Revisiting the Concept of School Connectedness: Is School Connectedness an Attribute of Schools, and Does Its Protectiveness Against Risky Health Behaviours Vary Between Schools?

By

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For my parents, Alanna Murphy and Don MacLellan.

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ABSTRACT

Objective: School connectedness has been found to be protective against negative health behaviours for adolescents. This study assesses 1) the extent that school connectedness is an attribute of the school, and 2) whether the protective associations of school connectedness with risky sexual and drinking behaviours are heterogeneous across schools.

Methods: In manuscript one, school connectedness was modelled as a random intercept. In manuscript two, school connectedness was modelled as a random coefficient, and risk behaviour was modelled as a random intercept. The percent of variation explained by school was estimated before and after adjustment for student background variables.

Results: Little variation in school connectedness or its protectiveness against sexual risk could be attributed to school differences. However, this study demonstrates that dependant on the school, school connectedness may be protective or a risk factor for binge drinking.

Conclusion: Future research should move away from a unitary concept of school connectedness.

LIST OF ABBREVIATIONS USED

ASDUS   Atlantic Student Drug Use Survey
CDC   Centres for Disease Control and Prevention
CI   Confidence interval
EBLUPS   Empirical Best Linear Unbiased Predictors
HRM   Halifax Regional Municipality
ICC   Intraclass correlation
LRT   Likelihood ratio test
SD   Standard deviation
SES   Socioeconomic status
NB   New Brunswick
NL   Newfoundland
NS   Nova Scotia

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CHAPTER 1: INTRODUCTION

The concept of school connectedness refers to a student's perception of how safe, happy, and cared for they are by the adults and other students at their school (1,2). It is argued that if a child is connected to their school, they will avoid acting outside that school's norm for fear of putting their connection at risk. School connectedness has been found to be protective against many negative health and social behaviours, including truancy, substance use, risky sexual behaviour, violence, and unintentional injuries (3).

Given these positive findings, interventions have been implemented in schools to increase the level of school connectedness (e.g. reducing class size or encouraging teamwork activities) among students (1). This research and associated policy responses imply certain assumptions which have not been adequately evaluated. First, there is an underlying assumption that school connectedness is a reflection of the school (4,5). School connectedness is a person-level measure of student perception, and little research has examined the degree to which school connectedness is, in fact, an attribute of the school (versus an attribute of the individual students). Second, there is an underlying assumption that the protective benefits of school connectedness will hold similarly across schools (1,2). While school connectedness may, on average, promote positive behaviours, it is plausible that student norms in some school environments may encourage riskier behaviours (6,7). Thus, the protective effects of school connectedness against negative health and social behaviours may differ across schools.

This study examined data from junior and senior high-school students in Atlantic Canada to assess: 1) the extent to which school connectedness is an attribute of the school and its environment versus the characteristics of the students within the school; and 2) whether the protective associations of school connectedness with high-risk sexual and drinking behaviours are heterogeneous across schools.

This document has six chapters. This thesis is a manuscript style thesis and follows the following format: introduction, background, manuscript one, manuscript two, and discussion/conclusion. This introduction is chapter one. Chapter two gives the

background information outlining the literature on school connectedness and the relationship between school, peers, and risk behaviours. Chapter three and four are the two manuscripts. Manuscript one addresses whether school connectedness is an attribute of the school, and manuscript two addresses whether the protectiveness of school connectedness is heterogeneous across schools. The final discussion and conclusion chapter summarizes the study's findings and the potential implications.

CHAPTER 2: BACKGROUND

2.1 What is School Connectedness and How Is It Measured?

The concept of school connectedness was formally discussed at the Wingspread Conference in Racine, Wisconsin in 2003 (1), where researchers and individuals representing areas of education and health defined school connectedness as the students' perceptions that adults at their school care about them as individuals, as well as caring about and supporting their academic success. This definition was adjusted to include the influence of peers on students' feelings of connectedness to the school. School connectedness includes the positive feelings a student has towards their school (2) and is measured by instruments that assess students' perception of connectedness to their school and the people at their school. While the Wingspread Declaration may include one of the most widely accepted definitions of school connectedness (1,8), there are numerous ways a student's bond to their school has been named and defined (9,10). Table 1 provides just some examples of the measures used to capture students' school attachment, school bond, and school connectedness. As is evident from the various examples, a student's bond to their school has been measured in a variety of ways. Sometimes definitions and questions include school qualities or teacher qualities, sometimes they focus more generally on the positive feelings students have for their school, and at other times they focus on students' bonds with the people at their school (not specifying teachers).

2.2 How Have These Individual Scores Been Used and What Has Been Found?

Large scale surveys such as the Atlantic Student Drug Use Survey (ASDUS) and The National Longitudinal Study of Adolescent Health have gathered individual level data on adolescent students' self-reported ratings of school connectedness as well as a variety of individual characteristics and behaviours (3,11). There has been an abundance of literature that uses these individual school connectedness scores to determine how they relate to students' characteristics and behaviours (1,3,12-14).

Evidence from these studies suggests that school connectedness is protective against adolescent behaviours that increase health risks (e.g. risky sexual behaviours and binge drinking (12-14). In 1995, The National Longitudinal Study of Adolescent Health

surveyed 36,000 students in grades 7 to 12 (3). They found that school connectedness had the strongest protective association with male and female students' truancy, substance use and sexual intercourse at a young age, violence, and unintentional injuries (3). After family connectedness, school connectedness was the second most protective factor when examining associations with emotional distress, eating disorders, and suicidal thoughts and attempts (3). While it is difficult to infer causality from cross sectional studies, previous literature using both cross sectional data (12,13) and longitudinal studies (15,16) have also allowed for estimations of how protective school connectedness might be against risky health behaviours such as sexual risk behaviours and binge drinking. Therefore, using this evidence as a spring-board, policy makers, researchers, and educators have attempted to increase school connectedness using a variety of interventions in schools (1).

2.3 Policy Implications and Approaches

In response to research on the protective effects of school connectedness, many attempts have been made to improve school connectedness with interventions that target teachers, parents, students, and peers. For example, interventions have included reducing class size, implementing tutoring programs, or encouraging teamwork activities (1). Not only are schools generally ideal locations for intervention because children and adolescents spend most of their days in this environment, but research has also demonstrated that school connectedness interventions can improve students' behaviours (1).

There are several different facets of a student's school experience that have been identified as areas where school connectedness can be increased (1): adult support, commitment to education, school environment, and belonging to a positive peer group. For a student to feel that they have adult support at their school, the teachers and staff must dedicate time, attention, and emotional support to the students, and must demonstrate caring not only about their academic work, but also about as them as individuals. Both students and teachers need to be committed to students' academic success, and the school environment must be safe, healthy, and have a good school community with opportunities for students. Finally, to have high levels of school

connectedness, research has found that students require a positive peer group, which includes a stable group of friends who support prosocial behaviour. This will not always be the case, given that it is possible for adolescents to have a close group of friends with whom they may engage in risky behaviours (17,18). Adolescents are at a period of development when responses to immediate rewards are heightened, but inhibitions are not fully developed (18,19). Therefore, it is plausible that connectedness of adolescents to peers in some school environments may promote risky behaviour.

2.4 Hidden Assumptions in the Literature of School Connectedness

There are two implicit assumptions in the school connectedness literature: 1) that school connectedness is an attribute of the school, and 2) that the protective effect of school connectedness is similar across schools. There is an underlying assumption in research and policy approaches that school connectedness is a reflection of the school, which is why researchers have attempted to identify how the school environment can be improved to increase school connectedness (4,5). However, school connectedness is measured at the individual level and little research has examined the degree to which school connectedness is, in fact an attribute of the school (versus an attribute of the individual students). Additionally, there is an implicit assumption in the literature that school connectedness demonstrates similar protective effects against risk behaviours across all schools. While school connectedness may, on average, promote positive behaviours, it is conceivable that some school environments may have peer norms that encourage riskier behaviours (6,7).

2.4.1 Is School Connectedness an Attribute of Schools?

The name of the measure and the policy focus often imply that school connectedness is a characteristic of schools, but that is not what the measure itself assesses. It is a self-report measure of students' perceptions of how connected they feel to their school. Depending on individual factors and peer groups they may belong to, students in the same school may or may not share the same perceptions of their school and how connected they feel to it. For example, students may come from different backgrounds or be in different grades, which could affect how safe and happy they feel at their school. In addition to

this, different peer groups could affect how individuals interact with and view their schools.

School connectedness is likely to be affected by many factors inside and outside of the school environment. Bronfenbrenner's ecological framework for human development outlines how humans develop in relation to their environment and support systems and can also be used to understand how students behave in relation to their surroundings. This framework includes five systems: microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The microsystem is the closest level to the child and includes settings such as family or school. The microsystem could include parents, peers, or teachers and how they influence the child. The mesosystem connects two or more microsystems. For example, this system may include how a child's home connects with their school life. The exosystem is the social setting that indirectly affects the child by interacting with the child's immediate environment (e.g. a parent's workplace). The macrosystem includes the culture and values that the child is exposed to, and the chronosystem includes the change or consistency in the child's environment over time. In this study, the microsystems of interest are the home and school. School connectedness and risk behaviours may be influenced by aspects of the school environment (teachers, peers, etc.), as well as aspects of the home environment (ex. student characteristics such as family structure, family connectedness, etc.). The mesosystem could include how student characteristics such as parental roles influence a child's relationship with their school and peers. The exosystem could also play a role with external pressures such as parents' workplace dynamics influencing the parents or the child's experience at home. The framework explains the complicated relationship between a child and the context of their development, and how this may impact their development and behaviour (20).

Studies have found that school-based interventions can increase school connectedness and have a positive effect on behaviours, demonstrating what schools do can affect connectedness and its associations with such behaviours (1,15,16,21). However, only some research has addressed the degree to which student connectedness is an attribute of the school itself versus the characteristics of students within schools. For example,

McNeely and colleagues used hierarchical linear models to estimate the association between several school level variables and school connectedness (4). These models partitioned the total variance between individual's assessments of their school connectedness into a between-school and within-school component. While the primary goal of McNeely's paper was to determine what school factors promoted connectedness, they estimated a baseline model which estimated that 12 percent of the variance in school connectedness levels among students was explained by school differences (with the remaining 88 percent variation between students). McNeely claimed that this percent of variance explained by the school demonstrates that differences between schools are partially responsible for different levels of school connectedness across a large sample of students.

They went on to examine school attributes that were associated with the variation in connectedness between schools. McNeely and colleagues controlled for individual and school level characteristics; however, while they reported that 12 percent of the variance in school connectedness is explained by the school, they did not report how much of that percentage is reflective of the different compositions of students in schools with respect to student characteristics related to school connectedness. For example, if most of the students in a school did not have a strong bond with their family, this may affect their school connectedness levels.

Waters and colleagues also addressed the between-school and within-school variance in school connectedness, and like McNeely and colleagues, their focus was to identify ecological factors that promote connectedness, as opposed to assessing the extent to which school connectedness differs between schools (5). They estimated that 27 percent of the variance in student perceptions of school connectedness was explained by between-school differences. After controlling for individual-level variables, Waters and colleagues stated that the "final student-level model accounts for 11% of the variation in school connectedness by between-school differences". It was unclear whether this meant that individual-level variables accounted for 11 of the 27 percent (leaving 16 percent of variation explained by school in the adjusted model), or if adjustment accounted for 11

percent of the 27 percent (leaving 24 percent of variation explained by school). Additionally, many of the individual-level variables included could be outcomes of school connectedness (e.g. participation, academic achievement, more connected to teachers, etc.), leading to over adjustment, thus underestimating the variation explained by school. Additionally, they did not adjust for background characteristics of the students, (e.g. family structure, perceived family wealth, etc.) which are associated with school connectedness (22,23), and likely clustered within schools. Failure to adjust for compositional differences between schools in background variables may result in overestimation of the percent of variation in connectedness explained by school. Thus, previous literature has either neglected to report the degree to which student characteristics account for between-school variance in school connectedness, or they have chosen to control for student characteristics that are closely related to the school environment.

Therefore, the degree to which school connectedness varies between schools, and why, remains unclear. It remains to be determined whether a school's impact on variations in school connectedness is large or negligible when compared to the impact of student characteristics on the variation in school connectedness levels. If school connectedness does not vary between schools, then it may be non-school factors that play a bigger role on students' feeling of belonging at school (e.g. family connectedness or grade). This outcome could influence whether schools consider targeted versus general approaches when implementing school connectedness interventions. For example, if there is considerable heterogeneity in school connectedness levels within schools, then the focus ought to be more on those students who are not as connected to their school.

2.4.2 How School Connectedness Works

In addition to the assumption that school connectedness levels will be notably different between schools, the school connectedness literature also makes the implicit assumption that the protective effects of school connectedness will be similar between schools (1,2). School connectedness is widely valued because of its protective relationship with adolescent risk factors. For example, higher ratings of school connectedness are

associated with fewer behaviours that put adolescents' health at risk (e.g. binge drinking, sexual risk factors, smoking, etc.; 1). According to Social Development Theory, school connectedness is protective because, if a child feels bonded to their school and the people in it, then they will avoid acting outside established norms in order to maintain that bond (15). Feeling strongly connected to one's school will protect against behaviours that deviate from the accepted norms. Aspects of this connection include positive attachment and commitment to the group. According to this theory, when this bond is formed, the individual will coordinate their behaviours to match the standards of behaviour within the group, and the individual will avoid behaviours that deviate from the norm. Perceptions of group values thus mediate the effect of the school bond on behaviours that individuals engage in. However, while the school connectedness literature implicitly assumes that these group values promote positive behaviours, Social Development Theory implies that norms may also promote negative behaviours (15). The assumption that school connectedness promotes positive behaviours in a similar way across schools has yet to be examined.

2.4.3 Is School Connectedness Always Protective?

It is assumed that the protectiveness of school connectedness is homogenous (i.e. always protective) across schools. However, there are reasons why school connectedness may not always be protective across all schools. For example, connectedness to some school climates and peer groups could promote negative health behaviours. Evidence and theories on adolescent risk-taking provide support for this hypothesis. A developmental neuroscience perspective claims that adolescent risk-taking stems from developmental stages that promote impulsivity, whereas other theories highlight the factors that may lead to risky behaviours (e.g., sexual risk behaviours or binge drinking) such as parental roles and peer group norms (24-26). Extensive research has demonstrated how peer groups can positively or negatively influence health behaviours in adolescents in middle school and high school (27,28). For example, research has demonstrated that peer behaviours or perception of peers' opinions influence sexual risk and drinking behaviours in adolescents (6,7,11). Edward Sutherland's Differential Association theory argues that individual decisions to engage in certain activities result from learned behaviour, drawing

on the influences of peers, family, or other influencers. What matters most is the strength or quality of the relationship, and if the peer influences are stronger, individuals may mimic peer behaviours (which can be either positive or negative; 27). Therefore, school connectedness potentially could create environments where risky behaviour (e.g. sexual risk taking or alcohol use) is more likely, if certain peer norms predominate.

