Changes in the Intraurban Social Dimensionality of Canadian CMAs: 1981-1986

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Metropolitan areas are exceedingly complex in a social context, and thus they are endlessly fascinating places to study. This social variety, however, makes them difficult to understand, let alone explain or accurately measure in any descriptive sense. Much of the reason for this situation is that most studies of the social differentiation of cities provide only a partial view of their complexity because such studies use quite distinctive approaches. Given the range of alternative philosophies and methods applied in this field of study, it seems impossible to achieve a complete understanding of the social differentiation of cities since the descriptions depend on the values and attitudes of the observers as much as on the object itself. Thus, attempts should be made to at least identify the range of alternative approaches in order to provide a framework for individual studies and establish the context and limitations of each approach. In this way, the interrelations and differences among individual studies can be defined and the precise contribution of any case study determined.

This study will contribute to the understanding of the social differentiation of cities in three ways. First, in methodological terms a conceptual background to recent empirical work is provided. The objective is to identify explicitly the principal reasons for the partiality of approaches in urban social analysis, thereby establishing the context for the case study that forms the main part of this article. It must be emphasized that this discussion provides only a context for the case

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study and is not a complete solution to the problems of integration of all the literature. Second, this study seeks to contribute to the quantitative literature on the social geography of Western cities by summarizing the contemporary social dimensionality within all Canadian Metropolitan Areas (CMAs)—that is, interpreting the basic dimensionality of the entire intraurban system rather than following the recent revival of multivariate analyses designed to capture the social dimensions of individual Canadian cities such as Winnipeg (Hamm et al. 1988), Montreal (Le Bourdais and Beaudry 1988), and Hamilton (Taylor 1988). This will be achieved by applying multivariate methods to the latest available (1986) census data on all census tracts in all 25 Canadian CMAs. By comparing the results with a parallel study carried out on 1981 data, we are able to review the short-term changes in social dimensionality. Third, this study will summarize the extent to which the dimensions have a differential impact among CMAs, interpreting not only the major location-specific variations in these dimensions but also their variations between 1981 and 1986.

Although the empirical study reported here will not create a grand holistic synthesis, it will present an overview of the reasons so many studies provide only a partial view of urban social differentiation. The empirical results of the accompanying case study of the social complexity of Canadian metropolitan areas are limited by the use of census data, the census tract scale, and the data set of 25 CMAs. Nevertheless, it is hoped that this essentially cross-sectional summary of the results for two census years will provide an overview of the general social characteristics of all Canadian metropolitan areas in the 1980s. In addition, by establishing the basic dimensions of intraurban social variation, which individual city studies will undoubtedly extend, it lays down a framework for future, more detailed studies and those using different philosophies.

Alternative Approaches to Urban Social Study

In an essentially analytical age, it has to be expected that urban descriptions of metropolitan centres will deal with only part of the range of approaches and characteristics that could be described. In itself, each study can be considered a contribution to knowledge, but unless the alternatives are understood, the context and limits of each case study cannot be defined. The partiality of approaches in the contemporary metropolitan literature in the developed world stems principally from three broad categories of alternatives to the study of intraurban social variation: (1) alternative contents and methods; (2) alternative goals; and (3) singularity of examples. In many ways, the multivariate case

study of Canadian cities contributes only to the third category, but particular decisions had to be made in the first two categories. Thus, the establishment of a broad context for the quantitative analysis should more easily reveal the precise contribution and limitations of the case study.

Alternative Contents and Methods

According to some analysts, social complexity can be identified and measured by the intrinsic characteristics of the people found in urban subareas. These characteristics might include age, education, family conditions, jobs, and ethnicity. Indicators of many such characteristics can be found in census sources and have been used extensively by social area analysts (see, for example, Shevky and Bell 1955) and factorial ecologists (such as Berry 1971 and Davies 1984). Yet this type of structural approach—in the older, anthropological sense before use of the term *structure* in a deep-seated causal context (Blau 1974; Davies 1983)—is only one of the perspectives that can applied. Beginning in the 1960s, studies of the ways individuals or groups behaved provided the foundation for a very different approach to the city: the interactional or behavioural approach. But to cloud the issue, this approach also has been called an "analysis of social structures" by Wellman and Berkovitz (1988). The problem, however, could be resolved if the term *network* were added after *social* to clarify the meaning. By the 1970s, a revival of humanistic and attitudinal approaches had occurred. The individualistic and perhaps phenomenological approaches were usually very different in purpose to the generalizing goals of quantitative analysis dealt with here. But within these new humanistic approaches, a series of important additional perspectives could be recognized, such as those that stressed the identity of people or areas, the meanings attributed to places, and what might be called the "social construction" of space. These cognitive-affective approaches to the study of urban areas, stimulated by Lynch's imageability studies (1960), Suttles's "defended neighborhoods" (1972), and Newman's "defensible space" (1968) arguments provided whole new perspectives on inner-city social differences and relationships by insiders and outsiders. Finally, the last two decades have seen a great interest in structuralism, identifying the deep-seated causal mechanisms of change. For example, studies pioneered by Harvey (1973, 1985) and Castells (1977) illustrated how capitalism is a primary mechanism in society, where it has altered social relationships. Unfortunately, few studies have used this literature convincingly to explain the social dimensionality and patterning of cities.

Each of these new methods has provided crucial new perspectives on urban social differentiation, but the extent to which these various approaches can be related, to provide a more integrated literature, is still unknown. In most cases, the breakthroughs have led to a new, specialized literature on intraurban social variations rather than to integration with the other studies.

