DOES NEIGHBOURHOOD RESIDENCE INFLUENCE THE READINESS TO LEARN OF KINDERGARTEN CHILDREN IN VANCOUVER? A MULTILEVEL ANALYSIS OF NEIGHBOURHOOD EFFECTS

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Abstract

This thesis investigates the relations between socio-economic dimensions of neighbourhoods and readiness to learn scores among kindergarten children, independent of family income. The study is based on readiness to learn data collected for 3,721 children attending kindergarten in the Vancouver School District in February 2000. Readiness to learn is assessed by each child’s teacher using the Educational Development Instrument (EDI), a questionnaire that assesses readiness to learn in five sub-scales: emotional health and maturity, social knowledge and competence, communication skills and general knowledge, physical health and well-being, and language and cognitive development. Factor analysis at the census tract level is used to agglomerate Vancouver census tracts with similar socio-economic dimensions into 68 neighbourhoods that have a minimum of 30 kindergarten children. Map displays, correlation analysis, and regression analysis, at the ecological level, show a positive relationship between readiness to learn in each of the 5 sub-scales and neighbourhood socio-economic status. Multilevel analysis shows that the socioeconomic status of neighbourhoods has an independent effect on children’s readiness to learn, when controlling for family income and ESL status, in each of the 5 EDI sub-scales. Results indicate that a neighbourhoods’ socioeconomic status statistically accounts for under 3 percent of the variance in children’s readiness to learn. Multilevel analysis for each of the sub-scales show that language and cognitive skills have stronger neighbourhood effects than emotional maturity and social skills, suggesting neighbourhoods may have more influence on certain dimensions of children’s development.
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1 INTRODUCTION

This study consists of an investigation of neighbourhood socioeconomic factors on the readiness to learn of kindergarten children in Vancouver, British Columbia. Readiness to learn, assessed by the Early Development Instrument (EDI), is a measure of early child development that evaluates development in five areas: physical health and well-being, emotional health and maturity, social knowledge and competence, language and cognitive development and communication skills and general knowledge. Because it is administered on kindergarten children it is effectively a measure of a child's pre-school developmental environment. Analysis is carried out separately for each of the five aspects of readiness to learn to evaluate if neighbourhood effects are more salient for particular aspects of readiness to learn. There are two objectives of this study:

1. To determine if there are ecological relations, both statistically and spatially at the neighbourhood level, between children's readiness to learn and neighbourhood socioeconomic characteristics in Vancouver.

2. To determine if neighbourhood socioeconomic characteristics have an independent effect on the readiness to learn of kindergarten children in Vancouver over and above individual socioeconomic status.

To assess the first objective of this study, visual map displays are used to investigate geographic relations between socioeconomic neighbourhood dimensions and readiness to learn across Vancouver neighbourhoods. Correlation and regression analysis is used to assess the ecological relation between neighbourhood socioeconomic variables and readiness to learn at the neighbourhood level. To assess the second objective of this study, multilevel modeling will be used to assess if neighbourhoods exert an independent effect on readiness to learn, after controlling for family characteristics.

Over the last decade there has been a growing interest in the study of neighbourhood effect on children within the disciplines of geography, sociology, psychology, education and epidemiology. Neighbourhood effects research is concerned with understanding how factors operating at the ecological level of the neighbourhood influences individual outcome (Johnson 2000). The discipline of geography though making significant contributions to the study of neighbourhoods and neighbourhood effects on voting behaviour and health (McCulloch 2001; Agnew 1996; Ley 1996; Bunting and Fillion 1991; Johnston 1979; Robson 1969), has not contributed in a substantial way to the present study of neighbourhood effects on children. Mercier and Harris (2000) suggest that the discipline of geography is well positioned to make a meaningful contribution to the study of neighbourhood effects on children.

Numerous studies in the 1990s have found associations between neighbourhood socioeconomic status and child and adolescent outcomes such as completion of high school (Halpern-Felsher et al. 1997; Brooks-Gunn et al. 1993), academic achievement (Entwistle, Alexander, and Olson 1994; Garner and Raudenbush 1991), behaviour problems/criminal activity (Ludwig, Duncan and Hirschfield 1998; Ennett, Fleweling, Lindrooth and Norton 1997; Peeples and Loeber 1994; Loeber and Wilkstrom 1993), sexuality/teenage pregnancy (Billy, Brewster and Grady 1994; Brewster 1994a/b; Brooks-Gunn et al. 1993; Ku, Sonestein and Pleck 1993; Billy and Moore 1992) and smoking (Briggs 1997a; Briggs 1997b; Ludwig, Duncan, and Hirschfield 1998; Billy and Moore 1992; ). This interest has largely stemmed from the disciplines of sociology and...
psychology, which began to consider the importance of ecology on individual outcomes, in the 1970s and 1980s. In sociology, Wilson (1987) argued that individuals living in inner-cities were disadvantaged not only by their own circumstances, but from living in neighbourhoods with concentrated poverty, crime and social disorganisation. In psychology, Bronfenbrenner (1979) put forth the notion that human development is shaped by the multiple ecological contexts in which an individual lives.

The development of multilevel modeling techniques in the 1980s and 1990s has enabled more appropriate calculation of neighbourhood effects – this method takes the hierarchical nature of the data (e.g., individuals within neighbourhoods) into account (Furstenburg and Hughes 1997; Raudenbush and Bryk 2002). This modeling allows for the effects of different contexts (e.g. family, neighbourhood, school, city) on an individual to be statistically modeled, as the structure of the data mimics the structure of the model. Multilevel modeling has become the preferred method for analysing hierarchical data in the social sciences (Gould, Jones and Moon 1997).

Neighbourhood effects studies are typically concerned with the effects of neighbourhood poverty or affluence on the educational and behavioural outcomes of youth (Leventhal and Brooks-Gunn 2000; McCulloch and Joshi 2001). These studies, though heterogeneous in design, have found modest but consistent neighbourhood effects on the outcomes of youth and children (Leventhal and Brooks-Gunn 2000; Furstenburg and Hughes 1997; Brooks-Gunn et al. 1997).

Only a small body of literature which focuses upon neighbourhood effects on young children (under 7 years of age) exists. Until the 1990s it was assumed that neighbourhoods would have little effect on young children who had less direct contact with the neighbourhood than older children and adolescents (Leventhal and Brooks-Gunn 2000; Furstenburg and Hughes 1997; McCulloch and Joshi 2001). Recent theoretical and empirical studies have suggested that neighbourhoods are also salient for young children, however (Leventhal and Brooks-Gunn 2000).

The major theoretical models that explain neighbourhood effects include: neighbourhood institution resource models, collective socialisation models, epidemic models, competition models and relative deprivation models (Jencks and Mayer 1990). Institutional resource models posit that more affluent neighbourhoods receive higher quality resources such as schools and libraries than less affluent neighbourhoods, positively influencing the development of all children in the neighbourhood. Collective socialisation models argue that affluent adults will act as role models, positively influencing the development of behaviour of less affluent children. Epidemic models focus upon how neighbourhood residents influence each other. Since academic achievement tends to be higher in more affluent neighbourhoods, it is assumed that a child, regardless of family socioeconomic status will have higher academic achievement if raised in affluent neighbourhoods. Competition models posit that individuals within a neighbourhood compete for scarce resources and less affluent individuals are less able to affluent neighbourhoods. Relative deprivation models maintain that less affluent individuals will do better if living in a disadvantaged neighbourhood as they will have a better opinion of themselves than if living in an affluent neighbourhood.

Three gaps in neighbourhood effects research on child development have been identified and are addressed in the design of this study. First, neighbourhood effects theory and the large majority of empirical studies have been carried out in the United
States (Small and Newman 2001). The applicability of this theory to other countries is not well understood. Second, few studies that estimate neighbourhood effects on children use multilevel modeling techniques that are required for more accurate estimates of the independent contribution of neighbourhood level factors over and above family level factors. This is due to data limitations of many studies that often lack enough children per neighbourhood to undertake multilevel modeling. Third, most empirical neighbourhood effect studies on child development use indices to estimate neighbourhood socioeconomic status. This has resulted in a lack of understanding about which dimensions of socioeconomic status (e.g., income level, employment, and education) are most relevant for child outcome (Small and Newman 2001).

This thesis is divided into five chapters. Chapter 2 consists of a review of the relevant literature on neighbourhood effects research. It covers the theoretical perspectives and models that attempt to explain the processes and mechanisms through which neighbourhoods influence children. It also covers empirical studies of neighbourhood effects, focusing on how neighbourhoods are studied and the results of empirical studies. Problems and issues in the theoretical and empirical study of neighbourhoods will also be discussed. In Chapter 3 the methodology used in this study will be described. The first part consists of a description of the individual level and neighbourhood level data used for this study. The second part consists of a description of the study design, definition of Vancouver neighbourhoods, and statistical analysis methods. In Chapter 4 the results of the statistical analysis will be presented. Chapter 5 consists of a discussion of the substantive, methodological and conceptual implications of the results, study limitations and suggestions for future research are also considered.
And, you know, there is no such thing as society. There are individual men and women, and there are families.
- Margaret Thatcher 1987

It still takes a village to raise a child.
- Hillary Clinton 1995

2 LITERATURE REVIEW

2.1 INTRODUCTION

The first interest in neighbourhood effects on child and adolescent outcomes can be traced back at least 60 years to the Chicago School of Sociology and the publication of *Juvenile Delinquency and Urban Areas* by Shaw and McKay in 1942. Due to underdeveloped neighbourhood effects theory and a lack of convincing methodology to test for neighbourhood effects academic interest in neighbourhood effects on children was limited until the 1980s (Jencks and Mayer 1990). There was renewed interest in neighbourhood effects on children in the 1980s. This renewed interest has multiple origins that are rooted in developments within the disciplines of psychology and sociology, as these disciplines began to focus attention on the importance of families, neighbourhoods, and communities on child and adolescent outcomes (Leventhal and Brooks-Gunn 2000; Massey 1999; Small and Newman 2001; Furstenburg and Hughes 1997). Consequently, literature that examines neighbourhood effects on early child development is relatively small and has a well-defined lineage less than two decades old (Furstenburg and Hughes 1997; Leventhal and Brooks-Gunn 2000). Unlike neighbourhood effects research published before the 1980s, current research shares similar theoretical frameworks and methodologies. This is evidenced by the publication of *Does it take a Village?* (Booth and Crouter 1999), a collection of papers that assesses current theoretical and methodological issues in neighbourhood effects on children and families, and the publication of *Neighbourhood Poverty: Contexts and Consequences for Children* (Brooks-Gunn et al. 1997) and *Neighbourhood Poverty: Policy Implications in Studying Neighbourhoods* (Brooks-Gunn et al. 1997). Enough research now exists to warrant the publication of several book chapters and journals that thoroughly review the theoretical, methodological and empirical study of neighbourhood effects on children (see Leventhal and Brooks-Gunn 2000; Furstenburg and Hughes 1997; Burton and Jarrett 2001; South 1999; Duncan and Raudenbush 1999ab; Small 1999).

This literature review follows the format of these reviews in many respects. In order to provide a comprehensive review of the literature relevant to this thesis it will touch upon two areas not discussed in previous reviews. First, it brings in the work of geographers who have studied neighbourhoods and neighbourhood context that may shed light into the mechanisms and processes through which neighbourhoods are theorised to operate and influence individuals. Second, it considers the applicability of neighbourhood effects theory, largely developed in response to conditions in the United States, to a Canadian context. This literature review will be divided into four sections. Section 2.2 consists of a discussion of developments in sociology and psychology that have led to the current interest in neighbourhood effects research. A discussion of theoretical frameworks that explain the processes and mechanisms through which
neighbourhoods are hypothesised to influence child development is presented in section 2.3. This section is further divided into three sub-sections. In section 2.3.1, the theoretical neighbourhood effects models identified by Jencks and Mayer (1990) are discussed. Section 2.3.2 discusses of Sampson's (1999) theorization of the processes and mechanisms through which neighbourhood effects operate.

In section 2.4, empirical studies that estimate neighbourhood effects are reviewed. To be included in this review a study had to estimate neighbourhood effects on children under 6 years old and control for family-level variables. In section 2.5 neighbourhood effects research that has taken place within the disciple of geography is discussed. Finally, section 2.6 discusses the applicability of neighbourhood effects theory developed in the United States to a Canadian context.

2.2 ORIGINS OF NEIGHBOURHOOD EFFECT STUDIES

The study of neighbourhood effects as a distinct area of academic inquiry has a short but well-defined history. Since the late 1980s there has been a proliferation of neighbourhood effects studies in education, psychology and sociology which share similar theoretical frameworks and methodologies (Leventhal and Brooks-Gunn 2000; Fürstenburg and Hughes 1997). Although some neighbourhood effect studies did occur before this time they tended to be infrequent and did not use well-established methodologies or theoretical frameworks (Jencks and Mayer 1990; Fürstenburg and Hughes 1997). This is partly due to the fact that statistical techniques were not well developed and statistical software packages were not widely available until the mid-1980s (Jencks and Mayer 1990).

The establishment of neighbourhood effects as a distinct area of academic study during the 1990s is rooted in developments in the disciplines of sociology and psychology in the 1970s and 1980s. William Julius Wilson, a sociologist at the University of Chicago, and Urie Bronfenbrenner, a psychologist at Cornell University, are credited with laying the groundwork for the resurgence in neighbourhood effect studies (Brooks-Gunn et al. 1997; Moen et al. 1995; Small and Newman 2001). These individuals put forth theoretical frameworks that reoriented their respective disciplines towards a consideration of the importance of context in influencing individual outcomes.

In order to study neighbourhood effects on child development a particular theoretical framework of human development is required. Such a framework must allow for the context in which an individual lives to have the capability to play a role in shaping that individuals' development. Neighbourhood effects studies cannot exist under a theoretical rubric that conceives of human development as an outcome, solely, of the individual and his or her characteristics. Thus, the first significant development that set the stage for neighbourhood effect studies was a book by Urie Bronfenbrenner (1979) titled *The Ecology of Human Development.*

In this influential book, Bronfenbrenner argued against prevailing models of human development that perceived development to be solely determined by individual characteristics, ignoring the environment in which an individual lives. He put forth a new

---

1 The term 'neighbourhood effects' in this study refers to the effect of neighbourhood-level socioeconomic factors on child development. Neighbourhood effect research concerned with the influence of neighbourhood and place on health status, health behaviour, voting behaviour, political views etc. will be referred to explicitly.
theory of human development that emphasised the importance of the multiple contexts in which an individual lives and grows. This theory redefined human development as a process in which the growing person is affected by the manner in which they perceive and act in their ecological environment (Bronfenbrenner 1979). Bronfenbrenner’s model of human development is premised upon how an individual perceives and mediates the influence of external contexts. Bronfenbrenner’s model divided context, or the ecological environment, into four nested levels based on the proximity at which they operate upon the individual:

1. A microsystem is a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics (e.g., daily routine of an individual).
2. A mesosystem comprises the interrelations among two or more settings in which the developing person actively participates (e.g., school and family).
3. An exosystem refers to one or more settings that do not involve the developing person as an active participant, but in which events occur that affect, or are affected by, what happens in the setting contains the developing person (e.g., political change).
4. The macrosystem refers to consistencies, in the form of content and lower-order systems (micro-, meso-, and exo-) that exist, or could exist, at the level of the subculture or culture as a whole, along with any belief system or ideology underlying such consistencies (e.g., belief in democracy, freedom etc.).

Source: Bronfenbrenner (1979) pg.22-26

Bronfenbrenner’s theoretical work laid the foundations for academic inquiry focusing on the role of the family and neighbourhood in human development (Moen et al.1995). The importance of his work is evidenced by the volume Examining Lives in Context (Moen et al.1995) which pays tribute to Bronfenbrenner and the lasting influence of his work. His analysis provided a theoretical framework that allowed neighbourhood residence to be seriously studied as a measurable influence on child development. His work did not, however, provide a methodology for studying neighbourhoods nor a theory that details the mechanisms and processes by which neighbourhoods influence a developing child.

The second significant development that led to the current level of interest in neighbourhood effects was the publication of The Truly Disadvantaged by Wilson in 1987, which examined inner-city poverty in the United States (Small and Newman 2001; Leventhal and Brooks-Gunn 2000; Massey 1999; Furstenburg and Hughes 1997). Interest in the consequences of urban poverty and impoverished urban neighbourhoods has its origins in the early part of the 20th century with the Chicago School Sociologists (see Shaw and McKay 1942; Park and Burgess 1924). By the 1960s, however, such interest in understanding the importance of social context on human behaviour had dwindled (Massey 1999, Small and Newman 2001). Wilson (1987), in his documentation of spatially concentrated poverty within inner-cities in the US, refocused attention on the existence of multiple forms of disadvantage within impoverished neighbourhoods (Small
and Newman 2001; Massey 1999; Small and Supple 1999). He argued that structural changes in the economy associated with deindustrialisation after the 1960s, increased joblessness in the inner cities. As conditions within the inner city residential areas began to deteriorate, those employed departed for suburbs, creating an unemployed ‘underclass’ in the inner-city (Wilson 1987). Wilson further argued that poor individuals residing in poor neighbourhoods were faced with added disadvantages that went beyond individual circumstances (Wilson 1987). This significant book reoriented sociology in North America and led to a rediscovery of the importance of family, neighbourhood and culture on human outcomes (Small and Newman 2001; Massey 1999).

A forerunner of the term neighbourhood effects, Wilson coined the term concentration effects to describe the extra disadvantage that poor people incur from living in a disadvantaged neighbourhood (Furstenburg and Hughes 1997). He drew upon social disorganisation theory from the Chicago School, which posits that neighbourhood social organisation can influence individual behaviour. Socially organised neighbourhoods are able to establish common norms, beliefs and principles among residents and adults are typically engaged in daily routines of employment activities. Specifically, he argued that poor neighbourhoods are characterised by social disorganisation, as the majority of families are not involved in the daily routines associated with employment activities. In contrast, affluent neighbourhoods in which adults are engaged in daily routines structured around employment activities are highly organised. Socially disorganised neighbourhoods are hypothesised to negatively influence child and adolescent outcomes. Wilson argued that a child with unemployed parents, living in a poor inner-city neighbourhood, is more likely to be unemployed as an adult, than if he or she lived in an affluent neighbourhood where he or she is exposed to adults that are engaged in daily routines structured around work. Wilson’s research stimulated interest in theoretically understanding how neighbourhood poverty may influence the outcomes of individuals and empirically measuring neighbourhood effects (Leventhal and Brooks-Gunn 2000; Small and Newman 2001; Massey 1999).

Wilson (1987) and Bronfenbrenner (1978), in reorienting their respective disciplines of sociology and psychology towards a consideration of the importance context on an individual’s life, laid the foundation for the study of neighbourhood effects. Neither Bronfenbrenner nor Wilson proposed methodologies to study neighbourhood context or quantitatively estimate the magnitude of neighbourhood effects. Rather, their work was important because they put forth theoretical models that placed emphasis on the importance of the neighbourhood. Researchers in the 1980s and 1990s have elaborated upon their theoretical frameworks to investigate the processes and mechanisms through which neighbourhoods influence individuals and have developed methodologies for measuring neighbourhoods and estimating neighbourhood effects.

2.3 REVIEW OF THEORETICAL LITERATURE

Theoretical understanding of the processes and mechanisms through which neighbourhoods influence child development has progressed considerably since the 1990s. It is widely noted that theoretical understanding of neighbourhood effects on child development has advanced much faster than empirical work (Furstenburg and Hughes 1997; Duncan and Raudenbush 1999b; Leventhal and Brooks-Gunn 2000). This is due to difficulties in implementing methodologies and techniques for measuring
neighbourhood processes and mechanisms theorised to influence child development. Jencks and Mayer (1990) published a review article titled The Social Consequences of Growing up in a Poor Neighbourhood, which has become a classic paper in neighbourhood effects research (Leventhal and Brooks-Gunn 2000). In this paper Jencks and Mayer (1990) review past research on the consequences of growing up in a poor neighbourhood in order to find theoretical and empirical support for neighbourhood effects. From this review Jencks and Mayer (1990) identified and named five models that theorise how neighbourhoods may influence child and adolescent outcomes. The five models are as follows: neighbourhood institutional resource models, collective socialization models, epidemic models, competition models and relative deprivation models. These frameworks have become fundamental to neighbourhood effects research; most studies are structured around testing one or more of these models of neighbourhood effects (see Brooks-Gunn and Duncan 1993).

Recent theoretical research on neighbourhood effects by Sampson (1999) and Sampson, Morenoff and Earls (1999) has prompted Leventhal and Brooks-Gunn (2000) to propose an alternative theoretical framework to Jencks and Mayer. Leventhal and Brooks-Gunn (2000) propose that 3 pathways: institutional resources, relationships, and norms/collective efficacy, be used as a theoretical base for studying neighbourhood research, an extension of Jencks and Mayer’s models.

2.3.1 Neighbourhood effects models

In their identification of five models that specify how the social composition of a neighbourhood influences young people’s behaviour, Jencks and Mayer (1990) identify three disparate schools of thought than underlie these models.

2.3.1.1 Advantages of socioeconomically advantaged neighbourhoods

The first school of thought assumes that advantaged neighbourhoods encourage positive outcomes among residents. This framework has garnered the most support from social scientists. Three models identified by Jencks and Mayer (1990) have been put forth by social scientists to explain how advantaged neighbourhoods confer advantages upon their residents. First, epidemic models focus upon the ways in which neighbourhood residents, especially peers, influence each other. Such models assume that children who grow up in neighbourhoods where peers graduate from high school will be more likely to graduate themselves. Because problem behaviours (e.g., stealing, crime, teenage pregnancy, and school non-completion) are more common in poor neighbourhoods, it is assumed that children raised in these neighbourhoods will behave worse than if raised in affluent neighbourhoods. To be credible, epidemic models allow for individual differences, as every individual in a neighbourhood will not conform to every set of norms in a neighbourhood.

In contrast to epidemic models that focus on peer influence, collective socialisation models focus on how adults in a neighbourhood influence young people who are not their children. Affluent adults who are educated and employed act as role models for young people, showing that success is possible if you are educated and work hard. Affluent adults act as enforcers, monitoring young peoples’ behaviour, maintaining order, and intervening when necessary. These adults, in acting as enforcers, teach young people to behave appropriately.
Institutional resource models are the final type of models which assume advantaged neighbourhoods confer advantages on residents. These models focus on the way adults who live outside the community, but work in neighbourhood institutions like schools, libraries, and police stations affect children. They are premised on the assumption that these affluent neighbourhoods will receive more capable workers than disadvantaged neighbourhoods, influencing child outcomes. For example, affluent neighbourhoods may receive better teachers than poor neighbourhoods influencing how well children learn. Similarly, affluent neighbourhoods may have higher quality daycares and sport coaches than poor neighbourhoods, and this may influence child outcomes.

All of these models hypothesise that advantaged neighbourhoods confer benefits on all residents regardless of socioeconomic status. Consequently, empirical testing of these models separately is problematic using neighbourhood socioeconomic data (Duncan and Raudenbush 1999a). For example, a positive relation between a neighbourhoods' socioeconomic status and individual outcomes could be due to epidemic, institutional resources or collective socialisation models as they all hypothesise this relationship. These models, then, are more useful as a way of thinking about the mechanisms through which advantaged neighbourhoods may be beneficial for all residents (Leventhal and Brooks-Gunn 2000)

2.3.1.2 Disadvantages of socioeconomically advantaged neighbourhoods

The second school of thought identified by Jencks and Mayer (1990) assumes that growing up in affluent neighbourhoods is disadvantageous for a less affluent individual. Three models, relative deprivation, cultural conflict, and competition for scarce resources fall into this school of thought. First, relative deprivation models argue that people judge themselves, and their success, by comparing themselves with those around them. According to this model, children will judge their economic position by comparing themselves to the standard of living of peers and neighbours. Similarly, children will base their academic capabilities in relation to that of their classmates. Given that affluent children tend to do better in school than less affluent children, a less affluent child in an affluent school will have a more favourable opinion of their abilities than if they attended an affluent school. This model posits that less affluent individuals living in an affluent neighbourhood will not have a favourable opinion of themselves or their abilities, negatively influencing outcomes, as some adolescents, for example, may drop out of school feeling they cannot compete with classmates. It has also been suggested that feelings of inadequacy may cause some to strive for a higher standard of achievement.

Second, cultural conflict models are similar to relative deprivation models, but focus on how groups create a common culture. This model argues that when a large number of individuals are unable to conform to what society expects them to do, they create a common culture that rejects traits the rest of society regards as desirable. Thus, it is hypothesised that disadvantaged neighbourhoods create a common culture where middle-class values such as receiving an education and obtaining employment are rejected. Children growing-up in these neighbourhoods would be less likely to become employed or stay in-school due to the common neighbourhood culture that rejects such behaviours.

Third, competition for scarce resources model is the final model that falls under the school of thought that considers advantaged neighbourhoods to be unfavourable for
disadvantaged individuals. This model argues that individuals within a neighbourhood compete for jobs, grades, and other resources. Thus, the presence of affluent neighbours, who are better equipped to compete, will result in less affluent individuals receiving fewer resources (e.g. less desirable jobs) than if they lived in a less affluent neighbourhood.

2.3.1.3 Irrelevance of neighbourhoods

The third school of thought outlines by Jencks and Mayer (1990) argues that advantaged neighbourhoods have no influence on individual outcomes. Rather, individuals determine their own outcomes irrespective of neighbourhood of residence. This view is supported, mainly by individualists, who believe neighbourhoods have no effect on individual behaviour.

2.3.2 Neighbourhood processes and mechanisms models

These schools of thought outlined by Jencks and Mayer (1990) have guided theoretical discussions of neighbourhood effects in the 1990s (Leventhal and Brooks-Gunn 2000). However, recent work by Sampson (1999), drawing upon social disorganisation theory and social control theory, has led to the development of an alternative theoretical structure to Jencks and Mayer (1990). Rather than putting forth discrete models like Jencks and Mayer (1990), Sampson (1999) employs a theoretical approach that probes social mechanisms within neighbourhoods that are deemed relevant for child and adolescent development. Neighbourhood effects, in this theoretical framework, operate through two related avenues: community social organisation and social control. Social organisation refers to the ability of a community to establish common norms, beliefs and principles, while social control refers to the ability of a community to regulate its self according to desired principles (established through social organisation). According to this theory, neighbourhoods with a greater level of social organisation and control are more equipped to create a neighbourhood environment that is beneficial for the developing child.

Sampson (1999) outlines three aspects of community organisation and control that have salience for child development. First, social capital and collective efficacy are two related aspects of social control that are important for maintaining and establishing community norms that can support children. Sampson (1999) marries social disorganisation theory and Coleman's (1988) social capital theory as he posits that socially disorganised neighbourhoods have less social capital than more socially organised neighbourhoods. Social capital is defined by Coleman (1988) as a community resource that is lodged in the relations between people that facilitates action and the establishment of common goals and norms. Thus, neighbourhoods with high levels of social capital will have more social organisation than neighbourhoods with less social capital. Social capital is thought to impact child development as children's development is supported through neighbourhoods that are able to establish common goals and norms that support children.