School connectedness considers a student's relationship to the adults in their school as well as their peers at their school, and research has demonstrated that both aspects of this school bond are important in determining better health outcomes in adolescents (16,22). As demonstrated in Table 1, some measures of school connectedness are more sensitive to these differences between adult and peer connectedness than others. While school connectedness is supposedly protective against sexual risk or drinking behaviours, studies have stated that having "socially irresponsible" peers can lead to lower school connectedness and negative health behaviours (1). However, if students feel connected to their "socially irresponsible" peers, but these peers greatly influence a student's school experience, this could hypothetically imply that "school connectedness" could encourage "socially irresponsible" behaviour. Therefore, school connectedness potentially could create environments where risk taking is more likely, if certain peer norms lead the trend. Additionally, if peer norms influence the protectiveness of school connectedness, one might expect school connectedness to be less protective in schools with higher levels of risky behaviour, and more protective in schools with lower levels of risky behaviour. For example, if a student is connected to their school and peers, but many of their peers binge drink on weekends, then a connected student may be more susceptible to binge drinking themselves, as Differential Association Theory would predict (27).

Adolescents engage in a range of risk behaviours. One example of a behaviour affected by peer influence is sexual activity. Approximately 50 percent of Nova Scotian students in grades 9, 10, and 12 report having engaged in sex (11). Many of these youths will engage in risky sexual behaviours. For example, only 53.6 percent of students in grades 7, 9, 10 and 11 had used a condom the last time they had sex (11). Risky sexual behaviours in adolescents can have serious consequences, including sexually transmitted

infections and teenage pregnancy. For example, about 3 percent of Nova Scotia teenagers become pregnant annually, and the highest rates of chlamydia and gonorrhea infections are reported in women ages 15 to 19 (28,29). Another example of a behaviour affected by peer influence is binge drinking. Approximately half of Nova Scotian students in grades 9, 10, and 12 report having engaged in binge drinking. Twenty-seven percent of students consumed alcohol once a month or more in the previous year (11). Not only is there potential for adolescent binge drinking to affect brain function (30), but alcohol also has been found to be strongly related to youth engaging in sexual risk behaviours (most specifically having casual or multiple partners; 31,32). Whether or not students engage in these risk behaviours could be influenced by peer norms.

Given that adolescents are going through biological changes that promote the discovery of new experiences and skills, without the proper supports, this period of exploration could lead to risky behaviours. For example, having peer norms that promote risky sexual behaviour could increase an individual's likelihood of engaging in these behaviours themselves (18). Teens are more likely to engage in sexual activity if such behaviour aligns with their personal beliefs and their friends' beliefs about sex, with peer influence being even more important than parental influence in abstaining from sexual activity (33). For example, parental social influence (parents' disapproval, modelling, and monitoring of child's health behaviours) did not influence whether seventh grade minority adolescents were sexually active or not; however, sexually active students reported lower levels of peer disapproval in engaging in health risk behaviours (33). When looking at students who had engaged in sexual activity at a very young age (12 years and under), the most predictive factor of a student's intent to engage in sex in the 6th grade (students entering grade 6 who had not yet had sex) was the belief that most of their friends had already engaged in sex. Intent to have sex was highly predictive of engaging in sexual activity. However, the belief that they would be stigmatized and experience social consequences if they had sex was an independent protective factor against early sexual initiation (7). Out of students engaging in sexual activities, as previously mentioned, many will engage in risky sexual behaviours (11,34). Not only does the perception of peer norms influence risk behaviour, but adolescents overestimate

how many or how often peers engage in riskier sexual behaviour, and they underestimate the frequency of protective behaviours related to sexual behaviour. Thus, to adolescents, peer norms appear even riskier than they are (35). McNeely and Falci (22) found that, when analyzing students who engaged in sexual intercourse with a condom versus those who did not, teacher support was protective, whereas social support alone had no protective effects. Social belonging was measured with three questions (see Table 1).

In the ASDUS, of students whose friends all drank alcohol, 91.9 percent reported drinking some alcohol in the past 12 months. However, for students whose friends who did not drink (or mostly did not drink), only 14.7 percent had some alcohol in the past 12 months (11). Friends were also the most common method of obtaining alcohol (71 percent of students had a friend buy or offer them alcohol last time they drank). When McNeely and Falci analyzed the protective effects of teacher support and peer support, they found that together, they were protective against initiating getting drunk (moderately or regularly). Additionally, teacher support was protective when analyzed alone. However, when analyzing the protectiveness of social support when controlling for teacher support, social support became a risk factor for initiating getting drunk (22). Bond and colleagues also found that students with low school connectedness, but good social connectedness were at higher risk for drinking (16). Given these findings, it seems that several facets of school connectedness, such as teacher and peer qualities, may positively or negatively influence sexual and drinking behaviours.

2.5 Summary
Two important gaps were identified in the school connectedness literature corresponding to implicit assumptions that are poorly substantiated: 1) the assumption that school connectedness is an attribute of the school (and not of the composition of students within it), and 2) that school connectedness is always protective. Only a handful of studies had estimated the degree to which school connectedness is an attribute of the school itself versus an attribute of the composition of students within the school (4,5). These studies used multi-level analyses to examine the variance in school connectedness between schools and within schools (thus presenting the degree to which variance in school

connectedness can be attributed to schools or students in schools). However, previous literature has either neglected to report the degree to which student background characteristics account for between-school variance in school connectedness, or they have chosen to control for student characteristics that are closely related to the school environment. An additional gap was that no studies had examined the degree to which heterogeneity exists in the potential protective effects of school connectedness on students' risky sexual and binge drinking behaviours. For example, it was not known whether there are schools where school connectedness is less protective, or even a risk factor for health compromising behaviours.

Table 1. *Examples of measures used in literature to capture school attachment, school bond, and school connectedness.*

Name	Citation for study in which measure was used	Measure or summarization of measure used
School Attachment	Moody & Bearman (2002) (10)	"I feel close to people at this school" "I am happy to be at this school" "I feel like I am part of this school"
	Mouton et al (1996) (10)	People at school like me
School Bond	Jenkins, 1997 (10)	- Commitment (how important is the student's education and academic performance to them) - Attachment (do they share a connection with their teachers) - Involvement (are they involved in the school's extra-curricular activities) - Belief in School Rules (are the school's rules and expectations fair)
School Connectedness These example measures are different adaptions from The National Longitudinal Study of Adolescent Health (ADD Health Survey)	Resnick et al (1997) (36) Langille et al (2012) (12)	"You feel close to people at your school" "You feel like you are a part of your school" "You are happy to be at your school." "The teachers at your school treat students fairly." "You feel safe at your school." "How much do you feel that your teachers care about you?"
	McNeely & Falci (2004) (12,22)	Social Belonging "You feel close to people at your school." "You feel like you are part of your school." "You are happy to be at your school." Perceptions of Teachers "The teachers at your school treat students fairly." "Since school started this year, how often have you had trouble getting along with your teachers?" "How much do you feel that your teachers care about you?"

Name	Citation for study in which measure was used	Measure or summarization of measure used
	McNeely, Nonnemaker, & Blum (2002) (22) Langille et al (2014) (4)	"I feel close to people in my school." "I feel I am part of my school." "I am happy to be at my school." "I feel the teachers at my school treat me fairly." "I feel safe at my school."
	Azagba, Asbridge, & Langille (2014) (23)*	**"I feel close to people at my school."** **"I feel happy at my school."** **"I feel safe in my school."**

*These last 3 questions were used in the Atlantic Student Drug Use Survey which was used in the current study.

CHAPTER 3: OBJECTIVES

In this study, two common assumptions of the school connectedness literature were assessed. It was determined whether school connectedness for junior and senior high school students (in grades 7, 9, 10 and 12) in Atlantic Canada was heterogeneous across schools, and whether the relationship between school connectedness and sexual risk or binge drinking behaviours was heterogeneous across schools. The specific research questions were:

1. To what extent is school connectedness an attribute of the school and its environment versus an attribute of the characteristics of the students within the school?

2. Is the protective relationship between school connectedness and adolescent sexual risk or binge drinking behaviours homogeneous across schools?

CHAPTER 4: MANUSCRIPT 1

IS SCHOOL CONNECTEDNESS AN ATTRIBUTE OF THE SCHOOL?

Abstract

Background: School connectedness has been found to be protective against many negative health behaviours, and school interventions have been implemented to increase such connectedness.

Objectives: This study assessed the extent to which school connectedness is an attribute of the school versus the characteristics of the students within the school.

Methods: This study used cross-sectional data from the 2012 Atlantic Student Drug Use Survey, which surveyed from over 9,000 students in junior and senior high-schools in Nova Scotia, New Brunswick, and Newfoundland/Labrador. Random-intercept regression models were used to assess the extent of variation in school connectedness accounted for by schools. Such variation was estimated before and after adjustment for student background variables previously associated with school connectedness.

Results: Schools accounted for a statistically significant but relatively small percentage of total variation in school connectedness. Intraclass correlations were very similar in the unadjusted (ICC 4.78%; 95% CI 3.56% to 6.37%) and adjusted models (ICC 3.99%; 95% CI 2.89 % to 5.49%).

Discussion: The results suggest that broad school connectedness interventions may not be the most efficient course of action. It may be more beneficial if interventions target schools with low connectedness or other risk factors in order to enhance feelings of safety, belonging, and happiness at school.

4.1 Introduction

The concept of school connectedness includes the positive feelings a student has towards their school (2). School connectedness is measured by instruments that assess students' perception of connectedness to their school and the people at their school. There are numerous ways a student's bond to their school has been named and defined (9,10). Some measures include school qualities or teacher qualities, some focus more generally on the positive feelings students have for their school, and others focus on students' bond with the people at their school (not specifying teachers). Large scale surveys such as the Atlantic Student Drug Use Survey (ASDUS) and The National Longitudinal Study of Adolescent Health have gathered individual level data on adolescent students' self-reported ratings of school connectedness as well as a variety of individual characteristics and behaviours (3,11). There has been an abundance of literature that uses these individual school connectedness scores to determine how they relate to students' characteristics and behaviours (1,3,12-14).

Evidence from these studies suggests that school connectedness is protective against adolescent behaviours that increase health risks (12-14). The National Longitudinal Study of Adolescent Health (1995) surveyed 36,000 students in grades 7 to 12 (3). They found that school connectedness had the strongest protective association with male and female students' truancy, substance use and sexual intercourse at a young age, violence, and unintentional injuries (3). After family connectedness, school connectedness was the second most protective factor when examining associations with emotional distress, eating disorders, and suicidal thoughts and attempts (3). While it is difficult to infer causality from cross sectional studies (12,13), previous literature examining longitudinal data (15,16) has estimated how protective school connectedness is against risky health behaviours. Therefore, using this evidence as a spring-board, policy makers, researchers, and educators have attempted to increase school connectedness using a variety of interventions in schools (1).

The name of the measure and the policy focus often imply that school connectedness is a characteristic of schools, but that is not what the measure assesses. It is a self-report

measure of students' perceptions of how connected they feel to their school. Depending on individual factors and the peer groups to which they belong, students in the same school may or may not share the same perceptions of their school and how connected they feel to it. For example, students may come from different backgrounds or be in different grades, which could affect how safe and happy they feel at their school. In addition to this, different peer groups could affect how individuals interact with and view their schools.

Health research often encounters the issue of whether health outcomes are a result of the composition or context of an area (37). For example, say we found that school connectedness was correlated with high socioeconomic status (SES) in a province. A compositional explanation might be that students with high SES experience high school connectedness, so schools with a large percentage of high SES students have higher school connectedness. A contextual explanation might be that schools in higher SES communities have more resources with which to encourage school connectedness. It is difficult to separate composition and context fully as there is often a relationship between the two (i.e. students with high SES living in high SES communities). Studies have found that school-based interventions can increase school connectedness and have a positive effect on behaviours, demonstrating what schools do can affect connectedness and its associations with such behaviours (1,15,16,21). However, rarely has literature clarified the extent to which school connectedness is a reflection of the school itself (context) versus the students attending the school (composition). To our knowledge, only two studies have estimated the degree to which school connectedness is an attribute of the school versus an attribute of the students within the school (4,5). These studies have used multilevel analyses to examine the percent of overall variation in school connectedness that is between schools (i.e. explained by school) versus within schools (i.e. between students within schools). Multilevel analysis examines how much school connectedness clusters by school. If school connectedness is not clustered by school, most of the overall variation is within schools, and school connectedness is likely an attribute of the students and their characteristics. If school connectedness clusters by school, and a significant percent of overall variation is between schools, then school connectedness is at least

partly an attribute of the schools. However, if student characteristics were then controlled for, and school connectedness no longer clustered by school, school connectedness would be considered an attribute of the types of students clustered within schools (the composition of schools).

McNeely and colleagues used hierarchical linear models (comparable to multilevel analyses) to estimate the association between several school level variables and school connectedness (4). These models partitioned the total variance between the individuals' assessments of their school connectedness into a between-school and within-school component. While the primary goal of McNeely's paper was to determine what school factors promoted connectedness, they estimated a baseline model which found that 12 percent of the variance in school connectedness levels was explained by school differences (with the remaining 88 percent being overall variation between students). McNeely claimed that this percent of variance explained by the school demonstrates that differences between schools are partially responsible for different levels of school connectedness across a large sample of students.

McNeely and colleagues went on to examine school attributes that were associated with the variation in connectedness between schools. McNeely and colleagues controlled for individual and school level characteristics; however, while they reported that 12 percent of the variance in school connectedness is explained by the school, they did not report how much of that percentage is reflective of the different compositions of students in schools with respect to those student characteristics related to school connectedness. For example, if most of the students in a school did not have a strong bond with their family, this may affect their school connectedness levels.