Alternative Goals

A major distinction in the literature on metropolitan centres can be drawn between those authors content to simply describe places and those whose objective is to introduce change—the prescriptive approach. This descriptive-prescriptive dualism may be clear conceptually and linked to the divergence between academics and planners; in practice, however, many academics prescribe, while planners describe. Yet even the descriptive approach is far from uniform. The ideographic-nomothetic divergence can be summarized as being between those who seek to understand the distinctiveness of areas and people, as opposed to those who search for the features that areas or places have in common. The difference is seen in the stimulating, perceptive, yet idiosyncratic writings of Jan Morris (1990) on Canadian cities. In contrast, most social scientists are concerned with generalization and testable statements. Yet even within the nomothetic approach there are differences among practitioners of different disciplines and a more basic and fundamental divergence between the empiricists and theoreticians. It is increasingly rare that the two approaches meet: there are few tests of the emerging theories, while descriptions are often city-specific and not linked to wider or integrative concerns. In addition, it is apparent that intellectual progress in the field in general—particularly in the technical competence and ability to handle large data sets—has led to a series of alternative approaches to the study of any part of the social structure of urban subareas. In the context of the case study to be dealt with here (urban social subarea description and classification), it has been shown that such investigations have had many different phases (Davies 1984): verbal description, univariate statistical description, urban ecology, social area analysis, multivariate analysis, and the multivariate-structuralist approach, each of which has its strengths and weaknesses.

Singularity

Most of the empirical knowledge of the social differentiation of urban and metropolitan centres is produced by analyses of single cities or a set of areas within a city. Only rarely do intraurban studies encompass more than a single place, although there are exceptions (Davies and Barrow 1973; Polèse and Carlos 1978). The problem here is determining the extent to which studies of a single city, area, or even a small sample are representative of Canadian cities as a whole, for there may be a number of place-specific features in the chosen examples that counter the generality. Moreover, most of the comparative studies of change focus on a single process or pattern or the latest problem or trend—in recent years gentrification and growing poverty—rather than attempt to describe the general contemporary social patterns in the city and relate them to the whole. Although a focus on new trends may be easy to understand, these essentially analytical approaches present real difficulties. For example, what is the degree of importance of one pattern or a particular process in each city? How do these features relate to the rest of the social complexity in the city? It is unusual to find answers to such questions.

Measuring the Social Dimensions

Method

In view of all the alternative approaches to the study of the social complexity of urban areas, it is not surprising that it is difficult to achieve any integrated understanding of cities. Indeed, given the incompatibility of the philosophies and methods applied, such an understanding may be impossible. What is feasible, however, for one of the alternative approaches identified above—namely, the quantitative, empirical analysis of structural data sets—is the identification of intraurban social dimensionality on a national basis. In other areas of social science (such as in the search for the dimensions of personality) factor analysis has proved useful in identifying and measuring precisely the basic dimensions of urban social variation from appropriate data sets (Berry 1971; Davies 1984). In this study, we did not adopt the typical approach of factorial research, which compares dimensions derived from individual single-city studies that may have particular or regional characteristics, Instead, we used the joint-analysis method of comparison (Davies 1984). In this method, all the subareas in a set of cities are included in one analysis, thereby producing a summary measurement of the dimensionality of all the cities. The approach has three major advantages over the centre-by-centre method of interurban comparison. First, the dimensions are derived from all the data, and the inevitable distortions linked to the often specific nature of factors drawn from individual cities are avoided. Second, the scores for each factor are directly

equivalent, providing a comparable measurement scale for all the city tracts in the data set and making it possible to precisely compare the variations in the impact of the dimensions. Third, the study can be useful for many of the other approaches described earlier. The results may be used to derive a set of sample areas measured on the same scale for more detailed behavioural or perceptual work, as well as to identify the social dimensions that structuralist theories of urban social variation need to explain.

But it also can be argued that the approach adopted has some disadvantages. For example, the local features of individual cities are not shown unless they are strong enough to appear at the national level. For studies whose object is to focus on these individual differences, this can be considered a disadvantage, but in this case it is an advantage since the objective of this study is the nomothetic one of identifying the summary dimensionality of the largest centres in Canada—the places described as metropolitan by Statistics Canada. Technically, of course, the analysis could be extended by including the census tracts of other centres, although one could not expect the same range of social variation in census tracts in much smaller centres. Similarly, it could be extended by partitioning the analysis into various size categories, such as those centres with a population of over 1 million. Because previous work (Davies and Murdie 1991) showed that the results for most factors were very similar and justified use of a single data set, such a partitioning by population was not attempted here.

Data

Thirty-six variables derived from the 1986 Statistics Canada census tract tables for all 25 metropolitan areas were used in measuring the social complexity of the areas. These variables initially were selected on the basis of a hypothesized relationship with 15 sources of variation—dimensions that either were identified in previous factorial ecologies or stem from speculation about the recent changes in urban areas. Indeed, the data set goes well beyond the Shevky and Bell (1955) and ethnic indicators that still dominate recent studies of Canadian cities (Hamm et al. 1988). Table 1 shows that in addition to the now-standard economic and family dimensions, a number of additional sources of variation were assumed. One set was associated with assumed splits in the economic sector, linked to impoverishment and educational attainment, because previous factorial studies have indicated the presence of such vectors (Davies and Lewis 1973; Davies 1984). A larger set of potential axes of differentiation was linked with the additional family, age, and gender relationships that seem to

have emerged with the development of the so-called postindustrial city (Bell 1974). Some of these dimensions have been recognized in various other factorial studies of individual Canadian cities: pre-family or young adult status, late family, completed family, non-family, family breakdown, migrant, housing, ethnic, and gender differences.

Each source of variation was indexed by two to four indicators (Table 1) with size differences removed by the use of percentage or ratio values in which closed number sets were avoided. Ideally, more variables for each postulated dimension should be used, but the restrictions of the census data source precluded this possibility. Because all census tracts in all Canadian CMAs are being analyzed, it was not feasible to incorporate additional data from outside census sources. The emphasis on family variables was justified by the results of previous research (Davies and Murdie 1991, 1992), which showed that the increasing social complexity of Canadian cities seemed very much linked to family variation. As for ethnicity, it seemed more important to restrict the number of variables employed. After all, previous work in the mapping of ethnic groups in Canada (Bourne et al. 1986) has shown that ethnicity is often city-specific in Canada. Also it can be argued that for many ethnic groups few social differences from the host population survive after a couple of generations. Thus, there is always the danger of deriving either meaningless axes or a series of city-specific dimensions if too many ethnic variables are included. It seemed more appropriate in this study, then, to simply measure the general degree of ethnicity in the Canadian census tracts rather than all the detailed variations. This was achieved by using three variables to measure the deviation of the census tracts from the majority British ethnicity (49.4 percent of the Canadian population in 1986): (1) French origin; (2) other ethnic origins; and (3) immigrants (born outside Canada). Thus, ethnic differentiation in the results would simply identify the general feature of ethnicity—not the specific ethnic type—with an expected ethnic axis separating francophones from other ethnic origins. Experiments with the addition of other ethnic variables confirmed the fact that a series of ethnic-specific factors would emerge, biasing the results in favour of these characteristics.

