POST-SECONDARY PERSISTENCE AND PARTICIPATION: 
DOES NEIGHBOURHOOD MATTER?

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ABSTRACT

Attrition is high in open-admission institutions. While educational patterns have been studied for decades and have arguably been the central focus of higher education research, despite this large body of inquiry approximately four of every ten new students at open-admission institutions do not continue their education.

Student characteristics such as socioeconomic status and academic ability have been consistently demonstrated to have explanatory relationships with educational attainment. However, open admission institutions seldom require these data as a matter of course and are therefore limited in regards to assessment of the educational patterns of their students. The absence of socioeconomic information in open admission institutions therefore presents a compelling argument for the exploration of alternate datasets to research variances in educational outcomes. As such, this study’s methodology was drawn from a body of literature that argues that neighbourhood effects (relationships between neighbourhood characteristics and education) rival predictions based on socioeconomic and academic factors.

To determine the feasibility of this approach, this study employed only those student-level data that are normally available to open admission institutions via the application process, including high school records, gender, age, and address. Using the postal code on record at the time of high school graduation, 10,000 high school students and 500 first-year university students were mapped to neighbourhoods which were subsequently characterized using multiple variables from the 2001 Canadian Census. The relationships between neighbourhoods and the participation, performance and persistence were subsequently explored.

Significant differences were found between neighbourhoods in regards to high school course options, final grades, and participation and persistence in post-secondary. Multiple regression was used to determine which of the neighbourhood characteristics were most strongly related to educational outcomes. Consistent with the literature, students living in neighbourhoods with higher proportions of affluent households, residential stability, household income and professionals generally enrolled in more academic courses in high school, attained higher grades, participated in post-secondary, and persisted longer than their peers in lower-class neighbourhoods.

Keywords: education, persistence, participation, retention, attrition, neighbourhood, census, ABSMs

Subject Terms: College attendance – Canada; neighbourhoods; Academic achievement; Universities and Colleges Open Admission; College Students; College Dropouts Prevention
To my family

This program has been an incredible journey. As it draws to a close and I reflect back on the past five years, I am filled with an immense sense of gratitude towards those in my ‘neighbourhood’ who made everything possible.

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CHAPTER 1: INTRODUCTION

Increased access to post-secondary education has been an important policy objective in British Columbia in recent years. Fueled by perceptions of limited access to university programs, the landscape of post-secondary education in BC was significantly changed when the mandates of college and university colleges were expanded to include programs typically reserved solely for offering at large research universities. Under an ambitious growth mandate, the BC Ministry of Advanced Education, Labour and Market Development (ALMD) pledged to “make BC the best-educated and literate jurisdiction on the continent” (Ministry of Advanced Education (BC), 2006, p. 1) by adding 25,000 new post-secondary student seats by the year 2010.

It can be argued that higher levels of participation are necessarily being achieved given that additional supply (e.g.: student seats) has been added to the system. What is not clear, however, is whether the goal of ‘access for all’ has made equitable gains across all socioeconomic gradients. While some Canadian evidence suggests that higher proportions of students from lower socioeconomic statuses are pursuing post-secondary education (Hoy,
Christofides & Cirello, 2001), other studies suggest that the trajectory of increases in participation rates has since flattened (Corak, Lipps & Zhao, 2003).

To complicate the question, this new challenge comes at a time when the demographics of the largest post-secondary bound group of British Columbians (18-24 year olds) is experiencing a steady decline (BC Stats, 2008). Under this reality, institutions will be increasingly challenged to meet enrolment targets. In so doing, it is important to ensure that access initiatives first do no harm: in the face of system-wide declining enrolments, pressure to meet enrolment targets must not overshadow institutions’ basic responsibilities to provide access only to those students who are prepared. The danger exists that aggressive marketing practices at institutions with little excess demand may result in the admission of students who would not normally be eligible. It is these students who are at risk: if they are less than optimally prepared to commence post-secondary studies, should they be left to their own devices once admitted? On the contrary, by dint of having been granted admission to an institution, it can be argued that it is incumbent upon the institution to (a) ensure adequate support service capacity for these students and (b) effectively communicate the range of services to these students such that they are apprised of all support available to them.
While there is an extensive body of retention literature that examines the relationships of participation and persistence factors with educational outcomes, by and large these analyses are restricted primarily to the study of retention at residential, competitive entry schools with a primarily traditional student body. In contrast, there has been comparatively little investigation of the factors that contribute to educational outcomes at commuter institutions that enrol both traditional and non-traditional students. Therefore, this dissertation examines a number of variables that contribute to participation, performance, and persistence amongst local direct-entry high school graduates in a mid-sized (population 80,000) university city.

Because open-admission institutions’ mandates typically include the provision of access to a wide scope of students, academic abilities and demographics are quite heterogeneous. These institutions often have mature student admissions categories that grant admission to any applicant over the age of 19 regardless of whether they have graduated from high school. Because they do not typically exercise admissions minima, students’ academic ability varies widely. Though pre-requisites do apply to some courses, students are able to complete a wide range of coursework without any specific prerequisites.
Therefore, open admission institutions would be well served by the acquisition of improved understanding about their applicants and students. Because of a declining demographic, these institutions have strong incentives to try to improve student performance and participation. The benefits of this are twofold: institutions, obviously, will benefit from increased enrolments and tuition revenues. More importantly, students will benefit from increased support services intended to mitigate involuntary withdrawal.

The literature provides a great deal of research to inform this study. While educational patterns have been studied for decades and have arguably been the central focus of higher education research, despite this large body of inquiry approximately four of every ten new students at open admission institutions do not continue their education (Bean & Eaton, 2002).

Student characteristics such as socioeconomic status and academic ability have been consistently demonstrated to have explanatory relationships with educational attainment. However, open admission institutions seldom require these data as a matter of course and are therefore limited in regards to their ability to assess the educational patterns of their students. The absence of socioeconomic information in open admission institutions therefore presents a compelling argument for the exploration of alternate datasets to research
variances in educational outcomes. As such, this study’s methodology was
drawn from a body of literature that argues that neighbourhood effects
(relationships between neighbourhood characteristics and education) rival
predictions based on socioeconomic and academic factors.

This study makes a contribution to the growing body of research
demonstrating the power of using area-based socio-economic measures (ABSMs)
for population studies. It will demonstrate how ABSMs, derived from Statistics
Canada’s 2001 Census, can be employed to gain a more complete understanding
of student access and retention than is afforded by limited data and extant
literature. This study ultimately seeks to build a practical model that will allow
open-admissions institutions, typically data-poor in terms of socioeconomic or
academic information about their applicants, to better understand the
participation and pathways of potentially vulnerable students.

This paper assesses several key aspects of educational attainment: (a)
participation and performance of Grade 12 students, (b) the degree to which
accessibility initiatives have begun to realize their intended results by examining
participation and outcomes by neighbourhood, and (c) the extent to which
neighbourhood effects influence students’ pursuit of post-secondary education at
an open-admission university. These explorations will be conducted at the local
level using a cross-sectional database of local high school graduates and university enrollees.

To determine the feasibility of this approach, this study employs only those student-level data that are normally available to open admission institutions via the application process, including high school records, gender, age, and address. Using the postal code on record at the time of high school graduation, 10,000 high school students and 500 first-year university students were mapped to neighbourhoods which were subsequently characterized using multiple variables from the 2001 Canadian Census. The relationships between this population's neighbourhood characteristics and educational participation, performance and persistence were subsequently explored.

This study is particularly relevant to open-admission institutions that, by definition, do not include measures of academic ability or socioeconomic status in the admissions process. Without these data, which are empirically proven to directly impact performance and persistence (for example, see Andres & Grayson, 2003; Bean & Metzner, 1985; Butlin, 1995; D'Angiulli, Siegel & Maggi, 2004; Finnie, Lascelles & Sweetman, 2005; Gallacher, 2006; Graunke & Woosley, 2005; Kuh, 2002; Pascarella & Terenzini, 2005; Tinto, 1996) open admissions institutions have few available mechanisms by which to gauge entering academic
ability. In essence, they lack a barometer that could facilitate identification of students vulnerable to attrition before they are lost to the institution. This study seeks to address this void by exploring the seemingly intuitive but complex question of how neighbourhood characteristics are related to educational outcomes.

General support for the notion that neighbourhoods play a role in educational attainment is provided in the literature (see Aaronson 1997; Brooks-Gunn, Duncan, Klebanov & Sealand 1993; Case and Katz 1991; Dornbusch, Ritter and Steinberg 1991, Duncan 1994, Duncan, Connell and Klebanov 1997, Garner & Raudenbush 1991). Though much debate about the pathways through which these effects mediate or exacerbate educational outcomes persists, the existence of relationships between neighbourhood characteristics and educational outcomes is increasingly accepted.

This study seeks to provide an enabling vehicle to permit institutions to ameliorate involuntary attrition by employing the general theory that pre-college characteristics directly influence student retention, and specifically, whether a student’s neighbourhood of origin influences educational outcomes as part of these pre-college characteristics. To this end, the relationships between neighbourhood socioeconomic characteristics and participation, performance
and persistence patterns of first-time students enrolled in the first year of an open admission program over three years will be explored.

To inform this investigation, this study draws on two bodies of literature: (a) retention theory and (b) neighbourhood effects theory. Retention theory provides a central hypothesis that pre-college characteristics directly affect student retention. Neighbourhood effects theory, which describes the impacts that students' communities and immediate neighbourhoods have on various factors, provides an opportunity for a contextual analysis of the relationship between neighbourhood-related pre-college characteristics and educational outcomes.

Personal Interest

I have worked in higher education for over fifteen years. During this period I have held several roles, most of which fall within the Student Services portfolio. After working with students in various capacities, it became clear to me that many students are academically prepared for university-level studies, but for an infinite number of reasons, many are not. Prior academic history, intellect, motivation, maturity, family situations, financial concerns and lack of an academic or career goal are just a few of these legitimate reasons. Some of these students are aware that they require assistance and avail themselves of
student services. Unfortunately, many do not. Every year, countless students have failing marks recorded on their transcripts, grades which are difficult to overcome. As an example, a student taking and failing five courses would need to take a further six semesters of study (30 courses) AND receive consistent grades of 'B' or higher to bring their cumulative GPA back up to a 'B' level. Therefore, the price of poor grades is indeed steep and irreversible. A criminal record can be expunged, but a transcript cannot! Following are two examples that demonstrate how damaging attrition can be:

When I was an Academic Advisor I one day spoke with a student who was a recent law graduate. As we discussed her academic background, she told me about her experience of applying to law school. Twenty years previous she attended university immediately after high school and fared very poorly academically, ultimately withdrawing after one year. After working for fifteen years, she went back to school and completed her undergraduate degree with top marks. However, upon applying to law school, she was denied admission because her initial attempt at first year merged with her current grades and brought her grade point average below admission cut-offs. She was able to appeal and was eventually granted admission, but it took considerable effort, knowledge and confidence to do so. In essence, because she had attempted university unsuccessfully at the age of seventeen, she was at a disadvantage
compared with other applicants who had not attended university after high
school.

I had a similar experience when enquiring about application to a different
law school. Their admission policy is based on an applicant's most recent 90
credits (three years) of undergraduate work. I spoke with a representative to
enquire how my transcripts might be assessed given that since completing my
undergraduate degree I had completed an additional 60 undergraduate credits as
well as a Master's degree. Like the law student, my grade point average in my
latter years of study was markedly higher than my first years as an
undergraduate. However, the admissions representative advised that their policy
was to assess the last three years of undergraduate work only, and as such, my
four years of subsequent study—with a grade point average well above the
minimum required—would not be considered. It would appear, therefore, that
decisions taken early in a post-secondary education can and do significantly
impact future options.

It is from these perspectives that I undertake this study. As a lifelong
learner and an administrator responsible for managing enrolments, I have been
uniquely situated on both sides of the enrolment mirror. Universities generally
are well intentioned regarding their commitment to reducing attrition; however,
with each new semester the transcriptable harm, so to speak, is perpetuated. By making a concerted effort to more fully understand and address attrition, I argue that much of this problem can—and must—be mitigated by the institution. This study intends to address the first phase in this process by augmenting the limited admissions dataset available to open admission institutions.

**Purpose**

The purpose of this quantitative study is to test the general theory that pre-college characteristics directly influence educational outcomes, and specifically, whether a student’s neighbourhood of origin is related to participation, performance and persistence patterns.

The factors that directly and indirectly impact educational outcomes have been the subject of considerable debate in the literature. In the proper context and given the appropriate independent variables, some scholars believe that the strongest predictors of attrition are a student’s background characteristics: for example, Corman, Barr and Caputo (1992) argue that background characteristics at commuter institutions may be more important predictors of persistence than academic and social integration; similarly, Astin (1997) found that four variables (high school grades, admissions test scores, gender and ethnicity) largely account for the variance in retention. Another body of theory speaks to the influence of
communities and neighbourhoods, through a number of pathways, on these
background characteristics. Therefore, this study is guided by the theoretical
perspective of retention theory and is viewed through a lens of neighbourhood
effects theory.

If this study identifies relationships between neighbourhood
characteristics and educational outcomes, a starting point is created to inform
institutions where to communicate or deploy interventions of various manners.
When it is not feasible to provide all interventions to the entire student body,
student services can be targeted to those most in need; similarly, where timing is
critical, specific strategies can be deployed at strategic decision points
throughout the semester.

Access to failure is not access. Due in large part to resource limitations,
many institutions do not have adequate support for students who require
assistance. The inevitable result is that students are granted access to the post-
secondary system but are often left to their own devices upon arrival (Corman,
Barr & Caputo, 1992). This raises a straightforward concern: the promotion of
equal opportunities through increased access and open admissions must be
cautiously approached to ensure that adequate levels of services are provided to
support all with an equal opportunity to benefit.
Because open admissions institutions face specific educational issues related to their student characteristics such as part-time attendance, age, employment, grade point average, ethnicity, family obligations, financial status, gender and non-traditional students (Mayo, Helms & Codjoe, 2004) it is imperative that an improved awareness of the relationships among these variables and educational outcomes be reached. Because most of these variables are not identified to the institution, this study examines the relationships between related neighbourhood characteristics that have been identified in the literature and educational outcomes in an open admission setting.

Significance of the Study

Many factors contribute to educational attainment. The literature reports a variety of demographic, school, individual and family characteristics that are related to educational outcomes. Numerous correlates of withdrawal have been uncovered, highlighting factors such as low socioeconomic status, neighbourhood level variables, individual characteristics, demographics and parental education (Jimerson, Egeland, Stroufe & Carlson, 2000). These studies, however, leave considerable variance unexplained. Authors suggest that this is because many factors that contribute to educational attainment are interrelated: for example, peer problems, behaviour problems, and achievement problems are
likely correlated with each other. They suggest that what the literature currently considers predictors of educational achievement may in fact be midpoint markers on a developmental pathway.

This is why, despite decades of research, no study yet purports to have developed a comprehensive rubric upon which educational outcomes can be predicted. In the same vein, the current study makes no such claims. However, even though influencing factors are inextricably linked to student characteristics, institutional policies and practices can and do affect educational outcomes (Bean & Eaton, 2002). While there is no definitive set of factors that predict individual student success or persistence, researchers generally agree that although some students leave for reasons beyond the control of the institution, much attrition is preventable (Pritchard & Wilson, 2003).

Why are educational outcomes important? Notwithstanding foregone tuition and opportunity costs borne by students and institutional costs related to revenues and performance targets, an educated citizenry is fundamental to the nation's economic performance (Finnie, Lascelles & Sweetman, 2005). Butlin (1999) argues that in today's continually evolving economy, an individual's knowledge, skills and propensity for lifelong learning are recognized as key vehicles for sustaining economic growth.
In addition, access to post-secondary education carries with it substantial implications regarding equality of opportunity. If access to successful educational opportunities is unequal, then those who do not have access gain disproportionate material benefits (Guppy, 1985). In other words, those that are disadvantaged become even more so because they cannot pursue education as easily as more advantaged peers. In an economy requiring high levels of education (for example, a recent study undertaken by Human Resources Development Canada estimated that nearly 50 percent of new jobs will require a minimum of five years' post-secondary education (Butlin, 1995)), equity of access to postsecondary education becomes an important policy issue. As discussed by Andres and Looker (2001), the issue of access to and participation of disadvantaged groups in postsecondary education requires careful attention. This study, therefore, is an attempt to provide a mechanism by which institutions can begin to identify inequities in regards to access and performance within their communities.

Research Questions

Open admission institutions know remarkably little about their students. While competitive-admissions institutions' databases are robustly populated with information on applicants' academic ability, achievements, aptitude,
finances and intentions, open admissions institutions typically request little more than basic demographics in the admissions process. Therefore, how can these institutions analyze the various subgroups of students? Few, if any, pre-college characteristics are in student records; therefore, studies to examine retention patterns are missing these very important pieces of the puzzle.

Because the neighbourhood effects literature is replete with empirical evidence that 'where we live' is related to many factors, including epidemiology, crime rates, low birth rates and educational outcomes, this study seeks to determine whether, above and beyond individual ability, relationships between the characteristics of neighbourhoods and educational outcomes exist. To do so, the following questions frame this analysis:

1. In regards to high school outcomes, do rates of participation in academic courses vary by neighbourhood characteristics; similarly, do outcomes (grades achieved) vary by neighbourhood?

2. In regards to post-secondary transitions, do rates of participation, grades achieved and persistence patterns vary by neighbourhood characteristics?
CHAPTER 2: REVIEW OF THE LITERATURE

Persisting high post-secondary attrition rates beg a number of questions: Are institutions exercising due diligence to ensure that every student granted admission is provided with the systems and supports to enable them to persist in their educational journey? Are the resources that are allocated to student services effectively deployed? If an institution does not require specific criteria for admission, how can it assess whether students are academically prepared to be successful? These questions are difficult to answer in the absence of appropriate data. This study takes a first step towards answering these questions in the context of an open admission institution.

Conceptual Framework #1: Educational Outcomes

History of Student Retention Analysis

Attrition, particularly in open admission institutions, is high. Notoriously difficult to define, attrition patterns vary between institutions depending on the context and program. For over seventy years scholars have studied the phenomenon of attrition and it is argued that student departure has been the central focus of higher education research (Astin, 1997). However, despite this
large body of inquiry, every year approximately four of every ten new students
do not continue their education (see, for example, Allen, 1999; Berger & Braxton,
1998; Braxton, 2000; Jencks, 1968; Pantages & Creedon, 1978; Pascarella &
1988, 1993, 1996). It can generally be argued that far too many students who enter
the post-secondary system fail to complete their studies.

Despite an increased focus on retention and attrition in recent decades and
the volume of extant literature on the retention puzzle, its causes and patterns
remain poorly understood. Part of the problem is that many of the findings are
contradictory, while others centre on definitions, programmatic variations,
student body differences, and other variables (Cabrera, Castaneda, Nora &
Hegstler, 1992; Grayson, 1997; Tinto, 1996).

The issue appears to be that of infinite complexity—retention theory
simply cannot provide an overarching framework to guide all institutions.
Because retention patterns are affected by variables internal and external to the
institution, retention studies may be best effective when they focus on a
perspective wherein each institution is individually situated (Kirby & Sharpe,
2001; Tinto, 1996).
Some theories of student persistence have reached paradigmatic status (e.g., Astin, 1997; Bean, 1980, 1989; Tinto, 1975, 1987, 1993) yet are still generally criticized for their inability to predict attrition as well as their restricted generalizability across post-secondary education. Part of the problem is that each institution is situated with a unique set of characteristics, and thus strategies for reducing attrition that work at one institution will not necessarily work at another (Tinto, 1998).

Another complication arises due to the lack of a generally accepted definition of attrition. Students have infinite course-taking patterns. Not all students choose to attend every semester, while others take only one or two courses in a lifetime. Others 'stop out' (i.e., they withdraw and return at a later date), and still others transfer to new programs or institutions. Should these students be included in an institution's attrition count? To simplify this concept, the definition of attrition as it relates to this study is confined to the concept of involuntary attrition, which speaks to students who intend to complete a credential but do not realize this goal. It is the contributors to these students' attrition patterns that institutions might first endeavor to understand, particularly in regards to identifying contributory factors within the institution's control.
Higher education scholars have developed an array of theories that explain the relationship between students and their institutions. Generally speaking, theoretical models have evolved within four perspectives on the influences on student outcomes: (a) pre-college characteristics, (b) student-institutional fit, (c) campus climate, and (d) organizational characteristics (Kuh, 2002; Strauss and Volkwein, 2004). These perspectives encapsulate a multitude of theories—some complementary, some contradictory—about the influences on student persistence.

Initially conceptualized in 1975, Tinto’s Theory of Interaction has achieved paradigmatic status among retention scholars. Of the theoretical models developed, Tinto’s has arguably formed the foundation of most retention research (Pascarella, Duby & Iverson, 1983) and has dominated our understanding of student retention (Braxton, 2000). Tinto’s model has been extensively tested and cited, particularly since its refinements in 1987 and 1993 (Braxton, Hirschy & McClendon, 2003). It is premised on a theoretical model that describes the degree of fit between students and their institutions. Students enter higher education with a range of background traits, including socioeconomic status (SES), ethnicity, academic preparedness, finances, achievements and
experiences. These background characteristics influence initial commitment to
the institution as well as the penultimate goal of graduation, and it is
hypothesized that these initial commitments have strong influences on students' academic performance and engagement with the institution's social and
academic systems (Pascarella, Duby & Iverson, 1983). It is argued that these interactions have a bearing on educational outcomes: the higher the fit or engagement, the more likely one is to be retained by the institution (Andres, 2004; Boyer, 1996; Gardner, 1986; Kuh, 1995).

Pre-college Characteristics

The relationship between pre-college characteristics and academic preparedness for college is viewed as the most traditional of the four perspectives on student retention (Strauss & Volkwein, 2004). Spady (1971) argued that each student enters college with a "definite pattern of dispositions, interests, expectations, goals and values shaped by his family background and high school experiences" (p. 38). Tinto's theory posits that a student's pre-college characteristics both directly and indirectly impact their persistence, influencing both their initial commitment to the institution and their commitment to the goal of graduation (Braxton, Hirschy & McClendon, 2003). Thirteen propositions have been derived from Tinto's theory and, with mixed results, have been
subsequently assessed. While the Theory of Integration has been criticized for its inconsistent explanatory power, Tinto (1993) asserts that the propositions within it should be applied to individual institutions and contexts and are not meant to explain systemic attrition.

In 1997, Braxton, Sullivan and Johnson found, at an aggregate level, that five of Tinto's thirteen propositions were empirically valid, and undertook further analysis to determine empirical support by institutional type. Of relevance to this study, the only proposition they could empirically confirm was Proposition Three: Pre-college Characteristics. They therefore assert that student entry characteristics directly affect the likelihood of students' persistence in college (Braxton, Hirschy & McClendon, 2003).

