SOCIAL CAPITAL AND DISPARITIES IN CANADIAN YOUTH'S MATHEMATICS ACHIEVEMENT

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This article examines the influence of youth's family and school contexts to understand disparities in Canadian youth's mathematics achievement. Using hierarchical linear analysis, some of the main assumptions of social capital theory are tested using the Canadian data from the1999 Programme for International Student Assessment. Findings revealed that many family-school contextualized effects were not significant, suggesting that researchers need to look at the conceptualization and operationalization of social capital. Relationships between family structure and some measures of school social and human capital in schools were, however, found to be significant. Results suggest that the similarity hypothesis needs to be further analyzed and perhaps integrated into social capital theory.

Key words: family, school, PISA, booster effect, double jeopardy effect, mitigating effect

Dans cet article, l'auteure analyse les influences des contextes familiaux et scolaires dans lesquels les jeunes évoluent en vue de comprendre comment ces contextes créent des disparités dans les résultats qu'ils obtiennent en mathématiques. Utilisant des données canadiennes tirées du Programme international pour le suivi des acquis des élèves (PISA) de 1999, l'auteure a testé ses hypothèses à l'aide d'une analyse linéaire hiérarchique. Ses résultats révèlent qu'un grand nombre des effets contextualisés familiaux et scolaires n'étaient pas statistiquement significatifs, ce qui donne à penser que les chercheurs doivent se pencher sur la conceptualisation et l'opérationalisation du capital social. Certaines relations entre la structure familiale et diverses mesures du capital social et humain dans les écoles se sont toutefois avérées significatives. Les résultats semblent indiquer que l'hypothèse de similarité a besoin d'être analysée davantage et peut-être intégrée dans la théorie du capital social.

Mots clés : famille, école, PISA, effet stimulant, effet double obstacle, effet atténuant

Over the past several decades, much research has examined how family and school environments interact to influence youths (e.g., Coleman et al, 1966; Parcel & Dufur, 2001), although only in recent decades have researchers gained the ability to model such complex relations (Willms & Raudenbush, 1989). The combination of advances in statistical analyses that permit hierarchical linear modeling and the development of longitudinal data sets to collect contextual information from both families and schools, in addition to youth's academic achievement, provides rich resources from which researchers can better understand the interrelated effects of families and schools to explain disparities in youth's academic achievement.

Within the family, the extant literature documents the role that context has in understanding disparities in youth's academic performance and general well-being: cultural (e.g., De Graff, DeGraff, & Kraaykamp, 2000; Dumais, 2002; Kalmijin & Kraaykamp, 1996; Lareau, 1987); financial (e.g., Bali & Alvarez, 2003; Caldas & Bankston, 1998); human (e.g., Joshi, 1995; O'Brien, Kopala, & Martinezpons, 1999; Parcel, Nicholl, & Dufur, 1996; Willms, 2002a, 2002b); material/physical (Guzman, Hampden-Thompson, & Lippman, 2003; Reynolds & Walberg, 1992; Wilkins & Ma, 2002; Willms & Somers, 2001); and social capital (Coleman, 1987, 1988; Guzman et al., 2003; Parcel et al., 1996). A smaller, yet still abundant literature has examined how these forms of capital in the school context shape youth's achievement (e.g., Desimone, 1999; Frempong & Willms, 2002; Morgan & Sorensen, 1999; Teachman, Paasch, & Carver, 1997). Much of this research has supported the notion that increased capital (in either families or schools) positively influences youth's achievement levels. Although invaluable, much of this research has had a one-dimensional focus, examining the effect that the family or school has on youth's academic achievement. Such a limited scope inevitably restricts educators' understanding of youth's well-being because the group dynamics that they experience are not simultaneously examined. Although some research has co-examined family and school contexts, these studies are limited because they typically do not embed youth within both their family and school. By this, I mean that they rely on one level of analysis, typically the individual level of analysis (student) and therefore use statistical analyses that do not account for the

embedded nature of youth's family and school. Both conceptually and analytically such studies cannot test how youth with specific family experiences are fairing in specific school settings (Parcel & Dufur, 2001).

Youth have varied experiences in school, entering with a unique set of life experiences, thereby shaping the essence of the school body. As such, school bodies are formed and constantly re-formed based on individuals within schools (i.e., students, teachers, staff). Youth-study researchers have become increasingly cognisant of the multi-layered, complex world in which youth are embedded, and a handful of scholars more recently have focused their attention on how the interrelation between families and schools influences youth's achievement (see Bali & Alvarez, 2003; Bankston & Caldas, 1998; Caldas & Bankston, 1999, 2001; Frempong & Willms, 2002; Willms & Somers, 2001). Contextualizing youth's lives is a fundamental step towards understanding why academic disparities exist among youth. This endeavour is not easy because several factors typically limit researchers, perhaps the most important of which is the use of secondary data sets that may not validly capture capital, thus leading to measurement misspecification. In addition, the literature, and the research presented herein, share a common limitation in that they do not capture the dynamic interplay of the numerous groups to which youth belong. The research that I present in this article solely focuses on family and school; yet youth belong to peer, community, work, leisure, and other groups that might impede or enhance their academic achievement. Although I do not consider other groups that youth belong to due to data limitations, the contributions of this article are three fold. First, the purpose of this article is to test one of the fundamental premises of social capital theory (SCT): the influence of the family-school interconnection on youth's mathematics achievement. Second, within the academic achievement literature, SCT has been developed from USA-based studies that used American data sets to test the importance of social capital on youth's academic achievement. Comparatively, few scholars have used the theory outside the US context to explain educational achievement disparities.[1] As a result, this article not only adds to the general Canadian educational literature, but also confronts this literature of usage and testing with primarily US data by examining SCT, with Canadian data a key limitation of the theory.