Waters and colleagues also addressed the between-school and within-school variance in school connectedness, and like McNeely and colleagues, their focus was to identify ecological factors that promote connectedness, as opposed to assessing the extent to which school connectedness differs between schools (5). They estimated that 27 percent of the variance in student perceptions of school connectedness was explained by

between-school differences. After controlling for individual-level variables, Waters and colleagues stated that the "final student-level model accounts for 11% of the variation in school connectedness by between-school differences". It was unclear whether this meant that individual-level variables accounted for 11 of the 27 percent (leaving 16 percent of variation explained by school in the adjusted model), or if adjustment accounted for 11 percent of the 27 percent (leaving 24 percent of variation explained by school in the adjusted model). Additionally, many of the individual-level variables included could be outcomes of school connectedness (e.g. participation, academic achievement, more connected to teachers, etc.), leading to over adjustment, and thus underestimating the variation explained by school. They also did not adjust for background characteristics of the students (e.g. family structure, perceived family wealth, etc.) which are associated with school connectedness (4,23) and likely clustered within schools. Failure to adjust for compositional differences between schools in background variables may result in overestimation of the percent of variation in connectedness explained by school. Thus, previous literature has either neglected to report the degree to which student characteristics account for between-school variance in school connectedness, or they have chosen to control for student characteristics that are closely related to the school environment.

Therefore, the degree to which school connectedness varies between schools (and whether it does vary between schools) remains unclear, as does the degree to which school connectedness is a reflection of the composition of schools with respect to student background characteristics associated with school connectedness. It remains to be determined whether a school's impact on the variation in school connectedness is large or negligible when compared to the impact of student characteristics on the variation in school connectedness levels. To the extent that school connectedness does not vary between schools, it may be non-school factors that play a bigger role (e.g. family connectedness or grade). This outcome could influence whether schools should consider targeted versus general approaches when implementing approaches to improve school connectedness and related interventions. For example, if there is considerable

heterogeneity in school connectedness levels within schools, then the focus perhaps might be more appropriately placed on students not as connected to their school.

Building on this gap in the literature, the primary objective of this study is to estimate, employing a large sample of junior and senior high school students (in grades 7, 9, 10 and 12) in Atlantic Canada, the extent to which school connectedness is an attribute of the school and its environment versus an attribute of the characteristics of the students within the school.

4.2 Methods

4.2.1 Overview

Using random-intercept regression models in a large sample of junior and senior high students in Atlantic Canada, this study estimated the extent to which variation in students' reported school connectedness is accounted for by schools (between-school variance), before and after adjustment for student background variables. Student characteristics were included as fixed effects to adjust for compositional differences of students between schools. The variables that were controlled for were sex, grade, language, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

4.2.2 Study Population and Data Source

This study employed cross-sectional data from the 2012 Atlantic Student Drug Use Survey (11). The survey was commissioned by the Governments of Nova Scotia, New Brunswick, and Newfoundland and Labrador, and collected data from 9,226 students in 246 junior and senior high-schools throughout Atlantic Canada. The sample design was a two-stage stratified cluster sample of randomly selected classes containing more than 20 students in each of the four surveyed grades (7, 9, 10 and 12) within each of the provinces. The response rate for those eligible and present the day of the survey was high (>90%). The survey collected valid and reliable measures of school connectedness and a range of covariates appropriate for this study (11,23). The 2012 survey was granted ethics approval by the Dalhousie University Health Sciences Research Ethics Board and all

participating school boards. Individual schools had the authority to decide whether parental consent was necessary, except for schools in the Halifax Regional School Board (Nova Scotia). In the Halifax Regional Municipality, all schools were required to obtain active parental consent for their children's participation in the surveys. Consent was obtained from the students at the time surveys were administered. Anglophone and Francophone schools were included in the survey. Excluded from the study were private schools, schools on reserves, street-youth, school-leavers, and students who were absent the day of the survey.

For this study, 108 respondents were excluded who answered yes to a survey question asking whether they had used a fictional drug, and 167 respondents who had missing data on the school connectedness measure. The remaining 8,951 subjects were included for analysis.

The surveys were administered in May and June 2012 by trained research assistants. Students completed surveys in their classrooms. The cover page of the survey provided information for students about the study's purpose, and explained that answers were confidential, anonymous, and voluntary. Students were informed that they could skip questions they felt uncomfortable answering, and that they could withdraw from participating at any point. Students were told to place completed surveys in an unmarked envelope before they were collected by the members of the research team.

4.2.3 Variables and Measures
School connectedness. In this study, school connectedness was measured using three questions from a six-item scale used in the National Longitudinal Study of Adolescent Health (3). The three items measure the degree to which a student feels that they belong at their school, and each uses a four-level response scale (strongly agree, somewhat agree, somewhat disagree, or strongly disagree): a) I feel safe in my school, b) I feel close to people at my school, c) I feel happy at my school. Answers were reverse-coded and averaged so that higher scores indicate higher school connectedness. To facilitate model interpretation, the school connectedness score was centred on its mean. This three-

item scale had an internal consistency of 0.74 (Cronbach's alpha) when calculated using data for all subjects from the Atlantic Student Drug Use Survey (23) and 0.73 when applied to the subset of subjects used in this study. However, these three items were thought to potentially tap into different aspects of connectedness (safety, happiness and belonging). Therefore, a sensitivity analysis was conducted to examine each school connectedness item separately.

Student variables. To estimate school effects on school connectedness it is important to adjust for the composition of student populations in schools with respect to background variables which are largely exogenous to the school environment, associated with connectedness, and likely to be clustered within schools. For example, some schools and classes might include a higher concentration of students of lower socioeconomic status. This study accounted for the compositional effects of the following background variables: sex, grade, sexual orientation, language, family structure, perceived family wealth, family connectedness, and religiosity. Detailed descriptions of student variables are included in Table 6 in the Appendix.

There was some missing data for all student variables except grade, ranging from 28 to 638 missing values (0.3 percent to 7.0 percent of variable responses). To handle missing data on these variables, multiple imputations were performed for all variables except for school connectedness and grade. Multivariate imputations were performed using chained ordinal logistic regression equations, using items from all other student background variables to predict the new values (38). To assess sensitivity of results to imputation, three different data sets with imputed values were generated by changing the random number seed, and analysis was compared with each set. Results were nearly the same for each imputation set, so reported results are from the first imputation set (38).

4.2.4 Analysis

A generalized linear mixed model was employed (i.e. mixed effects regression models) of the following form:

$$\mu_{ij} = X\beta_{ij} + Z\gamma_i + \varepsilon_{ij}, \quad \gamma_i \sim (0, \Sigma_\gamma) \text{ and } \varepsilon_{ij} \sim N(0, \sigma^2)$$

where μ_{ij} is the average level of school connectedness for student (*j*) in school (*i*), and ε_{ij} is the associated error term. For student (*j*) in school (*i*), $X\beta_{ij}$ is a vector of covariates and fixed effects to adjust for the composition of schools with respect to student characteristics. $Z\gamma_i$ includes a random intercept capturing variation between schools in the mean of school connectedness after adjustment for fixed effects. Analyses were conducted in STATA Version 14 (StataCorp College Station).

This study employed mixed effects regression models to estimate the percent of variance in school connectedness that could be attributed to the individual students or the school environment. From the model, the intraclass correlation (ICC) was estimated to measure how similar/reliable the school connectedness ratings were within each cluster (school). The ICC ranges between 0 and 1 and measures the proportion of variation in the dependent variable that is observed between schools. The closer the ICC is to 1, the more clustered (closely related) the school connectedness levels are within each group. The ICCs for both unadjusted and adjusted models were estimated and compared. As part of a sensitivity analysis to compare ICCs, additional models were run stratified by sex, grade, and province.

4.3 Results

4.3.1 Descriptive Characteristics

Descriptive characteristics of the study sample are provided in Table 1. The mean level of school connectedness is approximately 3 on a scale from 1 to 4. The population was approximately half female and half male. There was an equal proportion of students in each grade (7, 9, 10, and 12). The data also demonstrated variability in a number of other student characteristics as outlined in Table 1. There were 246 schools and 495 classes. The average class size was 20, and the average sample per school was 40.

4.3.2 Analysis

Our results indicated that, while school accounts for a statistically significant proportion of the variation in school connectedness (p<.0001), the vast majority of variation is within rather than between schools. In the unadjusted model, which does not account for

the composition of schools with respect to student background variables, the ICC was 0.0478 with a confidence interval of 0.0356 to 0.0637, meaning that approximately 4.78 percent of the overall variance in school connectedness was accounted for by schools, while the remainder was due to student variation within schools. In the adjusted model, where covariates were introduced to adjust for student background composition, the intraclass correlation decreased slightly to 0.0399 with a confidence interval of 0.0289 to 0.0549. Therefore, approximately 3.99 percent of the variance was attributed to variance between schools (Table 2). This indicates that compositional differences in student characteristics between schools explained little of the variation in school connectedness between schools. When analyses were stratified by sex, grade, and province, the ICCs were similarly low for all analyses.

Considering that the school connectedness measure is comprised of three questions, a sensitivity analysis was conducted to examine each school connectedness item separately (Table 3). In the unadjusted model, feeling safe at one's school was slightly more clustered by school (ICC 0.057; 95% CI 0.044-0.075) than feeling close or happy (ICC 0.032; 95% CI 0.022-0.045 and ICC 0.036; 95% CI 0.025-0.050 respectively). However, in the adjusted model, once controlling for student characteristics, feeling safe and happy at one's school stayed relatively the same (ICC 0.054; 95% CI 0.041-0.071 and ICC 0.032; 95% CI 0.023-0.046 respectively), but the ICC for feeling close to the people at one's school decreased to 0.014 (95% CI 0.009-0.024).

4.4 Discussion

The results demonstrate that while the variance in school connectedness can mostly be explained by within-school variation, there is still a small but statistically significant effect explained by school heterogeneity (approximately 4 and 5 percent for adjusted and unadjusted models respectively). McNeely and colleagues and Waters and colleagues calculated the ICC for schools to be 12 percent and 27 percent respectively in their unadjusted models (4,5). How might we reconcile the large observed differences in the ICC of school between the current study and the two previous studies?

One possible reason an ICC value could be smaller in this study is because the overall variation in connectedness in the data could be smaller. The ICC depends not only upon how much school connectedness is similar between students in the same school, but also the magnitude of total variation there is between school connectedness scores for the entire sample. The ICC is the percent of total variation accounted for by school, so if total variation decreases, the ICC increases (39). While McNeely and colleagues did not report the overall variation in individual scores of school connectedness, Waters and colleagues did report the overall variation in school connectedness. Waters and colleagues reported their standard deviation for school connectedness to be an average of 0.74, whereas school connectedness in the present sample had a standard deviation of 0.64. This demonstrates that total variation in school connectedness was lower in the present sample, and thus does not account for this study's lower estimate of variation in school connectedness accounted for by school.

Another possible reason for this study having less variation in school connectedness explained by school could be the measures used. The present study had three items from a larger scale that captured a general sense of school belonging, and thus previous studies had more items on their school connectedness scale from which to see variation. For example, Waters and colleagues used a four-item measure adapted from the ADD Health Study which included the questions: "I feel part of this school", "I feel close to people at this school", "I am happy to be at this school", and "teachers treat students fairly". McNeely and colleagues used a five-item scale similar to the scale used by Waters and colleagues which included one more question, "I feel safe in my school". The measure used in the current study captured school connectedness similarly to McNeely and colleagues and Waters and colleagues with three questions: "I feel safe in my school", "I feel close to people at my school", and "I feel happy at my school". However, the current study's three item measure did not include a question regarding teachers, which may be more specifically related to the school environment than a student's overall feelings of belonging. This could explain why McNeely and colleagues and Waters and colleagues found more variation in school connectedness accounted for by school.

Our sensitivity analysis demonstrated that out of the three school connectedness items, feeling safe (when compared to feeling happy and close) was most strongly associated with school in both the unadjusted and adjusted models. Relatedly, controlling for student characteristics accounted for half of the between-school variation in feeling close to the people at one's school. This could mean that feeling safe at one's school is slightly more dependent on the school than the other two school connectedness variables. Additionally, while feeling close to the people at one's school differs somewhat by school, given that much of the variation between schools goes away after adjustment, feeling close to the people at one's school may be more related to the types of students that compose schools (relative to safety or happiness). However, the ICC values for all items were similarly small. In addition, the items were found to be intercorrelated with each other, as indicated by the Cronbach's alpha of 0.73. Therefore, results were reported using the combined scale.

Our results suggest that compositional (student level) factors contributed little to the variation in school connectedness explained by school. These results offer some credibility to the ecological approach taken by McNeely and colleagues and Waters and colleagues. These studies did not assess the extent to which compositional factors (student background characteristics) explained school-level variation of school connectedness; instead their main interest was investigating which school level variables affected school connectedness. Given that compositional factors do not appear to account for school-level differences in school connectedness, it is fair to assume that while heterogeneity in school connectedness between schools is minimal, school connectedness is at least partly an attribute of the school.

4.4.1 Conclusion

This research has potential importance for school connectedness interventions that target the health of Atlantic Canadian adolescents attending school. This study demonstrated that while yes, school accounts for a small portion of the variation in school connectedness, most of the variation is explained by within-school differences (between students). This suggests that applying broad school connectedness interventions at a

structural (contextual) level may not be the most efficient course of action. Instead, it may be more beneficial if interventions target students who have low school connectedness or other risk factors in order to enhance their feelings of safety, belonging, and happiness at school. Interventions could target schools that have high numbers of students with low school connectedness by encouraging family, teacher, and student workshops that promote school connectedness and wellbeing in a variety of ways.