In a similar vein, Pascarella, Duby and Iverson (1983) also tested Tinto's model in a commuter institution and found that background characteristics accounted for an increase in variance explained versus that explained by academic and social integration. Because of similarities between community colleges and open admission universities, this study draws upon Tinto's Proposition Three as a conceptual framework.
Socioeconomic Status and Educational Outcomes

Sociologists do not agree on the measurement of socioeconomic status; however, most models reviewed used some combination of parental education, occupation and income to measure this variable. According to Mayer and Jencks (1989), the following empirical claims about how neighbourhoods affect children’s life chances are supported or rejected depending on the reader’s stance: (a) affluent neighbours confer positive benefits on less affluent children, and (b) poor neighbours do not significantly influence more affluent children. Those who favour economic and racial desegregation support these hypotheses, and those who do not reject them.

In a study published by the Canadian Medical Association, enumeration areas with a high proportion of single-parent families, low household incomes, high unemployment rates among people over 15 years of age and low levels of postsecondary education were identified as being of low socioeconomic status. Such grouped indicators have been used in other Canadian studies (Mustard & Frolich, 1995; Frolich & Mustard, 1996; Roos & Mustard, 1997) because it is argued that this method minimizes the limitations that arise when a single measure such as income is used (see also Krieger, Williams & Moss, 1997; Shortt & Shaw, 2003).
A number of studies demonstrate that students from families with high socioeconomic status are more likely than their less advantaged counterparts to participate and persist in post-secondary education (for example, Ainsworth, 2002; Butlin, 1995; D’Angiulli, Siegel & Maggi, 2004; Ensminger, Lamkin & Jacobson, 1996; Guppy, 1984, 1985; Guppy & Pendakur, 1989; Tierney, 1992). All things being equal, students from well-off families have consistently participated in post-secondary education at higher rates than their less-advantaged peers, and there is little evidence to suggest that this gap has narrowed: the socioeconomic status of the student’s family remains a strong predictor of participation in post-secondary education in both the United States and Canada (Butlin, 1995; Walpole, 2003; Willms, 2004; Yorke & Thomas, 2003). Students of higher socioeconomic status also have differing persistence patterns and tend to graduate from post-secondary education at disproportionate rates to their lower-SES peers (Andres & Grayson, 2003; Butlin, 1995; Duncan 1994; Guppy, 1985; Guppy & Pendakur, 1989; Jencks, 1968; Sampson, Morenoff & Gannon-Rowley, 2002; Sewell & Shah, 1967; Warburton, Bugarain and Nunez, 2001).

Students from higher socioeconomic statuses enjoy specific academic advantages. They attain fewer failing grades and achieve higher scores on academic tests (Andres & Grayson, 2003; Crooks, 2001; D’Angiulli, Maggi & Hertzman, 2004; Davies & Guppy, 1997; Sewell & Shaw, 1967). In a recent study
of Manitoba high school students, researchers found that 92 percent of high SES students passed the standard Grade 12 exams. In contrast, only 75 percent of the low SES students passed (a number that is overstated given that only 27% of the youths from low SES areas who should have been writing actually wrote and passed the tests). A further 36 percent were behind by one year and almost 20 percent had withdrawn from school (Roos & Mustard, 1997).

Canadian evidence suggests that low SES students perform better when they attend a high SES school; conversely, less advantaged students perform considerably worse when they attend a low-SES school (Willms, 2004). Therefore, students whose parents can afford to transport them or relocate to higher-SES catchment areas have an advantage over their lower-SES peers (Davies & Guppy, 1997).

Having university-educated parents is also highly correlated with post-secondary participation. These parents provide children with a number of competitive advantages: they are more willing to pay for university (Davies & Guppy, 1997), they can better maneuver their children through the applications and admissions process (Andres & Grayson, 2003; Davies & Guppy, 1997; Duncan, 1994) and their statuses in the professional or managerial level
occupations demonstrates to their children the importance of post-secondary education (Nakhaie & Curtis, 1998).

Limitations of Persistence Models

Given the abundance of research on persistence and the length of time over which it has been studied, it is surprising that most institutions do not better understand the factors which influence student persistence. While theories of retention are intuitive and explain retention in the aggregate, when they are rigorously tested they often fall short of explaining persistence. This is due in large part to the reality that retention patterns are highly influenced by the factors that are unique to an institution; therefore, theories based on global analysis become often little more than starting points for a retention initiative (Tinto, 1998). There are a number of additional limitations to the models, discussed in the following paragraphs.

Timing of attrition

Persistence research has typically failed to specify the timing of students' withdrawal decisions. Based on the argument that voluntary withdrawal seems to be heaviest at the end of the first year of studies, much of the research has focused on this period and beyond. As a result, little is understood about the
processes leading to attrition prior to the end of the academic year (Corman, Barr & Caputo, 1992). By ignoring early attrition, researchers have no mechanism by which to measure the degree that these experiences are similar to those of students who voluntarily withdraw after the first year.

However, more recent research has been expanded to include within-year attrition, and suggests that that the first year is the most critical period in a student's academic career (Allen, 1999; Astin, 1993; Pascarella & Terenzini, 1991). Therefore, recommendations based solely on the former body of literature result in policies aimed at those students who have already demonstrated their ability to succeed academically without assistance and thus do not efficiently address attrition (Corman, et al., 1992). Applied to higher education in British Columbia in the context of operating under a growth mandate of increased access for all, such limiting approaches carry significant ramifications.

*New types of students*

Students today are older, are more likely to be working part time, and may be the first in their family to attend university. Originally designed to assess persistence patterns of a young residential student population, theoretical developments and empirical studies usually focus on students in four year universities and assume full-time attendance. As such, they disregard the
demographic heterogeneity of today's student population. In addition, students may be first-generation students, an area of research that has more recently emerged. First-generation students may face a number of unique challenges (Grayson, 1997; Strauss & Volkwein (2004); Terenzini, Springer, Yaeger, Pascarella & Nora, 1996). These students have been found to be at greater risk for attrition, in part because they are typically from lower SES backgrounds and lack experienced parents to guide them in their studies (Kuh, Huh & Vesper, 2002; Rahilly & Buckley, in press).

Institution-type specifications

The type of institution (e.g., commuter versus residential, open versus competitive) will attract very different students for which the same retention patterns will not exist. In some institutions, it is only after first-year academic performance is considered that relatively clear distinctions can be made between students who persist into their second year and those who decide to leave early. These findings are consistent with previous research suggesting that voluntary withdrawal is less a function of pre-enrolment traits than of post-enrolment experiences; similarly, institutions with higher proportions of non-traditional students who must work and can only attend part time have higher attrition.
rates than their counterparts. In the same vein, institutions with open admission policies have significantly higher attrition rates (Mayo, Helms & Codjoe, 2004).

One of the major findings of a Statistics Canada study on school leavers is that the effect of predictor variables on the odds of participating in post-secondary education is highly dependent on the type of post-secondary program examined (Statistics Canada, 1995). For example, high school graduates who failed high school math had lower odds of attending university (controlling for other factors) versus not participating in post-secondary education; however, their odds were not reduced for participation in community college or trade-vocational programs (Butlin, 1995). The same pattern applied for higher average grades in high school, but failing a grade in elementary school lowered the odds of all types of post-secondary education participation. Therefore, the contextual nature is important for policy and planning purposes: for example, Grayson and Grayson (2003) cite Dietsche’s 1990 study of entering students at Humber College of Applied Arts and Technology, which found that background characteristics such as gender, age, SES and high school grades had no statistically significant impact on persistence. It is likely, however, that these characteristics had already been controlled for by the program’s competitive admission policy, and admitted students were relatively homogenous in regards
to SES and academic ability. In this light, the inability to highlight background differences between persisters and non-persisters is not surprising.

Given that sparse research exists on the attrition of students during their first semester of university, the research conducted for this dissertation seeks to develop a model to inform an open admission institution about (a) first-time, first-year student flows during the first semester, and (b) what relationships, if any, neighbourhood characteristics have with students' educational participation, performance and persistence.

The Link between Socioeconomic Status and Educational Persistence

Considering the relatively low utility that existing persistence literature provides for open admission commuter institutions, this study explores a simplified approach to assessing student participation and persistence by analyzing educational outcomes augmented by census information. Because most institutions' student records lack socioeconomic data, research efforts to understand social gradients in participation and persistence are restricted. Given that it is established that socioeconomic status is known to strongly influence both participation and persistence, the lack of these data creates real challenges for researchers exploring these phenomena. To address this issue, social researchers in education and other fields have sought to supplement individual-
level SES measures with area-based measures of socioeconomic status (ABSMs) and have found that these effects, known as neighbourhood effects, have correlations that rival individual-level measures (Ainsworth, 2002).

It must be stated from the outset that this study does not attempt to infer a student's socioeconomic status from the socioeconomic status of the neighbourhood in which he or she lives. To do so would risk committing ecological fallacy, in which individual-level inferences are drawn from aggregate-level variables. This dissertation does not attempt to determine a person’s SES from their neighbourhood of residence; rather, it explores the relationships between socioeconomic status of the neighbourhood and outcomes of residents, while controlling for a number of factors. Therefore, this study and its census-based methodology is not party to the typical type of ecological fallacy in which both independent and dependent variables are comprised of aggregate data (Krieger, 1992). It draws upon a rich literature that has been developed to explore contextual differences in epidemiology, crime, morbidity, birth weights, etc., and takes advice from higher education scholars that deeper understanding of participation and persistence in post-secondary education requires the consideration of the multiple contexts in which students operate, including their environments, communities and their wider society (Benjamin, 1994 cited in Andres, 2004).
Researchers have grappled conceptually with neighbourhood effects on educational persistence for several decades. For example, Ainsworth (2002) found that neighbourhood characteristics predicted educational outcomes with the strength rivaling predictions based on family factors. Willms (2001) found that students from less advantaged families tend to perform at lower levels if they attend a school with a student population drawn from a low socioeconomic status than when they attend a school with peers from a higher SES. Ensminger, Lamkin and Jacobson (1996) found that students who lived in a middle class neighbourhood were more likely to graduate from high school. D'Angiulli, Siegel and Maggi (2004) similarly found statistically significant relationships between neighbourhood socioeconomic status and literacy in a North Vancouver, BC study. This evidence, coupled with many more examples in the field, suggests that obtaining a better understanding of the impact that neighbourhood characteristics have on educational outcomes is important to our understanding of the processes that affect persistence.

Results from an analysis of the 2000 Program for International Assessment (PISA), an international survey of the reading, science and mathematics skills of 15 year olds, demonstrated that wide ranges in reading scores at all SES levels exist: many low-SES students performed well and many high-SES students performed poorly, but overall a large and statistically significant performance
gap between Canadian students from low and high SES backgrounds was found (Willms, 2001). These data were extended to measure the relationship between literacy and post secondary attendance. As would be expected, the results demonstrated that students with the lowest levels of literacy were only 10 percent as likely as their high-literacy level counterparts to attempt post-secondary. Similarly, students of average literacy were only half as likely to attend as were those with higher levels.

Generally speaking, researchers studying neighbourhood effects posit that several mediating processes—including collective socialization, social control, social capital, perception of opportunity and institutional characteristics—are at work in neighbourhoods, and have found both direct and indirect effects on epidemiology, crime, birth weights and educational attainment, among others. Some of the earliest research dates back to the early 1940s, when Shaw and McKay (1942) found that juvenile delinquency was associated more with the neighbourhood in which children lived rather than the kinds of families to which they belong. While it has been argued that such observations necessarily include the indirect results of families with influencing traits clustering in specific neighbourhoods, researchers in the past two decades have been able to employ statistical analyses that allow multilevel regression to be applied to data
modeling (Garner & Raudenbush, 1991) which permits neighbourhood effects to be assessed in greater independence of other influencing factors.

The present study seeks to determine whether a model for the early identification of an 'at risk' population can be developed so that appropriate services or interventions can be targeted at this group before they are lost to the institution. Ultimately, where a government has invested heavily in its higher education system, it has a particular interest in seeing that that investment is put to optimal use (Yorke & Thomas, 2003) and under ALMD's current mandate, this type of analysis should be a priority. This study therefore explores post-secondary education participation and persistence by adding a neighbourhood component to the existing persistence equation.

Family structure variables have long been understood to be predictors of educational aspirations of students. Hansen & McIntire (1986) found significant relationships between parental education, socioeconomic backgrounds, and educational aspirations. They further found that fully one-fourth of students and parents in the lowest SES quartile expect not to progress beyond high school, compared to less than four percent of their peers in the top SES quartile. This phenomenon extends beyond the undergraduate level: students from the top
quartile were twice as likely to expect to pursue doctoral studies as were
students from the third quartile.

In the absence of individual-level socioeconomic status data,
neighbourhood SES becomes an alternate vehicle for examining student retention
patterns. For example, Willms (2004) found that students from less advantaged
families tend to perform at lower levels when they attended a school with a
student population from a low SES than when they attended a school with peers
from a higher SES. Ensminger, Lamkin and Jacobson (1996) found that students
who lived in a middle class neighbourhood were more likely to graduate from
high school. Ainsworth (2002) found that neighbourhood characteristics
predicted educational outcomes that were very closely matched with those based
on family factors. D'Angiulli et al. (2004) similarly found significantly significant
relationships between neighbourhood socioeconomic status and literacy. This
dissertation therefore seeks to extend this trajectory by examining both
participation and persistence rates by neighbourhood.

In light of this body of research, it would appear that understanding the
influence that neighbourhood characteristics have on educational attainment is
important to understanding patterns of post-secondary participation and
persistence.
Conceptual Framework #2: Neighbourhood Effects

Introduction

The environments in which children live, play and learn are said to have profound influences on their development (Hertzman, McLean, Kohen, Dunn, Evans & Smit-Alex, 2004). These settings are reciprocally influenced by a host of socio-economic and family conditions, such as family income, education, parenting style, neighbourhood cohesion, safety and socioeconomic characteristics. These represent important factors from which inequalities in child development, particularly critical in a child’s first five years, originate (Hertzman et al., 2004).

Until recently, much of the literature examining children’s development has focused on peer-group and family influences. This is now being expanded to include the broader context of the effects that communities and neighbourhoods have on children (Kohen, Hertzman & Brooks-Gunn, 1998). Results increasingly suggest that neighbourhood characteristics such as affluence and cohesion are associated with competencies of children and remain significant over and above the effects of family characteristics (Kohen, et al., 1998). Scholars such as Ainsworth (2002), Ensminger, Lamkin and Jacobson (1996), Garner and Raudenbush (1991) and Sampson, Morenoff and Gannon-Rowley (2002) have
contributed to the growing literature on neighbourhood effects and their
relationships with education. While these studies primarily examine the
elementary and secondary years, viewing their arguments through the lens of
persistence theory permits an extension of these works to the post-secondary
arena.

Isolated from the effects of socioeconomic status, academic aptitude,
gender, ethnicity, motivation, and a host of other factors, neighbourhood
characteristics—particularly when they are associated with concentrated
disadvantage—have been found to both directly and indirectly affect a wide
range of outcomes. These neighbourhood effects have also been found to have
associations with a variety of health outcomes, incidence of crime, health and
well-being, infant mortality, low birth weight, teenage pregnancy, child abuse
and other behavioural outcomes (for example, Buka, Brennan, Rich-Edwards,
Raudenbush & Earls, 2003; Jencks & Mayer, 1990; Krieger, Chen, Waterman,
Rehkopf, Subramanian, 2003; Mayer & Jencks, 1989; O’Campo, 2002; Sampson,
Morenoff & Gannon-Rowley, 2002). Scholarly works also argue that a number of
health-related indicators are spatially clustered, including homicide, accidental
injury, and suicide (Sampson et al., 2002). Further studies have extended these
findings to the study of contextual effects on students’ academic achievement
In their 2002 review of forty recent peer-reviewed articles on
neighbourhood effects, Sampson, Morenoff and Gannon-Rowley report that a
relatively consistent set of facts relevant to children and adolescents has been
established: first, that considerable social inequality in regards to socioeconomic
and ethnic segregations exists in neighbourhoods; second, that social problems
such as crime, adolescent delinquency, school dropout and social and physical
disorder tend to be clustered at the neighbourhood level; third, that empirical
results do not vary significantly regardless of the unit of analysis, such as
community areas, census tracts or other neighbourhood conceptions; and forth,
that the ecological divide between the upper and lower ends of the income
continuum appears not to have decreased in recent decades, despite efforts to
reduce the gap.

There are increasing spatial concentrations of low-SES within cities, and
these clusters are increasingly becoming connected with other forms of
disadvantage (Diez Roux, 2001) and is not specific to educational attainment. For
example, researchers at the Institute for Clinical Evaluative Sciences (ICES) in
Toronto estimated SES from median income for patients' postal codes (divided
into quintiles). They examined the records of over 39,000 stroke admissions to
Ontario hospitals between 1994 to 1997. They found that for every $10,000 in
median neighbourhood income there was a 9% decrease in mortality at 30 days.
They also found that patients in the lowest-income quintiles had to wait an average of 90 days, whereas those in the richest quintile had to wait 62 days. Furthermore, physiotherapy, occupational therapy and speech therapy were more often given to patients in higher level quintiles (Taggart, 2001).

Decades of research have recently been rejuvenated by technological improvements in statistical analysis, information management, Geographic Information Systems (GIS) and more finely parsed census data. For example, Statistics Canada's 2001 Census introduced the Dissemination Area as the smallest unit of analysis to date: it reduces the level of aggregation to between 100 and 200 households compared to its predecessor, the Enumeration Area, which averaged 600-1,000 households (Statistics Canada, 2003a). In addition, researchers in the past two decades have been able to employ statistical software that allows multilevel regression analysis to be applied to social data modeling (Garner & Raudenbush, 1991) and neighbourhood effects can now be assessed in greater independence of other influencing factors. It is these new methodological approaches that are credited with having stimulated interest and empirical research in the neighbourhood effects field (Diez Roux, 2001).
History of Neighbourhood Analysis

The roots of the study of neighbourhood effects can be traced to the urban ecology models of the early Chicago ecologists Park and Burgess, who in 1916 laid the foundation for urban sociology by defining the patterning of city neighbourhoods (Longley, 2005; Sampson, Morenoff & Gannon-Rowley, 2002). Social area analysis of the 1950s led to the emergence of geodemographics in 1970s and was re-invigorated in 1987 after the publication of Wilson's The Truly Disadvantaged (Longley, 2003). A significant milestone in neighbourhood research came in the form of Jencks and Mayer's 1990 review of the theoretical frameworks upon which neighbourhood studies are based. In the past decade, though sociologists and social geographers have long recognized the importance of neighbourhoods in shaping children's development (Diez Roux, 2001), an explosion of literature in the form of an annual twofold increase in publications has further asserted the notion that "place" is vitally important to the study of social groups (Sampson et al., 2002).

Urban sociologists and geographers have theorized extensively about the importance of neighbourhood and the effects they have on the lives of their inhabitants (Ross, Tremblay & Graham, 2004). Extensive evidence from the field of epidemiology has also found that the same social structures that undermine
educational persistence above and beyond socioeconomic risk can also influence health outcomes (see Deonandan, Campbell, Ostbye, Tummon & Roberson, 2000; Leventhal & Brooks-Gunn, 2000; Tremblay, Ross & Bertholet, 2002).

The literature provides evidence that crime rates are related to neighbourhood ties and patterns of interaction, social cohesion and informal social control (Sampson et al., 2002) and evidence of neighbourhood effects on such phenomena as urban crime, deviant behaviour, voting behaviour, elder care, mental health and child abuse and neglect have also been found (Garner & Raudenbush, 1991). Neighbourhood relationships with violence, child development, low birthweight and teenage childbearing have also been empirically tested and validated (Diez Roux, 2001; Demmissie, Hanley, Menzies, Joseph, & Ernst, 2000; Hertzman, McLean, Kohen, Evans & Smit-Alex, 2004; Nelson, 1999).

Theoretical Perspectives

A number of theories have been developed to explain the ways in which neighbourhoods may influence their inhabitants. Some literature postulates that neighbourhood affluence rather than neighbourhood poverty is hypothesized as being a determinant of early competencies (Brooks-Gunn, Duncan, Klebanov & Sealand, 1993; Chase-Lansdale, Gordon, Brooks-Dunn & Klebanov, 1997;
Duncan, Brooks-Gunn & Klebanov, 1994). Others suggest that affluent neighbours may be either advantageous or disadvantageous. Both are discussed below.

Is the Presence of Affluent Neighbours Advantageous?

Beneficial models suggest that high-SES neighbours confer benefits to children and youth, whereas negative models predict that the presence of affluent neighbours negatively affect children and youth (Leventhal & Brooks-Gunn, 2000).

Collective socialization models concentrate on the role model effect that adults have on neighbourhood children. This theory posits that middle-class and professional neighbours assist adolescents in internalizing social norms (Gephart, 1997; Wilson, 1987). Supervision, monitoring and the presence of structure and routines are said to be positive effects.

Institutional models focus on the effects adults external to the neighbourhood have on children via structured and semistructured relationships such as those expressed through schools, libraries, community centres and other social institutions. Neighbourhood resources may affect children through parks, healthy development, and stimulating learning environments.
Epidemic or Contagion models explicate the relationships that peers have on one another and primarily focus on problem behaviours. They are based on the premise that children can be influenced by the negative behaviour of peers and neighbours and are more common (though not exclusive) in low SES neighbourhoods (Mayer & Jencks, 1989). For example, if children grow up in a community where many of their neighbours commit crimes, drink too much, or are verbally abusive, the children will be more likely to mirror this behaviour. The reverse is also true; where adults set good examples, children reared in these neighbourhoods will behave better.

The above models ascribe to the belief of positive conference of the benefits of the presence of affluent neighbours, assuming that their presence should increase the likelihood of neighbourhood youths' educational aspirations and employment options.

Is the Presence of Affluent Neighbours Disadvantageous?

A second set of models suggests that the presence of affluent neighbours can be disadvantageous (Gephart, 1997; Jencks & Mayer, 1990; Mayer & Jencks, 1989):
Social comparison/relative deprivation models suggest that as youth compare themselves with their peers, less successful youth will either work harder to improve, or give up altogether. If the latter is true, the presence of relatively affluent, successful neighbours may decrease the motivation of the less-advantaged youth. Mayer and Jencks (1989) also suggest that high-SES neighbours provoke resentment among their lower-SES counterparts.

Competition models suggest that peers and neighbours compete for scarce resources. For example, as detailed earlier in this study, higher-SES students may attain higher grades than low-SES students. As a result, academic standards may be set at a higher level in a class consisting primarily of advantaged youth (Mayer & Jencks, 1989).