THEORY

In this study, I tested one of the foundational notions of social capital theory (SCT): that the groups that youth belong to are interconnected and that this interconnectedness – depending on the situation – may have either positive or negative implications for them (Bassani, 2007; Coleman, 1987). Although Coleman (1987, 1988) first acknowledged this interconnection, his terminology and explanation were very broad, and his arguments were empirically limited (Fine, 2001; Baron, Field, & Schuller, 2000). Parcel and Dufur (2001) developed Coleman's arguments, applying concrete terms to the effects of family-school intersection by addressing three interaction effects: the booster effect, the double jeopardy effect, and the mitigating effect. As Bassani (2007) has discussed, SCT within the youth-study literature has developed beyond Coleman's early works (i.e., 1987, 1988). As such, the SCT that is used in this article draws on a number of social capital scholars, although it is rooted in a Colemanian approach and I draw on Parcel and Dufur's terminology. Other educational researchers, particularly Caldas and Bankston (1997, 1998, 1999, 2001), who have examined family-school interconnectedness, do not follow Coleman or Parcel and Dufur per se.

Traditionally, social theory has viewed and consequentially measured the influence of various groups (i.e., the family and school) on youth's achievement independent of one another. A key strength of SCT is that it takes a more contextually embedded approach to understanding youth's academic achievement disparities.

To briefly summarize, the theory within the youth-study literature has at least five major dimensions (Bassani, 2007). First, many forms of capital exist (i.e., cultural, financial, human, physical/material, and social capital); however, social capital is arguably the most valuable because it works to mobilize all other resources. Social capital has been defined in a great number of ways although, simply put, social capital is the investment that people make in social relations (ACT for Youth Centre of Excellence, 2003).

The second major dimension of SCT is that a positive relationship between social capital and youth's academic achievement tends to exist. Third, the theory maintains that social resources are transformed into capital. This leads to the fourth dimension, the fact that social capital is

created via a complex process whereby it is created by social resource efficiencies, and its development is hampered by social resource deficiencies. Two general components of social resources exist: structural social resources (who is in the groups), and functional social resources (what the group members do together and how they interact with one another). Both structural and functional social resource deficiencies hamper social capital's development although its formation is intricately complex and cannot be reduced to either component.

The last dimension of SCT is the focus of this article: the interrelationship of social capital between two or more groups to which youth belong. Theory emphasizes that youth belong to a variety of groups and that they can access some degree of capital from each of these groups. Each youth belongs to a primary group and a multitude of secondary groups. Typically the family forms a youth's primary group, while the school and other groups are secondary groups. Most often, the school is viewed as youth's most important secondary group. All these groups overlap with – or are bridged to – one another. Bridging occurs when a member of one group belongs to a member of a second group. The more family members, teachers, volunteers, siblings, and so forth that bridge two groups, then, ideally, the resources available in each group will be enhanced because stronger bridging occurs. Importantly, increased bridging enhances the potential capital available to all youth in the group, not only that of the youth whose parent(s), for example, bridges the school and family.

The influence that bridging has on youth is a direct product of the unique set of social resources that youth bring into a secondary group from their primary group (and/or secondary groups), the combined structural and functional social resource efficiencies/deficiencies that all youth in a secondary group bring with them into the group, and the unique interplay between an individual student's family social capital and that found in the school. As discussed earlier in this article, most of the social capital research conducted in youth studies has focused on the first and or second points above. In this article I focus on the third point to specifically test the influence of bridging.

When bridging occurs, one of three effects may result: booster effect, a double jeopardy effect, or a mitigating effect. The booster effect occurs

when high levels of social capital both in family and school interact to create a rich network of social capital, thereby boosting a youth's mathematics score. The double jeopardy effect, in contrast, occurs when low levels of social capital in both family and school interact to create an atmosphere that is poor in social capital, thus such youth are negatively affected. Last, the mitigating effect occurs when high levels of social capital in one group positively counteract the negative effect that is associated with low levels of social capital in another group. More specifically, the negative effect associated with low levels of social capital in a family may be mitigated when a youth attends a school that has rich social capital. In all three instances, students are triply influenced not only by their family and school contexts, but also the unique interplay of social capital that they experience between their family and school.

All three effects define the family group as youth's primary group and the school as their main secondary group, and as a result, the school is seen as influencing youth based on their family context. In reality, however, not only is this relation recursive because there is back-and-forth interaction between family and school (and other groups that youth belong to), but also the importance of the school group and other secondary groups (e.g., volunteer groups, the work place, peer groups) is not stagnant. As youth age, other secondary groups may compete with the school group and the primary family group.

DATA AND METHOD

Data

The data used to test SCT come from the 1999 Programme for International Student Assessment (PISA) survey. The PISA uses a repeated, cross-sectional, international research design. The Canadian data were extracted and examined for this article. These data have three main components: the literacy tests, which measure students' mathematics, science, and reading abilities; the student survey, which collects information on students' family backgrounds and their school experiences; and the principal school survey, which collects information about schools. This article draws on all three components, although mathematics literacy is solely examined.

The PISA data were collected based on a two-stage, random, stratified sample of all 15-year-old students, the age group across all provinces that is typically the oldest age of students attending public, compulsory schools. The stratified sampling frame ensured that students from each province and language group, as well as from a variety of school and community sizes, and both public and private schools, were included in the sample.[2] The school response rate was 93.3 per cent, and the student response rate was 84.9 per cent (Organisation for Economic Co-operation and Development [OECD], 1999). PISA-formed student weights were used to adjust for the possible over- and under-sampling of certain groups caused by the stratified sampling frame.

Analysis

Hierarchical linear modeling (HLM) was used to test the fifth dimension of SCT: the existence of the booster, double jeopardy, and mitigating effects. HLM, a useful technique, was developed to analyze nested data, such as students within schools (Raudenbush & Bryk, 2002). With nested data, this technique is preferred over ordinary least squares (OLS) regression because it can consider estimated error within and between student bodies. Because HLM can be easily used to test the embedded nature of students within student bodies, it is a good technique for testing the booster, double jeopardy, and mitigating effects.