Initially, we attempted to duplicate the variable set chosen by Davies and Murdie (1991) in an earlier analysis of the dimensions of Canadian metropolitan centres using 1981 census data so that we could make comparisons with these results. But four changes had to be made. First, Sherbrooke was added to the 1981 set of areas since it had joined the set of areas defined as metropolitan by Statistics Canada. Second, the number of census tracts had increased to 3,448 from the 2,961 used in 1981—a product of the expansion of cities and the growing population

TABLE 1 Hypothesized Sources of Variation and Corresponding Census Indicators

Source of Variation	Indicator	
	Name	Measure
Age	Children	% of population 0-14 years
	Old age	% of population over 65 years
Family	Persons per family	Average no. of persons per family
	Two-parent families	% of husband-and-wife families
Young adult/ prefamily	Young adult	% of population 20-24 years
	Female participation	% of females in labour force
Early family	Young children	% of children at home < 6 years old
	Adults 25-34 years	% of population 25-34 years
Late family	Early middle age	% of population 45-54 years
	Older children	% of children at home 18-24 years
Completed family	Late middle age	% of population 55-64 years
	Completed family	% of husband-and-wife families without children at home
Non-family	Non-family ratio	Ratio of non-family to family persons
	Childless families (O)	(% of families without children)
	Singles	% of adults never married
Family breakdown	Female-parent families	% of families with female parent
	Divorced ratio	Ratio of divorced to married adults
Economic status	Household income (A)	Median household income (% of households with an annual income of $40,000 or more)
	Male managers	% of employed males in managerial occupations
	Male blue collar	% of employed males in primary/industry/ construction occupations
	Female clerical (N)	% of employed females in clerical occupations
Impoverishment	Low income	% of economic families with low income as defined by Statistics Canada
	Male unemployment	% of males in labour force unemployed
	Poor housing (O)	(% of dwellings needing repair)
Educational attainment	University education	% of degree holders
	Limited education	% with less than Grade 9 education
Migration	Length of occupancy (O)	(Median length of occupancy of home)
	Movers	% of population changing residence in last five years
	Local movers	% of movers moving within census subdivision
	Long-distance movers	% of movers moving from different province
Housing	New housing	% of dwellings constructed in previous decade
	Old housing	% of dwellings constructed before 1946
	Renters	% of dwellings rented
	Apartments (A)	% of dwellings in apartment blocks of 5 or more stories (% of dwellings that are apartments)
Ethnicity	French	% of population of French origin
	Other ethnic	% of population of non-British/non-French origin
	Immigrants	% of population born outside Canada
Female	Female income (N)	Average female income
	Female unemployment (N)	% of females in labour force unemployed

Note: Indicators may be qualified by an O, A, or N. O denotes an indicator considered in 1981 but not in 1986 because it was not available in census sources; A an indicator altered between 1981 and 1986; and N an indicator considered in 1986 but not in 1981. For indicators qualified by an O or A, the measure used in 1981 is shown in parentheses.

size of some tracts, which led to a subdivision of the originally defined units. Third, some of the 1981 variables could not be duplicated in the 1986 analysis because of changes in the information provided by Statistics Canada. Three indicators (childless families, housing needing major renovations, and length of occupancy) were no longer available, and three other variables (apartments, new housing, and household income) had to be measured slightly differently. Fourth, because these changes had to be made, it was decided to make a greater effort to incorporate gender variations in 1986, given the extent of gender separation in the geography of cities recently shown by Pratt and Hanson (1988) as well as Winchester (1988). Two gender-related variables (female parent families and female participation rate) were in the 1981 data set, but three more were added from the 1986 data source (average female income, female unemployment rate, and female clerical workers). In this way, it should be possible to determine the presence and the relative importance of gender variation—not as a single issue or a set of contructs to be identified but in the context of other social dimensions of variation within Western cities.

Techniques

The advantages and disadvantages of the factorial approach to the problem of measuring urban dimensionality have been discussed in detail elsewhere (Davies 1984). This study used a joint-analysis method incorporating all census tracts of over 150 population and/or 50 households to avoid the use of small areas and exaggerated indicator values. In total, 3,448 tracts were used with an average population of 4,392 inhabitants. Pearson product correlation coefficients were calculated for each pair of variables, followed by principal axes component analysis since the latter has been shown to be robust and to produce results comparable to more recent factorial methods (Davies 1978a). For the final solutions we adopted the oblique rotation method, using the direct oblimin technique (SPSS 1988) with gamma at 0.0 to ensure comparability with the 1981 results, although tests showed the same titles could be given to solutions based on the orthogonal varimax approach—a finding also true for the 1981 analysis (Davies and Murdie 1991).

We considered the data set to be as comprehensive as possible—given the limitations of the data source and the desire to avoid highly skewed potential indicators. The latter would have violated the linearity assumptions of the similarity measures and the factor procedure. Statistical purists, however, might argue for use of a data sample rather than the complete data set of census tracts. This would have the advantage of making it possible to obtain additional vari-

ables for the census tracts, but the cost would be prohibitive. More to the point, it also would allow adoption of the common factor model and its range of inferential statistics—but this is an inappropriate method if all the data are used because the probabilistic tests only apply to samples. In this study, use of the complete data set of census tracts was necessary because we wished to measure the extent of factor score consistency between and within the metropolitan areas and to map patterns of these scores. Because of space constraints, these cannot be shown in this article.

A series of different results was scrutinized before a final decision to adopt the eleven-axis solution was made. This solution accounted for 88.1 percent of the original variance in the 1986 data set in which the communalities for all variables were greater than 0.75, meaning that each variable had three-quarters of its variance accounted for. Beyond this level, individual axes were split into correlated dimensions associated with single variables. The technical procedures basically followed the 1981 analysis, which produced nine axes accounting for 85.7 percent of the variance, although one of the 1981 axes was bipolar, with two different migration characteristics at either end of the factor. No attempt was made in this study to produce a quantitative comparison of the two sets of results or to measure temporal comparisons, given the slight differences in the variable sets. Instead, the comparison was kept at an indicative rather than confirmatory level. When the 1981 data sets were separated into size groups, relatively small variations in the factors were produced, which led to the decision to focus only on the complete set of metropolitan areas for the 1986 analysis.