Tables

Table 1. *Descriptive characteristics from the Atlantic Student Drug Use Survey for schools and students in grades 7, 9, 10, and 12.*

Variables of Interest	Mean/Percent	S.D.	N	Median	Interquartile Range	
					25th	75th
School Connectedness	3.07	0.64	8951	3.00	2.67	3.67
Student Variables						
% Female	50.67		4516			
% Living With Two Parents	65.00		3160			
% High Importance of Religious Events	20.80		3737			
% High Importance of Religion	41.56		1876			
% Heterosexual	84.15		1452			
Family Connectedness	4.24	0.70	8998	4.33	3.33	4.67
Perceived Family Wealth (SES)	6.98	1.59	8480	7.00	6.00	8.00
Language Spoken at Home (%)						
%English only	78.87		7160			
%French with or without English	17.98		1628			
%Another language	3.15		294			
Grade (%)						
7	25.58		2332			
9	23.58		2150			
10	26.46		2413			
12	24.38		2223			
Description of Schools						
Total Number of Schools			246			
Min. Number of Students sampled from a school			2			
Max. Number of Students sampled from a school			177			
Mean Number of Students sampled from a School			37			
Total Number of Classes			438			
Min. Number of Students sampled from a class			1			
Max. Number of Students sampled from a class			70			
Mean Number of Students sampled from a class			20			

Table 2. *Random intercept parameters (standard deviation) and intraclass correlations for the mixed-effects model examining how the mean of school connectedness varies by school.*

	Estimate (95% Confidence Interval
Unadjusted Model	
Standard Deviation (Intercept)	0.141 (0.121 , 0.164)
Standard Deviation (Residual)	0.629 (0.620 , 0.638)
Intra-Class Correlation	0.048 (0.036 , 0.064)
Adjusted Model	
Standard Deviation (Intercept)	0.121 (0.102 , 0.142)
Standard Deviation (Residual)	0.591 (0.583 , 0.600)
Intra-Class Correlation	0.040 (0.029 , 0.055)

*Model adjusted for sex, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

Table 3. *Sensitivity analysis: random effect parameters (standard deviation) and intraclass correlations for the mixed-effects model examining how each school connectedness item varies by school.*

Random-Effects Parameters (By School)	Intraclass Correlation (Confidence Interval)					Intraclass Correlation (Confidence Interval)				
	Unadjusted Model					**Adjusted Model**				
I feel safe at my school	0.057	(	0.044	,	0.075	)	0.054	(	0.041	,	0.071	)
I feel close to the people at my school	0.032	(	0.022	,	0.045	)	0.014	(	0.009	,	0.024	)
I feel happy at my school	0.036	(	0.025	,	0.050	)	0.032	(	0.023	,	0.046	)

*Model adjusted for sex, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

CHAPTER 5: MANUSCRIPT 2

IS THE PROTECTIVENESS OF SCHOOL CONNECTEDNESS HETEROGENEOUS ACROSS SCHOOLS?

Abstract

Background: The concept of school connectedness refers to a student's perception of how safe, happy, and cared for they are by the adults and other students at their school. School connectedness has been found to be protective against many negative health and social behaviours, but it is plausible that student norms in some school environments may encourage riskier behaviours.

Objectives: This study examined data from junior and senior high-school students in Atlantic Canada to assess whether the protective associations of school connectedness with risky sexual behaviour and binge drinking are homogeneous across schools.

Methods: This was a cross-sectional study using data for grades 9, 10, and 12 from the 2012 Atlantic Student Drug Use Survey. Using mixed-effects logistic regression models, we assessed the heterogeneity in the effect of school connectedness on risky behaviours between schools.

Results: The protectiveness of school connectedness against risky sexual behaviour does not vary by school, but the protectiveness of school connectedness against binge drinking behaviour does. Furthermore, we found that school connectedness may be a risk factor for binge drinking in some schools.

Conclusion: Future research should not only attempt to identify why some schools may promote healthier behaviours than other schools, but it may also be important to move away from a unitary concept of school connectedness.

5.1 Introduction

The concept of school connectedness (a student's bond to their school) includes the positive feelings a student has towards their school (2) and is measured by instruments that assess students' perceptions of connectedness to their school and the people in it. There are a number of ways school connectedness has been defined and measured (9,10). Some measures include school qualities or teacher qualities, some focus more generally on the positive feelings students have for their school, and others focus on students' bond with the people at their school (not specifying teachers). Large scale surveys such as the Atlantic Student Drug Use Survey (ASDUS) and The National Longitudinal Study of Adolescent Health have gathered individual level data on adolescent students' self-reported ratings of school connectedness as well as a variety of individual characteristics and behaviours (3,11).

An abundance of literature has used this individual level data to estimate associations between school connectedness and student characteristics or behaviours (1,3,12-14). Evidence from these studies suggests that school connectedness is protective against risky adolescent behaviours such as sexual risk and substance use (13,36). A common assumption made in the school connectedness literature is that the protective effect of school connectedness is similar across schools (1,2). Thus, in response to the evidence that school connectedness is protective, policy makers, researchers, and educators have proposed increasing school connectedness through school-based interventions targeting teachers, parents, students, and peers (1). Research has demonstrated that school connectedness can be improved in four key areas: adult and teacher support, a commitment to academic success (from teachers and students), a healthy school environment, and a positive peer group (1). This implies that for students to experience the potential benefits of school connectedness, they need a stable group of friends that promotes prosocial behaviours. This may not always be the case, given that it is possible for adolescents to have a close group of friends with whom they may engage in risky behaviours (17,18). Adolescents are at a period of development when responses to immediate rewards are heightened, but inhibitions are not fully developed (18,19).

Therefore, it is plausible that connectedness of adolescents to peers in some school environments may promote risky behaviour.

According to Social Development Theory, the reason that school connectedness is protective is because, if a child feels bonded to their school and the people in it, then they will avoid acting outside established norms in order to maintain that bond (15). Feeling strongly connected to one's school will protect against behaviours that deviate from the accepted norms. According to this theory, when this bond is formed, individuals will coordinate their behaviours to match the standards of behaviour within the group, and individuals will avoid behaviours that deviate from the norm. Perceptions of group values thus mediate the effect of the school bond on behaviours in which individuals engage. However, the school connectedness literature implicitly assumes that these group values promote positive behaviours, and social development theory implies that norms may also promote negative behaviours (15).

The assumption that school connectedness promotes positive behaviours in a similar way across schools has yet to be examined. However, from other theoretical perspectives, there are reasons why the protectiveness of school connectedness against risky behaviors may be heterogeneous between schools. Connectedness to some school climates and peer groups could promote negative health behaviours. Evidence and theories on adolescent risk-taking provide support for this hypothesis. A developmental neuroscience perspective claims that adolescent risk-taking stems from developmental stages that promote impulsivity, whereas other theories highlight the factors that may lead to risky behaviours (e.g. sexual risk behaviours or binge drinking) such as parental roles and peer group norms (24-26). Extensive research has demonstrated how peer groups can positively or negatively influence health behaviours in adolescents in middle school and high school (40,41). For example, research has demonstrated that peer behaviours or perception of peers' opinions influence sexual risk and drinking behaviours in adolescents (6,7,11). Therefore, school connectedness potentially could create environments where sexual risk taking or alcohol use is more likely, if certain peer norms lead the trend. Additionally, if peer norms influence the protectiveness of school

connectedness, one might expect school connectedness to be less protective in schools with higher levels of risky behaviour, and more protective in schools with lower levels of risky behaviour. For example, if a student is connected to their school and peers, but many of their peers binge drink on weekends, then connected students may be more susceptible to binge drinking themselves.

Adolescents engage in a range of risky behaviours. One example of a behaviour affected by peer influence is sexual activity. Approximately 50 percent of Nova Scotian students in grades 9, 10, and 12 report having engaged in sex (11). Many of these youths will engage in risky sexual behaviours. For example, only 53.6 percent of students in grades 7, 9, 10 and 11 had used a condom the last time they had sex (11). Risky sexual behaviours can lead to serious consequences such as unwanted teenage pregnancies and sexually transmitted infections (28,29). Another example of a behaviour affected by peer influence is binge drinking. Approximately half of Nova Scotian students in grades 9, 10, and 12 report having engaged in binge drinking (11). Not only is there potential for adolescent binge drinking to affect brain function (30), but alcohol has also been found to be strongly related to youth engaging in sexual risk behaviours (most specifically having casual or multiple partners; 31,32). Whether or not adolescents engage in these risk behaviours could potentially be influenced by peer norms (18).

Having peer norms that promote risky behaviour could increase an individual's likelihood of engaging in these behaviours themselves (18). In young adolescents (6th or 7th grade), peer attitudes about sexual activity or perceptions of peer sexual behaviour were more predictive of an individual's engaging in sexual activity than parental influence (7,33). Out of students engaging in sexual activities, many will engage in risky sexual behaviours (11,34). Not only does the perception of peer norms influence risky behaviour, but adolescents overestimate the number of peers who engage in risky sexual behaviours, and they underestimate the number of peers engaging in protective behaviours related to sexual behaviour (35). Thus, to adolescents, peer norms appear even riskier than they in fact are. McNeely and Falci found that, when analyzing students

who engaged in sexual intercourse with a condom versus those who did not, teacher support was protective, whereas social support alone had no protective effects (22).

For students whose friends all drank alcohol, 91.9 percent reported drinking some alcohol in the past 12 months. However, for students whose friends did not drink alcohol (or mostly did not drink), only 14.7 percent reported drinking some alcohol in the past 12 months (11). Friends were also the most common method of obtaining alcohol (71 percent of students had a friend buy or offer them alcohol the last time they drank). When McNeely and Falci analyzed the protective effects of teacher support and peer support, they found that together, they were protective against initiating getting drunk (moderately or regularly; 22). Additionally, teacher support was protective when analyzed alone. However, when analyzing the protectiveness of social support when controlling for teacher support, social support became a risk factor for initiating getting drunk. Bond and colleagues also found that students with low school connectedness, but good social connectedness were at higher risk for drinking (16). Given these findings, it seems that several facets of school connectedness, such as teacher and peer qualities, may positively or negatively influence sexual and drinking behaviours. If school connectedness influences adolescent risk behaviours differently depending on the school, it is conceivable that the protectiveness of school connectedness may be heterogeneous between schools.

To date, no studies have examined the heterogeneity between schools in the protective effects of school connectedness on students' risky behaviours. For example, it is not known the extent to which there are schools where school connectedness is less protective, or even a risk factor for health compromising behaviours. Some literature has investigated whether school connectedness itself is heterogeneous across schools (4,5), and results have demonstrated that there is a small percentage of variation in school connectedness that is explained by school. However, regardless of these findings, the actual effects of school connectedness on risk behaviours could behave very differently across schools.

The objective of this study was to assess, for junior and senior high-school students in grades 9, 10 and 12 in Atlantic Canada, whether the protective relationship between school connectedness and adolescent sexual risk or binge drinking behaviours is homogeneous across schools. This study hypothesized that the protectiveness of school connectedness would vary between schools, and that school connectedness would be less protective in schools that have higher prevalence of risky behaviors.

5.2 Methods

5.2.1 Overview

Using data from a large survey of junior and senior high-school students in grades 9, 10 and 12 from 170 schools, mixed-effects logistic regression models were estimated to assess if the effect of students' ratings of school connectedness on risk behaviors varied by school, and whether the effect was correlated with the prevalence of risky behaviour in each school. The primary exposure variable was school connectedness, and the outcome variables were risky sexual behaviour and binge drinking. Student characteristics were included as fixed effects to adjust for potentially confounding student characteristics. The variables that were controlled for were sex, grade, language, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

5.2.2 Study Population and Data Source

This study employed cross-sectional data from the 2012 Atlantic Student Drug Use Survey (11). The survey was commissioned by the Governments of Nova Scotia, New Brunswick, and Newfoundland and Labrador and collected data from over 9,000 students in 246 junior and senior high-schools throughout Atlantic Canada. The sample design was a two-stage stratified cluster sample of randomly selected classes containing more than 20 students in each of the four surveyed grades (7, 9, 10 and 12) within each of the provinces. The response rate was high for those eligible and present the day of the survey (>90%). The survey collected valid and reliable measures of school connectedness and a range of covariates appropriate for this study (23). The 2012 survey was granted ethics approval by the Dalhousie University Health Sciences Research Ethics Board and all

participating school boards. With the exception of the Halifax Regional School Board (HRM) in Nova Scotia requiring all schools in their district to obtain active parental consent, individual schools were given the authority to decide whether parental consent was necessary for their children's participation in the surveys. For students who were eligible to complete the survey, consent was obtained from the students at the time surveys were administered. Anglophone and Francophone schools were included in the survey. Excluded from the study were private schools, schools on reserves, street-youth, school-leavers, and students who were absent the day of the survey.

Data for this study included students in grades 9, 10, and 12. Grade 7 students were excluded as very few have engaged in sexual or binge drinking activities. This study also excluded 83 respondents who answered yes to a survey question asking whether they had used a fictional drug. When risky sexual behaviour was the outcome variable, 162 respondents were excluded who had missing data on the school connectedness and sexual risk behaviour measures. When binge drinking was the outcome variable, 180 respondents were excluded who had missing data on the school connectedness and binge drinking measures. The remaining 6,624 and 6,606 subjects were included in the study when analysing the effects of school connectedness on sexual risk and binge drinking respectively.

The surveys were administered in May and June 2012 by members of the research team who had been trained by the study's Principal Investigators. Students completed surveys in their classrooms. The cover page of the survey provided information to students about the study purpose and explained that answers are confidential, anonymous, and voluntary. Students were informed that they could skip questions they felt uncomfortable answering, and that they could withdraw from participating at any point. Students were told to place completed surveys in an unmarked envelope before they were collected by the members of the research team.

5.2.3 Variables and Measures

School connectedness. School connectedness was the exposure variable of interest. In this study, school connectedness was measured using three questions from a six-item scale used in the National Longitudinal Study of Adolescent Health (3). The three items measure the degree to which a student feels that they belong at their school, and each uses a four-level response scale (strongly agree, somewhat agree, somewhat disagree, or strongly disagree): a) I feel safe in my school, b) I feel close to people at my school, c) I feel happy at my school. Answers were reverse-coded and averaged so that higher scores indicate higher school connectedness. The school connectedness score was also centred around the mean by subtracting the mean from the variable. This was done to facilitate the interpretation of results. This three-item scale had an internal consistency of 0.74 (Cronbach's alpha) when calculated using data for all subjects from the Atlantic Student Drug Use Survey (23), and 0.73 when applied to the subset of subjects used in this study. However, as these three items may potentially tap into different aspects of connectedness (safety, happiness and belonging), a sensitivity analysis was conducted to examine each school connectedness item separately.

Sexual risk behaviours. Sexual risk behaviour was an outcome variable measured with two risky behaviours: multiple partners and unplanned sex. The questions asked, "in the past 12 months, with how many different female/male partners did you have sex with", and "in the past 12 months, did you have unplanned sex?" Engaging in no sexual risk behaviours was coded as 0, and having two or more partners and/or unplanned sex was coded as 1. In this questionnaire, sex was defined as vaginal, oral, or anal sex. Vaginal sex was defined as an act where a male's penis enters a woman's vagina. Oral sex was defined as a male's penis entering someone's mouth or someone's mouth coming in contact with a female's vulva. Anal sex was defined as an act where a male's penis enters an anus or rectum. When any of these acts occur, both partners are engaging in the sexual act (vaginal, oral, or anal sex). A sensitivity analysis was performed to examine the sexual risk items separately.