Three regression coefficients are reported: first, the beta coefficients, which are individual, student-level effects that indicate the strength of the relation between family-level variables and individual mathematics scores when school-level variables are controlled, and second, the gamma coefficients, which are school-level effects that show the influence of school variables on school mathematics scores, while controlling the effect of family-level variables. A third group of coefficients, the central feature of this article, is also reported: the cross-level interactions (also referred to as interaction effects). The unit of analysis is the individual; however, the cross-level interactions situate the student (individual) slope within the school slope. Through these coefficients, researchers can estimate how family (e.g., students living in single-parent families) and school context (e.g., classroom disruption)

work to influence youth's mathematics scores. T-scores and their respective p-values illustrate the coefficients' statistical significance.

Three model-fit statistics are presented: the change in the model deviance and the explained variance within and between schools. These statistics are similar to regular, regression-explained, variance statistics, although they do not report an $R.^2$ With HLM, researchers can examine the reduction in the deviance (which is similar to the unexplained variance in OLS regression) of the tested model from the null model. As the deviance in consecutive models decreases, more of the variation in youth's mathematics scores is explained.

The second model-fit statistic, the variance explained within schools indicates the degree of variation in mathematics scores that existed among students in the same school. The third model-fit statistic is the between-school variation, which tells researchers how much of the difference in youths' mathematics scores is attributable to differences between schools, based on the school variables that were included in the model. These variance statistics do not test the family-school interaction effects, although I include them to provide background information about the analysis and sample.

Some Guidelines for Interpreting the Results

Understanding the coefficients that are produced in HLM regressions is not difficult; however, these coefficients are not synonymous with those produced in OLS regression. Readers need to be aware that, first, centring is typically used in HLM to help interpret the coefficients. In this article, all family variables are centred on the school's mean. Because students are clustered in schools, this centring technique is commonly used when assessing youth's academic achievement (Raudenbush & Bryk, 2002). For example, the coefficient for family social interaction represents the mathematics score change that occurs when a youth's social interaction is one point above the mean family social interaction among youth in his or her school. The school variables are alternately centred on the national school average. This means, for example, that the classroom disruption coefficient represents the mean mathematics score increase that a school would experience if its disruption level fell one point below the average (school) disruption level in the nation.

Researchers use these two centring techniques because they provide meaningful coefficients and because individual youths and their relation to the school social context can be statistically considered.

Also, to aid the interpretation of these complex, multilayered relationships, I have plotted the statistically significant interaction effects because it is easier to understand these relations graphically. These plotted regression lines show the effect of a particular interaction after controlling for all other variables in the model.

Dependent Variable

The dependent variable used to test the booster, double jeopardy, and mitigating effects is a scaled "youth mathematics score." The PISA-constructed mathematics scale is argued to be a highly valid and reliable measure of mathematics knowledge (Bonnet, 2002; OECD, 2001). The alpha for this PISA constructed scale was 0.90 (OECD, 2001). Item response theory was used to construct the math-score scale.[3] Test scores ranged from approximately 200 to 800 points, indicating low to high mathematics proficiency. The mean mathematics score was approximately 522 points, with a standard deviation of approximately 88 points. Achieving a high-proficiency mathematics score suggested that a student could complete complex tasks that involve multi-step processing, while interpreting various problems and developing creative and active solutions. Students who scored at the lowest level of proficiency could complete only single-step processes that are associated with reproducing well-known mathematical facts and skills. OECD researchers have found that a 41-point mathematics score difference is associated with being ahead or behind a full school year (OECD, 2004).

Independent Variables

Table 1 presents the univariate descriptive statistics for all independent variables used in the analyses.

SCT maintains that social capital is a central aspect of youth's academic achievement although it also recognizes the integral role that human capital plays in shaping youth's well-being. As a result, measures of both social and human capital are included in the analyses.

Table 1
Univariate Descriptive Statistics of Independent Variables (PISA, 1999)

Student Sample Size	2364	
School Sample Size	156	
Continuous Variables	**Mean**	**SD**
Family Social Capital		
Number of Siblings	1.9	1.27
Family Social Interaction Scale	18.4	4.02
Family Human Capital		
ISEI	44.2	17.5
School Social Capital		
Proportion of Students from Single-Parent Families	0.15	0.11
Classroom Disruption Scale	8.9	0.99
Teacher Encouragement Scale	15.2	1.51
School Human Capital		
Mean ISEI	43.2	8.0
Categorical Variables	**Percent**	
Family Social Capital		
Family Structure Two Parent Biological Family	74.1 %	
Single-Parent Biological Family	14.0 %	
Other Family Structure	11.9 %	
TOTAL	100.0%	
School Social Capital		
School Attendance		
Public	94.5%	
Private	5.5%	
Background Variables		
Gender		
Female	49.1%	
Male	50.9%	
Community Size		

Village & Small Town	56.2%
Town	12.4%
City	26.1%
Suburb/ Urban	5.2

Family. Within the family, three measures of social capital and one measure of human capital were assessed.

Social capital. The number of siblings, a social interaction scale, and family structure were used to measure family social capital. The number of siblings that a youth had living in the family household was a PISA-computed variable that added the number of older and younger siblings that a student reported as living in his or her household.

According to the dilution hypothesis (in SCT), as the number of children in a family increases, the social capital available to each youth necessarily declines due to a decline in parent-youth social interaction. Within the literature, findings regarding the effect of siblings on youth's academic achievement have been inconclusive, however, showing that siblings tend to have a negative (Dunifon & Kowaleski-Jones, 2002; Han, Waldfogel, & Brooks-Gunn, 2001) or non-significant effect (Cook & Willms, 2002; Parcel et al., 1996) on youth's achievement levels.

The second measure of family social capital was a social interaction scale. General family social interaction, a measure of functional social resources in the family, has a positive influence on youth's academic achievement (e.g., Dunifon & Kowaleski-Jones, 2002). I created a general family interaction scale by combining five variables: discussing politics, books, or school issues with parents; eating together; and just talking with parents. Students chose the frequency of their interactions with parents on a five-point scale and had the option of choosing: never or hardly ever, a few times a year, about once a month, several times a month, and several times a week. This scale ranged from 5, representing the lowest level of family interaction, to 25, the highest level of family interaction. On average, students scored 18.4 points on this scale. Reliability and validity tests were performed. A Cronbach's alpha of 0.69 was found, which tests the scale's reliability and suggests how well the variables fit together (Zeller & Carmines, 1980). An exploratory factor

analysis was used to examine the scale's validity, or the latent fit of the five items. One factor with an Eigen value of 2.3 was found, suggesting a good fit. Factor loadings for this scale can be found in Appendix 1.