While these models do not implicitly delineate how specific mediators or mechanisms may affect children, they permit researchers a lens through which to hypothesize (Leventhal & Brooks-Gunn, 2000).

Neighbourhood Effects and Education

Which characteristics influence educational achievement and what mechanisms mediate these associations? Ainsworth (2002) linked data from the 1988 National Educational Longitudinal Study to 2001 census information at the
neighbourhood level to address these questions. He found not only that
neighbourhood characteristics predict educational outcomes, but that the
strength of the predictions rivalled those of family- and school-related factors.
His research also revealed that these mediators account for approximately 40% of
the neighbourhood effect on educational outcomes with the strongest effect
conferred by collective socialization. Other authors have similarly found
significant linear effects from neighbours' education on individuals' education
(Ioannides, 2000; Kremer, 1997).

Studies suggest that the relationship between socioeconomic status and
educational achievement is a byproduct of the context in which people live, in
terms of resources and the value that is placed on individual and family capital
(Andres & Looker, 2001; D’Angiulli, Siegel & Maggi, 2004). A recent study of
kindergarten children in Vancouver, British Columbia demonstrated that early
childhood competency development varied widely by SES such that the
proportion of kindergarten students vulnerable to later academic difficulties
ranged from 0% to 21% across Vancouver’s 23 planning neighbourhoods (Maggi,
Hertzman, Kohen & D’Angiulli, 2004). Hertzman’s related work with the Early
Learning Partnership’s Early Development Index has demonstrated a similar
relationship between census tract SES and kindergarten competencies across
British Columbia (Hertzman, McClean, Kohen, Evans & Smit-Alex, 2004).
Similarly, a recent Statistics Canada study lends strong support for a neighbourhood effect: students from families with lower SES origins attained higher scores when they attended a high-SES school than those that attended low-SES schools. The reverse trend, though less pronounced, was found for high-SES students attending lower SES schools (Willms, 2001). This finding lends support to the notion that the benefits ascribed by a strong community are greatest for those who are the most vulnerable (Dornbusch, Ritter & Steinberg, 1991).

The support and encouragement of one's peers and parents are crucial mediating links in causal models of educational attainment and their effects appear to be stronger than any other source, including academic ability or achievement (Davies & Kandel, 1981). Families, as well as communities, shape individuals' futures (Andres & Looker, 2001).

Family and neighbourhood characteristics have been found to affect children even prior to their entry into the elementary school system (D'Angiulli, Maggi & Hertzman, 2004; Kohen, Hertzman & Brooks-Gunn, 1998), with indirect effects operating on young children via neighbourhood effects on parents. When children are young, parents control experiences within their neighbourhoods (i.e.: trips to parks and libraries, social outings) thus exercising full control over
children's neighbourhood experiences. As children become older, these indirect effects diminish and direct effects become more prominent as children begin to have more independence and self-control over their actions within the neighbourhood (Kohen et al., 1998).

Participation in post-secondary education is in part affected by geographic location (Andres & Looker, 2001). While this assertion relates to inequitable participation rates between youth from urban and rural communities, the same logic extends to differences between urban neighbourhoods. They cite Haller & Virkler’s (1993) assertions that reduced educational aspirations result from limited exposure to positive role models – ultimately, adolescents aspire to what they observe and know. Since external forces have major effects on how and whether students participate in post-secondary education, it is important that persistence researchers better understand the effects that SES has on educational expectations and attainments (Andres & Looker, 2001).

Many studies have found that dropout rates in severely distressed neighbourhoods can be more than three times higher than rates in those that are not distressed. This has been viewed as a function of how expectations and aspirations about future employment can be shaped by the neighbourhood context (Leventhal & Brooks-Gunn, 2000). In lower SES neighbourhoods, sub-par
work ethic and educational levels can subsequently alter adolescents' outcomes (Dornbusch, Ritter & Steinberg, 1991; Gallacher, 2006; Ogbu, 1991). Such risks are likely to be more widespread when collective efficacy is low and norms are lacking (Sampson, Morenoff & Gannon-Rowley, 2002).

Economic pressures can cause youth to leave school early. Although income is essentially a family-level effect, studies have demonstrated that youth who are raised in areas with significant deprivation are predisposed to feel a sense of futility about their economic future, and have difficulty reconciling the effort and time invested in school with the opportunity to earn an immediate income (Garner & Raudenbush, 1991).

Even where economic pressures do not result in school leaving, having to work while attending school has a deleterious effect. In a Canadian study of the determinants of post-secondary education, Butlin found that working more than 20 hours per week lowers a young person's odds of attending university from 45% to 27% (Butlin, 1995). A similar study by Fralick (1993) found that 82% of non-returning students had worked while attending college; of these, 36% had worked more than 40 hours per week.
Pathways of Neighbourhood Effects

It is argued that growing up in poor (or more affluent) neighbourhoods matters, and that intervening processes such as collective socialization, peer influences and institutional resources are part of the reason (Brooks-Gunn, Duncan, Leventhal & Aber (1987); Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Mayer & Jencks, 1989; Sampson, Morenoff & Gannon-Rowley, 2002). Neighbourhood effects are the result of a combination of forces functioning at different levels (Dornbusch, Ritter & Steinberg, 1991): for example, the neighbourhood monitoring of adolescents at the community level may affect student performance through encouragement and support, or through the actions of community schools who set high academic standards with the support of a strong community of parents (Dornbusch et al., 1991). Family-level characteristics are important because they provide a mediating role through which neighbourhood effects operate, particularly for younger children (Hansen & McIntire, 1989). However, though family-level mediation is strong, neighbourhood effects remain significant over and above family characteristics (Kohen, Hertzman, & Brooks-Gunn, 1998).

It is expected that the effects of neighbourhoods increase as children grow older. As they become adolescents, they become more independent, parental
monitoring is decreased, and peer relationships within the neighbourhood become more frequent (Kohen, Brooks-Gunn, Leventhal & Hertzman, 2002).

To contextualize exploration of the mechanisms by which neighbourhood effects may be transmitted to children and adolescents, three mediating pathways have been identified: (a) cohesion; (b) relationships, and (c) norms/collective efficacy. As a testament to the complexity of these forces, researchers have found that each of these pathways of influence can occur at a number of levels: (a) individual, (b) family, (c) peer group, (d) school and (e) community (Garner & Raudenbush, 1991; Gephart, 1997; Harris & Frost, 2003).

Social Cohesion: Much of the impetus behind research on neighbourhood effects has originated from the construct of social capital, which is conceptualized as a resource that is made possible through social relationships and networks (Buka, Brennan, Rich-Edwards, Raudenbush & Earls, 2003; Coleman, 1988; Leventhal & Brooks-Gunn, 2000). Community cohesion is generally measured by level or density of social ties between neighbours, the frequency of social interaction among neighbours, and patterns of neighbouring (Ioannides, 2000; Jimerson, Egeland, Sroufe & Carlson, 2002).

Wilson (1987) argued that families that live in neighbourhoods exhibiting low cohesion may not emphasize socialization practices and family routines that
reinforce behaviour and lifestyles associated with competencies that are rewarded in present day society. In contrast, families living in affluent neighbourhoods are more likely to be surrounded by more positive role models who may reinforce norms leading to future success (Maggi, Herzman, Kohen & D'Angiulli, 2004). Peer effects are particularly important: a recent *Statistics Canada* study found that having friends who think school is important significantly increases the odds of post-secondary education participation: only 28% of graduates whose friends thought school was somewhat or not important went on to university, compared with approximately 50% of graduates whose friends thought school was important (Butlin, 1995).

*Norms and Collective Efficacy:* This concept is linked to the organization of a community, in which social and cultural processes result in shared norms, informal social control, social cohesion and a willingness to intervene for the common good. Collective efficacy exists when neighbours have shared norms and collectively address social problems that run counter to the community's common values. The willingness of residents to intervene may depend on conditions of mutual trust and shared expectations among residents; one is unlikely to intervene in a neighbourhood context where the rules are unclear and people mistrust or fear one another (Kohen, Hertzman, Brooks-Gunn, 198; Sampson, 1991; Sampson, Raudenbush & Earls, 1997). Collective efficacy is
generally positively related to income (Brooks-Gunn, Duncan, Klebanov & Sealand, 1993; Wilson, 1991).

Institutional Resources: The quantity, quality and diversity of learning, social, and recreational activities, child care, schools, medical facilities and employment opportunities present in the community will positively or negatively impact residents. These provide contexts for social relations for children and youth and social support for adults. Children living in communities resource-poor in terms of libraries, schools, learning centres, child care, organized social and recreational activities, medical facilities, family support centres and employment opportunities demonstrate vastly reduced developmental outcomes (Brooks-Gunn, Duncan, Klebanov & Sealand, 1993; Crooks, 2001).

The measurement of these constructs is difficult, and as such, limited empirical work has been undertaken to better explicate the processes though which neighbourhoods mediate adolescent outcomes. Because researchers cannot assign people randomly to neighbourhoods, true experiment design cannot easily be conducted. By and large, social scientists have primarily relied on survey instruments or ethnographic studies that measure both family and neighbourhood characteristics (Mayer & Jencks, 1989). Because of this gap in
knowledge, researchers have not yet properly experimentally examined even the most influential theories (Ainsworth, 2002; Connell & Halpern-Felsher, 1997).

The alternative approach suggested by Mayer & Jencks (1989) includes following people as they move from neighbourhood to neighbourhood, a model that has been used less frequently due to its enormous cost and logistical complexity (Mayer & Jencks, 1989).

**A Census-Based Approach to Neighbourhood Analysis**

Overcoming the absence of SES data in the study of neighbourhood effects has necessitated the use of census data. Canadian census data is particularly rich: it has the widest scope of data (income data, for example, is not collected in the UK’s census) and is conducted frequently (every five years compared with every ten in the US and UK).

The concept of categorizing individuals in relation to the socioeconomic characteristics of their neighbourhood is not new. Krieger, Chen, Waterman, Rehkopf & Subramanian (2005) note that US health researchers have used this technique for more than 75 years, and it has been similarly employed by European researchers for several decades. Krieger et al., argue that this methodology has been validated by the US Public Health Disparities Geocoding Project. Their 2005 research demonstrates the ‘salience and feasibility’ of
categorizing the neighbourhood effects by the commonly available metric of the poverty level of the census tract in which the individual resides, and results indicate that significant gradients of socioeconomic deprivation exist across multiple outcomes. This is a key distinction: ABSMs are not being used to make inferences about an individual's individual situation; rather, it is the socioeconomic factors/qualities of the area in which people live that are asserted to have the effect.

The benefits of including area-based socioeconomic measures when defining socioeconomic status are increasingly being recognized (Krieger, Williams & Moss, 1997). Because census data are readily available to researchers and can be easily appended to any data sets that contain residential addresses, a census-based methodology offers valid and relatively inexpensive measures of area-based socioeconomic position (Longley, 2003) and limits non-response bias endemic to surveys (Demissie, Hanley Menzies, Joseph & Ernst, 2000). ABSMs can be applied to all persons residing in an area, are easily available, and with improvements to classifications such as the Dissemination Area are very precise (Puderer, 2001).

The time lag between census administration and dissemination results is sometimes raised as a concern due to population growth and migration.
Analyses in the health field have reported that this issue makes little difference in predicting outcomes (Demissie et al., 2000; Geronimus & Bound, 1998), though it is recommended that this methodology be used only for residential addresses falling within five years of the closest census (Deonandan, Campbell, Ostbye, Tummon & Robertson, 2002).

While generally supportive of ABSMs, Krieger, Chen, Waterman, Rehkopf and Subramanian (2005) criticize zip-code level measures in earlier research, stating that these measures are not aligned closely enough with the concept of neighbourhood. Their findings, however, have been disputed. Carretta and Mick (2003) take issue with Krieger’s work, asserting that this paper presents an unbalanced examination of geographical techniques, and criticizes problems at the zip-code level while ignoring similar problems with other geographic units. Carretta and Mick suggest that postal codes provide a more nimble unit of analysis because they reflect population changes more rapidly than do census tracts. Because census data in both Canada and the United States have now been released at the postal code/zip code level, these tabulation areas remain stable until the next census and provide highly accurate sociodemographic data.

The importance of testing the validity of aggregate-based SES measures is a clear agenda for neighbourhood researchers, particularly given the number of
studies that employ census-derived data in the absence of individual-level socioeconomic status measures. While results of these explorations of validity are mixed, the current balance of evidence tends to support the use of appropriately defined ABSMs. A recent analysis of 14,000 people by individual, census tract and block group measures of SES and education were found to be highly comparable (Krieger, 1992). A Statistics Canada study (Willms, 2004) compared individual-level measures of SES area-based measures and found that 64% of the ABSMs were equal to or within one income quintile of the individual-level SES quintile. More recently, a BC Vital Statistics Agency report (Luo, Kierans, Wilkins, Liston, Mohamed & Kramer, 2004) lends support to the continued investigation of the validity of using neighbourhood-level income as a relative measure of neighbourhood deprivation, and suggests that they may have more precision and relevance in defining neighbourhood than measures used in previous studies.

Summary

That relatively high post-secondary attrition rates persist despite decades of research suggest that more variables may be at play than those identified in previous literature. This study takes a first step towards determining whether the literature on ABSMs, neighbourhood effects and educational attainment can
inform policy and practice a post secondary setting by analyzing educational outcomes and neighbourhood characteristics in the context of an open admission institution.

As detailed in the previous chapters, it is generally argued that community- and individual-level measures are strongly correlated. While these measures are not perfect, new Dissemination Areas and methods are being derived with a view to a better representation of constituents living within them. These include multivariate indices, designed to represent numerous facets of deprivation, which identify different populations and areas from those highlighted by univariate measures (Harris & Longley, 2002). Coupled with newer statistical techniques and datasets made more accessible to researchers in recent years, new facets of neighbourhood research have grown exponentially, and inform the current study's methodology described in Chapter Three.
CHAPTER 3: METHOD

Introduction

This study contributes to the literature on attrition and retention by applying the analysis of area-based socioeconomic measures (ABSMs) that are widely employed in social science disciplines to the study of post-secondary participation and persistence.

Sociologists and social geographers have long recognized the importance of neighbourhood environments as structural conditions that shape individual lives and opportunities. Given that the literature on retention in post-secondary education suggests that differences in academic ability and socioeconomic status only partially explain varying patterns of participation and persistence, it is theorized that neighbourhood characteristics may further account for these differences. This study explores these relationships in a mid-sized (population 80,000) British Columbia city by using 2001 Canadian Census data to measure neighbourhood characteristics. While early identification of vulnerable students will not address the myriad factors that contribute to attrition beyond those that are constitutive of one’s neighbourhood and socioeconomic status, administrators should better understand the persistence patterns that are unique to their institution. If this study is able to identify neighbourhood differences as
hypothesized, it becomes a starting point for research into the role that
neighbourhood effects have on students' educational pursuits as well as into the
types and manner of interventions that assist in reducing student attrition. In the
absence of individual-level socioeconomic data, it may also have practical
implications that permit institutions to analyze educational outcomes by various
stratifications.

The literature on participation and persistence speaks to the relationship
between students' socioeconomic and academic backgrounds and persistence. It
can be argued that many institutions of higher education, particularly in the
United States and to a lesser extent in Canada, are able to 'control' for attrition by
their admissions policies; entrance requirements and financial aid submissions
provide a healthy profile of the student by which predictive models about
retention and persistence patterns can be designed. However, a challenge exists
with respect to institutions with open admission policies when such models are
considered. These institutions typically do not require academic history
information; students are generally not admitted based on academic criteria, nor
are socioeconomic data required. These institutions are therefore more
constrained in regards to the socioeconomic measures they might employ to
build a predictive model of the successful student.
The absence of socioeconomic information in open admission institutions therefore presents a compelling argument for using area-based socioeconomic measures to explore differences in educational outcomes. To determine the feasibility of this approach, this study employs only those data that are normally available to open admission institutions via the application process (high school records, gender, age, and address) to determine what relationship, if any, these data might have with participation and persistence. In addition, this study will explore three challenges by which neighbourhood researchers are generally confronted: (a) operationalizing neighbourhood processes, (b) potentially non-linear relationships between neighbourhood characteristics and outcomes, and (c) selection bias (Galster, 2002).

Overview of methodology

This study examines data from three secondary datasets as well as Statistics Canada’s 2001 Census files. The first dataset is comprised of the course patterns and final grades achieved in selected Grade 11 and 12 courses by all local public high school students graduating between 2004 and 2006. The second phase considers the participation rates of these students as they moved from Grade 12 to post-secondary studies, and the third analysis examines a subset of this participating group and the grade point average achieved in first year. In all
three cases, students will be coded to a neighbourhood based on their postal
code at time of high school graduation.

*Area-based socioeconomic measures*

The concept of categorizing individuals in relation to the socioeconomic
characteristics of their neighbourhood is not new. Krieger, Chen, Waterman,
Rehkopf and Subramanian (2005) report that health researchers have used this
technique for more than 75 years, and the volume of extant literature employing
this methodology speaks to its longevity and breadth of application.

There is considerable debate, however, as to the sufficiency of census-
derived ABSMs in neighbourhood research. Part of the problem is that the
definition of a neighbourhood remains a complex concept that is not easily
simplified. Further, the question of how neighbourhood socioeconomic measures
should be quantified has not reached consensus. Many studies have found that
tract-level socio-economic demographic indicators are strongly related to various
intra-neighbourhood social processes (see, for example, Ainsworth, 2002; Andres
& Looker, 2001; Buka, Brennan, Rich-Edwards, Raudenbush & Earls, 2003; Case
& Katz, 1991; Coleman, 1988; Furstenberg & Hughes, 1997; Galster, 2003;
Geronimus, 2006; Harris & Longley, 2002; Leventhal & Brooks-Gunn, 2000; and
Tremblay & Bertholet, 2002). However, the sometimes inconsistent findings of
these studies have lead to suggestions that area-based socio-economic-demographic indicators should be considered imperfect proxies at best (Subramanian, Chen, Rehkopf, Waterman & Kreiger, 2006).

Debate notwithstanding, there is considerable recent support for the use of ABSMs (see, for example, Fiedler, Schuurman & Hyndman, 2006; Geronimus & Bound, 1998 and Krieger, 1992) and the literature suggests several alternatives for designing the neighbourhood unit of analysis. Leventhal and Brooks-Gunn (2000) support the employment of census data, local city boundaries, and school districts. Sampson (1997) found evidence that residents' reports of neighbourhood boundaries reflect the actual size of census tracts; however, other studies have found higher associations by using smaller aggregations such as the Dissemination Area (DA) and postal code (Brooks-Gunn, Duncan, Klebanov & Sealand, 1993; Demmissie, Hanley, Menzies, Joseph & Ernst, 2000). D'Angiulli, Maggi & Hertzman (2004) found that the census information for the tract in which a school was located provided a good approximation of the socioeconomic background of the children's families in a study of educational outcomes in North Vancouver, BC, as did Harris & Mercier (2000) and Maggi, Hertzman, Kohen & D'Angiulli (2004).
One of the previous criticisms of census data is that prior to 2001, Canadian census data was aggregated by zones that were designed primarily for administrative purposes (to address the workloads of census enumerators) and had limited geographical meaning in regards to a sense of neighbourhood (Openshaw, 1984, cited in Harris & Longley, 2002). To address this and other concerns detailed in the following section, Dissemination Areas were redesigned specifically for research purposes. Researchers have empirically tested their performance and found that, in particular conditions, they can be reasonable proxies for naturally-defined neighbourhoods (for example, Luo, Kierans, Wilkins, Liston, Mohamed & Kramer, 2004; Ross, Tremblay & Graham, 2004; Subramanian, Chen, Rehkopf, Waterman & Krieger, 2006). These results suggest that aptly chosen ABSMs can be used to monitor socioeconomic inequalities. The risk, if any, in the absence of individual-level socioeconomic information is that these estimates may be conservative (Subramanian, Chen, Rehkopf, Waterman & Krieger, 2006).

2001 Census and Dissemination Area

New to the 2001 Canadian Census, the Dissemination Area was designed to improve temporal stability, reduce area suppression, allow for the creation of intuitive boundaries, and facilitate compactness and homogeneity (Puderer,
2001) and was created specifically for the purpose of data dissemination.

Requests from the research community to modify and improve the enumeration area (EA) have been addressed with the creation of DAs, (Statistics Canada, 1994 & 1999) some of which include: temporal stability (EA locations tended to vary from census to census due to changes in field collection and population growth); suppression (population counts were too low and problems of minimum population suppression were encountered; for example, between 10% and 27% of the 1996 EAs were suppressed; conversely, DAs are estimated to have suppression rates between 2% and 4%); and population counts (EAs often had inconsistent population sizes, whereas DA populations are optimized between 400 and 700 residents). Along with other changes, the implementation of the DA as a unit of measure has greatly expanded the utility of census data (Puderer, 2001).

Design

*Phase 1: Constructing neighbourhoods*

Gaining consensus on what constitutes an ecologically meaningful neighbourhood boundary is a difficult task: the literature demonstrates that any definition of community is easily challenged (Willms, 2001). Most authors recognize that no single variable effectively captures all neighbourhoods; for
example, some neighbourhoods are defined by their socio-economic status, some by their ethnic makeup, some by lifestyle and others by their architecture or housing type (Ross, Tremblay & Graham, 2004). Still others are defined by historical practice and city planning departments. This study approaches the definition of neighbourhood by testing the utility of the DA in measuring neighbourhood outcomes.

*Phase 2: Educational measures*

Using data obtained from the British Columbia Ministry of Education (MoE), this study investigates the association of neighbourhood socioeconomic characteristics with educational outcomes and participation among Grade 11, 12 and first-year university students. Students were matched to Dissemination Areas by their postal codes on record with the MoE at the time of high school graduation. *Statistics Canada’s Postal Code Conversion File (PCCF)* (Wilkins, 2006) was then used to code the student data to a physical location. The PCCF is an electronic file that provides a link between postal codes and Dissemination Areas and also provides latitude and longitude coordinates to support GIS mapping. In the event that a postal code straddles more than one Dissemination Area, a ‘single link indicator’ (SLI) is assigned to the postal code by the PCCF and used to allocate the postal code to the appropriate DA (Shortt & Shaw, 2003).
Subjects

The study population was composed of two groups of students. The first dataset, comprised of BC Ministry of Education data, included the final grades achieved in selected Grade 11 and 12 courses by all local public high school students graduating between 2004 and 2006. The second dataset was extracted from the university's student information system and consisted of all students who had graduated from a public secondary school within the municipal limits of the city where the study was conducted AND who entered the local university in the year following Grade 12 graduation, from the years 2004 through 2006. Student level data included variables from which a constructed dependent variable of persistence could be created (credits attempted, credits completed, and grades) as well as selected independent variables: gender, age, postal code, academic program, year level, financial aid status, high school grades and date of application.