Factor Dimensions

The loadings for the eleven-axis 1986 solution are shown in Tables 2 and 3. The values in parentheses show the comparable results of the parallel 1981 analysis. Variable titles are based on the most important loadings. In general, it can be seen that the major axes extracted between the two dates are very similar in terms of the size and pattern of the loadings. No evidence of five of the initially hypothesized axes could be found: a separate education vector; one uniquely associated with age and distinct from family; a separate late- and completed-family dimension; an independent female axis; or a family breakdown factor in addition to a non-family axis. All of the indicators measuring these characteristics were associated with one or other dimensions of variation identified from the 1981 analysis. The increased number of vectors between the two dates were a product of

TABLE 2 Component Loadings for 1986 (1981): First Set of Component Axes

Indicator	Economic Status [2(3)][a]	Impoverishment [1(1)]	Ethnicity [4(4)]	Long-distance Migration [9][b]	Local Migration [10][b]	Occupation [6]
Female income (N)	0.84					
University education	0.91 (0.92)					
Male managers	0.85 (0.86)					
Household income (A)	0.65 (0.78)					
Limited education	-0.49 (-0.60)			-0.41		
Male blue collar	-0.93 (-0.93)					
Female-parent families		0.86 (0.99)				
Low income		0.71 (0.72)				
Renters		0.55 (0.52)				
Female unemployment (N)[c]		0.49	(-0.35)			
Male unemployment[c]		0.36 (0.38)				
Two-parent families		-0.85 (-0.96)				
Female participation rate[c]		-0.33	(0.40)			
Immigrants			0.97 (0.95)			
Other ethnic			0.92 (0.95)			
French			-0.67 (-0.73)	-0.50 (-0.37)		
Long-distance movers				0.74 (0.73)		
Apartments (A)[c]		(0.42)		(-0.32)		
Local movers		(0.45)		(-0.44)	0.97	
Female clerical (N)						-0.95

Notes: 1981 results are shown in parentheses.

a. Figures in brackets indicate order of extraction in 1986 (1981).

b. In 1981, the unique migration axis was extracted in eighth position.

c. These indicators also appear in the second set of component axes.

the extraction of the single variable female occupation factor and the division of the migrant variables into two dimensions rather than a bipolar vector separating these features in 1981—but all were minor dimensions.

One of the strongest and certainly most familiar components in factorial ecology is the economic status sector identified in Table 2. In 1986, this traditional factor scale was composed of high positive loadings for males in managerial occupations, people with a university education, and high female income, compared with high negative values for the blue-collar, low-educational-attainment, and median-income variables. The loadings are very similar to those in 1981, but the addition of the new female-income variable should be noted. Although not recognized in many previous single-city factorial studies in Canada because of their restriction to a Shevky and Bell (1955) data set, the impoverishment factor confirms—indeed measures—an additional economic and family dimension. It shows that Canadian census tracts do not have a single scale of prosperity. Another dimension is based on non-affluent areas in which there are high proportions of single-parent families with low incomes and headed by females. Also associated with this axis are the variables measuring high levels of rental occupation and unemployment, although the loadings in these cases are not strong. Opposed to these characteristics on this axis is the two-parent family indicator. In part, this axis seems to measure another aspect of the growing poverty found in Western cities, which others have indexed through measures not incorporated in this study, such as homelessness (Dear and Wolch 1987) and the provision of food banks for the needy (Laws 1988). The strong association of this axis with single-parent families at the census tract level must be stressed. It indicates a strong gender association with low income, linked to the increasing incidence of marriage breakdowns, which has led to a higher number of children being raised in a single-parent household. For Canada as a whole, 12.6 percent of families are now headed by a female parent, an increase from 7.6 percent in 1951. Although this is very similar to the 1981 findings, the older minor association with local movers and apartments is lost. The latter is probably a consequence of the more restricted definition of the variable to that of high- and medium-rise apartment buildings.

The third axis shown in Table 2 is the ethnic component, again with a clear factor scale. One side is linked to immigrants and people of non-British or non-French ethnic origin, the other to those of French origin. The axis therefore provides a basic ethnicity scale, picking out the areas with people of francophone and non-British origin rather than identifying the detail of particular ethnic groups. Two migrant dimensions also can be seen in Table 2, although those must be considered relatively minor vectors because of the limited number of variables that load on them. The most important of these is the component based on the long-distance-mover variable. Significantly perhaps, this axis has medium inverse associations with French ethnicity and with the limited formal education indicator, demonstrating that relatively few people of French origin or low education migrated between the provinces in the five years before the 1986 census. This illustrates the two "solitudes" in Canada in a migration context, and the relative absence of major economic projects in the depressed early 1980s that required the migration of unskilled workers between provinces. Again, it must be noted that the 1986 results show a broad similarity to the comparable 1981 axis, but the latter had a more general migratory character, having minor links to the local mover variable. Yet it must be emphasized that the 1981 analysis extracted only nine axes because of the decision to avoid the extraction of single-variable vectors. The tenth axis derived from the 1981 data would have been a median-length-of-occupancy component—a variable that was not available in 1986. Yet this potential single variable axis had such a high correlation with the long-distance vector that Davies and Murdie (1991) thought it not appropriate to extract the component in the 1981 analysis.

Table 2 shows that the second difference between the two sets of results is the presence of a separate occupation component in 1986—one that is uniquely linked to the female clerical-occupation variable, which was included in 1986 but not in 1981. This means the distribution of this variable in Canadian metropolitan areas as a whole is so unique that it has little in common with the other indicators. The separation appears to confirm both previous factorial work that has shown the presence of axes associated with service workers, such as that by Davies and Barrow (1973), as well as those single-variable analyses of gender variations that were based on single cities (Pratt and Hanson 1988). But this factor must be treated with some caution because Pineo et al. (1977) have shown that many occupational categories defined by Statistics Canada, especially clerical and service workers, cover a wide variety of very different types of activity and fail to adequately define job or income status. Moreover, it has been known for many years (Duncan and Duncan 1955) that this occupational variable has low levels of residential segregation. Thus, the variable may be a composite one, ensuring that its unique association with a factor is a product of its compilation rather than an indicator of real gender distinctiveness.