The last measure of family social capital was family structure. Three dummy-coded family structures were examined: single-parent family (students living in a household with only one parent; biological or otherwise); two-parent, biological family; and "other" family (a mixed family, one biological parent and one other non-biological parent or two non-biological parents, or any other family structure, such as extended, that was not previously classified). The two-parent, biological family structure was used as the reference category because the largest percentage of students (74.1%) fell into this category. Fourteen per cent of students lived in single-parent biological family, while 11.9 per cent resided in other family structures.

The influence of family structure on youth's academic achievement has been widely examined. Research illustrates that youth living in two-parent families outperform youth in single-parent families, even after controlling for income and parental education (e.g., Cook & Willms, 2002; Dunifon & Kowaleski-Jones, 2002; Jeynes, 2002). SCT purports that youth living with two biological parents tend to have more social capital than youth living in other family structures because they have more structural resource efficiencies, which may increase the likelihood of having more functional resource efficiencies.

Human capital. One measure of family human capital was assessed in the model: a student's family International Socio-Economic Index of Occupational Status (ISEI). This is a PISA-constructed scale that Ganzeboom, De Graaf, and Treiman (1992) originally conceptualized as a proxy for socio-economic status. The PISA used the following open-ended questions to develop the ISEI indicator: "What is your mother's main job?" and "What is your father's main job?" The ISEI variable was constructed by first separately ranking both the mother's and father's jobs according to the International Standard Classification and then taking the father's occupational ranking. When the father's occupational code was missing, the mother's occupational ranking was used to create the family's ISEI. When both the father's and mother's occupations were missing, the respondent's ISEI was labelled missing. The lower the ISEI

number, the lower the corresponding job's status. For example, 20 represents an occupation such as a heavy machinery operator, and 80 represents an occupation comparable to a judge.

Researchers have found that human capital measures have large, positive, statistically significant effects on youth's mathematics scores (Joshi, 1995; Parcel et al., 1996; Willms, 2002a, 2002b). SCT recognizes that human capital is essential to youth's well-being and has an intimate role in shaping academic achievement. As a result, family human capital was included as a control variable in the analysis.

School. Four measures of social capital and one measure of human capital in the school were included in the analysis.

Social capital. School social capital was measured with the proportion of students in the school living in single-parent families, a classroom disruption scale, a teacher encouragement scale, and public school attendance. The proportion of youth in a school residing in single-parent families was computed by aggregating the "single-parent" variable that was described in the previous section. As illustrated in Table 1, on average, 15 per cent of the students in classrooms resided in single-parent families.

Although other studies have not included this variable as a measure of social capital, some scholars have used it when examining the influence of the school context on youth's academic achievement (Bankston & Caldas, 1998; Caldas & Bankston, 1999). Such studies have emphasized the importance of considering family structure within classrooms or schools to understand disparities in youth's academic achievement, showing that collectively, the proportion of students in a school living in single-parent families has a sizable, negative effect on youth's academic achievement.

The second measure of social capital in the school was classroom disruption. Classroom disruption has been found to negatively influence students' mathematics scores (e.g., Ma & Klinger, 2000). This disruption is indicative of functional social resource deficiencies, and thus as these deficiencies increase in the school, this score will create a decrease in social capital – which has the effect of reducing youth's mathematics scores. I created a classroom disruption scale by combining four survey questions that asked students about their classroom atmosphere.

Students were asked how often the following happened in their classes: "students cannot work well," "students do not listen to what the teacher says," "students do not start working for a long time after the lesson begins," and "there is noise and disorder in the class." Students could choose one of four responses: never, some lessons, most lessons, or every lesson. This disruption scale ranged from 4 (never disruption) to 16 (always disruption) points and had a mean of 8.9 points. These four indicators of classroom disruption had a Cronbach's Alpha of 0.80 and formed one factor with an Eigen value of 2.5. This rating suggests that the scale is both a reliable and valid measure of classroom disruption. Factor loadings for this scale are located in Appendix 1.

Teacher encouragement also was considered in the analyses. I created a scale of five indicators to suggest how teachers encourage learning in the classroom. These indicators include the following statements: "the teacher shows an interest in every student's learning," "the teacher gives opportunity to express opinions," "the teacher continues teaching until students understand," "the teacher does a lot to help students," and "the teacher helps with learning." Students were given the following four choices for their responses: never, some lessons, most lessons, every lesson. This scale ranged from 5 (low teacher encouragement) to 20 points (high teacher encouragement). The scale had high reliability and validity, with a Cronbach's Alpha of 0.88 and an Eigen Value of 4.0, which represented only one factor. Factor loadings for this scale are located in Appendix 1.

General teacher-student relations have been measured in a variety of ways and have been found to have a positive influence on youth's academic achievement (Willms & Sommers, 2001). Encouragement is an integral measure of functional social resources that should enhance the development of social capital in school. This variable thus is expected to have a positive effect on youth's mathematics scores.

Lastly, school type was measured. The principal survey asked whether the school was a public school (a school managed directly or indirectly by a public education authority, government agency, or governing board appointed by government or elected by public franchise) or a private school (a school managed directly or indirectly by a non-government organization [e.g. church, trade union, business, or

other private institution]) (OECD, 1999) . Private school attendance was used as the reference category (0), to which public school attendance (1) was compared. Comparisons between youth's academic achievement in public and private schools suggest that youth in private schools outperform their peers in public schools (Goddard, 2003; Parcel & Dufur, 2001; Perie, Sherman, Phillips, Riggan, & Snyder, 1999; Teachman et al., 1997). These achievement differences might occur because of more bridging between family and school (parents-school and students-school) in private schools.

Human capital. Human capital in schools was measured by examining the mean ISEI of students in each school. Each individual student's ISEI was aggregated to create this school-level variable.