Delimitations

Students living in rural areas and on reserves were excluded from the study in an attempt to hold constant extraneous neighbourhood effects, given that research has demonstrated that students residing in rural areas and on reserves experience different neighbourhood effects than do urban students.
(Andres & Looker, 2001). In a similar vein, measurement of post-secondary participation and outcomes was restricted to local students only, so that the potential effects of moving to a new city and living away from home would not confound the results. A further concern exists around the construction of the participation variable: students choosing to attend a post-secondary institution other than the university that is the focus of this study have thusly been excluded from this study. It is possible that these students may be of a higher SES and/or have higher academic ability than the students attending the local university; however, from mobility studies conducted provincially this number is estimated to be relatively small (Ministry of Advanced Education (BC), 2007).

Analysis

Analyses were conducted in several phases. In the first stage, descriptive statistics (stem and leaf plots comparing mapped data that were linked to geographic coordinates through the PCCF) were performed to check for normal distribution. Additionally, Student's t-tests were performed on continuous variables and Fisher's exact chi-square tests ($\chi^2$) were performed on categorical variables. Pearson's correlation coefficients were calculated on DA level data to check for ecological associations between educational outcomes and the neighbourhood socioeconomic classifications derived from the 2001 Census data.
Comparisons of respondents were made using chi-square to identify similarities and dissimilarities of neighbourhood groupings. Both analysis of variance (ANOVA) and multiple regression were carried out on the independent variables to determine which, if any, demonstrated significant relationships with educational outcomes and to determine whether differences exist between students who depart and students who persist.

Multiple regression is one of the most commonly used statistical techniques in educational research due to its versatility and the amount of information it yields about relationships between variables (Gall, Gall & Borg, 2003). It is suitable for this study because it permits determination of the effects of each independent variable in explaining variation in the dependent variable; it also provides an assessment of the overall influence of the independent variables on the dependent variables. In addition, assumptions to consider when employing multiple regression were generally met: (a) linear relationships between variables, (b) independent error terms, (c) homoscedasticity (constant variance of the error versus independent variables) and (d) normal error distribution) (Anderson, 2008). In accordance with most social science research, .05 was chosen as the alpha level for this study (Bennet, 1995).
Measures

Variables in this study are broadly grouped into several categories: dependent variables represent educational achievement and participation rates by neighbourhood. Independent variables represent the economic and demographic characteristics of the neighbourhoods. At the neighbourhood level, this study employs variables from the 2001 Census of Canada. Based on the literature, particularly that which examines the Canadian context, initial variables included measures of single parenthood, immigration, home ownership, unemployment, residential stability, income levels, education levels, occupational categories, and median household income (Deonandan, Campbell, Ostbye, Tummon & Roberson, 2000; Galster, 2003; Harris & Frost, 2003; Raffe, Croxford, Iannelli, Shapira & Howieson, 2006; Sampson & Groves, 1989; Shortt & Shaw, 2003). While these variables are posited to effectively describe the socioeconomic conditions of neighbourhoods, there is no effort in this paper to measure the quality or quantity of social relations in these neighbourhoods, as this is beyond the scope of the current analysis. Table 3-1 reports the metrics, means and standard deviations for key measures. Final Grade 12 scores, post-secondary participation and first-year GPA are primary measures of interest for this study.
Table 3-1.

*Descriptive Analysis of Dependent Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 12 final grade</td>
<td>5,225</td>
<td>29.55</td>
<td>69.95</td>
<td>4.73</td>
</tr>
<tr>
<td>First year GPA</td>
<td>988</td>
<td>4.21</td>
<td>2.44</td>
<td>0.95</td>
</tr>
<tr>
<td>Participation: census data</td>
<td>988</td>
<td>0.72</td>
<td>0.61</td>
<td>0.15</td>
</tr>
<tr>
<td>Participation: university data</td>
<td>988</td>
<td>0.46</td>
<td>0.21</td>
<td>0.08</td>
</tr>
<tr>
<td>Persistence</td>
<td>988</td>
<td>1.00</td>
<td>0.86</td>
<td>0.35</td>
</tr>
</tbody>
</table>

*Dependent Variables*

*Educational achievement measures*

*Grade 12 Grade Point Average:* This variable lists the Grade 12 English and Communications average final exam scores of all local students in each local Dissemination Area that graduated from a public high school in 2004, 2005 or 2006.

*First-Year Grade Point Average:* Full year grade point average of all local students in each local Dissemination Area that graduated from a public high
school in 2004, 2005 or 2006 and subsequently enrolled at the local university within one year of graduation.

*Participation measures*

*Participation rate: census data.* This measure reports the proportion of persons 15-24 who attended school, college or university full time or part time during the nine-month period between September 2000 and May 15, 2001. Attendance is counted only for courses that could be used as credits towards a certificate, diploma or degree. Denominator = total 15-24 year old population (100% sample).

*Participation rate: university data.* The proportion of public high school graduates from 2004, 2005 and 2006 in each local Dissemination Area that subsequently enrolled at the university within one year of high school graduation. The denominator is the number of high school graduates by local Dissemination Area from Ministry of Education data.

*Persistence.* A constructed dichotomous variable (1,0) derived from the university data; indicates the proportion of students who remained at the institution from the Fall to Spring semester.
Independent Variables

Neighbourhood Variables

Reviews of the literature and experimentation resulted in the selection of thirteen neighbourhood measures. Although strong correlations exist among some variables, tests of multicollinearity demonstrate that they are not too highly correlated to be a concern for the regression estimates. Descriptive statistics for these variables are presented in Table 3-2.

Neighbourhood economic deprivation. This variable is a standardized composite of the following: 1) proportion of unemployed persons 15 years and over and 2) the proportion of economic families or unattached individuals in a Dissemination Area below the low income cut off. Low income cut-off is the income level at which families spend 70% or more of their income on food, shelter and clothing (Statistics Canada, 2003a). This score is designed to have a mean of 0 and a standard deviation of 1 for the study DAs. This variable was constructed to permit consideration of two related yet separate dimensions of deprivation in neighbourhoods, and is abundant in the literature (Elliott, Wilson, Huizinga, Sampson, Elliott & Rankin, 1996; Sampson & Groves, 1989; Shaw & McKay, 1942).
Neighbourhood high-status SES residents. This variable is a standardized composite of the following: 1) proportion of college and university certificate, diploma and degree holders among persons 20 years and over and 2) proportion of employed persons with professional or managerial occupations. This score is designed to have a mean of 0 and a standard deviation of 1 for the study DAs, and is included to permit an estimation of the potential pool of positive role models in the student's neighbourhood (Morenoff & Tienda, 1997). In the neighbourhood literature such indicators have been found to be quite influential (e.g., Brooks-Gunn, Duncan, Klebanov & Sealand, 1993; Finnie, Lascelles & Sweetman, 2005; Raffe, Croxford, Iannelli, Shapira & Howieson, 2006).
Neighbourhood income status. This variable is a median household income indicator and represents variations in low- and high-SES families within a neighbourhood. It is included not to suggest that income on its own is important; rather, studies have shown that income-based neighbourhood measures have a high correlation with other dimensions of SES, such as schooling levels or occupational prestige (Butlin, 1995; Duncan, 1994).

Proportion of Aboriginals. To capture the neighbourhood’s level of diversity, a variable representing the number of persons of Aboriginal origin was included based on the theoretical expectation that ethnic heterogeneity keeps disadvantaged residents from forming consensus about norms and values (Kremer, 1997; Maggi, Hertzman, Kohen & D’Angiulli, 2004).

Proportion of Graduates. This variable represents the proportion of high school graduates residing in each Dissemination Area.

Proportion of Low Income Households. Defined by Statistics Canada, this variable represents the proportion of economic families or unattached individuals who spend at least 70% of their income on food, shelter and clothing.
Proportion of Managerial Households. The proportion of persons in managerial occupations according to the National Occupation Classification for Statistics (NOCS).

Proportion of Population 15 to 24. This measure represents the proportion of persons between the ages of 15 and 24 among the total population.

Proportion of Single Parents. This variable indicates the proportion of mothers or fathers with no spouse or common-law partner present, living in a dwelling with one or more children.

Proportion of Visible Minorities. This variable represents the proportion of persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour.

Proportion Unemployed. The proportion of the labour force over 15 years, excluding institutional residents, who are unemployed.

Neighbourhood Residential Stability. This measure reflects the proportion of residents who have lived in the same census subdivision five years prior to Census day. The neighbourhood effects literature suggests that this is an important characteristic to consider because residential mobility can act as a barrier to the development of social cohesion, which generally has an inverse
relationship with educational outcomes (Brooks-Gunn, Duncan, Leventhal & Aber, 1997). Residential stability is observed to enhance processes related to collective socialization and social networks and thus improve the educational outcomes of neighbourhood youth (Sampson, 1991). For instance, Sampson argued that high ethnic heterogeneity and high residential instability lead to a weakening of adult friendship networks and value consensus in the neighbourhood. It is also theorized that as children remain longer in a neighbourhood they are likely to become better known to other adults in the neighbourhood, thus rendering them more subject to behavioural limitations through neighbours’ shared interests or ‘collective efficacy’ (Sampson, Morenoff & Gannon-Rowley, 2002).
Table 3-2.

Descriptive Analysis of Neighbourhood Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Deprivation</td>
<td>124</td>
<td>5.58</td>
<td>.00</td>
<td>1.00</td>
</tr>
<tr>
<td>High Status SES</td>
<td>124</td>
<td>5.02</td>
<td>.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Neighbourhood Income Status</td>
<td>124</td>
<td>1.00</td>
<td>.50</td>
<td>.50</td>
</tr>
<tr>
<td>Median HH Income</td>
<td>124</td>
<td>83,527</td>
<td>49,738</td>
<td>19,124</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td>124</td>
<td>.26</td>
<td>.06</td>
<td>.06</td>
</tr>
<tr>
<td>Proportion of Graduates</td>
<td>124</td>
<td>.57</td>
<td>.48</td>
<td>.12</td>
</tr>
<tr>
<td>Proportion Low Income HH</td>
<td>124</td>
<td>.74</td>
<td>.18</td>
<td>.15</td>
</tr>
<tr>
<td>Proportion of Managerial</td>
<td>124</td>
<td>.36</td>
<td>.12</td>
<td>.08</td>
</tr>
<tr>
<td>Proportion of 15-24 year olds</td>
<td>124</td>
<td>.35</td>
<td>.15</td>
<td>.05</td>
</tr>
<tr>
<td>Proportion of Single Parent HH</td>
<td>124</td>
<td>.58</td>
<td>.19</td>
<td>.12</td>
</tr>
<tr>
<td>Proportion of Visible Minorities</td>
<td>124</td>
<td>.38</td>
<td>.06</td>
<td>.07</td>
</tr>
<tr>
<td>Proportion Unemployed</td>
<td>124</td>
<td>.43</td>
<td>.11</td>
<td>.07</td>
</tr>
<tr>
<td>Residential Stability</td>
<td>124</td>
<td>.60</td>
<td>.54</td>
<td>.14</td>
</tr>
</tbody>
</table>
Methodological Challenges

The documentation, digitization and accessibility of the Statistics Canada data retrieval and compilation systems make the use of census data for SES estimation an attractive technique (Deonandan, Campbell, Ostbye, Tummon & Robertson, 2000). However, researchers studying the impact that neighbourhoods have on those who live within them nonetheless face several challenges.

Subjectivity of neighbourhood definition

Carefully selected measurement units may be too large, too small, or simply incongruent with a subject’s neighbourhood (Brooks-Gunn, Duncan, Klebanov & Sealand, 1993). For example, school districts may be the appropriate neighbourhood unit when examining child outcomes. Others may consider the street upon which they reside to be their neighbourhood; for others, it may be the blocks around their home, or the zone that encompasses the stores and institutions they regularly visit (Diez Roux, 2001).
Ecological fallacy

Ecological analysis is based on the assumption that neighbourhoods are composed of persons who share similar characteristics; however, researchers employing this methodology very strongly caution against making individual-level inferences from aggregate-level variables. Considerable debate in the literature exists as to whether these inferences would be over- or underestimated. Geronimus (2006) argues that it is not unusual for substantially overestimated effects to be observed when using aggregate variables versus individual-level variables; however, this opinion is countered by authors who assert that properly chosen ABSMs provide comparable individual-level socioeconomic measures, and believe that the risk, if any, is of underestimating neighbourhood effects (Greenland, 2001; Krieger, 1992; Subramanian, Chen, Rehkof, Waterman & Krieger, 2006).

Selection effects

A third concern commonly cited regarding neighbourhood effects is that of selection effects or bias. This concept recognizes that individuals and families have some degree of choice regarding where they live; they are not randomly
assigned to neighbourhoods. If unmeasured characteristics (such as attitudes towards ethnicity, education, crime, etc.) lead people both to choose where they live and their educational aspirations, then neighbourhood effects may be distorted (Diez Roux, 2001; Ioannides, 2000; Tienda, 1989). However, as long as limitations offer few other options, social scientists will continue to use ABSMs to stand in for contextual effects (Geronimus, 2006). It is generally understood that ABSMs miss a substantial proportion of between-individual/within-area variation in education and income, but there is evidence that the area-based measures capture other aspects of socioeconomic position that often cannot be captured by individual-based measures of socioeconomic position (Subramanian, Chen, Rehkopf, Waterman & Krieger, 2006).

Geronimus provides an appropriate summation:

Cautious use of imperfect data with due attention to limitations is different than promoting the use of imperfect data with enthusiasm...investigators should exercise caution in interpreting results, be transparent about limitations, and thoughtfully consider theory and substantive knowledge that is relevant (2006, p. 839).
It is argued that this study does not commit ecological fallacy because it investigates the educational outcomes of students living in specific neighbourhoods and does not attempt to infer individual socioeconomic status from the Dissemination Area. However, without adjustments for the processes by which parents select neighbourhoods, selection bias may exist. The findings of this study should therefore be considered within this context.

Summary

To recapitulate, the methodology employed for this study is drawn from neighbourhood effects theory that posits that census-based socioeconomic measures, when cautiously applied, can serve as effective indicators for various trends. In the absence of individual-level SES measures, as is the case for open admission institutions, the literature provides examples where ABSMs have been successfully employed to inform the effective disbursement of interventions to a perceived problem.

This methodology and its associated measures are not without challenges, however. Generally speaking, three challenges confront statistical researchers of neighbourhood impacts on individual behaviours: (a) operationalizing ‘neighbourhood processes’, (b) potentially non-linear relationships between neighbourhood characteristics and outcomes; and (c) the selection bias problem.
These challenges notwithstanding, if one accepts the neighbourhood effects theory that suggests that the educational performance of peers is a key mechanism linking neighborhood disadvantage to youth educational attainment, questions on whether affluent neighbours bestow positive or negative benefits can be explored. However, without individual-level socioeconomic data, institutions are logistically constrained in regards to these analyses. Therefore, this study seeks to assess the utility of ABSMs in the absence of case-level SES data. The results of these analyses follow in Chapter Four.
CHAPTER 4: RESULTS

This chapter describes the results of the analyses employed to address the research questions explored in this study. Specifically, results of visual maps, correlations, analysis of variance, chi-square and multiple linear regressions are presented to permit assessment of the research questions:

1. In regards to high school outcomes, do rates of participation in academic courses vary by neighbourhood characteristics; similarly, do outcomes (grades achieved) vary by neighbourhood?

2. In regards to post-secondary transitions, do rates of participation, grades achieved and persistence patterns vary by neighbourhood characteristics?

Variables

To examine the relationships among neighbourhood variables and educational outcomes, a selection of variables was made based on reviews of the existing literature. Eighteen variables were selected for analysis and are detailed in Table 4-1 and Table 4-6. Education-related variables, detailed in Table 4-1, comprised the dependent variables. Neighbourhood measures, described in Table 4-6, were drawn from census data and served as the independent variables.
Table 4-1.

*Education-related Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Educational Achievement</strong></td>
<td></td>
</tr>
<tr>
<td>Grade 11 GPA</td>
<td>The average percent (range 0-100) attained by public high school graduates enrolled in English 11 or Communications 11.</td>
</tr>
<tr>
<td>Grade 12 GPA</td>
<td>The average percent (range 0-100) attained by public high school graduates enrolled in English 12 or Communications 12.</td>
</tr>
<tr>
<td>First-year GPA</td>
<td>The grade point average (range 0-4.3) of post-secondary credit courses taken in the first year of study.</td>
</tr>
<tr>
<td><strong>Participation Rates</strong></td>
<td></td>
</tr>
<tr>
<td>Participation-census data</td>
<td>Total number of 15-24 year olds attending school full-time or part-time divided by the calculated total number of 15-24 year old population (100% sample)</td>
</tr>
<tr>
<td>Participation-University data</td>
<td>The proportion of students at the university from each local, urban DA divided by the number of public high school graduates in each DA</td>
</tr>
</tbody>
</table>

Two data files were obtained from the British Columbia Ministry of Education. The first included the final grades attained in courses indicated by the literature to be predictive of future academic achievement, namely Mathematics 11 and English 11 and 12 (Butlin, 1995). These data were obtained for all 2004, 2005 and 2006 public high school graduates in the city that was the site of this study.

Over 18,000 course records were returned for approximately 10,000 students. Using the postal code on record at the time the student graduated, these records were coded via Statistics Canada’s Postal Code Conversion File
(PCCF) (Statistics Canada 2003b) to assign each student to a Dissemination Area (DA). In total, 4,385 records were removed because their DAs fell either outside the city’s boundaries or on a First Nations Reserve. The resulting dataset included 13,794 records and was distributed as described in Table 4-2:

Table 4-2.

Ministry of Education Dataset Distributions

<table>
<thead>
<tr>
<th>Course</th>
<th>Original</th>
<th>Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications of Math 11</td>
<td>455</td>
<td>25</td>
</tr>
<tr>
<td>Principles of Math 11</td>
<td>4,194</td>
<td>939</td>
</tr>
<tr>
<td>Communications 11</td>
<td>713</td>
<td>234</td>
</tr>
<tr>
<td>Communications 12</td>
<td>1,016</td>
<td>399</td>
</tr>
<tr>
<td>English 11</td>
<td>5,601</td>
<td>1,196</td>
</tr>
<tr>
<td>English 12</td>
<td>5,675</td>
<td>1,515</td>
</tr>
<tr>
<td>English Literature 12</td>
<td>525</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>18,179</td>
<td>4,385</td>
</tr>
</tbody>
</table>

The second dataset provided by the Ministry of Education appended postal codes at time of high school graduation to a third dataset extracted from the university’s student information system (SIS). Records were linked via the Personal Education Number (PEN), a unique identifier assigned to all students in British Columbia. These data included students who graduated from a local
public high school in the years 2004, 2005 or 2006 and commenced studies at the university within one year of graduation. This dataset included 5,674 records and was distributed as described in Table 4-3.

Table 4-3.

Ministry of Education Record Summary

<table>
<thead>
<tr>
<th>Course</th>
<th>Number of final records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matched by PEN</td>
<td>5,674</td>
</tr>
<tr>
<td>Duplicate records</td>
<td>1,844</td>
</tr>
<tr>
<td>Subtotal</td>
<td>3,830</td>
</tr>
<tr>
<td>Excluded (rural DAs)</td>
<td>2,179</td>
</tr>
<tr>
<td>Final dataset (urban DAs)</td>
<td>1,651</td>
</tr>
</tbody>
</table>

Table 4-4 provides a summary of the dependent variables. Grade 12 grades are based on a percentage grade out of 100; first-year post-secondary grades are based on the university’s four-point scale (A+=4.33, A=4.0...F=0). Two forms of participation data were included and were calculated using two datasets. Census data participation rates were derived solely from the census data and were calculated as a percentage of the total number of 15-24 year olds attending school full-time or part-time divided by the total number of 15-24 year olds in the population. In contrast, the university participation rate details the proportion of the students attending the university from each local, urban
Dissemination Area divided by the number of public high school graduates in each DA. The final variable, Persistence, is an indicator variable (1,0) derived from the university data and indicates whether a student persisted at the institution from the Fall to Spring semester.

Table 4-4.

Descriptive Analysis of Dependent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 12 final grade</td>
<td>5,225</td>
<td>29.55</td>
<td>69.95</td>
<td>4.73</td>
</tr>
<tr>
<td>First year GPA</td>
<td>988</td>
<td>4.21</td>
<td>2.44</td>
<td>0.95</td>
</tr>
<tr>
<td>Participation – census</td>
<td>988</td>
<td>0.72</td>
<td>0.61</td>
<td>0.15</td>
</tr>
<tr>
<td>Participation – university</td>
<td>988</td>
<td>0.46</td>
<td>0.21</td>
<td>0.08</td>
</tr>
<tr>
<td>Persistence</td>
<td>988</td>
<td>1.00</td>
<td>0.86</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Excluded Records

Table 4-5 details the comparison of course means between the included and excluded populations depicted in Table 4-2. Of note, in each academic course version, students from neighbourhoods included in the study achieved significantly higher mean scores than their peers in the neighbourhoods excluded from the study, whereas differences in the means of less-academic courses were not significant. This trend supports evidence from the literature
(Andres & Looker, 2001) and though further examination of these differences is beyond the scope of this study, this finding is worthy of further examination.

Table 4-5.

<table>
<thead>
<tr>
<th>Course</th>
<th>Excluded records</th>
<th>Final records</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mathematics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applications of Math 11</td>
<td>61.6</td>
<td>64.6</td>
<td>insignificant</td>
</tr>
<tr>
<td>Principles of Math 11</td>
<td>65.9</td>
<td>67.7</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Language Arts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications 11</td>
<td>63.1</td>
<td>60.6</td>
<td>.016</td>
</tr>
<tr>
<td>Communications 12</td>
<td>64.2</td>
<td>61.7</td>
<td>.051</td>
</tr>
<tr>
<td>English 11</td>
<td>69.6</td>
<td>71.0</td>
<td>.001</td>
</tr>
<tr>
<td>English 12</td>
<td>68.7</td>
<td>70.5</td>
<td>.002</td>
</tr>
<tr>
<td>English Literature 12</td>
<td>58.9</td>
<td>70.7</td>
<td>.003</td>
</tr>
</tbody>
</table>

*Neighbourhood Variables*

Neighbourhood variables were selected from the literature (see Chapter Three) and were derived from the 2001 Canadian Census (Statistics Canada, 2003b). Initial plans for analysis included an update of the data collected in the 2006 Canadian Census; however, the data collection methodology was altered slightly by Statistics Canada. One of the changes made for 2006 included a reassignment of some Dissemination Areas, which significantly altered
comparability between the two census years for this dataset. Therefore, the
neighbourhood variables in this study are drawn from the 2001 Census and are
listed in Table 4-6.
Table 4-6.