Related to social capital is collective efficacy, the “linkage of mutual trust and shared willingness to intervene for the common good (Sampson 1999 pg.10).” An example of collective efficacy is the practice of neighbours who collectively monitor local children, ensuring safety and appropriate behaviour. Three mechanisms drawn from
Coleman (1988) have been identified by Sampson, Morenoff, and Earls (1999) that may potentially produce collective efficacy for children: (1) *intergenerational closure*, which occurs when the adults and children in a community know each other, allowing the establishment of child behaviour and parenting norms; (2) *reciprocated exchange*, which is the interaction of parents in a community who develop friendships, share advice, and consequently establish parenting norms and personal ties within the community; (3) *informal social control and mutual support*, which is the shared expectation that neighbourhood residents will intervene on the behalf of children. While collective efficacy and social capital for children share similarities, Sampson, Morenoff and Earls (1999) point out an important difference:

"Social capital for children refers to the resource potential of personal and organizational networks, whereas collective efficacy is a task-specific construct that refers to the shared expectations and mutual engagement by adults in the active support and social control of children." (pp. 635)

The second aspect of community control that has salience for child development is the construct *institutions and public control*, which consider the place of a community in the wider political system. A community with strong local institutions is better able to lobby for public resources (e.g. libraries, police, schools, hospitals) which promote community stability and public order/control. Such resources and institutions may positively influence the developing child.

The final aspect of the framework of community control and organisation Sampson (1999) outlines as having relevance for child development is *routine activities*. This component argues that illegal activities depend upon the time and space patterns of routine legal activities. For example, the presence of unsupervised areas in a neighbourhood may be conducive to adolescents engaging in problem behaviour. Routine activities in some neighbourhoods may provide increased opportunity for behaviours that may be either beneficial or detrimental to child and adolescent outcomes.

This theoretical framework proposed by Sampson (1999) attempts to understand the processes and mechanisms through which neighbourhood social organisation may affect child and adolescent development. This is in contrast to the models identified by Jencks and Mayer (1990) that hypothesize relations between child outcomes and neighbourhood dimensions, but do not identify how specific dimensions of neighbourhoods may influence children and adolescents (Leventhal and Brooks-Gunn 2000). Recent publications on neighbourhood effects have drawn upon Sampson’s ideas of collective efficacy and social capital (see Willms 2000; Earls and Carlson 2001; Arum 2001; Small and Supple 1999; Massey 1999), suggesting that the models identified by Jencks and Mayer (1990) are no longer adequate.

In this section a discussion of the theoretical frameworks that have been put forth in order to understand the pathways and mechanisms through which neighbourhoods influence child outcomes has been presented. Jencks and Mayer (1990) put forth five models that explain how neighbourhoods influence outcome individuals. Sampson (1999) has put forth an alternative theory that probes the mechanisms and pathways through which neighbourhood effects operate. In the following section attention will turn towards empirical studies that attempt to measure neighbourhood effects.
2.4 REVIEW OF EMPIRICAL LITERATURE

This section will consist of a review of existing empirical studies that have estimated neighbourhood effects on child development. To be included in this review a study has to satisfy four criteria. First, it had to empirically test for neighbourhood effects on some child development outcome using established statistical procedures, either multiple regression or multilevel modeling. Second, the statistical models had to control for children's family characteristics. Third, studies had to test for neighbourhood effects on the development of children 6-years and under. Fourth, the study had to appear in a refereed journal or chapter in an edited book. Only a limited number of studies meeting these criteria were found, they are listed in Table 2.1. Several researchers have pointed out this scarcity, as the majority of neighbourhood effects focus on adolescents rather than children (Furstenburg and Hughes 1997, Brooks-Gunn et al. 1993; Brooks-Gunn et al. 1997; Leventhal and Brooks-Gunn, 2000). This is due to the assumption that neighbourhoods matter more for older children who spend more time outside the home than younger children. However, recent research has suggested that neighbourhoods do matter for young children – especially during the transition to school (Brooks-Gunn et al. 1997; Small and Newman 2001). Small and Newman (2001) have noted that recent research has shown neighbourhood effects to influence child development and such effects are strongest during early childhood and late adolescence. This section focuses upon the study design, methodologies, findings, and limitations of the empirical studies included in this literature review.

2.4.1 Study designs

Neighbourhood effect studies have typically used one of three types of designs to estimate neighbourhood effects: city-based designs, national designs and selected site designs. A description of each is followed by a comparison of the study designs.

City-based study designs attempt to estimate neighbourhood effects using data limited to a particular region or city. Kalff et al. (2001) employs a city-based design to study neighbourhood effects in the Netherlands City of Maastricht using city-wide data from children aged 6 attending second grade Kindergarten. They found that child behaviour problems were more prevalent in deprived neighbourhoods. The data sample included 734 children living in 36 neighbourhoods, with an average of 20 children per neighbourhood. The number of children per neighbourhood varies given that there is not an even distribution of children across the city. Thus, a problem with city-based designs is that they are not carried out to ensure even sampling across neighbourhoods. However, city-based designs are advantageous because they allow variation between and within neighbourhoods to be estimated. Multilevel modeling techniques, which are required to statistically estimate neighbourhood effects, can therefore be carried out in most city-based designs.

Neighbourhood effects are most often studied using data from national longitudinal studies of children and families (see McCulloch and Joshi 2001; Chase-Lansdale and Gordon 1996; Chase-Lansdale et al. 1997). Such data sets include the National Longitudinal Study of Youth in the United States and the British National Child Development Study in Britain. These studies typically consist of a nationally representative sample of children and youth with few children per neighbourhood. For example, in the National Longitudinal Study of Youth 70 percent of children are the only
child in their neighbourhood (represented by census tract) (Chase-Lansdale and Gordon 1996; Chase-Lansdale et al. 1997). These studies obtain neighbourhood measures by using census data from the census tract in which each child resides. These studies can compare neighbourhood effects between large geographical regions. Chase-Lansdale and Gordon (1996) have estimated neighbourhood effects for the South, West, Midwest and North-eastern United States using the National Longitudinal Survey on Youth. Multilevel modeling is not possible with these studies because variation between neighbourhoods cannot be measured as neighbourhoods typically have data for only a single child. These studies use multiple regression to estimate neighbourhood effects which does not take the hierarchical nature of the data into account. The estimates obtained from these statistical methods are not as robust as those obtained through multilevel modeling (Raudenbush and Bryk 2002).

The third type of study design that has been used to estimate neighbourhood effects on child development are selected site studies. These studies use data that is collected at a limited number of places; for example, children born at a particular hospital or who participate in a particular program. The Infant Health and Development Program is an example of such a dataset that has been used by Brooks-Gunn et al. (1993), Chase-Lansdale et al. (1997), Duncan, Brooks-Gunn, and Klebanov (1994), Klebanov et al. (1998) to estimate neighbourhood effects on child development. These studies allow neighbourhood effects to be estimated within a single region and comparisons to be made between regions. Like national designs, these studies do not have enough neighbourhoods and enough children per neighbourhood to estimate variation within neighbourhoods and are consequently limited to the use of multiple regression and ordinary least squares regression to estimate neighbourhood effects.

Each of these research designs has advantages and limitations. Leventhal and Brooks-Gunn (2000) have found that multi-site and national study designs have stronger and more consistent estimates of neighbourhood effects. However, the limited number of study participants per neighbourhood results in an underestimation of neighbourhood effects (Chase-Lansdale and Gordon 1996).

Recently it has been recognized that multilevel analysis, or hierarchical linear modeling (HLM), is required to accurately estimate neighbourhood/contextual effects (Bryk and Raudenbush 2002; Furstenburg and Hughes 1997; Gould Jones and Moon 1997; McCulloch and Joshi 2001; Pickett and Pearl 2001). Only one study, McCulloch and Joshi (2001), uses multilevel analysis to estimate neighbourhood effects. HLM estimates variability within neighbourhoods and between neighbourhoods, mimicking the theoretical assumption that both neighbourhoods and families influence child development. Both multi-site and national study designs cannot typically use multilevel modeling because there are too few study participants per neighbourhood to measure variability within a neighbourhood. Duncan and Raudenbush (1999a) note that 15-30 study cases per neighbourhood are required for multilevel modeling. City-based designs can use multilevel modeling techniques provided that there are enough study children per neighbourhood. In order for more multilevel analyses of neighbourhood effects to take place, neighbourhood-based study designs are necessary. No neighbourhood-based study designs that estimate neighbourhood effects on child development exist. Neighbourhood-based designs are focused upon the neighbourhoods: sampling is conducted to obtain a particular number of neighbourhood and study participants per neighbourhood, allowing
multilevel modeling. Duncan and Raudenbush (1999a) are hopeful that new study
designs will enable more accurate estimations of neighbourhood effects.

2.4.2 Definition of neighbourhoods

This section will focus upon the neighbourhoods in neighbourhood effects studies. Neighbourhoods, conceptually, are spatial units in which individuals and families interact in a social context with institutions and societal agents that control access to community resources (Aber et al. 1997). In order for neighbourhood-effects to be estimated empirically, neighbourhood spatial units must be defined and particular characteristics of neighbourhoods much be measured. This section will discuss three aspects of neighbourhoods relevant to neighbourhood-effects research: (1) how neighbourhoods are defined; (2) how neighbourhood context is measured; and (3) what characteristics of neighbourhoods have been found to be relevant for children. As shown in Table 2.1, all studies reviewed here use census tracts as proxies for neighbourhood units. Census tracts are administrative geographic units containing approximately 3000-5000 people for which a wide range of demographic data is collected every decade in the United States (Duncan and Raudenbush 1999a). Lee (1999) and Aber et al. (1997) point out that census tracts are used because of the availability of census data rather than strong theoretical evidence linking the census tract to the level which neighbourhood effects operate. However, a recent study by Overman (2002) has shown that neighbourhood effects on adolescents in Australia operate at multiple geographic scales, but these effects are strongest at the census tract level suggesting they are acceptable approximations of neighbourhoods.

2.4.3 Measurement of neighbourhood attributes

The neighbourhood effect studies reviewed here are concerned with estimating the association between neighbourhood characteristics and child development outcomes. In order to undertake such research, characteristics of neighbourhoods that are considered salient for children's development need to be measured. The studies reviewed all use census data to estimate characteristics of neighbourhoods that are thought to influence child development. Although census variables do not measure all relevant neighbourhood characteristics, neighbourhood data from other sources such as resident interviews and ethnographies are difficult to obtain, expensive and labour intensive, especially for large scale studies (Aber et al.1997). National censuses take place every five years in Canada and provide information on the ethnic, social, and economic characteristics of populations at the level of the census tract. More limited information is available at the level of the enumeration area (app.120 households) in some nations. Table 2.1 shows the characteristics of neighbourhoods, obtained from census data, used in the studies reviewed here.

The census-based neighbourhood dimensions used in the studies reviewed here were selected based on theoretical models of neighbourhood effects identified by Jencks and Mayer (1900) and statistical analysis. Theoretical approaches have, in most cases, selected census variables that most closely approximate theoretically identified neighbourhood dimensions that may influence child outcomes. Statistical approaches generally combine several census variables into a single index.
Table 2.1 Studies estimating neighbourhood effects on child outcomes

<table>
<thead>
<tr>
<th>Study Author/Year</th>
<th>Published Findings</th>
<th>Study</th>
<th>Design</th>
<th>Dependent sample and measure</th>
<th>Neighbourhood-level measures</th>
<th>Statistical Methods</th>
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<tbody>
<tr>
<td>McCulloch and Joshi (2001)</td>
<td>Association between neighbourhood poverty and poor child outcomes.</td>
<td>British National Child</td>
<td>Children born to women who participated in the British National</td>
<td>2290 Children; 609 aged 8-10, 1057 aged 6-9, and 760 aged 10+.</td>
<td>-% labour force underemployed -% no car access -% household with 1 room per person or greater -% households rent</td>
<td>Regression</td>
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<td>Child Development Study</td>
<td>Child Development Study</td>
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<td>Klebanov (1994)</td>
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<td>Program (I HDP)</td>
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<td>(1996)</td>
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<tr>
<td>McCarton, and McCormick</td>
<td>at age 3. No association between low income and IQ of 1- and 2-year-olds.</td>
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<td>Survey of Youth</td>
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<td>(1998)</td>
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<td>Klebanov and Sealand (1993)</td>
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<tr>
<td>Study</td>
<td>Description</td>
<td>Sample</td>
<td>Measures</td>
<td>Variables</td>
<td>Methodology</td>
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<tr>
<td>Kalff et al. (2001)</td>
<td>Child behaviour problems more frequent in families living in deprived neighbourhoods</td>
<td>Study of Attention disorders in Maastricht and Attention Deficit/Hyperactivity Disorder Children living in Maastricht, the Netherlands born 1990-91.</td>
<td>734 Children aged 5-7 (1417 eligible). Behaviour Measure: - Child behaviour checklist (parent completed) Family measures: - Parental marital status - Parental occupation, 8 point scale from high school to university - Parental occupation - Parental country of birth</td>
<td>36 Neighbourhoods in Maastricht. Variables: - unemployment rate - dependence on social welfare - single parent families - non-voters - foreign born - migrants (combined into 3-levels of deprivation)</td>
<td>Multilevel analysis</td>
<td></td>
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<tr>
<td>Study</td>
<td>Sample Description</td>
<td>Measures</td>
<td>Methods</td>
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<tr>
<td>Chase-Lansdale, Gordon, Brooks-Gunn, and Klebanov (1997)</td>
<td>Positive association with girls problem behaviour (aged 5-6) and high SES; Negative association between boys (aged 5-6) internalizing problem behaviour and low SES; Ethnic diversity positive association with 5-6 year old externalizing behaviour problems; Positive association between male joblessness and 3-4-year old European American externalizing and internalizing behaviour problems.</td>
<td>Tests of Mathematics and Reading (PIAT) Family Measures: - Female headship - Number of adults in household - Mother's employment status - Mother's age at birth - Family income - Home environment, measured by 55 item interview.</td>
<td>- Concentration - Racial Similarities</td>
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Four studies reviewed here (Brooks-Gunn et al. 1993; Duncan, Brooks-Gunn, and Klebanov 1994; and Klebanov et al. 1998; Chase-Lansdale and Gordon 1996) have selected neighbourhood dimensions from census data that most closely approximate theoretical models of neighbourhood effects. These studies use the theoretical models identified by Jencks and Mayer (1990) to guide the choice of census variables. Brooks-Gunn et al. (1993) select the variables female headship, male joblessness, racial composition, and people receiving public assistance based on the models identified by Jencks and Mayer (1990). Following the collective socialization model, female headship is selected because it is thought that a neighbourhood with a high proportion of female-headed single parent families will reduce the number of adults available for monitoring children’s behaviour in the neighbourhood (Brooks-Gunn et al. 1993). The collective socialization model also presumes that neighbourhoods with a high proportion of unemployed males will reduce the number of role models in a neighbourhood that can show children the benefits of staying in school, working hard, and obtaining employment. Following this theory, Brooks-Gunn et al. (1993) also select the variables male joblessness and people receiving public assistance. Ethnicity has been selected to test the cultural conflict model discussed by Jencks and Mayer (1990), which argues that neighbourhoods that are ethnically mixed will negatively influence child outcomes.

The neighbourhood dimensions selected by Brooks-Gunn et al. (1993) have become the standard variables used in many succeeding neighbourhood effect studies. Table 2.1 shows that Chase-Lansdale and Gordon (1996), Klebanov et al. (1998) and Chase-Lansdale et al. (1997) have used almost identical neighbourhood dimensions. The use of similar census variables in the majority of neighbourhood-effects studies is beneficial because it allows for the results of different studies to be compared. However, given the availability of over 250 census variables, it is possible that other relevant theoretically based neighbourhood dimensions are being overlooked.

The second method employed to measure neighbourhood dimensions from census data is to create indices through statistical techniques such as factor analysis and principal component analysis. Of the studies reviewed, Kalff et al. (2001) and McCulloch and Joshi (2001) have employed a statistical approach to measure neighbourhood dimensions. Kalff et al. (2001) undertook principal component analysis on the following census variables: unemployment rate, dependence on social welfare, single parent families, non-voters, foreign born, and migrants. The principal component of these variables was divided into a three-level index which represented the most, intermediate and least socioeconomically deprived neighbourhoods. While not providing theoretical justification for the selection of these variables, Kalff et al. (2001) point out that they have been used in a previous study. McCulloch and Joshi (2001) use the Townsend deprivation index which combines neighbourhood socioeconomic characteristics into a single measure. A problem with selecting neighbourhood dimensions based on statistical analysis is that these dimensions do not directly relate to a particular theoretical model of neighbourhood effects (Leventhal and Brooks-Gunn 2000).

Often neighbourhood effect studies use statistical techniques to measure neighbourhood dimensions (Leventhal and Brooks-Gunn 2000). Typically this involves the use of statistics to create indices from a selected set of census variables. As indices have both advantages and drawbacks, their use has been a source of contention in neighbourhood effects research (Lee 1999). The merit of indices is statistical efficiency
and that they allow neighbourhoods to be ranked against each other for comparison (Pickett and Pearl 2001). Analysing many single variables (e.g., unemployment, income, lone parent families) may lead to high levels of multicollinearity between variables which can make interpreting results difficult, especially when the intention is to examine a single dimension such socioeconomic status (Pickett and Pearl 2001; Overman 2002). Unfortunately, indices are often employed ad hoc, with different researchers using different variables, making comparisons between studies difficult and replicating studies problematic (Small and Newman 2001). For example, none of the neighbourhood effects studies reviewed here provide adequate detail to replicate indices created. Furthermore, indices make it difficult to discern which neighbourhoods’ characteristics affect people as they are clustered together obscuring their individual effect (Small and Newman 2001). Because indices lump together neighbourhood characteristics such as unemployment, lone parent families, and racial homogeneity, any statistical outcome will not discern which particular characteristics are more salient for child development. The index, therefore, will fail to identify particular neighbourhood variables which may be causing neighbourhood effects (Small and Newman 2001). Indices also mask variation between neighbourhoods—it is possible that two areas with the same score will differ in the variables contributing to that score (Pickett and Pearl 2001). Small and Newman (2001) suggest that future neighbourhood effects research not use indices.

2.4.3.1 Relevant neighbourhood dimensions

All of the studies reviewed here use census data to estimate the effect of neighbourhood context on child development, while taking family-level variables such as family income and parental education into account. The following paragraphs consider the census-based neighbourhood characteristics that have been found to be relevant for child development, and the benefits and limitations to the use of census data. Table 2.1 provides a full list neighbourhood dimensions associated with child outcomes.

In the studies reviewed here, measures of neighbourhood socioeconomic status (SES) have been found to be significantly associated with child development. Chase-Lansdale and Gordon (1996) found a composite index of occupational status, income and education level of a neighbourhood to be positively associated with 5- and 6-year olds’ internalizing behaviour problems and reading achievement. Chase-Lansdale et al. (1997) found an association between high SES and 5- and 6-year old boys reading and achievement, and three year old European American boys IQ. This study also found an association between 3-year olds IQ and high SES neighbourhoods. Klebanov et al. (1998) has found a positive association between affluent neighbourhoods and 3-year olds IQ, but not the IQ of 1- and 2-year olds. Duncan, Brooks-Gunn, and Klebanov (1994) and Brooks-Gunn et al. (1993) have both found a positive association, using data from the Infant Health and Development Program, between the presence of affluent neighbours and the IQ 5-year olds. Chase-Lansdale and Gordon (1996) found a positive association between neighbourhood socioeconomic status (measured by an average of neighbourhood income, education level and occupational status) and 5- and 6-year olds cognitive functioning and internalising behaviour problems when family-level variables are taken into account. When controlling for family characteristics only high SES neighbourhoods were significantly positively associated with 3- and 4-year olds IQ. McCulloch and Joshi (2001) found cognitive test scores of children to be negatively associated with increasing
neighbourhood deprivation. Kalff et al. (2001) found an association between child behaviour problems, measured by the Child Behaviour Checklist and SES. Both McCulloch and Joshi (2001) and Kalff et al. (2001) used indices to measure neighbourhood socioeconomic status. The exact procedures used to create these indices are not fully described by the authors making appraisal of their techniques and results difficult. Though conducted using different measures and methods, the studies reviewed here consistently find neighbourhoods with high SES to be positively associated with children’s cognitive and behavioural outcomes. This suggests that neighbourhood affluence is salient for the development of young children.

Several studies have also found associations between child outcomes and neighbourhood characteristics other than SES measures, although evidence for these measures tends to be less consistent. Chase-Lansdale et al. (1997) found ethnic diversity to be negatively associated with 5- and 6-year old boys’ behaviour problems, and male joblessness to be negatively associated with boys’ reading achievement and verbal IQ. This may suggest that neighbourhood structural dimensions matter more for boys than for girls. The same study found ethnic diversity to be negatively associated with 5- and 6-year old verbal IQ scores and cognitive test scores. Brooks-Gunn et al. (1993) have found a negative association between the percent employed as managers/professionals and 3-year old behaviour problems. Population density at the neighbourhood level has also been found to be associated with the cognitive test scores of 5- and 6-year olds. Male joblessness has also been found by Chase-Lansdale and Gordon (1996) to be associated with 5- and 6-year olds internalising and externalising behaviour problems for African American children but not white children. This indicates that neighbourhood effects may operate differently on whites than on African Americans.

With the exception of Kalff et al. (2001) who use multilevel modeling, all of the studies reviewed here use ordinary least squares regression to estimate the amount of variation that can be accounted for by neighbourhood level variables. After controlling for family level factors, neighbourhood effects in the studies reviewed here are modest but consistent. After controlling for family income neighbourhood effects accounted for less than 5% of the variation in child outcomes. Duncan, Brooks-Gunn, and Klebanov (1994) found that for each 10% increase in the proportion of affluent neighbours, IQ scores of 5-year old boys’ increased 1.6 points, contributing to 1% of the variance in children’s achievement. Chase-Lansdale and Gordon (1996) found that neighbourhood context contributes to 2.8% of the variance in children’s verbal ability. Examined separately, this study also finds that neighbourhood effects on internalizing and externalizing behaviour problems for the north-west and south-east US account for 0.5 to 6.9% of the variance in children’s behaviour. This suggests that there may be regional differences in neighbourhood effects. These studies indicate that the explained variance attributed to neighbourhood context is modest but consistent between studies. This may also be partly due to the use of census data which mainly measures the compositional structural characteristics of neighbourhoods rather than the processes through which specific attributes of neighbourhoods may influence child development, but may also be attributed to the use of inadequate statistical techniques.

2.4.3.2 Issues in neighbourhood measures
Achieving robust, unbiased estimates of neighbourhood effects has proven to be difficult a task in the literature to date. Many problems arise in the definition and measurement of neighbourhoods which are unlikely to be easily solved. This section of the literature review consists of a discussion of the major problems and issues in examining and measuring the neighbourhood in neighbourhood effects research.

Obtaining measures of neighbourhood context that closely approximate processes and mechanisms theoretically linked to child outcomes is necessary to achieve reliable estimates of neighbourhood effects. Three problems in achieving reliable estimates of neighbourhood effects that pertain to the neighbourhood level will be discussed: (1) the selection of appropriate spatial neighbourhood units; (2) the simultaneity problem; and (3) the omitted-context variable problem.

In order to obtain accurate estimates of neighbourhood effects, neighbourhoods should be studied at the geographic scale at which these processes are thought to operate. There has been significant debate about the use of census tracts as neighbourhoods in neighbourhood effects literature (Leventhal and Brooks-Gunn 2000). It has been suggested in that neighbourhoods should approximate the size and boundaries of neighbourhoods reported by residents rather than simply using census tracts (Furstenburg and Hughes 1997; Clumpet-Lundquist 1998). Evidence suggests that census tracts, despite being administrative units, do approximate the actual size of resident reported neighbourhoods. Sampson (1997) justifies the use of census tracts in neighbourhood-effects research through resident interviews which indicates census tracts (app. 3,000-5,000 people) reasonably approximate residents reported size of their neighbourhood (average 25 blocks). Similarly, Lee (1999) in a study of 612 people found the average person reported their neighbourhood to be 20 blocks, which approximates the size of a census tract. Lee (1999) also found significant variations in resident reported neighbourhood size suggesting that the mean may not be a useful measure of average neighbourhood size. While the mean reported neighbourhood size was 20 blocks, the standard deviation was 71.7 and neighbourhood size ranged from 1 to 900 blocks, revealing huge variations in what individuals define as their neighbourhood.

Efforts to determine neighbourhood size and boundaries based on residents’ perceptions of their neighbourhood solely for the design of neighbourhood effect studies may be ill-conceived. Neighbourhood effects literature has not found links between the scale at which neighbourhood effects operate and residents' neighbourhood perception. Sampson (1999) notes a discrepancy exists between the scale at which neighbourhood effects operate and an individuals perceived neighbourhood. This is further complicated when studying neighbourhood effects on children. For example, neighbourhood processes may operate at a more proximate scale for young children who may have little direct contact with their neighbourhood (Duncan and Raudenbush 1999ab, Aber, Gephart, Brooks-Gunn and Connell 1997; Furstenburg and Hughes 1997; Duncan and Raudenbush 1999ab; Chase-Lansdale et al. 1997). Both the size of neighbourhood and neighbourhood processes may be different for children, youth and adolescents (Aber, Gephart, Brooks-Gunn and Connell 1997). Additionally, neighbourhood factors operating at multiple scales may influence children, so it is possible that a small-sized neighbourhood may operate directly upon young children, but a larger neighbourhood may operate indirectly on children through their parents.
Sampson (1999) has employed a thoughtful approach to defining neighbourhood units in Chicago (Lee 1999). The method employed by Sampson (1999) involves agglomerating adjacent census tracts in Chicago to create neighbourhoods that may more closely correspond to the scale at which neighbourhood processes affecting child development operate. Factor analysis based on socioeconomic and ethnic census data as well as local knowledge is used as criteria for joining similar adjacent census tracts. This strategy is preferable to simply using census tracts because Sampson (1999) argues spatial units that more closely approximate ‘actual’ neighbourhoods can be studied. Lee (1999) suggests that this approach to defining neighbourhood units should be used in future studies. This approach, however, is only feasible when neighbourhood units larger than census tracts are appropriate. Defining neighbourhood units that correspond to the level at which neighbourhood effects operate is not a simple task and requires a more thorough understanding of how neighbourhood effects operate. But such work is necessary to achieve more reliable estimates of neighbourhood effects. The methodology employed by Sampson (1999) is an important step towards studying neighbourhood units at the level at which they may operate to influence individual outcomes.

The second problem in obtaining reliable estimates of neighbourhood effects is the *simultaneity problem* which occurs when contextual conditions at the neighbourhood level may be caused, in part, by an individual’s behaviour (Duncan and Raudenbush 1999a). The simultaneity problem makes disentangling the multiple determinants of context difficult as individuals both shape and are shaped by the context in which they live. An example of a *simultaneity problem*, as discussed by Billy (1999), surrounds estimating the neighbourhood effects of family planning clinics. Billy (1999) notes that family planning clinics are most likely to be placed in areas of need, where there is a high rate of non-marital births. Studies that attempt to assess impact of family planning clinics on neighbourhood non-marital births may falsely indicate that family planning clinics lead to increased non-marital births because clinics only tend to be placed in neighbourhoods with high non-marital birth rates. The simultaneity problem highlights difficulties associated with estimating neighbourhood effects as having an independent influence on individuals, when in fact neighbourhood context is shaped by individuals.

One of the major problems in estimating neighbourhood effects is the *omitted-context variable problem*. This occurs when important contextual variables at the neighbourhood level (and family-level) are left unmeasured (Raudenbush and Duncan 1999b; Leventhal and Brooks-Gunn 2000; Burton 1999). At the neighbourhood level, unmeasured contextual variables that are associated with individual outcomes will lead to an underestimation of neighbourhood effects. Raudenbush and Duncan (1999) suggest that most neighbourhood effects studies suffer from this problem because of their reliance on census data. As previously mentioned, most US–based neighbourhood studies use census data, at the census tract level, which is collected every ten years and measures demographic dimensions including employment, income, ethnicity, and occupation.