Research has found that the average socio-economic status of a classroom or school has a positive statistically significant relation with youth's academic achievement (Bali & Alvarez, 2002; Caldas & Bankston, 1997, 1998, 1999; Frempong & Willms, 2002).

BACKGROUND VARIABLES

Gender and community size were included in the analysis as background variables because previous research generally has found both of these variables to have a consistent effect on youth's mathematics achievement: females tend to perform lower than males on standardized mathematics tests (Campbell & Beaudry, 1998; Levine, Pollack, & Comfort, 2001), while researchers have argued that geographic disparities in education create higher academic achievement within more urban areas (e.g., Brooks-Gunn, Duncan, Klebanov, & Sealand, 1993, Caldas & Bankston, 1999; Willms, 2002b). Females (1) were compared to males (0), who were used as the reference category. Community size was measured via four dummy-coded variables: small town, town, city, urban/suburban area – the reference category. In the school survey, principals were given six options to respond to this question, "Which of the following best describes the community in which your school is located?": a village (fewer than 3,000 people), a small town (3,000 to 15,000 people), a town (15,000 to 100,000 people), a city (100,000 to 1 million people), an area close to the centre of a city (urban area with over 1 million people), or an area elsewhere in a city, such as a suburb

(suburban area with over 1 million people). Because of the small number of schools located in villages, this category was merged with the small town category. Similarly, because the sample size of suburban and urban schools was so small, these two categories were merged. This study considers the geographic location in which students attend school to control for differences that exist within schools across Canada. Province/territory was not controlled for in this study, but community size was. Although univariate PISA mathematics score differences exist between the education systems in Canada (Brussiere et al., 2001), general education research has found that resources within schools tend to be more aligned with community size, and as such community size and not province/territory was used as a control in this research.[4]

Limitations

This study has four main limitations. First, my focus is on social capital. Although I include human capital in the analysis, I did not consider other forms of capital (such as cultural, financial and physical/material capital). Although the literature suggests that other forms of capital influence youth's mathematics scores, I could not include these measures due to data issues. Because HLM uses maximum likelihood estimates, and not OLS estimates to compute the regression equations, the number of variables that can be included in the regression model is limited, and consequently, I focused on social and human capital.

Second, as previously mentioned, youth belong to numerous groups, but I was able to model only the family and school due to data limitations. Although this article makes a valuable contribution to the existing literature by taking a more contextualized approach to understand the interaction between family and school social and human capital using Canadian data, its contextualization is nevertheless limited.

The third key limitation involves the use of a secondary data set, which resulted in a limited fit between conceptualization and operationalization. As discussed in the theory section, social capital in any given group is comprised of both structural and functional social resources. Although the PISA data have many strengths, it was not developed to measure social capital. As a result, many structural and functional social resources within the family and school could not be

examined, thereby limiting the results. Generally, such measurement error is unavoidable when measuring non-tangible concepts, such as social capital.

As its fourth limitation, this study uses a cross-sectional data set, which focuses only on 15-year-old youth; thus it is not generalizable to all "youth." Although all studies have restrictions, I point out these specific limitations not only to caution the reader, but also to stress the need for future research to confront these issues using a variety of data sets. The results that are reported in this article are exploratory in nature because youth-studies scholars have yet to empirically test the fifth dimension of SCT. I say this to both warn readers about generalizing these findings, but also, of equal of importance, to encourage other scholars to further explore and question the dimensions of SCT, which tend to be held as concrete notions.

RESULTS

Model Variance Statistics

Model variance statistics are reported in Table 2, which shows a statistically significant decline in the deviance between the null and test models. This finding suggests that the test model made a significant contribution toward understanding mathematics achievement in this sample.

Table 2 shows that the explained variance within schools was much lower than the explained variance between schools: 10.1 per cent of the variance around mathematics scores could be explained by within-school differences in the student population, while 3.0 per cent of the variance of youth's mathematics scores could be explained with across-school differences, which could be attributed to varying student bodies because of regional variations.

The Booster Effect, the Double Jeopardy Effect, and the Mitigating Effect

The statistically significant interaction effects are illustrated in the middle of Table 2, while the main family and school effects are reported at the top of the table.

Table 2

Hierarchical Linear Modeling Results of Human and Social Capital in the Family and School on Youth's Mathematics Scores (PISA 1999)

	beta	t
Constant	530.91***	156.74
Family Main Effects		
Social Capital		
Number of siblings	-2.23	-0.76
Single-parent family (1)	-27.52**	-3.13
Other family (1)	-8.78	-1.12
Family interaction	2.03**	2.56
Human Capital		
ISEI	0.40**	2.77
Flag ISEI	-83.27***	-4.35
Background		
Girl	-20.16***	-4.20
School Main Effects	gamma	t
Social Capital		
Public school (2)	-26.33*	-2.17
Proportion single	-0.72**	-2.59
Disruption	-7.27*	-2.07
Encouragement	-4.58	-1.53
Human Capital		
Mean ISEI	2.38***	4.24
Background		
Village/small town (3)	3.44	1.81
Town (3)	37.47	1.87
City (3)	22.12	1.26
Embedded Effects of Students within School		
Single-parent X Proportion single	1.40*	2.21
Other family X Public school	-89.69***	-4.39
Other family X Encouragement	-13.55**	-2.52
Other family X Mean School ISEI	-2.60**	-2.58
Student observations	1939	
School observations	143	

Measures of Association	
Deviance: Null Model	25438.29
Deviance: Test Model	22468.08
Variance Explained within Schools (%)	10.1%
Variance Explained between Schools (%)	40.2%

(1) reference category for family structure is biological two parent family
(2) reference category is private school
(3) reference category for all community size variables is urban area
Note. analysis is weighted at the student level
* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$

Of the family-school interaction effects that were tested, family structure was found to interact with a number of measures of social and human capital in the school. Living in a single-parent family significantly interacted with the proportion of students in a school who lived in single-parent families; and living in an other family type interacted with public school attendance, in addition to teacher encouragement. Lastly, living in this family structure significantly interacted with the school's mean family ISEI.