Five age, family, and housing components also were produced by the 1986 study (see Table 3). As such, the results confirm the predicted presence of a number of family vectors rather than the single axis

TABLE 3 Component Loadings for 1986 (1981): Second Set of Component Axes

Indicator	Early-late Family [3(2)][a]	Family and Age [11(5)]	Non-family [8(9)]	Young Adult/ Prefamily [5(6)]	Housing [7(7)]
Young children	0.88 (0.86)				
Adults 25-34 years	0.88 (0.79)	(0.32)			
Movers	0.56 (0.53)				
Older children	-0.78 (-0.81)				
Early middle age	-0.82 (-0.90)				
Late middle age	-0.53 (-0.42)	(-0.67)	(-0.42)		-0.47
Apartments (A)[b]		-0.82	0.35 (0.30)		
Completed family		-0.49 (-0.93)	-0.42		-0.34
Old age		-0.42 (-0.82)		-0.50	
Renters		-0.43			
Persons per family		0.50 (0.75)	0.35	(-0.30)	0.37
Children		0.40 (0.62)	0.42 (-0.42)		0.41
Female unemployment (N)[b]		-0.38	-0.30		
Male unemployment[b]		0.35	-0.48 (0.36)		
Non-family ratio			-0.94 (0.87)		
Singles	(-0.32)		-0.56 (0.76)	0.45	
Divorced ratio			-0.72 (0.68)		
Childless families(O)	(0.34)		(0.53)	(0.38)	
Young adult				0.77 (0.76)	
Female participation rate[b]				0.54 (0.59)	
Old housing					-0.92 (-0.76)
New housing	(0.36)				0.86 (0.59)
Length of occupancy (O)					(-0.68)

Notes: 1981 results are shown in parentheses.
a. Figures in brackets indicate order of extraction in 1986 (1981).
b. Such indicators also appear in the first set of component axes.

postulated by Shevky and Bell (1955) and shown in many early factorial ecologies. The most familiar is the family and age axis, which consists of a factor scale of positive loadings for the children and persons-per-family variables, and negative ones for the old-age, completed-family, and apartment indicators. The general composition of this vector remains the same as in 1981, but many of the loadings show a reduction in size. This may be related to the 1980s housing crisis in so many Canadian cities, where vacancy levels were low and housing costs were often beyond the means of many families. As a result, many more families with children now live in higher-density blocks. It must be noted, however, that the results were probably also influenced by the change in the census definition of apartment blocks because low-rise apartments were excluded in 1986. The largest family axis in terms of the size of the loadings is the early-and-late-family vector. This axis indexes the variables measuring people in their early childbearing years, young children, and movers on one side of the axis, with older children and people in early and late middle age on the other. The similarity with the 1981 results must be stressed, for the results demonstrate the important difference between new and old suburbs in metropolitan areas. But the higher loading for the late-middle-age (55-64 years of age) variable in 1986 demonstrates the aging of many communities, which are dominated by middle-aged people with families who have left home—popularly described as "empty nester" areas.

Strong loadings also are found in the non-family vector, particularly for the non-family and divorce rate indicators. The vector is rounded out by medium loadings for the variables measuring single people, unemployment, completed family, and high-rise apartments. Again, the 1986 loadings paralleled the 1981 results, although it is noteworthy that all are higher, indicating the intensification of this character. The exception—the singles-ratio variable—has a smaller loading because of the higher incidence of divorce, ensuring a more widely scattered characteristic. The young-adult or pre-family vector is also strong in both years, associated with individuals in the 18-24 age category and female participation rates. In 1986, however, the medium loadings show a relationship with the singles-ratio variable and an inverse linkage with the old-age indicator, implying that there were lower incidences of marriage in the group and a more distinct separation from older people because of increasing residential separation. Table 3 also shows that a housing vector was identified in both years. In 1986, this takes the form of a factor scale separating new and old housing, in which the former is linked to family characteristics and the latter to the late-middle-age and completed-family variables. The 1981 results are somewhat similar, although the

changing variables make it impossible to make an exact comparison. Previous factorial investigations often identified the axis as a growth vector linked to such other variables as population change (Murdie 1968).

It had to be expected that these results would be very similar to the 1981 study, given the lapse of only five years and the absence of a climactic social transformation in the period. Certainly the results are not identical, but they seem similar enough to confirm the basic social dimensionality of the metropolitan census tracts of Canada. It seems particularly important to emphasize that they confirm, once again, the need to identify several family-related axes, as well as an impoverishment factor to be shown alongside the economic-status vector. This suggests that the social complexity of Canadian metropolitan areas is greater than the traditional three-axis model of Shevky and Bell (1955) would imply in four major areas: (1) the separation of several family dimensions, in addition to the family-and-age vector, which are linked to the aging of older suburbs and the segregation of both young adults and those of non-family character; (2) the importance of the impoverishment-single female parent association, which can be regarded as a new type of family dimension related to economic conditions; (3) the distinctiveness of a separate housing vector, although the limitations of the census in not distinguishing publicly provided housing must be noted; and (4) the importance of migration as a component in intraurban differentiation, confirming the early modification of classical social area ideas by McElrath (1968) and Timms (1971). The additional detail of ethnicity, however, is not dealt with in this study.

It is true that the evidence for some of these additional axes is not as strong as one might like. This is especially the case for local (or intraurban) and long-distance migration as separate dimensions of variation. There are too few useful indicators in census sources to provide a comprehensive view of this potential vector, although the amount of long-distance migration is certainly affected by the relative economic performance of the national and regional economies. The same conclusion must apply to the female clerical-occupation axis. As always in factorial studies, however, a dilemma exists as to whether single-variable vectors simply reflect the uniqueness or individuality of an indicator, or whether they represent more general sources of differentiation that are only partially measured because related variables were not included in the analysis. It is worth emphasizing that there is no evidence in this study supporting a single, separate gender axis. Except for female clerical occupation, most of the gender variables included are related to other sources of differentiation, although the low income-female parent family dimension could perhaps be regarded as a new family-economic stress dimension of gender variation.