*Neighbourhood Variables from the 2001 Canadian Census*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Deprivation</td>
<td>Standardized composite of: (1) proportion of unemployed persons 15 years and over; (2) proportion of persons 15 years and over in low-income private households.</td>
</tr>
<tr>
<td>High-status Residents</td>
<td>Standardized composite of: (1) proportion of trades, college and university certificate, diploma and degree holders among persons 20 years and over; (2) proportion of employed persons with professional or managerial occupations.</td>
</tr>
<tr>
<td>Income Status</td>
<td>DA median household indicator (0=DA median household income is ≤ overall DA median household income; 1= DA household income is &gt; overall DA household income.</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>Mid-point of range of household income in Dissemination Area.</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td>Proportion of persons who reported identifying with at least one Aboriginal group.</td>
</tr>
<tr>
<td>Proportion of Graduates</td>
<td>Proportion of high school graduates.</td>
</tr>
<tr>
<td>Proportion of Low Income</td>
<td>Proportion of economic families or unattached individuals who spend 70% of their income on food, shelter and clothing.</td>
</tr>
<tr>
<td>Proportion of Managerial</td>
<td>Proportion of persons in managerial occupations according to the National Occupation Classification for Statistics (NOCS).</td>
</tr>
<tr>
<td>Proportion of Population 15-24</td>
<td>Proportion of persons between the ages of 15 and 24 among the total population.</td>
</tr>
<tr>
<td>Proportion of Single Parents</td>
<td>Proportion of mothers or fathers with no spouse or common-law partner present, living in a dwelling with one or more children.</td>
</tr>
<tr>
<td>Proportion of Visible Minorities</td>
<td>Proportion of persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour.</td>
</tr>
<tr>
<td>Proportion Unemployed</td>
<td>Proportion of the labour force over 15 years, excluding institutional residents, who are unemployed.</td>
</tr>
<tr>
<td>Residential Stability</td>
<td>Proportion of residents who have lived in the same house for five or more years.</td>
</tr>
</tbody>
</table>
Table 4-7 provides the descriptive statistics relating to neighbourhood variables:

Table 4-7.

**Descriptive Analysis of Neighbourhood Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Deprivation</td>
<td>124</td>
<td>5.58</td>
<td>.00</td>
<td>1.00</td>
</tr>
<tr>
<td>High Status SES</td>
<td>124</td>
<td>5.02</td>
<td>.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Neighbourhood Income Status</td>
<td>124</td>
<td>1.00</td>
<td>.50</td>
<td>.50</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>124</td>
<td>83,527</td>
<td>49,738</td>
<td>19,124</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td>124</td>
<td>.26</td>
<td>.06</td>
<td>.06</td>
</tr>
<tr>
<td>Proportion of Graduates</td>
<td>124</td>
<td>.57</td>
<td>.48</td>
<td>.12</td>
</tr>
<tr>
<td>Proportion Low Income Households</td>
<td>124</td>
<td>.74</td>
<td>.18</td>
<td>.15</td>
</tr>
<tr>
<td>Proportion of Managerial Occupations</td>
<td>124</td>
<td>.36</td>
<td>.12</td>
<td>.08</td>
</tr>
<tr>
<td>Proportion of 15-24 year olds</td>
<td>124</td>
<td>.35</td>
<td>.15</td>
<td>.05</td>
</tr>
<tr>
<td>Proportion of Single Parent Households</td>
<td>124</td>
<td>.58</td>
<td>.19</td>
<td>.12</td>
</tr>
<tr>
<td>Proportion of Visible Minorities</td>
<td>124</td>
<td>.38</td>
<td>.06</td>
<td>.07</td>
</tr>
<tr>
<td>Proportion of Unemployed</td>
<td>124</td>
<td>.43</td>
<td>.11</td>
<td>.07</td>
</tr>
<tr>
<td>Residential Stability</td>
<td>124</td>
<td>.60</td>
<td>.54</td>
<td>.14</td>
</tr>
</tbody>
</table>

Table 4-8 presents neighbourhood demographic and SES characteristics by quartile. Unemployment, single parenthood, persons of Aboriginal status and proportion of visible minorities were highest in Quartile 1 and descended
steadily to Quartile 4. Conversely, residential stability and proportions of managerial occupations and graduates increased from Quartiles 1 through 4.

With the exception of two variables (Proportion of Visible Minorities and Proportion of Population 15-24), differences between quartiles were statistically significant, $p < .01$. In regards to income, a gap of $50,000 exists between the median household incomes in Quartile 1 ($25,000) and Quartile 4 ($75,000).

Table 4-8.

*Demographic and Socioeconomic Status Characteristics by Quartile*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Quartile</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Deprivation</td>
<td>1.27</td>
<td>-0.04</td>
</tr>
<tr>
<td>High-status Residents</td>
<td>-0.82</td>
<td>-0.25</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>$25,760</td>
<td>$42,360</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td>0.11</td>
<td>0.06</td>
</tr>
<tr>
<td>Proportion of Graduates</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>Proportion of Low Income</td>
<td>0.37</td>
<td>0.17</td>
</tr>
<tr>
<td>Proportion of Managerial Occupations</td>
<td>0.07</td>
<td>0.11</td>
</tr>
<tr>
<td>Proportion of Population 15-24</td>
<td>0.16</td>
<td>0.15</td>
</tr>
<tr>
<td>Proportion of Single Parents</td>
<td>0.28</td>
<td>0.22</td>
</tr>
<tr>
<td>Proportion of Visible Minorities</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>Proportion Unemployed</td>
<td>0.18</td>
<td>0.11</td>
</tr>
<tr>
<td>Residential Stability</td>
<td>0.42</td>
<td>0.54</td>
</tr>
</tbody>
</table>

*p < 0.1  **p < 0.05  ***p < 0.01  n.s. = non-significant/insignificant*
Initial Analysis: Maps

Mapping census data is appealing because it reduces the complexity of the data into colour-coded population groups, and provides an intuitive method of demonstrating data characteristics. While authors argue that maps should not be used in isolation (Fiedler, Schuurman & Hyndman, 2006) they are powerful data analysis tools when complemented with other datasets.

In the city of this study there exists a general north-south bifurcation of socio-economic status, crime, low-birth weight and other epidemiological factors known to be associated with neighbourhood effects (see, for example Ainsworth, 2002; Andres & Looker, 2001; Buka, Brennan, Rich-Edwards, Raudenbush & Earls, 2003; Case & Katz, 1991; Coleman, 1988; Furstenberg & Hughes, 1997; Galster, 2003; Geronimus, 2006; Harris & Longley, 2002; Leventhal & Brooks-Gunn, 2000; and Tremblay & Bertholet, 2002). In order to provide an initial assessment about the hypotheses regarding educational outcomes and neighbourhood characteristics, geographic information system (GIS) software was used to create visual depictions of relationships among dependent and independent variables. Each DA is outlined in the following figures, and the values for a selection of educational and neighbourhood variables have been coded to each DA.
Figure 4-1 provides the imagery of the distribution of the city’s median household income: the light shades represent DAs household incomes less than or equal to the median neighbourhood income, and the dark shades represent above-average incomes. The general north-south pattern can readily be observed, though it is somewhat distorted by a few DAs: for example, the large, lower income section on the south side of the river represents a sparsely populated area; conversely, the similarly-coloured southern tip of the north shore near the centre of the map is very densely populated. Therefore, their proportions are somewhat over- and understated respectively.
Using the same methodology, Grade 11 and 12 outcomes were also matched to DAs and plotted as in Figure 4-2. The general patterns of colour distribution in these maps are similar: neighbourhoods with below-average high school grades are often neighbourhoods with below-average household incomes. Therefore, the convergence of patterning in these maps initially supports the hypothesis that neighbourhood income and educational outcomes are related.
Figure 4-2.

Grade 12 Outcomes by Dissemination Area

Note: Light shades represent below-median grades; dark shades represent above-average grades.
Neighbourhood GPA in post-secondary studies was also mapped to investigate whether the consistency in income and educational outcome patterns generally persisted. Grade point averages were divided into three categories: (a) low GPA, which represented GPAs between 0.00 and 1.99, (b) average GPA, which included GPAs between 2.00 and 2.99, and (c) high GPAs, which represented GPAs between 3.00-4.33. These relationships are mapped in Figure 4-3 and again demonstrate expected characteristics: lower-income neighbourhoods have lower grade point averages than do higher-income neighbourhoods, though the patterns were not as marked as those related to high school grades.
Figure 4-3.

Post-secondary Grade Point Averages by Dissemination Area

Note: Light shades represent DAs with low GPAs, medium shades represent DAs with average GPAs and dark shades represent DAs with high GPAs.
Correlations

Correlation matrices were produced to examine relationships between the dependent variables (Table 4-9), the independent variables (Table 4-10) and between both sets of variables (Table 4-11). Table 4-9 details the correlations among dependent variables. Correlations range from nearly 0 to .36 (English 12 Grade and First year GPA). Generally speaking, the dependent variables appear to have relatively weak correlations.

Table 4-9.

*Dependent Variable Correlations*

<table>
<thead>
<tr>
<th></th>
<th>Grade 12 GPA</th>
<th>First year GPA</th>
<th>Participation – census</th>
<th>Participation – university</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 12 GPA</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First year GPA</td>
<td>.36***</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation – census</td>
<td>.20***</td>
<td>.13***</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Participation – university</td>
<td>.30***</td>
<td>-.04**</td>
<td>.03**</td>
<td>—</td>
</tr>
</tbody>
</table>

*p < 0.1  **p < 0.05  ***p < 0.01

Correlations among the neighbourhood measures range (in absolute values) from 0 to .89 and are detailed in Table 4-10. As would be expected, the highest correlations are between the neighbourhood income measures.
Economic Deprivation was strongly correlated with both Proportion of Low Income Households (.89) and Proportion Unemployed (.89). As detailed in Table 4-10, other strong correlations exist: High Status SES was correlated with both Proportion of Managers (.86) and Proportion of Graduates (.87); Median Household Income was strongly correlated with both Neighbourhood Income Status (.83) and Proportion of Low Income (-.80).

Given that high correlations are noted, the question of whether multicollinearity is present is raised. Multicollinearity exists when predictor variables are themselves highly correlated, which can sometimes result in undesired consequences. The resulting regression equation might overfit the model (meaning that the model appears to fit the data much better than it does in reality), thereby including too many variables. There is considerable debate in the literature in regards to correlation scores and multicollinearity. Some scholars use .90 or .95 as a threshold whereas others suggest that lower numbers are more appropriate (Conklin, personal communication, July 30, 2008). Another test for multicollinearity requires calculation of Tolerance and Variable Inflation Factor (VIF) statistics, and exclude variables that have Tolerances less than .4 and/or VIFs greater than 2.5. None of these thresholds were exceeded by variables in this study, and therefore all were retained for subsequent analyses.
Table 4-10.

*Neighbourhood Variable Correlations (N=124)*

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Economic Deprivation</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. High Status SES</td>
<td>.57***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Neighbourhood Income Status</td>
<td>-.62***</td>
<td>.53***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Median HH Income</td>
<td>-.76***</td>
<td>.67***</td>
<td>.83***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Prop'n Aboriginals</td>
<td>-.67***</td>
<td>-.36***</td>
<td>-.34***</td>
<td>-.48***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Prop'n Graduates</td>
<td>-.56***</td>
<td>.87***</td>
<td>.59***</td>
<td>.71***</td>
<td>-.34***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Prop'n Low Income HH</td>
<td>.89***</td>
<td>-.53***</td>
<td>.66***</td>
<td>-.80***</td>
<td>.58***</td>
<td>-.53***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. Prop'n of Managers</td>
<td>-.42***</td>
<td>.86***</td>
<td>.33***</td>
<td>.44***</td>
<td>-.28***</td>
<td>.47***</td>
<td>-.38***</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Prop'n of 15-24 year olds</td>
<td>.16*</td>
<td>-.03</td>
<td>-.12</td>
<td>-.15</td>
<td>.02</td>
<td>.00</td>
<td>.31***</td>
<td>.04</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. Prop'n Single Parent HH</td>
<td>.67***</td>
<td>-.47***</td>
<td>-.54***</td>
<td>-.60</td>
<td>.44***</td>
<td>-.47***</td>
<td>.62***</td>
<td>-.34***</td>
<td>.07</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K. Prop'n of Visible Minorities</td>
<td>.15</td>
<td>-.19**</td>
<td>-.20**</td>
<td>-.19**</td>
<td>.08</td>
<td>-.23***</td>
<td>.17</td>
<td>-.09</td>
<td>.36***</td>
<td>.01</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Prop'n Unemployed</td>
<td>.89***</td>
<td>-.49***</td>
<td>-.44***</td>
<td>-.56***</td>
<td>.62***</td>
<td>-.46***</td>
<td>.59***</td>
<td>-.37***</td>
<td>-.03</td>
<td>.58***</td>
<td>.09</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>M. Residential Stability</td>
<td>-.45***</td>
<td>.15*</td>
<td>.41***</td>
<td>.50***</td>
<td>-.32***</td>
<td>.21**</td>
<td>-.54***</td>
<td>.06</td>
<td>-.36***</td>
<td>-.35***</td>
<td>-.17*</td>
<td>-.26***</td>
<td>—</td>
</tr>
</tbody>
</table>

*p < 0.1  **p < 0.05  ***p < 0.01
The third correlation analysis examined relationships between the neighbourhood-level measures and educational outcome variables. Correlations are strongest for High-status SES, Economic Deprivation and Income Status, and range from .45 to .56 for Grade 12 outcomes and .22 to .28 for Post Secondary GPA. High-status SES and Economic Deprivation are also moderately correlated with both participation variables, and range from .30 to .39.

With the exception of a few variables, all the correlations between neighbourhood characteristics and educational outcomes have the expected signs and are highly significant. Correlations are shown in Table 4-11. Because none of the correlations or VIFs exceed recommended thresholds, concerns about the presence of multicollinearity were considered minimal.
Table 4-11.

*Independent and Dependent Variable Correlations (N=124)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Grade 12 GPA</th>
<th>First Year GPA</th>
<th>Participation: census data</th>
<th>Participation: university data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Deprivation</td>
<td>-.451***</td>
<td>-.246***</td>
<td>-.347***</td>
<td>-.296***</td>
</tr>
<tr>
<td>High Status SES</td>
<td>.571***</td>
<td>.137</td>
<td>.340***</td>
<td>.318***</td>
</tr>
<tr>
<td>Neighbourhood Income Status</td>
<td>.485***</td>
<td>.280***</td>
<td>.370***</td>
<td>.121</td>
</tr>
<tr>
<td>Median HH Income</td>
<td>.526***</td>
<td>.260***</td>
<td>.292***</td>
<td>.216*</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td>-.250***</td>
<td>-.160</td>
<td>-.315***</td>
<td>-.265***</td>
</tr>
<tr>
<td>Proportion of Graduates</td>
<td>.575***</td>
<td>.174</td>
<td>.349***</td>
<td>.265***</td>
</tr>
<tr>
<td>Proportion in Low Income</td>
<td>-.449***</td>
<td>-.197*</td>
<td>-.305***</td>
<td>-.268***</td>
</tr>
<tr>
<td>Proportion of 15-24 year olds</td>
<td>-.094</td>
<td>.033</td>
<td>.159</td>
<td>.020</td>
</tr>
<tr>
<td>Proportion of Single Parent HH</td>
<td>-.321***</td>
<td>-.089</td>
<td>-.261***</td>
<td>-.225**</td>
</tr>
<tr>
<td>Proportion of Visible Minorities</td>
<td>-.127</td>
<td>-.003</td>
<td>.041</td>
<td>.091</td>
</tr>
<tr>
<td>Proportion of Unemployed</td>
<td>-.356***</td>
<td>-.228**</td>
<td>-.312***</td>
<td>-.260***</td>
</tr>
<tr>
<td>Residential Stability</td>
<td>.238***</td>
<td>.084</td>
<td>.152</td>
<td>.030</td>
</tr>
</tbody>
</table>

*p < 0.1  **p < 0.05  ***p < 0.01

High school outcomes

The next phase of the analysis was carried out to establish the validity of the initial hypotheses regarding high school outcomes by again addressing the research questions:

1. In regards to high school outcomes, do rates of participation in academic courses vary by neighbourhood characteristics; similarly, do outcomes (grades achieved) vary by neighbourhood?
2. In regards to post-secondary transitions, do rates of participation, grades achieved and persistence patterns vary by neighbourhood characteristics?

*Academic streams*

The BC secondary education curriculum offers several options for students in senior level English and mathematics courses: students can choose among versions of Mathematics and English. In this study, Communications 11 and 12 and Applications of Math 11 are considered to be less academic versions of the standard English 11 and Principles of Mathematics 11 curricula, and students are generally streamed into these courses based on ability. To assess whether differences in course enrolment exist by neighbourhood, the proportions of students in differing academic streams were examined. If educational outcomes are independent of neighbourhood socioeconomic status, a proportionately equal distribution of students in each level by neighbourhood SES is expected.

To test this hypothesis, students were assigned to neighbourhood income quartiles (Q1=lowest; Q4=highest) based on their Dissemination Area’s median household income. Expected versus observed proportions were compared in relation to the number of students in each stream and quartile.
As demonstrated in Figure 4-4, the proportion of students in less-academic courses decreases as neighbourhood SES rises, suggesting that participation in academic courses differs by neighbourhood. Students living in low-income neighbourhoods (irrespective of family income) participate in less-academic streams at higher proportions than their peers living in the highest-income neighbourhoods (for example, over 25% of students in Quartile 1 are in Applications of Math 11, compared to 12%, 11% and 7% for Quartiles 2, 3 and 4, respectively).
To determine whether these differences were significant, expected enrolments by stream were calculated by applying the proportion of the overall population in each stream to the number of students in each quartile. For example, of the 4,884 Grade 11 English course registrations, approximately 90% (4,405) were enrolled in the academic version (English 11) and 10% (479) were enrolled in the less-academic version (Communications 11). If enrolments by stream are indeed independent of neighbourhood characteristics, approximately 10% of each quartile should be enrolled in Communications 11. However, this was not the case. As demonstrated in Figure 4-5, for each of the three academic courses, expected enrolments were greater than observed for Quartiles 1 and 2 and less than observed for Quartiles 3 and 4.
To determine whether the resulting differences were significant for each course, the data were next analyzed with a chi-square test of independence. As demonstrated in Table 4-12, significant differences between expected and observed proportions were found.

Table 4-12.

**Chi-square Test Statistic by Quartiles**

<table>
<thead>
<tr>
<th>Course</th>
<th>df</th>
<th>X²</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 11</td>
<td>3</td>
<td>88.22</td>
<td>.000</td>
</tr>
<tr>
<td>Communications 11</td>
<td>3</td>
<td>86.14</td>
<td>.000</td>
</tr>
<tr>
<td>Principles of Math 11</td>
<td>3</td>
<td>44.77</td>
<td>.000</td>
</tr>
<tr>
<td>Applications of Math 11</td>
<td>3</td>
<td>101.19</td>
<td>.000</td>
</tr>
</tbody>
</table>
The consistency of these results across subjects suggests that neighbourhood effects do indeed exist.

Course outcomes

The previous analysis examined proportions of students in various streams, but did not consider whether final grades differed by neighbourhood quartile. This question was next pursued with a second set of analyses which explored whether average grades in English 11 attained by quartile were equivalent. Descriptive statistics for these data are detailed in Table 4-13.

Table 4-13.

*English 11 Grades by Quartile (n=4,405)*

<table>
<thead>
<tr>
<th>Quartile</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>Q1</td>
<td>606</td>
<td>65.5</td>
<td>14.4</td>
<td>.586</td>
<td>64.3</td>
</tr>
<tr>
<td>Q2</td>
<td>844</td>
<td>69.2</td>
<td>13.7</td>
<td>.473</td>
<td>68.3</td>
</tr>
<tr>
<td>Q3</td>
<td>1,522</td>
<td>71.6</td>
<td>14.4</td>
<td>.368</td>
<td>70.9</td>
</tr>
<tr>
<td>Q4</td>
<td>1,433</td>
<td>73.8</td>
<td>13.4</td>
<td>.355</td>
<td>73.1</td>
</tr>
<tr>
<td>Total</td>
<td>4,405</td>
<td>71.0</td>
<td>14.2</td>
<td>.214</td>
<td>70.6</td>
</tr>
</tbody>
</table>

A one-way analysis of variance was performed on the final grades and was found to be significant, $F (3, 4401) = 55.716, p < .01$, suggesting that
significant differences in average grades by neighbourhood exist. Q1 students achieved the lowest scores with a mean of 65.5, Q2 students' scores were higher with a mean of 69.2, Q3 students achieved a mean of 71.6, and the highest scores were achieved by Q4 students who earned a mean of 73.8.

To further evaluate differences among the quartile means, a post hoc Tukey HSD test was undertaken. Detailed in Table 4-14, the results of these tests indicate that a significant difference in the means of all quartiles exists. In general, the emerging patterns suggested that these groups differed on the expected scales and in the expected directions: students from lower SES neighbourhoods had lower average grades than students living in higher SES neighbourhoods.
Table 4-14.

English 11 Tukey HSD Post Hoc Test

<table>
<thead>
<tr>
<th>(I) Quartile</th>
<th>J (Quartiles)</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>p</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>-3.685*</td>
<td>.743</td>
<td>.000</td>
<td>-5.60</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>-6.075*</td>
<td>.671</td>
<td>.000</td>
<td>-7.80</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-8.267*</td>
<td>.677</td>
<td>.000</td>
<td>-10.01</td>
</tr>
<tr>
<td>Q2</td>
<td>Q1</td>
<td>3.685*</td>
<td>.743</td>
<td>.000</td>
<td>1.77</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>-2.390*</td>
<td>.599</td>
<td>.000</td>
<td>-3.93</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-4.582*</td>
<td>.606</td>
<td>.000</td>
<td>-6.14</td>
</tr>
<tr>
<td>Q3</td>
<td>Q1</td>
<td>6.075*</td>
<td>.671</td>
<td>.000</td>
<td>4.35</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>2.390*</td>
<td>.599</td>
<td>.000</td>
<td>.85</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-2.192*</td>
<td>.514</td>
<td>.000</td>
<td>-3.51</td>
</tr>
<tr>
<td>Q4</td>
<td>Q1</td>
<td>8.267*</td>
<td>.677</td>
<td>.000</td>
<td>6.53</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>4.582*</td>
<td>.606</td>
<td>.000</td>
<td>3.03</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>2.192*</td>
<td>.514</td>
<td>.000</td>
<td>.87</td>
</tr>
</tbody>
</table>

* The main difference is significant at the 0.05 level.

To determine whether these differences might be an artifact of patterns in the variances rather than a true difference, the homogeneity of variances was assessed using the Levene test \( F (3, 4401) = .254, \ p = .859 \). The insignificant Levene statistic indicates that these data do not violate the assumption of homogeneity of variance.
The analyses undertaken for English 11 were repeated for all course outcomes with similar findings, and are available in the Appendix.