The first interaction effect reported in Table 2 is between youth living in single-parent families and the proportion of students in a school living in single-parent families. A sizable, positive effect was found among these youth. As the proportion of the student body residing in single-parent families increased by .01, students who themselves resided in single-parent families increased their mathematics scores by an average 1.4 points. This score increase may seem to be a small effect; however, for students attending schools where most of their peers lived in single-parent families, say 60 per cent of the student body, this would be equated with a 35.5-point advantage.[5] This interaction may be better understood by looking at Figure 1.

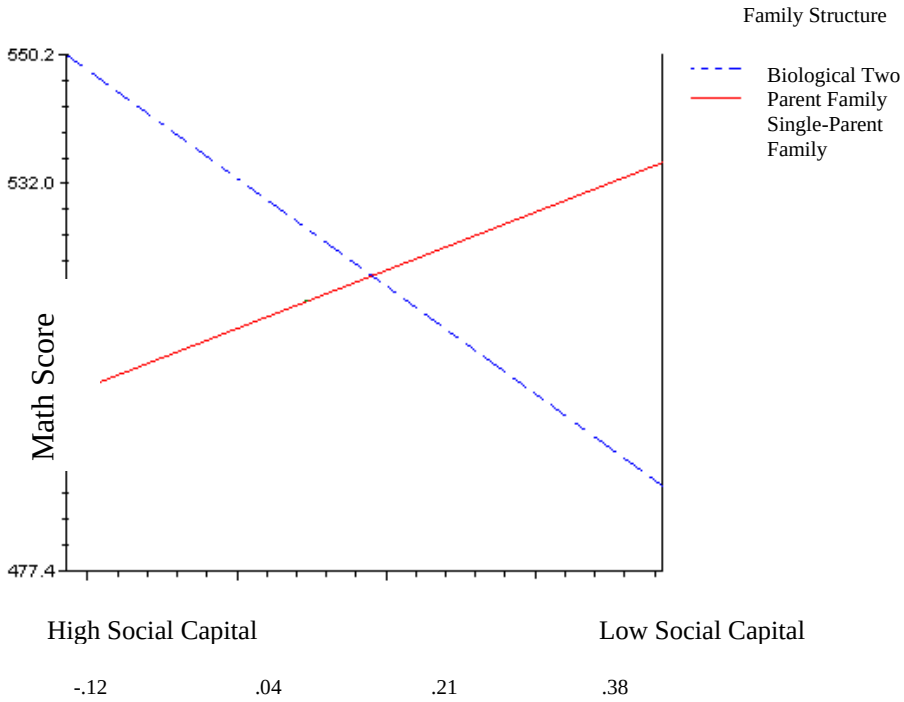

Figure 1. The Effect of Living in a Single-Parent Family by the Proportion of Youth in Single-Parent Families in the School on Students' Math Scores.

Figure 1 shows that, on average, youth living in biological, two-parent family structures performed the highest in classes where social capital was highest. This finding illustrates a booster effect because youth with high family and school social capital tended to achieve the highest mathematics scores.

The double jeopardy effect could not be supported, however. This finding contradicts the argument that students who lack social capital at home will be positively influenced when they attend schools that are rich

in social capital. Rather, this interaction effect suggests that students may achieve higher mathematics scores when they share their classmates' social characteristics because youth living in single-parent families tended to achieve higher mathematics scores as the proportion of youth in the class living in single-parent families increased and youth in two-parent families tended to achieve higher mathematics scores as the number of students in single-parent families decreased. Figure 1 clearly illustrates this interaction effect. In fact, when the proportion of students residing in single-parent families was over .35, youth living in single-parent families tended to outperform their classmates who lived in biological two-parent families. This relation might be explained by a "similarity" hypothesis: Students who are most similar to others at their school will perform higher than those who do not share similar characteristics or experiences with their peers. Caldas and Bankston (1999) generated a comparable finding with a US data set, reporting a small, positive interaction effect between living in a one-parent family and the percentage of one-parent families in a school. Although this relationship is important to note, I must highlight that it works to counteract both the negative effects that are associated with living in a single-parent family and the proportion of students in a school residing in a single-parent home. This similarity hypothesis has been supported in other studies examining a school's ethnic composition and its effect on students of various ethnicities (Bali & Alvarez, 2003). Although the present study does not assess ethnic background, the similarity hypothesis appears to be evident in the results. Future research needs to focus solely on exploring the similarity hypothesis. The mitigating effect was also not supported because youth with low social capital in their families scored above youth with higher levels of family social capital when they were in schools with low levels of social capital. Following the similarity hypothesis, it may be that youth, although they have high social capital in their families, may be particularly negatively affected when attending schools where they are dissimilar or set apart from the rest of the students.

The other three significant interaction effects illustrate the negative effects that youth in other families experienced. To begin, youth who lived in other family structures and attended a public school experienced

a large, negative interaction effect. These youth scored 89.7 points lower on their mathematics tests compared to youth living in the biological, two-parent family reference group when attending public schools. This finding supports the notion of the booster, double jeopardy, and mitigating effects. Not only do these youth experience a negative interaction effect, but they also experience a heightened decrease in their mathematics scores because they live in "other" parent families (-8.78) and attend public schools (-26.33).

Youth living in other family structures also were particularly disadvantaged when teachers were too encouraging. Compared to the reference group, youth in biological, two-parent families, youth living in other parent family structures were quite negatively affected when they were in schools that had heightened teacher encouragement. As the teacher-encouragement level increased by 1 point in their schools, these youth experienced a 13.6-point decrease in their mathematics scores. This relation, which is plotted in Figure 2, does not support the booster, the double jeopardy, or the mitigating effect.

The last interaction effect was between youth who lived in other family structures and a school's mean ISEI (International Socio-Economic Index of Occupational Status). When such students attended a school that had a mean student body ISEI of one point above the national mean, they scored, on average, 2.58 points lower than their schoolmates who lived in biological, two-parent families. For these students, this negative interaction effect counteracted the positive effect that is otherwise associated with being in a school that has a higher-than-average ISEI. As a result, a great disparity occurred between students in "other" family structures and those in biological, two-parent family structures. Figure 3 clearly depicts this advantage. This finding suggests that for students living in "other" parent families, the school ISEI has little affect on mathematics scores, while for students living in biological, two-parent families, there is a large, positive effect associated with an increase in the school's mean ISEI. This finding illustrates that there is a booster effect; however, double jeopardy and mitigating effects were not found.