Differential Impact of the Dimensions

Although the social dimensions are derived from the data set of all the Canadian metropolitan areas, the axes will not have a similar impact in each city. It is obvious that the presence of a distinctive factorial dimension stems from a two-stage process: one produced by a societal influence, which leads to a societal separation of the characteristics, and the other derived from an ecological or geographical effect, in which people with these characteristics are concentrated into census tracts. For example, successive governments have encouraged immigration to Canada, but immigrants (15.6 percent of the total population in 1986) will only contribute to a separate social axis at the census tract level if they are concentrated in particular census tracts. If they are scattered equally among the areas, they will not separate out as an individual factor or component of social variation. A moment's reflection will demonstrate that the impact of the dimensions could easily vary among cities because either the societal or the ecological force (or both) was not as influential in all cities. The question addressed in this study is to what extent do the dimensions identified have similar patterns in the various cities, not why such segregation takes place. Such issues have to be addressed by studies that seek to explain the factors of variation in theoretical terms.

Component scores were calculated for all census tracts for all centres using the approximation method described by Murdie (1980) rather than the traditional regression method. To remove the effects of minor loadings, only the loadings $> + 0.5$ or $< - 0.5$ were used. An important feature of the joint analysis method used in this study is that all the scores are measured on a set of common scales so that each census tract is directly comparable to each other. Because of space constraints, it impossible to portray the variations in all 11 dimensions for all census tracts. Instead, some summary measures of the distribution of scores in the various centres are provided. Table 4 shows the results of calculating Eta^2 values on the distribution of factor scores. Essentially, an Eta^2 value is similar in function to the more familiar F ratio. It measures the differences in the distribution of any factor score among the various CMAs and within the areas. A high score for any dimension on the scale of 0.0-1.0 means that there are bigger differences in the scores for that component among the CMAs than within the cities. In other words, the place-specific variations (those among cities) in the scores for that factor outweigh the variations found among tracts within individual cities.

TABLE 4 Eta^2 Statistics of Component Axes

Component Axis	Eta^2
Ethnicity	.62 (.62)
Long-distance migration	.42 (.54)
Young adult/prefamily	.17 (.24)
Local migration	.14[a]
Economic status	.13 (.11)
Impoverishment	.12 (.10)
Occupation	.10
Early-late family	.10 (.07)
Housing	.08 (.06)
Family and age	.04 (.07)
Non-family	.05 (.06)

Note: First figure is 1986 value; second figure in parentheses is 1981 value.
a. Combined with long-distance migration in 1981.

Two major conclusions can be gleaned from Table 4. First, the values confirm the expected result that the ethnicity factor displays high city-specific variations in 1986 because the Eta^2 score is 0.62—the highest value of the 11 scores. Part of this difference is linked to the obvious concentration of francophone population in the Quebec CMAs, but it is also a function of the opposite side of the axis, which is linked to the concentration of immigrants, and those of non-British ethnic origin, in the census tracts of a limited number of Canadian cities. All other values are small except the long-distance-mover axis, meaning that the differences in the factor score values among the tracts in the individual cities are greater than the differences among the areas. On balance, therefore, the social variations within Canadian cities for nine of the factorial dimensions are bigger than those among the cities, with the housing, family-and-age, and non-family dimensions in particular having very small Eta^2 values.

Second, through time the differences in the two sets of Eta^2 values were minor. Correlation coefficients calculated between the percentage of tracts in the top and bottom quintiles for each axis over the 24 comparable cities and nine factors in 1981 and 1986 showed that nine out of 18 paired comparisons had correlation coefficients over 0.9 and another six were over 0.75. Even the three smallest correlations were all over 0.5. Some changes took place in the late-family side of the early-and-late-family vector because the correlation was only 0.62, while the unavoidable changes in the apartment and older-housing variables accounted for the lower correlations (0.50 and 0.53, respectively) between the old-age side of the housing and the family-and-age vectors. In the comparison of Eta^2 coefficients shown in Table 4, only the long-distance-mover and young-adult factors show more than a 5 percent difference in values between the two dates. The direction of

the changes indicate some important social differences between the two dates. The reduced Eta^2 values of the migration factor reflect the fact that the lower economic prosperity in many of the areas that had grown substantially in the 1970s led to reduced levels of long-distance migration and the lesser impact of this source of differentiation among cities. But the difference in the minor variables that loaded on the migration factor is worthy of note, meaning that it does not measure exactly the same thing. For the pre-family age groups, the smaller Eta^2 value likely reflects the increase in the cost and availability of accommodation, particularly in the larger metropolitan centres and those in Quebec, although some may be positively discouraged in leaving home, such as in the case of many family-oriented ethnic groups. Thus, young adults were less likely to leave home and contribute to the concentration of these groups in parts of the city—one of the important trends in the post-World War II Western city.

Table 5 shows the centres most highly associated with each axis by listing the CMAs with the highest proportion of tracts with high factor scores. For example, 56.9 percent of the census tracts in Toronto on the immigrant side of the ethnicity dimension were in the top 20 percent of scores on the factor for the country as a whole. Winnipeg and Vancouver are the only other metropolitan areas that have this high immigrant and non-British ethnic origin character. In contrast, all the Quebec centres have virtually all of their tracts in the 100 percent francophone category, although it is worth noting the almost 50:50 split in the bilingual city of Montreal and the fact that only three other Canadian centres have 20 percent or more of their tracts in the high scoring quintile: Ottawa-Hull (29.6 percent), Sudbury (27.0 percent), and Saint John (20.0 percent). Table 5 also shows the cities that have relatively higher proportions of their census tracts with high or low scores on each of the other extracted factors—that is, those with 25 percent or more of their scores in the category for 1981 or 1986 rather than the expected 20 percent that would occur if the distribution of scores were the same for all the cities. The temporal changes in the distribution of values were also shown by identifying the 1981 values that were greater than 10 percentage points from the 1986 proportions. In the smaller CMAs, however, these differences may only involve a small number of census tracts. Thus, minor differences in the smaller places should not be exaggerated.