*Regression Results*

Building upon the correlation and variance analyses, multiple regression was conducted to further explore the relationships between neighbourhood characteristics and academic performance. Multiple regression analysis is a statistical technique that predicts values of one variable on the basis of two or more other variables. In this study, neighbourhood characteristics represent the independent variables, and student-level variables constitute the dependent variables. To determine which regression technique was applicable for this study, the independent and dependent variables were analyzed to determine whether assumptions required for linear regression held. These generally include (a) linear relationships between variables, (b) independence of errors (that the errors are independent of one another) (c) normality – requires that the errors are normally distributed, and (d) equal variances (homoscedasticity). Results of these tests supported the appropriateness of linear regression for these datasets.

Multiple regression analysis was conducted to investigate the relationship of various factors with course performance in Grade 12. Detailed in Table 4-15, four variables were statistically significant in explaining Grade 12 outcomes. By
the absolute magnitude of their beta weights, these were: High Status SES (b=.42), Neighbourhood Income Status (b=.20), Residential Stability (b=.07) and Neighbourhood Economic Deprivation (b=-.06). All zero order correlations for the determinants were in the predicted direction, and the determinants in the model account for 36 percent of the variance (Adjusted $R^2 = .36$).
Table 4-15.

*Grade 12 Average Grades Regression Model (n=124)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Status SES</td>
<td>2.30*** (0.45)</td>
<td>2.34*** (0.45)</td>
<td>2.22*** (0.49)</td>
</tr>
<tr>
<td>Neighbourhood Income Status</td>
<td>2.65*** (0.89)</td>
<td>2.26** (0.97)</td>
<td>2.05** (1.04)</td>
</tr>
<tr>
<td>Residential Stability</td>
<td>3.16 (3.06)</td>
<td>2.54 (3.24)</td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Economic Deprivation</td>
<td></td>
<td>-0.33 (0.55)</td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Number of Observations 124

Standard errors are in parentheses.

*p < 0.1  **p < 0.05  ***p < 0.01

Model 1 demonstrates that two neighbourhood variables (Prevalence of High SES neighbours and Neighbourhood Income Status) account for approximately 36% of the total variance in Grade 12 outcomes. The addition of two additional variables (Models 2 and 3) does not improve the model as the Adjusted R² value does not increase.

Transitions to post-secondary

The next phase of the study examined factors related to transitions between high school and post-secondary education and included analyses related to participation, performance and persistence.
Participation rates

Participation in post-secondary education was measured using two discrete sets of data. The first dataset calculated participation rates solely with census data (Statistics Canada, 2003b), whereas the second set of participation rates was derived from the number of high school graduates in each Dissemination Area between 2003 and 2006 divided by the number of direct-entry registrants from each Dissemination Area local to the university (Friesen, 2008). A caution about using this method is that these data will exclude the registration activity of students who do transition to post-secondary institutions other than the local university, which poses a risk of selection bias. However, a recent project published jointly by the BC Ministry of Education and the BC Ministry of Advanced Labour and Market Development (Student Transitions Project, 2008) demonstrates that a relatively small proportion (less than ten percent) of the city’s direct-entry university-bound students choose to study at other universities. Further, the results of the following analyses that used census data (necessarily including those students studying elsewhere) and local university data had similar findings. Consequently, this bias is believed to be minimal.
Participation Rates (University Data)

To determine whether differences in participation rates exist between income quartiles, an ANOVA test was carried out on the university data. The results of the ANOVA were found to be significant ($F (3, 120) = 2.859, p < .05$); however, the Levene test for homogeneity was also found to be significant ($\text{Levene} = (1,1358) = 54.516, p < .01$). In order to reduce heteroscedasticity, the dependent variables were transformed by their log, and the ANOVA and Levene tests were re-calculated. As a secondary tests, the ANOVA also executed using the Games-Howell post-hoc test, which does not require that variances be equal, as well as a Brown-Forsythe test, which transforms the response variable. All results were consistent with the results using the log-transformed data. The new Levene statistic was insignificant ($\text{Levene} = (3, 120) = 2.033, p = .113$), thereby removing the suggested violation of the homogeneity assumption. The ANOVA remained significant ($F (3, 120) = 3.449, p < .05$), and a Tukey HSD post-hoc test was undertaken to identify which quartiles demonstrated differences. This determined that differences were observed only between Quartiles 1 and 4. Interestingly, Quartiles 2 and 3 did not demonstrate significant differences in participation rates.
Regression Results: Participation (University Data)

Multiple regression was carried out on the second participation dataset to examine whether results would align with the first dataset. Significant variables changed slightly: Proportion of Visible Minorities became a factor in the second model, whereas Economic Deprivation no longer contributed. However, the Adjusted R² improved slightly to .235 as demonstrated in Table 4-16.

Table 4-16.

Participation (University data) Regression Model (n=510)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS Students</td>
<td>-.002***</td>
<td>-.002***</td>
<td>-.002***</td>
<td>-.003***</td>
</tr>
<tr>
<td></td>
<td>(.000)</td>
<td>(.000)</td>
<td>(.000)</td>
<td>(.000)</td>
</tr>
<tr>
<td>Census count</td>
<td>-.042***</td>
<td>-.050***</td>
<td>-.056***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.009)</td>
<td>(.009)</td>
<td>(.009)</td>
<td></td>
</tr>
<tr>
<td>Proportion of Visible Minorities</td>
<td>-.376***</td>
<td>-.338***</td>
<td>-.481***</td>
<td>-.356***</td>
</tr>
<tr>
<td></td>
<td>(.073)</td>
<td>(.072)</td>
<td>(.097)</td>
<td>(.101)</td>
</tr>
<tr>
<td>High Status SES</td>
<td></td>
<td>.020***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(.005)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Income Status</td>
<td>.088***</td>
<td>.092***</td>
<td>.102***</td>
<td>.105***</td>
</tr>
<tr>
<td></td>
<td>(.012)</td>
<td>(.012)</td>
<td>(.012)</td>
<td>(.012)</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td>-.574***</td>
<td>-.615***</td>
<td>-.481***</td>
<td>-.356***</td>
</tr>
<tr>
<td></td>
<td>(.098)</td>
<td>(.096)</td>
<td>(.097)</td>
<td>(.101)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.142</td>
<td>.127</td>
<td>.214</td>
<td>.235</td>
</tr>
</tbody>
</table>

Number of Observations: 510 510 510 510

Standard errors are in parentheses.
* p < 0.1  ** p < 0.05  *** p < 0.01
Participation Rates (Census-based Data)

In alignment with the university-level data, the census-based data based participation rates demonstrated a similar but more differentiated relationship. In this case, participation rates (Table 4-17) again varied by quartile, with 51%, 53%, 64% and 63% participation rates for Quartiles 1 through 4, respectively. An ANOVA test demonstrated that these percentages were significantly different, $F(3, 120) = 6.471, p < .01$ and did not result in a significant Levene test (Levene $(3, 120) = 1.261, p = .291$). The subsequent Tukey HSD test (Table 4-17) indicated that Quartiles One and Two were significantly different than Quartiles Three and Four. In other words, students in lower-SES neighbourhoods participated at significantly lower rates than did students in more affluent neighbourhoods.

Table 4-17.

Tukey HSD Post Hoc Analysis - Participation Rates (Census Data)

<table>
<thead>
<tr>
<th>(I) Quartile</th>
<th>J (Quartiles)</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>-.020</td>
<td>.039</td>
<td>-121</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>-.134***</td>
<td>.039</td>
<td>-.235</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-.126***</td>
<td>.039</td>
<td>-.228</td>
</tr>
<tr>
<td>Q2</td>
<td>Q1</td>
<td>.020</td>
<td>.039</td>
<td>-.082</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>-.114**</td>
<td>.039</td>
<td>-.215</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-.107**</td>
<td>.039</td>
<td>-.208</td>
</tr>
<tr>
<td>Q3</td>
<td>Q1</td>
<td>.134***</td>
<td>.039</td>
<td>.032</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>.114**</td>
<td>.039</td>
<td>.013</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>.007</td>
<td>.039</td>
<td>-.094</td>
</tr>
<tr>
<td>Q4</td>
<td>Q1</td>
<td>.126***</td>
<td>.039</td>
<td>.025</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>.107**</td>
<td>.039</td>
<td>.005</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>-.007</td>
<td>.039</td>
<td>-.109</td>
</tr>
</tbody>
</table>

*p < 0.1  **p < 0.05  ***p < 0.01
Regression Results: Participation (Census-based Data)

Results from a regression on Participation Rate (census data) are summarized in Table 4-18. Four sets of regressions were run: (a) the first set includes as regressors a demographic measure which was found to be significant in the correlation analyses (Proportion of Aboriginals) as well as three neighbourhood-level variables, Prevalence of High SES, Neighbourhood Income Status, and Proportion of High Status SES; (b) to Model 1, Economic Deprivation was added; (c) in Model 3, Census Count was added; and (d) in Model 4, High School Student Count was added as a final neighbourhood variable. The data presented in Table 4-18 include the raw-score regression coefficients and the associated standard errors (in parentheses). Model 3 appears to predict approximately 20% of the variation in the census-based participation scores; this model was not improved by the addition of the fourth variable in Model 4. Additional models were constructed but did not improve the Adjusted R² score so were not considered further.
Table 4-18.

*Participation (Census-based Data) Regression Models (n=124)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Status SES</td>
<td>0.04*** (0.05)</td>
<td>0.03*** (0.02)</td>
<td>0.02 (0.02)</td>
<td>0.02** (0.02)</td>
</tr>
<tr>
<td>Economic Deprivation</td>
<td>-0.03 (0.02)</td>
<td>-0.01 (0.02)</td>
<td>-0.01 (0.02)</td>
<td></td>
</tr>
<tr>
<td>Neighbourhood Income Status</td>
<td>0.08** (0.04)</td>
<td></td>
<td>0.07** (0.04)</td>
<td></td>
</tr>
<tr>
<td>Residential Stability</td>
<td></td>
<td></td>
<td>0.06 (0.12)</td>
<td></td>
</tr>
<tr>
<td>Proportion of 15-24 year olds</td>
<td>0.58** (0.29)</td>
<td>0.67** (0.29)</td>
<td>0.70** (0.29)</td>
<td>0.75** (0.30)</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td>-0.62** (0.24)</td>
<td>-0.35 (0.31)</td>
<td>-0.43 (0.31)</td>
<td>-0.42 (0.31)</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.17</td>
<td>0.17</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>124</td>
<td>124</td>
<td>124</td>
<td>124</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.  
*p < 0.1  **p < 0.05  ***p < 0.01

*Post-Secondary Outcomes*

The next phase of the analysis investigated whether grade point averages differ by neighbourhood characteristic. In order to examine whether differences in neighbourhood GPA performance exist, the grade point averages of local students were analyzed by quartile. Descriptive results are presented in Table 4-19:
Table 4-19.

Descriptives: University GPA by Quartile ($n=510$)

<table>
<thead>
<tr>
<th>Quartile</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>57</td>
<td>2.62</td>
<td>.87</td>
<td>.11</td>
<td>2.40</td>
<td>2.83</td>
</tr>
<tr>
<td>Q2</td>
<td>85</td>
<td>2.48</td>
<td>.96</td>
<td>.10</td>
<td>2.27</td>
<td>2.69</td>
</tr>
<tr>
<td>Q3</td>
<td>137</td>
<td>2.59</td>
<td>.94</td>
<td>.08</td>
<td>2.43</td>
<td>2.75</td>
</tr>
<tr>
<td>Q4</td>
<td>231</td>
<td>2.76</td>
<td>.84</td>
<td>.06</td>
<td>2.65</td>
<td>2.87</td>
</tr>
<tr>
<td>Total</td>
<td>510</td>
<td>2.65</td>
<td>.89</td>
<td>.04</td>
<td>2.57</td>
<td>2.73</td>
</tr>
</tbody>
</table>

Figure 4-6 illustrates grade point averages by Program Category and quartile. An interesting pattern emerges that runs counter to the patterns viewed in high school student grade data: students residing in low-SES neighbourhoods have higher average grades than do students living in middle-income neighbourhoods. This will be discussed in the following chapter.
Figure 4-6.

GPA by Program Category and Quartile (n=510)
Table 4-20.

**Descriptives: GPA by Program and Quartile**

<table>
<thead>
<tr>
<th>Program Category</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Degree</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>39</td>
<td>2.7030</td>
<td>.75720</td>
<td>.12125</td>
<td>2.4575</td>
<td>2.9484</td>
</tr>
<tr>
<td>Q2</td>
<td>62</td>
<td>2.4608</td>
<td>.95991</td>
<td>.12191</td>
<td>2.2170</td>
<td>2.7045</td>
</tr>
<tr>
<td>Q3</td>
<td>106</td>
<td>2.5371</td>
<td>.91557</td>
<td>.08893</td>
<td>2.3607</td>
<td>2.7134</td>
</tr>
<tr>
<td>Q4</td>
<td>176</td>
<td>2.7818</td>
<td>.79729</td>
<td>.06010</td>
<td>2.6632</td>
<td>2.9004</td>
</tr>
<tr>
<td>Total</td>
<td>383</td>
<td>2.6541</td>
<td>.86222</td>
<td>.04406</td>
<td>2.5674</td>
<td>2.7407</td>
</tr>
<tr>
<td><strong>Diploma</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>5</td>
<td>1.9296</td>
<td>.95046</td>
<td>.42506</td>
<td>.7494</td>
<td>3.1098</td>
</tr>
<tr>
<td>Q2</td>
<td>10</td>
<td>2.4120</td>
<td>.90343</td>
<td>.28569</td>
<td>1.7657</td>
<td>3.0583</td>
</tr>
<tr>
<td>Q3</td>
<td>11</td>
<td>2.7518</td>
<td>1.10853</td>
<td>.33423</td>
<td>2.0071</td>
<td>3.4965</td>
</tr>
<tr>
<td>Q4</td>
<td>18</td>
<td>2.7538</td>
<td>.86973</td>
<td>.20500</td>
<td>2.3213</td>
<td>3.1863</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>2.5820</td>
<td>.95689</td>
<td>.14426</td>
<td>2.2910</td>
<td>2.8729</td>
</tr>
<tr>
<td><strong>Certificate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>3</td>
<td>2.3712</td>
<td>1.15574</td>
<td>.66726</td>
<td>-.4998</td>
<td>5.2422</td>
</tr>
<tr>
<td>Q2</td>
<td>5</td>
<td>2.4684</td>
<td>.64157</td>
<td>.28692</td>
<td>1.6718</td>
<td>3.2651</td>
</tr>
<tr>
<td>Q3</td>
<td>4</td>
<td>1.4858</td>
<td>1.10814</td>
<td>.55407</td>
<td>-.2775</td>
<td>3.2491</td>
</tr>
<tr>
<td>Q4</td>
<td>9</td>
<td>2.5067</td>
<td>.76263</td>
<td>.25421</td>
<td>1.9205</td>
<td>3.0929</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>2.2838</td>
<td>.89001</td>
<td>.19422</td>
<td>1.8787</td>
<td>2.6889</td>
</tr>
<tr>
<td><strong>Trades</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>8</td>
<td>2.5860</td>
<td>.99663</td>
<td>.35236</td>
<td>1.7528</td>
<td>3.4192</td>
</tr>
<tr>
<td>Q2</td>
<td>7</td>
<td>2.6433</td>
<td>1.39681</td>
<td>.52794</td>
<td>1.3514</td>
<td>3.9351</td>
</tr>
<tr>
<td>Q3</td>
<td>13</td>
<td>3.0192</td>
<td>.67979</td>
<td>.18854</td>
<td>2.6084</td>
<td>3.4300</td>
</tr>
<tr>
<td>Q4</td>
<td>24</td>
<td>2.7763</td>
<td>1.06396</td>
<td>.21718</td>
<td>2.3270</td>
<td>3.2256</td>
</tr>
<tr>
<td>Total</td>
<td>52</td>
<td>2.7898</td>
<td>1.00403</td>
<td>.13923</td>
<td>2.5103</td>
<td>3.0694</td>
</tr>
<tr>
<td><strong>Prep</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>2</td>
<td>3.1426</td>
<td>.87052</td>
<td>.61555</td>
<td>-4.6787</td>
<td>10.9639</td>
</tr>
<tr>
<td>Q2</td>
<td>1</td>
<td>3.2525</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Q3</td>
<td>3</td>
<td>3.3981</td>
<td>.54582</td>
<td>.31513</td>
<td>2.0422</td>
<td>4.7539</td>
</tr>
<tr>
<td>Q4</td>
<td>4</td>
<td>2.1063</td>
<td>1.24499</td>
<td>.62250</td>
<td>.1252</td>
<td>4.0874</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>2.8157</td>
<td>1.02408</td>
<td>.32384</td>
<td>2.0831</td>
<td>3.5483</td>
</tr>
</tbody>
</table>
A one-way analysis of variance was next undertaken to determine whether GPAs differed by program category and quartile. The ANOVA indicated that only Degree program GPAs differed significantly by quartile ($F (3, 379) = 3.067, p < .05$). All other programs had nonsignificant differences.

Regression Results: Post-Secondary Outcomes

To examine potential predictive relationships among the outcomes variables, a regression analysis was undertaken for the post-secondary data. Initially, all programs were analyzed as a whole, then parsed into each of the program categories for disaggregated results.

In the aggregated analysis, none of the neighbourhood variables were retained for the final models: only English 12 GPA and Gender resulted in a relatively sufficient Adjusted $R^2$. As detailed in Table 4-21, Model 1 first examines the relationship of English 12 GPA with post-secondary outcomes. When Gender is added to form Model 2, the Adjusted $R^2$ improves slightly to .25, thus accounting for 25% of the variance in university GPA.
Table 4-21.

*Regression Results for Post-Secondary Outcomes (All Program Categories)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 12 GPA</td>
<td>.615*** (.050)</td>
<td>.649*** (.050)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td>-.282*** (.070)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.23</td>
<td>.25</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>510</td>
<td>510</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.

*p < 0.1  **p < 0.05  ***p < 0.01

The second phase of analysis parsed the data by program category to explore whether relationships were consistent for all programs. The resulting data indicates that relationships vary a great deal based on program for this dataset. For example, under the same criteria as Model 2 in Table 4-21, Trades programs achieve a similar Adjusted R² score of .25. However, by including a range of neighbourhood variables as demonstrated in Table 4-22, the Adjusted R² improves to .30.
Table 4-22.

*Regression Results for Post-Secondary Outcomes: (Trades Programs)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of Population 15-24</td>
<td>-15.56**</td>
<td>-15.56**</td>
</tr>
<tr>
<td></td>
<td>(6.33)</td>
<td>(6.22)</td>
</tr>
<tr>
<td>Proportion of Visible Minorities</td>
<td>-11.25***</td>
<td>-9.48**</td>
</tr>
<tr>
<td></td>
<td>3.62</td>
<td>(3.74)</td>
</tr>
<tr>
<td>Proportion of Graduates</td>
<td>2.46*</td>
<td>5.53**</td>
</tr>
<tr>
<td></td>
<td>(1.23)</td>
<td>(2.32)</td>
</tr>
<tr>
<td>Prevalence of High Status SES</td>
<td>- .42</td>
<td>.27</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.28</td>
<td>.30</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>52</td>
<td>52</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.
*p < 0.1  **p < 0.05  ***p < 0.01

On the other hand, the regression models for Degree programs were quite different. No neighbourhood factors were included in two models developed:

Model 1 accounts for 21 percent of the variance with just one variable, English 12 GPA; Model 2 adds Gender, which increases the explanatory power to 24 percent.
Table 4-23.

*Regression Results for Post-Secondary Outcomes (Degrees)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 12 GPA</td>
<td>.575***</td>
<td>.619***</td>
</tr>
<tr>
<td></td>
<td>(.056)</td>
<td>(.057)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td>-.302***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(.079)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.21</td>
<td>.24</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>510</td>
<td>510</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.
*p < 0.1  **p < 0.05  ***p < 0.01

Upgrading programs include high school-level course content but are offered at post-secondary institutions, and were analyzed next. The variables included in the model for these programs also differed from the aggregate analysis. Table 4-24 reports that the Adjusted R² values were above .50 with the indicated neighbourhood variables; however, given the low n of 10 these results should be interpreted with caution.
Table 4-24.

*Regression Results for Post-Secondary Outcomes: (Upgrading Programs)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of Graduates</td>
<td>-6.53** (2.38)</td>
<td>-9.22** (3.22)</td>
</tr>
<tr>
<td>Residential Stability</td>
<td>-4.82* (2.47)</td>
<td>-5.10* (2.41)</td>
</tr>
<tr>
<td>Proportion of Unemployed</td>
<td>-6.30 (2.75)</td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.51</td>
<td>.54</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.
* p < 0.1  ** p < 0.05  *** p < 0.01

Finally, diploma and certificate programs were analyzed. In regards to diplomas, the only variable that resulted in a comparable Adjusted R² was English 12 GPA (see Table 4-25); conversely, none of the independent variables resulted in any significant scores for certificate programs.

Table 4-25.

*Regression Results for Post-Secondary Outcomes: (Diploma Programs)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Diploma</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 12 GPA</td>
<td>.662*** (.160)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.27</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>44</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.
* p < 0.1  ** p < 0.05  *** p < 0.01
Persistence

The final research question regarding student persistence was pursued by creating a dichotomous variable to indicate whether students persisted from the fall to spring semester. Table 4-26 details the distribution of data by persistence category.

Table 4-26.

*Descriptive Results for Persistence Rates by Overall GPA*

<table>
<thead>
<tr>
<th>Grouping</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retained</td>
<td>845</td>
<td>2.51</td>
<td>.89</td>
<td>.03</td>
<td>2.45 – 2.57</td>
</tr>
<tr>
<td>Not Retained</td>
<td>143</td>
<td>2.03</td>
<td>1.23</td>
<td>.10</td>
<td>1.83 – 2.24</td>
</tr>
<tr>
<td>Overall</td>
<td>988</td>
<td>2.44</td>
<td>.96</td>
<td>.03</td>
<td>2.38 – 2.50</td>
</tr>
</tbody>
</table>

Next, analysis of variance was conducted to discern whether significant differences in overall GPA existed between those who persisted from Fall to Spring versus those who did not. Since overall GPA is a continuous variable, an ANOVA was performed with institutional retention as the independent variable and overall GPA as the dependent variable. It is detailed in Table 4-27.
These results suggest that those students who persisted generally achieved a higher overall GPA (mean of 2.51) compared to that of students who did not persist (mean of 2.03). To determine whether differences in grade point averages were associated with program categories, mean GPAs by persistence status and program category were calculated as demonstrated in Table 4-28. With the exception of Upgrading programs, grade point averages of students who were retained were higher than those who were not.
Next, an analysis of variance was calculated to determine whether the significant differences observed in the means of the overall dataset (Table 4-27) held true for students in varying program categories. The results revealed that differences were not significant for all categories: while Degrees, Diplomas, and Certificates demonstrated significant differences ($F (1, 701) = 149.64, p < .01$, $F (1, 101) = 52.56, p < .01$, and $F (1,38) = 11.29, p < .01$, respectively), Trades ($F (1, 115) = 1.41, p = .237$) and Upgrading ($F = .50 (1, 23), p = .49$) did not.