Under ideal circumstances, census variables are selected based on their theoretical importance in the literature or statistical analysis. Census data, however, is often not well-suited to account for the theoretical processes and mechanisms through which neighbourhoods are hypothesised to influence child outcomes (Duncan and Raudenbush 1999ab; Korbin and Coulton 1997). For example, census does not contain information on neighbourhood institutions, gangs and drug activity, social cohesion, collective efficacy,
and networks between residents that may be relevant for child outcomes (Sampson 1999). The use of census data can entail a black box approach to the estimation of neighbourhood effects. For example, a positive association between neighbourhood affluence and child outcomes may do little to reveal the actual processes and mechanisms through which affluence neighbourhoods influence child development.

Even when census data is available it may still be difficult to distinguish distinct dimensions of neighbourhoods that are theoretically important, given multicollinearity among socioeconomic variables (Pickett and Pearl 2001). For example, epidemic models argue that neighbourhoods with a high proportion of affluent individuals are beneficial for child outcomes. Wilson (1987) focuses on the importance of male joblessness in child outcomes, it is theorised that in communities where most males are employed children are more likely to finish school and get jobs themselves because of employed males acting as role models. Because of high multicollinearity between variables such as affluence and low levels of male joblessness it may be difficult to distinguish which theory is at work. Sampson (1999) and Billy (1999) point out that neighbourhood disadvantage tends to occur in ‘bundles.’ Given a high correlation at the neighbourhood level between dimensions such as unemployment, poverty, low education, residential instability and rental tenure it is often difficult to untangle which dimension is most important suggesting the use of indices would be useful.

Duncan and Raudenbush (1999b) suggest that using a diverse sample of neighbourhoods that range from poor to affluent may help isolate which neighbourhood dimensions are most important and enable researchers to distinguish empirically between neighbourhood theories. Brooks-Gunn et al. (1997) points out that many existing studies of neighbourhood effects use a limited range of neighbourhoods in their studies, weighted toward disadvantaged neighbourhoods. Consequently, little has been learned about the effects of living in advantaged neighbourhoods on child development. The lack of adequate representation of affluent neighbourhoods in neighbourhood effects research is in part due to the use of data sets that are biased towards low income individuals and families (Duncan and Raudenbush 1999b). Inadequate neighbourhood sampling makes disentangling important neighbourhood dimensions difficult and also tends to provide inaccurate estimates of neighbourhood effects.

Although the inadequacies of census data are often discussed in neighbourhood effects literature, it is important to note the positive aspects of census data. Census data is inexpensive, widely available, has low levels of measurement error when compared with other measuring techniques, and allows for comparisons between studies. Billy (1999) notes that census data does provide neighbourhood variables that have theoretical importance in neighbourhood effects literature. Census data appears to provide data on neighbourhood dimensions that are particularly salient for child outcomes (Leventhal and Brooks-Gunn 2000).

Although all of the studies reviewed here have relied on census data to measure neighbourhood context, other approaches are available which may relieve some of the constraints imposed by census data (Duncan and Raudenbush 1999b). These approaches include surveying a sample of residents and aggregating results to create neighbourhood context variables as well as systematic social observation of neighbourhoods. Surveys may provide information on the processes and mechanisms through which neighbourhoods influence child outcomes and avoid omitted context variable problems.
associated with census data. For example, Sampson, Morenoff, and Earls (1999) have assessed collective efficacy and social cohesion in Chicago neighbourhoods through resident surveys. In order to undertake multilevel analysis, as well as achieve stable measures of neighbourhood context through surveys, at least 15 to 30 respondents per neighbourhood should be sampled in at least 50 neighbourhoods (Duncan and Raudenbush 1999a; Duncan and Jones 1995). Systematic social observation is another approach which has recently been used to assess neighbourhood context in Chicago (Duncan and Raudenbush 1999a). In this approach, a van with a video-recorder drives down every street within 80 neighbourhoods and trained observers record the physical environment (garbage, condition of houses, graffiti etc.) of the neighbourhood and social activity (gang activity, children, social order, etc.). Surveys and systematic social observation are promising methods of assessing and measuring neighbourhood processes and mechanisms through which neighbourhood influence families (Duncan and Raudenbush 1999a). Unfortunately, such approaches tend to be expensive, geographically limited, and lack clear methodologies for measuring theoretically important neighbourhood dimensions. However, there appears to be a consensus in neighbourhood effects research that future research needs to move beyond census data and develop methodologies that measure the processes and mechanisms through which neighbourhoods exert influence on individuals (Duncan and Raudenbush 1999ab, Leventhal and Brooks-Gunn 2000).

2.4.3.3 Individual level measures

As presented in Table 2.1, data sets used to obtain measures of child development in the studies reviewed. With the exception of Kalff et al. (2001) measures of child development used in the studies reviewed here are those contained in the US-based Infant Health and Development Program (IHDP) and children of the National Longitudinal Survey of Youth (NLSY). These datasets are reviewed here because they are used by most neighbourhood effects studies. Data from the IHDP comes from an early education intervention program for low-birth weight and premature children and their parents living in or near one of eight US cities. The IHDP is a longitudinal data set in which children are assessed at age 3 and 5. The data set is not representative of all children, however. To be included in the study a child had to be born under-weight and therefore at risk of developmental delay. Data from the children of the NLSY come from children born to youth (ages 14 to 21) who participated in a national survey of youth and adolescents beginning in 1979. While the NLSY is representative of all children and youth in the United States the children of the NLSY are not. Children of the NLSY were assessed in 1986 when original participants would be between the ages of 21 and 28. Most women who originally participated in the NLSY had not completed their child bearing years by 1986. Children of the NLSY, contained in the 1986 data set used in many neighbourhood effect studies, are disproportionately born to teenage mothers and are not a representative sample of all children.

The IHDP and NLSY use the Peabody Picture Vocabulary Test (PPVT or PPVT-R(revised)) to assess children’s verbal ability. The PPVT measures verbal ability by requiring children to indicate which picture best indicates a word said by the examiner (Leventhal and Brooks-Gunn 2000). The IHDP uses the Peabody Individual Achievement Test (PIAT) to measure a child’s achievement in mathematics (PIAT Math)
and reading (PIAT Reading). Achievement in assessed by recognition of numbers and words. Cognitive ability of children of the NLSY is measured by the Stanford-Binet intelligence test (IQ). Behavioural functioning of children in the IHDP is assessed by the Child Behaviour Checklist (CBC) a ninety-nine item parent completed questionnaire. The questions in the CBC focus on assessing externalizing and internalizing behaviour problems. Behavioural functioning in children of the NLSY was measured by the Behaviour Problems Index (BPI) which assesses behaviour problems in children aged four to seven.

Studies reviewed here have found neighbourhood dimensions to be associated with particular aspects of child development. Table 2.1 list the associations found in each study. These studies find neighbourhood dimensions to influence both the cognitive development and behaviour of children aged 3 to 6. Neighbourhood effects were not found for children aged 1 and 2, suggesting that age 3 may be when neighbourhood effects are most critical for young children (Duncan and Raudenbush 1999ab; Leventhal and Brooks-Gunn 200). Neighbourhood dimensions are more consistently associated with children’s cognitive functioning, measured by PPVT-R, PIAT, and Stanford-Binet IQ than behaviour, measured by CBC and BPI, in the studies reviewed here. Leventhal and Brooks-Gunn (2000) have found a similar pattern in a review of neighbourhood effects on children and adolescents. It appears that the cognitive aspects of child development are more sensitive to neighbourhood influences than behavioural aspects.

2.4.3.4. Family level measures

In order to estimate neighbourhood effects on children it is advantageous to control for family-level variables that are particularly salient for child development outcomes. Because of the association between family characteristics and neighbourhood characteristics, the amount of variation attributed to the neighbourhood-level cannot be accurately estimated without controlling for family characteristics. Studies reviewed here use a variety of measures of family-level characteristics including: maternal education, female headship, family income, family income to needs ratio, duration of poverty, mother’s employment, mother’s race, and mother’s age a birth. Table 2.1 details the exact family-level measures used in each study reviewed here. Given that a wide range of family-level variables are used, surprisingly little debate exists in neighbourhood effects research regarding the choice of variables. This may be due to the use of national data sets that only contain a limited number of family-level variables. One of the main findings of neighbourhood effects studies reviewed here is that family characteristics are the most important predictors of child development. McCulloch and Joshi (2001) note that the results of their study emphasise the importance of families rather than neighbourhoods in influencing children’s outcomes.

2.4.3.5 Issues in family measures

Families mediate and moderate the influence of neighbourhoods on children in complex ways which are not well understood (Burton and Jarrett 2000). Some parents may adopt parenting strategies to shield or protect their children from dangerous neighbourhoods, thereby reducing potential neighbourhood effects on their child. Other parents may take no action to protect children from dangerous situations, causing their children to receive greater exposure to negative neighbourhood influences. In an article
that examines the place of families in neighbourhood effects research, Burton and Jarrett (2000) correctly point out that families are given little theoretical and methodological attention in neighbourhood research. In order to estimate neighbourhood effects, family-level variables salient for child outcomes such as parental competency, education, and socioeconomic status need to be controlled for in order to prevent neighbourhood effects from being overestimated due to omitted variable bias. Because neighbourhood effect studies have consistently found variables at the family-level to be most strongly correlated with child outcomes, obtaining measures for critical family-level variables is important to accurate estimates of neighbourhood effects (Leventhal and Brooks-Gunn 2000; McCulloch and Joshi 2001).

Burton (1999) suggests that neighbourhood effects research needs to take ‘one step back’ and re-theorise the role of families. According to Burton (1999), understanding the relations between neighbourhoods, families, and children is critical to obtaining valid measures of neighbourhood effects that are not compromised by omitted variable bias at the family-level. The ‘step back’ involves identifying, conceptually defining, and measuring critical family-level variables (Burton 1999). For example, is parental education or the amount of time a parent spends reading to a child more important for child development? Or some combination of both? A theoretical framework and methodology to guide the choice of family-level variables is lacking (Burton 1999). The consequence of this is that family-level variables included in neighbourhood effects studies are often chosen ad hoc with little theoretical justification, resulting in significant discrepancies between studies in the choice of family-level variables (Burton and Jarrett 2000).

Jarrett and Burton (2000) look to ethnographic and qualitative research that explore links between family, neighbourhood, and child and adolescent outcomes in order to identify crucial family-level processes that current neighbourhood effects research overlooks. At the family-level, the following constructs were identified as having theoretical importance: family structure and socioeconomic indicators, residential movements, extended kin networks, family role flexibility, family routines, family protection strategies, family orientation and the idea of distinctiveness. Relevant parental-level factors identified include: parental role commitment, generational role boundaries, parenting styles, resource-seeking behaviours, advocacy efforts, child-monitoring strategies, in-home learning strategies, and normative values orientations concerning education, social mobility and humanistic values. A full discussion of how family and parent characteristics influence child development is beyond the scope of this literature review (see Burton and Jarrett (2000) for a discussion of family influences). Once theoretical work has identified important family factors, methodologies need to be developed to accurately measure these factors. Burton and Jarrett (2000) indicate that focusing (both theoretically and methodologically) on the place of the family in neighbourhood effects research is a worthwhile pursuit.

Another problem in neighbourhood effects research concerning the family is the endogenous membership problem, which occurs when family-level variables that influence the choice of neighbourhood residence are unmeasured (Duncan and Raudenbush 1999ab). For example, children may grow up in a particular neighbourhood because of parents wish to be close to family or employment. The endogenous membership problem occurs because children are not allocated to neighbourhoods by a
random process. Rather, children grow up in particular neighbourhoods based on parental choices and circumstances, which cannot be easily measured. For example, parents may choose between working long hours to afford living in an affluent neighbourhood and working fewer hours to spend more time with their children and living in a poor neighbourhood. Thus, the effects of living in a poor neighbourhood may be compensated for by the extra time a parent spends with their children. It is plausible that parents who lack the wherewithal to move to better neighbourhoods are also less equipped to shield children from the negative effects of poor neighbourhoods leading to an overestimation of neighbourhood effects (Duncan and Raudenbush 1999a). Similarly, parents who positively promote their children's development may choose more affluent neighbourhoods also leading to an overestimation of neighbourhood effects.

Duncan and Raudenbush (1999a) propose three solutions to addressing the endogenous membership problem. The first solution, random assignment, proposes that data from studies in which families are randomly assigned to live in different neighbourhoods be utilized. Random assignment will eliminate the correlation between unmeasured family factors and neighbourhood context. This approach is problematic given the ethical issues involved in randomly assigning individuals to live in different neighbourhoods and manipulating people's lives for scientific study. Existing data sets in which families are randomly assigned to neighbourhoods are from programs that randomly assign families in need of social housing to live in neighbourhoods with different levels of affluence. It has been found that only more motivated families are willing to volunteer for such programs, causing endogenous effects to occur anyway (Brooks Gunn and Aber 1997). Furthermore, such studies only examine neighbourhood effects on disadvantaged families in need of economic support; it is unlikely that more affluent families would find being randomly assigned to live in a particular neighbourhood acceptable.

The second solution, measure the unmeasured, consists of undertaking research to uncover why families move to certain neighbourhoods and to consequently measure these variables. Qualitative research such as ethnographies and interviews may be useful approaches to capture factors influencing choice of neighbourhood. Duncan and Raudenbush (1999a) correctly point out that it is not feasible to capture all of the factors that determine neighbourhood choice. The third solution, sibling models proposes that siblings be studied, as it is assumed that family factors do not differ between children. The study of siblings will eliminate both endogenous membership problem and omitted variable bias at the family-level. Duncan and Raudenbush (1999a) propose that siblings developmental scores be measured as their individual score subtracted from the average of all children in the family.

It is likely that family-level variables will never be accurately measured as families tend to be quite fluid (Burton 1999). For example, families may move often, making estimates of neighbourhood effects unreliable. Family structure may also change during a child's life, as parents divorce and remarry. A family's economic situation may also change significantly through a child's life, for instance, a once poor family may become an affluent family as a parent receives education and a well-paying job. On the other hand, an affluent family may become poor due to job loss. Research that considers the place of families in neighbourhood effect research should recognize the fluidity nature of families (Burton 1999).
This section has reviewed empirical studies that estimate neighbourhood effects. It has concentrated upon study design, measures of neighbourhood context, child development and family-level variables. Problems and issues such as choosing appropriate neighbourhood boundaries, the specificity problem, and omitted-variable bias at the family and neighbourhood-level have also been examined. Despite these problems, neighbourhood effects research has shown consistent neighbourhood effects for many aspects of child development. It is likely that neighbourhoods will never be accurately measured or defined, but the increasing consciousness about the problems in neighbourhood effects research is a hopeful sign that future studies may be better designed.

2.5 GEOGRAPHY

Harris and Mercier (2001) suggest that geographers are well-equipped to contribute to research on neighbourhood effects on child achievement. Yet, the discipline of geography has not contributed significantly to the recent literature that investigates neighbourhood effects on child and youth outcomes (but see Bauder and Sharpe 2000; Clumpet-Lundquist 1998). The section examines research within the discipline of geography that may contribute to neighbourhood effects research. It focuses on the work of geographers who have studied urban neighbourhoods, and the importance of context on political behaviour, education and health.

A major focus of urban geography is concerned with studying and documenting neighbourhoods and neighbourhood change (Broadway and Jetsy 1998). Extensive research has focused on the concentration of social and economic problems in inner city neighbourhoods, the establishment of the ‘cycle of poverty’ in inner-cities associated with deindustrialisation, and gentrification of select inner-city neighbourhoods (see Ley 1996; Bunting and Filion 1988; Filion and Bunting 1990). Neighbourhood effects research may benefit from drawing upon this work to better understand the processes and mechanisms at the neighbourhood level. For example, gentrification research has provided detailed, descriptive studies of the process of revitalization of inner-city neighbourhoods, for example: replacement of neighbourhood residents from poor to affluent, land tenure change from rental to owner, improved physical condition of neighbourhoods, new neighbourhood organisation and increased business investment such as stores and restaurants (Ley 1996). Such detailed documentation of neighbourhoods may identify pathways through which neighbourhood effects operate. However, the problem of translating such processes into measurable variables remains. Especially since neighbourhood effects research is strongly steeped in the positivist tradition unlike urban geography research, which is more theoretically and methodologically diverse.

The second area where geographers may contribute to neighbourhood effects research is in the geographical study of context. While studying the unit of the ‘neighbourhood’, neighbourhood effects research tends to be a-spatial. Neighbourhood tend to be studies as a-spatial units divorced from the wider city/community they are a part of (but see Sampson, Morenoff and Earls 1999 and Sampson 1999). Few studies of neighbourhood effects consider geographic patterns of neighbourhood socioeconomic status and child outcomes within a city or region. The work of several geographers who study context and geography with respect to politics and health will be discussed.
Robson (1969) was one of the first geographers to carry out research that probes ecological effects on individuals and elucidate how geography might undertake ecological research. In a study of ecological forces in attitudes towards education in Sutherland, UK, Robson (1969) has suggested that the area in which an individual lives appears to have a strong relation to attitudes towards education above and beyond social class. Results of his study indicate that working class individual residing in middle class neighbourhoods have more positive attitudes towards their children’s education than working class individual who live in working class neighbourhoods. This study ended with a call for other geographers to examine the effect of ecological influences on individuals.

John Agnew is a political geographer who has studied the importance of context on the voting patterns on individuals. Agnew (1996) is critical of neighbourhood effects studies in which context seen as an external effect on individual behaviour that occurs because of social interaction with an environment. Unlike most neighbourhood effects researchers that conceptualise and methodologically study neighbourhood effects as operating at a single level, the neighbourhood, Agnew (1996) employs a hierarchical-geographical approach. In this approach, context is rooted in a series of hierarchical levels that vary over space and produce spatially differentiated outcomes. Four components of the hierarchical-geographical context put-forth by Agnew (1996) follow: (1) the social division of labour takes a spatial form as certain places have particular types of investments, skills and markets; (2) neighbourhoods and communities are embedded in states, where differing degrees of political and economic inequality may exist; (3) social class, ethnic and gender division have particular meanings that are not uniform across a nation; and (4) micro-geography of everyday life defines the settings in which people interact.

This framework allows context at the neighbourhood level to be understood as produced by a set of hierarchical-geographical contexts that vary over space, not solely at the level of the neighbourhood. Neighbourhood effects research may find examining different levels of geographic context fruitful in understanding the mechanisms and processes through which neighbourhood operates. It is possible that while neighbourhood effects can be empirically estimated at the neighbourhood level they are actually rooted in the wider city and economic system. The work of Agnew (1996), while not directly applicable to neighbourhood effects on child development, may provide a framework by which this research can look beyond the neighbourhood to understand neighbourhood context.

The discipline of geography has contributed to the study of the influence of place on individual health outcomes. This research has suggested that the context of place exerts an influence on individual health outcomes (Jones and Duncan 1995; LeClair 2001; Macintyre 1993; Jones and Moon 1993). Similar to current trends in neighbourhood effects research, Jones and Duncan (1995) use multilevel modeling to more accurately model the independent effect of place on individual health outcomes. This research, similar to neighbourhood effects research, often considers the influence of place deprivation, or living in disadvantaged neighbourhoods on individual health (Jones and Duncan 1995; Wilkinson 1996). Macintyre (1993) probes the linkages between an individuals’ health, social class, and area in which they live. Jones and Moon (1993) discuss the importance of place in influencing an individual’s health status. Similar to the
epidemic models identified by Jenks and Mayer (1990), LeClair (2001) frames his research assessing the relations between socioeconomic status at the ecological level (census tract) and child behaviour through the ‘breeder hypothesis.’ The breeder hypothesis argues that individuals are placed at risk due to the particular area in which they live. Geography has also made significant contributions to the study of ecological fallacy, which occurs when relations at the ecological level do not hold true at the individual level (LeClair 2001). Neighbourhood effects studies may benefit from this research to inform the selection of appropriate neighbourhood units. Although geography has not made significant contributions to research on neighbourhood effects on child development, theoretical and methodological research in geography that examines neighbourhoods and the influence of place on individuals may be useful for neighbourhood effects research.

2.6 CANADIAN CONTEXT

The neighbourhood effects studies reviewed here, with one exception, have all studied neighbourhood effects in the United States. The one Canadian study by Kohen and Hertzman (1998) investigates neighbourhood effects on children’s school readiness. They found neighbourhood effects on children’s readiness to learn comparable to US studies. Neighbourhood effects theory largely derived from social disorganisation theory and underclass theory was developed through examination of problems in US inner-cities (Wilson 1995). Small and Newman (2001) suggest that the applicability of this theory to other places should be considered. No study to date has examined the applicability of neighbourhood effects in the United States to a Canadian context. Inner-city neighbourhoods in the United States are characterized by population decline, poverty, joblessness, crime, physical deterioration (Bourne 1993; Wilson 1987). Racial and ethnic tensions are also a feature of many US inner-city neighbourhoods with concentrations of blacks and other disadvantaged minority groups. In Canada, inner-city poverty is less severe and similar segregation along racial lines is not present in Canadian inner-cities (Broadway and Jesty 1998). For example, the cultural conflict model outlined by Jencks and Mayer is hypothesises that ethnically diverse neighbourhoods have a negative effect on child outcomes. This model is based upon ethnic tension between whites, Hispanics and blacks present in many US cities. It is unlikely that this model is directly applicable to Canadian cities that do not experience similar ethnic tensions. Kohen and Hertzman (1998) did not include an ethnic neighbourhood variable in their Canadian neighbourhood effect study. While Small and Newman (2001) indicate that neighbourhood effects theory may not be applicable to other places, research has not suggested the ways in which neighbourhood effects theory might be modified to places outside of the United States.

2.7 CONCLUSION

In conclusion, this literature review has discussed the theoretical origins of research on neighbourhood effects research on child development in psychology and sociology during the 1970s and 1980s which began to focus attention on understanding the role of context on individual outcomes. Urie Bronfenbrenner (in psychology) and William Julius Wilson (in sociology) were the first in their respective disciplines to put forth theoretical frameworks that gave importance to neighbourhood context in influencing individual
outcomes. The field of neighbourhood effects became established as researchers following Bronfenbrenner (1979) and Wilson (1987) focused theoretical and empirical attention on understanding and estimating the influence of neighbourhood context on individual outcomes. Neighbourhood effects research has attempted to understand the mechanisms and processes through which neighbourhood effects operate: norms/collective efficacy, relationships, and institutions/resources.

Since the 1990s many studies that empirically estimate neighbourhood effects on child and adolescent outcomes have been published, this review considered those that empirically estimate neighbourhood effects on children. All studies reviewed here use census tracts to approximate neighbourhoods, and neighbourhood context is derived from census data including socioeconomic status, residential mobility, and education. The literature reviewed here shows modest neighbourhood effects on the cognitive and behavioural development of children. Neighbourhood effects are stronger for cognitive dimensions of child development than behavioural aspects suggesting that neighbourhoods may be more salient for particular aspects of child development. At the neighbourhood level, socioeconomic status is most strongly related to child development outcomes. Problems in the estimation of neighbourhood effects include the specificity problem, omitted variable bias, endogenous membership, and family fluidity. This literature review has considered the work of geographers who have studies neighbourhoods and neighbourhood change may potentially contribute to neighbourhood effects research by elucidating mechanisms and pathways in neighbourhoods. Finally, this review considered the appropriateness of transferring neighbourhood theories developed in the United States to a Canadian context.
We cannot but recognize the importance of the construction of theoretical models...the juxtaposition of which leads one to comprehend, at least, more than might appear from the information presented piecemeal...”

- Haggett and Chorley, 1965

3. METHODOLOGY

3.1 INTRODUCTION

The review of relevant literature in Chapter 2 identified methodological gaps and limitations that need to be addressed in research concerning neighbourhood effects on child development; for example, study design, emphasis on disadvantaged neighbourhoods, statistical methods, and use of indices. In the design of this study an attempt has been made to address these issues.

The theoretical framework which guides this study design is based on Brofenbrenner’s (1979) ecological model of human development, in which an individual’s development is influenced by their ecological environment. The conceptual theoretical model used in this thesis (Figure 3.1) is adapted from a model developed by Aber et al. (1997). In this model a child’s development is an outcome of the child’s family characteristics and neighbourhood characteristics as well as the neighbourhood’s place in the wider city, province, nation and political system. The empirical work of this study will focus upon a more limited version of this model. Child outcomes are hypothesized to be a product of a limited set of neighbourhood and family characteristics. The methodology employed in this study is designed to address the two purposes outlined in the introduction:

1. To determine if there are ecological relations, both statistically and spatially at the neighbourhood level, between children’s readiness to learn and neighbourhood characteristics in Vancouver.

2. To determine if neighbourhood characteristics have an independent effect on the readiness to learn of kindergarten children in Vancouver over and above individual socioeconomic status.

The methods employed to investigate neighbourhood effects on children’s readiness to learn in Vancouver are guided by the methodology used in past research as well as the gaps and limitations identified in the literature review in Chapter 2.

3.2 STUDY DESIGN

A city-based design was selected in order to estimate neighbourhood effects on the readiness to learn of kindergarten children in Vancouver. In this study design the study participants are distributed throughout the city – sampling was not done to target particular neighbourhoods or areas nor were individuals selected. The design specifically addresses these two limitations. First, the population of individuals studied is diverse and neighbourhood boundaries are also delineated to ensure there are enough study children per neighbourhood to permit multilevel analysis. Second, all neighbourhoods in Vancouver are included in the study; neighbourhoods were not sampled to target affluent or disadvantaged neighbourhoods. There will therefore be a wide variability in the
number of individuals per neighbourhood and neighbourhood socioeconomic status. The only shortcoming of the present study is that it does not reflect the entire spectrum of variation in socioeconomic status (SES) that one would see if studying the whole Vancouver metropolitan area. By limiting the study area to the City of Vancouver there is likely some truncation of the potential variability at the upper end of the socioeconomic status spectrum.

3.3 DATA DESCRIPTION

Data for this thesis consists of individual-level data on the readiness to learn of kindergarten children and neighbourhood-level socioeconomic data from the Statistics Canada 1996 Census. Three types of data are used in this study:

A. Outcome variable
   a. Individual level: EDI scores (5 sub-scales)

B. Predictor variables
   a. Individual level:
      i. English as a second language
      ii. Family income (measured by proxy)
   b. Neighbourhood level:
      i. Percent mother tongue English
      ii. Unemployment rate
      iii. Percent no high school certificate
      iv. Median family income
      v. Percent non movers 5 year
      vi. Percent families lone parent

3.3.1 Individual level data

Individual level data for this thesis consists of readiness to learn assessments for kindergarten children in Vancouver. Residential postal codes were recorded for each child allowing them to be geocoded into their neighbourhood of residence. The following sections will discuss the concept of readiness to learn, the survey instrument used to assess readiness to learn, and the collection of this data. The process of geocoding postal codes will be discussed in section 3.3.3.