In the case of the economic axis, the differences shown in Table 5 are relatively clear. Higher proportions of high-status areas (those with more people in managerial occupations and having large incomes) are found in four centres: Ottawa, the national capital; Toronto, the economic capital; Calgary, the oil company headquarters; and Halifax, the naval, provincial government, and educational

TABLE 5 CMAs with Concentration of Tracts Having High or Low Factor Scores in 1986 (1981): Percentage in Top 20%-Bottom 20% on Factors for all CMAs

	High (% in Top 20%)		Low (% in Bottom 20%)	
A. Major Axes in the First Set				
Economic status	Ottawa	47.1	Trois-Rivières	56.7
	Toronto	30.9	St. Catharines	55.4
	Calgary	29.4	Sudbury	54.1
	Halifax	27.0	Windsor	46.6
	Saskatoon	7.0 (24.2)	Saint John	45.0 (25.7)
			Chicoutimi	40.6
			Hamilton	37.2
			Saskatoon	34.9 (12.1)
			Oshawa	31.8
			Thunder Bay	30.0
			Kitchener	28.0
Impoverish-ment	Saint John	42.5	Oshawa	38.6
	Montreal	39.9	Hamilton	31.1
	Trois-Rivières	36.7	Toronto	28.3
	Sherbrooke	35.5	Windsor	25.9
	Quebec	31.9	St. Catharines	25.3
Ethnicity	Toronto	56.9	Chicoutimi	100.0
	Winnipeg	29.3	Quebec	100.0
	Vancouver	29.0	Trois-Rivières	100.0
			Sherbrooke	96.8
			Montreal	53.4
			Ottawa	29.6
			Sudbury	27.0
			Saint John	20.0
			St. John's	15.4 (0.0)
B. Major Axes in the Second Set				
Early-late family	Calgary	53.8	Hamilton	33.1
	Regina	51.1 (34.3)	St. Catharines	28.9
	Saskatoon	48.8 (36.4)	Toronto	28.7
	Edmonton	43.2	Trois-Rivières	26.7
	Victoria	33.9 (24.5)	Sudbury	21.6 (2.9)
	London	27.9 (14.5)	Regina	10.6 (22.9)
	Halifax	27.0		
	Ottawa	26.5		
	Vancouver	26.5		
	St. John's	15.4 (24.2)		
Family and age	St. John's	71.8 (51.5)	Toronto	34.6 (16.4)
	Chicoutimi	50.0	Ottawa	31.7 (14.3)
	Sudbury	40.5	Hamilton	28.4
	Saskatoon	34.9	London	26.7
	Edmonton	34.1	Halifax	24.3 (11.3)
	Regina	34.0 (22.9)	Victoria	18.6 (6.2)
	Calgary	26.6 (36.6)	Winnipeg	17.0 (29.0)
	Oshawa	27.3	Vancouver	16.2 (26.6)
	Halifax	27.0	Saint John	15.0 (25.7)
	Quebec	26.1	Regina	8.5 (28.6)
	Kitchener	25.3 (13.3)	Saskatoon	7.0 (27.3)
	Saint John	22.5 (11.4)	Trois-Rivières	6.7 (20.0)
	Windsor	20.7 (8.9)		
	Trois-Rivières	13.3 (24.0)		

TABLE 5 (Continued)

	High (% in Top 20%)		Low (% in Bottom 20%)	
Non-family	Sherbrooke	38.7	Sudbury	45.9
	Montreal	33.9	Oshawa	43.2
	Saint John	25.0	Hamilton	35.8
			St. Catharines	31.3 (50.7)
			Kitchener	30.7
			London	26.7
			Windsor	22.4 (33.9)
			Saskatoon	16.3 (6.1)
			St. John's	15.4 (27.3)
			Thunder Bay	13.3 (30.0)
Young adult/ prefamily	Saskatoon	55.8	Trois-Rivières	63.3 (44.0)
	Regina	44.7 (28.6)	Chicoutimi	62.5 (33.3)
	Edmonton	41.5 (62.5)	Victoria	50.8
	Calgary	39.2 (74.8)	Quebec	46.4 (34.1)
	Halifax	36.5	Saint John	40.0 (25.7)
	Ottawa	31.2	St. Catharines	38.6 (47.9)
	St. John's	30.8 (12.1)	Sudbury	29.7 (45.7)
	Kitchener	29.3	Montreal	28.5
	London	26.7	Vancouver	25.0
			Windsor	20.7 (44.6)

Note: Normally, for each axis the only values shown are for CMAs in which the percentage of tracts in the top or bottom quintiles of scores surpasses 25 percent for 1981 or 1986. Exceptions include CMAs where there are major differences between 1981 and 1986. Temporal comparisons of scores on the other axes are not made because these axes have different variables loading on the dimensions. Thus, direct comparisons may be biased. The first figure is the 1986 value; the second figure in parentheses is the1981 value.

centre. Most of the higher concentrations of low-status areas, signifying blue-collar occupations, are found among the census tracts in the Quebec and Ontario CMAs, but Saint John and Saskatoon have the biggest changes between 1981 and 1986, with increases in their blue-collar character and, in the case of Saskatoon, a decline in the proportion of high-status areas—relative, of course, to the rest of the metropolitan areas. For the impoverishment factor, the Quebec centres and Saint John display the largest proportion of census tracts with the combination of low-income and female single-parent families. By contrast, there are far fewer areas with these features in the southern Ontario industrial heartland, suggesting that there is a cultural and economic explanation for the relative concentration of this dimension. Yet the fact that Table 5 is restricted to the relative proportion of high- and low-scoring tracts must be emphasized. It does not reflect the areas having the highest or lowest scores. The highest scores on the low income-single parent family axis are found in Toronto, where the North and South Regent Park public housing tracts have scores of 5.5 and 5.2, respectively. Similar details can be derived from the other factor scores but cannot be reported here because of space limitations.