A second question relating to GPA and persistence was next explored by analyzing the GPA distribution among the students who were not retained. Table 4-29 details, by GPA category, the proportion of degree and diploma students who were retained:
Table 4-29.

Number and Proportion of Students by GPA and Program Categories

<table>
<thead>
<tr>
<th>GPA Category</th>
<th>Degrees</th>
<th></th>
<th>Diplomas</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Retained</td>
<td>n</td>
<td>Retained</td>
</tr>
<tr>
<td>0.00 – 0.49</td>
<td>41</td>
<td>0.49</td>
<td>4</td>
<td>0.25</td>
</tr>
<tr>
<td>0.50 – 0.99</td>
<td>27</td>
<td>0.81</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1.00 – 1.49</td>
<td>62</td>
<td>0.89</td>
<td>8</td>
<td>0.88</td>
</tr>
<tr>
<td>1.50 – 1.99</td>
<td>94</td>
<td>0.87</td>
<td>12</td>
<td>0.92</td>
</tr>
<tr>
<td>2.00 – 2.49</td>
<td>141</td>
<td>0.98</td>
<td>18</td>
<td>0.91</td>
</tr>
<tr>
<td>2.50 – 2.99</td>
<td>138</td>
<td>0.96</td>
<td>21</td>
<td>1.00</td>
</tr>
<tr>
<td>3.00 – 3.49</td>
<td>108</td>
<td>0.94</td>
<td>19</td>
<td>1.00</td>
</tr>
<tr>
<td>3.50 – 4.33</td>
<td>92</td>
<td>0.97</td>
<td>21</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Statistical differences between GPA categories were only observed in Degree and Diploma programs. Of these, the only GPA category that demonstrated significant differences was ‘0.00 to 0.49’: \( F(7, 695) = 18.301, p < .01 \) and \( F(6, 96) = 7.519, p < .01 \), respectively. Differences in Certificate students were close to significance \( F(5, 34) = 2.464, p < .10 \), but the final two categories—Trades: \( F(7, 109) = .481, p = .847 \) and Upgrading \( F(6, 18) = 1.41, p = .264 \)—demonstrated non-significant differences.

However, a test of homogeneity of variance using the Levene statistic \( [\text{Levene}(1, 1358) = 54.52, p < .01] \) suggested that the groupings of retained versus not retained students may not display similar variances in overall GPA. In short, the assumption of homogeneity of variance was violated. Although this result is
undesirable, studies have demonstrated that ANOVA tends to be robust to the violation of the test of homogeneity of variance (Coughlin, 2005). Nonetheless, inferences drawn may need to be made with caution.

Regression Results: Persistence Data

Regression results were calculated for the Persistence data, and very low Adjusted R² scores resulted. Detailed in Tables 4-30 and 4-31, less than 10% of the variance in the persistence rates could be explained in the models generated for degree programs and only a slight improvement to 14% was made for diplomas and certificates.

Regression results: Persistence (Degrees)

Four regression models were developed to explain persistence in degree programs. The initial model explained approximately 9% of the variance in persistence rates with just one variable (Student GPA). Grade 12 means were added in Model 2, but no change in the Adjusted R² resulted. Proportion of Aboriginals was added in Model 3 and Residential Stability was added in Model 4, with a slight increase in variance explained to 11%. 
Table 4-30.

_Regression Results for Persistence: Degrees_

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student GPA</td>
<td>.09***</td>
<td>.09***</td>
<td>.09***</td>
<td>.09***</td>
</tr>
<tr>
<td></td>
<td>(.01)</td>
<td>(.01)</td>
<td>(.01)</td>
<td>(.01)</td>
</tr>
<tr>
<td>Grade 12 DA mean</td>
<td></td>
<td>.01***</td>
<td>.01***</td>
<td>.01***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(.00)</td>
<td>(.00)</td>
<td>(.00)</td>
</tr>
<tr>
<td>Proportion of Aboriginals</td>
<td></td>
<td>.67***</td>
<td></td>
<td>.75***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(.24)</td>
<td></td>
<td>(.24)</td>
</tr>
<tr>
<td>Residential Stability</td>
<td></td>
<td></td>
<td></td>
<td>.18**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(.08)</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>.09</td>
<td>.09</td>
<td>.11</td>
<td>.11</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>703</td>
<td>703</td>
<td>703</td>
<td>703</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.
*p < 0.1  **p < 0.05  ***p < 0.01

Regression results: Persistence (Diplomas and Certificates)

Similar to Model 1 for Degree programs, the regression analysis for diploma and certificate programs identified only one significant predictor variable as detailed in Table 4-31. Models for Trades and Upgrading programs did not result in significant Adjusted $R^2$ scores. Probit and OLS regression with White’s heteroscedasticity correction were also undertaken, and produced similar results.
Table 4-31.

Regression Results for Persistence: Diplomas and Certificates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Diplomas</th>
<th>Certificates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student GPA</td>
<td>.11***</td>
<td>.15***</td>
</tr>
<tr>
<td></td>
<td>(.03)</td>
<td>(.07)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.14</td>
<td>.10</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>103</td>
<td>40</td>
</tr>
</tbody>
</table>

Standard errors are in parentheses.
*p < 0.1  **p < 0.05  ***p < 0.01

Summary

This chapter detailed the results of the analysis described in the Methodology chapter. The primary goals were to assess whether neighbourhood factors had any relationships with educational outcomes, and to determine which, if any, variables might be useful in predicting these outcomes.

Spatial distribution patterns in the maps demonstrated that neighbourhoods of low socioeconomic status were patterned similarly to neighbourhoods of lower educational outcomes, and generally supported the contextual divide between the north and south sides of the city. These observations were further supported by the descriptive analysis, which separated the population into income quartiles based on neighbourhood median household income. Quartiles with lower income rates were found to have significantly higher proportions of Aboriginals, visible minorities, single parent...
and unemployed households and significantly lower proportions of high school graduates, managerial occupations, and residential stability than neighbourhoods in higher quartiles.

The next phase of the analysis calculated correlation coefficients for each variable set. These demonstrated moderate to strong correlations among SES indicators (prevalence of high SES households, proportion of managerial occupations, proportion of graduates, and proportion employed) with outcomes such as Grade 12 GPA and participation. Correlations were not as strong for first-year university GPA with generally low significant correlations observed.

Next, enrolment in varying high school academic streams was examined by neighbourhood characteristics, as well as grades received in these courses. Patterns of higher enrolment in less-academic courses were evident among lower SES neighbourhoods, as were lower final grades. Multiple regression extended these analyses and several models to explain variations were developed; approximately 36% of the variation in outcomes is explained by these equations.

Finally, transitions to post-secondary were examined, including participation, performance and persistence rates. The results of the ANOVA and chi-square analyses were similar to those of the high school cohort, with relationships between lower SES and lower educational outcomes again
identified. Regression analyses were also undertaken and resulted in Adjusted R²s ranging between .14 and .50 for the various equations.

In summary, the analyses indicated that neighbourhood characteristics do indeed have predictable relationships in regards to educational outcomes. These will be discussed in greater detail in the following chapter.
CHAPTER 5: DISCUSSION AND
POLICY IMPLICATIONS

Introduction

Decades of research have investigated the complexities of differing educational outcomes. It is generally understood that educational attainment is affected by a complex of variables. Significant among these, socioeconomic status and academic ability have been demonstrated to have explanatory relationships with educational attainment. However, open admission institutions seldom collect these data as a matter of course and are therefore limited in regards to assessment of the educational patterns of their students. The absence of socioeconomic information in open admission institutions therefore presents a compelling argument for the exploration of alternate datasets to research variances in educational outcomes. As such, this study's methodology was drawn from a body of literature that argues that analyses with neighbourhood data rival results based on individual-level socioeconomic and academic factors.

The growing interest among academic scholars and policymakers in the neighbourhoods in which children and adolescents live has largely been centred on a variety of outcomes associated with residence. A number of social problems tend to be correlated at the neighbourhood level, including, but not limited to,
crime rates, adolescent delinquency, mortality, health behaviours, social and physical disorder, low birth weight, infant mortality, disability, and obesity, among others (see Brooks-Gunn, 1997; Dornbusch, Ritter & Steinberg, 1991; Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Mayer & Jencks, 1989; Sampson, Morenoff & Gannon-Rowley, 2002). In addition, these issues are also related to the concentration of poverty, racial isolation, single-parent families, and rates of home ownership and stability (Sampson et al., 2002).

Similarly, studies have observed significant associations between neighbourhood characteristics—particularly socioeconomic status—on children and adolescent educational attainment, though the mechanisms through which these effects operate have been largely unexplored.

This study is unique in that it examines educational outcomes that bridge both secondary and post-secondary populations. Its intent was to provide a vehicle by which open admission institutions can better assess educational outcomes among student populations, a necessary component for the development of effective student success policies. The results provide some evidence that neighbourhood characteristics are related to educational outcomes.
Research Questions

This study investigated two overarching research questions:

1. In regards to high school outcomes, do rates of participation in academic courses vary by neighbourhood characteristics; similarly, do outcomes (grades achieved) vary by neighbourhood?

2. In regards to post-secondary transitions, do rates of participation, grades achieved and persistence patterns vary by neighbourhood characteristics?

In order to assess these questions, data from students local to the city that was the site of this study were assessed in regards to their participation, performance and persistence in high school course options, final grades, and participation and persistence in post-secondary.

To ensure that the results of this study provided utility to open admission institutions, analyses were restricted to student-level data normally available to these institutions. These variables included high school records, gender, age, address, program information, course load, and grades achieved. Transfer credit does not appear in this list because the scope of this study includes only first-
time, first-year students; therefore, students with transfer credit were not included in the sample.

Using the postal code on record at the time of high school graduation, 10,000 high school students and 500 first-year university students were mapped to neighbourhoods that were subsequently characterized using multiple variables from the 2001 Canadian Census (Statistics Canada, 2003b). The relationships between neighbourhoods and the participation, performance and persistence of these students were then explored.

The purpose of this chapter is to review and interpret the results presented in Chapter Four, elaborate on their potential meaning, and relate them to the existing literature on neighbourhood effects and educational outcomes in the context of an open-admission institution. A discussion on the strengths and limitations of the study is followed by suggestions for future avenues of research.

Socioeconomic Status and Educational Outcomes

Research demonstrates that socioeconomic status (SES) is a strong predictor of educational outcomes. Regardless of academic ability, students from more affluent backgrounds are more likely than their less-advantaged peers to participate and persist in post-secondary education (see for example, Ainsworth,
DOES NEIGHBOURHOOD MATTER? 141

2002; Butlin, 1995; D’Angiulli, Siegel & Maggi, 2004; Ensminger, Lamkin & Jacobson, 1996; Guppy, 1984; Tierney, 1992; Walpole, 2003; Willms, 2004; Yorke & Thomas, 2003). Though these findings have been prevalent in the literature for decades, it would appear that attempts at remedy have had minimal impact: in both the Canadian and US literature, as there is little evidence to suggest that the gap between low and high income families has narrowed (Butlin, 1995; Guppy, 1984, 1985; Guppy & Pendakur, 1989).

Why is socioeconomic status positively associated with educational outcomes? There are a number of hypotheses that support this: (a) more affluent students have the mobility and means to attend better schools and thus receive better preparatory education (Davies & Guppy, 1997; Willms, 2004), (b) affluent parents are more willing and able to pay for private or special purpose schools (Butlin, 1995), (c) affluent parents are better equipped to guide students through the educational paperwork process because they are more likely to have been students themselves (Andres & Grayson, 2003; Davies & Guppy, 1997; Duncan, 1994), and (d) affluent parents typically have managerial or professional level occupations which demonstrates the importance of higher education (Nakhaie & Curtis, 1998).
In a related manner, neighbourhood affluence and cohesion are also associated with educational competencies (Kohen, Hertzman & Brooks-Gunn, 1998). There are several theoretical perspectives that provide guidance for consideration of the ways in which neighbourhoods might influence educational outcomes (Gephart, 1997). Much of this work, primarily conceptualized as collective socialization (Jencks and Mayer, 1990; Jencks and Peterson, 1991; Wilson, 1987) is based on role model theories, where middle-class and professional adults in a neighbourhood influence youth and serve as role models by clarifying social norms, acceptable behaviour, and social control. Other theories, such as contagion, social disorganization and competition models also provide explanatory pathways and have been described earlier in this dissertation in Chapter Two.

Understanding the relationships between neighbourhood characteristics and educational attainment is important to understanding patterns of post-secondary participation, performance and persistence within institutions. This study has evaluated variations in educational outcomes across neighbourhoods and has assessed the extent to which socioeconomic and other variables are related to these outcomes.
Secondary School Educational Outcomes

Significant differences by neighbourhood were found between both the proportions of students enrolled in academic and less-academic high school course streams, as well as final grades achieved in courses. Analyses by course found that students from lower SES neighbourhoods earned significantly lower average grades in high school and were more likely to be enrolled in less-academic course options and than their peers in higher socioeconomic neighbourhoods.

Academic streams

If educational outcomes are independent of neighbourhood socioeconomic status, a proportionately equal distribution of students in each level by neighbourhood SES was expected. However, significant differences in proportions were observed. Students registered in less-academic course options are primarily from lower-SES neighbourhoods; similarly, a much smaller proportion of students from affluent neighbourhoods register in less-academic options.
**Grades**

The presence of high SES households and median income explained approximately 36% of the variance in Grade 12 scores. Consistent with the literature on educational outcomes, these results indicate similar results and strength as those found by individual-level findings. For example, Ainsworth found that area-based measures of socioeconomic status rival those of individual measures (2002), and Willms (2001) found that 40% of the variations in mean scores were attributable to students' family background. Therefore, this study's ability to explain roughly 36% of the variance lends support to the notion that neighbourhood estimates can provide results of similar magnitude as those based on individual-level data.

**Transitions to Post-Secondary**

The relationships between neighbourhood characteristics and transitions to post-secondary were assessed by analyzing three aspects of educational outcomes: (a) participation in post secondary studies, (b) performance and grade point averages, and (c) persistence from the Fall to Spring semester.
Participation Rates

Because of methodological concerns about assessing rates of participation from the available data, this concept was examined using two datasets so that results could be triangulated. One participation rate dataset was drawn from the student-level data, and the second was derived from census data. Both analyses found significant differences between neighbourhood participation rates: students who live in lower-SES neighbourhoods participate in post-secondary at significantly lower rates than students who live in more affluent neighbourhoods.

As expected, the mean participation rates of each dataset were different and require discussion. These dissimilarities likely arise from the differing constructs of the calculation: in alignment with the scope of this study, university-based rates considered only those students who were commencing studies in the twelve-month period immediately after their high school graduation. In contrast, by including all students between the ages of 15 through 24, the census-based rates necessarily include all variants of study patterns, including students who delayed their studies for several years after graduation, those who didn't graduate from high school and commenced studies under the mature student status category, and a number of other possibilities. Therefore,
while the absolute rates should not be similar, the results of the analyses were expected to be in agreement if neighbourhood effects were supported. This was demonstrated by the data.

A total of seven neighbourhood economic and demographic variables were related to post-secondary participation rates. Positively associated variables included Prevalence of High SES Households, Number of 15 to 24 Year Olds, Number of High School Students and Neighbourhood Income Status. Neighbourhood Economic Deprivation, Proportion of Visible Minorities and Proportion of Aboriginals demonstrated negative associations with participation. The regression models produced Adjusted $R^2$ scores of .24 for university-based data and .20 for census-based data.

These results are in alignment with previous research supporting collective socialization theories: neighbourhoods with a high proportion of affluent households, low proportions of low-income households and low unemployment rates have higher participation rates than do their corollaries.

Post-Secondary Outcomes

This study next considered the relationships between neighbourhood characteristics and academic success in the first year of post-secondary studies.
Consistent with the literature that recommends analyses by sub-categories within institutions (Butlin, 1995; Tinto, 1993), the predictor variables for grade point average differed significantly by program type. As detailed below, the variables included in the models for Diploma and Degree programs were markedly different than those included in the Trades and Upgrading models.

An unexpected result was observed for Degree and Upgrading programs when grade point averages were compared by income quartile. Degree program students living in the lowest quartile income neighbourhoods (Q1) earned significantly higher grades than their counterparts living in the next quartile (Q2). One possible explanation is that the students from the lowest income brackets that do make it to post-secondary programs, and in particular Degree programs, have already overcome many of the negative impacts that their low SES might bestow upon them (see Chapter Two) and are thus the brightest and best of this quartile.

The inverse situation may be the cause of the very low Q4 GPA scores observed in the Upgrading program distribution – because these students are in upgrading programs, by definition they did not fare particularly well in high school (recall that the population of study are students who have transitioned directly to post-secondary studies from high school. This eliminates those
students who enroll in Upgrading programs as refresher courses after having been out of school for some time). However, only ten students were included in this group and therefore this result may be an anomaly.

This regression analyses found that grade point averages in Degree programs were best predicted by neighbourhood mean English 12 GPA and Gender, whereas the model for Diploma programs was based only on English GPA. These findings are aligned with prior research that has found that high school grades generally are important variables in predicting educational outcomes (Adelman, 1999; Robbins, Lauver, Davis, Langley & Carlstrom, 2004).

However, neither high-school performance variables nor gender emerged as contributing factors in the models explaining Trades and Upgrading variances. In regards to Trades programs, four neighbourhood variables (namely Proportion of Population 15 to 24, Proportion of Visible Minorities, Proportion of Graduates, and Prevalence of High-Status SES) were found to explain 30% of the variance in scores.

As expected, the model for students in Upgrading programs was altogether different from the previous models. It identified three variables (Proportion of Graduates, Residential Stability, and Proportion of Unemployed) and demonstrated the largest Adjusted $R^2$ of .54. Unfortunately the low n of 10
students does not permit these results to be generalizable. This would certainly be worth exploring further in a study with a larger sample size.

Also as expected, the models for Trades and Upgrading programs were different than those of more academic programs: student abilities and backgrounds in these programs may logically be dissimilar to those in academic programs. Because the literature often speaks to students in four-year baccalaureate programs and typically does not address other types of students, this evidence that a 'one size fits all' approach to improving educational outcomes is important, and is perhaps the reason that a solution to 'fix' related problems has not yet been identified in the literature. In addition, research internal to this institution has found that retention patterns differ even among baccalaureate programs, where cohort-based programs such as education, nursing and social work demonstrate lower attrition rates than do larger programs in the fields of arts, business and science (Friesen, 2009).

Generally speaking, post-secondary research has ignored a large component of higher education, namely non-baccalaureate programs. The majority of research relating to educational outcomes has focused on residential institutions with traditional students (i.e.: full-time students aged 18 to 22 years) (Bean & Eaton, 2002; Braxton, 2000). The few studies conducted in non-
traditional educational settings such as two-year commuter colleges have found differences in students' achievement patterns, but these results, not surprisingly, have been inconsistent (Napoli & Wortman, 1998).

Finally, none of the neighbourhood-related variables emerged as factors that could be used to predict Certificate students' outcomes. A variety of reasons may account for why this construct did not relate to this category's participation measures; however, it is likely due to the varying mix of programs that are considered as Certificates: they can be either classified as either academic or non-academic, and therefore significant differences were not observed.

Persistence

The final research question explored the persistence rates of students by neighbourhood and program. It was measured by constructing a variable (1,0) to indicate whether a student was retained from the Fall to Spring semester. This variable permitted the analysis of persistence rates by a number of variables including gender, program category and grade point average.

Students who persisted in Degree, Diploma and Certificate programs demonstrated significantly higher grade point averages than do students who
did not. Students persisting in Trades programs also demonstrated higher GPAs but they were non significant.

As might be expected, students who persisted in Upgrading programs averaged lower grades than did their peers in other programs. This is a logical finding considering that Upgrading programs serve as a starting point for many students, and once successfully completed, students typically move into higher-level programs.

The next analyses examined differences in persistence rates at varying GPA categories to explore whether grades differed at lower or higher categories. Significant differences were observed between the lowest GPA category (0.00 to 0.49) and every other category. In other words, Degree students in this GPA category persisted at much lower levels than all other students, but this is the only category that exhibited differences in persistence rates among GPA categories. No significant differences were exhibited among GPA categories for other programs.

The multiple regression analyses did not result in large proportions of variance explained, but did identify significant models for Degrees, Diplomas and Certificates. Eleven percent of the variance in Degree persistence is accounted for in a model that includes Student GPA, Grade 12 DA mean, and
Proportion of Aboriginal students. It is interesting that two neighbourhood variables were included in this model, lending further support to the notion of neighbourhood effects on educational attainment. However, the neighbourhood variables were not retained in the Diploma and Certificate models, which only identified Student GPA as a significant predictor. Adjusted R² scores for these models were 14 and 10 percent, respectively.

**Contributions to the Literature**

On average, approximately 40 percent of Canadian first year post-secondary students do not continue their studies (Deitsche, 1989; Stoll & Scarff, 1983). For the most part, educational outcomes research has sought to explain why the attrition problem exists to the extent that it does (Bean, 1983; Cabrera, Nora, & Castaneda, 1993; Tinto, 1993). However, few, if any, have been able to identify a general remedy for this issue, particularly in regards to open admission institutions. Though relationships between student characteristics such as academic ability and socioeconomic status are widely accepted, open admission institutions typically do not require these data and therefore are challenged to even begin to examine SES-related patterns.

The current study contributes to the educational literature by demonstrating that certain neighbourhood characteristics (particularly the
presence of high-status residents) can be influential predictors of educational outcomes. It does so by examining whether an area-based socioeconomic measurement methodology is appropriate for an open admission institution, and explores educational outcomes by a number of variables identified in the literature to be predictive of educational success. By applying neighbourhood effects theory to educational concepts, models that explain proportions of variance were developed. By no means a final solution, this study serves as a first investigation of the application of this practical and accessible methodology.