Regular binge drinking. Binge drinking was the second outcome variable. The measure that was used in the present study asks: "in the past 30 days, how many times have you had five or more drinks of alcohol on the same occasion?" The response options were: "I did not drink alcohol in the past 30 days", "I have not had five or more drinks of alcohol on the same occasion in the past 30 days", "once, I had five or more drinks of alcohol on the same occasion in the past 30 days", "twice", "three times", "four times", or "five or more times". The variable was dichotomized into not having engaged in regular binge drinking (0) and having engaged in regular binge drinking (1). Students who answered "three times" or more to having five or more drinks of alcohol on the same occasion in the past 30 days were categorized as having engaged in regular binge drinking. Given that non-drinkers, drinkers, and infrequent binge drinkers are captured in the reference category, we acknowledge that this variable may underestimate the full extent of risky drinking behavior.

Student variables. In estimating the effects of school connectedness on risky behaviours, previous studies have adjusted for background variables which are largely exogenous to the school environment and associated with connectedness, and thus are potential confounders (12,13). These student characteristics may be clustered within schools. For example, some schools and classes might include a higher concentration of students of lower socioeconomic status. This study accounted for the compositional effects of the following background variables: sex, grade, language, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity. A sensitivity test included depressive symptoms in the adjusted model to determine if depressive symptoms accounted for variation in the effects of school connectedness by school. Detailed descriptions of the student variables are included in Table 7 in the Appendix.

There was some missing data for all student variables except grade, ranging from 18 to 374 (0.2 percent to 5.5 percent of variable responses). To handle missing data on these variables, multiple imputations were performed for all variables except for school connectedness and grade. Multivariate imputations were performed using chained ordinal logistic regression equations, using items from all other student background variables to

predict the new values (38). To assess sensitivity of results to imputation, three different data sets with imputed values were generated by changing the random number seed, and analysis was compared with each set. Results were nearly the same for each imputation set. The reported results in the current study were from the first imputation set (38).

5.2.4 Analysis

Generalized linear mixed models were employed (i.e. mixed effects regression models) of the following form:

$$h(\mu_{ij}) = X\beta_{ij} + Z\gamma_i + \varepsilon_{ij}, \quad \gamma_i \sim N(0, \Sigma_\gamma) \text{ and } \varepsilon_{ij} \sim N(0, \sigma^2)$$

where $h(\mu_{ij})$ is the logistic link function of the mean outcome (i.e. sexual risk taking or binge drinking) for student *(j)* in school *(i)*, and ε_{ij} is the associated error term. For student *(j)* in school *(i)*, $X\beta_{ij}$ is a vector of covariates and fixed effects to estimate the average effect of school connectedness and adjust for potentially confounding variables. $Z\gamma_i$ is a vector of school random effects (used to capture variation between schools in the intercept and the effects of school connectedness) after adjustment for fixed effects. Analyses were conducted in STATA Version 15 (StataCorp College Station).

For each of the outcome variables measuring risk taking, three models were estimated and compared before and after adjusting for potentially confounding variables. The first model included only fixed effects for student variables and school connectedness. This model followed the logic of existing literature examining the effect of school connectedness on risky behaviour, and it was expected that school connectedness would be protective. The second model added a random intercept for school and assessed the degree to which risky behaviour varied between schools. The third model included school connectedness as a random coefficient to assess the degree to which the effects of school connectedness on risky behaviour are heterogeneous between schools. The third model also investigated the covariance between the random coefficient and random intercept. A sensitivity test was performed where analyses were stratified by sex, grade, and province.

For each model, unadjusted and adjusted models were estimated and compared, with the adjusted model controlling for student variables by including them as fixed effects. The

unadjusted model examines how the protectiveness of school connectedness differs by school without controlling for the individual characteristics of the students. In the unadjusted model, "school" captures the complete environment of the school, including the different types of students and peers that may cluster in a certain school. The adjusted model controls for potential confounders which may bias the effect of school connectedness, but may also adjust for compositional variables that affect the normative environments of schools. It is thus valuable to investigate both the unadjusted and adjusted model, depending on what factor of school differences may be of interest. Students' t-tests were used to assess the significance of individual fixed effects while likelihood-ratio tests were used to assess the statistical significance of the random coefficients.

To assess the effect size of the variation in the protectiveness of school connectedness that was accounted for by school, the present study used a series of graphs. The first graphs illustrated the mean slope (coefficient) of school connectedness against the probability of risky behaviour for the average school, for a school that was one standard deviation above the average school, and for a school that was one standard deviation below the average school.

To better visualize and describe the extent of heterogeneity in school connectedness effects between schools, empirical Bayes estimates of the probability of risky behaviour (intercept) and school connectedness effects (slope) of each school were generated for models where significant heterogeneity in effects were observed. Estimates of effects for individual schools were Empirical Best Linear Unbiased Predictors (EBLUPS; 42). EBLUPS used the normal distribution of the random coefficients and predictions from the model, as priors, and the data from each school to generate a posterior distribution (estimated probability distribution) of the intercept (prevalence of risky behavior) and effect of school connectedness in each school (42). Empirical Bayes estimates alleviate the issue of outliers by relying on model predictions more in schools with fewer students. Using empirical Bayes estimates, the estimated effect and associated confidence intervals of school connectedness for each school were graphed. These estimates were arranged by

school in order from school connectedness being most protective to school connectedness being least protective (or a risk factor). Empirical Bayes estimates were also graphed to describe the association between school-specific intercepts (probability of risky behaviour) and effects of school connectedness. The correlation between the intercept and the odds ratio (slope) demonstrated how the mean level of binge drinking or sexual risk at a school correlated with the effect of school connectedness.

5.3 Results

5.3.1 Descriptive Characteristics

Descriptive characteristics of the study sample are provided in Table 1. With grade 7 removed, there were 170 schools and 326 classes. The average class size was 21, and the average sample taken from one school was 40. The mean level of school connectedness is approximately 3 on a scale from 1 to 4. The population was approximately half female and half male. There was an equal proportion of students in each grade (9, 10, and 12). With grade 7 removed, 37 percent of students had engaged in risky sexual behaviour, and 15 percent of students had engaged in binge drinking behaviour.

5.3.2 Analysis

Sexual Risk. Consistent with previous literature, school connectedness was found to be protective against risky sexual behaviours in both the unadjusted and adjusted fixed-effect models. Table 2 provides the fixed-effect odds ratios from logistic regression models for school connectedness and sexual risk (multiple partner and/or unplanned sex) for unadjusted and adjusted models.

The protective effect of school connectedness against risky sexual behaviour was not found to be heterogeneous between schools, even though the prevalence of risky sexual behaviour was variable between schools. There was no significant variation in the effect of school connectedness on sexual risk between schools for the unadjusted or the adjusted models. In fact, for the unadjusted analyses, a model with both a random intercept and random coefficient would not converge because the variance of the school connectedness effect was so close to zero. This was confirmed by running a model with a random

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coefficient and a fixed intercept. For the adjusted model, no significant variation in the effect of school connectedness between schools was found (p=0.84); while significant variation in the random intercept showed that the level of risk behaviour is quite variable between schools. When risky sexual behaviour was the outcome variable, stratified models by sex and province indicated that while the effects of school connectedness were slightly more heterogeneous across schools for females (compared to males) and Nova Scotian students (compared to NB and NL), there was little variation in school connectedness effects between schools for all categories.

Binge Drinking. Fixed-effect logistic regression models indicated that school connectedness is not protective against binge drinking (Table 3). In the unadjusted fixed-effect model, the effect of school connectedness on binge drinking is not significant, and after adjustment for potential confounders, school connectedness was found to be a significant risk factor for binge drinking. A unit increase in the school connectedness measure was associated with a 14 percent increase in the odds of binge drinking (OR=1.14, 95% CI: 1.01, 1.30).

Unlike the relationship between school connectedness and risky sexual behaviour, there is evidence that the protectiveness of school connectedness against binge drinking behaviour varies between schools. Table 4 shows the random-effects estimates from the mixed-effects regression models for binge drinking and school connectedness for unadjusted and adjusted models. The variation between schools in the protectiveness of school connectedness was significant for the unadjusted model (p=0.03). For the adjusted model, the protectiveness of school connectedness was not significantly different between schools (p=0.08; Table 5). When binge drinking was the outcome variable, the sensitivity analysis demonstrated some differences by sex, grade, and province. The school connectedness effects were slightly more variable by school for males compared to females. The effects of school connectedness were more heterogeneous by school for higher grades (compared to grade 9), and the effects of school connectedness were more heterogeneous across schools in Nova Scotia and Newfoundland than in New Brunswick.

To more clearly describe heterogeneity between schools in the association between school connectedness and binge drinking, the unadjusted and adjusted estimated effects of school connectedness on the probabilities of binge drinking were graphed for schools whose school connectedness effects were one standard deviation above and below that of the average school (Figure 1). For schools with a school connectedness effect one standard deviation lower than the average, the slope is negative (i.e. school connectedness is protective). However, if the slope is one standard deviation above the average, the slope becomes positive, and higher school connectedness is associated with a higher risk of binge drinking.

Further insight was obtained by estimating and graphing school-specific estimates (EBLUPs) of intercepts and school connectedness effects. Figure 2 shows school-specific estimates and associated confidence intervals for the relationship between school connectedness and the log odds of binge drinking. The relationship between school connectedness and binge drinking (including the coefficient for slope and confidence intervals) spans from a negative relationship to a positive relationship. Therefore, regardless of whether adjusted or unadjusted models are used, school connectedness is estimated to be a risk factor in some schools, and protective in others.

Figure 3 illustrates that school-specific point estimates of the effect of school connectedness and intercepts (mean probability of binge drinking) were significantly correlated in the unadjusted model, but not the adjusted model. In the unadjusted model, school connectedness tends to be protective in schools with lower levels of binge drinking (smaller intercepts), but in schools with higher levels of binge drinking (larger intercepts), school connectedness tends to be a risk factor. Once adjusting for student variables, the level of binge drinking in a school had no correlation with the protectiveness of school connectedness.

Sensitivity analyses did not show any notable differences in the results when examining the school connectedness items individually, the sexual risk items individually, or adding depression to the adjusted model as a covariate.

5.4 Discussion

This evidence suggests that school connectedness is protective against risky sexual behaviours, and that there is close to zero heterogeneity in these protective effects across schools. This is especially interesting considering that sexual risk is quite variable across schools, but the protective effects of school connectedness hold regardless of school. These findings suggest that feeling connected to one's school is protective against risky sexual behaviour regardless of one's school environment or peer norms. This makes sense given that sexual behaviour is generally more personal and private compared to other risk behaviours such as binge drinking.

The protectiveness of school connectedness against binge drinking, however, was heterogeneous across schools, and more importantly, there was evidence that school connectedness may even be a risk factor for binge drinking in some schools. The relationship between school connectedness and binge drinking varied more by school in the unadjusted model than in the adjusted model. The adjusted model controlled for student characteristics, and was not statistically significant.

While the adjusted model is usually the model of focus, in the present study, it was valuable to examine both the unadjusted and adjusted model for the following reasons. The unadjusted model does not attempt to control for confounding variables when examining how school connectedness effects vary between schools. Consequently, the unadjusted model does not control for compositional differences in student characteristics between schools and includes individual characteristics of the students as part of the school environment. Therefore, the "school" level in the unadjusted model may capture the culture of the school, including the different types of students and peers that make up the school. The adjusted model controls for student characteristics that may cluster in a school and attempts to capture the protectiveness attributed to the school if student characteristics were held constant. Therefore, the adjusted model holds constant factors that likely affect the normative culture of the school. The protectiveness of school connectedness against binge drinking may be slightly less related to the school when adjusting for student characteristics because binge drinking is influenced by peer norms

(11,22). Therefore, the school differences may be explained in part by the different clusters of students (i.e. peers) in certain schools. If some types of student clusters or peer groups are more likely to engage in binge drinking than others, controlling for student characteristics may account for some of the school variation in the effects of students' connection to their school on drinking behaviours.

However, while in the adjusted model, variation in the effect of school connectedness on binge drinking across schools was short of being statistically significant using the likelihood ratio test, the graphs using empirical Bayes estimates demonstrated that for both the unadjusted and adjusted models, it appears that school connectedness has varying protectiveness against binge drinking depending on the school. The empirical Bayes estimates illustrate the best estimate for the effect of school connectedness on binge drinking in individual schools (Figure 2), and it appears that even in adjusted models, school connectedness is predicted to be a risk factor for binge drinking in some schools (and protective in others). Therefore, if a student is highly connected to their school, they could have increased or reduced odds of engaging in binge drinking behaviour depending on which school they attend. This could be explained by Social Development Theory and the influence of peer behaviours (11,15,22). Social Development Theory states that students will avoid acting outside of peer norms for fear of losing that bond (15), and research has demonstrated that peers can positively or negatively influence drinking behaviours (11,22). Therefore, if peers play a large role in a student's feeling of connectedness to their school, then depending on the peer group, this could explain why school connectedness can have a positive or negative influence on binge drinking. These results are also in line with the findings from studies by McNeely and Falci and Bond and colleagues (16,22). These studies demonstrated that when social bonding was analyzed separately from teacher support or school connectedness, higher social bonding alone put students at higher risk of drinking behaviours. This could indicate that in the current study, the peer effects that are captured in school connectedness may be mediating whether or not the school bond is protective.

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Figure 3 provided evidence that in the unadjusted model, school connectedness is protective in schools with lower levels of binge drinking, but school connectedness tends to be a risk factor in schools with higher levels of binge drinking. If peers in schools influence binge drinking behaviours, it makes sense that feeling connected to a school where peers do not binge drink would be protective. Alternatively, if a student feels connected to their school where binge drinking is a common behaviour, it makes sense that students may be more at risk of engaging in binge drinking behaviours themselves. However, once adjusting for the composition of schools with regard to confounding student characteristics, the correlation between binge drinking levels at a school and the protectiveness of school connectedness disappeared. This could provide further evidence that peer norms influence the effects of school connectedness (unadjusted model) and controlling for student characteristics may also control for the influence of peer norms on binge drinking. Regardless, even in the adjusted model, some aspect of school seems to influence whether school connectedness is protective.

Not only do these findings highlight that sexual risk and binge drinking are affected differently by school connectedness depending on the school, they also imply that school connectedness may not always be protective against binge drinking depending on the school a student is attending.