Table 5 shows the metropolitan centres with high and low proportions of scores on the family-related axes. In the case of the young-adult dimension, the larger proportion of tracts with high scores in the four Saskatchewan and Alberta centres reflects not only their rapid growth in the 1970s, but also the provision of accommodation for this age group, which enabled individuals to leave home. In contrast, the depression in the oil-related economies of Calgary and Edmonton in the early 1980s led to the lower capability of these groups to establish their own homes and a decline in the proportion of tracts with high values. All the other centres with relatively more tracts in the high-scoring group on the young-adult dimension have high proportions of government offices and educational institutions—activities likely to attract young adults who are from other areas and who set up their own homes. The CMAs with low-scoring tracts on the axis consist largely of industrial centres in Ontario and Quebec as well as the retirement centre of Victoria. In all cases, the separation of the young-adult sector in distinctive areas has been relatively low. Between 1981 and 1986, many become less characterized by the separation of the young-adult age group—a consequence of the increasing cost of accommodation, more traditional family life, and fewer economic magnets to attract the mobile pre-family groups.

In the case of the non-family dimension, some Quebec and New Brunswick CMAs display higher-than-expected concentrations of tracts with non-family traits, while the reverse is true for many of the Ontario industrial cities, where high levels of traditional family character are found. No simple regional association can be seen among the cities identified in Table 5 as having large changes in status. The cities with large concentrations of high-scoring tracts on the early-and-late family dimension are more easily accounted for. The growth of many Prairie CMAs in the 1970s led to many new family-oriented suburbs and high scores for many of their tracts, with many areas in the Saskatchewan centres becoming more youthful through time. By contrast, the Ontario centres have larger proportions of older suburbs with a middle-aged character—the "empty nester" characteristic described earlier. The largest change in the proportion of late-family tracts is seen in Sudbury, which has more aging areas—a function of the limited growth in the CMA because of stagnation in the mining sector, which is still its primary economic prop. Regina's rapid decline in the proportion of late-family tracts is rather surprising, but it may be linked to the revitalization of many older suburbs and the recent large influx of native people into the city.

The city-by-city variations in the incidence of high-scoring tracts on the family-and-age vector are harder to understand, particularly in light of the decline in the intensity of the old and completed family

association axis through time and the stronger loadings for the apartment variable shown in Table 3. The higher birthrate in St. John's is reflected in the youthful nature of many of its tracts—a feature also found in the relatively isolated centres of Chicoutimi, Sudbury, and the western Prairie cities. Table 3 showed that the negative side of the vector is associated primarily with apartments. Ottawa and Toronto, followed by Hamilton and London, have far more tracts characterized by apartment-living and old-age profiles. Through time, these characteristics have been strengthened in Ottawa and Toronto. Again, however, the change in the census definition of apartment dwelling to the more restrictive high-rise type must be noted and would have affected the results. Victoria and Halifax display a trend toward a greater number of high-scoring old-age tracts—a function of the aging and segregation of the population in these cities. This is in contrast to the other six places shown as having important changes where there are fewer high-scoring tracts having old-age and small-family characteristics.

This summary of the short-term changes in the incidence of census tracts based on seven major types of social dimensionality show the major variations from centre to centre, even though the dimensions are typical of all metropolitan areas. The changes in the other four sets of scores cannot be shown because of variations in the variables loading on the axes. Ideally, this summary should be complemented by sets of component score maps to demonstate the geographical variations in the location of the scores within the various centres, but such a detail is beyond the scope of this study. Examples for the 1981 study are shown elsewhere (Davies and Murdie 1992).

Conclusion

This case study of the social dimensionality of Canadian metropolitan areas in 1981 and 1986 has dealt with three problems. First, it has identified the different approaches to the study of urban social variation that have resulted in so much of the literature providing what can only be described as a partial view of the social differentiation of cities. By establishing a framework of alternative approaches, it demonstrates the particular contribution of the case study and shows how one of the three major sources of incompleteness in the study of urban social differentiation can be solved. Second, it has attempted to provide a basic profile of the social dimensionality of Canadian metropolitan areas—one that can be derived from census sources by measuring the dimensions found in a wide-ranging data set derived from the 1986 census. A comparison of the results with a similar study

in 1981 has revealed the similarities and short-run changes in the social dimensions. Third, this case study has isolated the extent to which the major dimensions have a differential impact in the various CMAs. In doing so, it has set the place-specific variations, and the changes through time, in the context of the general dimensionality of Canadian metropolitan areas.

The results have confirmed once again that census tracts in Canadian CMAs as a whole can no longer be considered differentiated only by the traditional dimensions of economic status, family status, and ethnicity, identified first for the post-World War II city (Shevky and Bell 1955). The persistence of migrant and housing dimensions provide minor additional axes of differentiation that have been found in studies of single cities (Davies 1984). But the important change to the earlier literature lies in the fractionation of the former unitary family dimension, producing four separate family axes. Moreover, the association of the low-income, single-parent families with a separate dimension testifies to the importance of this additional characteristic in contemporary CMAs—one that combines family and economic features. Although a gender-related occupation axis was found in 1986, it is small in size and seems to indicate that gender variations cannot be considered major sources of variation in their own right—at least when compared with the size of the other axes. It is recommended that the dimensions identified in this study be used in future attempts to classify the social differences of Canadian centres. The Shevky and Bell three-axis model and its modifications belong to the post-World War II city, one that has changed radically in the last 40 years.

It was not expected that there would be big changes in the dimensionality of the cities through time given the short period investigated here. With the partial exception of the migrant dimensions, the 1981 and 1986 results must be considered very similar. Indeed, the similarity of the results provides further evidence that a basic social dimensionality of these cities has been identified—at least at this scale and from the census data source. This does not preclude the presence of additional axes in particular places or the use of more comprehensive data sets. Most of these additional axes of differentiation are more likely to be in other domains of interpretation—perhaps in the cognitive-affective area (Davies and Herbert 1993)—but such issues are not dealt with here.

A real problem in many multivariate investigations has been the identification of the extent to which the axes of differentiation are unique to individual places, for most multivariate studies have been confined to single-city investigations. Adoption of the joint-analysis approach meant that each source of variation was measured on the same scale for all census tracts in Canadian CMAs. This demonstrated

the extent to which each axis showed place-specific associations and which cities had high or low proportions of tracts with large or small scores on the factors. Thus, a comprehensive and comparative measurement of the tracts was derived, scaling each census tract in the 11-axis space of the social dimensions. Future empirical work in this area is needed to investigate the spatial variations of the scores within the centres and to carry out longer temporal investigations of change in order to determine the dynamic evolution of the social dimensionality of Canadian cities.

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