, CTs' share of 50-59 in 1996 and their share of 60-69 in 2006, which would capture this process; however, these measures may well have their own shortfalls, one of which might be the further added complexity such a new measure would mean for the eventual interpretation of my results (Viaud, 2022). In addition to potential issues with normality or multicollinearity, one issue could be that the magnitude of these shifts would be impacted by residents who are 50-59 in 1996 and enter or leave the CT population by 2006. My main point is that only by testing and comparing these alternatives would I arrive at the most suitable measure. Thus, future conceptualizations of aging and life stage transition in urban social ecology would benefit from considering the potential applications of both sorts of measures.

[205] Together, these making up 26-28% of the three static variable sets for 1996, 2006, and 2016 (Table 3.4).

Finally, while including housing and urban form as static measures in my change-based datasets innovates, is more conceptually accurate (Section 3.7.1), and achieves my objective of avoiding the low communality they achieve in prior studies (Perle, 1982; Le Bourdais & Beaudry, 1988), some result in a 'change' dimension near-entirely saturated by static, spatial measures. The primary example of this is the Dense Apartment vs. Single Residential dimension, which in its 1996-2006 iteration is almost entirely comprised of static, spatial saturations (Table 4.17) and is entirely so in its 2006-2016 manifestation (Table 4.25). In other words, my attempt to accurately depict spatially structural elements may have worked too well. In my change results, many social changes simply cannot register patterns of covariance that can compare to some of my spatial, structural indicators which – while not changing in proportion much over a decade – have marked spatial variance at the CT level. Future change PCA might retool their inclusion of structural, spatial elements, options including – but not limited to – preserving only measures of highest relevance in the static models (e.g., pre-1960 homes) or one half of a pair that strongly oppose i.e., either single-detached or 5+ story apartments. This still captures important elements of built form that influence change dynamics without overshadowing them. In closing, these are the several methodological limitations I encountered in specific relation to my PCA and the proposed approaches I might take to addressing these in future applications of factorial analysis.