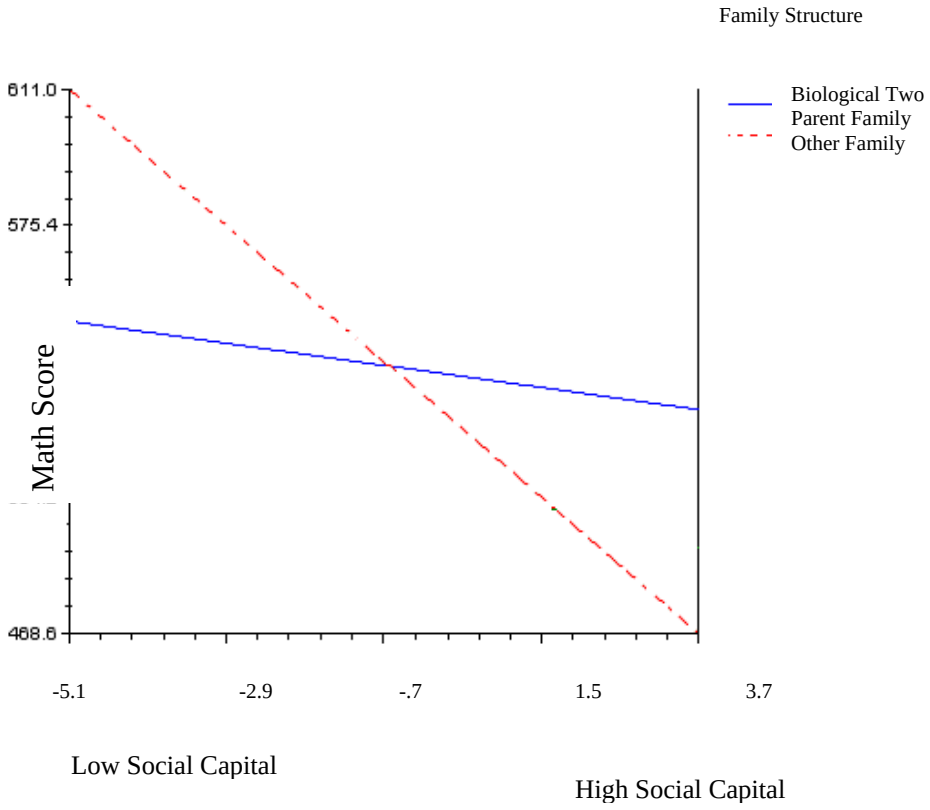

Figure 2. The Effect of Living in an "Other" Family Type by Teacher Encouragement on Students' Math Scores.

Many of the tested interaction effects were not statistically significant, illustrating that the focus that SCT places on these family-school interactions may be overzealous.

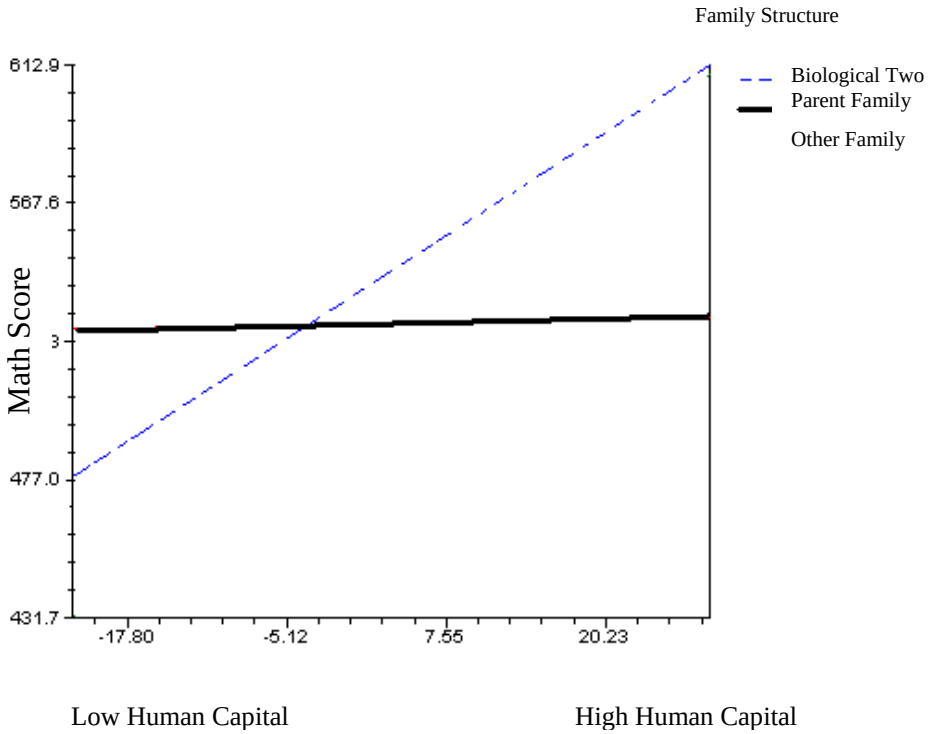

Figure 3. The Effect of Living in an "Other" Family Type by School ISEI on Students' Mathematics Scores.

DISCUSSION AND CONCLUSION

The occurrence of the booster, double jeopardy, and mitigating effects were tested and found to be largely statistically insignificant. Although the findings cannot lend exclusive support to social capital theory (SCT), statistically significant interaction effects were found between family structure and various measures of social and human capital in schools.

This article has highlighted a number of interesting findings. In some instances, youth who had heightened social capital in both their families and schools experienced higher mathematics scores, lending support to the booster effect. This relationship was especially the case among youth who resided in biological, two-parent families who attended schools that had 3 to 25 per cent of the student body living in single-parent families. What was intriguing, however, was that as social capital in a school decreased, students from biological, two-parent families (who traditionally have been conceptualized as having high social capital) experienced a dramatic decline in their mathematics scores, while students in single-parent families experienced a dramatic increase in their mathematics scores.