3.3.1.1 Outcome variable instrument

Readiness to learn is a measure of child development that assesses how well-equipped a child is to learn upon entry to formal schooling. It is a strong predictor of future success in school (Meisels 1999). Children with higher levels of readiness to learn
Exogenous forces
- city, province, nation, political situation

Neighbourhood Processes
- institutions/resources
- affluence
- norms/collective efficacy
- relationships

Family Processes
- economic resources
- parental education
- parenting characteristics
- family structure

Individual Processes

Child Outcomes

Figure 3.1 Model of contextual effects on child outcomes.
at the beginning of formal schooling are more likely to be successful in school and are more likely to complete schooling (Meisels 1999). Meisels (1999) argues that there are four theoretical ways of understanding children’s readiness to learn that influence how readiness is measured. First, in the *idealist/nativist* view, readiness is achieved through the maturation of a child with little influence from the external environment (e.g., parents, pre-school) through predictable developmental stages. Second, in the *empiricist/environmentalist* view readiness is a set of curriculum-specific behaviours and skills related to what children can do. For example, being able to properly hold a pencil and sit still during class. Third, the *social constructivist* view defines readiness with reference to how children’s behaviour and development is supported and what children should be ready for at a given age. Finally, the *interactionalist* view posits that readiness is a relative concept that is differentially based on the skills, experiences and learning opportunities of a child, as well as the goals of the community, classroom and teacher.

In this study, readiness to learn has been assessed through the *Early Development Instrument: A Population-based Measure for Communities* (EDI) which combines the *social constructivist* and *interactionalist* views of readiness to learn. The EDI assesses how equipped a child is to meet the task demands of school and to benefit from school (Mustard, Janus and Offord 1999). The EDI is a community-level measure of school readiness to learn designed to assess 4 and 5 year olds. Although the EDI assesses individual children it is intended to facilitate inferences about groups of children. The EDI was developed by Fraser Mustard at the Founders’ Network in Toronto and Magdalena Janus and Dan Offord in The Canadian Centre for Studies of Children at Risk at McMaster University (Mustard, Janus and Offord 1999). In the development of the EDI, educators and kindergarten teachers in the Toronto School Board were consulted. However, the basic structure of the EDI is based upon existing tests and the National Longitudinal Survey of Children and Youth (NLSCY). The EDI questionnaire is designed to be completed by a teacher who has observed the child in a classroom setting between 2 and 6 months. This allows enough time for the teacher to make reliable assessments of a child’s abilities but it is also short enough that the school experiences should not have substantially altered the developmental level the child entered school with. As such, the EDI acts as a measure of the child’s pre-school developmental environment.

The EDI questionnaire consists of 113 questions grouped into five domains: (1) *physical health and well-being*; (2) *social knowledge and competence*; (3) *emotional health and maturity*; (4) *language and cognitive development*; and (5) *communication skills and general knowledge*. These five areas have been identified in the relevant literature as important dimensions of a child’s readiness to learn (Janus and Offord 2000). The skills and behaviours assessed by the EDI for each sub-scale are summarized in Table 3.1 and all questions contained in the EDI questionnaire can be found in Appendix 2. *Physical health and well-being* is assessed by questions that evaluate gross and fine motor skills and the child’s independence in looking after their own needs. *Social knowledge and competence* is assessed by questions that evaluate ability to follow rules, co-operate with others, and behave appropriately. *Emotional health and maturity* is evaluated by questions that determine the child’s ability to deal with feelings and respond to others’ feelings. *Language and cognitive development* is assessed by questions that evaluate reading and writing skills, numeracy skills, and reading memory.
Communication skills and general knowledge are evaluated by questions that assess ability to communicate in English and age-appropriate knowledge about the world.

Through testing of the EDI on 4,528 children in North York, Ontario, the following profile of the children in the lowest 10 percent of the EDI has been created (Janus, Offord and Walsh 2001). These descriptions are important because they help to translate a quantitative value of readiness to learn into a qualitative account of child characteristics. A child scoring in the lowest 10 percent of the physical health and well-being sub-scale is described as having “average or poor fine (e.g., holding a pencil, manipulating objects) and gross (climbing stairs) motor skills, often tired, usually clumsy, with flagging energy levels, and average or poor overall development” (Janus, Offord and Walsh 2001, pg 3). A child scoring in the lowest ten percent of the social knowledge and competence EDI sub-scale is described as having “poor overall social skills, with regular serious problems in more than one area of getting along with other children, accepting responsibility for own actions, following rules and class routines, respect for adults, children, and for other people’s property, with self-confidence, self-control, adjustment to change, usually unable to work independently” (Janus, Offord and Walsh 2001, pg 3).

In the emotional health and maturity sub-scale a child scoring within the lowest ten percent is described as “[a] child with regular problems with managing aggressive behaviour, prone to disobedience, and/or easily distractible, inattentive, impulsive, usually unable to show helping behaviour towards other children, and who is sometimes upset when left with the caregiver” (Janus, Offord and Walsh 2001, pg 3). In the language and cognitive development sub-scale a child scoring in the lowest ten percent is described as “[a] child with serious problems with both reading/writing and numeracy, unable to read and write the simplest words, uninterested in trying and often unable to identify letters and attach sound to letters, has difficulty with remembering things, counting to 20, recognizing and comparing numbers, shapes, and with time concepts and is usually not interested in numbers” (Janus, Offord and Walsh 2001, pg 3). A child that scores in the lowest ten percent of the communication and general knowledge sub-scale is described as “[a] child with poor communication skills and articulation, whose command of English is poor or very poor, who has difficulty talking to others, understanding, and being understood, has poor general knowledge” (Janus, Offord and Walsh 2001, pg 4). It is assumed that these descriptions will be applicable to the EDI data used in this study.

The EDI was tested with over 16,000 students nation-wide in 1998/99 for its cultural validity (Mustard, Janus and Offord 1999). The results of this testing has demonstrated that the EDI has a very good internal and test-retest reliability, and external validity (Mustard, Janus and Offord 1999). Family level data was collected for a sample of 480 children assessed by the EDI, showing correlations with expected parent characteristics (Janus, Offord and Walsh 2001). For example, EDI scores tended to be higher if parents were more educated, healthier, and often read to their child. Testing of the EDI has found a 46 percent agreement between teacher and parent ratings; a 40 percent level is considered acceptable in the literature (Janus, Offord and Walsh 2001).
Table 3.1 Description of readiness to learn sub-scales assessed by the EDI

<table>
<thead>
<tr>
<th>Physical health and well-being</th>
<th>Social knowledge and competence</th>
<th>Emotional health/maturity</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>-holding a pencil</td>
<td>-curiosity about the world</td>
<td>-ability to reflect before acting</td>
<td>-reading awareness</td>
<td>-skills to communicate needs and wants in socially appropriate ways</td>
</tr>
<tr>
<td>-running on the playground</td>
<td>-eagerness to try new experiences</td>
<td>-balance between too fearful and too impulsive</td>
<td>-age-appropriate reading and writing skills</td>
<td>-story telling</td>
</tr>
<tr>
<td>-motor coordination</td>
<td>-knowledge of standards of acceptable behaviour in a public place</td>
<td>-ability to deal with feelings at the age-appropriate level</td>
<td>-age-appropriate numeracy skills</td>
<td>-age-appropriate knowledge about life and the world around</td>
</tr>
<tr>
<td>-adequate energy levels for classroom activities</td>
<td>-ability to control own behaviour</td>
<td>-empathic response to other people’s feelings</td>
<td>-board games</td>
<td></td>
</tr>
<tr>
<td>-daily living skills</td>
<td>-appropriate respect for authority</td>
<td></td>
<td>-ability to understand similarities and differences</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-cooperation with others</td>
<td></td>
<td>-ability to recite back specific pieces of information from memory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-following rules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-ability to play and work with other children</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The cognitively oriented sub-scales of the EDI, *language and cognitive development* and *communication skills and general knowledge*, showed acceptable correlations, 0.26 and 0.57, respectively, with the Peabody Picture Vocabulary Test Revised (PPVT-R) (Janus, Offord and Walsh 2001). The PPVT-R is a direct test of children’s cognition commonly used in neighbourhood effects research and is considered an approximation of IQ (Janus, Offord, Walsh 2001). These correlations are important because they suggest that in the present study the *language and cognitive development* and *communication skills and general knowledge* sub-scales of the EDI are comparable to existing neighbourhood effects studies that use the PPVT-R.

Since this testing of the EDI in 1998/1999 with 16,000 students it has been implemented in kindergarten classes in several communities (Janus, Offord and Walsh 2001). The EDI has been used in kindergarten classes in the Metro Toronto and North York sections of the Toronto District School Board and the Parry Sound School District and part of the Ottawa-Carelton School District in Ontario, the Woodstock School District in New Brunswick, and the Baffin District in Nunavut.

One disadvantage of the EDI is that there is only a single informant (one teacher) for a group of children. It is possible that certain teachers may assess their classes’ readiness to learn differently. Some teachers may have a higher expectation of their students than other teachers and complete the EDI accordingly. The disadvantage of having a single informant (one teacher) has been found to be surpassed by the feasibility
and acceptability of this survey, allowing it to be administered to significant populations of children at a reasonable cost (Mustard, Janus and Offord 1999).

3.3.1.2 Data collection

The Readiness to learn data used in this thesis was collected from the population of kindergarten children, aged five to six, attending a public elementary school in British Columbia School District No.39, the Vancouver School Board, during February to April 2000. The majority of these children were born in 1994 and their average age is 5.59 years at the time of data collection. The majority of kindergarten children living in Vancouver are included in Vancouver. However, kindergarten children living in Vancouver but attending an elementary school on native reserves or private schools were not assessed by the EDI. Children living in Vancouver but attending an elementary school in another school district were also not assessed by the EDI.

In total, readiness to learn data was collected from 3,921 kindergarten children attending a Vancouver School Board school in 2000. This is 98 percent of the 4,049 kindergarten children enrolled in the Vancouver school board during the 1999/2000 school year (Vancouver School Board, 2002). In February 2000 each public school kindergarten teacher was provided with EDI questionnaires to complete for all children in their classes. Teachers had until April 2000 to complete the EDI questionnaires. Each teacher was allotted twenty minutes per student to complete the EDI survey. Of the 3,921 children for which the EDI questionnaire was completed, 4.7 percent of this sample, or 185 children are excluded from the data set. Residential postal codes were not provided or were incorrect for 62 children, and 49 children had residential postal codes outside of the Vancouver study area. Students enrolled in special education programs, totalling 73, are also excluded from the data set. The final data set used in this study consists of 3,736 children.

Responses to each of the 113 questions contained in the EDI survey are based on an ordinal scale. For example, teachers are asked to rate particular skills as excellent, good, average or poor. These answers are assigned a numerical equivalency (e.g., poor=1, average=2) and totalled by sub-scale at the individual level. The totalled values by sub-scale are treated as ratio data. Due to variation in the total possible score for each sub-scale, scores have been scaled to a total of 100 for each of the sub-scales, with the highest score in each sub-scale receiving a value of 100.

The postal code of each child’s home residence was obtained during completion of the EDI. The postal code is used to geocode children into particular neighbourhoods and thereby can be used to obtain a proxy measure of individual income (which will be discussed later in the chapter). A translation master file for British Columbia is used in the geocoding process. This file contains every postal code in the province and their respective geographic units, including census tract and enumeration area. Using Microsoft Access this file was linked to the postal codes of the EDI children. This new file allows EDI children to be grouped by census tract and enumeration area, and also allows census data at the census tract and enumeration area to be linked to each child.

3.3.1.3 Individual level predictor variables

Predictor variables at the individual level are selected in order to control for the influence of individual and family characteristics on neighbourhood effects. As
identified in the literature review in Chapter 2, families have the greatest effect on child outcomes. Family measures for each child, such as the mother’s age at birth, family income, and family structure are often used in neighbourhood effect studies. If this information is not included it is likely that neighbourhood effects will be overestimated, as unmeasured family characteristics may be attributed to neighbourhood effects. Unfortunately, family characteristics were not collected with the EDI scores.

Because family data is not available at the individual level for each child, group level data will be used as a proxy. Based on the sensitivity testing by Mustard et al. (1999), average family income from each child’s enumeration area of residence is used as a proxy for individual income. Enumeration areas are the smallest level of census geography for which group-level data is available (Statistics Canada 2002). Enumeration areas refer to the area over which one census representative distributes questionnaires. Enumeration areas average 210 – 650 dwellings in urban areas and are typically one or more adjacent blocks in size (Statistics Canada 2002). Unfortunately, the use of enumeration area income as a proxy for individual income introduces error in the measurement of individual income. However, Mustard et al. (1999), using a sample of 47,935 individuals in Manitoba, have assessed the use of group-level income at the enumeration area as a proxy for individual level income in health research. They studied relations between 13 selected measures of health and individual income and group-level income. The strength of the association between health and income measured at the individual and ecological level (enumeration areas) was the same for 5 health measures, in 2 health measures group-level income had a greater association than individual income, and in 6 health measures there was a greater association with individual income. The results of their analysis lend support to the use of enumeration area measures of income when individual level measures are not available.

The Mustard et al. (1999) study indicates that group level income can be used as a reasonable proxy to estimate individual income in health research when individual income is not available. The Mustard et al. (1999) study did not examine the validity of group level income data as a proxy for individual income on child development, but evidence suggests that there are similar relationships between income and health status and income and child development at the individual level (FTP 2000). Given this similar relation and Mustard et al.’s (1999) study, this study assumes that average income can be used as a proxy for individual income for children’s readiness to learn.

Using the enumeration area ID code linked to each child by their home residence postal code, the average family income from the 1996 Census of Canada at the enumeration area level was obtained. Unfortunately, due to low population counts, some children’s postal codes were located in an enumeration area with suppressed data. These children were excluded from any analysis that required family income data.

In total 3545 EDI children’s postal codes were successfully linked to enumeration areas. There is some variation in total counts of EDI children by sub-scale because some sub-scales were not fully completed for all children. This is because teachers were not always able to provide an assessment of all skills and behaviours of their students contained in the EDI questionnaire. An adjusted total EDI score was computed based on the questions answered.

It may have been possible to use enumeration area data from the 1996 census to estimate family characteristics other than average income, such as education, family
structure and employment. However, there is no evidence for the validity of using ecological proxies for these variables to estimate individual or family characteristics. Therefore, it was decided to include only the one measure - family income by proxy. Unfortunately, this may introduce unmeasured variable bias, as important family level variables may have been excluded from the study.

3.3.2 Neighbourhood data

Consistent with past research identified in the literature review in Chapter 2, neighbourhood characteristics will be measured using census data in this study. Census data was not available for the year 2000, when the readiness to learn data was collected. The most recent census data available is from 1996, reflecting neighbourhood conditions when each EDI child was approximately one to two years old. This time-lag of four years may introduce some error as some neighbourhoods may have undergone significant socioeconomic and population change. In this study, 1996 Statistics Canada census data at the census tract level is used. The census tract, therefore, is the operational definition of the neighbourhood in this study. Census tracts are located in areas with an urban core population over 50,000. They have an average population of 4,000 and a range of 2,500 to 8,000. Census tracts are created to be as homogenous as possible in terms of the social and ethnic characteristics of their population. Census tract boundaries are created in consultation with a committee of local planners, health and social workers, and educators in conjunction with Statistics Canada. The use of census data to measure neighbourhood dimensions is common in neighbourhood effects literature due to its widespread availability and range of data (Leventhal and Brooks-Gunn 2000).

3.3.2.1 Defining neighbourhood units

Neighbourhood effects research most commonly uses the census tract to represent neighbourhoods. Evidence suggests that census tracts often do in fact represent actual neighbourhoods accurately (Sampson Morenoff and Earls 1999, Leventhal and Brooks-Gunn 2000). Figure 3.2 shows the counts of EDI children per census tract in Vancouver. Census tracts with few EDI children are problematic because of issues of confidentiality and statistical parsimony. Computations of average scores are unstable and subsequent statistical analysis unreliable when there are few cases per census tract. In total, 28 out of 88 census tracts in Vancouver have less than 25 EDI children. Research suggests that neighbourhoods should have a minimum of 15-30 cases for the computation of stable rates and for performing multilevel modeling (Duncan and Raudenbush 1999a). Jones and Moon (1997) suggest that both the minimum number of neighbourhoods and cases within neighbourhoods should be 25 for multilevel modeling.

In order to perform robust statistical analysis, modified neighbourhood boundaries were created to ensure a minimum number of EDI children per neighbourhood. Based on Jones and Moon (1997) 25 EDI children per neighbourhood are selected as the minimum number. Drawing upon a methodology employed by Sampson (1999), census tracts with few EDI children are joined or merged with adjacent census tracts that have a similar socioeconomic profile. The advantage of joining census tracts to create neighbourhoods is that census data can still be used to measure neighbourhood dimensions.

Based on Sampson (1999), factor analysis is used to obtain factor scores for each census tract in Vancouver. Factor analysis works by identifying factors or underlying
dimensions that explain the variance of a set of variables. Factor analysis, then, reduces a data set with interrelated variables to a few uncorrelated variables that explain maximum variance with a minimum number of factors. Factor scores indicate the similarities between units based on a set of variables and can be used to join adjacent census tracts with the most similar socioeconomic dimensions. Sampson (1999) performs cluster analysis using census data to join census tract in Chicago to create neighbourhood units that are relatively homogenous in terms of racial/ethnic mix, socioeconomic status, housing density and family structure.

The selection of census variables used by Sampson (1999) is based on the social and ethnic dimensions in Chicago. These variables are not necessarily those which are most salient in a Canadian context. The work of Davies and Murdie (1996) will be used to guide the selection of census variables within a Canadian context. Davies and Murdie (1996) used factor analysis to understand the main components of social variation in Canadian cities. They selected 35 census variables hypothesized to be associated with social variation in Canadian cities. Factor analysis using these 35 variables and 2981 census tracts in Canadian cities was performed. Through this analysis, Davies and Murdie (1996) identified fourteen census variables that are hypothesised to be the main sources of social variation in Canadian cities.

These fourteen variables were used to inform the selection of census variables for the factor analysis performed in this study. Field (2000) recommends that an approximately one-to-ten ratio, between the number of variables selected and cases be used in factor analysis. Using this one-to-ten ratio, nine census variables are selected since there are 88 census tracts in Vancouver. Unfortunately, in keeping with this ratio there are not enough census tracts in Vancouver to allow the fourteen hypothesized sources of social variation in Canadian cities identified by Davies and Murdie (1996) to be included. The nine variables selected are listed in Table 3.2, they include measures of family structure, socioeconomic status, residential stability, dwelling tenure, language and population density. Seven variables were selected based on their identification as important sources of social variation in Canadian cities by Davies and Murdie (1996) research. Two variables, percent mother tongue English and population density were not based on Davies and Murdie (1996). Mother tongue English was selected because of its importance to the present study. It is expected that neighbourhoods with a large non-English speaking population may have lower EDI scores in some sub-scales as these children are more likely to be ESL. Therefore, it is desirable to join census tracts with a similar percentage of the population with mother tongue English. Population density was selected because it was used by Sampson (1999) in his study using cluster analysis to join census tracts in Chicago.

Using these nine selected variables, an un-rotated factor analysis using a principal component analysis as the extraction method was performed using SPSS 9.0 software. Field (2000) suggests that only factors with eigenvalues (a measure of significance or importance) over 1 should be retained for further analysis. Following Field's (2000) recommendation only two factors, component 1 with an eigenvalue of 3.964 and component 2 with an eigenvalue of 2.903 were retained (Table 3.3). The proportion of variance explained by each component is listed in Table 3.3, combined the two components explain 76.3 percent of variation among the nine census variables. The contribution of each variable to component 1 and 2 is listed in Table 3.3.
Table 3.2 1996 Census variables selected for factor analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Families lone parent</td>
<td>0.396</td>
<td>0.627</td>
</tr>
<tr>
<td>% Visible minorities</td>
<td>0.927</td>
<td>-0.165</td>
</tr>
<tr>
<td>% Mother tongue English</td>
<td>-0.931</td>
<td>0.045</td>
</tr>
<tr>
<td>% Non movers 5-years</td>
<td>0.517</td>
<td>-0.719</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.606</td>
<td>0.603</td>
</tr>
<tr>
<td>Population density</td>
<td>-0.344</td>
<td>0.540</td>
</tr>
<tr>
<td>% No high school certificate</td>
<td>0.915</td>
<td>0.091</td>
</tr>
<tr>
<td>Median household income</td>
<td>-0.557</td>
<td>-0.748</td>
</tr>
<tr>
<td>% Dwellings rented</td>
<td>-0.422</td>
<td>0.861</td>
</tr>
</tbody>
</table>

Table 3.3 Component matrix for factor analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Component 1</th>
<th>Component 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Families lone parent</td>
<td>0.396</td>
<td>0.627</td>
</tr>
<tr>
<td>% Visible minorities</td>
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<td>% Dwellings rented</td>
<td>-0.422</td>
<td>0.861</td>
</tr>
</tbody>
</table>

In order to join census tracts, components 1 and 2 were added together to produce a combined factor score for each census tract (Figure 3.3). The factor scores based on components 1 and 2 for each census tract are displayed in Figure 3.3. Similar factor scores are have similar values based on the nine selected variables. For example census tracts with high unemployment, low income, and low education will likely have more similar scores that a census tract with low unemployment, high income, and high education.

Based on the factor scores in Figure 3.3, census tracts with less than 25 EDI children were either joined together or to the adjacent census tract with the most similar
score. Local knowledge of Vancouver, such as knowledge of main streets and neighbourhoods was also used in the grouping of census tracts. Figure 3.4 shows the final neighbourhoods created through joining tracts census tracts by using factor scores. This analysis has defined 68 neighbourhoods in Vancouver with a minimum of 28 and a maximum of 140 EDI children. All neighbourhood level analyses in this study will use the 68 neighbourhoods displayed in Figure 3.4.

There are some limitations to the use of census tract as proxies for neighbourhoods. Census tracts are administrative units and may not correspond to the level at which neighbourhood processes influence child development. The neighbourhoods created by joining census tracts may be considerably larger that the size of neighbourhood that factors influencing child development operate. It is possible that the neighbourhood units selected for this study are too large, considering that young children have limited exposure to their neighbourhood than older children.

3.3.2.2 Neighbourhood level predictor variables

As discussed in the literature review in Chapter 2, neighbourhood effects literature uses two methods to select neighbourhood characteristics that are considered to matter most for children. Measures can be statistically derived through the use of indices, factor analysis or principal component analysis. The literature review in Chapter 2 pointed out that a limitation of statistical methods is that they make comparisons between studies difficult as well as being difficult to replicate. Measures can also be selected theoretically based on neighbourhood characteristics that are theorized to influence child

Figure 3.2 Counts of EDI children per Vancouver census tract
Figure 3.3 Factor scores for Vancouver census tracts

Figure 3.4 New Vancouver neighbourhood units with counts of EDI children
development. Based on the identified limitations of statistically derived measures, this study will use theoretically based neighbourhood measures. As identified in the literature review in Chapter 2, neighbourhood measures typically fall into one of four constructs: socioeconomic status, family structure, residential stability and ethnicity. Neighbourhood measures used for this study are selected to represent these four constructs and are based upon past theoretical and empirical literature. However, some modification has taken place due to circumstances unique to Vancouver.

Six neighbourhood characteristics, listed in Table 3.5, have been selected to represent the four neighbourhood constructs: median family income, % no high school certificate, unemployment rate, % families lone parent, % non movers 5-years and % mother tongue English. Rationale for the selection of each characteristic will follow.

Neighbourhood socioeconomic status has theoretical importance in the models identified by Jencks and Mayer (1990). Furthermore, empirical studies reviewed here have found neighbourhood socioeconomic status to be positively associated with child outcomes. The institutional resource model suggests that affluent neighbourhoods are more likely to have quality resources such as libraries, recreation centres, and preschools that may positively influence child development (Jencks and Mayer 1990). The collective socialization model outlined by Jencks and Mayer (1990) also suggests that affluent neighbours who are educated, and employed, can act as role models for children in the neighbourhood. Following the Jencks and Mayer (1990) collective socialization and institutional resource model, as well as the empirical neighbourhood effect literature, three measures of socioeconomic status were selected as variables: median family income, % no high school certificate (over 15 year of age) and unemployment rate.

Because neighbourhood characteristics that indicate socioeconomic disadvantage often occurs in bundles (Sampson 1999), indices are often used to avoid high multicollinearity between variables. For example, neighbourhoods with high unemployment tend to also have lower incomes and lower levels of education. Small and Newman (2001) and Pickett and Pearl (2001) have criticised indices because they obscure which neighbourhood characteristic, such as employment or education, are more important at the neighbourhood level. Despite the potential problems of high multicollinearity between variables, following the recommendations of Small and Newman (2001) and Pickett and Pearl (2001), this study will not use an index to combine measures of socioeconomic status.

Median family income was selected based on Jencks and Mayer’s (1990) collective socialization model which theorized that neighbourhoods with higher incomes are advantageous for child development. This measure has been used previously by Chase-Lansdale and Gordon (1996) in estimating neighbourhood effects on child development. Unemployment rate was selected based on its use in many of the studies reviewed in the literature review in Chapter 2. These studies have based this selection on Jencks and Mayer’s (1990) collective socialization model and Wilson (1987). These authors hypothesise that neighbourhoods with low levels of unemployment will lack adults that can act as role models.

The variable % no high school certificate was selected as a socioeconomic variable because it is used in most neighbourhood effect studies considered in the literature review in Chapter 2. Based on Jencks and Mayer (1990) collective
socialization model it is hypothesized that educated adults will act as role models for other children in the neighbourhood as well as ensure that neighbourhoods have resources to promote their children' s development.

At the neighbourhood level, % families lone parent was selected to represent the construct of family structure. The selection of this variable is based on the collective socialisation model outlined by Jencks and Mayer (1990), which suggests that neighbourhoods with many lone parent families have few adults available for monitoring and supervising children in the neighbourhood. Also important in the selection of this variable is its use in neighbourhood effects literature, almost all studies listed in Table 2.1 includes a variable that represents the percent of lone parent families.

Based on theoretical research a measure of residential stability is selected - it is hypothesised that stable neighbourhoods will be positively associated with child development. The literature review in Chapter 2 has discussed the theorised importance of the social organisation of neighbourhoods, focusing on intergenerational closure, and reciprocal exchange for child development. Intergenerational closure occurs when adults and children in a community are linked to one another and establish parenting norms and kinships, reciprocal exchange is when neighbours draw upon each other for support (e.g., babysitting, advice). Sampson, Morenoff and Earls (1999) found residential stability to be associated with intergenerational closure and reciprocal exchange. Child development is hypothesized to be supported in communities where there are ties and relationships between adults and children in neighbourhood. Neighbourhood stability is required to establish these ties and relations between neighbours. The census variable, % non movers 5 years, has been selected as a measure of neighbourhood stability.

A measure of ethnicity or race is often used in US studies because they often focus upon inner cities with large white, Hispanic, and black populations. Such measures typically include the percent black and white per census tract. Racially mixed neighbourhoods are hypothesized to be negatively associated with child outcomes. This is due to racial tensions as well as different cultural values making social organization among residents difficult. While Vancouver is a multicultural city with a diverse ethnic mix it lacks many of the racial problems of large US studies. Evidence could not be found in support of neighbourhood ethnicity in Vancouver having a negative or positive influence on child development due to racial tensions. Furthermore, Sampson (1999) argues against the negative influence of racial mix and posits that neighbourhoods that are mixed ethnically can establish shared norms and values to support children. In place of measures relating to concentration of black and white population common in neighbourhood effects literature, % mother tongue English was selected at the neighbourhood level. Language barriers may limit the interactions and linkages between neighbours, preventing the establishment of norms of child raising, support among parents, and organization to support programs and institutions for children. This may cause lower levels of intergenerational closure, reciprocal exchange and collective efficacy, hypothesised by Sampson, Morenoff and Earls (1999) to support the development of children. It is hypothesized that neighbourhoods where a large proportion of the population does not speak English may be negatively associated with child outcomes.
3.4 STATISTICAL TREATMENT

3.4.1 Univariate analysis

Spatial and non-spatial univariate analysis is carried out using individual and neighbourhood level data. Descriptive statistics including mean, median, and standard deviation are calculated for the entire sample of EDI children and separately for ESL and non-ESL students for each sub-scale. The rationale for this is to investigate if any differences in EDI scores exist at the disaggregated level by ESL status.