A second contribution of this study is the application of the Dissemination Area (DA) as a unit of measure. Quite often, census tracts are used in neighbourhood research. However, Sheppard (1990) contends that the scale of neighbourhood described by Wilson (1987) is smaller than a census tract, warning that the functional neighbourhoods perceived by residents could be more localized, thus mismatched with census tracts. He argues that coarsely aggregated census tracts over-generalize socioeconomic patterns, yet studies of Canadian cities prior to the release of the DA in 2001 have employed census tracts to conduct neighbourhood analyses. Other literature supports this notion, suggesting that using census tracts as a unit of measure has contributed to the sometimes inconsistent findings because of their inability to identify pockets of poverty or affluence not apparent at the tract level (Krieger, 1992). In short, the
greater heterogeneity among residents of census tracts as compared with smaller groups has long been of concern to researchers. Ioannides (2000) concurs, arguing that CTs are too large for studying residential neighbourhood interactions, though they are quite appropriate for other types of interactions. Accordingly, this study is based on the institution’s 124 local Dissemination Areas rather than 23 census tracts.

Another benefit unique to this study is its reliance upon an objective data source for SES information. Some limitations of educational outcomes studies surround the feasibility and reliability of self-reported socioeconomic data. These data are typically challenging and expensive to obtain at the individual level. One of the primary vehicles for collecting SES data is survey research, which carries with it a host of potential pitfalls. Beyond the issues surrounding proper instrument design, proper sampling and dissemination of questionnaires can be resource-intensive. Even when robust procedures and funding permit appropriate survey design, socioeconomic data is difficult to collect due to response rate, bias and self-reporting issues (Demissie, Hanley Menzies, Joseph & Ernst, 2000, Kuh, 2004). Further, since survey research is typically conducted over the telephone or Internet, both options potentially exclude populations that do not have telephones or computers and risk biasing the results. In addition, the literature around the accuracy of respondents, particularly in regards to
personal questions, is rife with examples of skewed data. For example, in phone interviews, interviewees may subconsciously want to please the interviewer and respond more positively than they might on paper; similarly, students may prefer to report that they left school due to work reasons rather than for more personal reasons such as unsuccessful performance (Brogger, Bakke, Eide & Gulsvik, 2002; Grunig, 1997). These issues are to some extent controlled in this study by assessing outcomes using an aggregated neighbourhood measurement drawn from the Canadian Census.

The benefits of census-based methodologies are increasingly being acknowledged (Krieger, Williams & Moss, 1997). Because census data are readily available to researchers and can be easily appended to any data sets that contain residential addresses, the area-based socioeconomic measurement (ABSM) methodology provides relatively inexpensive and valid indicators of neighbourhood-based socioeconomic status (Krieger, 1992). ABSMs can be applied to all persons residing in an area, are easily available, and with improvements to classifications such as the Dissemination Area, are very precise (Geronimus, 2006; Puderer, 2001).

Generally speaking, the census-based methodology used by this study provides a valid and useful approach to overcoming the absence of
socioeconomic data in educational research. However, the use of area-based socioeconomic measures is not without problems. The results discussed here must be treated with caution because of the challenges inherent in interpreting and analyzing neighbourhood data discussed in the next section.

Limitations of the Study

Several limitations of this study should be noted. As with most studies of neighbourhood effects, and in particular those that attempt to understand why some students succeed and others do not, this study has focused on the role of background characteristics. Simple causal relationships are unlikely, and by focusing attention on a narrow range of variables, this study has restricted the investigation of other factors associated with educational outcomes. Therefore, caution must be exercised in interpreting the results of this approach, and differentiations between causation and correlation must be appropriately considered.

First, it bears repeating that the results from this study do not attempt to infer individual-level SES; rather, they indicate which variables acting at an aggregate level are important determinants of educational outcomes. The measures of neighbourhood income relied on census data linked at the postal code level. Although these units are only rough proxies for neighbourhood
boundaries, they do allow for the examination of characteristics such as the extent of neighbourhood affluence and poverty, single parent-headship, and rates of unemployment (Furstenberg & Hughes, 1997). However, these data cannot be considered a reliable proxy for individual-level characteristics.

A second concern surrounding neighbourhood-level analysis is that of ecological fallacy. Ecological fallacy occurs when individual-level inferences are made from aggregate-level variables. This problem can occur when both independent and dependent variables are measured at the aggregate level and results are used to characterize individuals; in essence, the grouped data and the associated underlying factors overstate the results (Geronimus, 2006; Ioannides, 2000). This study, in contrast, used individual-level data for all dependent variables, and examined the outcomes of these variables by neighbourhood.

A third concern pertains to selection bias, a potential confound. Selection bias in this study might refer to the ways in which individuals self-select into neighbourhoods, as it is likely that certain individual characteristics may influence a person's choice of residence. If certain traits are related to a person's choice of residence and also to educational outcomes, then the relationships identified in this study may be spurious. Sampson, Morenoff and Gannon-Rowley (2002) suggest that serious obstacles are presented in regards drawing
definitive conclusions on the causal role of neighbourhood social context.

However, it is important to remember that the possibility of bias does not demonstrate the presence of bias, and that a conflict between ecologic and individual-level estimates does not by itself demonstrate that the ecologic estimates are the most biased (Brooks-Gunn & Leventhal, 2000). Further work on this subject is recommended.

Another limitation of this study exists in that it does not disentangle family effects from neighbourhood effects. The literature has demonstrated that both these factors have important influences on youth and adolescents' educational outcomes (Brody, Ge, Conger, Gibbons, Murry, Gerrard, et al., 2001; Brooks-Gunn, Duncan, Klebanov & Sealand, 1993; Buka, Brennan, Rich-Edwards, Raudenbush & Earls, 2003; Elliott, Wilson, Huizinga, Sampson, Elliot & Rankin, 1996) but this study design does not permit analyses of each. The literature provides examples of methodologies that undertook multilevel modelling to extricate these and other effects (Garner & Raudenbush, 1991; O'Campo, 2003) and were able to partition variances at the individual and neighbourhood level. The study borrows findings from these studies claiming that reasonable effects can be identified at the neighbourhood level (Ainsworth, 2002). Describing the role of specific neighbourhood dimensions is complex because many of these characteristics may be inter- and intrarelated (Diez Roux, 2001) and thus are very
difficult to separate. For example, physical neighbourhood characteristics such as poor lighting, graffiti, rundown buildings and unsafe parks may influence the types of social interactions that occur in the neighbourhood, which in turn limits cohesion, safety, and quality of social networks.

Further, the current study’s operationalization of variables does not correspond perfectly with the theoretical constructs. For example, this study did not attempt to measure any of the variables thought to mediate the relationship between neighbourhoods and educational outcomes, such as motivation, self-efficacy, norms, neighbourhood cohesion, etc. Though these mediating variables do not account for all neighbourhood effects, future research should involve measures of mediating processes.

In addition, this study only included data only for those high school students that graduated from Grade 12, another potential confound. It is possible that differences between low and high-SES outcomes may have been understated by the exclusion of non-graduates in the datasets.

A further limitation of this study was that it was conducted at only one post-secondary institution. However, the institution and city has many comparable peers; paired with its large sample size and outcomes that were
generally consistent with other findings, it is posited that this limitation is minor. Replication in other institutions and contexts will test this assertion.

A final limitation applies to the contextual analysis. Only a limited number of neighbourhood characteristics were considered in the current study, and future research should remedy this. However, the purpose of the study was to evaluate the associations between educational outcomes and neighbourhood factors, rather than to identify the pathways through which these factors exert their effects. Nonetheless, some researchers may contend that if individual-level models are not fully specified, seemingly significant relationships may be spurious (Krieger, 1992), only identifying variance that could be better accounted for by individual-level data. This may well be the case, but the goal of this study was to identify whether neighbourhood characteristics could identify relationships in the absence of individual-level data. However, a validation of the representativeness of ABSMs is in order and is discussed in the next section.

A number of limitations to this study have been highlighted. It is important to consider, however, that the limitations faced by this and many other neighbourhood research studies should not be seen as reasons for avoiding such studies (Ainsworth, 2002). Instead, these issues should guide researchers
towards new avenues of discovery to develop an improved understanding of how neighbourhoods affect those who live within them.

Recommendations for Future Studies

The results of this study contribute to a growing body of research demonstrating relationships and patterns for educational outcomes and neighbourhood characteristics. While the findings demonstrate associations between these constructs, future studies will need to extend these findings to examine the actual processes by which these patterns occur.

This study did not resolve the issue as to why or how neighbourhoods may mediate or affect educational achievement. Educational outcomes were assessed using variables that described the neighbourhoods in which the subjects lived. However, these measures do not provide a comprehensive assessment of the pathways in which neighbourhood effects might work. Future research should augment these findings with individual-level variables that have been identified as working through neighbourhood effects, such as collective socialization, neighbourhood resources, cohesion and safety.

A first step might comprise a validation of the alignment between neighbourhood- and individual-level SES in Canada. Using data collected in national surveys such as Statistics Canada's Survey of Labour and Income
Dynamics or the General Social Survey would provide evidence as to the degree of corroboration between neighbourhood and individual-level characteristics. The importance of validating this approach to measuring socioeconomic position is underscored by the numerous studies that have used area-based SES measures in the absence of individual-level data.

Another related validation exercise might examine selection bias, which is a concern for virtually all neighbourhood research. To assess the extent to which potential bias might exist, future studies might consider a methodology that compares (a) students who have improved their neighbourhood conditions by moving, to (b) those who did not move, or to those who moved to more disadvantaged neighbourhoods. Such comparisons would allow researchers the ability to control selection bias to some extent. Some authors, however, caution against the desire to control for selection bias because it is perceived to be an individual trait. Sampson, Morenoff & Gannon-Rowley (2002) suggest that though individuals select neighbourhoods, they may be influenced through a complex interplay of friendship ties, economic status and other social characteristics which as yet are not clearly understood.

In addition, methodological issues such as the selection of individuals into communities, indirect pathways of neighbourhood effects and measurement
error represent serious obstacles to studying causal relationships linked to
neighbourhood effects (Sampson et al., 2002). It is evident that educational
outcomes are influenced by a multitude of interactions among variables. Since
causal mechanisms hypothesized to account for the relationships among
variables are rarely observed directly, it is not surprising that research has been
unable to identify a model that fully accounts for the variance in educational
participation, performance and persistence.

Implications

Both theoretical and practical implications result from this study. In the
main, there exists a general vacuum of institutional understanding of influencers
of educational pathways. The results of this study suggest that further
examination of the relationships between neighbourhood effects theory and
educational outcomes in both the secondary and post-secondary context should
be pursued. Because much educational outcomes research shows that
educational outcomes vary depending on the subpopulation being studied, the
methodology employed in this study provides a practical means of identifying
subpopulations for analyses. Further, this study represents for institutions a
possible first step towards early identification of high-risk student populations.
These results may also support implications for social policy. These findings, as well as those of other studies, imply that improving the socioeconomic conditions of poor communities may enhance educational outcomes. Based on the literature that demonstrates three main pathways through which neighbourhoods influence adolescents (institutional resources, relationships and norms/collective efficacy) (Jencks & Mayer, 1990; Sampson, 1992), the results of this study suggest that the development of a framework for further research is warranted in the open admission context.

These findings also suggest implications for policies focused on promoting educational attainment, particularly for those living in the lowest socioeconomic neighbourhoods. These results should encourage educators and policymakers to undertake further research into these areas with the goal of designing and implementing appropriate assessments and interventions to reduce inequality in educational outcomes across income spectrums. Since the literature on educational outcomes has generally concluded that background characteristics are some of the most reliable predictors of success (Astin, 1975; Gope and Hannah, 1975; Pantages and Creedon, 1978), reducing the equity gap is key.
The challenge, however, is to put these findings into operation. Though this is a daunting task, it would appear that some simple truths exist. For example, we know that:

(a) People from disadvantaged groups are most likely to view post-secondary education as 'not for them'. Is this partly due to a lack of information, or perhaps information not available in appropriate ways or sources of use to this group?

(b) Since much involuntary attrition is due to lack of clear direction, more can be done to provide learners with more advice and guidance about academic and career advising, particularly for underrepresented groups.

(c) Financial costs can be misunderstood: better education about the costs and benefits of higher education should be attempted. There is evidence that persons of less-advantaged backgrounds may not be well informed about the real costs of education, and may believe that education is more expensive than it is. In addition, they are more likely to be unfamiliar with financial aid options to avail themselves of. McGoldrick reminds us that:
"Genuine equality of opportunity should recognize that people with the same innate ability start from different places and that some have to travel up a steeper and longer hill to achieve. For some, participation will mean going to university, for some college, for others it will be training. Almost all should benefit from at least one of these at some point in their lives" (2005, p. 34).

Educational leaders should prioritize activities that identify and address the problems faced by the most deprived areas as they relate to student participation, performance and persistence. Though it is ultimately incumbent upon students to take responsibility for their education, by developing the capacity to both identify and meet the support needs of students, institutions can make the process more easily navigated.

In addition, the role of the family should not be forgotten. Though neighbourhood factors proved influential, family-level factors are also important and efforts to influence individual families should not be neglected (Andres, 2003, 2004; Brody, Ge, Conger, Gibbons, Murry, Gerrard, et al., 2001; Fiedler, Schuurman & Hyndman, 2006; Furstenberg & Hughes, 1997). To the extent that neighbourhood influences are mediated through family-level variables, strategies oriented towards families as well as neighbourhood structure may of benefit.
Summary

This study has explored a number of factors related to educational attainment. By examining outcomes by neighbourhood characteristics, it identified a number of important relationships. Significant differences were found between neighbourhoods in regards to high school course options, final grades, and participation and persistence in post-secondary. Multiple regression analyses were used to explore which of the neighbourhood characteristics may most strongly related to educational outcomes. Consistent with the literature, students living in neighbourhoods with higher proportions of affluent households, residential stability, household income and professionals generally enrolled in more academic courses in high school, attained higher grades, participated in post-secondary, and persisted longer than their peers in lower-class neighbourhoods. This study therefore represents the first steps towards a more robust level of persistence analysis for open admission institutions. Though these schools lack individual-level socioeconomic data, this study suggests that census-based measures may provide reasonable proxies for SES and can be leveraged to inform policies around student success and persistence.

Even though influencing factors are inextricably linked to student characteristics, institutional policies and practices can and do affect educational
outcomes (Bean & Eaton, 2002). While there is no definitive set of factors that predict individual student success or persistence, researchers generally agree that although some students leave for reasons beyond the control of the institution, much attrition is preventable (Pritchard & Wilson, 2003).

In a society that recognizes both the value of post-secondary education and the existence of inequities in regards to the pursuit of this goal, it is therefore incumbent upon higher education administrators to better understand the factors relevant to educational outcomes at their institutions. As has been reviewed, student attrition is to a large extent impacted by factors external to institutions; however, there remain some influences that are within institutions’ control. In the spirit of due diligence, post-secondary leaders should – or must – prioritize the identification of these factors within their unique contexts so that evidence-based strategies can be developed to mitigate the high rates of student departure that exist in open admission institutions.
REFERENCE LIST


Sampson, R. J. (2003). The neighborhood context of well-being. Perspectives in Biology and Medicine, 46(3), S53-S64.


### Table A-1.

*Grade 11 Scores by Neighbourhood Income Status (n=8,569)*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower 50%</td>
<td>2,771</td>
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<td>15.105</td>
<td>.287</td>
<td>65.79</td>
<td>66.91</td>
</tr>
<tr>
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<td>70.03</td>
<td>14.888</td>
<td>.196</td>
<td>69.64</td>
<td>70.41</td>
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<tr>
<td>Total</td>
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<td>15.058</td>
<td>.163</td>
<td>68.52</td>
<td>69.16</td>
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</table>

### Table A-2.

*Grade 11 Scores One-way ANOVA by Median Income*

<table>
<thead>
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<th>df 2</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>123.25</td>
<td>.000</td>
</tr>
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<td>Communications 11</td>
<td>1</td>
<td>477</td>
<td>3.69</td>
<td>.055</td>
</tr>
<tr>
<td>Math 11</td>
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<td>3253</td>
<td>8.07</td>
<td>.005</td>
</tr>
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<td>Applications of Math 11</td>
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<td>0.25</td>
<td>.615</td>
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<td>.000</td>
</tr>
<tr>
<td>Communications 12</td>
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<td>.357</td>
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<td>English Lit 12</td>
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<td>.000</td>
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### Table A-3.

*Grade 11 Outcomes Post Hoc Test (n=8,569)*

<table>
<thead>
<tr>
<th>(I) Quartile</th>
<th>J (Quartiles)</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>P</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>-2.409*</td>
<td>.574</td>
<td>.000</td>
<td>-3.89</td>
<td>-3.93</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>-4.333*</td>
<td>.516</td>
<td>.000</td>
<td>-5.66</td>
<td>-3.01</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-5.848*</td>
<td>.520</td>
<td>.000</td>
<td>-7.18</td>
<td>-4.51</td>
</tr>
<tr>
<td>Q2</td>
<td>Q1</td>
<td>2.409*</td>
<td>.574</td>
<td>.000</td>
<td>.93</td>
<td>3.89</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>-1.924*</td>
<td>.463</td>
<td>.000</td>
<td>-3.11</td>
<td>-.74</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-3.438*</td>
<td>.467</td>
<td>.000</td>
<td>-4.64</td>
<td>-2.24</td>
</tr>
<tr>
<td>Q3</td>
<td>Q1</td>
<td>4.333*</td>
<td>.516</td>
<td>.000</td>
<td>3.01</td>
<td>5.66</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>1.924*</td>
<td>.463</td>
<td>.000</td>
<td>.74</td>
<td>3.11</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>-1.514*</td>
<td>.392</td>
<td>.000</td>
<td>-2.52</td>
<td>-.51</td>
</tr>
<tr>
<td>Q4</td>
<td>Q1</td>
<td>5.848*</td>
<td>.520</td>
<td>.000</td>
<td>4.51</td>
<td>7.18</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>3.438*</td>
<td>.467</td>
<td>.000</td>
<td>2.24</td>
<td>4.64</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>1.514*</td>
<td>.392</td>
<td>.000</td>
<td>.51</td>
<td>2.52</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

### Table A-4.

*Math 11 Scores by Neighbourhood Income Status (n=3,255)*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>Lower 50%</td>
<td>909</td>
<td>66.45</td>
<td>16.146</td>
<td>.536</td>
<td>64.50</td>
</tr>
<tr>
<td>Upper 50%</td>
<td>2346</td>
<td>68.19</td>
<td>15.558</td>
<td>.321</td>
<td>67.56</td>
</tr>
<tr>
<td>Total</td>
<td>3255</td>
<td>67.70</td>
<td>15.741</td>
<td>.276</td>
<td>67.16</td>
</tr>
</tbody>
</table>
Table A-5.

*Math 11 Scores by Quartile (n=3,255)*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>340</td>
<td>66.21</td>
<td>16.240</td>
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<td>67.94</td>
</tr>
<tr>
<td>Q2</td>
<td>589</td>
<td>66.59</td>
<td>16.103</td>
<td>.675</td>
<td>65.26</td>
<td>67.91</td>
</tr>
<tr>
<td>Q3</td>
<td>1152</td>
<td>68.02</td>
<td>15.568</td>
<td>.459</td>
<td>67.12</td>
<td>68.92</td>
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<tr>
<td>Q4</td>
<td>1194</td>
<td>68.38</td>
<td>15.552</td>
<td>.450</td>
<td>67.47</td>
<td>69.24</td>
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<tr>
<td>Total</td>
<td>3255</td>
<td>67.70</td>
<td>15.741</td>
<td>.276</td>
<td>67.16</td>
<td>68.25</td>
</tr>
</tbody>
</table>

Table A-6.

*English 11 Scores by Median (n=4405)*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower 50%</td>
<td>1450</td>
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<td>14.152</td>
<td>.372</td>
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<td>68.37</td>
</tr>
<tr>
<td>Upper 50%</td>
<td>2955</td>
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<td>.257</td>
<td>72.13</td>
<td>73.14</td>
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<tr>
<td>Total</td>
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<td>70.99</td>
<td>14.220</td>
<td>.214</td>
<td>70.57</td>
<td>71.41</td>
</tr>
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</table>
Table A-7.

**English 11 Scores by Quartile (n=4405)**

<table>
<thead>
<tr>
<th>Quartile</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
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<td>65.50</td>
<td>14.436</td>
<td>.586</td>
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<td>66.65</td>
</tr>
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<td>13.748</td>
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<tr>
<td>Q3</td>
<td>1522</td>
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<td>14.369</td>
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<td>70.85</td>
<td>72.29</td>
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<tr>
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<td><strong>Total</strong></td>
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<td>70.99</td>
<td>14.220</td>
<td>.214</td>
<td>70.57</td>
<td>71.41</td>
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</tbody>
</table>

Table A-8.

**Applications of Math 11 Scores by Median (n=430)**

<table>
<thead>
<tr>
<th>Median Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower 50%</td>
<td>197</td>
<td>64.19</td>
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<td>62.18</td>
<td>66.21</td>
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<tr>
<td>Upper 50%</td>
<td>233</td>
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<td>14.099</td>
<td>0.924</td>
<td>63.06</td>
<td>66.70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>430</td>
<td>64.57</td>
<td>14.194</td>
<td>0.685</td>
<td>63.22</td>
<td>65.91</td>
</tr>
</tbody>
</table>
Table A-9.

*Applications of Math 11 Scores by Quartile (n=430)*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>116</td>
<td>63.15</td>
<td>14.385</td>
<td>1.336</td>
<td>60.50</td>
<td>65.79</td>
</tr>
<tr>
<td>Q2</td>
<td>81</td>
<td>65.69</td>
<td>14.211</td>
<td>1.579</td>
<td>62.55</td>
<td>68.83</td>
</tr>
<tr>
<td>Q3</td>
<td>138</td>
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<td>14.250</td>
<td>1.213</td>
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<td>67.20</td>
</tr>
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<td>14.194</td>
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<td>65.91</td>
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</table>

Table A-10.

*English & Communications 12 Final Grades (N=5,221)*

<table>
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<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
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<td>Q1</td>
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<td>71.44</td>
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<td>72.54</td>
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Table A-11.

*Tukey Post Hoc - English & Communications 12 Final Grades (N=5221)*

<table>
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<tr>
<th>(I) Quartile</th>
<th>J (Quartiles)</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>p</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
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<tbody>
<tr>
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<td>.341</td>
<td>-3.51</td>
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<td>.746</td>
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<tr>
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<td>Q4</td>
<td>-6.479*</td>
<td>.722</td>
<td>.000</td>
<td>-8.33</td>
<td>-4.62</td>
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<td>Q1</td>
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<td>.341</td>
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<td>.722</td>
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Table A-12.

*Communications 11 Scores by Median (n=479)*

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<th>N</th>
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<th>Std. Deviation</th>
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<th>Upper Bound</th>
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Table A-13.

*Communications 11 Scores by Quartile (n=4,779)*

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<th>Std. Deviation</th>
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Table A-14.

*Grade 11 Course Proportions – Observed Versus Expected Results*

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