These findings may be related to the fact that what is considered average within a group necessarily changes as the group members change physically or socially. As such, as the proportion of youth in a school living in single-parent families increases, this social milieu becomes the norm within the school. Caldas and Bankston (1999) noted a similar effect in their examination of general academic achievement scores. Other research that has focused on youth who share ethnic similarities with their classmates has also supported this argument. For example, Bali and Alvarez (2003) found that Hispanic youth's reading scores increased as the percentage of minority teachers in the school increased, while inversely, non-Hispanic and African American youths performed lower as the percentage of Caucasian teachers in the school decreased. Similarly, Johnson, Crosnoe, and Elder (2001) found that when students share a common ethnicity with others in their school, they tend to be more engaged in learning, a finding that is linked to higher academic achievement. All these findings suggest that a group's social milieu, or what is considered typical within the group, has an important influence on academic achievement levels. If this is true, then our understanding of social capital needs to be seen as contingent on who comprises the group, and not as a concrete concept, as it is currently viewed.

The results presented in this article lend some support to the double jeopardy effect, although the amount of support depends on how social capital is measured: Youth who lived in another parent family tended to

be much more disadvantaged when attending public schools than students who attended the same public school, but lived in biological two-parent families. Interestingly, youth living in single-parent families were not negatively influenced by these low levels of school social capital, despite the fact that researchers traditionally have theorized them to have the lowest levels of family social capital (out of the three general family structure forms). More research needs to examine this relationship, analyzing a greater variety of social capital measures and a wider range of family structures.

Based on these findings, the notion that the negative effects of low human capital (low ISEI) in the family are mitigated by heightened human or social capital in a school is not supported. Alternatively, however, a heightened mean ISEI in a school boosted the mathematics scores of students who came from two-parent families. Without a doubt, this is a highly complex relation that future studies need to consider.

One last point worth mentioning is the questionable interaction effect between other family structures and teacher encouragement. This relation negated the booster and mitigating effects. It is interesting to note that although youth residing in other family types experienced the most dramatic reduction in their mathematics scores as teacher encouragement increased, youth in the two other family structures also experienced a decline in their mathematics scores. A similar effect of teacher encouragement on youth's mathematics scores has been noted by other researchers when parent-youth study time is examined (Desimone, 1999; Guzman et al., 2003). Previous studies have found that the more parents study with their youth, the lower their general academic achievement and mathematics scores tend to be, suggesting that these youth were already doing poorly in school before they started studying with their parents. Similarly, increased academic teacher encouragement may have occurred when students needed extra attention because they were falling behind in their class work. In such classes, students may have lacked the mathematical knowledge base that was required, and thus increased reinforcement of learning materials was needed. Previous research did not support this negative finding because teacher-student interaction has tended to be associated with increased academic test scores (Cohen, Raudenbush & Lowenberg, 2003). This disparity is likely

attributed to a difference in measurement because past studies have tended to focus on students' attitudes towards their teachers (Crosnoe, Johnson, & Elder, 2004; Reynolds & Walberg, 1992; Wilkins & Ma, 2002; Willms & Somers, 2001), or teachers' attitudes towards their students (Willms & Somers, 2001). Compared to measures of parent-child relations, measures of teacher-student relations are at a preliminary stage. Future research should focus on this area to better gauge the social capital held between teachers and their students. Such studies should control for previous academic performance when possible because this measure was not included in the present study because of data limitations.

This study has found social capital to be a chameleon-like resource that changes depending on a group's social milieu. This finding in itself is invaluable because social capital currently is viewed as a concrete concept that does not alter across time and place. If what is considered to be social capital changes as a group changes, then researchers need to examine changes in social capital over time, but also perhaps more fundamentally, the history, culture, and dynamics of a group needs to be considered prior to operationalizing social capital. At this time, many researchers do not conceptualize and reflexively examine social capital within each group, but instead draw on preconceived notions of social capital in family or school. Perhaps by honing researchers conceptualization and thus the measurement of social capital, they can capture a fuller understanding of youth's social worlds, and in doing so, equip themselves with a richer understanding of why academic achievement disparities exist among youth.

Lastly, I emphasize that this study used a Canadian sample to test one aspect of social capital theory (SCT). More research needs to test the theory in the Canadian context with different data sets. Because the foundations and testing of SCT have largely rested on American data, future research needs to examine SCT through the lens of other cultures and/or nations.

NOTES

[1] Although many researchers may use the concept of social capital in their analyses, this practice is not synonymous with using the theory of social capital. See Bassani (2007) for further discussion.

[2] See OECD (1999, pp. 5-25) for a thorough account of the stratified sampling frame.

[3] See Frank (2001) for an in depth discussion on Item Response Theory

[4] In analyses of the data for this article that have not been published, provincial mathematics score differences became statistically insignificant after family and school capital, in addition to community size, were accounted for.

[5] The effect of 39.7 was calculated in the following way: (60% - 15%) X 1.40] + (-27.52) = 35.5; Where 15 per cent was the across group mean, 1.4 is the coefficient associated with the proportion of youths in the school living in a single-parent family, and -27.52 was the main effect associated with living in a single-parent family.

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Appendix 1: Communalities and Component Matrix
for all Social Capital Scales

Communalities for Family Social Interaction Scale	
Discuss Politics	0.442
Discuss Books	0.550
Discuss School Problems	0.505
Eat Meals Together	0.232
Talk Together	0.539

Communalities for Classroom Disruption Scale	
Students cannot work well in their classroom	0.535
Students do not listen to what the teachers says	0.695
Students do not start working for a long time after the lesson begins	0.642
Noise and disorder in the class	0.620

Communalities for Teacher-Student Educational Interaction Scale	
Teacher shows an interest in every student's learning	0.652
Teacher gives opportunity to express opinions	0.546
Teacher continues teaching until students understand	0.689
Teacher does a lot to help students	0.765
Teacher helps with learning	0.752