EDI scores and neighbourhood characteristics are aggregated by Vancouver neighbourhood units. Maps will be used to illustrate spatial variation in neighbourhood level EDI scores and neighbourhood characteristics across Vancouver. This will determine if there are variations in the readiness to learn of kindergarten children across Vancouver neighbourhoods. By comparing these maps spatial patterns between EDI scores and neighbourhood characteristics at an ecological level can be examined.

3.4.2 Bivariate analysis

Ecological level correlation analysis will be performed between mean EDI scores and neighbourhood characteristics by Vancouver neighbourhoods. Correlations at the neighbourhood and individual level between the EDI sub-scales will also be performed. The correlation statistic selected is Pearson's product moment correlation, this statistic estimates the linear relation between two variables. This statistic calculates a correlation coefficient which is the standardized covariance of two variables (see Field 2000). In order to perform robust correlation analysis variables must be normally distributed. Both EDI scores and neighbourhood characteristics are roughly normally distributed. Two histograms are displayed to show the normal distribution - one EDI variable, Total EDI (Figure 3.5) and one neighbourhood variable, % families lone parent (Figure 3.6). Thirty-six separate correlations are performed at the neighbourhood level with each EDI sub-scale and each neighbourhood characteristics, using SPSS 9.0 software. The purpose of this correlation analysis is to determine if EDI scores averaged at the neighbourhood level are associated with particular neighbourhood characteristics without interactions from other variables.

3.4.3 Multivariate analysis

Multiple linear regression analysis will be used to examine the relation between multiple neighbourhood characteristics and EDI scores at the neighbourhood level. A forced-entry method will be used in which the predictor variables (neighbourhood characteristics) will be entered simultaneously to predict EDI scores by sub-scale. Hierarchical entry is used when there is an assumed order to the importance of each variable. While socioeconomic status is found to be most significantly related to child

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2 The term *neighbourhood characteristics* refer the 6 neighbourhood characteristics identified in Table 3.5.
3 The terms *Vancouver neighbourhoods* and *neighbourhood units* refer to the 68 Vancouver neighbourhoods used in this study.
4 EDI sub-scales refers to the 5 sub-scales including Total EDI, a composite of the 5 sub-scales.
Figure 3.5 Histogram of Total EDI score (neighbourhood level)

Figure 3.6 Histogram of % families lone parent (neighbourhood level)
outcomes in previous research at the individual level there is no clear evidence suggesting the importance of the remaining variables. Furthermore, since this study has used three variables to represent socioeconomic status instead of an index there is no clear evidence if *median family income, unemployment rate, or % no high school certificate* is more important. A forced entry method is employed given there is no clear order to the hypothesized importance of each variable. Another option for the regression analysis would have been to use a stepwise entry method instead of a forced entry method. In this method predictors are entered into the model based on purely statistical criteria. This method is useful because it can remove redundant predictor variables and thereby reduce multicollinearity. However, this method is problematic because it only selects the most important variables and may potentially eliminate theoretically important variables (Field 2000). Another problem is that different predictor variables may be selected for each EDI sub-scale making comparisons between different models problematic. Because of these shortcomings of the stepwise method, the following analysis will use a forced entry method.

Table 3.4 Individual level outcome and predictor variables

<table>
<thead>
<tr>
<th>Individual-level measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome Variables (from Early Development Instrument)</td>
</tr>
<tr>
<td>1. Physical health and well-being</td>
</tr>
<tr>
<td>2. Social knowledge and competence</td>
</tr>
<tr>
<td>3. Emotional health and maturity</td>
</tr>
<tr>
<td>4. Language and cognitive development</td>
</tr>
<tr>
<td>5. Communication skills and general knowledge</td>
</tr>
<tr>
<td>6. Total EDI</td>
</tr>
<tr>
<td>Predictor Variables</td>
</tr>
<tr>
<td>1. ESL status (coded by dummy variable 1=ESL, 2=No ESL)</td>
</tr>
<tr>
<td>2. Family income (1996 Census of Canada <em>average family income</em> enumeration area)</td>
</tr>
</tbody>
</table>

Table 3.5 Neighbourhood level variables

<table>
<thead>
<tr>
<th>Neighbourhood-level measures (1996 Census of Canada)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Socioeconomic characteristics</td>
</tr>
<tr>
<td>1. Median family income</td>
</tr>
<tr>
<td>2. % No high school certificate (over 15-years old)</td>
</tr>
<tr>
<td>3. Unemployment rate</td>
</tr>
<tr>
<td>B. Family structure</td>
</tr>
<tr>
<td>4. % Families lone parent</td>
</tr>
<tr>
<td>C. Residential stability</td>
</tr>
<tr>
<td>5. % Non movers 5-years</td>
</tr>
<tr>
<td>D. Ethnicity/Language</td>
</tr>
<tr>
<td>% Mother tongue English</td>
</tr>
</tbody>
</table>

The purpose of performing multiple regression analysis is to estimate the proportion of variation in EDI scores at the neighbourhood level that can be explained by multiple variables and to assess the importance of each variable simultaneously. Multiple linear regression works by fitting a straight line to the outcome variable and predictor

---

5 A preliminary stepwise regression analysis was carried out with the data. For most sub-scales only one variable was selected. Since the purpose of carrying out this regression analysis is to examine relations between multiple neighbourhood predictor variables a stepwise regression was not selected.
variables. This requires that outcome variables be linearly related to the predictor variables.

Multicollinearity exists when there is a sizeable correlation between two or more predictor variables in a regression model. Multicollinearity increases the chance that a good predictor in the regression model will be rejected. A single variable (e.g. average income) may predict a sizeable (R = 0.90) amount of an outcome variable. If two correlated variables (e.g. average income and percent low income) are included in the equation then the amount predicted will be split among the correlated variables. This may mis-specify important variables as insignificant and may make distinguishing between the importance of predictor variables difficult (Field 2000).

Sampson (1999) notes that neighbourhood disadvantage tends to occur in ‘bundles,’ so that neighbourhood with high levels of unemployment will tend to have lower levels of education and lower average incomes. There is a possibility of high levels of multicollinearity among the neighbourhood level predictor variables used in this study that may compromise the multiple regression analysis. Field (2000) suggests that Pearson’s correlation coefficients between predictor variables should be below 0.8 or 0.9. To test for potentially high levels of multicollinearity between predictor variables prior to performing multiple regressions Pearson’s correlation coefficients were calculated between all predictor variables (Table 3.6). With the exception of % no high school certificate and % mother tongue English correlations of the predictor variables were all below the upper boundary of 0.9 recommended by Field (2000). Although multicollinearity may potentially influence the results of the regression model no correlations have a coefficient greater than 0.9.

Table 3.6 Correlations between neighbourhood level predictor variables

<table>
<thead>
<tr>
<th></th>
<th>% Mother tongue English</th>
<th>Unemployment rate</th>
<th>Median family income</th>
<th>% No high school certificate</th>
<th>% Non movers 5 years</th>
<th>% Families lone parent</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Mother tongue English</td>
<td>Pearson Correlation</td>
<td>.623</td>
<td>-.551</td>
<td>-.808</td>
<td>-.387</td>
<td>-.184</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.001</td>
<td>.134</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>Pearson Correlation</td>
<td>-.551</td>
<td>1.000</td>
<td>-.799</td>
<td>.634</td>
<td>-.206</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.092</td>
<td>.000</td>
</tr>
<tr>
<td>Median family income</td>
<td>Pearson Correlation</td>
<td>.623</td>
<td>-.799</td>
<td>1.000</td>
<td>-.606</td>
<td>.335</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.005</td>
<td>.000</td>
</tr>
<tr>
<td>% No high school certificate</td>
<td>Pearson Correlation</td>
<td>-.808</td>
<td>.634</td>
<td>-.606</td>
<td>1.000</td>
<td>.346</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.092</td>
<td>.000</td>
<td>.004</td>
<td>.001</td>
</tr>
<tr>
<td>% Non movers 5 years</td>
<td>Pearson Correlation</td>
<td>-.387</td>
<td>-.206</td>
<td>.335</td>
<td>.346</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.001</td>
<td>.092</td>
<td>.005</td>
<td>.004</td>
<td>.020</td>
</tr>
<tr>
<td>% Families lone parent</td>
<td>Pearson Correlation</td>
<td>-.184</td>
<td>.656</td>
<td>-.602</td>
<td>.395</td>
<td>-.602</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.134</td>
<td>.000</td>
<td>.000</td>
<td>.001</td>
<td>.020</td>
</tr>
</tbody>
</table>

Note: Bolded values are significant at p<0.05
3.4.4 Multilevel analysis

This study will use hierarchical linear modeling, sometimes called multilevel analysis, to estimate neighbourhood effects on children’s readiness to learn. HLM 5.0 for Windows software will be used in this study. Due to software and data availability there has been a notable increase over the last ten years in studies that use multilevel modeling to estimate neighbourhood effects on health status (Pickett and Pearl 2001). It was only during the mid to late 1980s that feasible techniques were developed to perform multilevel modeling (Raudenbush and Bryk 2002). Hierarchical linear modeling has become widely accepted as an appropriate method for examining group level effects on individual health status. Only one neighbourhood effect study reviewed here used multilevel modeling to estimate neighbourhood effects. This is because most studies do not have data sets that allow multilevel modeling to be performed. Several researchers including: Duncan and Raudenbush (1999a) and Leventhal and Brooks-Gunn (2000) and Furstenburg and Hughes (1997), have noted that multilevel modeling is required to obtain more accurate estimates of neighbourhood effects on child and adolescent outcomes.

3.4.4.1 Theory of multilevel analysis

Multilevel analysis provides a sophisticated way of analyzing data with a hierarchical structure. Multilevel analysis resolves the problem of ecological fallacy by analyzing both individual and group level data simultaneously (Jones and Moon 1997). By modeling variance within and between groups, multilevel models are able to estimate how higher level units (e.g., schools, neighbourhoods) influence individuals nested within these units. Commonly used quantitative techniques such as multiple linear regression do not take the hierarchical nature of the data into account. As a consequence, variability at the individual level attributed to a higher level is captured within the error term (Bullen, Jones and Duncan 1997). In effect, multilevel modeling attempts to assign a portion of this error term to a higher level.

In developing a multilevel model the hypothesized relations between individuals and places needs to be modeled appropriately. Raudenbush and Bryk (2002) emphasise the importance of specifying a model that corresponds to the hypothesized relations between people and places. Though not comprehensive of all relations between individuals and places, Jones and Duncan (1997) outline six probable models, displayed in Figure 3.5, using cigarette consumption as the outcome variable (Y-axis) and age (X-axis) as the predictor variable. Figure 3.5(a) shows a general relationship where context, or place, does not matter, all places have the same positive relationship between smoking and age, as age increases smoking increases. In Figure 3.5(b) the lines between each place are parallel indicating that the strength of the association between age and smoking is the same across all places, but the overall smoking consumption varies between places. This model has equal slopes between places but varying intercepts. In Figure 3.5(d) place matters more for the smoking consumption rates of older people than for younger people. The opposite relation is displayed in Figure 3.5(e) where place has a greater influence on smoking rates for the young rather than for the old. In Figure 3.5(d), higher intercepts are associated with steeper slopes, indicating that where overall smoking rates are higher the relation between smoking and age is stronger and weaker where overall smoking consumption is lower. The opposite is displayed in Figure 3.5(e) - where average smoking consumption is lower there is a steeper slope between smoking...
Figure 3.7 Six models showing relations between individuals and places
Smoking consumption on Y-axis and age on X-axis. Adapted from: (Jones and Moon 1997)
consumption and age. In these two models the differences between places influences the
relations between age and smoking consumption. Unlike Figure 3.5(b), in these models
the different places the relation between age and smoking has varying slopes and
intercepts. Figure 3.5(c) shows a complex relation between age and smoking
consumption for different places.

Unlike Figure 3.5(d) and Figure 3.5(e), the strength of the association between
smoking consumption and age is not related to overall consumption, though this
association is always positive. The last plot, Figure 3.5(f), shows a relation where young
people have similar smoking rates across all places but the strength and direction of the
relation between age and smoking changes across places. In areas with higher overall
smoking rates there is a strengthening positive relation between age and smoking
consumption. In places with lower overall smoking rates there is a strengthening
negative relation between age and smoking consumption.

These six models show how relations between smoking consumption and age can
vary by place. These models are important because they provide examples of the
hypothesized relations between individuals and places which must be specified in the
multilevel model. For example, if a relation similar to Figure 3.5(d) -- where places with
higher average consumption of cigarettes have stronger relations (i.e. steeper slopes)
between age and smoking, consumption was hypothesized the multilevel model would
need to specify how slopes are influenced by the intercepts. While possible, such a
model may be difficult to define.

3.4.4.2 Generic multilevel model

In this study a regression with means-as-outcomes model specified by
Raudenbush and Bryk (2002) will be used. This model is similar to Figure 5(b), in which
places have a similar slope but different intercepts. This model takes the form of a basic
multiple regression equation with the intercept predicted by data at level 2. The basic
level 1\(^6\) and level 2\(^7\) equations, with only a single level 1 and level 2 predictor variable,\(^8\)
are specified:

Level 1 (e.g., individuals)

\[ Y_{ij} = \beta_{0j} + \beta_{ij}X_{ij} + r_{ij} \]  

Equation a

Level 2 (e.g., neighbourhoods)

\[ \beta_{0j} = y_{00} + y_{0j}W_{j} + u_{0j} \]  

Equation b

Where:

i are level 1 units (individuals)

j are level 2 units (places, in which individuals i are nested)

\( Y_{ij} \) is the outcome variable (level 1)

\( \beta_{0j} \) is a level 1 coefficient, the y - intercept

\( \beta_{ij} \) is a level 1 coefficient

\( X_{ij} \) is a level-1 predictor

\(^6\) Level 1 refers to the individual level

\(^7\) Level 2 refers to the neighbourhood level

\(^8\) Predictor variables are also known as ‘dependent variables’
$W_j$ is a level-2 predictor
$r_{ij}$ is a level-1 random effect, normally distributed with mean 0
$u_{0j}$ is a level-2 random effect, normally distributed with mean 0
$y_{00}$...$y_{11}$ is a level 2 coefficient also called a fixed effect

In this general two level model, level 1 is displayed in Equation a, the outcome variable
$Y_{ij}$ is at level 1, it is modeled by $\beta_{0j}$ the y-intercept, the level 1 predictor and coefficient $\beta_{ij}x_{ij}$ and the error term or random effect, $r_{ij}$, with a mean of 0 and normally distributed. The y-intercept, $\beta_{0j}$ is predicted by level 2, displayed in Equation b. At level 2, $\beta_{0j}$ is predicted by the fixed or constrained level 2 coefficients $y_0$ and $y_{11}$, and the random effect, $u_{0j}$, which is an error term that is normally distributed with a mean of 0. This model will produce a regression line for each $j$ level 2 unit, in which each level 2 unit has the same slope but a different intercept, similar to the graph Figure 3.5(b). This model is referred to as a mixed model because it has fixed effects, as the slope of the regression line is fixed and not allowed to vary by place, and random effects are given by $u_{0j}$ and $r_{ij}$.

3.4.4.3 Neighbourhood effects multilevel models

In this study, two types of multilevel models will be carried out to estimate independent neighbourhood effects on child development. The first types are preliminary or “null” models that do not contain any neighbourhood level variables. These models are required to estimate how much variation in readiness to learn can be attributed to individual characteristics. These values are required to calculate neighbourhood effects in subsequent full models. The second types are full models which contain variables at both the individual and neighbourhood level, they are used to estimate how much variance in EDI scores can be explained by characteristics at the neighbourhood level.

Two types of preliminary models are required to provide accurate estimates of variance explained by neighbourhood and individual variables. The first model, often termed a fully unconditional model, is a preliminary model that will provide information about how much variation in EDI scores can be explained by the individual level and the neighbourhood level. The level 1 model is given by the following equation,

Level 1

\[ Y_{ij} (\text{individual EDI score}) = \beta_{0j} + r_{ij} \]  

Equation c

Where $Y_{ij}$ is the individual outcome variable, total EDI score or sub-scale, $i = 1, \ldots, nj$ children in $j$ neighbourhoods. The model will be run separately for the total EDI score and for each of the sub-scales as the outcome variable. This model predicts the outcome variable, $Y_{ij}$, with just one level-2 parameter, the y intercept, $\beta_{0j}$. The level 2 fully unconditional model is given by:

Level 2

\[ \beta_{0j} = y_{00} + \mu_{0j} \]  

Equation d

---

9 Outcome variables are also known as ‘independent variables’
In Equation d, the outcome variable, $\beta_{0j}$, is the y-intercept of Equation c, it is given by $y_{00}$, which represents the grand-mean outcome in EDI scores for all children and $\mu_{0j}$, which is the random effect associated with unit $j$ neighbourhood. Substituting Equation d into Equation c gives the combined model

$$Y_{ij}(\text{individual EDI score}) = y_{00} + \mu_{0j} + r_{ij}$$

Equation e

The fully unconditional model is a primary model that estimates the total amount of variance in EDI scores can be attributed to the individual and neighbourhood level. These values are required for subsequent models that include predictor variables. When predictor variables, at level 1 or 2, are included in the model, variance tends to be explained resulting in reduced variance estimates. These ‘reduced’ variance values need to be subtracted from the total variance values from the fully unconditional model to determine how much variance the predictor variables explain. The preliminary fully unconditional model, therefore, is necessary in order to interpret the results of subsequent models (Raudenbush and Bryk 2002). Without this preliminary model it is not possible to calculate the percentage of variance explained by neighbourhood and individual characteristics.

The second preliminary model used is similar to the fully unconditional model but has predictor variables specified at level 1, the individual level, but no variables at level 2. Since there are two individual level predictor variables there are three versions of this model that are required to estimate the percentage of variance in EDI scores explained by ESL, family income and both together. The first model, termed ESL variance, includes only one predictor variable, ESL at level 1. This model is used to estimate the percent of variance in EDI scores explained by individual ESL status. The second model, termed income variance, includes only one predictor variable, family income, at level 1. This model is used to estimate individual variance explained by family income.

The third model, termed full individual level, includes no neighbourhood level variables but individual level variables, ESL and family income. The purpose of this model is to estimate how much variance in EDI scores can be explained by the individual level variables ESL and family income. This model also provides a more accurate estimate of the amount of variance attributed to the neighbourhood level. Often, the fully unconditional model mis-specifies variance explained by level 1 to the neighbourhood level (Raudenbush and Bryk 2002). The neighbourhood variance value is used to calculate percent of variance explained by the neighbourhood characteristics specified in subsequent models.

Two types of full models that include variables at the individual level and neighbourhood level will be used. Both models are regression means as outcomes model with predictors at level 1 and 2. This type of model tests whether an average (or mean) neighbourhood characteristic (e.g., income, unemployment rate) influences individual outcomes. This model, then, tests whether if neighbourhood characteristics have an independent effect on individual EDI scores when controlling for ESL status and family income. ESL status is used as a control variable because 57 percent of the children included in this study are ESL. Children who are ESL tend to have lower EDI scores because many questions on the EDI relate to knowledge of English, especially the communication and general knowledge subscale, which measures communication in English. Family income is used to control for the effects of individual family income of
EDI scores. The literature review in Chapter 2 has indicated that neighbourhood effect studies typically control for the effect of family income.

The first model, termed a partial neighbourhood level model, contains two neighbourhood level predictor variables: % mother tongue English and median family income. The purpose of this model is to test if there are ecological effects attributed to the individual level predictor variables which are hypothesised to be important predictors of EDI score without influence from other variables. The neighbourhood level variable % mother tongue English is the census variable that most closely mirrors the individual level ESL variable. The neighbourhood level variable median family income closely mirrors the individual level family income variable. The second model contains all six neighbourhood level predictor variables. This model is specified by the following equation (though total EDI score is listed as the predictor variable, the model will be run separately for each of the sub-scales).

Level 1
\[ Y_{ij} (\text{individual EDI score}) = \beta_{0j} + \beta_{1j} (\text{ESL}) + \beta_{2j} (\text{Family income}) + r_{ij} \]  

Equation f

Level 2
\[ \beta_{0j} = y_{00} + y_{01}(% \text{Mother tongue English}) + y_{02}(\text{Median family income}) + \mu_{0j} \]  

Equation g

\[ B_{1j} = y_{10} \]  

Equation h

\[ B_{2j} = y_{20} \]  

Equation i

The combined model, with Equation g, h and i inserted into Equation f is given by the equation:
\[ Y_{ij}(\text{Individual EDI score}) = y_{00} + y_{01}(% \text{Mother tongue English}) + y_{02}(\text{Median family income}) + y_{10}(\text{ESL}) + y_{20}(\text{Family Income}) + \mu_{0j} + r_{ij} \]  

Equation j

The outcome variable, at level 1, is given by \( Y_{ij} \), individual EDI score, in Equation f. \( \beta_{0j} \), the y-intercept of Equation f, is specified by level 2. Equation g. Equation g is given by \( y_{00} \), the y-intercept for \( \beta_{0j} \), or the grand-mean outcome in the population. There are two predictor variables with associated coefficients \( y_{01} \) and \( y_{02} \), these are % mother tongue English and median family income. Raudenbush and Bryk (2002) suggest that variables should centred so that the intercepts can be interpreted as they depend upon the location of level 1 and level 2 predictors. Recall that the intercept, \( \beta_{0j} \), refers to the value of the outcome variable when predictor variables are equal to zero. If a predictor variable such as average income never reaches zero, the intercept, when average income equals zero is not particularly meaningful. Following the advice of Raudenbush and Bryk (2002) all predictor variables at level 2 are centred around their neighbourhood mean using the equation (\( X_j - \bar{X} \)) (Table 3.7).
The final component of Equation g is \( u_0 \), the level 2 random effect. In Equation f, \( \beta_2j \) is the coefficient for ESL status, an individual predictor variable, coded as ESL = 1, Non ESL = 0. In Equation h, the value of \( \beta_2j \) is equal to \( y_{10} \) and specified at level 2. This simply means that the coefficient for ESL is constrained, or fixed, by level 2 and is not allowed to vary randomly by neighbourhood. In other words, the slope of the ESL variable, or relation between ESL and EDI score is the same for each neighbourhood. This is similar to the relation between individuals and places depicted in Figure 3.5(b), in which the slope of the relation between smoking and age does not vary between places. If this was not constrained there would be differences in the slope of the line between ESL and EDI score for each neighbourhood, this could possibly resemble the relations between individuals and places depicted in Figure 3.5(c, d, e or f).

\( \beta_3j \) is the coefficient for family income in Equation f, it is centred around the grand mean, so that the average family income for all individuals has a mean of 0, the equation \((X_{ij} - \bar{X})\) was used. The value for the family income predictor variable is specified at level 2 by Equation i. \( \beta_3j \) is equal to \( y_{20} \) a fixed effect coefficient that does not allow this coefficient to vary between neighbourhoods. In other words, the relation between family income and EDI score is the same for all neighbourhoods. The final component of level 1 is \( r_{ij} \), the individual level error component. The combined level 1 and level 2 model is given in Equation j.

The second full multilevel model, termed a full neighbourhood level model, consists of the individual level predictor variables family income and ESL status at level 1. Level 1 is given by Equation f and all neighbourhood level predictor variables: % mother tongue English, unemployment rate, % non movers 5 years, % families lone parent, and median family income. The purpose of this model is to investigate if these variables the neighbourhood level have an independent effect on individual EDI and to assess the relative contribution of each variable. Similar to the partial neighbourhood level model all predictor variables at the neighbourhood level (level 2) are centred at zero (Table 3.7).

The level 1 equation is given by Equation f. Level 2 is given by the equation

\[
\begin{align*}
\beta_0j &= y_{00} \\
&+ y_{01}(\% \text{ Mother tongue English}) \\
&+ y_{02}(\text{Unemployment rate}) \\
&+ y_{03}(\% \text{ No high school certificate}) \\
&+ y_{04}(\% \text{ Non movers 5 years}) \\
&+ y_{05}(\text{Median family income}) \\
&+ y_{06}(\% \text{ Families lone parent}) + u_0
\end{align*}
\]

Equation k

and Equation h and i. The combined model, Equation 1 is created by inserting Equation k, h and i into Equation f. That is,

\[
Y_i(\text{individual EDI score}) = y_{00} \\
+ y_{01}(\% \text{ Mother tongue English}) \\
+ y_{02}(\text{Unemployment rate}) \\
+ y_{03}(\% \text{ No high school certificate}) \\
+ y_{04}(\% \text{ Non movers 5 years}) \\
+ y_{05}(\text{Median family income})
\]

57
+ $y_{00}$ (ESL)  
+ $y_{10}$ (Family Income)

**Table 3.7 Descriptive statistics for multilevel analysis**

<table>
<thead>
<tr>
<th>INDIVIDUAL LEVEL</th>
<th>N=</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESL (ESL=1, Non-ESL = 0)</td>
<td>3,641</td>
<td>3.50</td>
<td>12.91</td>
</tr>
<tr>
<td>Family Income</td>
<td>3,645</td>
<td>52881.00(0.00)</td>
<td>24555.31</td>
</tr>
<tr>
<td>Physical Health and well-being</td>
<td>3,641</td>
<td>80.47(0.00)</td>
<td>12.91</td>
</tr>
<tr>
<td>Social knowledge and competence</td>
<td>3,637</td>
<td>78.97(0.00)</td>
<td>18.39</td>
</tr>
<tr>
<td>Emotion health and maturity</td>
<td>3,622</td>
<td>74.82(0.00)</td>
<td>17.56</td>
</tr>
<tr>
<td>Language and cognitive development</td>
<td>3,582</td>
<td>77.11(0.00)</td>
<td>20.41</td>
</tr>
<tr>
<td>Communication skills and general knowledge</td>
<td>3,630</td>
<td>61.35(0.00)</td>
<td>24.00</td>
</tr>
<tr>
<td>Total EDI</td>
<td>3,645</td>
<td>70.76(0.00)</td>
<td>15.69</td>
</tr>
</tbody>
</table>

| NEIGHBOURHOOD LEVEL | | | |
|---------------------|----------------|----------------|
| % Mother tongue English | 68 | 47.88(0.00) | 16.9 |
| Unemployment rate   | 68 | 10.16(0.00) | 3.86 |
| % No high school certificate | 68 | 18.42(0.00) | 5.25 |
| % Non movers 5 years | 68 | 44.94(0.00) | 10.89 |
| Median family income | 68 | 46198.37(0.00) | 16349.96 |
| % Families lone parent | 68 | 16.63(0.00) | 5.25 |

+ $\mu_{0j}$ + $r_{ij}$  

Equation 1

As in the partial neighbourhood level model, individual level characteristics, ESL and family income are constrained at the neighbourhood level by $y_{10}$ and $y_{20}$. As already mentioned this simply means that the slope (or coefficient) of these variables is not allowed to vary between neighbourhoods. This model will carried out separately with each of the EDI sub-scales and total EDI score as the outcome variable.