5.4.1 Conclusion

This research has potential importance for school connectedness interventions that target the health of Atlantic Canadian adolescents attending school. There is evidence that with appropriate involvement of members of the school community, students' school connectedness can be increased (1); however, this research provides insight into how school connectedness interventions should be targeted. This is the first study to assess whether the protective nature of school connectedness is heterogeneous across schools. While school connectedness had similar protectiveness against sexual risk across schools, school connectedness varied in protectiveness across schools for binge drinking and may even be a risk factor in some schools. These findings suggest that while policy-makers may be tempted to apply broad school connectedness interventions at the school level

(contextual), this may not be the most efficient option for improving the wellbeing of students, unless the specific goal is only to improve risky sexual behaviour. Instead, it may be important to tailor interventions to specific schools and their needs. For example, in areas where high levels of school connectedness are associated with binge drinking, perhaps interventions should attempt to create a healthier school norm. Additionally, given that previous research has demonstrated that teacher support is more protective than peer support (16,22), interventions could target their focus on strengthening the teacher-student bond, while also ensuring that teachers are encouraging healthy behaviours. Future research should attempt to identify why some schools may promote healthier behaviours than other schools. It would also be interesting to investigate schools where school connectedness is especially protective or a risk factor, and interview teachers and students to gather information on why that may be. Finally, these findings suggest that school connectedness literature may need to move away from a unitary concept of school connectedness. For example, teacher support and school safety could have different effects on student well-being than feeling close to peers at one's school. Separating school connectedness into different concepts as McNeely and Falci did in their study (e.g. social belonging vs. teacher support) may be more beneficial (22). Taking into consideration different school climates and cultures as well as the various risk behaviours one may want to address, a broad concept of school connectedness may not be universal in its ability to reduce risky behaviour.

Tables

Table 1. Descriptive characteristics from the Atlantic Student Drug Use Survey for students in grades 9, 10, and 12.

Variables of Interest	Mean/Percent	S.D.	N	Median	Interquartile Range	
					25th	75th
School Connectedness	3.04	0.64	8951	3.00	2.67	3.33
% Sexual Risk	36.88%		2482			
% Binge Drinking	14.98%		1004			
Student Variables						
% Female	51.32%		3466			
% Living With 2 Parents	64.34%		2423			
% High Importance of Religious Events	17.59%		2458			
% High Importance of Religion	36.25%		1196			
% Heterosexual	84.15%		1081			
Family Connectedness	4.17	0.71	6786	4.33	3.70	4.67
Perceived Family Wealth	6.92	1.54	6786	7.00	6.00	8.00
Language at home						
% English Only	78.87%		5355			
% French with or without English	17.98%		1218			
% Another Language is Spoken at Home	3.15%		213			
Grade						
9	31.68%		2150			
10	35.56%		2413			
12	32.76%		2223			
Description of Schools						
Total Number of Schools			170			
Min. Number of Students sampled from a school			5			
Max. Number of Students sampled from a school			177			
Mean Number of Students sampled from a School			40			
Total Number of Classes			326			
Min. Number of Students sampled from a class			1			
Max. Number of Students sampled from a class			80			
Mean Number of Students sampled from a class			21			

Table 2. *Fixed effect models: unadjusted and adjusted odds ratios for school connectedness effects on the odds of risky sexual behaviour from students.*

Sexual Risky Behaviour	Odds Ratio (95% Confidence Interval)											
	Unadjusted Model						Adjusted Model+					
School Connectedness (Centred)	0.73	(	0.67	,	0.79	)	**	0.87	(	0.79	,	0.95	)	**
Constant	0.58	(	0.55	,	0.61	)	**	3.16	(	2.04	,	4.89	)	**
Sex (vs. Male)												
Female							1.22	(	1.09	,	1.36	)	**
Language (vs. English Only)												
French w or w/o English							0.78	(	0.67	,	0.91	)	**
Other language spoken at home							0.83	(	0.60	,	1.14	)
Grade (vs. Grade 9)												
10							2.22	(	1.93	,	2.55	)	**
12							3.96	(	3.44	,	4.56	)	**
Family Structure (vs. Two Parents)												
Other Family Structure							1.42	(	1.27	,	1.60	)	**
Perceived Family Wealth							1.08	(	1.04	,	1.12	)	**
Religious Events (vs. Low Importance)												
High Importance							0.65	(	0.54	,	0.77	)	**
Religion (vs. Low Importance)												
High Importance							0.86	(	0.75	,	0.97	)	**
Family Connectedness							0.48	(	0.44	,	0.52	)	**
Sexual Orientation (vs. Heterosexual)												
Not Heterosexual							1.00	(	0.86	,	1.17	)	**

* significant at the p<0.05 level

** significant at the p<0.01 level

+Adjusted model includes: sex, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

Table 3. *Fixed effect models: unadjusted and adjusted odds ratios for school connectedness effects on the odds of binge drinking from students.*

Binge Drinking	Odds Ratio (95% Confidence Interval)											
	Unadjusted Model						Adjusted Model+					
School Connectedness (Centred)	0.96	(	0.86	,	1.06	)		1.14	(	1.01	,	1.30	)	*
Constant	0.18	(	0.16	,	0.19	)	**	1.34	(	0.78	,	2.33	)	
Sex (vs. Male)													
Female								0.73	(	0.63	,	0.85	)	**
Language (vs. English Only)													
French w or w/o English								0.80	(	0.65	,	0.98	)	*
Other language spoken at home								0.55	(	0.35	,	0.86	)	**
Grade (vs. Grade 9)													
10								2.21	(	1.79	,	2.74	)	**
12								4.64	(	3.78	,	5.70	)	**
Family Structure (vs. Two Parents)													
Other Family Structure								1.15	(	0.98	,	1.35	)	
Perceived Family Wealth								1.11	(	1.05	,	1.16	)	**
Religious Events (vs. Low Importance)													
High Importance								0.53	(	0.41	,	0.68	)	**
Religion (vs. Low Importance)													
High Importance								1.08	(	0.91	,	1.29	)	
Family Connectedness								0.43	(	0.39	,	0.48	)	**
Sexual Orientation (vs. Heterosexual)													
Not Heterosexual								0.67	(	0.54	,	0.84	)	**

* significant at the p<0.05 level
** significant at the p<0.01 level

+Adjusted model includes: sex, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

Table 4. *Random effect models: unadjusted and adjusted estimates (standard deviation) for the protectiveness of school connectedness (slope), the average level of binge drinking (intercept), and the correlation between the two.*

Random-Effects Parameters (By School)	Unadjusted Model Estimate (95% Confidence Interval							Adjusted Model+ Estimate (95% Confidence Interval						
Standard Deviation (Slope: Effect of SC)	0.31	(	0.16	,	0.60	)		0.38	(	0.22	,	0.67	)	
Standard Deviation (Intercept)	0.67	(	0.55	,	0.81	)		0.48	(	0.38	,	0.61	)	
Correlation (Slope and Intercept)	0.53	(	0.03	,	1.02	)	*	-0.02	(	-0.51	,	0.48	)	

* significant at the p<0.05 level

+Adjusted model includes: gender, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

Table 5. *Likelihood ratio tests demonstrating whether adding a random coefficient for school connectedness (model 2) improves the model when compared to only having a random intercept for school (model 1).*

Sexual Risk*	**Adjusted+ Model**	
	LR difference (df)	p-value
1. Random Intercept Only		
2. Random Intercept, Random Slope, and Covariance (vs. Model 1)	2	0.8366

Binge Drinking	**Unadjusted Model**		**Adjusted+ Model**	
	LR difference (df)	p-value	LR difference (df)	p-value
1. Random Intercept Only				
2. Random Intercept, Random Slope and Covariance (vs. Model 1)	1	0.0313	2	0.0815

*Unadjusted model for sexual risk did not converge because variation by school was too close to zero.
+Adjusted model includes: gender, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.
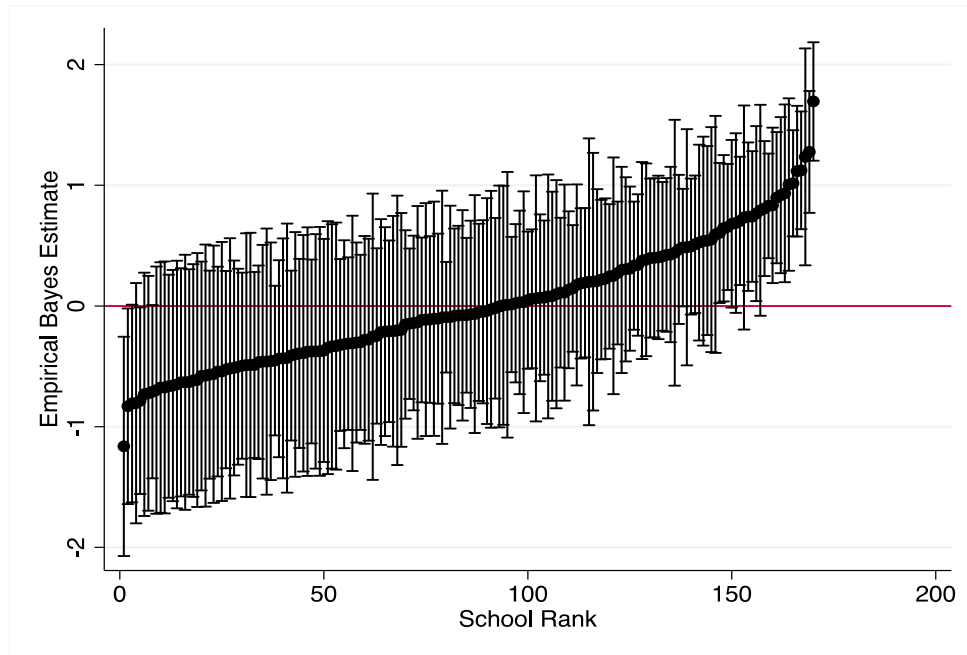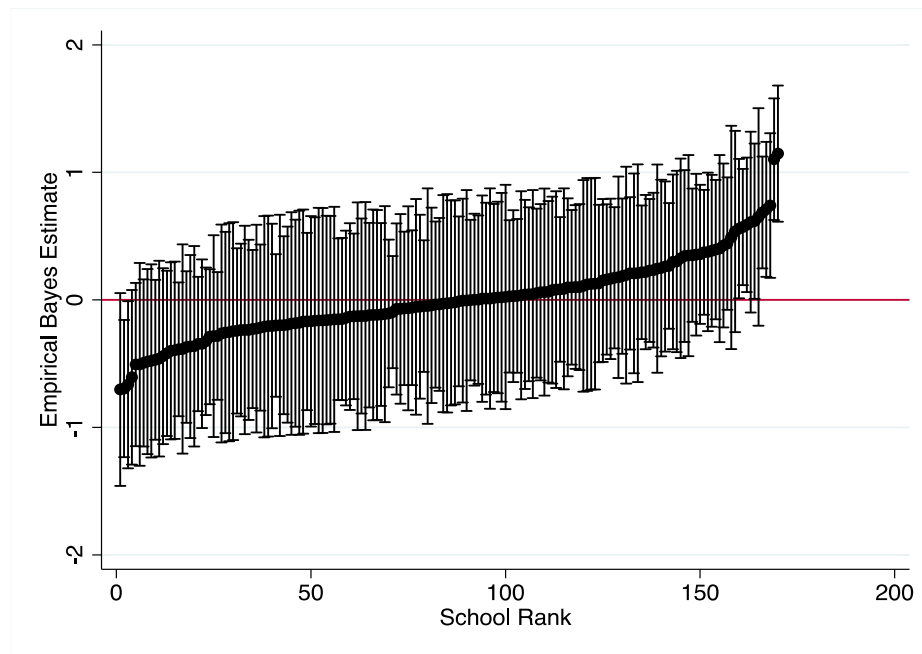
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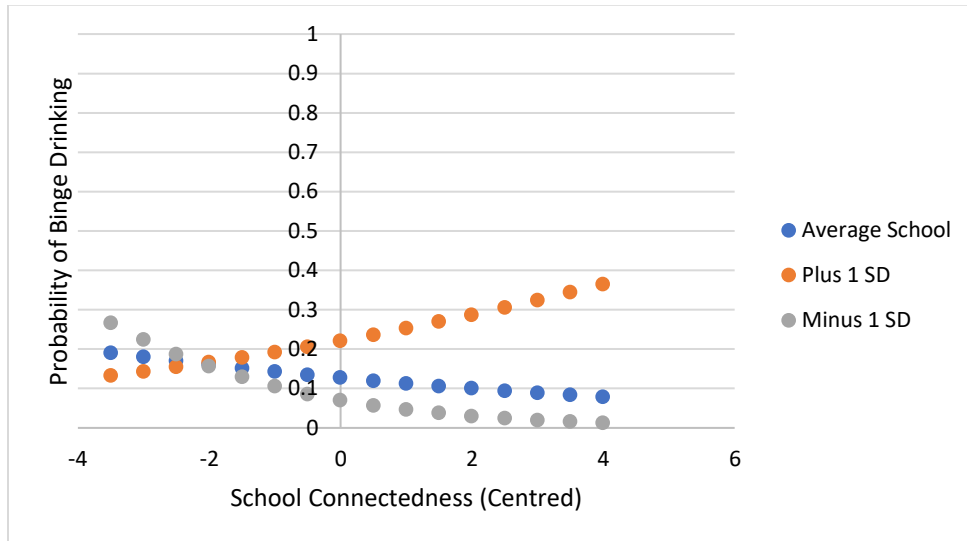
(a)
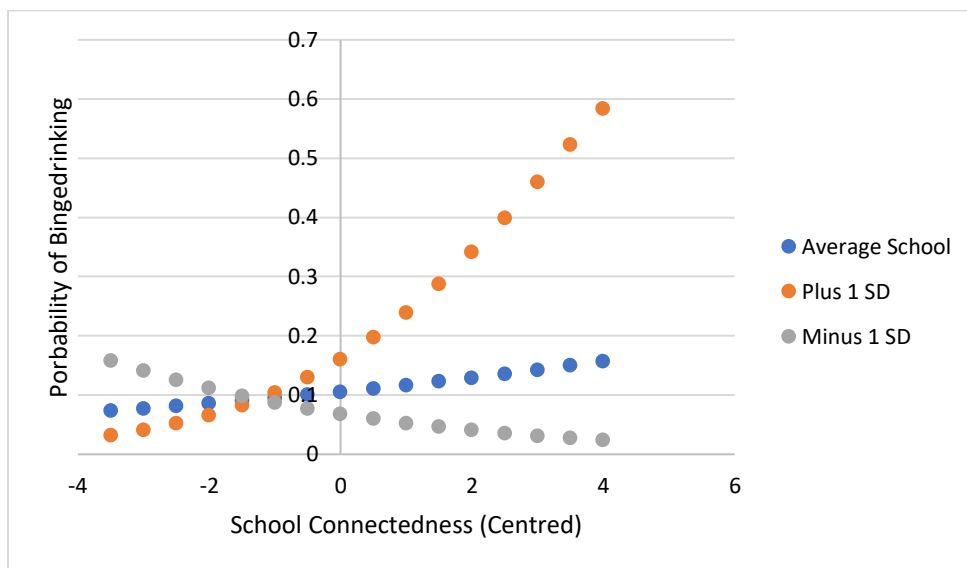
(b)

Figure 1. *For the unadjusted model (a) and adjusted model* (b), Figure 1 shows the relationship between school connectedness and the probability of binge drinking for an average school and for one standard deviation above and below the average school.*

*Adjusted model includes: sex, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.