**3.5 LIMITATIONS**

It is necessary to consider the limitation of the data used in this study and the analytical strategy employed. A limitation of the EDI data is that over 50 percent of kindergarten children assessed in this study have ESL status. Prior testing of the EDI has not been done on enough ESL children to provide an adequate understanding of how ESL status influences readiness to learn assessments. An ESL child may be quite competent at age 5 in his or her home language but score low on the EDI because he or she has not received instruction in English. This ESL child may receive the same score as a native English speaker with developmental problems who has achieved only a minimal knowledge of English by kindergarten. Thus, readiness to learn scores may not always be reflective of child abilities. ESL status, however, was used as a control variable to account for the
lower EDI scores among ESL students. Another limitation is that no family level socioeconomic status data was available which would allow for more reliable estimation of neighbourhood and individual effects. Furthermore, data was not available on the length of time in which a child has lived in a particular neighbourhood. A child who recently moved to Vancouver and was included in the study may not be as affected by their neighbourhood as a child who has lived their entire life in one neighbourhood.

Another limitation is that some census tracts did not have a sufficient number of EDI children. Without at least 15-30 children per neighbourhood multilevel modeling cannot be performed and averages at the neighbourhood level tend to be unstable. Thus, many census tracts had to be merged in order to perform robust statistical analysis. These merged neighbourhoods may be larger than the size of neighbourhoods in which neighbourhood processes influence child outcomes. Another limitation of this study design is the use of census data to measure neighbourhood characteristics. While census data contains information on neighbourhood characteristics such as average income and employment rate, it does not contain information on the mechanisms and pathways through which neighbourhoods influence child outcomes. Although potentially important, collecting this data was beyond the scope of this project.

3.6 CONCLUSION

In conclusion, data for this study assesses children’s readiness to learn using the Early Development Instrument (EDI). The postal code of each child’s home residence has been used to assign each child to a neighbourhood in Vancouver. Neighbourhoods in Vancouver were created by merging census tracts in order to ensure an adequate number of children per neighbourhood. Factor analysis was used to merge census tracts with similar socioeconomic status. Neighbourhood characteristics were measured using census data from the 1996 Census of Canada. Six neighbourhood characteristics were selected based on theoretical importance in neighbourhood effects literature (Table 3.4). The statistical analyses outlined in this chapter were selected to address the two research objectives of the thesis. First, univariate, bivariate, and multivariate analysis at the neighbourhood level will examine relations between EDI scores and neighbourhood characteristics at the ecological neighbourhood level. Univariate analysis consists of neighbourhood level maps of EDI scores by sub-scale and neighbourhood characteristics. Bivariate analysis will consist of the computation of Pearson’s product moment correlation coefficient between neighbourhood EDI score and neighbourhood characteristics. Correlations between EDI sub-scales and the individual and neighbourhood level will also be examined. Multivariate analysis consists of a forced entry multiple regression between each EDI sub-scale and neighbourhood characteristics. Second, Multilevel analysis will estimate if neighbourhoods have an independent effect on children’s readiness to learn, above and beyond individual or family characteristics.
4.0 RESULTS

4.1 INTRODUCTION

In this chapter, the results of the ecological and multilevel analysis will be presented; it will be divided into two sections by the research objectives of this study. The first section will present the results of the analysis that address the first research objective, that is:

1. To determine if there are ecological relations, both statistically and spatially at the neighbourhood level, between children's readiness to learn and neighbourhood socioeconomic characteristics in Vancouver.

Descriptive statistics for the Early Development Instrument (EDI) sub-scales and neighbourhood characteristics are presented below. Recall from Chapter 3 that the EDI is a teacher completed questionnaire that assesses kindergarten children's readiness to learn, it was administered in February of 2000 to kindergarten children attending a Vancouver school board public school. The EDI assesses readiness to learn in five sub-scales considered to be salient dimensions of children's readiness to learn: physical health and well-being, emotional health and maturity, social knowledge and competence, language and cognitive development, communication skills and general knowledge. Neighbourhood characteristics, obtained from the 1996 Statistic Canada Census, are selected based upon neighbourhood constructs identified in the relevant literature (see Chapter 2) as important for child development. To represent the first construct, ethnicity, % mother tongue English is selected. Three characteristics, median family income, unemployment rate and % no high school certificate are selected to represent the second construct, socioeconomic status. The third neighbourhood construct, residential stability is represented by the variable % non movers 5 years. The fourth construct, family structure, is represented by the variable % families lone parent.

A series of maps displaying readiness to learn scores and neighbourhood characteristics across Vancouver neighbourhoods is presented. The results of ecological level correlation and multiple regression analysis are discussed. These statistical techniques assess ecological relations between EDI scores and neighbourhood socioeconomic status at the neighbourhood level.

The second section of this chapter, section 4.3, presents the results of multilevel analysis that addresses the second research objective of this thesis, that is:

2. To determine if neighbourhood characteristics have an independent effect on the readiness to learn of kindergarten children in Vancouver, over and above individual socioeconomic characteristics.

Neighbourhood characteristics refer to the six 1996 Census of Canada variables selected for this study: % mother tongue English, median family income, unemployment rate; % no high school certificate; % non movers 5 years and % families lone parent.
The results of preliminary models are then presented. Recall from the Chapter 3 methodology, that these models are required to estimate variance in EDI scores explained by individual level variables and for calculating variance explained by the neighbourhood characteristics in full models. The results of the full models described are then presented. Recall from the Chapter 3 methodology, that these models estimate how much variation in EDI scores can be explained by neighbourhood characteristics and the significance of each characteristic.

4.2 RESULTS OF ECOLOGICAL ANALYSIS

4.2.1 Descriptive statistics

Table 4.1 lists the descriptive statistics for the children included in this study by ESL. Across all EDI sub-scales children classified as ESL have lower average scores than non-ESL children. This disparity is most pronounced in the communication skills and general knowledge sub-scale. In this measure non-ESL children have an average score of 77.83 compared to ESL children who have an average score of 48.35. The difference between ESL and non-ESL children is so pronounced in this scale because it measures communication skills in English. Therefore, it is expected that ESL children will have lower assessments than non-ESL children due to lower proficiency in English. In the language and cognitive development sub-scale ESL children have an average score of 73.16, compared to non-ESL children who have an average score of 82.25. As this sub-scale has an English language component, this difference is likely due to the lower English skills of ESL children. The standard deviation in this sub-scale for ESL children is 21.65, for non-ESL children the standard deviation is considerably lower at 17.3, indicating that there is greater variation in the language and cognitive skills of ESL children than non-ESL children. As displayed in Table 4.1, across other sub-scales the standard deviations are similar, although the scores of ESL children have slightly higher standard deviations than the scores of non-ESL children. Differences are apparent between the average family income (measured by proxy) of ESL and non-ESL children. ESL children are more likely to live in families with a lower income - the average family income of ESL children is $45,270 and $60,682 for non-ESL children. Given relations between child development and family socioeconomic status, it is possible that lower EDI scores of ESL children may be partly due to lower family income. Thus, both lower family income and lower English language skills may contribute to the difference in EDI scores among ESL and non-ESL children. The descriptive statistics, including mean, standard deviation, minimum and maximum for EDI sub-scales and neighbourhood characteristics aggregated at the neighbourhood level, are listed in Table 4.2. Standard deviations for EDI sub-scales at the neighbourhood level, displayed in Table 4.2, are lower than at the individual level displayed in Table 4.1, showing that there is more variation between individuals than between neighbourhoods. Among neighbourhood characteristics there are considerable differences between the 68 neighbourhood units. For example, median family income at the neighbourhood level ranges between $19,832 and $93,964. Similarly, there is a large range in the variable % mother tongue English (21% to 82%) across Vancouver neighbourhood units. There is also considerable variation in average EDI scores among Vancouver neighbourhoods. With the exception of the communication and general knowledge and language and cognitive development
Table 4.1 Descriptive statistics of study participants

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<thead>
<tr>
<th>Variables</th>
<th>All EDI</th>
<th></th>
<th></th>
<th></th>
<th></th>
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<td>Standard</td>
<td>N</td>
<td>Mean</td>
<td>Standard</td>
<td>N</td>
<td>Mean</td>
<td>Standard</td>
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<td>80.41</td>
<td>12.91</td>
<td>2,110</td>
<td>78.62</td>
<td>12.99</td>
<td>1,596</td>
<td>82.78</td>
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<td>18.41</td>
<td>2,106</td>
<td>76.41</td>
<td>18.61</td>
<td>1,596</td>
<td>82.30</td>
<td>17.62</td>
<td></td>
</tr>
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<td>17.55</td>
<td>2,098</td>
<td>72.68</td>
<td>17.37</td>
<td>1,590</td>
<td>77.69</td>
<td>17.39</td>
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</tr>
<tr>
<td>Language and cognitive development</td>
<td>3,646</td>
<td>77.07</td>
<td>20.42</td>
<td>2,075</td>
<td>73.16</td>
<td>21.67</td>
<td>1,571</td>
<td>82.25</td>
<td>17.35</td>
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</tr>
<tr>
<td>Communication skills and general knowledge</td>
<td>3,707</td>
<td>61.04</td>
<td>24.17</td>
<td>2,111</td>
<td>48.35</td>
<td>19.70</td>
<td>1,596</td>
<td>77.83</td>
<td>18.68</td>
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</tr>
<tr>
<td>Total EDI</td>
<td>3,717</td>
<td>70.71</td>
<td>15.69</td>
<td>2,112</td>
<td>66.62</td>
<td>15.43</td>
<td>1,593</td>
<td>76.13</td>
<td>14.35</td>
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</tr>
<tr>
<td>Income</td>
<td>3,730</td>
<td>51,893.6</td>
<td>25,188.67</td>
<td>2,127</td>
<td>45,270.1</td>
<td>17,766.0</td>
<td>1,603</td>
<td>60,682.3</td>
<td>30,371.3</td>
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</table>

Table 4.2 Descriptive statistics at neighbourhood level

<table>
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<tr>
<th>Neighbourhood Characteristics</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
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</thead>
<tbody>
<tr>
<td>% Mother tongue English</td>
<td>68</td>
<td>21.01</td>
<td>82.13</td>
<td>47.87</td>
<td>16.93</td>
</tr>
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<td>Unemployment rate</td>
<td>68</td>
<td>3.18</td>
<td>22.89</td>
<td>10.16</td>
<td>3.86</td>
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<tr>
<td>% no high school certificate</td>
<td>68</td>
<td>4.75</td>
<td>28.39</td>
<td>18.41</td>
<td>5.24</td>
</tr>
<tr>
<td>% Non movers 5 years</td>
<td>68</td>
<td>15.10</td>
<td>59.90</td>
<td>44.94</td>
<td>10.89</td>
</tr>
<tr>
<td>Median family income</td>
<td>68</td>
<td>19,832.00</td>
<td>93,964.00</td>
<td>46,198.36</td>
<td>16,349.96</td>
</tr>
<tr>
<td>Percent families lone parent</td>
<td>68</td>
<td>7.50</td>
<td>31.65</td>
<td>16.63</td>
<td>5.24</td>
</tr>
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<td>Readiness to learn sub-scales</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical health and well-being</td>
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<td>69.51</td>
<td>89.33</td>
<td>80.57</td>
<td>4.45</td>
</tr>
<tr>
<td>Social knowledge and competence</td>
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<td>65.29</td>
<td>87.89</td>
<td>78.87</td>
<td>4.77</td>
</tr>
<tr>
<td>Emotional health/maturity</td>
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<td>63.60</td>
<td>85.14</td>
<td>75.00</td>
<td>4.76</td>
</tr>
<tr>
<td>Language and cognitive development</td>
<td>68</td>
<td>60.50</td>
<td>91.46</td>
<td>77.72</td>
<td>6.63</td>
</tr>
<tr>
<td>Communication skills and general knowledge</td>
<td>68</td>
<td>46.48</td>
<td>88.33</td>
<td>62.24</td>
<td>10.22</td>
</tr>
<tr>
<td>Total EDI</td>
<td>68</td>
<td>59.93</td>
<td>83.58</td>
<td>71.05</td>
<td>5.29</td>
</tr>
</tbody>
</table>
sub-scale there is about a 20-point difference between the neighbourhood unit with the highest and lowest score.

4.2.2 Spatial analysis

Using a series of chloropleth maps at the neighbourhood level, the geographic pattern of EDI scores and neighbourhood socioeconomic status across the City of Vancouver is described. Figure 4.1 shows the study area, the City of Vancouver, in relation to other cities in the Vancouver Census Metropolitan Area. To aid in map interpretation, names of the official Vancouver communities, as defined by the City of Vancouver, are displayed in Figure 4.1. Abbreviated versions of these names have been overlaid on the EDI and socioeconomic maps (Figure 4.3 to 4.13). Major roads in Vancouver are displayed in Figure 4.2. The classification system displayed on each EDI sub-scale map is quartiles (Figure 4.3 to 4.8), this system was chosen so that a similar number of neighbourhoods fall within each category representing each 25\textsuperscript{th} percentile. The drawback of this classification system, however, is that categories do not break at equal intervals. A grey-scale graduated colour scheme has been selected; darker grey indicates higher EDI scores and higher socioeconomic status.

Figure 4.3 is a map of the EDI sub-scale physical health and well-being across the City of Vancouver by neighbourhood units. The West Side of Vancouver has neighbourhoods with higher levels of physical health and well-being than the East Side. The West Side of Vancouver refers to the area West of Main St (Figure 4.2) and East Side refers to the area East of Main St. There are many divisions in Vancouver between East Side and West Side in terms of voting behaviour and socioeconomic status (SES) of residents. The physical health and well-being map (Figure 4.3) shows a cluster of neighbourhoods in the Strathcona and Grandview-Woodland area with scores in the lowest quartile. This map indicates a significant spatial pattern to the assessed physical health and well-being of kindergarten children in Vancouver at the neighbourhood level. The spatial pattern of communication skills and general knowledge across Vancouver neighbourhood units (Figure 4.4) is similar to the pattern of physical health and well-being (Figure 4.3). A similar distinct east-west pattern is evident in average scores across the City; average scores are higher on the West Side of Vancouver than on the East Side of Vancouver. Neighbourhoods on the West Side are among the highest two quartiles of all Vancouver neighbourhoods while neighbourhoods on the East Side are among the lowest two quartiles of all neighbourhoods. This map shows considerable geographic variation in average communication skills and general knowledge scores across Vancouver neighbourhood units. Children in neighbourhoods on the East Side are more likely to have lower scores in communication skills and general knowledge than children in neighbourhoods on the West Side. As well, a notable cluster of neighbourhood units with average scores in the lowest quartile are located in the Strathcona, Grandview-Woodlands and Mt Pleasant areas.

The well-defined East-West pattern evident in the communication skills and general knowledge neighbourhood map is less pronounced in the emotional health and maturity sub-scale (Figure 4.5). This may be because emotional health and maturity is possibly more intrinsic to the child than other sub-scales that assess learned skills. Figure 4.6 displays the EDI sub-scale language and cognitive development by Vancouver neighbourhood units. Vancouver neighbourhoods on the West Side have higher average
Vancouver Census Metropolitan Area

Official communities of the City of Vancouver

Figure 4.1 Official communities of the City of Vancouver
scores than neighbourhoods on the East Side. Also, there is a North–South corridor of low scores on the East Side of the City running south from Strathcona to Sunset. This map reveals pronounced geographic patterns in kindergarten children’s language and cognitive development scores across Vancouver neighbourhoods.

A map of the EDI sub-scale social knowledge and competence is displayed in Figure 4.7. West Side neighbourhoods have higher average scores than the East Side Neighbourhoods. Similar to other sub-scale maps there is a cluster of low scores in the Strathcona and Grandview-Woodlands area. This pattern is similar to language and cognitive development scores by neighbourhood displayed in Figure 4.6 and communication skills and general knowledge displayed in Figure 4.3. Figure 4.8 is a map of Total EDI score by Vancouver neighbourhoods. The geographic pattern displayed in this map is similar to the maps of other EDI sub-scales. Total EDI scores at the neighbourhood level are higher in neighbourhoods on the West Side of Vancouver and lower on the East Side. Also, there is a corridor of neighbourhoods with average scores in the lowest 50 percent of all neighbourhoods, running north–south from Strathcona to Sunset and a cluster of low scores in the Strathcona and Grandview-Woodlands areas of Vancouver. These six maps indicate that there a strong spatial component to the variation in children’s readiness to learn across Vancouver neighbourhood units. At the neighbourhood level these maps suggest that there are considerable differences in children’s readiness to learn across the city. On average children living in West Side of Vancouver have higher levels of readiness to learn than children living in the East Side neighbourhoods.
Figure 4.3 Vancouver neighbourhood units: Physical health and well-being

Figure 4.4 Vancouver neighbourhood units: Communication skills and general knowledge
Figure 4.5 Vancouver neighbourhood units: Emotional health and maturity

Figure 4.6 Vancouver neighbourhood units: Language and cognitive development
Figure 4.7 Vancouver neighbourhood units: Social knowledge and competence

Figure 4.8 Vancouver neighbourhood units: Total EDI
Maps showing the neighbourhood characteristics used in this study are displayed in Figures 4.9 to 4.14. Many of these maps exhibit similar spatial patterns to the maps of readiness to learn sub-scales at the neighbourhood level indicating a relation between the socioeconomic characteristics of neighbourhoods and children’s readiness to learn. Figure 4.9 displays the variable % mother tongue English, selected to represent the ethnicity construct across Vancouver neighbourhood units. Neighbourhoods on the West Side of Vancouver have a higher percentage of the population with a mother tongue of English than neighbourhoods on the East Side. The Renfrew–Collingwood, Sunset, and Victoria areas of Vancouver have neighbourhoods with the lowest percentage of the population that has a mother tongue English.

Figures 4.10 to 4.12 are maps of the three variables selected to represent the socioeconomic construct identified through the literature review as an important neighbourhood dimension for child outcomes. Figure 4.10 is a map of median family income, Figure 4.11 is a map of % no high school certificate and Figure 4.12 is a map of unemployment rate. These three maps exhibit a similar east-west divide with the West Side having neighbourhoods with higher median family income, lower unemployment rate and a lower % no high school certificate. This spatial pattern is similar to the EDI maps displayed in Figures 4.3 to 4.8, in which West Side neighbourhoods tend to have higher levels of readiness to learn than East Side neighbourhoods.

The spatial pattern of the variable % non movers 5 years (Figure 4.13) does not match the other maps in terms of an east-west divide. The neighbourhoods with the least residential stability are concentrated in the West End, Central Business District, Kitsilano and Fairview communities. This may be due to a high number of rental apartments and a young population in these areas. The final variable, % families lone parent, has a definite east-west divide. The West Side has fewer lone parent families than the East Side of Vancouver. Similar to many other maps, there is a concentration of neighbourhoods with high percentages of lone parent families in the Strathcona and Grandview Woodland areas.

4.2.3 Correlation analysis results

The results of two types of correlation analyses are discussed in this section. First, results of correlation analysis between EDI sub-scales at both the individual and neighbourhood level are discussed. Second, results of correlation analysis between EDI scores by sub-scale and neighbourhood characteristics (at the neighbourhood level) are presented. Pearson’s product moment correlation coefficient statistic was selected to provide an estimate of the linear relation between EDI scores and neighbourhood characteristics at the neighbourhood level. Recall from Chapter 3 that correlation analysis estimates the linear relations between two variables. In this study the minimum acceptability level for establishing statistical significance for the correlation coefficients is an alpha level of 0.5 or a p-value of p<0.05.
Figure 4.9 Vancouver neighbourhood units: Percent mother tongue English

Figure 4.10 Vancouver neighbourhood units: Median family income
Figure 4.11 Vancouver neighbourhood units: Percent no high school certificate

Figure 4.12 Vancouver neighbourhood units: Unemployment rate
Figure 4.13 Vancouver neighbourhood units: Percent non movers 5 years

Figure 4.14 Vancouver neighbourhood units: Percent families lone parent
Pearson’s correlations between EDI sub-scales are fairly high at both the individual and neighbourhood level (Table 4.3). Individual level correlations indicate that children who do well in one sub-scale are likely to do well in all sub-scales. The correlation coefficients are similar between EDI sub-scales at both the individual and neighbourhood level (Table 4.3). However, correlations at the neighbourhood level appear to be slightly higher than at the individual level. This may be due to an aggregation effect – typically as the level of aggregation increases correlation values also increase (Openshaw 1977). For both the individual and neighbourhood level correlations are lowest between the emotional health and maturity and communication skills and general knowledge sub-scales. Similarly, correlations are highest between the sub-scales physical health and well-being and social knowledge and competence.

As displayed in Table 4.4, the neighbourhood characteristic % mother tongue English, is positively related to EDI score in all sub-scales at the neighbourhood level. In other words, neighbourhood units with a higher proportion of residents with mother tongue English are associated with higher EDI scores. However, the statistical significance of the correlation coefficient varies by sub-scale. Total EDI and physical health and well-being, language and cognitive development, and communication skills and general knowledge sub-scales are significantly associated, at the p<0.001 level with % mother tongue English. The correlation coefficients of the sub-scales social knowledge and competence and emotional health and maturity are significantly associated with % mother tongue English at the p<0.05 level.

Correlation coefficients and their significance level for the three neighbourhood characteristics, unemployment rate, % no high school certificate and median family income are also listed in Table 4.4. All three of these variables are significantly associated with EDI scores in the expected direction. The unemployment rate correlation coefficient indicates a negative association with all EDI sub-scales. Specifically, EDI scores tend to increase as the unemployment rate decreases. The correlation coefficient for median family income indicates a positive association with all EDI sub-scales - as median family income, EDI score also increases. The correlation coefficient for the variable % no high school certificate indicates a negative association with all EDI sub-scales- EDI scores increase as the percent of adults with no high school certificate decreases. The variables selected to represent the socioeconomic status construct are significantly related to several EDI sub-scales. Unemployment rate correlation coefficients are significantly associated at the p<0.001 level with all EDI sub-scales. Correlation coefficients for the variables % no high school certificate and median family income are significantly associated at the p<0.001 level with all EDI sub-scale except emotional health and maturity.

Correlation coefficients can be compared to assess the relative strength of association between a single neighbourhood characteristic and each of the six EDI sub-scales. Consistently, across the three socioeconomic variables (unemployment rate, % no high school certificate and median family income) the correlation coefficients are lowest (closest to 0) for the social knowledge and competence and emotional health and maturity sub-scale. From Table 4.4 the weakest coefficients are -0.274 between emotional health and maturity and % no high school certificate and -0.381 between social knowledge and competence and % no high school certificate. This result is expected as past studies.

Correlations including Total EDI are not included as it is a composite of the five scales.
Table 4.3 Individual level and neighbourhood level correlations between EDI sub-scales

<table>
<thead>
<tr>
<th>INDIVIDUAL LEVEL</th>
<th>Physical health and well-being</th>
<th>Social knowledge and competence</th>
<th>Emotional health and maturity</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical health and well-being</td>
<td>Pearson Correlation</td>
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<td>0.629</td>
<td>0.505</td>
<td>0.594</td>
<td>0.480</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Social knowledge and competence</td>
<td>Pearson Correlation</td>
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<tr>
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<td>0.477</td>
<td>0.393</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Language and cognitive development</td>
<td>Pearson Correlation</td>
<td>0.594</td>
<td>0.606</td>
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<tr>
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<td>Sig. (2-tailed)</td>
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<tr>
<td>Communication skills and general knowledge</td>
<td>Pearson Correlation</td>
<td>0.480</td>
<td>0.495</td>
<td>0.393</td>
<td>0.577</td>
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</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
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<td>0.000</td>
<td>0.000</td>
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<th>NEIGHBOURHOOD LEVEL</th>
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<th>Emotional health and maturity</th>
<th>Language and cognitive development</th>
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<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Social knowledge and cognitive development</td>
<td>Pearson Correlation</td>
<td>0.860</td>
<td>1</td>
<td>0.806</td>
<td>0.658</td>
<td>0.563</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Emotional health and maturity</td>
<td>Pearson Correlation</td>
<td>0.664</td>
<td>0.806</td>
<td>1</td>
<td>0.584</td>
<td>0.411</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Language and cognitive development</td>
<td>Pearson Correlation</td>
<td>0.668</td>
<td>0.658</td>
<td>0.584</td>
<td>1</td>
<td>0.564</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Communication skills and general knowledge</td>
<td>Pearson Correlation</td>
<td>0.744</td>
<td>0.563</td>
<td>0.411</td>
<td>0.564</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Total EDI</td>
<td>Pearson Correlation</td>
<td>0.907</td>
<td>0.877</td>
<td>0.805</td>
<td>0.830</td>
<td>0.767</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: Bolded values are significant at p<0.05

identified in the literature review in Chapter 2 have found social and emotional development of children to be less associated with neighbourhood characteristics as they tend to be more intrinsic to the child than more cognitively oriented scales. For all of these three socioeconomic characteristics, the strongest correlations are for the communication skills and general knowledge and physical health and well-being sub-scales. The two highest Pearson's correlation coefficients are between % no high school and communication skills and general knowledge (-0.738) and median family income and communication skills and general knowledge (0.731). These results provide statistical
evidence for ecological-level relations between EDI scores and neighbourhood socioeconomic status at the neighbourhood level.

Recall that the variable % non movers 5 years, was chosen to represent the neighbourhood construct of residential stability. The coefficient of this variable is positively associated with most EDI sub-scales. However, the sub-scale communication skills and general knowledge is negatively associated with residential stability (Table 4.4). None of these coefficients, however, are statistically significant. These results do not provide statistical evidence for ecological relations between readiness to learn and % non movers 5 years.

Recall that to represent the family structure construct the variable % families lone parent was selected. There is a negative relation between % families lone parent and each EDI sub-scale (Table 4.4). This means that, at the neighbourhood level, as the proportion of families that are composed of a lone parent increases, average EDI scores decrease. This relationship is significant at the p<0.001 level for all sub-scales except for communication skills and general knowledge which is significant at the p<0.01 level. This relationship is strongest for Total EDI (R= -0.629), language and cognitive development (R= -0.662) and physical health and well-being (R= -0.606). These results provide statistical support for ecological relations between family structure and readiness to learn at the neighbourhood level.

Correlation analysis has provided statistical evidence for ecological relations between several EDI sub-scales and neighbourhood characteristics. Correlation analysis has provided little statistical support for ecological relations between residential stability and readiness to learn. The EDI sub-scales emotional health and maturity and social knowledge and competence have weaker relations to neighbourhood characteristics than the other sub-scales. The variable unemployment rate is the only neighbourhood characteristic significant with all sub-scales at the p<0.001 level.

4.2.4 Multiple regression results

The correlation results presented above discuss the relations between two variables; they do not assess how EDI sub-scales are simultaneously related to multiple neighbourhood characteristics. In this section, the results of multiple linear regression analysis are presented. Recall from Chapter 3 that multiple linear regression is used to estimate how multiple neighbourhood characteristics contribute to EDI scores at the neighbourhood level.

The R² model summary results in Table 4.5 indicate the proportion of variance in each EDI sub-scale score that can be explained by the neighbourhood characteristics. The R² value is greatest for the communication skills and general knowledge sub-scale, in which 73.3% of variation at the neighbourhood level can be attributed to the neighbourhood characteristics. Variance in the three sub-scales, Total EDI, language and cognitive development and physical health and well-being are also highly predicted by the neighbourhood characteristics. Neighbourhood characteristics explain 58.7% of variation in Total EDI scores, 55.0% of variation in language and cognitive development and 53.3% of variation in physical health and well-being. Neighbourhood characteristics explain a much lower percentage of variation in the social knowledge and competence and emotional health and maturity sub-scale. For example, 38.2% of variation in social knowledge and competence and 29.1% of variation in emotional health and maturity is
explained by neighbourhood characteristics. Table 4.5 also indicates which
eighbourhood characteristics contribute most significantly to explaining variance in each
sub-scale. The physical health and well-being sub-scale has no neighbourhood
characteristics significant at the p<0.05 level. The social knowledge and competence and
emotional health and maturity sub-scale both have one variable, % families lone parent,
significant at the p<0.05 level (p<0.01 for emotional health and maturity). From Table
4.5 the standardized coefficients indicate that the variables % families lone parent and
unemployment rate are the strongest predictors of emotional health and maturity at the
ecological level. The EDI sub-scale language and cognitive development has two
neighbourhood characteristics that are significant at the p<0.05 level. The variable %
mother tongue English has a significance level of p<0.05 and a standardized coefficient
of 0.440; % families lone parent is also significant with a p-value of p<0.001 and a
standardized coefficient of -0.547. From Table 4.5 these two neighbourhood
characteristics have the largest (closest to +/-1) standardized coefficients indicating they
are the strongest predictor variables.

The results for the multiple regression model with communication skills and
general knowledge as the outcome variable are listed in Table 4.5. Two predictor
variables, % mother tongue English and % non movers 5 years significantly predict
communication skills and general knowledge at the neighbourhood level. The variable %
mother tongue English is significant at the p<0.001 level and the variable % non movers
5 years is significant at the p<0.05 level. The standardised coefficients of these variables
are .703 and .205 respectively, which are the highest coefficients among all predictor
variables in this sub-scale. Table 4.5 lists the final regression model with Total EDI
as the outcome variable. Two predictor variables, % mother tongue English (p<0.05) and
% families lone parent (p<0.01) are significant predictors of Total EDI. The standardized
coefficients are 0.460 and -0.418 respectively, which are the two strongest coefficients.

4.3.5 Summary of ecological results

The results of the correlation and multiple regression analysis are briefly
discussed. Across all EDI sub-scales none of the predictor variables selected to represent
the socioeconomic status construct at the neighbourhood level are statistically significant
at a p<0.05 level in the multiple regression analysis. These variables, however, are the
most significant predictors of EDI sub-scales in the correlation analysis results presented
in Table 4.4. Recall that multiple regression estimates how multiple predictor variables
simultaneously explain variance in an outcome variable. It is likely that multicollinearity
between these predictors cause variance to be split among the three variables resulting in
low significance levels. Second, it should be pointed out that in the correlation analysis
the predictor variable % families lone parent is the variable least strongly related to the
communication skills and general knowledge sub-scale. However, in the multiple
regression analysis this variable is the strongest predictor variable with the highest
standardized coefficient and greatest significance. This paradox is further illustrated by
the fact that in the correlation analysis results presented in Table 4.4, the variable % non
movers 5 years is negatively related to the sub-scale communication and general
knowledge, while, in the multiple regression model, which considers the simultaneous
influence of multiple predictors, this variable is positively related and
Table 4.4 Correlation results between neighbourhood socioeconomic characteristics and mean EDI sub-scale scores

<table>
<thead>
<tr>
<th>% Mother tongue English</th>
<th>Physical health and well-being</th>
<th>Social knowledge and competence</th>
<th>Emotional health/maturity</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>.447</td>
<td>.262</td>
<td>.180</td>
<td>.412</td>
<td>.810</td>
<td>.486</td>
</tr>
<tr>
<td>Sig(2-tailed)</td>
<td>.000</td>
<td>.031</td>
<td>.141</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>Pearson Correlation</td>
<td>-.677</td>
<td>-.523</td>
<td>-.440</td>
<td>-.633</td>
<td>-.682</td>
</tr>
<tr>
<td>Sig(2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>% no high school certificate</td>
<td>Pearson Correlation</td>
<td>-.541</td>
<td>-.381</td>
<td>-.274</td>
<td>-.467</td>
<td>-.738</td>
</tr>
<tr>
<td>Sig(2-tailed)</td>
<td>.000</td>
<td>.001</td>
<td>.024</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Median family income</td>
<td>Pearson Correlation</td>
<td>.675</td>
<td>.497</td>
<td>.313</td>
<td>.583</td>
<td>.731</td>
</tr>
<tr>
<td>Sig(2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.009</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>% non movers 5 years</td>
<td>Pearson Correlation</td>
<td>.160</td>
<td>.156</td>
<td>.077</td>
<td>.151</td>
<td>-.044</td>
</tr>
<tr>
<td>Sig(2-tailed)</td>
<td>.192</td>
<td>.205</td>
<td>.533</td>
<td>.220</td>
<td>.719</td>
<td>.186</td>
</tr>
<tr>
<td>% Families lone parents</td>
<td>Pearson Correlation</td>
<td>-.606</td>
<td>-.579</td>
<td>-.503</td>
<td>-.662</td>
<td>-.366</td>
</tr>
<tr>
<td>Sig(2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.002</td>
</tr>
</tbody>
</table>

Note: Bolded values are significance at p<0.05
Table 4.5 Multiple regression results between neighbourhood socioeconomic characteristics and mean EDI sub-scale

<table>
<thead>
<tr>
<th>Neighbourhood Characteristics</th>
<th>Physical health and well-being</th>
<th>Social knowledge and competence</th>
<th>Emotional health/maturity</th>
<th>Language and cognitive development</th>
<th>Communication and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Mother tongue English</td>
<td>0.026</td>
<td>0.906</td>
<td>-0.048</td>
<td>0.850</td>
<td>0.125</td>
<td><strong>0.440</strong></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>-0.190</td>
<td>0.250</td>
<td>-0.121</td>
<td>0.532</td>
<td>-0.308</td>
<td>-0.173</td>
</tr>
<tr>
<td>% No high school certificate</td>
<td>-0.163</td>
<td>0.362</td>
<td>-0.108</td>
<td>0.607</td>
<td>0.039</td>
<td><strong>0.861</strong></td>
</tr>
<tr>
<td>Median Family Income</td>
<td>0.243</td>
<td>0.307</td>
<td>-0.134</td>
<td>0.629</td>
<td>-0.258</td>
<td>-0.214</td>
</tr>
<tr>
<td>% Non movers 5-years</td>
<td>0.034</td>
<td>0.844</td>
<td>-0.004</td>
<td>0.983</td>
<td>0.009</td>
<td>0.966</td>
</tr>
<tr>
<td>% Families lone parent</td>
<td>-0.256</td>
<td>0.056</td>
<td><strong>-0.387</strong></td>
<td>0.015</td>
<td><strong>-0.446</strong></td>
<td><strong>-0.547</strong></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.533</td>
<td>0.382</td>
<td>0.219</td>
<td>0.550</td>
<td><strong>0.773</strong></td>
<td><strong>0.587</strong></td>
</tr>
<tr>
<td>Constant</td>
<td>84.972</td>
<td>0.000</td>
<td>86.985</td>
<td>0.000</td>
<td>86.554</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: Bolded values are significant at p<0.05
and significant at the p<0.05 level with the communication skills and general knowledge sub-scale.

The correlation analysis and multiple regression shows considerable evidence for an ecological relation, at the neighbourhood level, between neighbourhood characteristics and EDI scores across all sub-scales. This analysis shows that ecological effects appear to be higher for particular aspects of children’s readiness to learn. This analysis has also suggested that particular neighbourhood characteristics have greater ecological relations with children’s readiness to learn. Both the correlation analysis and multiple regression analysis found relations weakest between the neighbourhood level predictor variables and the social knowledge and competence and emotional health and maturity sub-scales. The multiple regression analysis model summary found that less than 40 percent of the variation in these sub-scales at the neighbourhood level could be explained by the neighbourhood level predictor variables. For the remaining three sub-scales and Total EDI, neighbourhood characteristics explain more than 50 percent of the variation. The correlation values among all neighbourhood characteristics used in this study are the lowest for the social knowledge and competence and emotional health and maturity sub-scales.

4.3 MULTILEVEL ANALYSIS RESULTS

In this section results are presented of the multilevel analysis described in the section 3.4.4 of the methodology in Chapter 3. Recall that multilevel analysis is performed in order to answer the second research objective of this thesis, which is to determine if neighbourhood characteristics have an independent influence on children’s readiness to learn, above and beyond individual and family characteristics. First the results of preliminary models that contain no neighbourhood characteristics are presented. These models are required to estimate the percentages of variance explained by individual characteristics, and for the calculation of neighbourhood effects in subsequent full models. Second, results are presented for the full models that estimate how neighbourhood characteristics explain variance in EDI scores. The descriptive statistics for the variables included in the multilevel models are discussed in the Chapter 3 methodology. Multilevel modeling estimates the variance attributed to the individual and neighbourhood level as well as variance explained by predictor variables included in the model. The variance estimates have been calculated into a percentage for discussion in the results section. The variance values for each model are contained in the appendix of this thesis.

A preliminary multilevel model termed a fully unconditional model is performed to estimate the proportion of variance in EDI scores explained by the individual level (level 1) and the neighbourhood level (level 2). Recall that this model is specified by Equation c and includes no predictor variables at the individual level (level 1) or neighbourhood level (level 2), only the outcome variable is included. Six models have been calculated, one for each of the EDI sub-scales and total EDI as the outcome variable. The results of these models are presented in Tables 4.6. Across all models the p-value for neighbourhood level variance is at the level p<0.001 (Appendix 2), indicating that variance in EDI scores attributed to the neighbourhood level is statistically significantly. Section 1 of Table 4.6 shows percentage of variation attributed to the individual and neighbourhood level given by the fully unconditional model.
<table>
<thead>
<tr>
<th>Physical health and well-being</th>
<th>Emotional health and maturity</th>
<th>Social knowledge and competence</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 (individual level)</td>
<td>91.09</td>
<td>94.35</td>
<td>95.05</td>
<td>91.39</td>
<td>84.50</td>
</tr>
<tr>
<td>Level 2 (neighbourhood level)</td>
<td>8.91</td>
<td>5.65</td>
<td>4.95</td>
<td>8.61</td>
<td>15.49</td>
</tr>
</tbody>
</table>

2. % LEVEL 1 (individual level) VARIANCE explained by:

<table>
<thead>
<tr>
<th></th>
<th>Physical health and well-being</th>
<th>Emotional health and maturity</th>
<th>Social knowledge and competence</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>0.59</td>
<td>0.30</td>
<td>0.37</td>
<td>0.18</td>
<td>0.06</td>
<td>0.42</td>
</tr>
<tr>
<td>ESL</td>
<td>0.71</td>
<td>1.39</td>
<td>1.76</td>
<td>2.98</td>
<td>30.03</td>
<td>6.07</td>
</tr>
<tr>
<td>Income and ESL</td>
<td>1.25</td>
<td>1.63</td>
<td>205</td>
<td>3.12</td>
<td>30.09</td>
<td>6.40</td>
</tr>
</tbody>
</table>

3. % TOTAL VARIANCE explained by Level 1 variables (individual level):

<table>
<thead>
<tr>
<th></th>
<th>Physical health and well-being</th>
<th>Emotional health and maturity</th>
<th>Social knowledge and competence</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>0.56</td>
<td>0.28</td>
<td>0.35</td>
<td>0.16</td>
<td>0.05</td>
<td>0.41</td>
</tr>
<tr>
<td>ESL</td>
<td>0.67</td>
<td>1.32</td>
<td>1.69</td>
<td>2.81</td>
<td>29.06</td>
<td>5.80</td>
</tr>
<tr>
<td>Income and ESL</td>
<td>1.19</td>
<td>1.55</td>
<td>1.97</td>
<td>2.94</td>
<td>29.12</td>
<td>6.12</td>
</tr>
</tbody>
</table>

4. % LEVEL 2 (neighbourhood level) VARIANCE explained by:

<table>
<thead>
<tr>
<th></th>
<th>Physical health and well-being</th>
<th>Emotional health and maturity</th>
<th>Social knowledge and competence</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full level 2: All neighbourhood characteristics</td>
<td>24.10</td>
<td>15.55</td>
<td>12.98</td>
<td>34.37</td>
<td>27.26</td>
<td>26.79</td>
</tr>
<tr>
<td>Partial level 2: Median family income and % mother tongue English level 2</td>
<td>10.29</td>
<td>-1.61</td>
<td>0.74</td>
<td>0.19</td>
<td>28.41</td>
<td>0.32</td>
</tr>
</tbody>
</table>

5. % TOTAL VARIANCE explained by Level 2 (neighbourhood level):

<table>
<thead>
<tr>
<th></th>
<th>Physical health and well-being</th>
<th>Emotional health and maturity</th>
<th>Social knowledge and competence</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full level 2: All neighbourhood characteristics</td>
<td>1.23</td>
<td>0.78</td>
<td>0.50</td>
<td>2.03</td>
<td>1.24</td>
<td>1.27</td>
</tr>
<tr>
<td>Partial level 2: Median family income and % mother tongue English</td>
<td>0.53</td>
<td>-0.08</td>
<td>0.03</td>
<td>0.01</td>
<td>1.29</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Percentages are computed by dividing variance at the neighbourhood or individual level by total model variance.

Section 1 of Table 4.6 shows that across the EDI sub-scales there are differences in the amount of variation that is eligible to be explained by the neighbourhood level. The EDI sub-scales social knowledge and competence and emotional health and maturity have the lowest percentage of variance in EDI scores attributed to the neighbourhood level suggesting neighbourhoods matter less for these aspects of readiness to learn. From section 1 of Table 4.6 the social knowledge and competence sub-scale 4.94% of variation in individual scores can be attributed to the neighbourhood level and 5.65% for the emotional health and maturity sub-scale. The EDI sub-scales with the highest variance attributed to the neighbourhood level are: communication skills and general knowledge (15.49%), Total EDI (8.91%), physical health and well-being (8.91%) and language and cognitive development (8.69%). These results suggest that neighbourhoods may be more salient for children’s cognitive and language skills than emotional and social skills.

Section 2 and 3 of Table 4.6 shows the results of the next set of models that contains predictor variables at the individual level but no variables at the neighbourhood level. Three versions of this model are calculated for each EDI sub-scale, the first model termed income variance includes only family income as a predictor variable, the second model termed ESL variance only has ESL as the predictor variable, the third model termed full individual level includes both ESL and family income as predictor variables. The rationale for calculating these models is twofold. First, these models estimate how much variation at the individual level can be explained by the individual level predictor variables. Second, in order to obtain reliable estimates of neighbourhood effects it is necessary to include individual level variables so that variance due to individual characteristics is not mis-specified at the neighbourhood level (Raudenbush and Bryk 2002). Calculating a model with only individual characteristics will provide a more reliable estimate of variation in EDI scores that can be attributed to the neighbourhood level. This variance estimate will be used in calculations to determine the amount of variance explained by neighbourhood characteristics in the full models.

The results of the first two models, income variance and ESL variance are listed in section 2 of Table 4.6. In the physical health and well-being sub-scale only a small percentage of variance in scores at the individual level can be explained by the individual level variables, ESL(0.71) and family income (0.59). The low value for ESL is expected as it is not presumed that ESL status should influence a child's physical health score. It is expected that ESL should explains a greater percentage of sub-scales that tap language and communication skills.

From section 2 of Table 4.6, across all EDI sub-scales the percentage of variance at the individual level that can be explained by family income is small, ranging from 0.06% to 0.57%. This value may be so low because of error due to the measurement of family income by proxy using Enumeration Area data from the 1996 Census of Canada. There is more variation across EDI sub-scales in the amount of variance at the individual level explained by ESL than family income. ESL status explains the least variance amount of variance for the physical health and well-being sub-scale (0.71%) of individual status variance. This is consistent with Table 4.1 which shows only minimal difference in the physical health and well-being sub-scale between ESL (80.41) and non-ESL (82.78) children. Thus, ESL status appears to have a little influence on physical health
and well-being scores. The percent of individual variance explained by ESL is fairly consistent among the following sub-scales: social knowledge and competence (1.76%), emotional health and maturity (1.39%), and language and cognitive development (2.98%). For Total EDI the percent of individual level variance explained by ESL is slightly higher at 6.07%, and much higher for the communication skills and general knowledge sub-scale in which ESL status explains 30.03% of variation in scores. The percent of individual variance explained by ESL is likely so high for communication and general knowledge sub-scale because this scale assesses communication skills in English. ESL children have much lower scores in this sub-scale than non-ESL children, this was shown in Table 4.1, which shows that the average score in communication skills and general knowledge among non-ESL children was 77.8 and much lower at 45.3 among ESL children.

It can be useful to know how much variance in the entire model (including level 1 and 2) can be explained by a given characteristic. For example, an individual level characteristic may explain 95% of variance at the individual level indicating it is an important variable. However, if only 1% of variance can be attributed to the individual level than this characteristic may not be particularly relevant with respect to the entire model, explaining only 0.95% of variance. In section 3 of Table 4.5 the percent of total model variance (individual and neighbourhood) explained by the individual characteristics for each EDI sub-scale is listed. The communication skills and general knowledge sub-scale has the greatest amount of variance explained by individual level variables at 30.09%. The individual characteristics explain 6.04% of variation in Total EDI and less than 4% of variation in the remaining four sub-scales.

Two full multilevel models that include both individual and neighbourhood predictor variables are performed to estimate independent neighbourhood effects on children’s readiness to learn. The first full model termed a partial neighbourhood level is specified by Equation 1, the model includes all individual level variables and only two neighbourhood level variables, % mother tongue English and median family income. The second full model termed a full neighbourhood level model is specified by Equation j, this model includes all individual level and neighbourhood level variables.

The first full model, which includes neighbourhood and individual level variables termed, a partial neighbourhood level model, is specified in Equation 1 (Chapter 3). This model was chosen to determine if there are neighbourhood effects attributed to characteristics that mirror the individual characteristics, ESL and family income. In this model the outcome variable is EDI score and the predictor variables are ESL and family income at the individual level and % mother tongue English and median family income at the neighbourhood level. The percentage of variation at the neighbourhood level that can be explained by the neighbourhood characteristics % mother tongue English and median family income varies considerably by sub-scale (Table 4.7). Less than one percent of neighbourhood variance is explained by the two neighbourhood characteristics for the sub-scales: social knowledge and competence, emotional health and maturity, language and cognitive development and Total EDI. The emotional health and maturity sub-scale has a negative value of variance explained. This is because the two neighbourhood characteristics have negligible explanatory power, thus the difference is random variation (Raudenbush and Bryk 2002). The neighbourhood characteristics explain a larger percent of neighbourhood variation for the physical health and well-being (10.29%) and
communication skills and general knowledge (28.41%) sub-scales. Table 4.5.5 lists the percentage of variation these neighbourhood characteristics explain in the total variation. Across all sub-scales these values are quite low, except for the communication skills and general knowledge sub-scale (1.29%) all other sub-scales are below 1 percent.

The significance of variables included in the partial neighbourhood level multilevel model specified by Equation 1 varies by sub-scale (Table 4.7). For the physical health and well-being sub-scale the neighbourhood characteristic median family income is significant at the p<0.05 level. Both individual level characteristics are statistically significant; income at the p<0.01 level and ESL at the p<0.001 level. The emotional health and maturity sub-scale, has no neighbourhood characteristics that have a significance level falling within the p<0.05 level. Individual level variables are statistically significant, income at the p<0.01 level and ESL at the P<0.001 level. Similar to the emotional health and maturity sub-scale no neighbourhood characteristics are significant at p<0.05. At the individual level income is significant at the p<0.01 level and ESL is significant at the p<0.001 level. For the language and cognitive development sub-scale, none of the neighbourhood variables are significant at the p<0.05 level. The individual variable income is significant at the p<0.05 level and ESL is significant at the p<0.001 level. The neighbourhood characteristic % mother tongue English is significant at the p<0.001 level for the communication and general knowledge sub-scale, the neighbourhood characteristics median family income is not significant given a p<0.05 level as the minimum significant level. At the individual level only the ESL variable is significant at the p<0.001 level. Lastly, Total EDI has no significant neighbourhood level variables; one individual level variable, ESL, is significant at the p<0.001 level.

The second model, termed a full neighbourhood level model, contains all predictor variables at the individual and neighbourhood level. This model is given by Equation 1 in the Chapter 3 methodology. Results of this model indicate considerable variation in the amount of neighbourhood level variation explained by the model across the EDI sub-scales (Table 4.8). The EDI sub-scales with the lowest proportion of neighbourhood variation explained by the model are social knowledge and competence (12.98%) and emotional health and maturity (15.55%). Interestingly, these two sub-scales also have the lowest proportion of variation eligible to be explained by the neighbourhood level. Neighbourhood characteristics explain over 20 percent of variance eligible to be explained by the neighbourhood level across all other sub-scales. Neighbourhood characteristics explain 34.37% of variation in the language and cognitive development sub-scale of the EDI at the neighbourhood level. Slightly lower are the sub-scales communication skills and general knowledge (27.26%), Total EDI (26.79%) and physical health and well-being (24.10%). The neighbourhood characteristics selected do not explain equivalent amounts of variation across all sub-scales of readiness to learn, suggesting that the selected neighbourhood characteristics have more salience for particular aspects of child development.

It is important to know the percentage of total variance (level 1 and level 2) that can be explained by all neighbourhood characteristics to assess the magnitude of neighbourhood effects (Table 4.8). Because the majority of variance in individual scores is explained by the individual level, only a small percentage of total variance remains to be explained by the selected neighbourhood characteristics. The lowest values are for the social knowledge and competence (0.50%) and emotional health and maturity (0.78%)
sub-scale. The *language and cognitive development* sub-scale has the highest percentage of explained variance attributed to the given neighbourhood characteristics at 2.03%.

In Table 4.8 the coefficients and significance levels of individual and neighbourhood predictor variables for the *full neighbourhood level* model specified by Equation j which includes all six neighbourhood characteristics are presented. The *physical health and well-being* sub-scale has no neighbourhood level coefficients that are significant at a p<0.05 level. Though not all coefficients are significant, all are related in the expected direction, with the exception of the variable % mother tongue English which is negatively related to *physical health and well-being*. The value of this coefficient is -0.008 and the standard error for this variable 0.066 which gives a 95% confidence interval of [0.12, -0.13] indicating that the coefficient direction is not meaningful.

At the individual level family income is significant at the p<0.01 level and ESL is significant at the p<0.001 level for the *physical health and well-being* sub-scale. The *emotional health and maturity* sub-scale has two neighbourhood characteristics significant at the p<0.01 level, median family income and % families lone parent. As expected, median family income is positively related to emotional health and maturity and % families lone parent is negatively related. For the emotional health and maturity sub-scale, the individual level income is significant at the p<0.01 level and ESL is significant at the p<0.001 level. *Social knowledge and competence* has only one neighbourhood characteristic, % families lone parent significant at the p<0.05 level with a coefficient of -0.341. The individual characteristics are both significant predictors, income is significant at p<0.01 and ESL is significant at p<0.001. The *social knowledge and competence* sub-scale has two neighbourhood characteristics that are significant predictor variables of this outcome variable. The variable median family income is significant at the p<0.01 level and % families lone parent is significant at the p<0.001 level.

*Median family income* is positively associated and % families lone parent is negatively associated with *social knowledge and competence* sub-scale. The individual predictor variables, family income and ESL, are both significant predictors of the social knowledge and competence sub-scale at the p<0.001 level. The EDI sub-scale *communication skills and general knowledge* has only one statistically significant neighbourhood characteristic, % mother tongue English, significant at the p<0.001 level. At the individual level both neighbourhood characteristics are significant at the p<0.001 level. *Total EDI* has two neighbourhood characteristics that are significant predictors. The variable median family income is significant at the p<0.05 level and % families lone parent is significant at the p<0.01 level. The individual level variables are both significant at the p<0.001 level.

The following paragraphs provide a brief summary of the multilevel results. The majority of variance in EDI scores across all sub-scales can be attributed to the individual level. The neighbourhood level explains less than ten percent of variance for most EDI scores. However, the individual level variables explain only a small percentage of model variance (with the exception of the *communication and general knowledge* sub-scales). This suggests that additional individual level variables are required. It is possible that error may be introduced in the neighbourhood effects estimates (explained neighbourhood level variance) as individual characteristics are not adequately controlled.
Table 4.7 Coefficients for \textit{partial neighbourhood level} multilevel model

<table>
<thead>
<tr>
<th>Physical health</th>
<th>Emotional health/maturity</th>
<th>Social knowledge and competence</th>
<th>Language and cognitive development</th>
<th>Communication and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>P</td>
<td>se</td>
<td>R</td>
<td>P</td>
<td>se</td>
</tr>
<tr>
<td><strong>LEVEL 2 Predictor variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>79.58</td>
<td>.000</td>
<td>.548</td>
<td>72.89</td>
<td>.000</td>
</tr>
<tr>
<td>%Mother tongue English</td>
<td>-.013</td>
<td>.723</td>
<td>.037</td>
<td>-.039</td>
<td>.397</td>
</tr>
<tr>
<td>Median family income</td>
<td>.000</td>
<td>.031</td>
<td>.000</td>
<td>.000</td>
<td>.742</td>
</tr>
<tr>
<td><strong>LEVEL 1 Predictor variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>.000</td>
<td>.002</td>
<td>.000</td>
<td>.000</td>
<td>.004</td>
</tr>
<tr>
<td>ESL</td>
<td>2.41</td>
<td>.000</td>
<td>.641</td>
<td>4.55</td>
<td>.000</td>
</tr>
</tbody>
</table>

Variance explained (%) by neighbourhood characteristics at:

- Neighbourhood level: 10.29
- Neighbourhood level and individual level: 0.53

Note: Bolded values are significant at \(p<0.05\)
Table 4.8 Coefficients for full neighbourhood level multilevel model

<table>
<thead>
<tr>
<th>Predictor variables</th>
<th>Physical health</th>
<th>Emotional health/maturity</th>
<th>Social knowledge and competence</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>79.63 (0.00)</td>
<td>72.96 (0.00)</td>
<td>76.83 (0.00)</td>
<td>74.50 (0.00)</td>
<td>49.85 (0.00)</td>
<td>67.35 (0.00)</td>
</tr>
<tr>
<td>%Mother tongue English</td>
<td>-0.08 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Median family income</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>-0.203 (0.00)</td>
<td>-0.415 (0.00)</td>
<td>-0.211 (0.00)</td>
<td>-0.369 (0.00)</td>
<td>-0.230 (0.00)</td>
<td>-0.141 (0.00)</td>
</tr>
<tr>
<td>%no high school certificate</td>
<td>-0.139 (0.00)</td>
<td>0.089 (0.00)</td>
<td>0.045 (0.00)</td>
<td>0.022 (0.00)</td>
<td>0.030 (0.00)</td>
<td>0.164 (0.00)</td>
</tr>
<tr>
<td>% Non movers 5 years</td>
<td>0.026 (0.00)</td>
<td>0.024 (0.00)</td>
<td>0.030 (0.00)</td>
<td>0.022 (0.00)</td>
<td>0.030 (0.00)</td>
<td>0.164 (0.00)</td>
</tr>
<tr>
<td>%Families loneparent</td>
<td>-0.193 (0.00)</td>
<td>-0.386 (0.00)</td>
<td>-0.341 (0.00)</td>
<td>-0.688 (0.00)</td>
<td>-0.174 (0.00)</td>
<td>-0.033 (0.00)</td>
</tr>
</tbody>
</table>

LEVEL 1 Predictor variables

| Family Income | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 2.868 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| ESL | 376 (0.00) | 4.494 (0.00) | 5.588 (0.00) | 7.447 (0.00) | 27.34 (0.00) | 8.24 (0.00) |

Variance explained(%) by neighbourhood characteristics at:

| Neighbourhood level | 24.10 | 15.55 | 12.98 | 34.37 | 27.26 | 26.79 |
| Neighbourhood level and individual level | 1.23 | 0.78 | 0.50 | 2.03 | 1.24 | 1.27 |

Note: Bolded values indicate correlations significant at p<0.05
Variance at the neighbourhood level is statistically significant for the full neighbourhood level model and the partial neighbourhood level model, using the p-value of neighbourhood variance as a measure of significance. There is considerable variation across the EDI sub-scales in the amount of variance eligible to be explained by the neighbourhood level and amount of neighbourhood level variance explained by the full neighbourhood level model.