(a)

(b)

Figure 2. *For the unadjusted model (a) and the adjusted model* (b), Figure 2 illustrates the empirical Bayes estimates of the linear coefficients (protectiveness of school connectedness against binge drinking) and confidence intervals ranked by school from school connectedness being most protective to least protective.*

*Adjusted model includes: sex, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.
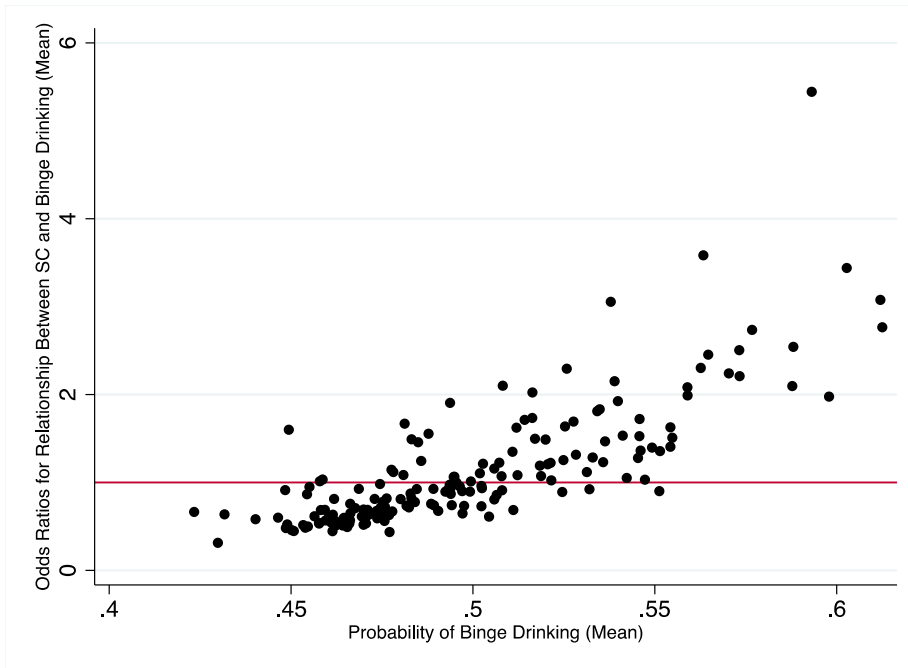
(a)

(b)

Figure 3. *For the unadjusted (a) and adjusted (b)* model, the predicted relationship between the protectiveness of school connectedness (empirical Bayes estimates as odds ratios) and probability of binge drinking for every school.*

*Adjusted model includes: sex, grade, sexual orientation, family structure, perceived family wealth, family connectedness, and religiosity.
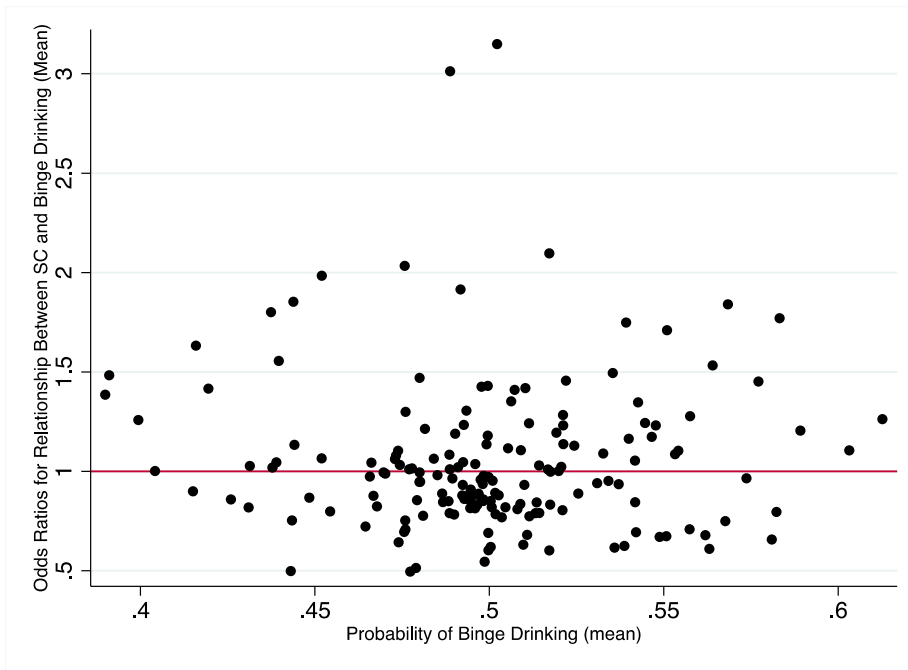
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CHAPTER 6: DISCUSSION

6.1 Manuscript 1

The objective of Manuscript one was to examine the extent to which school connectedness was an attribute of the school and its environment versus an attribute of the characteristics of the students within the school.

The results demonstrate that while there is some heterogeneity in school connectedness between schools (approximately 5 and 4 percent for unadjusted and adjusted models respectively), most of the variance in school connectedness can be attributed to individual student differences. This study found less variation in school connectedness between schools (smaller intraclass correlation) than in previous studies (4,5). This could be explained by several reasons.

The first factor that can affect the intraclass correlation is the overall variation in school connectedness. The more variation there is for the entire sample, the smaller the intraclass correlation (proportion of variation attributed to between-school differences; 39). However, this explanation did not appear to hold true for this study. Waters and colleagues reported overall variation in school connectedness, but they had both a larger value for overall variation and a larger intraclass correlation than the present study (5). McNeely and colleagues did not report overall variation, so values of overall variance could not be compared with the present study.

The second factor that could have explained why the current study had a smaller intraclass correlation than previous studies was the measure used. The current study used a three-item scale containing questions that asked students if they feel safe at their school, happy at their school and close to the people at their school. Waters and colleagues and McNeely and colleagues used a four and five item scale respectively. Both of these scales included similar questions to the current study, but they both had an additional question that asked if students felt teachers treated them fairly (4,5). Given that teacher behaviour may be more related to the actual school than a student's broader feelings of safety and

belonging, this could explain why variation in school connectedness was explained more by school differences in previous studies.

Our sensitivity analysis demonstrated that out of the school connectedness items, feeling safe (when compared to feeling happy and close) was slightly more related to school in both the unadjusted and adjusted models, and feeling close to the people at one's school had the least variation attributed to school once the model was adjusted. This makes sense given that safety could be slightly more related to the school structures, and feeling close to the people at one's school could be more related to the cluster of students at one's school (and student characteristics are controlled for in the adjusted model). However, the items were found to be intercorrelated, and the combined scale did have a reasonable Cronbach's alpha, so the combined scale is still appropriate. Results were reported using the combined scale.

6.2 Manuscript 2

The objective of Manuscript two was to assess the extent to which the protective relationship between school connectedness and adolescent sexual risk or binge drinking behaviours was homogeneous across schools. Drawing on theories about peer influence on adolescent development (15,24-27), this study hypothesized that the protectiveness of school connectedness would vary between schools, and that school connectedness would be less protective in schools that have higher prevalence of risky behaviors.

The results demonstrated that the protectiveness of school connectedness against sexual risk behaviours showed little variation between schools. This suggests that school connectedness is protective against risky sexual behaviours regardless of the school. However, the same cannot be said for the effects of school connectedness on binge drinking.

The protectiveness of school connectedness against binge drinking was heterogeneous across schools, and more importantly, school connectedness was found to be a risk factor for binge drinking in some schools. The relationship between school connectedness and

binge drinking varied more by school in the unadjusted model than in the adjusted model. While the effects of school connectedness on binge drinking varied significantly by school in the unadjusted model (p=0.03), the adjusted model controlled for student characteristics and was not statistically significant (p=0.08). However, even in the adjusted model, graphing empirical Bayes estimates illustrated that school connectedness is predicted to be protective against binge drinking in some schools and a risk factor for binge drinking in other schools (Figure 2). Therefore, if a student is highly connected to their school, they could have increased or reduced odds of engaging in binge drinking behaviour depending on what school they attend. Theory and previous research support these findings. Social Development Theory states that students will avoid acting outside of peer norms for fear of losing the school connectedness bond (15), and research has demonstrated that peers can positively or negatively influence drinking behaviours (11,22). Therefore, if peers play a large role in a student's feeling of connectedness to their school, then depending on the peer group and school, this explains why school connectedness can have a positive or negative influence on binge drinking. Additionally, McNeely and Falci and Bond and colleagues demonstrated that when social bonding was analyzed separately from teacher support or school connectedness, higher social bonding alone put students at higher risk of drinking behaviours (16,22). This could indicate that in the current study, the peer effects that are captured in school connectedness may be mediating whether or not the school bond is protective. Figure 3 provided evidence that in the unadjusted model, school connectedness was protective in schools with lower levels of binge drinking, but school connectedness tended to be a risk factor in schools with higher levels of binge drinking. If peers in schools influence binge drinking behaviours, it makes sense that feeling connected to a school where peers do not binge drink would be protective. Alternatively, if a student feels connected to their school where binge drinking is a common behaviour, it makes sense that students may be more at risk of engaging in binge drinking behaviours themselves. However, once adjusting for the composition of schools with regard to confounding student characteristics, the correlation between binge drinking levels at a school and the protectiveness of school connectedness disappeared. This could indicate that peer norms influence the effects of school connectedness (unadjusted model) and controlling for student characteristics may

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also control for the influence of peer norms on binge drinking. Regardless, even in the adjusted model, some aspect of schools seems to influence whether school connectedness is protective.

While the adjusted model is usually the model of focus, in the present study, it was valuable to examine both the unadjusted and adjusted model for the following reasons. The unadjusted model does not attempt to control for confounding variables when examining how school connectedness effects vary between schools. Consequently, the unadjusted model does not control for compositional differences in student characteristics between schools and includes individual characteristics of the students as part of the school environment. Therefore, the "school" level in the unadjusted model may capture the culture of the school, including the different types of students and peers that make up the school. The adjusted model controls for student characteristics that may cluster in a school and attempts to capture the protectiveness attributed to the school if student characteristics were held constant. Therefore, the adjusted model holds constant factors that likely affect the normative culture of the school. The protectiveness of school connectedness against binge drinking may be slightly less related to the school when adjusting for student characteristics because binge drinking is influenced by peer norms (11,22). Therefore, the school differences may be explained in part by the different clusters of students (i.e. peers) in certain schools. If some types of student clusters or peer groups are more likely to engage in binge drinking than others, controlling for student characteristics may account for some of the school variation in the effect of students' connection to their school on drinking behaviours.

6.3 Strengths and Limitations

6.3.1 Limitations

The survey only included three items to represent school connectedness, whereas some school connectedness studies include six or more items to measure school connectedness. However, as previously mentioned, this three-item scale had an internal consistency of 0.73 (Cronbach's alpha) when calculated with the subset of data used from the Atlantic

Student Drug Use Survey. While there are only three items, they could be addressing different aspects of connectedness (safety, happiness and belonging). For example, the question about belonging could be more of a result of peer relationships than the question on safety. Therefore, a sensitivity analysis was performed to analyze the three items separately for the second objective, as well as analyses being performed with the composite measure of school connectedness. There were some differences between the items, but ultimately analyzing the three items separately did not change the results.

We were also limited in the variables used to capture sexual risk. However, the present study focussed on multiple partners and unplanned sex. Condom use was not included because it did not account for monogamous couples using birth control pills, and it included condom use at last vaginal, anal, or oral sex. While it is important to wear condoms for all sexual activity, overall condom use for oral sex is very low (9 percent for males and 8 percent for females when examined in the United States (43). A sensitivity analysis was performed to compare analysis using multiple partners, unplanned sex, and the combined measure of sexual risk. They all demonstrated similar results.

One disadvantage of looking at sexual risk across grades 9 through to 12, is that the number of students who have engaged in sexual intercourse may be low. However, approximately 10 percent of adolescents have had intercourse by age 15 (44). Therefore, even with small numbers, samples sizes were still high enough to maintain sufficient power. This study used the composite outcome for sexual risk behaviours, with sexual risk behaviours including unplanned sex and/or multiple partners. This allowed for a higher prevalence. Data from students in grade 7 were removed for objective two because the number of students who have had sex by grade 7 is very low. In addition to this, grade was controlled for, which is mentioned under confounding variables.

In the survey, the question for sex did not include an alternative option for students who do not identify with being either being male or female. The question does not ask them to specify "biological sex" and instead asks, "Are you male or female". This gives some freedom to interpret as to how they identify. However, there still may be students who do

not feel comfortable identifying as male or female, and therefore future surveys could include an "other' category.

6.3.2 Strengths.

This study had a large sample size of students in grades 7, 9, 10, and 12 (N=9229). Even when students in grade 7 were removed for objective two, N= 6869. In addition, the overall response rate of those eligible to be surveyed and present the day of the survey was quite high (>90%). This allowed the study to make descriptive conclusions with more confidence.

One of the main strengths of this study was that this was the first study to explicitly assess the assumption that school connectedness is an attribute of the school itself (versus an attribute of the composition of students within the school). Unlike Waters and colleagues, this study controlled for student demographic and background characteristics when determining the between-school variance of school connectedness (5). Also, unlike McNeely and colleagues, this study reported the between-school variance in school connectedness after controlling for individual factors (4). Furthermore, the current study provides new information regarding the protectiveness of school connectedness against certain risk factors. Research has consistently demonstrated that school connectedness is protective against risk behaviours, but not whether the strength of this protectiveness differs between schools. This study provided novel information about school connectedness affecting risk behaviours differently depending on the school, and the potential for school connectedness to be a risk factor for binge drinking behaviours.