The emotional health and maturity and social knowledge and competence sub-scales have the smallest proportion of variation attributed to the neighbourhood level and explained by the six neighbourhood characteristics included in the full neighbourhood level model. This finding is consistent with past research, as discussed in the literature review in Chapter 2, which suggests that neighbourhood effects are weaker for social, behavioural and emotional measures of children than cognitive measures. While the given neighbourhood characteristics explain a considerable proportion of variance at the neighbourhood level, this translates into only a small percentage of explanation of total variance (see Table 4.6 and Table 4.8). This suggests that characteristics at the family and individual level, not the neighbourhood level, explain most variation in EDI scores. The partial neighbourhood level model, with neighbourhood characteristics % mother tongue English and median family income explains only a minimal proportion of total variance in EDI scores. This suggests these neighbourhood characteristics have only minimal ecological effects.

The variables % families lone parent, median family income and % mother tongue English are the only neighbourhood level variables that are statistically significant for any of the sub-scales. This indicates that these characteristics, at the neighbourhood level, are most salient for child development. The variable % families lone parent is most consistently significant for the EDI sub-scales, suggesting that this variable may be most salient for child development at the neighbourhood level. Of the three socioeconomic status variables, only median family income was significantly related for any of the sub-scales, indicating that neighbourhood level income may be the most important socioeconomic dimension.

4.4 CONCLUSION

In conclusion, this chapter has presented the results of ecological and multilevel analysis designed to answer the research objectives of this study. Results of correlation analysis and multiple regression analysis show statistically significant ecological relations between neighbourhood characteristics and EDI scores. Cartographic analysis revealed a prominent geographic pattern to the readiness to learn of kindergarten children in Vancouver neighbourhoods, which mirrors the pattern of socioeconomic factors. Neighbourhoods on the West Side tend to have higher levels of readiness to learn than neighbourhood on the East Side. Similarly, cartographic analysis of neighbourhood characteristics shows a similar pattern whereby West Side neighbourhoods tend to have a higher socioeconomic status than East Vancouver neighbourhoods. Multiple regression analysis, which estimates how multiple neighbourhood characteristics predict EDI scores demonstrated that the variable % families lone parent was the best predictor of EDI scores across most sub-scales. Multilevel analysis subsequently showed that most variation in EDI scores can be largely explained by individual characteristics. The individual level variables included in the multilevel models only explained a small
proportion of individual level variance, leaving a large proportion unexplained by the model. This suggests that additional individual level characteristics would be useful for future analysis.

For most sub-scales less than ten percent of variance in scores is attributed to the neighbourhood level. However, the full neighbourhood level model explains at least 12 percent of variance at the neighbourhood level across all sub-scales. The percent of neighbourhood level explained by the model is greatest for the language and cognitive development (34.37%), communication skills and general knowledge (27.62%) and total EDI (26.27%) sub-scales. Neighbourhood characteristics are weakest for the emotional health and maturity (12.98%) and social knowledge and competence (15.55%) sub-scales. This indicates that neighbourhoods are more salient for particular aspects of readiness to learn. These findings are consistent with past research which suggests that neighbourhood effects are weakest for emotional and behavioural aspects of child development and greatest for cognitive aspects of child development (Leventhal and Brooks-Gunn 2000). The neighbourhood characteristic % families lone parent is most significantly related to child outcomes in the multiple regression analysis and multilevel model. This suggests that this neighbourhood characteristic has the greatest ecological effect on child outcomes. In conclusion, this analysis has demonstrated that neighbourhood socioeconomic characteristics have a modest but statistically significant effect of children’s readiness to learn in Vancouver.
5.0 CONCLUSIONS

This thesis has described ecological relations between kindergarten children's readiness to learn and neighbourhood characteristics and estimated the magnitude and significance of neighbourhood effects on kindergarten children's readiness to learn in Vancouver, British Columbia. This research was designed to fill four gaps in neighbourhood effects research identified in the literature review in Chapter 2. First, this study brings a Canadian perspective to neighbourhood effects research which is typically focused on the United States. Second, this study uses multilevel modeling techniques which are required to accurately estimate neighbourhood effects but are rarely carried out in neighbourhood effects on young children due to data limitations. Third, this study includes all neighbourhoods in Vancouver; neighbourhoods were not samples to target affluent or disadvantaged neighbourhoods. Studies considered in the literature review tend to focus mainly upon disadvantaged neighbourhoods. Such studies do not provide reliable estimates of how affluent neighbourhoods may influence child outcomes. Fourth, this study measures socioeconomic status by using a set of six individual predictor variables. Many studies in the literature combine socioeconomic predictor variables into a single composite measure or index, which obscures the importance of the individual variables. Therefore, an index was not used so that the relative importance of each socioeconomic variable can be assessed. This study addressed two research objectives:

1. To determine if there are ecological relations, both statistically and spatially at the neighbourhood level, between children's readiness to learn and neighbourhood characteristics in Vancouver.

and,

2. To determine if neighbourhood characteristics have an independent effect on the readiness to learn of kindergarten children in Vancouver, over and above individual socioeconomic status.

The findings of this research have methodological and substantive implications for the study of neighbourhood effects and the readiness to learn of kindergarten children in Vancouver. The substantive implications are related to the applications of the research findings and directions for future research. The methodological implications relate to the research design, neighbourhood measures and individual measures.

5.1 SUBSTANTIVE IMPLICATIONS

The substantive implications of this research are related to the spatial pattern of readiness to learn across Vancouver neighbourhoods, ecological relations between readiness to learn and neighbourhood characteristics, and neighbourhood effects on the readiness to learn of kindergarten children in Vancouver.

The cartographic portion of the ecological analysis has shown a distinct geographic pattern in readiness to learn across Vancouver neighbourhoods. For all EDI sub-scales children on the East Side of Vancouver have lower levels of readiness to learn than children on the West Side. A policy implication that could be drawn from this
finding is to place programs and supports to increase children's readiness to learn in
neighbourhoods that have lower levels of readiness to learn.

Maps of neighbourhoods characteristics are similar in pattern to the readiness to
learn maps. Neighbourhoods on the West Side are more socioeconomically advantaged
than neighbourhoods on the East Side. These maps suggest a positive ecological relation
between affluence and readiness to learn. Correlation analysis and multiple regression
analysis at the neighbourhood level indicate that there are statistically significant
ecological relations between children's readiness to learn and neighbourhood affluence.
These results indicate that neighbourhood affluence underlies the spatial pattern of
readiness to learn in Vancouver. Children who live in more affluent neighbourhoods are
more likely to have higher levels of readiness to learn than children who live in less
affluent neighbourhoods.

Multilevel analysis has estimated how individual and neighbourhood
characteristics explain variance in the readiness to learn of kindergarten children. These
results have indicated that approximately 90 percent of variance in Total EDI scores can
be attributed to the individual level, though only 6 percent can be explained by ESL and
family income. This result is consistent with studies reviewed in the literature review in
Chapter 2, in most studies individual and family characteristics explain the majority of
variation in child outcomes. The individual level variable ESL did not explain a
consistent amount of variance across sub-scales, ranging from less than one percent to
over 30 percent. Further research is required to understand the influence of ESL status on
the result of this study. It is also possible that this is because of the binary nature of the
ESL data.

Similar to past neighbourhood effects research (Leventhal and Brooks-Gunn
2000) this study finds that neighbourhood characteristics have a modest but statistically
significant effect on kindergarten children's readiness to learn. According to these
results, a parent could increase a child's readiness to learn by about 2 percent through
moving from a poor to affluent neighbourhood. However, because neighbourhoods do
have a measurable effect, the neighbourhood may be an appropriate site for programs and
interventions to increase children's readiness to learn.

Results from this study suggest that neighbourhood effects may be more salient
for particular aspects of children's readiness to learn. Neighbourhoods matter more for
language and cognitive development, communication skills and general knowledge, and
physical health and well-being sub-scales than for the emotional health and maturity and
social knowledge and competence sub-scales. This finding is also consistent with past
neighbourhood effect studies which find neighbourhood effects stronger for cognitive and
skill-based measures of development than emotional and social (Leventhal and Brooks-
Gunn 2000). These results suggest that neighbourhood based programs to increase
readiness to learn may be most successfully if they target language, cognitive and
communication skills.

Since the majority of neighbourhood effects research has been undertaken in the
United States (Small and Newman 2001), one of the motivations behind this research was
to investigate if neighbourhood effects are occurring in Canada. The findings of this
study are consistent with neighbourhood effect studies carried out in the United States.
This is an important finding because it indicates that neighbourhood effects are not
unique to the United States and that similar processes may underlie neighbourhood
effects in Canada. It also suggests that neighbourhood effects theory, which has largely been developed through the study of American cities, may be applicable, at least in part, to the Canadian context.

Neighbourhood effect studies on child outcomes carried out in the United States typically include a measure of race, often % black and % white, as a measure of potential racial tension that is theorised to have a negative effect on child development. Because the Canadian context does not have a similar racial situation the variable % mother tongue English was selected. It is hypothesised that neighbourhoods in which a large percentage of the population does not speak English may have limited interaction between neighbourhoods and may affect the ability of non-English speaking parents to enrol children in programs and seek support, negatively influencing child development. In this study the variable % mother tongue English is a significant neighbourhood-level predictor for children’s readiness to learn. This is expected given the variability in scores associated with ESL status of EDI children. Further research is required to more fully understand the contextual effects of language at the neighbourhood level.

Based on identified gaps in neighbourhood effects literature the study design did not use an index to estimate the neighbourhood socioeconomic status construct in order to estimate which characteristics is most important. The variables median family income, unemployment rate and % no high school certificate were selected represent the socioeconomic construct. Median family income is the only socioeconomic status variable significant for any of the EDI sub-scales. This suggests that the neighbourhood income is more salient for children’s readiness to learn than education or employment. Conclusions about the relative importance of unemployment rate and % no high school certificate could not be drawn.

The neighbourhood characteristics, % mother tongue English, median family income and % families lone parent have statistically significant neighbourhood effects on Total EDI score. The remaining neighbourhood characteristics are not significant. Neighbourhoods with a greater proportion of the population with a mother tongue of English appear to have a positive influence on children’s readiness to learn. As mentioned in the previous paragraph, it is possible that in neighbourhoods where a low percentage of the population does not speak English, some parents may be to enroll children in programs or seek support which may improve children’s development due to language or cultural barriers. Median family income at the neighbourhood level also has a positive influence on children’s readiness to learn. This finding supports Jencks and Mayer (1990) epidemic model which posits that individuals in a neighbourhood influence each other. For example, it is possible that neighbourhoods with more affluent individuals have established standards or norms such as programs, networks and supports to encourage the development of their children. All neighbourhood residents regardless of social status may conform to such standards, positively promoting all children’s development. Neighbourhood effects are statistically significant for the % families lone parent variable, neighbourhoods with fewer lone parent families are associated with higher levels of readiness to learn. This lends support to the collective socialisation model by Jencks and Mayer (1990), which contends that neighbourhoods with a high proportion of lone parent families have fewer adults available for raising/monitoring children. There may also be an economic dimension that this variable is tapping given
that lone parent families typically have only one wage earner often resulting in lower family incomes than two parent families.

Past neighbourhood effect studies have estimated neighbourhood effects separately based on a child’s gender and ethnicity to determine if there are differences among these groups. Although this is an interesting area of research this was not feasible for the study at hand. The number of children per neighbourhood unit is too small to permit reliable multilevel modeling results if analysis was carried out separately based on gender or ethnicity.

5.2 METHODOLOGICAL IMPLICATIONS

The methodological implications of this thesis relate to recommendations based on the design of this study as well as study limitations. Earls and Carlson (2001) discuss the tension between adequate sample size and meaningfulness of neighbourhood units. The selection of appropriate neighbourhoods is further complicated by a lack of research that can guide the selection of appropriate neighbourhood units for children. In this study there were not enough children per census tract, the standard neighbourhood unit in neighbourhood effects research, to permit multilevel modeling. Using factor analysis 88 census tracts were combined to form 68 neighbourhood units with an adequate number of EDI children in each unit and similar socioeconomic status and ethnicity. Research that examines the appropriateness of these neighbourhood units to the scale at which neighbourhood effects operate has not been carried out. It is possible that these neighbourhood units are larger than the actual size of the neighbourhood that affects children. However, ecological relations and neighbourhood effects have been found for the neighbourhood units created for this study, suggesting they may be meaningful units. The strategy of combining census tracts may be useful for other studies where census tracts are not appropriate.

A limitation of this study was the lack of individual characteristics which are required in order to obtain more accurate estimations of the influence of individual and neighbourhood factors. Only a small amount of variance attributed to the individual level could be explained by ESL status and family income. Because family income was not available for this study, it was measured by proxy using average family income level from the 1996 Census for the Enumeration Area of each child’s home residence. Individual income has typically explained a considerable portion of variation in child outcomes in past research (Leventhal and Brooks-Gunn 2000). Though statistically significant, the individual income measure used in this study explained less that 1 percent of the variation in total EDI. While some error is expected when ecological measures are used to estimate group level effects, these results are significantly lower than expected. These results suggest that using an ecological measure as a proxy for individual income measure may not be appropriate. Further research is required to examine the appropriateness of using ecological measures as proxies for individual level measures.

Neighbourhood context is theorised to affect children through norms of behaviour, institutions and relations between neighbours, parents and children (Leventhal and Brooks-Gunn 2000). This study did not include any contextual neighbourhood measures that tap the specific mechanisms and processes through which neighbourhood context affect children. Following past studies, census data was used to approximate neighbourhood characteristics theorised to be salient for child outcomes. The lack of
contextual variables likely means that neighbourhood dimensions which affect children went unmeasured. Termed unmeasured variable bias, the lack of inclusion of these variables causes neighbourhood effects to be underestimated. The results of this study may have underestimated neighbourhood effects because of the lack of contextual neighbourhood measures. Future research would benefit from undertaking surveys, ethnographies, and neighbourhood observation to provide more robust measurement of neighbourhoods. At present, few established methodologies exist for measuring neighbourhood context (Earls and Carlson 2001). Furthermore, strategies for combining quantitative and qualitative neighbourhood measures are not adequate. This makes complementing census based neighbourhood measures with more qualitative measures difficult. This is an important area for future research, but such a task was beyond the scope of this project.

5.3 CONTEXTUAL IMPLICATIONS

The conceptual framework that guides this study is depicted in Figure 3.1. In this model a child's development is influenced by the child's own characteristics and the family, neighbourhoods and community in which he or she lives. This study theoretically recognises that multiple contexts extending to the neighbourhood, community and region influence children. The model developed for this study only includes the contextual neighbourhood level. It is possible that neighbourhood effects may be tapping effects at other scales. Future research that investigates the effect of multiple contexts on child outcomes may be useful to unravel contextual effects at different levels.

5.4 CONCLUSION

In conclusion this study has found that neighbourhoods have a significant but modest influence on the readiness to learn of kindergarten children in Vancouver. Neighbourhood effects are strongest for aspect of readiness to learn that assess communication, language and cognitive skills than aspects related to social and emotional development. This study has also shown geographic variation in the readiness to learn of kindergarten children in Vancouver at the neighbourhood level. Children on the West side of Vancouver typically enter kindergarten better prepared to learn than children on the East side. Findings of this study support the establishment of neighbourhood level programs to increase readiness to learn of children. These programs could be targeted to neighbourhoods in East Vancouver that have lower levels of readiness to learn.
REFERENCES


APPENDIX 1
EARLY DEVELOPMENT INSTRUMENT QUESTIONNAIRE
Dear Parents/Guardian of Kindergarten Students

As we all know, children can be quite different in how ready they are to start school. Children who are ready to learn from the first day they start school, have a better chance to do well in each grade and finish high school. The Vancouver School Board is doing a study in all schools in February 2000 to find out how ready kindergarten children are for school.

McMaster University, with the help of kindergarten teachers and principals has made up a questionnaire called the Early Development Instrument. This questionnaire is answered by all kindergarten teachers on all children in their classes. The answers will help us find out what needs to be done to make sure that all children do well in school. Your child’s name will not be on the questionnaire.

If you have any questions about this study, please contact your school principal.
Use ballpoint pen
Fill in circles
like this | or X
NOT ✓
If any of the information on the label appears incorrectly, please print correction below

Child's first language: O English
O French
O Other
O Don't know

Child's gender: O Female O Male
Child in this class less than one month: O Yes O No
Child considered ESL: O Yes O No
French Immersion: O Yes O No
Type of class: O JK O SK O JK/SK O JK/SK/1 O SK/1-
Class assignment: O JK O SK

Section A - Physical Well-being

1. About how many regular days has this child been absent since the beginning of school in the fall?
   Number of days:

2. over- or underdressed for school-related activities
   Never rarely sometimes usually always

3. too tired to do school work
   Never rarely sometimes usually always

4. late
   Never rarely sometimes usually always

5. hungry
   Never rarely sometimes usually always

Would you say that this child:

6. is independent in washroom habits most of the time
   Yes no don't know

7. shows an established hand preference (right vs. left or vice versa)
   Never rarely sometimes usually always

8. is well coordinated (i.e., moves without running into or tripping over things)
   Never rarely sometimes usually always

How would you rate this child's:

9. proficiency at holding a pen, crayons, or a brush
   Excellent good average poor very poor

10. ability to manipulate objects
    Never rarely sometimes usually always

11. ability to climb stairs
    Never rarely sometimes usually always

12. level of energy throughout the school day
    Never rarely sometimes usually always

13. overall physical development
    Never rarely sometimes usually always

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### Section B - Language and Cognitive Skills

**How would you rate this child's:**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>Very Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ability to use language effectively in English</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2.</td>
<td>ability to listen in English</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3.</td>
<td>ability to tell a story</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>4.</td>
<td>ability to take part in imaginative play</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5.</td>
<td>ability to communicate own needs in a way understandable to adults and peers</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6.</td>
<td>ability to understand on first try what is being said to him/her</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7.</td>
<td>ability to articulate clearly, without sound substitutions</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Would you say that this child:**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>knows how to handle a book (e.g., turn a page)</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>9.</td>
<td>is generally interested in books (pictures and print)</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>10.</td>
<td>is interested in reading (inquisitive/curious about the meaning of printed material)</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>11.</td>
<td>is able to identify some letters of the alphabet</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>12.</td>
<td>is able to attach sounds to letters</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>13.</td>
<td>is showing awareness of rhyming words</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>14.</td>
<td>is able to participate in group reading activities</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>15.</td>
<td>is able to read simple words</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>16.</td>
<td>is able to read complex words</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>17.</td>
<td>is able to read simple sentences</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>18.</td>
<td>is experimenting with writing tools</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>19.</td>
<td>is aware of writing directions in English (left to right, top to bottom)</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>20.</td>
<td>is interested in writing voluntarily (and not only under the teacher's direction)</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>21.</td>
<td>is able to write his/her own name in English</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>22.</td>
<td>is able to write simple words</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>23.</td>
<td>is able to write simple sentences</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>24.</td>
<td>is able to remember things easily</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>25.</td>
<td>is interested in mathematics</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>26.</td>
<td>is interested in games involving numbers</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>27.</td>
<td>is able to sort and classify objects by a common characteristic (e.g., shape, colour, size)</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>28.</td>
<td>is able to use one-to-one correspondence</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Would you say that this child:

29. is able to count to 20. 
30. is able to recognize numbers 1 - 10. 
31. is able to say which number is bigger of the two. 
32. is able to recognize geometric shapes (e.g., triangle, circle, square). 
33. understands simple time concepts (e.g., today, summer, bedtime). 
34. demonstrates special numeracy skills or talents. 
35. demonstrates special literacy skills or talents. 
36. demonstrates special skills or talents in arts. 
37. demonstrates special skills or talents in music. 
38. demonstrates special skills or talents in athletics/dance. 
39. demonstrates special skills or talents in problem solving in a creative way. 
40. demonstrates special skills or talents in other areas (please specify). 
41. can communicate adequately in his/her first language (based on your observation or parent/guardian information). 
42. English is the child’s first language.

Section C - Social and Emotional Development

How would you rate this child’s:

1. overall social/emotional development. 
2. ability to get along with peers. 

Below is a list of statements that describe some of the feelings and behaviours of children. For each statement, please fill in the circle that best describes this child now or within the past six months.

Would you say that this child:

3. plays and works cooperatively with other children at the level appropriate for his/her age. 
4. is able to play with various children. 
5. follows rules and instructions. 
6. respects the property of others. 
7. demonstrates self-control. 

often or very true sometimes or somewhat true never or not true
**Would you say that this child:**

<table>
<thead>
<tr>
<th></th>
<th>often or very true</th>
<th>sometimes or somewhat true</th>
<th>never or not true</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>shows self-confidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>demonstrates respect for adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>demonstrates respect for other children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>accepts responsibility for actions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>listens attentively</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>follows directions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>completes work on time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>works independently</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>takes care of school materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>works neatly and carefully</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>is curious about the world</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>is eager to play with a new toy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>is eager to play a new game</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>is eager to play with/read a new book</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>is able to solve day-to-day problems by him/herself</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>is able to follow one-step instructions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>is able to follow class routines without reminders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td>is able to adjust to changes in routines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>answers questions showing knowledge about the world (e.g., leaves fall in the autumn, apple is a fruit, dogs bark, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>shows tolerance to someone who made a mistake (e.g., when a child gives a wrong answer to a question posed by the teacher)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>will try to help someone who has been hurt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>volunteers to help clear up a mess someone else has made</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>if there is a quarrel or dispute will try to stop it</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>offers to help other children who have difficulty with a task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td>comforts a child who is crying or upset</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Would you say that this child:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>often or very true</th>
<th>sometimes or somewhat true</th>
<th>never or not true</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.</td>
<td>spontaneously helps to pick up objects which another child has dropped (e.g., pencils, books)</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>34.</td>
<td>will invite bystanders to join in a game</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>35.</td>
<td>helps other children who are feeling sick</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>36. is upset when left by parent/guardian</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>37. gets into physical fights</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>38. bullies or is mean to others</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>39. kicks, bites, hits other children or adults</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>40. takes things that do not belong to him/her</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>41. laughs at other children's discomfort</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>42. can't sit still, is restless</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>43. is distractible, has trouble sticking to any activity</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>44. fidgets</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>45. is disobedient</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>46. has temper tantrums</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>47. is impulsive, acts without thinking</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>48. has difficulty awaiting turn in games or groups</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>49. cannot settle to anything for more than a few moments</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>50. is inattentive</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>51. seems to be unhappy, sad or depressed</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>52. appears fearful or anxious</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>53. appears worried</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>54. cries a lot</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>55. is nervous, high-strung or tense</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>56. is incapable of making decisions</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>57. is excessively shy</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>58. sucks a thumb most of the time</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
Section D - General

Do any of the problems listed below influence this student's ability to do school work in a regular classroom? Please base your answer on medical diagnosis or parent/guardian information. Mark all that apply:

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
<th>don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. physical disability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. visual impairment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. hearing impairment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. speech impairment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. learning disability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. emotional problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. behavioural problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. home environment/problems at home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. other (specify below, please print)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Do you feel that this child needs further assessment?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section E - Comments

To the best of your knowledge, please mark all that apply to this child:

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
<th>don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. attended an early intervention program (specify if known, please print)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. attended day care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. attended other language or religion classes (specify if known, please print)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. attended any other organized pre-school centre (specify if known, please print)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. has an older sibling(s) in the same school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. attended junior kindergarten</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you have any additional comments about this child and her/his readiness for school, list them below, please print.

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Hamilton, Ontario.
Tel. (905) 521-2100, ext. 74377
## APPENDIX 2

Table 6. 1 Variance estimates of multilevel models

<table>
<thead>
<tr>
<th>MODEL</th>
<th>Physical health and well-being</th>
<th>Social knowledge and competence</th>
<th>Emotional health and maturity</th>
<th>Language and cognitive development</th>
<th>Communication skills and general knowledge</th>
<th>Total EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Model: Fully unconditional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1-no variables</td>
<td>Level 2</td>
<td>14.90</td>
<td>16.74</td>
<td>17.44</td>
<td>35.75</td>
<td>91.75</td>
</tr>
<tr>
<td>Level 2-no variables</td>
<td>Level 1 (individual level)</td>
<td>152.40</td>
<td>321.77</td>
<td>291.46</td>
<td>379.69</td>
<td>500.24</td>
</tr>
<tr>
<td>2. Model: Income Variance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1-income</td>
<td>Level 2 (neighbourhood level)</td>
<td>9.02</td>
<td>13.10</td>
<td>15.44</td>
<td>26.61</td>
<td>58.59</td>
</tr>
<tr>
<td>Level 2-no variables</td>
<td>Level 1 (individual level)</td>
<td>151.51</td>
<td>320.59</td>
<td>290.59</td>
<td>379.02</td>
<td>499.95</td>
</tr>
<tr>
<td>3. Model: ESL Variance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1-ESL</td>
<td>Level 2 (neighbourhood level)</td>
<td>11.87</td>
<td>13.45</td>
<td>15.29</td>
<td>26.40</td>
<td>19.61</td>
</tr>
<tr>
<td>Level 2-no variables</td>
<td>Level 1 (individual level)</td>
<td>151.33</td>
<td>316.11</td>
<td>287.40</td>
<td>368.38</td>
<td>349.99</td>
</tr>
<tr>
<td>4. Model: Full individual level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1-ESL, income</td>
<td>Level 2 (neighbourhood level)</td>
<td>8.09</td>
<td>12.61</td>
<td>15.17</td>
<td>23.13</td>
<td>16.71</td>
</tr>
<tr>
<td>Level 2-no variables</td>
<td>Level 1 (individual level)</td>
<td>150.49</td>
<td>315.18</td>
<td>286.72</td>
<td>367.83</td>
<td>349.69</td>
</tr>
<tr>
<td>5. Model: Partial neighbourhood level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1-ESL, income</td>
<td>Level 2 (neighbourhood level)</td>
<td>7.25</td>
<td>12.51</td>
<td>15.41</td>
<td>23.09</td>
<td>11.96</td>
</tr>
<tr>
<td>Level 2-Median family income and %mother tongue English</td>
<td>Level 1 (individual level)</td>
<td>150.49</td>
<td>315.19</td>
<td>286.69</td>
<td>367.92</td>
<td>349.70</td>
</tr>
<tr>
<td>6. Model: Full neighbourhood level</td>
<td></td>
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<tr>
<td>Level 1-ESL, income</td>
<td>Level 2 (neighbourhood level)</td>
<td>6.14</td>
<td>10.97</td>
<td>12.81</td>
<td>15.18</td>
<td>12.15</td>
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<tr>
<td>Level 2-All neighbourhood characteristics</td>
<td>Level 1 (individual level)</td>
<td>150.54</td>
<td>315.30</td>
<td>286.63</td>
<td>367.91</td>
<td>349.66</td>
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