6.4 Policy Implications

This research has potential importance for school connectedness interventions that target the health of Atlantic Canadian adolescents attending school. There is evidence that with appropriate involvement of members of the school community, students' school connectedness can be increased (1); however, this research provides insight into how school connectedness interventions should be targeted. Very little research had previously addressed the simple question of whether school connectedness is

heterogeneous across schools, and no one had yet addressed the question of whether the protective nature of school connectedness may be heterogeneous across schools.

6.4.1 Manuscript 1

The variation in school connectedness accounted for by school was lower in this study compared to previous literature. While school did account for some of the variation in school connectedness, the variation between individuals accounted for most of the variance. This suggests that when policy makers wish to increase school connectedness, they may want to target interventions focussed around individuals in a school and their particular needs (e.g. students with low school connectedness).

6.4.2 Manuscript 2

For the model looking at the protectiveness of school connectedness against sexual risk, these results suggest that interventions can be applied similarly across schools (without being tailored to certain schools), and the interventions should have similar protective benefits for sexual behaviour across schools.

However, for binge drinking, not only may the protectiveness of school connectedness vary by schools, but school connectedness may even be a risk factor for binge drinking in certain schools. Interventions will have to account for this. When it comes to preventing binge drinking, one aspect of connectedness is probably not enough. For example, boosting a school bond with sports teams and extra-curricular activities may only be beneficial against binge drinking if teachers and coaches also form a bond with their students that upholds safe and healthy practices. While school connectedness interventions have been targeted at all areas of a student's school experience, the specification must now be made to support the school bond, but also ensure that it is healthy and not solely relying on peer support and good morale.

Furthermore, while the relationship between school connectedness and binge drinking was heterogeneous in both the unadjusted and adjusted models, it was more pronounced in the unadjusted model than the adjusted model. This could be due to the fact that binge

drinking may be influenced by peer groups, and the adjusted model attempts to separate student composition from the "school" by controlling for potentially confounding student characteristics, whereas the unadjusted model's school effect includes student composition as part of the "school" environment. This may suggest that certain student compositions and types of peer groups should be targeted differently when creating school connectedness interventions in an effort to reduce substance use.

This information is fundamentally important to not only understanding school connectedness, but also how we treat school connectedness and interventions. School connectedness interventions may have to be targeted in different ways for different schools or groups of students. The role of school connectedness and school differs for sexual risk and binge drinking. This implies that sexual risk and binge drinking cannot be treated the same when implementing interventions to reduce risk behaviour given that school connectedness may be a risk factor for binge drinking in some schools.

6.5 Conclusion

This study demonstrated that different adolescent risk behaviours can have different relationships with school connectedness depending on what school a child attends. Specifically, the protective relationship between school connectedness and sexual risk does not seem to change from school to school; however, school connectedness may be protective against, or a risk factor for binge drinking, depending on where a student goes to school. This has critical implications for policy makers given the current focus on interventions to increase school connectedness, especially considering that school connectedness interventions are frequently supported and implemented.

This study has demonstrated that future school connectedness interventions will need to be tailored to the specific needs of certain students or schools. If sexual risk is the behaviour of interest, region-wide interventions may be beneficial, but if binge drinking is the behaviour of interest, then school connectedness interventions may need to be designed differently depending on the school. For example, the teacher-student bond may be important to reduce drinking behaviours, or interventions may be more beneficial implemented at the school level rather than the school district level.

These findings also suggest that school connectedness literature may need to move away from a unitary concept of school connectedness. The 2003 Wingspread Conference originally defined school connectedness as students' perceptions that adults at school care about them and their academic success, but this definition was updated to include peer influence (1). However, instead of grouping peer connectedness and teacher connectedness together under one concept of "school connectedness", perhaps there are two or more classifications of school connectedness which would be better investigated as separate measures. For example, teacher support and school safety could have different effects on student well-being than feeling close to peers at one's school. Separating school connectedness into different concepts like McNeely and Falci did in their study (e.g. student bonding vs. teacher support) may be more beneficial (22). Additionally, school connectedness may operate different ways for different risk factors, as suggested by this study. Therefore, improving risky behaviour may not be as simple as addressing one or more of the four suggested areas to increase connectedness as outlined by the CDC (adult support, positive peer group, commitment to education, or school environment; 1). Taking into consideration different school climates and cultures as well as the various risk behaviours one may want to address, a broad concept of school connectedness may not be universal in its ability to reduce risky behaviour.

The current study only provides a first step to understanding why school connectedness could affect binge drinking differently depending on the school. Future studies could provide much more insight into what qualities of the school or peer groups may make this school connection more or less protective. Finally, researchers should consider trading in the unitary concept of school connectedness for a more nuanced approach to school connectedness.

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APPENDIX: STUDENT VARIABLES

Table 6. *Student variable details for Manuscript 1.*

Student Variables	Question Asked	Response Options	Coding	Rationale
Sex	"Are you male or female"	"Male" or "Female"	Dichotomized: Male [0] and Female [1]	Some studies have demonstrated that females experience higher school connectedness (45) and some literature has found no differences between males and females (4,12,13).
Grade	"What grade are you in?"	"Grade 7", "Grade 8, "Grade 9","Grade 10/ level I", "Grade 11/ level II", or "Grade 12/ level III"	Categorical: 7, 9, 10, or 12	Older age is significantly associated with lower school connectedness (4). School connectedness is also associated with grade, similarly as it is associated with age, with school connectedness decreasing with grade level (13,45). The current study used the variable "grade" instead of "age" because there could be differences between grade that are not captured by the variable age alone.
Sexual Orientation	"People have different feelings about themselves when it comes to questions of being attracted to other people. Which of the following best describes your feelings?"	"100% heterosexual (attracted to persons of the opposite sex)", "mostly heterosexual", "bisexual (attracted to both males and females)", "mostly homosexual", "100% homosexual ("gay/lesbian"; attracted to persons of the same sex)", or "not sure".	Dichotomized: Heterosexual [0] and Not Heterosexual [1]	LGBTQ students often experience a more hostile school environment leading to low school connectedness (46).

Student Variables	Question Asked	Response Options	Coding	Rationale
Language	"What language do you usually speak at home?"	"English", "French", "English and French", "English and Another Language", "French and Another Language", or "Another Language"	Categorical: Only English at home [1], speaking French at home with or without English [2], and speaking another language at home, with or without English and/or French [3].	Having a language spoken at home other than English is significantly related to lower school connectedness (47).
Family Structure	"Who are you living with now?"	"mother and father", "mother", "father", "mother and step-father", "father and step-mother", "I live alone or with friends (independent living)", or "other (please state)"	Dichotomized: Living with two parents [0] or Other Family Structure [1]	Students who live with two parents are somewhat more connected to their school than students with other family living conditions (4).

Student Variables	Question Asked	Response Options	Coding	Rationale
Perceived Family Wealth	"Imagine this ladder to the right shows how Canadian society is set up. At the top of the ladder is people who are the "best off" – they have the most money, the most education and the jobs that bring the most respect. At the bottom are the people are the people who are the "worst off" – they have the least amount of money, little education, no job or jobs that no one wants. Now think about your family. Please fill out the bubble next to the box that best shows where you think your family would be on this ladder."	The "ladder" is numbered on a scale of 1 to 10 from "worst off" [1] to "best off" (10).	Continuous: Worst off [1] to Best off [10]	Lower school connectedness is associated with lower subjective social status in students (23).
Family Connectedness	"Please indicate how much you agree or disagree with the following statements": 1) "my parent(s) or guardian(s) usually know where I am when I am not at home"; 2) "my parent(s) or guardian(s) usually know who I am with when I am not at home"; and 3) "it is important that I do not let down or disappoint my parent(s) or guardian(s)"	"Strongly agree", "Agree", "I do not know", "Disagree", or "Strongly disagree"	Continuous: 1 to 5. The 3 questions were averaged to create a single Family Connectedness score.	Higher family connectedness is associated with higher school connectedness (22,23).

Student Variables	Question Asked	Response Options	Coding	Rationale
Religiosity				
Importance of Religion	"How often do you attend religious services or events?"	"never", "a few times a year", "at least once a month", or "at least once a week"	Dichotomized: Low attendance [0] and High attendance [1] and high/low importance	Religiosity is associated with higher school connectedness (23).
Importance of Religious Events	"How important would you say religion is to you?"	"not important at all", "not very important", "fairly important", or "very important"	Dichotomized: Low importance [0] and High importance [1]	

Table 7. *Student variable details for Manuscript 2.*

Student Variables	Question Asked	Response Options	Coding	Rationale
Sex	"Are you male or female"	"Male" or "Female"	Dichotomized: Male [0] and Female [1]	Some studies have demonstrated that females experience higher school connectedness (45) and some literature has found no differences between males and females (4,12,13).
				However, lower school connectedness has been found to be associated with sexual risk behaviour in males but not in females, and males are more likely to engage in risky sexual behaviours then females (13). Some research has demonstrated that males are more likely to drink alcohol (48). However, in more recent literature, frequent alcohol use does not differ by sex (11,16).
Grade	"What grade are you in?"	"Grade 7", "Grade 8, "Grade 9","Grade 10/ level I", "Grade 11/ level II", or "Grade 12/ level III"	Categorical: 9, 10, or 12 Grade 7 was removed because of the low numbers of students who have engaged in risk behaviours.	Older age is significantly associated with lower school connectedness (4). School connectedness is also associated with grade, as with age, with school connectedness decreasing with grade level (13,45). The current study used the variable "grade" instead of "age" because there could be differences between grade that are not captured by the variable age alone.
				As students age, they are more likely to have engaged in sex, and older females are more likely to consistently use contraception than younger females (25). Drinking alcohol more than once a month increased with grade (11).

Student Variables	Question Asked	Response Options	Coding	Rationale
Sexual Orientation	"People have different feelings about themselves when it comes to questions of being attracted to other people. Which of the following best describes your feelings?"	"100% heterosexual (attracted to persons of the opposite sex)", "mostly heterosexual", "bisexual (attracted to both males and females)", "mostly homosexual", "100% homosexual ("gay/lesbian"; attracted to persons of the same sex)", or "not sure".	Dichotomized: Heterosexual [0] and Not Heterosexual [1]	LGBTQ students often experience a more hostile school environment leading to low school connectedness (46). LGBTQ youth are also more likely to engage in sexual risk behaviours and substance use (46,49).
Language	"What language do you usually speak at home?"	"English", "French", "English and French", "English and Another Language", "French and Another Language", or "Another Language"	Categorical: Only English at home [1], speaking French at home with or without English [2], and speaking another language at home, with or without English and/or French [3]. Speaking only English at home was the reference category.	Having a language spoken at home other than English is significantly related to lower school connectedness (47). Speaking a language other than English was a protective factor against sexual intercourse in grade 7, and English or French speaking students were more likely to binge drink than students who spoke another language (50,51).
Family Structure	"Who are you living with now?"	"mother and father", "mother", "father", "mother and step-father", "father and step-mother", "I live alone or with friends (independent living)", or "other (please state)"	Dichotomized: Living with two parents [0] and Other Family Structure [1]	Students who live with two parents are somewhat more connected to their school than students with other family living conditions (4). Additionally, adolescent students who come from a single parent home are significantly more likely to have engaged in sex and alcohol use (52).

Student Variables	Question Asked	Response Options	Coding	Rationale
Perceived Family Wealth	"Imagine this ladder to the right shows how Canadian society is set up. At the top of the ladder is people who are the "best off" – they have the most money, the most education and the jobs that bring the most respect. At the bottom are the people are the people who are the "worst off" – they have the least amount of money, little education, no job or jobs that no one wants. Now think about your family. Please fill out the bubble next to the box that best shows where you think your family would be on this ladder."	The "ladder" is numbered on a scale of 1 to 10 from "worst off" [1] to "best off" [10].	Continuous: Worst off [1] to Best off [10]	Lower school connectedness is associated with lower subjective social status in students (23). Students who come from a family with a lower income are more likely to have had sex (52). Students in older grades who came from higher-income households engaged in slightly more alcohol use, whereas in younger grades, students from lower-income households were more likely to drink alcohol (52,53).
Family Connectedness	"Please indicate how much you agree or disagree with the following statements": 1) "my parent(s) or guardian(s) usually know where I am when I am not at home"; 2) "my parent(s) or guardian(s) usually know who I am with when I am not at home"; and 3) "it is important that I do not let down or disappoint my parent(s) or guardian(s)"	"Strongly agree" , "Agree", "I do not know", "Disagree", or "Strongly disagree"	Continuous: 1 to 5. The 3 questions were averaged to create a single Family Connectedness score	Higher family connectedness is associated with higher school connectedness (22), and parental monitoring has been associated with decreased odds of sexual risk and alcohol use (54-57)

Student Variables	Question Asked	Response Options	Coding	Rationale
Religiosity				
Importance of Religion	"How often do you attend religious services or events?"	"never", "a few times a year", "at least once a month", or "at least once a week"	Dichotomized: Low attendance [0] and High attendance [1] and high/low importance	Religiosity is associated with higher school connectedness (23) and lower risk of engaging in sexual risk behaviours and drinking behaviours in adolescents (58,59).
Importance of Religious Events	"How important would you say religion is to you?"	"not important at all", "not very important", "fairly important", or "very important"	Dichotomized: Low importance [0] and High importance [1]	
Depressive Symptoms

The scale is a validated adoption of the CES-D (Center for Epidemiological Studies Depression) scale (48) | "Please mark the response that best describes how you felt in the past 7 days."

"I did not feel like eating; my appetite was poor."
"I felt like I could not shake off the blues even with help from my family or friends."
"I had trouble keeping my mind on what I was doing."
"I felt depressed."
"I felt like I was too tired to do things."
"I felt hopeful about the future."
"My sleep was restless."
"I was happy."
"I felt lonely."
"I enjoyed life."
"I had crying spells."
"I felt people disliked me. | "Never or rarely", "Sometimes", "Often" or "Always" | Continuous: 0 to 36 | As part of a sensitivity check, depressive symptoms were added to the adjusted model as a student variable. School connectedness was protective against depression or depressive symptoms (3,12), and lower school connectedness was associated with depression (60). Depression is also related to sexual risk behaviour and alcohol use in adolescents. (61,62) |